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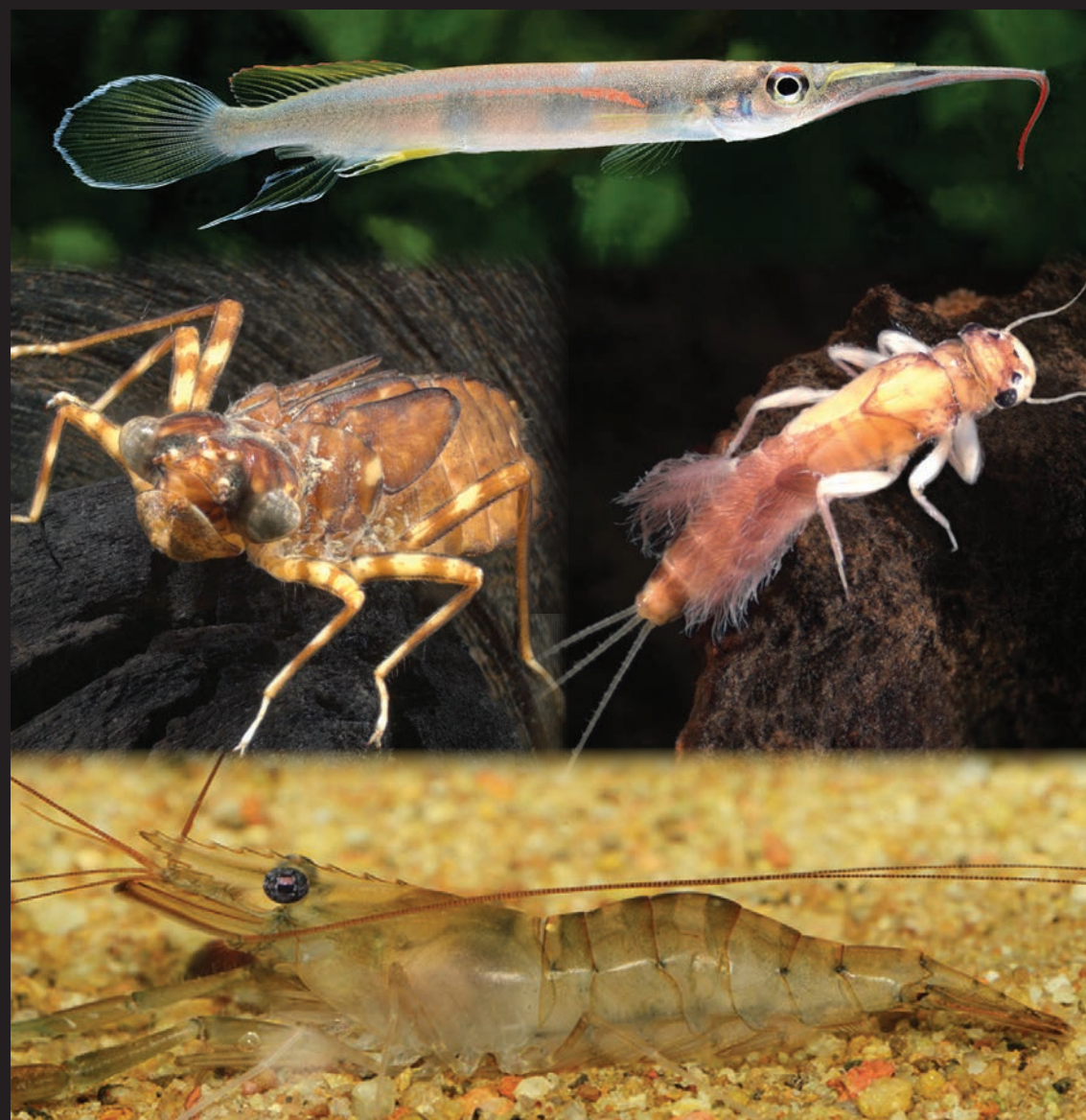
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# A Guide to the Freshwater Fauna of Nee Soon Swamp Forest

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# INTRODUCTION

Freshwater swamp forests are perhaps less well known than other more iconic types of swamp forest habitats in Southeast Asia such as mangrove and peat swamp forests, but are just as vital to biodiversity. They are generally formed in low-lying alluvial plains, and are associated with river and stream systems. The water table tends to be near the surface in such habitats, and the typical heavy rainfall in Southeast Asia results in large parts of the forest being inundated much of the time. This almost permanently waterlogged environment has led to the development of a unique flora and fauna, which can both tolerate and thrive in such environmentally harsh conditions.

Streams found in such habitats are usually acidic, with an average pH of 5 and below, due to the large deposits of leaf litter and other organic detritus. Tannins (organic acids) from the leaf litter leach out into the water, staining the streams the colour of tea and acidifying them as well. The waterlogged soil tends to be unstable and low in oxygen, with a shallow layer of peat (partially or slowly rotting vegetation) (Yeo & Lim, 2011). Organisms living in the swamp forest need to adapt to this inhospitable environment. For example, many species of plants in the flooded areas of the swamp forest develop stilt roots or pneumatophores to allow them to access oxygen from the air (Corner, 1978).

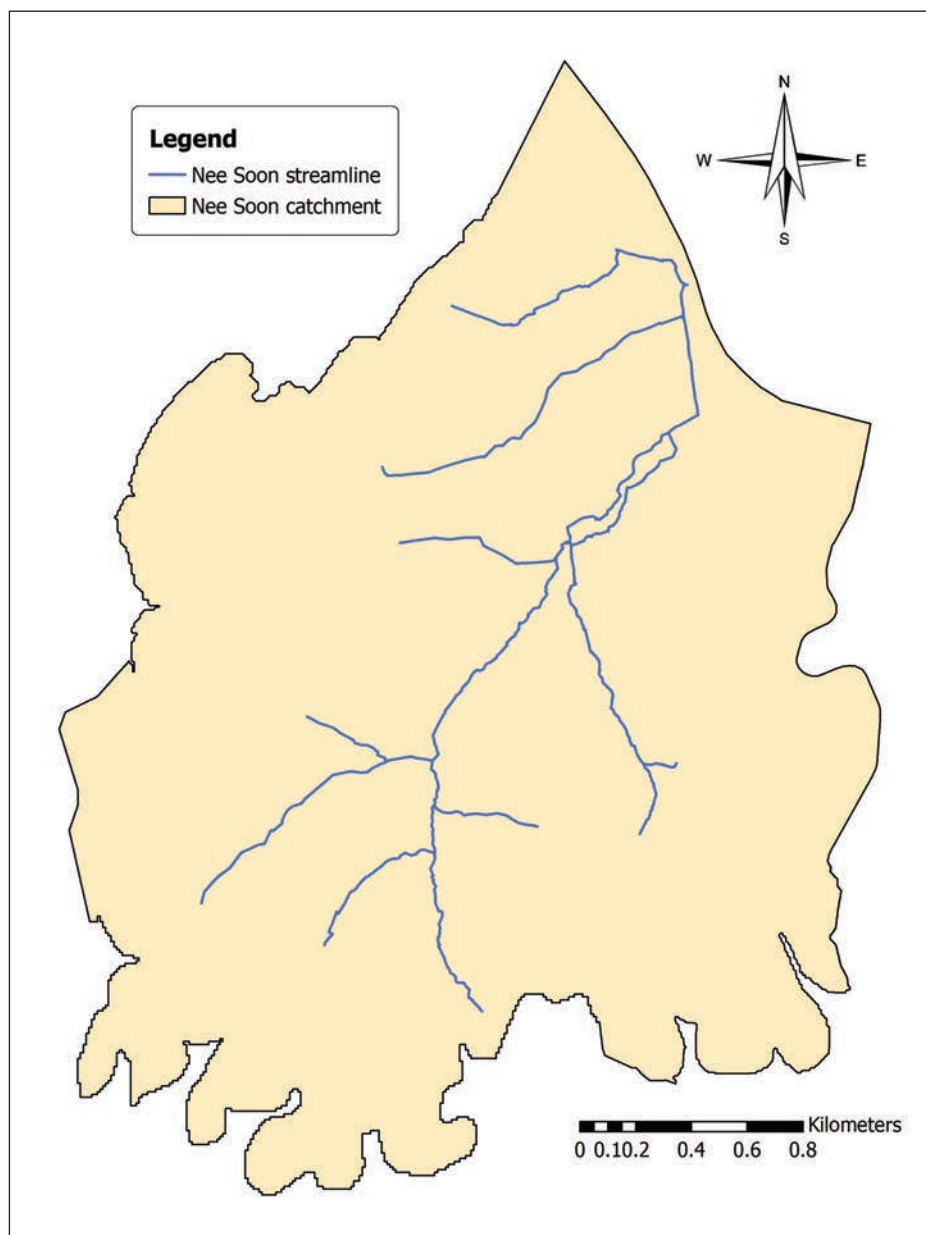
The Nee Soon Swamp Forest (NSSF) is the last substantial area of freshwater swamp forest remaining in Singapore, protected both by the presence of the nearby Nee Soon Firing Ranges and its inclusion in the Central Catchment Nature Reserve. In the past, freshwater swamp forests also existed in Jurong, Ang Mo Kio, Mandai, and Pulau Tekong, but were cleared during the course of development in Singapore (Corner, 1978). Even the NSSF has not been completely spared, as large areas of freshwater swamp forest were cleared or submerged during the expansion and construction of the Upper Seletar Reservoir. Today, the remaining freshwater swamp forest in the Nee Soon area covers a patch of land roughly bounded by the Executive Golf Course (adjacent to Upper Seletar Reservoir Park) in the north, the Seletar Expressway and Old Upper Thomson Road in the east, Upper and Lower Peirce Reservoirs to the south, and the northern-most and southern-most tributaries of the Upper Peirce and Upper Seletar Reservoirs, respectively, in the west. The terrain there consists mainly of swampy, low-lying valleys, which are drained by slow-moving streams. In between the valleys, higher ground with dryland forest can be found (Yeo & Lim, 2011).

The NSSF does not cover a very large area, but it is an important conservation area for Singapore and is rich in native biological diversity. For example, it holds 31% of Singapore's vascular plants, 48% of the primary freshwater fishes, 71% of the amphibians, 28% of the reptiles, and 34% of the birds. The diversity of aquatic organisms within the NSSF is the highest of any area in Singapore. Many of the plants

and animals found in the NSSF cannot be found anywhere else in Singapore, due to the uniqueness of the habitat and habitat requirements of the organisms and/or because of habitat loss and the expansion of the urban environment elsewhere. For example, plants like the Singapore kopsia, *Kopsia singaporensis*; invertebrates like the torrent prawn, *Macrobrachium platycheles* and the potbellied elf dragonfly, *Risiophlebia dohrni*; and fishes like the grey-banded loach, *Nemacheilus selangoricus*, and Singapore warty catfish, *Parakysis longirostris*, are limited to the NSSF in Singapore. In total, 16% of Singapore's native fauna are restricted solely to this small area (Yeo & Lim, 2011).

Additionally, the NSSF houses the world's entire population of the critically endangered swamp forest crab, *Parathelphusa reticulata*, a species which is endemic to Singapore and found nowhere else (Yeo et al., 2010). Should anything adversely affect their habitat in the NSSF, it is highly possible that the species could be driven to global extinction.

Assuming that NSSF remains a protected area shielded from habitat loss, it still faces other threats, one of which is the introduction of exotic species. The streams of the NSSF are directly connected to at least two reservoirs, which contain established populations of many exotic species, including ones which have been known to become invasive elsewhere. Streams on the outskirts of the NSSF also harbour large numbers of exotic species such as the guppy, *Poecilia reticulata*, that have been known to outcompete native species. Several of the exotic species have the potential to thrive in low pH environments and therefore spread into NSSF streams. These include large predatory fish species such as the peacock bass, *Cichla orinocensis*, and African sharptooth or walking catfish, *Clarias gariepinus*. If such species manage to invade and establish within the NSSF proper, they may adversely affect the ecosystem of the NSSF. Therefore, it is crucial to constantly monitor the NSSF for incursions of these species to ensure that rapid and effective management actions can be taken to prevent this from occurring.



*Streamline and catchment area of the Nee Soon Swamp Forest (NSSF). The NSSF is located in the Central Catchment Nature Reserve and is the last remnant of primary freshwater swamp forest on Singapore island.*

## Sampling methods:

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Sampling for fishes and macroinvertebrates in a freshwater swamp carries multiple challenges, among which are the soft, muddy terrain, and the dense thickets of roots and thorny branches, which can block attempts at accessing streams and various microhabitats. Streams in the NSSF are usually shallow and narrow, which preclude the use of methods that require large amounts of space, such as cast nets. In this guidebook, we describe the use of several methods that are the most effective in such environments.

For fishes, several methods can be used to obtain samples efficiently. A rectangular push net (60 × 40 cm, 1 × 1 mm mesh size) may be used to scoop up fishes from streams. Catching fishes with a push net is usually easiest when working in a pair, as one person can drive the fishes into the push net held by the other. For narrower or more confined spaces where the push net may be too unwieldy, smaller hand nets can be used to catch fishes and decapod crustaceans.

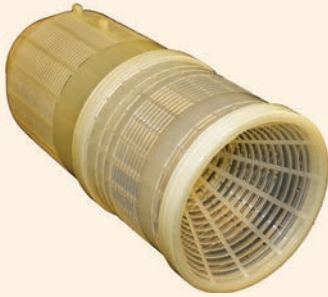
Traps can also be used to sample for fishes or large decapod crustaceans. Several types of traps may be used, such as bottle/minnow traps or larger box traps (Bottle traps: 35 × 15 cm, 5 × 25 mm mesh size; Box traps: 60 × 40 cm, 15 × 15 mm mesh size). These traps can be deployed unbaited or containing bait such as liver or sausage. They should be checked within 24 hours to prevent death of the organisms within from overcrowding, and should not be fully submerged to allow any obligate air-breathing organism or fish to obtain atmospheric air (e.g., members of Clariidae, Synbranchidae, Osphronemidae and Channidae).

For smaller macroinvertebrates, a kick-net (36 × 30 cm, 250 µm mesh size) can be used to obtain samples. The kick-net is dragged vigorously across the bottom of the stream for a set period of time or a set area, and then the contents are collected, to be further examined in the laboratory. Molluscs in the NSSF are typically between one and twenty millimetres, whilst arthropods are typically between one and fifty millimetres. However, larvae in the Aeshnidae family (Order Odonata) can exceed fifty millimetres. Because of the small size, the diagnostic features of macroinvertebrates are very hard to see with the naked eye, therefore, examining the samples with the aid of a microscope is crucial if most macroinvertebrates are to be observed and identified.



*A 60 × 40 cm push net. This net is used to catch fishes and large macroinvertebrates*

A.



B.



*A bottle trap (A) and a box trap (B). These traps can be used with or without bait to trap fishes and large macroinvertebrates like decapod crustaceans.*



*A kick net, used for sampling macroinvertebrates located in the substrate.*

## HOW TO USE THIS GUIDEBOOK

This guidebook is meant to be used to identify fishes, decapod crustaceans, and other aquatic macroinvertebrates found within the Nee Soon Swamp Forest (NSSF) and areas around its periphery. The dichotomous keys provided will allow for preliminary identification down to distinct types or groups (e.g., order or family level) of fishes and macroinvertebrates. The keys indicate the relevant parts of the guidebook (page numbers) to refer to for more specific identification, and further details on the particular species (fishes and decapod crustaceans) or families (other aquatic macroinvertebrates). These details include information on physical appearance (accompanied by colour photographs), ecological notes, localities within Singapore and globally, and where available, conservation status or notes. All conservation data for Singapore is taken from the second edition of the Singapore Red Data Book, and international conservation status is taken from the International Union for Conservation of Nature (IUCN) Red List.

# Key to main groups of fishes from Nee Soon Swamp Forest\*

\*including introduced species in adjacent habitats that could potentially be found in NSSF

1. Lower jaw distinctly elongated, very much longer than upper jaw ..... **Zenarchopteridae (halfbeaks) (2 species, Pg. 28–29)**
- Lower jaw not elongated, shorter than to not much longer than upper jaw ..... 2
2. Body eel-like or snake-like in appearance (very slender and elongated) ..... 3
- Body not eel-like or snake-like in appearance (relatively stouter and less elongate) ..... 5
3. Body lacking scales. Dorsal and caudal (tail) fins greatly reduced; pectoral fins absent. Gill opening reduced to vertical slit on underside of head. Lacking barbels on snout ..... **Synbranchidae (swamp eels) (1 species, Pg. 25)**
- Body possessing scales. Dorsal, caudal, and pectoral fins present and well developed. Gill openings normal (running from side to underside of head), not reduced ..... 4
4. Small in size (adult total length 8 cm). Body yellow-brown, covered with irregular black blotches. Possessing one pair of short barbels on lower lip, with short, sharp spine beneath eye. Pelvic fins present. Snout not modified into a proboscis. Lacking short spines along dorsum ..... **Cobitidae (loaches) (1 species, Pg. 17)**
- Relatively larger in size (adult total length 19–46 cm). Body dorsum with distinct yellow-brown stripe, without irregular black blotches. Lacking barbels and spine beneath eye. Lacking pelvic fins. Snout modified into a proboscis. Possessing short spines along dorsum ..... **Mastacembelidae (spiny eels) (2 species\*, Pg. 26, 52)**
5. Body lacking scales (skin may be naked or covered by armour plates) ..... 6
- Body possessing scales ..... 10
6. Body laterally compressed. Dorsal fin reduced, anal fin only fused to elongated caudal (tail) fin. Possessing two pairs of barbels on snout, in which one pair is much longer than the other ..... **Siluridae (catfish) (1 species, Pg. 24)**
- Body not laterally compressed, but cylindrical to torpedo-shaped or dorsoventrally compressed. Dorsal fin well developed, anal fin not fused to tail fin or both anal fin and dorsal fin fused to tail fin, tail fin not elongated. Lacking two pairs of barbels on snout, in which one pair is much longer than the other ..... 7



7. Body dorsoventrally compressed, covered by amour plates, with ventral suckermouth ..... **Loricariidae (armoured sucker catfish) (3 species\*, Pg. 49–51)**
- Body cylindrical to torpedo-shaped in appearance, not covered by amour plates, lacking ventral suckermouth ..... 8
8. Large in size (adult total length 40–170 cm). Body relatively elongate and cylindrical in shape. Dorsal and anal fins elongated. Possessing sharp spines on pectoral fins only ..... **Clariidae (walking catfishes) (4 species\*, Pg. 21–23, 48)**
- Small in size (adult total length 3–6 cm). Body torpedo-shaped. Dorsal and anal fins not elongated. Possessing sharp spines on dorsal fin as well as pectoral fins ..... 9
9. Very small in size (adult total length 3 cm). Body covered with rough warty skin; lacking an adipose fin ..... **Akysidae (catfish) (1 species, Pg. 19)**
- Relatively larger in size (adult total length 6 cm). Body smooth, not covered with rough warty skin; with small adipose fin present ..... **Bagridae (catfish) (1 species, Pg. 20)**
10. Body dorsoventrally flattened, disc-like in shape, possessing slender elongated tail with barbed sting near base of tail ..... **Potamotrygonidae (freshwater stingray) (1 species\*, Pg. 42)**
- Body not flattened, lacking slender elongated tail, lacking sting near base of tail ..... 11
11. Body relatively more cylindrical- to torpedo-shaped (tube-like) rather than laterally compressed ..... 12
- Body relatively more laterally compressed rather than cylindrical- to torpedo-shaped (tube-like) ..... 17
12. Small in size (adult total length 3-12 cm). Body short and slim. Possessing flattened head with upturned mouth ..... 13
- Small to large in size (adult total length 3–100 cm). Body not short and slim. Lacking flattened head with upturned mouth. .... 14
13. Small in size (adult total length 3–12 cm). Body relatively short and slim. Possessing flattened head with upturned mouth. Males possessing modified anal fin for reproduction (gonopodium) ..... **Poeciliidae (mosquitofish, guppies, mollies) (3 species\*, Pg. 53–55)**
- Small in size (adult total length less than 8 cm). Body relatively more elongate. Possessing flattened head with distinct shiny white spot on dorsal surface, with upturned mouth and distinct black lower jaw margin. Males lacking modified anal fins for reproduction. .... **Aplocheilidae (whitespot) (1 species, Pg. 27)**
14. Body brown with white belly and black stripe running along the middle of the body. Head elongated and tapered to a sharp point ..... **Anabantoidea (part) (pikehead) (1 species, Pg. 34)**



- Body lacking colour pattern of brown with white belly and black stripe running along the middle. Head rounded, not elongated or tapered to sharp point ..... 15
- 15. Body cream-coloured with multiple grey bars. Snout possessing three pairs of barbels. Caudal (tail) fin forked ..... **Nemacheilidae (sand loach) (1 species, Pg. 18)**
- Body lacking colour pattern of cream with multiple grey bars. Snout lacking three pairs of barbels. Caudal (tail) fin rounded, not forked ..... 16
- 16. Head elongated, snake-like in appearance. Possessing single elongated dorsal fin ..... **Channidae (snakeheads) (5 species\*, Pg. 37–40, 64)**
- Head relatively stouter, not elongated or snake-like in appearance. Possessing two separate dorsal fins ..... **Gobioidae (gobies and relatives) (4 species\*, Pg. 31–32, 62–63)**
- 17. Body covered with large prominent scales. Possessing a toothed bone on floor of the mouth that resembles a “bony tongue”. Possessing two barbels protruding forward from tip of lower jaw ..... **Osteoglossidae (arowana) (1 species\*, Pg. 47)**
- Body covered with relatively small scales. Lacking any “bony tongue” in the the mouth. Lacking two barbels protruding forward from tip of lower jaw ..... 18
- 18. Body translucent, with clearly visible vertebral column. Head and gill cover possessing several rows of spines ..... **Ambassidae (glass fish) (1 species\*, Pg. 56)**
- Body opaque, with vertebral column not visible. Head and gill cover lacking rows of spines ..... 19
- 19. Head with one pair of nostrils visible instead of two. Lateral line discontinuous or interrupted alongside of body, with anterior (forward) part running in upper half of body and posterior (rear) part running along midline of body ..... **Cichlidae (cichlids) (5 species\*, Pg. 57–61)**
- Head with two pair of nostrils visible instead of one. Lateral line continuous or uninterrupted alongside of body ..... 20
- 20. Mouth with small but distinct teeth. Pelvic fins with elongate ray or filament. Possessing labyrinth organ for air breathing ..... **Anabantoidae (part) (gouramies and relatives) (4 species, Pg. 30, 33, 35–36)**
- Mouth lacking any teeth. Pelvic fins lacking elongate ray or filament. Lacking labyrinth organ for air breathing ..... **Cyprinidae (carps and relatives) (11 species\*, Pg. 10–16, 43–46)**

## PHYLUM CHORDATA

CLASS ACTINOPTERYGII

ORDER CYPRINIFORMES

FAMILY CYPRINIDAE

Common name SADDLE BARB

Scientific name *BARBODES BANKSI*  
(HERRE, 1940)

- **LOCAL STATUS – NOT EVALUATED**
- **INTERNATIONAL THREAT STATUS – NOT EVALUATED**
- **NATIVE**



*Large, wedge-shaped blotch below the dorsal fin.*

### Appearance/Description

- The saddle barb can easily be identified by the large black blotch below the dorsal fin as well as a black spot on the caudal peduncle. The blotch only appears at adulthood, with juveniles instead possessing several black spots and sometimes a slim black bar below the dorsal fin.
- Juveniles are also slimmer and generally silvery, with adults being a more pale golden or silvery-grey with red-tinged fins.
- Two pairs of barbels are present around the mouth.
- Adult fish can grow up to 18 cm.

### Biology

- One of the more common cyprinids found within the Nee Soon Swamp Forest, the saddle barb is an omnivorous fish and can form large schools (up to 50 individuals) with other species such as the two-spot rasbora.
- They are active swimmers which tend to occupy the lower and middle portions of the water column.
- They are omnivores, generally feeding on small invertebrates, plant matter and other organic debris.

### Habitat

- Generally found in forest streams. It is common and widely distributed within the NSSF.

*In Singapore, they can be found in the Bukit Timah Nature Reserve and the Central Catchment Nature Reserve, as well as the Western Catchment and Pulau Tekong. Worldwide, they can be found in the Malay Peninsula, Sumatra and Borneo.*

## PHYLUM CHORDATA

CLASS ACTINOPTERYGII

ORDER CYPRINIFORMES

FAMILY CYPRINIDAE

Common name SPANNER BARB

Scientific name *BARBODES*

*LATERISTRIGA* (VALENCIENNES, IN  
CUVIER & VALENCIENNES, 1842)

- **LOCAL STATUS – NOT EVALUATED**
- **INTERNATIONAL THREAT STATUS – LEAST CONCERN**
- **NATIVE**



*T-shaped marking on sides.*

### Appearance/Description

- The spanner or T-barb can be distinguished by its characteristic markings, resembling a spanner or an upper-case 'T' placed on its side, found on both flanks.
- They have silvery bodies with two pairs of barbels at their mouths.
- They can reach a size of 20 cm.

### Biology

- These gregarious and active fish frequent the middle and bottom water levels in forest streams, and form schools with both their own species and other similarly sized cyprinids.
- They are omnivorous, feeding mostly on small invertebrates, plant matter and other organic debris.

### Habitat

- Generally found in forest streams. It is uncommon in the NSSF, only being found in a few streams.

*In Singapore, they can be found in the Central Catchment Nature Reserve. Worldwide, they are distributed in the Malay Peninsula, Sumatra, Java, and Borneo.*

## PHYLUM CHORDATA

CLASS ACTINOPTERYGII

ORDER CYPRINIFORMES

FAMILY CYPRINIDAE

Common name MALAYAN PYGMY

RASBORA

Scientific name *BORARAS MACULATUS*  
(DUNCKER, 1904)

- LOCAL STATUS – CRITICALLY ENDANGERED
- INTERNATIONAL THREAT STATUS – LEAST CONCERN
- NATIVE



*Small, bright red body with large black spot on side.*

### Appearance/Description

- The pygmy rasbora is a tiny, bright red fish with a larger black spot on either side, and smaller black spots at the base of the tail and the anal fin.
- It generally does not grow any larger than 3 cm.

### Biology

- It is a schooling fish, living in groups in shallow forest streams.
- This fish is popular among aquarists for its vibrant colours, but can be difficult to maintain.

### Habitat

- It prefers acidic, slow-flowing forest streams, and cannot tolerate much disturbance in its environment.
- In the NSSF, it is relatively rare, and only found in a few streams.

*In Singapore, this fish is known only from a few areas in the Central Catchment Nature Reserve. Worldwide, it is known to be found in the Malay Peninsula and Sumatra.*

## PHYLUM CHORDATA

CLASS ACTINOPTERYGII  
ORDER CYPRINIFORMES  
FAMILY CYPRINIDAE

Common name SIX-BANDED TIGER BARB  
Scientific name *DESMOPUNTIOUS*  
*HEXAZONA* (WEBER & DE BEAUFORT,  
1912)

- **LOCAL STATUS – CRITICALLY ENDANGERED**
- **INTERNATIONAL THREAT STATUS – NOT EVALUATED**
- **NATIVE**



*Six black bands found along flank of body.*

### Appearance/Description

- The six-banded tiger barb is another fish which is both highly attractive and rare in Singapore.
- This fish is reddish-gold with six black bars, with iridescent green speckles on the side being visible when they catch the light.
- It has a slimmer body than its more well-known relative, the four-banded tiger barb, which has a deeper, more rhomboidal body.
- It generally reaches sizes of about 5 cm.

### Biology

- The six-banded tiger barb forms small schools, and frequents the area near the bottom of the water column.
- It is an omnivore, subsisting on invertebrates and other organic debris.
- This fish is also a popular fish with aquarists, due to its attractiveness.

### Habitat

- Lives in acidic, shaded forest streams. This species is relatively rare in the NSSF, and only known from a few sites.

*In Singapore, it is only known from the Central Catchment Nature Reserve. Worldwide, it is known from Borneo, Sumatra and the Malay Peninsula.*

## PHYLUM CHORDATA

CLASS ACTINOPTERYGII

ORDER CYPRINIFORMES

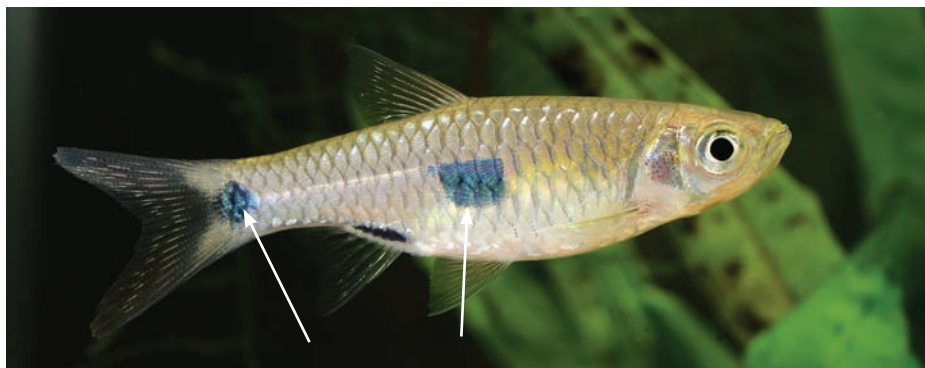
FAMILY CYPRINIDAE

Common name TWO-SPOT RASBORA

Scientific name *RASBORA ELEGANS*

VOLZ, 1903

- **LOCAL STATUS – NOT EVALUATED**
- **INTERNATIONAL THREAT STATUS – LEAST CONCERN**
- **NATIVE**



*Two spots on sides of fish.*

### Appearance/Description

- The two-spot rasbora possesses a silvery, slim body and black-edged fins.
- A distinctive feature of the two-spot rasbora are the two black spots found on its body.
- One of these spots is located in the middle of the body, and the other at the base of the tail. However, the spots can be quite faint at times, especially when the fish is stressed.
- Juveniles have black spots at the end of the caudal fin tips.
- This fish grows to about 13 cm.

### Biology

- The two-spot rasbora is one of the common cyprinids found in Singapore, and is one of the more common fishes within the Nee Soon Swamp Forest.
- This fish can usually be found in schools of 5-10 fish, which frequent the middle and upper water levels in streams.
- It feeds mostly on detritus and invertebrates.

### Habitat

- Lives In shaded forest streams. It is common and widespread in the NSSF.

*Within Singapore, it can be found within the Central Catchment Nature Reserves and the Bukit Timah Nature Reserve. Worldwide, it is known from the Malay Peninsula, Sumatra and Borneo.*

## PHYLUM CHORDATA

CLASS ACTINOPTERYGII  
ORDER CYPRINIFORMES  
FAMILY CYPRINIDAE

Common name EINTHOVEN'S RASBORA  
Scientific name *RASBORA EINTHOVENII*  
(BLEEKER, 1851)

- LOCAL STATUS – NOT EVALUATED
- INTERNATIONAL THREAT STATUS – NOT EVALUATED
- NATIVE



*Single black stripe with ragged edge along length of body.*

### Appearance/Description

- Einthoven's rasbora can easily be distinguished by the long black stripe along its body, which extends from the snout to the fork of the caudal fin.
- Its body is slim and silvery, much like the two-spot rasbora.
- It sometimes exhibits bluish or purplish iridescence on the dorsal half of the body.
- It usually only reaches 9 cm compared to the 13 cm of the two-spot rasbora.

### Biology

- This rasbora feeds on small invertebrates and generally prefers the upper and middle levels of the water column.

### Habitat

- The Einthoven's rasbora prefers acidic, slow-flowing and shady streams, and is a widespread but uncommon denizen of the Nee Soon Swamp Forest.

*Within Singapore, this rasbora can be found in the Central Catchment Nature Reserves, Bukit Timah Nature Reserve, the Western Catchment Area and Pulau Tekong. Worldwide, it is distributed in the Malay Peninsula, Sumatra and Borneo.*



## PHYLUM CHORDATA

CLASS ACTINOPTERYGII

ORDER CYPRINIFORMES

FAMILY CYPRINIDAE

Common name HARLEQUIN RASBORA

Scientific name *TRIGONOSTIGMA*

*HETEROMORPHA* (DUNCKER, 1904)

- **LOCAL STATUS – ENDANGERED**
- **INTERNATIONAL THREAT STATUS – LEAST CONCERN**
- **NATIVE**



*Large triangle-shaped marking on flank.*

### Appearance/Description

- The harlequin rasbora possesses a deep body, with an overall reddish colouration but a silvery abdomen.
- The most distinctive feature is the triangular black blotch on the side, as well as the narrow black bar behind the gill cover.
- It reaches sizes of 5 cm.

### Biology

- The harlequin rasbora is a common fish within the Nee Soon Swamp Forest, spending most of its time moving in schools within the middle and upper zones of the water column.
- An insectivorous fish, it is also a very popular fish in the aquarium/ornamental fish trade.
- It was originally described from Singapore.

### Habitat

- It prefers shaded, acidic forest streams, and is common and widespread within the NSSF.

*Within Singapore, it is now only found in the Central Catchment Nature Reserves. Worldwide, it is distributed throughout the Malay Peninsula and Sumatra.*



## PHYLUM CHORDATA

CLASS ACTINOPTERYGII

ORDER CYPRINIFORMES

FAMILY COBITIDAE

Common name SPOTTED EEL-LOACH

Scientific name *PANGIO*

*MURAENIFORMIS* (DE BEAUFORT, 1933)

- **LOCAL STATUS – ENDANGERED**
- **INTERNATIONAL THREAT STATUS – NOT EVALUATED**
- **NATIVE**



*Mottling found on whole body.*

### Appearance/Description

- The spotted eel-loach is a long and very slender fish resembling an eel, with a yellow-brown body covered with irregularly-shaped black blotches and three black bands on its head, while juvenile fish possess black bands ringing the body.
- This fish possesses a pair of short barbels as well as a small, ventrally located mouth; and a short sharp spine beneath the eye.
- It reaches roughly 8 cm in length.

### Biology

- This fish is an omnivore which is usually found in the stream bed among the fine substratum and submerged leaf litter.
- It primarily feeds on small invertebrates and detritus.
- It was originally described from Singapore.

### Habitat

- It prefers shaded, acidic forest streams. It is widespread but uncommon within the NSSF.

*In Singapore, it is only known from the Nee Soon Swamp Forest within the Central Catchment Nature Reserve. Worldwide, it is distributed from the Malay Peninsula and Sumatra.*

## PHYLUM CHORDATA

CLASS ACTINOPTERYGII  
ORDER CYPRINIFORMES  
FAMILY NEMACHEILIDAE

Common name GREY-BANDED  
SAND LOACH

Scientific name *NEMACHEILUS*  
*SELANGORICUS* DUNCKER, 1904

- **LOCAL STATUS – CRITICALLY ENDANGERED**
- **INTERNATIONAL THREAT STATUS – DATA DEFICIENT**
- **NATIVE**



*Cream body with multiple grey bars.*

### Appearance/Description

- This fish has a cylindrical, cream body with multiple grey bars ringing it.
- This loach also possesses three pairs of barbels, as well as a forked tail fin; the presence of acuminate scales along the lateral near the caudal fin is also distinctive (visible under the microscope).
- Juveniles generally resemble the adults.
- It generally reaches lengths of up to 9 cm.

### Biology

- It primarily feeds on small invertebrates and detritus.

### Habitat

- The grey-banded sand loach is a bottom-dwelling fish, which tends to prefer fast-flowing forest streams with sandy substratum and acidic water. It is a relatively uncommon fish within the NSSF, and can be found at several sites.

*Within Singapore, it can only be found within the Nee Soon Swamp Forest in the Central Catchment Forest Reserve. Worldwide, it is present in the Malay Peninsula, Sumatra and Borneo.*

## PHYLUM CHORDATA

CLASS ACTINOPTERYGII

ORDER SILURIFORMES

FAMILY AKYSIDAE

Common name SINGAPORE LITTLE  
WARTY CATFISH

Scientific name *PARAKYSIS*  
*LONGIROSTRIS* NG & LIM, 1995

- **LOCAL STATUS – CRITICALLY ENDANGERED**
- **INTERNATIONAL THREAT STATUS –LEAST CONCERN**
- **NATIVE**



*Small, torpedo-shaped body with mottling and rough skin.*

### Appearance/Description

- The little warty catfish is a small catfish which lacks an adipose fin and has rough warty skin, without any scales.
- It possesses sharp spines on its pectoral and dorsal fins, which can cause painful wounds.
- It is coloured a dark brown with cream blotches.
- It reaches lengths of 3 cm.

### Biology

- This catfish tends to stay concealed beneath submerged vegetation or debris, and is usually solitary.
- It was originally described from Singapore.

### Habitat

- They tend to prefer acidic forest streams. This fish is rare even in the NSSF, only being found in a few locations.

*It is only found within the Nee Soon Swamp Forest in Singapore. Worldwide, it can also be found in southern Peninsular Malaysia and the Riau Archipelago.*

## PHYLUM CHORDATA

CLASS ACTINOPTERYGII

ORDER SILURIFORMES

FAMILY BAGRIDAE

Common name DWARF BUMBLEBEE

CATFISH

Scientific name *PSEUDOMYSTUS*

*LEIACANTHUS* (WEBER & DE BEAUFORT,  
1912)

- **LOCAL STATUS –  
CRITICALLY ENDANGERED**
- **INTERNATIONAL THREAT  
STATUS –LEAST CONCERN**
- **NATIVE**



*Three broad black bars on yellow body.*

### Appearance/Description

- This attractive fish gets its common name from its yellow, scaleless body with three broad black bars.
- It possesses a small adipose dorsal fin, as well as a broad blackish band over its caudal fin, which allows it to be distinguished from its congeners.
- It usually reaches a size of about 6 cm.

### Biology

- It feeds on small aquatic invertebrates.

### Habitat

- This catfish prefers acidic, shaded forest streams with a fast flow and submerged vegetation. It is rare even within the NSSF, and can only be found in a few locations.

*Within Singapore, this fish is only found in the Nee Soon Swamp Forest in the Central Catchment Nature Reserve. Worldwide, it is distributed in the Malay Peninsula, Riau Archipelago, and Sumatra.*

## PHYLUM CHORDATA

CLASS ACTINOPTERYGII

ORDER SILURIFORMES

FAMILY CLARIIDAE

Common name COMMON WALKING CATFISH

Scientific name *CLARIAS BATRACHUS*  
(LINNEAUS, 1758)

- **LOCAL STATUS – NOT EVALUATED**
- **INTERNATIONAL THREAT STATUS – LEAST CONCERN**
- **NATIVE**



*Four pairs of barbels on head.*

### Appearance/Description

- The common walking catfish has a long, scaleless body with a head covered in bony plates.
- It possesses four pairs of barbels, as well as a long dorsal and anal fin, which are separate from the caudal fin.
- The gap between the origin of the dorsal fin and the bony plates of the head is narrow, while the head is rounded when viewed from above.
- The body is usually a greyish-brown with multiple rows of faint white spots present along the sides.
- It can reach a size of 40 cm.

### Biology

- It is capable of surviving out of water for some time, as well as being able to move short distances on land using its pectoral fin spines to 'walk', hence its common name.
- It is mostly bottom dwelling, nocturnal and omnivorous.

### Habitat

- This catfish is highly adaptable, and can tolerate disturbed environments such as concretised canals and urban ponds. While common elsewhere in Singapore, it is rarely found within the NSSF, and even then only at the more open outskirts.

*Within Singapore, it can be found throughout the island in rural and suburban areas. Worldwide, it is widely distributed over Southeast Asia and has been introduced to many other places.*

## PHYLUM CHORDATA

CLASS ACTINOPTERYGII

ORDER SILURIFORMES

FAMILY CLARIIDAE

Common name FOREST WALKING

CATFISH

Scientific name *CLARIAS LEIACANTHUS*  
(BLEEKER, 1851)

- **LOCAL STATUS – NOT EVALUATED**
- **INTERNATIONAL THREAT STATUS –NOT EVALUATED**
- **NATIVE**



*Distinct rows of white spots on body.*

### Appearance/Description

- This catfish resembles the common walking catfish superficially, with a long, scaleless body, but has several differences which allow it to be distinguished.
- A wider gap exists between the origin of the dorsal fin and the bony head plates, compared to the common walking catfish; and the head of the forest walking catfish appears more angular when viewed from above.
- The dorsal and anal fins are also separate and not fused with the caudal fin. It usually grows to about 40 cm.

### Biology

- It is capable of surviving out of water for some time, as well as being able to move short distances on land, hence its common name.
- It is mostly bottom dwelling, nocturnal and omnivorous.

### Habitat

- The forest walking catfish is much more limited in its distribution compared to the common walking catfish, only being found in forest streams and swamps with acidic waters. Within the NSSF, it is relatively widespread and can be found throughout the whole forest.

*In Singapore, it is found within the Central Catchment Nature Reserves. Worldwide, it can be found in the Malay Peninsula, Java, Sumatra and Borneo.*

## PHYLUM CHORDATA

CLASS ACTINOPTERYGII

ORDER SILURIFORMES

FAMILY CLARIIDAE

Common name SLENDER WALKING CATFISH

Scientific name *CLARIAS NIEUHOFII*  
(VALENCIENNES, IN CUVIER &  
VALENCIENNES, 1840)

- **LOCAL STATUS – CRITICALLY ENDANGERED**
- **INTERNATIONAL THREAT STATUS –LEAST CONCERN**
- **NATIVE**



*Longer, more slender body than other walking catfishes.*

### Appearance/Description

- The slender walking catfish is more slender when compared to its relatives, but resembles them in most other ways.
- It possesses a long, scaleless body which is coloured grey-brown and has multiple rows of tiny yellowish spots on its side.
- It has four pairs of barbels, and a wide gap between the bony plates covering its head and the origin of the dorsal fin, as well as a more angular head when viewed from above.
- The dorsal and anal fins of this species are fused to the caudal fin, and it can reach 50 cm in length.

### Biology

- This catfish has similar habits to the forest walking catfish, but is much rarer in the Nee Soon Swamp Forest.
- It is capable of surviving out of water for some time, as well as being able to move short distances on land, hence its common name.
- It is mostly bottom dwelling, nocturnal and omnivorous.

### Habitat

- The slender walking catfish is much more limited in its distribution compared to the common walking catfish, only being found in forest streams and swamps with acidic waters. This fish is relatively uncommon in the NSSF.

*In Singapore, it is only found in the Central Catchment Nature Reserve. Worldwide, it is distributed over the Malay Peninsula, Java, Borneo, and Sumatra.*



## PHYLUM CHORDATA

CLASS ACTINOPTERYGII

ORDER SILURIFORMES

FAMILY SILURIDAE

Common name HASSELT'S LEAF CATFISH

Scientific name *SILURICHTHYS HASSELTII*

BLEEKER, 1858

- **LOCAL STATUS – CRITICALLY ENDANGERED**
- **INTERNATIONAL THREAT STATUS – NOT EVALUATED**
- **NATIVE**



*Fused anal and tail fin.*

### Appearance/Description

- This catfish has a laterally compressed and scaleless body and two pairs of barbels, one of which is much longer than the other.
- The anal fin is also fused to the long and elongated tail fin, effectively forming one large fin which extends along most of the body of the fish, while the dorsal fin is very much reduced, consisting of only a few fin rays.
- The body is coloured a mottled yellowish brown. It reaches lengths of about 14 cm.

### Biology

- The Hasselt's leaf catfish is mostly nocturnal, preferring to hide in submerged leaf litter during the day, but emerges at night to hunt for prey on the surface.

### Habitat

- It prefers acidic waters in forest streams and swamps, and is uncommon even within the Nee Soon Swamp Forest.

*In Singapore, it is only found in the Central Catchment Nature Reserve. Worldwide, its range extends from the Malay Peninsula to Java and Sumatra.*



## PHYLUM CHORDATA

CLASS ACTINOPTERYGII

ORDER SYNBRANCHIFORMES

FAMILY SYNBRANCHIDAE

Common name ORIENTAL SWAMP EEL

Scientific name *MONOPTERUS*

*JAVANENSIS* LA CEPÈDE, 1800

- **LOCAL STATUS – NOT EVALUATED**
- **INTERNATIONAL THREAT STATUS – NOT EVALUATED**
- **NATIVE**



*Elongated, slender body.*

### Appearance/Description

- The oriental swamp eel is relatively distinctive, with its long, snake-like scaleless body.
- It generally has brownish colouration, with black specks.
- The dorsal and tail fins are greatly reduced, with the tail tapering to a point, and the pectoral fins are missing altogether.
- The gill opening is reduced to a vertical slit below the head.
- The eel generally reaches a length of 40 cm in total but has been known to grow longer.

### Biology

- It requires access to atmospheric air, and can survive for a time completely out of water. It usually hides in burrows during the day, hunting only at night.
- This fish is farmed widely for human consumption.

### Habitat

- It can be found in a wide range of environments within Singapore, including concretised canals and drains, as it tolerates a wide range of water conditions. It is rare in the NSSF, and only found in the outskirts.

*In Singapore, it is widespread, and can even be found in canals, as it is able to tolerate brackish water. Elsewhere, it is widespread naturally within Southeast Asia.*

## PHYLUM CHORDATA

CLASS ACTINOPTERYGII  
ORDER SYNBRANCHIFORMES  
FAMILY MASTACEMBELIDAE

Common name BUFF-BACKED SPINY EEL

Scientific name *MACROGNATHUS  
MACULATUS* (CUVIER, IN CUVIER &  
VALENCIENNES, 1832)

- **LOCAL STATUS –  
CRITICALLY ENDANGERED**
- **INTERNATIONAL THREAT  
STATUS – LEAST CONCERN**
- **NATIVE**



*Proboscis-like snout.*

### Appearance/Description

- This eel-like fish has a laterally compressed body with long dorsal and anal fins.
- It lacks pelvic fins, and possesses a row of short spines along its dorsum (hence its common name).
- The body is usually dark brown with a buff back, but colour can be variable in this species.
- The snout of this species is modified into a pointed fleshy proboscis which is used for locating prey buried in the substrate of the stream.
- It can reach lengths of about 19 cm.

### Biology

- Nocturnal and solitary, this eel hides in the daytime in leaf litter and usually only emerges at night. It feeds on small invertebrates.

### Habitat

- It lives in acidic forest streams. This fish is relatively uncommon within the NSSF, but is widely distributed across the swamp forest.

*In Singapore, this fish is only found in the Central Catchment Nature Reserve. Worldwide, this fish is widely distributed in Southeast Asia. It can be found in Indochina, Thailand, the Malay Peninsula, Java, Sumatra and Borneo.*

## PHYLUM CHORDATA

CLASS ACTINOPTERYGII  
ORDER CYPRINODONTIFORMES  
FAMILY APLOCHEILIDAE

Common name WHITESPOT

Scientific name *APLOCHEILUS PANCHAX*  
(HAMILTON, 1822)

- **LOCAL STATUS – NOT EVALUATED**
- **INTERNATIONAL THREAT STATUS – LEAST CONCERN**
- **NATIVE**



### Appearance/Description

- The whitespot's head is flattened on the top, with a distinctive shiny white spot present as well, which gives this fish its common name.
- Its body is slender and yellowish, with an upturned mouth. A blackish line can be seen along the lower jaw when viewed from the side.
- The dorsal fin is small, with a black blotch sometimes visible as well.
- This fish usually reaches lengths of 8 cm or so.

### Biology

- The whitespot can usually be found in shoals near the surface of the water.
- It has an omnivorous diet, and is known to feed on insects, especially mosquito larvae. This has led to its introduction to new areas for purposes of mosquito control.

### Habitat

- This fish is highly adaptable, and lives in a wide range of habitats, including open streams and brackish areas. It has even been recorded from hot springs in Singapore.

*In Singapore, it can be found in the Central Catchment Nature Reserves as well as streams and ditches in open areas and scrubland. Worldwide: It can natively be found in India, Indochina and down through the Malay Peninsula, Sumatra, and Java.*

## PHYLUM CHORDATA

CLASS ACTINOPTERYGII

ORDER BELONIFORMES

FAMILY ZENARCHOPTERIDAE

Common name MALAYAN PYGMY  
HALFBEAK

Scientific name *DERMOGENYS*  
*COLLETTEI* MEISNER, 2001

- **LOCAL STATUS – NOT EVALUATED**
- **INTERNATIONAL THREAT STATUS – NOT EVALUATED**
- **NATIVE**



*Dorsal fin origin posterior to origin of anal fin.*

### Appearance/Description

- The most distinctive feature of the pygmy halfbeak is its extremely elongated lower jaw, which has earned it the name 'halfbeak'.
- It superficially resembles the other species of halfbeak in Singapore, the forest halfbeak, but is distinguishable from its forest relative by several features.
- Firstly, it possesses a more robust build, with a generally thicker body.
- It is also coloured a light grey, while the dorsal fin can have a red blotch (in males only).
- Finally, the dorsal fin begins after the anal fin origin.
- The females tend to be larger than the males, and are slightly less colourful as well. They can reach about 6 cm in length.

### Biology

- The pygmy halfbeak is a live-bearing fish, which gives birth to live young.
- The males possess a modified anal fin called an andropodium, which assists in fertilising the female.
- These fish are gregarious and frequent the surface of the water, hunting for insects which fall in.

### Habitat

- They can be found in both forest and open streams and ponds in both fresh and brackish water.
- Within the NSSF drainage, they are only found on the outskirts, in open water, and are not found elsewhere.

*Within Singapore, they are relatively widely distributed, and can be found in the Central Catchment Nature Reserve and the Western Catchment Area. Worldwide, they occur from the Malay Peninsula to Sumatra and Borneo.*

## PHYLUM CHORDATA

CLASS ACTINOPTERYGII

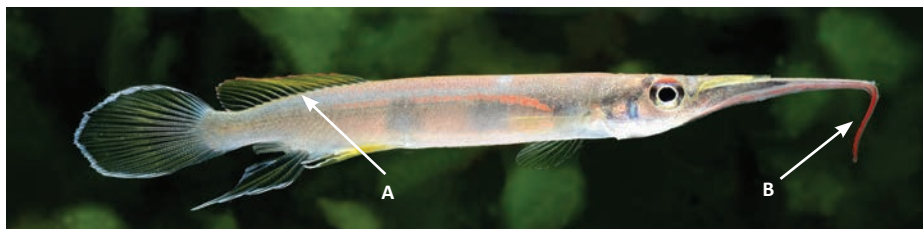
ORDER BELONIFORMES

FAMILY ZENARCHOPTERIDAE

Common name MALAYAN FOREST  
HALFBEAK

Scientific name *HEMIRHAMPHODON*  
*POGONOGNATHUS* (BLEEKER, 1853)

- LOCAL STATUS – NOT EVALUATED
- INTERNATIONAL THREAT STATUS – LEAST CONCERN
- NATIVE



Dorsal fin origin anterior to anal fin origin (A). Also, note the red fleshy tassel at tip of lower jaw (B).

### Appearance/Description

- The forest halfbeak has a lower jaw which is extremely elongated and extends past its upper jaw, hence the common name of ‘halfbeak’.
- It has a slender body, and has a dorsal fin with a long base that begins before the anal fin origin.
- It is more colourful than the pygmy halfbeak, and may have a fleshy red growth curving down from the tip of its beak.
- It can reach lengths of 9 cm.

### Biology

- The forest halfbeak gives birth to live young, while the male possesses a modified anal fin referred to as an andropodium, which is used to fertilise the female.
- This fish is gregarious, and forms groups on the surface, where they look for insects which fall into the water.

### Habitat

- They prefer shaded forest streams, and are common and widely distributed within the Nee Soon Swamp Forest.

*Within Singapore, they can be found within the Central Catchment Nature Reserve. Worldwide, they are distributed from southern Thailand and down the Malay Peninsula to Sumatra and Borneo.*

## PHYLUM CHORDATA

CLASS ACTINOPTERYGII

ORDER PERCIFORMES

FAMILY ANABANTIDAE

Common name ASIAN CLIMBING PERCH

Scientific name *ANABAS TESTUDINEUS*

(BLOCH, 1792)

- **LOCAL STATUS – NOT EVALUATED**
- **INTERNATIONAL THREAT STATUS – DATA DEFICIENT**
- **NATIVE**



*Spine-lined gill cover.*

### Appearance/Description

- The climbing perch is a non-descript looking fish with a roughly rectangular body and rounded head.
- The edge of its gill covers are lined with short spines, with a black spot present.
- It is coloured a dull olive-grey, with occasional and irregular black striping.
- The dorsal and anal fins have long bases, and are stiffened with spiny rays.
- There is also another black spot present on its caudal fin base.
- It reaches lengths of 23 cm.

### Biology

- This fish is capable of breathing atmospheric air with the aid of a specialised organ referred to as the labyrinth organ located above its gills, as well as being able to crawl across land by using their spiny gill covers.
- It is generally omnivorous, and spends much of its time at the bottom of the water column.
- It is widely kept in aquaria as it is reputed to be able to drive away evil spirits (in Malay folklore).

### Habitat

- It lives in streams and ponds in rural and open areas. In the NSSF, it is rare and generally found only in the outskirts.

*In Singapore, it is relatively common, being found in streams and ponds in both forested and rural areas. Worldwide, it is widely distributed across Southeast Asia.*

## PHYLUM CHORDATA

CLASS ACTINOPTERYGII

ORDER PERCIFORMES

FAMILY ELEOTRIDAE

Common name MARBLED GUDGEON

Scientific name *OXYELEOTRIS*  
*MARMORATA* (BLEEKER, 1852)

- LOCAL STATUS – NOT EVALUATED
- INTERNATIONAL THREAT STATUS – LEAST CONCERN
- NATIVE, BUT INTRODUCED IN INLAND WATERS



*Mottled body with two dorsal fins.*

### Appearance/Description

- The marbled gudgeon has a slender, cylindrical body with two dorsal fins.
- Its pelvic fins are separate, and the pectoral fins are large, round and reddish.
- The fish is mostly coloured a greyish brown with multiple marbled black markings.
- It can reach lengths of 60 cm or more.

### Biology

- This fish is relatively sluggish, nocturnally active and solitary.
- It mostly spends its time on the bottom of streams or ponds waiting to ambush prey such as small shrimps or fishes.
- Referred to as the 'soon hock' in Singapore, it is much prized by gourmets for its tender and tasty flesh, and thus is intensely farmed.

### Habitat

- It can live in rivers, ponds, or lakes. In the NSSF, it is common in the outskirts, and occasionally found in the rest of the swamp forest.

*Currently, it can be found in the Central Catchment Nature Reserve, as well as multiple reservoirs across the island. It appears to have been introduced into inland waters, as it was previously only found in estuarine areas in Singapore. Elsewhere, it is distributed over a wide area from Indochina across the Malay Peninsula, Sumatra, Java, and Borneo to the Philippines.*

## PHYLUM CHORDATA

CLASS ACTINOPTERYGII

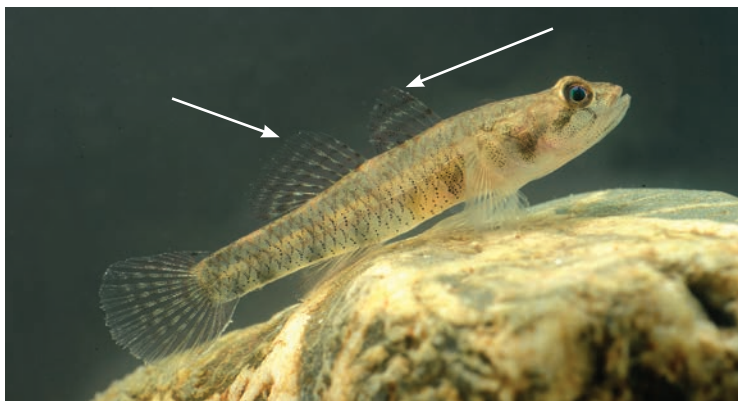
ORDER PERCIFORMES

FAMILY GOBIONELLIDAE

Common name BIGMOUTH STREAM  
GOBY

Scientific name *PSEUDOGOBIOPSIS  
OLIGACTIS* (BLEEKER, 1875)

- **LOCAL STATUS – NOT EVALUATED**
- **INTERNATIONAL THREAT STATUS – LEAST CONCERN**
- **NATIVE**



*Note the two separate dorsal fins.*

### Appearance/Description

- This small goby has a torpedo-shaped body, with a short snout.
- It is generally coloured olive-grey, with black speckles and blotches along the length of the body.
- Like all true gobies, its pelvic fins have fused into a sucker-like structure.
- Males generally have an enlarged head and jaw.
- It can reach about 5 cm in length.

### Biology

- This goby was once thought to be extinct in Singapore before being recently rediscovered in 2010.

### Habitat

- It is normally found in open and exposed streams with clean water, and spends most of its time on the bottom of the stream.
- In the NSSF drainage, it is relatively rare, only being found in one or two areas in the outskirts of the NSSF.

*In Singapore, it is found in the Central Catchment Nature Reserves as well as several other reservoirs. Worldwide, it is distributed from Thailand and throughout the Malay Peninsula to Indonesia.*



## PHYLUM CHORDATA

CLASS ACTINOPTERYGII

ORDER PERCIFORMES

FAMILY OSPHRONEMIDAE

Common name MALAYAN FOREST BETTA

Scientific name *BETTA PUGNAX*

(CANTOR, 1849)

- **LOCAL STATUS – NOT EVALUATED**
- **INTERNATIONAL THREAT STATUS – NOT EVALUATED**
- **NATIVE**



*Robust, blunt head.*

### Appearance/Description

- This fish may be distinguished by its slender, laterally compressed body and robust, blunt head.
- The colour patterns of this fish are variable, but the two most common forms are brown with greenish-blue spots on each scale, and brown with two black stripes along the body.
- The throats of adults also possess vivid iridescent green scales.
- It reaches about 10 cm in length.

### Biology

- It tends to hide in submerged vegetation and leaf litter, feeding on insects and other invertebrates.
- The males of this species brood fertilised eggs in their mouth until they hatch. It is widely distributed throughout the entire NSSF and can be found in almost all streams.

### Habitat

- The forest betta is a common fish which prefers shallow and shaded forest streams. It is widely distributed throughout the entire NSSF and can be found in almost all streams.

*This species can be found in the Bukit Timah Nature Reserve, the Central Catchment Nature Reserve and the Western Catchment area within Singapore. Worldwide, it is distributed throughout the Malay Peninsula and Sumatra.*

## PHYLUM CHORDATA

CLASS ACTINOPTERYGII

ORDER PERCIFORMES

FAMILY OSPHRONEMIDAE

Common name MALAYAN PIKEHEAD

Scientific name *LUCIOCEPHALUS*

*PULCHER* (GRAY, 1830)

- **LOCAL STATUS – CRITICALLY ENDANGERED**
- **INTERNATIONAL THREAT STATUS – NOT EVALUATED**
- **NATIVE**



*Long, pointed snout.*

### Appearance/Description

- The pikehead has a long, cylindrical body with a pointed snout.
- The upper half of its body is brown, with a white belly and a black stripe running along the middle of the body as well.
- The black stripe may be broken up into multiple spots as well.
- The pikehead can reach the length of 18 cm.

### Biology

- This fish is a voracious predator that ambushes smaller fishes and shrimps.
- It possesses an extendable mouth which is used to suck up unsuspecting prey.
- It usually spends its time near the surface of the water, waiting for food to come by.
- Males practice mouth-brooding, guarding their eggs in their mouth until they hatch.

### Habitat

- It prefers acidic, slow-flowing and shaded streams. This fish is uncommon within the NSSF, but is reasonably widespread.

*Within Singapore, this fish can only be found in the Central Catchment Nature Reserve. Worldwide, it is found in the Malay Peninsula, Sumatra and Borneo.*

## PHYLUM CHORDATA

CLASS ACTINOPTERYGII

ORDER PERCIFORMES

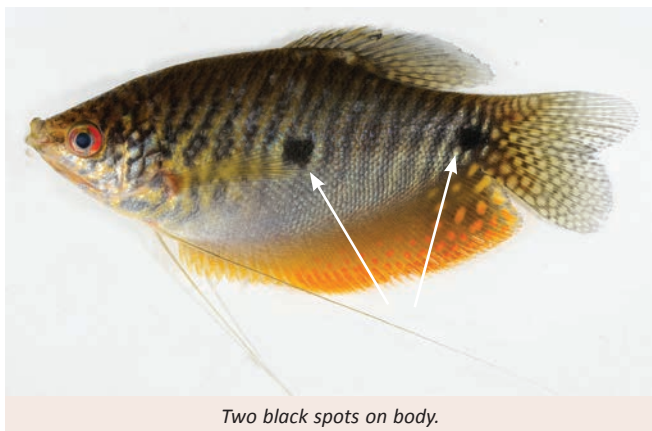
FAMILY OSPHRONEMIDAE

Common name THREE-SPOT GOURAMI

Scientific name *TRICHOPODUS*

*TRICHOPTERUS* (PALLAS, 1870)

- **LOCAL STATUS – NOT EVALUATED**
- **INTERNATIONAL THREAT STATUS – LEAST CONCERN**
- **NATIVE**



### Appearance/Description

- The main distinguishing feature of this fish are the two black spots found on its body, one on the base of the caudal fin and one in the middle of the body.
- The body is laterally compressed and oval-shaped and silvery-grey, with orange spots on the anal fin.
- The pelvic fins are modified into long, filament-like structures which are used for sensory purposes.
- This fish reaches lengths of 15 cm.

### Biology

- This fish is both hardy and common, as it can breathe atmospheric air and thus tolerate lower dissolved oxygen levels in water.
- It prefers to stay near the surface, and is a generalist omnivore.
- It tends to stay in groups, which rise to gulp air from the surface together.
- It is a popular aquarium fish, and is consumed for food in Malaysia and Indonesia.

### Habitat

- It prefers slow-flowing and vegetated streams. While common elsewhere in Singapore, it is rare within the NSSF, and only found on the outskirts.

*Within Singapore, this fish is widely distributed in streams and ponds in rural areas. Worldwide, it is found in Indochina, the Malay Peninsula, Sumatra, Borneo and Java.*

## PHYLUM CHORDATA

CLASS ACTINOPTERYGII

ORDER PERCIFORMES

FAMILY OSPHRONEMIDAE

Common name CROAKING GOURAMI

Scientific name *TRICHOPSIS VITTATA*  
(CUVIER, IN CUVIER & VALENCIENNES,  
1831)

- **LOCAL STATUS – NOT EVALUATED**
- **INTERNATIONAL THREAT STATUS – LEAST CONCERN**
- **NATIVE**



*Pointed, slightly curved snout.*

### Appearance/Description

- This fish possesses a slender, laterally compressed body, with a pointed snout.
- The body is generally coloured a greyish brown with four blackish stripes running along the length of the body from the head to the base of the caudal fin.
- The eye usually has a distinct blue ring, while the dorsal, anal and caudal fins have red markings.
- This fish can reach 6 cm in length.

### Biology

- The croaking gourami gets its common name from the ability of the male fish to produce a croaking sound during breeding activities.
- These fish create bubble nests in clumps of floating vegetation when breeding, where the eggs are laid.
- They are omnivorous, feeding on insects and other organic matter.

### Habitat

- It prefers vegetated streams. This species is rare in the NSSF drainage, and is only found on the outskirts.

*In Singapore, found in densely vegetated ponds and streams in rural and open areas. Worldwide, they can be found in Indochina, the Malay Peninsula, Sumatra, Borneo and Java.*

## PHYLUM CHORDATA

CLASS ACTINOPTERYGII

ORDER PERCIFORMES

FAMILY CHANNIDAE

Common name DWARF SNAKEHEAD

Scientific name *CHANNA GACHUA*

(HAMILTON, 1822)

- **LOCAL STATUS – CRITICALLY ENDANGERED**
- **INTERNATIONAL THREAT STATUS – LEAST CONCERN**
- **NATIVE**



Adult (A) and juvenile (B).

### Appearance/Description

- The dwarf snakehead possesses a slender body, with the head being broad and dorso-ventrally compressed.
- The body is generally coloured a pale brown, while the dorsal, anal and caudal fins are greenish-blue with an attractive bright red or orange margin.
- The yellow pectoral fins possess several black bars as well.
- This fish generally only achieves a length of 18 cm, being the smallest snakehead found in Singapore.

### Biology

- It is a carnivore which hunts other fish and invertebrates from ambush.
- The male broods eggs and fry in his buccal cavity during the breeding season.

### Habitat

- This fish prefers shallow, muddy streams or swamps which are shaded and acidic. Within NSSF, this fish is widespread but uncommon.

*In Singapore, this fish is only known from the Central Catchment Nature Reserves, and was thought to be extinct since 1966, only to be rediscovered in 1989. Worldwide, it is distributed from India to Myanmar, Indochina, the Malay Peninsula, Sumatra, Java and Borneo, and is part of a species complex.*

## PHYLUM CHORDATA

CLASS ACTINOPTERYGII

ORDER PERCIFORMES

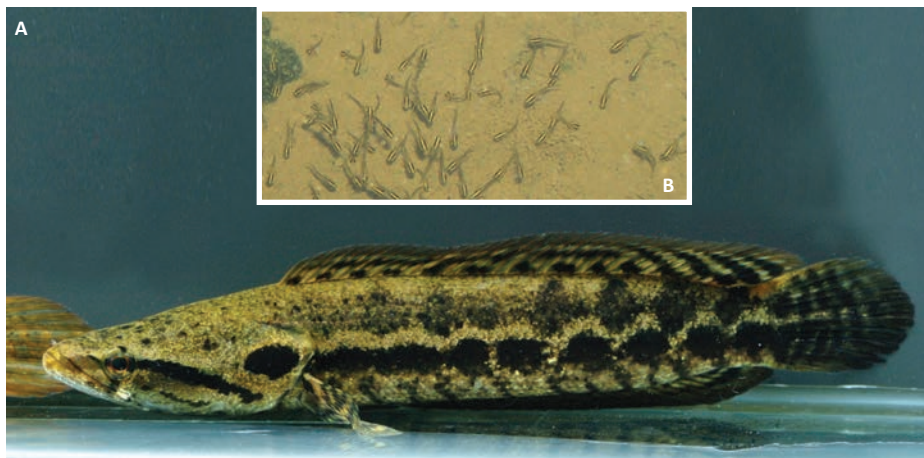
FAMILY CHANNIDAE

Common name FOREST SNAKEHEAD

Scientific name *CHANNA LUCIUS*

(CUVIER, IN CUVIER & VALENCIENNES, 1831)

- LOCAL STATUS – NOT EVALUATED
- INTERNATIONAL THREAT STATUS – LEAST CONCERN
- NATIVE



Adult forest snakehead (A) and a shoal of juveniles (B).

### Appearance/Description

- The forest snakehead has a slender body with a head which tapers slightly, especially in side profile.
- Several black blotches resembling portholes can be found along the flanks, with another black blotch on the gill cover and a black stripe behind the eye.
- The overall colour is brown with a whitish underside, while the pectoral fins are brown with many yellow spots. Juveniles are pale yellow with two black stripes extending from head to caudal fin. Adults reach about 40 cm in length.

### Biology

- It is a carnivore which hunts other fishes and invertebrates from ambush.

### Habitat

- The forest snakehead lives in forested, acidic streams singly or in pairs. This fish is widespread within the NSSF, and is reasonably common.

*Within Singapore, these fish are limited to the Central Catchment Nature Reserve. Worldwide, they may be found in Indochina, the Malay Peninsula, Sumatra, Borneo and Java.*



## PHYLUM CHORDATA

CLASS ACTINOPTERYGII

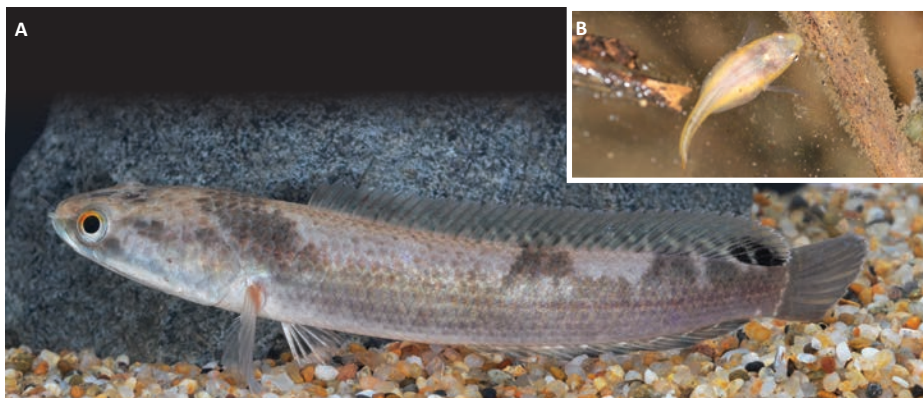
ORDER PERCIFORMES

FAMILY CHANNIDAE

Common name BLACK SNAKEHEAD

Scientific name *CHANNA MELASOMA*  
(BLEEKER, 1851)

- **LOCAL STATUS – CRITICALLY ENDANGERED**
- **INTERNATIONAL THREAT STATUS – LEAST CONCERN**
- **NATIVE**



Adult black snakehead (A) and juvenile (B).

### Appearance/Description

- The black snakehead has a slender body with a wide, dorso-ventrally compressed head.
- The body is a dark greyish-black, with the edges of the dorsal, caudal and anal fins having a distinctive white fringe.
- There is usually also a black spot on the posterior part of the dorsal fin.
- Juveniles have black and orange stripes as well as a white spot on the top of the head.
- Adults generally reach 30 cm in length.

### Biology

- It appears to be nocturnal, and is carnivorous as well, feeding on smaller fishes and invertebrates.
- It was first reported from Singapore only in 1990.

### Habitat

- This fish prefers slow-flowing, shaded forest streams with acidic waters, frequently hiding in the leaf litter or submerged vegetation. This fish is uncommon within the NSSF, and only found in a few sites.

*In Singapore, it may be found in the Central Catchment Nature Reserve and Bukit Timah Nature Reserve. Worldwide, it is known from the Malay Peninsula and Riau Archipelago.*



## PHYLUM CHORDATA

CLASS ACTINOPTERYGII

ORDER PERCIFORMES

FAMILY CHANNIDAE

Common name COMMON SNAKEHEAD

Scientific name *CHANNA STRIATA*

(BLOCH, 1793)

- **LOCAL STATUS – NOT EVALUATED**
- **INTERNATIONAL THREAT STATUS – LEAST CONCERN**
- **NATIVE**

A



B



Adult common snakehead (A) and juvenile (B).

### Appearance/Description

- The common snakehead is coloured a greyish brown on the upper part of its body, with a white underside.
- There is a distinct boundary between the two areas of colouration along the side of the body as well.
- Black slanted bars are also found on the upper part of the body, with a black spot on the posterior of the dorsal fin found in young specimens.
- Adults can reach a maximum length of 90 cm, though 30 cm is a more common length.

### Biology

- This fish is the most common snakehead species in Singapore and the region, and is prized for food (used particularly in post-surgery recuperative food). It is carnivorous, feeding on smaller animals including fishes, insects and frogs.

### Habitat

- It is more adaptable than the other snakeheads in Singapore, and is found in streams and ponds in rural or forested areas, as well as reservoirs and concretised waterways. While common elsewhere in Singapore, it is rare in the NSSF and only found in the outskirts.

*In Singapore, it is common and widely distributed.* Worldwide, it is found in India, Indochina, the Malay Peninsula, Sumatra, Borneo and Java.

## INTRODUCED FISHES

The fish species listed in this section are not native to Singapore. Some have been found in the streams at the outskirts of the Nee Soon Swamp Forest, while others have not yet been recorded from the Nee Soon Swamp Forest, but have the potential to establish within the NSSF, since the environmental conditions found in their native habitats resemble the conditions found in the NSSF. These introduced fishes have the potential to broadly affect the ecosystem of the NSSF, as they may compete with native fishes for resources. Alternatively, they may directly affect the population of a single native fish species via predation.

As such, it is important to be able to identify such introduced fishes, to ensure that they can be recognised and dealt with appropriately. Thus, the inclusion of the following section facilitates identification of these fishes should they be encountered.



*The outskirts of the Nee Soon Swamp Forest.  
This is the most likely area to encounter introduced species.*

## PHYLUM CHORDATA

CLASS CHONDRICTHYES

ORDER MYLOBATIFORMES

FAMILY POTAMOTRYGONIDAE

Common name MOTORO RAY

Scientific name *POTAMOTRYGON*

*MOTORO* (MÜLLER & HENLE, 1841)

- **LOCAL STATUS – NOT EVALUATED**
- **INTERNATIONAL THREAT STATUS – DATA DEFICIENT**
- **INTRODUCED**



*Disc-shaped, dorso-ventrally flattened body.*

### Appearance/Description

- This is the only freshwater ray currently known to be established in Singapore's water bodies, and can be easily identified by its flat, disc-like body shape.
- It has an elongated tail with a barbed sting near the tail base, which can inject venom, inflicting extremely painful wounds.
- The upper body is brown and covered with orange spots, while the underside is cream.
- It has been known to reach sizes of 50 cm across the body disc.

### Biology

- A livebearer which carries its developing young within its body for about three months before giving birth.
- It is likely that the population in Singapore resulted from discarded aquarium fish.

### Habitat

- This ray prefers sandy or muddy substrates and deep water bodies, but is adaptable and may be found in smaller waterways.
- It is recently recorded from the buffer zone outside NSSF, and has the potential to establish due to similar water conditions in its native range.

*In Singapore, this ray has been recorded from the Upper Seletar, Lower Seletar, and Lower Peirce Reservoirs. Worldwide, it is known from the Amazon basin, the Rio Orinoco, Rio Uruguay, Rio Paraná and Rio Paraguay.*

## PHYLUM CHORDATA

CLASS ACTINOPTERYGII  
ORDER CYPRINIFORMES  
FAMILY CYPRINIDAE

Common name INDOCHINESE SPOTTED BARB

Scientific name *BARBODES RHOMBEUS*  
(KOTTELAT, 2000)

- LOCAL STATUS – NOT EVALUATED
- INTERNATIONAL THREAT STATUS – LEAST CONCERN
- INTRODUCED



*Small spot below dorsal fin.*

### Appearance/Description

- This barb is generally silvery-grey to golden, with a black spot underneath the dorsal fin and a black spot on the base of the caudal fin.
- The black spot is much smaller than the blotch of the native saddle barb (*Barbodes banksi*).
- The fins are tinged red, with two pairs of barbels being present at the mouth as well.
- This fish can reach lengths of 7 cm.

### Biology

- A shoaling fish that can form large schools, this barb is a close relative of the native saddle barb.
- It frequents the middle column of the water, and is omnivorous, feeding mostly on small invertebrates and organic matter.
- This fish was probably introduced into Singapore via the aquarium trade, either as a feeder fish or as a pet fish in its own right.

### Habitat

- Generally inhabits open streams. In the NSSF, it is only found in the outskirts.

*In Singapore, found around rural and open streams, as well as reservoirs. Worldwide, it can be found in Indochina and Thailand north of the Isthmus of Kra.*

## PHYLUM CHORDATA

CLASS ACTINOPTERYGII

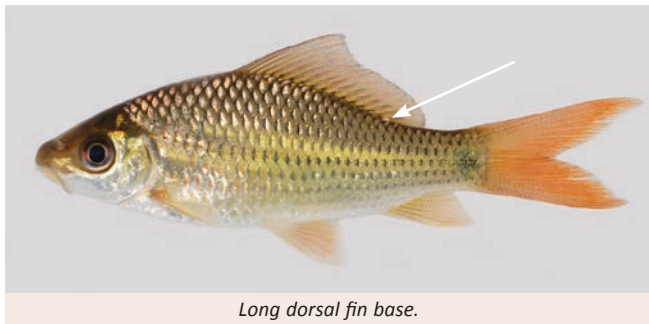
ORDER CYPRINIFORMES

FAMILY CYPRINIDAE

Common name BONY-LIPPED BARB

Scientific name *OSTEOCHILUS VITTATUS*  
(VALENCIENNES, IN CUVIER &  
VALENCIENNES, 1842)

- **LOCAL STATUS – NOT EVALUATED**
- **INTERNATIONAL THREAT STATUS – LEAST CONCERN**
- **INTRODUCED**



### Appearance/Description

- This barb has a laterally compressed, elongate rhomboidal body, with a small pair of barbels.
- The lower part is silvery, while the upper part is greenish-gold; sometimes with red spots on the sides along the belly area. The fins are tinged a light red, with a single black spot at the base of the caudal fin.
- The dorsal fin has a long base, beginning midway through the body and ending opposite the beginning of the anal fin.
- This species can exhibit an alternate body pattern, which consists of a diffused black stripe along the middle of the body to the caudal fin base.
- It can reach sizes of up to 32 cm.

### Biology

- It is an omnivorous fish, mostly consuming algae and other plant matter but also taking small crustaceans and other invertebrates.

### Habitat

- The bony-lipped barb usually lives in large rivers with muddy or sandy substrates, but is highly adaptable. Within the NSSF, it is only found in the outskirts.

*In Singapore, known from several reservoirs such as Upper Seletar Reservoir, as well as streams connected to them within the CCNR. Worldwide, it can be found in the Mekong and Chao Phraya basins, the Salween and MaeKlong basins, the Malay Peninsula, Sumatra, Java and Borneo. It has also been reported from southern China (Yunnan) and an introduced population is found in Hong Kong.*



## PHYLUM CHORDATA

CLASS ACTINOPTERYGII

ORDER CYPRINIFORMES

FAMILY CYPRINIDAE

Common name SUMATRAN TIGER BARB

Scientific name *PUNTIGRUS TETRAZONA*  
(BLEEKER, 1855)

- **LOCAL STATUS – NOT EVALUATED**
- **INTERNATIONAL THREAT STATUS – NOT EVALUATED**
- **INTRODUCED**



*Stockier body than the six-banded tiger barb.*

### Appearance/Description

- This fish has a laterally compressed, rhomboidal body with four black bars.
- One bar passes through the eye, while the other bars are in front of the dorsal fin, behind the dorsal fin, and at the base of the caudal fin respectively.
- The body is a silvery-brown with a tinge of yellow, while the fins are red, with the dorsal and anal fin having a black bar on its base as well.
- The black body bar behind the dorsal fin more or less forms a continuous line with the black bar extending from the dorsal fin to the anal fin. It reaches lengths of 7 cm.

### Biology

- It is primarily an omnivore, consuming small invertebrates, algae and organic debris.
- It is a highly popular aquarium fish and was likely introduced to Singapore's waterways via the ornamental fish trade. There are many colour variants artificially produced in the ornamental fish trade, e.g., green tiger barb, albino tiger barb, ghost tiger barb.

### Habitat

- The Sumatran tiger barb lives in thickly vegetated, clear streams in the wild. In the NSSF drainage, it is rare and only found on the outskirts.

*In Singapore, found in reservoirs as well as streams in open and rural areas. Worldwide, appears to be endemic to Sumatra. Feral populations are present in many countries, including the USA, Australia, Colombia, and Suriname.*

## PHYLUM CHORDATA

CLASS ACTINOPTERYGII

ORDER CYPRINIFORMES

FAMILY CYPRINIDAE

Common name RED-TAILED RASBORA

Scientific name *RASBORA*

*BORAPETENSIS* SMITH, 1934

- **LOCAL STATUS – NOT EVALUATED**
- **INTERNATIONAL THREAT STATUS – LEAST CONCERN**
- **INTRODUCED**



*Distinctive red patch at base of tail.*

### Appearance/Description

- This fish has a silvery, slim body, with transparent fins.
- A distinctive feature of this species is the red patch at the base of the caudal fin.
- A single long, black stripe with a straight edge runs along the body of this fish, originating behind the operculum and ending at the caudal peduncle. A golden stripe runs immediately above and parallel to the black stripe.
- It can reach sizes of about 6 cm in length.

### Biology

- The red-tailed rasbora is relatively hardy and adaptable, and is capable of tolerating somewhat polluted habitats.
- It usually frequents the middle of the water column, feeding on small invertebrates and organic matter.
- This fish is likely to have been introduced to Singapore via the aquarium trade.

### Habitat

- In its native habitat, it lives in wetlands and shallow waterways, moving into larger rivers when they flood.
- It has so far only been recorded from the outskirts of the NSSF.

*In Singapore, it can be found in open and rural streams, as well as several reservoirs. Worldwide: It is native to Indochina, Thailand and the northern Malay Peninsula, Borneo and Sumatra. It has also been introduced in the Philippines.*



## PHYLUM CHORDATA

CLASS ACTINOPTERYGII

ORDER OSTEOGLOSSIFORMES

FAMILY OSTEOGLOSSIDAE

Common name ASIAN AROWANA

Scientific name *SCLEROPAGES*

*FORMOSUS* (MÜLLER & SCHLEGEL, 1840)

- LOCAL STATUS – NOT EVALUATED
- INTERNATIONAL THREAT STATUS – ENDANGERED
- INTRODUCED



*Distinctive barbels on lower jaw tip.*

### Appearance/Description

- The Asian arowana has a long, laterally compressed body with large, prominent scales.
- It has two barbels protruding forward from its lower jaw tip.
- The fish is usually a silvery-grey colour, but many colour variants exist naturally in the wild including green, gold and red.
- It usually reaches sizes of 40-60 cm, but unverified reports have suggested that it can reach lengths of 90 cm.

### Biology

- The Asian arowana is a predatory fish which feeds on smaller fish and amphibians. It primarily stays near the surface of the water column.
- This fish is a mouthbrooder, with the male guarding the fertilised eggs in its mouth till hatching occurs, and thereafter guarding the fry for another 7 to 8 weeks.
- The arowana is highly prized as an ornamental fish, and trade in it is controlled under Appendix I of CITES.

### Habitat

- They are naturally found in large rivers, lakes, swamps and flooded areas, with some forms being found in acidic, blackwater habitats.
- It has not yet been recorded from the NSSF drainage, but has the potential to establish itself eventually.

*In Singapore, this fish has been found in multiple reservoirs including Upper Seletar, MacRitchie, Upper Peirce and Lower Peirce Reservoirs. Worldwide, it is naturally distributed in the lower Mekong basin, southern Thailand, the Malay Peninsula, Sumatra and Borneo.*

## PHYLUM CHORDATA

CLASS ACTINOPTERYGII

ORDER SILURIFORMES

FAMILY CLARIIDAE

Common name AFRICAN WALKING  
CATFISH

Scientific name *CLARIAS GARIEPINUS*  
(BURCHELL, 1822)

- **LOCAL STATUS – NOT EVALUATED**
- **INTERNATIONAL THREAT STATUS – LEAST CONCERN**
- **INTRODUCED**



*Mottled body with granulations on head.*

### Appearance/Description

- This catfish has a long, scaleless body with a head covered in bony plates.
- It superficially resembles its native relatives, but can be differentiated by its mottled body colouration, pigmented stripes on the underside of the head, and a large, flattened head with granulations on the top.
- It is known to reach lengths of 170 cm.

### Biology

- The African walking catfish is a bottom-dwelling species that is mostly nocturnal. It is omnivorous, eating anything that will fit into its mouth.
- It is capable of surviving out of water for some time, as well as being able to move short distances on land, hence its common name.
- It is a popular aquaculture fish, which has led to its introduction and establishment in many places around the world, including Singapore.

### Habitat

- It is highly adaptable and can tolerate diverse habitats, including human-influenced ones such as concretised canals and reservoirs.
- This fish has not yet been recorded from the NSSF or its buffer zone, but has the potential to establish itself due to its adaptability.

*In Singapore, known from several reservoirs and streams in open and rural areas. Worldwide, it is distributed over almost the entire continent of Africa, as well as the Levant and Asia Minor. Introduced populations are found in multiple countries including China, Brazil, Greece, Iraq and Indonesia.*

## PHYLUM CHORDATA

CLASS ACTINOPTERYGII

ORDER SILURIFORMES

FAMILY LORICARIIDAE

Common name VERMICULATED SAILFIN  
CATFISH

Scientific name *PTERYGOPLICHTHYS*  
*DISJUNCTIVUS* (WEBER, 1991)

- LOCAL STATUS – NOT EVALUATED
- INTERNATIONAL THREAT STATUS – NOT EVALUATED
- INTRODUCED



*Brown chevron patterns on side and vermiculate patterns on belly.*

### Appearance/Description

- This fish is a typical sailfin catfish, with a dorso-ventrally compressed body, ventral suckermouth, and armour plates on its body.
- The dorsal fin is large and sail-like, while the caudal fin is also large, resembling a fan.
- The fish is a dark brown colour, with dark brown chevron-like patterns on the dorsal side, and black vermiculate patterns on the ventral portion of the fish.
- It can reach sizes of 70 cm.

### Biology

- This fish can tolerate low oxygen levels due to its modified gut, which acts as an additional respiratory organ.
- It feeds on algae, plant matter and organic debris. It is a popular aquarium fish, and was likely introduced to Singapore via the ornamental fish trade.

### Habitat

- The vermiculated sailfin catfish lives in floodplain lakes and swamps.
- It has not yet been recorded from the NSSF or its buffer zone, but has the potential to establish itself due to suitable water conditions.

*In Singapore, it is established in several reservoirs. Worldwide, it originates from the Rio Madeira basin in Brazil and Peru, but has been introduced to multiple countries including the USA, Mexico, the Philippines, and Taiwan.*

## PHYLUM CHORDATA

CLASS ACTINOPTERYGII

ORDER SILURIFORMES

FAMILY LORICARIIDAE

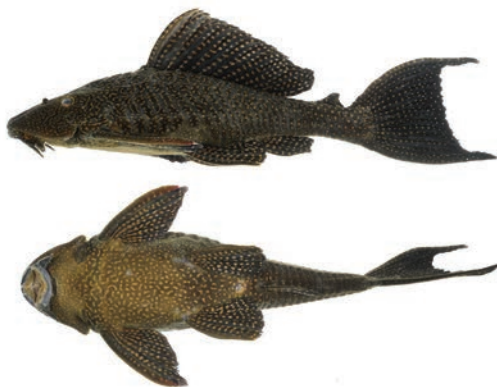
Common name SPOTTED SAILFIN

CATFISH

Scientific name *PTERYGOPLICHTHYS*

*JOSELIMAIANUS* (WEBER, 1991)

- LOCAL STATUS – NOT EVALUATED
- INTERNATIONAL THREAT STATUS –NOT EVALUATED
- INTRODUCED



*Yellow spots on body and belly.*

### Appearance/Description

- This fish is easily distinguished by its dorso-ventrally compressed body, ventral suckermouth, and armour plates on its body.
- The dorsal fin is large and sail-like, while the caudal fin is also large, resembling a fan.
- This particular sailfin catfish has yellowish-brown spots on a dark brown body.
- It grows to lengths of about 35 cm.

### Biology

- This fish can tolerate low levels of oxygen, due to its modified gut which allows it to respire atmospheric air.
- It mostly feeds on algae and other organic detritus which is scraped off using its suckermouth.
- It is a popular aquarium fish, and was likely introduced to Singapore via the ornamental fish trade.

### Habitat

- The spotted sailfin catfish lives in large, shallow rivers. It has been recorded from the NSSF drainage, but only from the outskirts.

*In Singapore, known from the Lower Seletar Reservoir and the Sungei Seletar. Worldwide, this fish is native to Brazil, where it is found in the Tocantins River basin.*

## PHYLUM CHORDATA

CLASS ACTINOPTERYGII

ORDER SILURIFORMES

FAMILY LORICARIIDAE

Common name AMAZON SAILFIN

CATFISH

Scientific name *PTERYGOPLICHTHYS*

*PARDALIS* (CASTELNAU, 1855)

- LOCAL STATUS – NOT EVALUATED
- INTERNATIONAL THREAT STATUS –NOT EVALUATED
- INTRODUCED



*Multiple black spots on sides and belly. Example shown has a shortened body.*

### Appearance/Description

- The Amazon sailfin catfish is very similar to its congeners, with a dorso-ventrally flattened body, ventral suckermouth, and armour plates on its body.
- The dorsal fin is large and sail-like, while the caudal fin is also large, resembling a fan.
- The fish is light brown in colour, with many large black spots densely covering the whole body, including the fins. It reaches sizes of 50 cm.

### Biology

- A bottom-dweller which can tolerate low oxygen levels due to its modified gut acting as a secondary respiratory organ.
- This sailfin catfish feeds on algae and organic debris, with its suckermouth allowing it to scrape off food from rocks. In Singapore, it is likely that it was introduced through the aquarium trade, as this is a popular aquarium fish.

### Habitat

- The Amazon sailfin catfish lives in large rivers.
- It has not yet been recorded from the NSSF or its buffer zone, but has the potential to establish itself due to suitable water conditions.

*In Singapore, known to be established in several reservoirs, including Upper and Lower Seletar Reservoirs. Worldwide, it originates from the Amazon River basin, but has now been introduced to several places around the world. It is known to be established in the USA, Indonesia, Malaysia, and the Philippines.*

## PHYLUM CHORDATA

CLASS ACTINOPTERYGII

ORDER SYNBRANCHIFORMES

FAMILY MASTACEMBELIDAE

Common name ZEBRA SPINY EEL

Scientific name *MACROGNATHUS*  
*ZEBRINUS* (BLYTH, 1858)

- **LOCAL STATUS – NOT EVALUATED**
- **INTERNATIONAL THREAT STATUS – LEAST CONCERN**
- **INTRODUCED**



*Elongated body with multiple black bars.*

### Appearance/Description

- The zebra spiny-eel has an elongated, laterally compressed body, as well as a distinct pointed proboscis on the snout.
- Like all spiny-eels, it has a row of short dorsal spines before the dorsal fin, which can be sharp.
- The body is coloured a light brown or beige, with a series of thin, dark bars along its length.
- It can reach a length of about 46 cm.

### Biology

- It usually stays near the bottom, preying mostly on small fishes and aquatic invertebrates.
- It is likely to have been introduced into Singapore via the aquarium trade.

### Habitat

- In the wild, this fish is primarily found in rivers and swamps with large amounts of aquatic vegetation. It has only been recorded from the outskirts of the NSSF drainage so far.

*In Singapore, it has been recorded from several reservoirs, including Lower Seletar Reservoir. Worldwide, it is found in Myanmar, with some reports from Indonesia as well.*

## PHYLUM CHORDATA

CLASS ACTINOPTERYGII

ORDER CYPRINODONTIFORMES

FAMILY POECILIIDAE

Common name MOSQUITOFISH

Scientific name *GAMBUSIA AFFINIS*  
(BAIRD & GIRARD, 1853)

- **LOCAL STATUS – NOT EVALUATED**
- **INTERNATIONAL THREAT STATUS – LEAST CONCERN**
- **INTRODUCED**



Female (A) and male (B) mosquitofish.

### Appearance/Description

- This fish has a short, slim body, with a flattened head and an upward-turned mouth.
- The colouration of the fish is a dull greyish-brown with a faint bluish-purplish sheen on the abdomen region. The caudal fin is rounded and transparent.
- Males have a modified anal fin known as a gonopodium, which is long and thin, and used for the transfer of sperm during internal fertilisation.
- Females are usually larger than males, and can reach sizes of 6-7 cm, while males usually are no larger than 3 cm.

### Biology

- The mosquitofish is an adaptable fish that can tolerate almost any condition
- It feeds on small invertebrates, including mosquito larvae, and has been released worldwide in efforts to control mosquito populations.
- It is a livebearer which gives birth to live young.

### Habitat

- In the wild, it is found in shallow water with thick vegetation, but can tolerate high pollution, brackish conditions, as well as low oxygen levels. So far, this fish is only present on the outskirts of the NSSF drainage.

*These hardy fish are almost ubiquitous in drains and canals, as well as rural and open streams throughout Singapore, together with other poecilids.* It originates from the south-central United States, but has been widely introduced both in the rest of the USA as well as worldwide.

## PHYLUM CHORDATA

CLASS ACTINOPTERYGII

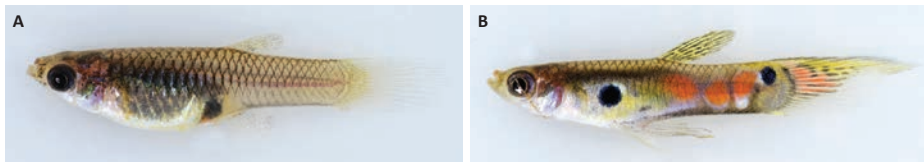
ORDER CYPRINODONTIFORMES

FAMILY POECILIIDAE

Common name GUPPY

Scientific name *POECILIA RETICULATA*  
PETERS, 1859

- **LOCAL STATUS – NOT EVALUATED**
- **INTERNATIONAL THREAT STATUS – NOT EVALUATED**
- **INTRODUCED**



Female (A) and male (B) guppy.

### Appearance/Description

- The guppy has a short body, flattened head and an upturned mouth for taking food from the surface.
- Females are a pale olive-grey, with tinges of colour on the fins, while males have colourful blue, black and red spots or streaks on their flanks.
- The males also have their anal fin modified into an organ called the gonopodium.
- Domesticated versions are highly colourful (in males) with large fan-like caudal fins, but are unlikely to survive long in the wild.
- The females usually reach sizes of 6-7 cm, while the males are rarely larger than 4-5 cm.

### Biology

- These fish are omnivorous, feeding on plankton, small invertebrates and detritus.
- They are livebearers which give birth to live young.
- This fish is a highly popular aquarium fish, and has also been introduced widely for purposes of mosquito control. It is likely that it was introduced to Singapore for either of these reasons.

### Habitat

- Guppies are highly adaptable fish which can be found in a wide range of habitats, from stagnant water in ponds and drains to clean, fast-flowing hill streams. So far, this species has only been recorded from the outskirts of the NSSF drainage.

*In Singapore, widely distributed in drains and canals, as well as reservoirs and ponds. This fish originally was found in Brazil, Guiana, Venezuela, and multiple West Indian islands including Trinidad and Jamaica, but is now distributed almost world-wide.*



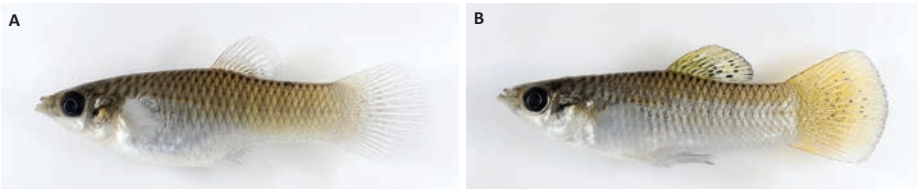
## PHYLUM CHORDATA

CLASS ACTINOPTERYGII  
ORDER CYPRINODONTIFORMES  
FAMILY POECILIIDAE

Common name MOLLY

Scientific name *POECILIA SPHENOPS*  
VALENCIENNES, IN CUVIER &  
VALENCIENNES, 1846

- **LOCAL STATUS – NOT EVALUATED**
- **INTERNATIONAL THREAT STATUS – LEAST CONCERN**
- **INTRODUCED**



Female (A) and male (B) molly.

### Appearance/Description

- The molly superficially resembles its poeciliid relatives, with a short body, flattened head and upturned mouth, but is generally stockier, with tinges of colour on its caudal, anal and dorsal fins.
- Males possess a modified anal fin, referred to as a gonopodium.
- Domesticated variants of the molly include golden, platinum, black, albino and piebald strains.
- It generally reaches sizes of 8 cm for males and 12 cm for females.

### Biology

- It mostly feeds on small invertebrates and detritus.
- This species is a livebearer, giving birth to live young.
- The colourful variants are popular aquarium fish, while the drabber ones are sold as feeder fish. It is likely that the species was introduced to Singapore via the aquarium trade.

### Habitat

- In the wild, the molly lives in small streams, and can tolerate brackish water. So far, this species has only been recorded from the outskirts of the NSSF drainage.

*In Singapore, the molly may be found in drains, canals and ponds throughout the island, as well as rural and open streams and reservoirs.* It is native to Mexico and Guatemala, but has established feral populations in many countries, including the USA, Japan, and the Philippines.

## PHYLUM CHORDATA

CLASS ACTINOPTERYGII

ORDER PERCIFORMES

FAMILY AMBASSIDAE

Common name INDOCHINESE GLASS-PERCHLET

Scientific name *PARAMBASSIS SIAMENSIS* (FOWLER, 1937)

- **LOCAL STATUS – NOT EVALUATED**
- **INTERNATIONAL THREAT STATUS – LEAST CONCERN**
- **INTRODUCED**



*Translucent body with a deeply notched single dorsal fin.*

### Appearance/Description

- This fish is easily identified by its translucent, laterally compressed rhomboidal body, with a deeply notched single dorsal fin and a large anal fin.
- The head is silvery, while the rest of the body is translucent, with a visible vertebral column.
- There is a black blotch at the very tip of the dorsal fin, and another may be present at the edge of the gill cover.
- The head and gill cover has several rows of spines.
- This fish reaches a length of 6 cm.

### Biology

- This fish forms large schools in the middle of the water column.
- This fish primarily feeds on small invertebrates and organic debris.

### Habitat

- It normally inhabits marshy areas and still water bodies, only migrating to flowing water in the flood season. In the NSSF drainage, this species is only found on the outskirts.

*In Singapore, this fish is established in multiple reservoirs and streams in open areas. Worldwide, it is found in the Mekong basin, as well as Thailand, the Malay Peninsula, and Java.*

## PHYLUM CHORDATA

CLASS ACTINOPTERYGII

ORDER PERCIFORMES

FAMILY CICHLIDAE

Common name THREADFIN ACARA

Scientific name *ACARICHTHYS HECKELII*  
(MÜLLER & TROSCHEL, 1849)

- LOCAL STATUS – NOT EVALUATED
- INTERNATIONAL THREAT STATUS – NOT EVALUATED
- INTRODUCED



*Elongated fin rays on dorsal fin.*

### Appearance/Description

- This cichlid has a laterally compressed body which is somewhat oval, brown on the dorsal side, silvery on the sides, and whitish on the ventral portion.
- Larger individuals develop yellow colouration on the front half of the body as well as on the fins. There is a black bar under the eye, a black spot in the middle of the body as well as a black blotch on the upper front of the dorsal fin.
- Mature individuals also develop elongated reddish fin rays on the distal regions of both dorsal and anal fins.
- This fish usually reaches sizes of 15 cm.

### Biology

- This fish prefers soft acidic water, and feeds by sifting through fine substratum in water bodies.
- During breeding season, bonded pairs will form up and the female will excavate burrows in the sediment, which are used for spawning. The brood of young will be defended till the fry have reached a certain size.
- This is a popular ornamental fish, and is likely to have been introduced to Singapore via the aquarium trade.

### Habitat

- It lives in large rivers in the wild. It is rare within the NSSF drainage, occasionally being found on the outskirts. It has been recorded deeper within the NSSF once.

*In Singapore, found in several reservoirs including Upper Peirce, Lower Seletar and Upper Seletar Reservoirs. Has been recorded from the NSSF before.* It originates from Guyana, the Amazon and the Orinoco river basins in South America.

## PHYLUM CHORDATA

CLASS ACTINOPTERYGII

ORDER PERCIFORMES

FAMILY CICHLIDAE

Common name UMBRELLA DWARF

CICHLID

Scientific name *APISTOGRAMMA*

*BORELLI* (REGAN, 1906)

- **LOCAL STATUS – NOT EVALUATED**
- **INTERNATIONAL THREAT STATUS – NOT EVALUATED**
- **INTRODUCED**



*Small, laterally compressed body.*

### Appearance/Description

- This cichlid has an elongated, laterally compressed body with a rounded caudal fin.
- The males are usually blue, while the females are yellow.
- There is a black bar beneath the eye, and a lateral black stripe along the length of the body.
- This fish usually reaches sizes of 4 cm.

### Biology

- It feeds on small invertebrates as well as organic debris.
- It is highly popular in the aquarium trade, and was likely introduced to Singapore via escaped or released pet fish.

### Habitat

- This fish inhabits cool, soft waters in the wild, preferably ones with large amounts of vegetation. It has only been recorded once on the outskirts of the NSSF drainage.

*In Singapore, recorded from an open stream near Upper Seletar Reservoir Park.* Its native habitat is the Paraguay River basin and the lower Parana River of Argentina.

## PHYLUM CHORDATA

CLASS ACTINOPTERYGII

ORDER PERCIFORMES

FAMILY CICHLIDAE

Common name ORINOCO PEACOCK BASS

Scientific name *CICHLA ORINOCENSIS*

HUMBOLDT, IN HUMBOLDT &

VALENCIENNES, 1821

- LOCAL STATUS – NOT EVALUATED
- INTERNATIONAL THREAT STATUS – NOT EVALUATED
- INTRODUCED



*Male peacock bass, as shown by the forehead/nuchal hump.*

### Appearance/Description

- This predatory cichlid can be distinguished by its greenish-gold elongated body, with three large, thick black bars on the flank, and a single blotch on the base of the caudal fin.
- It has a large head and mouth, with breeding males developing a nuchal hump on the forehead.
- Juveniles have three black bars together with an abbreviated lateral stripe.
- This fish usually reaches lengths of about 60 cm.

### Biology

- This fish is a voracious predator that feeds on smaller fishes.
- In sport fishing, this fish is prized due to its fighting prowess, and was likely introduced to Singapore by sport anglers.

### Habitat

- It primarily lives in large rivers, preferring slow-flowing shallow areas. This species has been recorded from the outskirts of the NSSF drainage.

*In Singapore, populations have been established in several reservoirs, including Upper and Lower Seletar Reservoirs, as well as rural and open waterways. This fish originates from the Orinoco River basin, in Colombia and Venezuela, as well as the Amazon River basin, in Brazil.*

## PHYLUM CHORDATA

CLASS ACTINOPTERYGII

ORDER PERCIFORMES

FAMILY CICHLIDAE

Common name SPECKLED PEACOCK BASS

Scientific name *CICHLA TEMENSIS*

HUMBOLDT, IN HUMBOLDT &

VALENCIENNES, 1821

- **LOCAL STATUS – NOT EVALUATED**
- **INTERNATIONAL THREAT STATUS – NOT EVALUATED**
- **INTRODUCED**



*Speckles present along flanks distinguish it from other peacock bass species.*

### Appearance/Description

- This predatory cichlid can be distinguished by its greenish-grey, elongated body, with three black, thick bars along the side, and a single blotch on the base of the caudal fin.
- Yellowish speckles are present along the sides of the body.
- It has a large head and mouth, with black blotches present on the operculum.
- The anal, pelvic and the bottom half of the caudal fin are orange-red.
- It is generally slimmer than its congener, *C. orinocensis*.
- It can reach a maximum size of 75 cm.

### Biology

- This fish is a voracious predator that feeds on other, smaller fishes.
- In sport fishing, this fish is prized due to its fighting prowess, and was likely introduced to Singapore by sport anglers.

### Habitat

- It primarily lives in large rivers, preferring slow-flowing shallow areas.
- So far, this species has not yet been recorded from the NSSF or its buffer zones, but has the potential to establish due to similar water conditions.

*In Singapore, this fish is known from the Upper Seletar Reservoir.* This fish originates from the Orinoco River basin, in Colombia and Venezuela, as well as the Amazon River basin, in Brazil.

## PHYLUM CHORDATA

CLASS ACTINOPTERYGII

ORDER PERCIFORMES

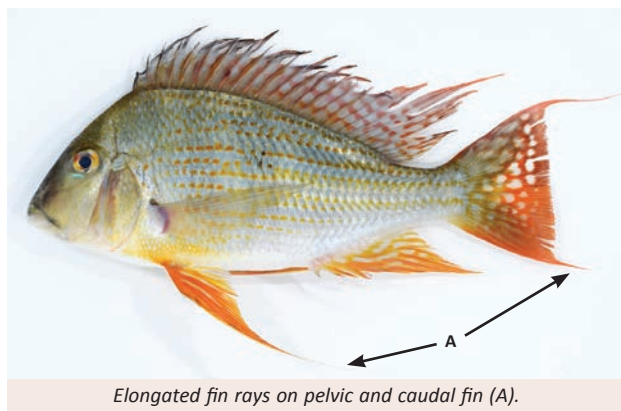
FAMILY CICHLIDAE

Common name EARTHEATER

Scientific name *GEOPHAGUS ALTIFRONS*

HECKEL, 1840

- **LOCAL STATUS – NOT EVALUATED**
- **INTERNATIONAL THREAT STATUS – NOT EVALUATED**
- **INTRODUCED**



*Elongated fin rays on pelvic and caudal fin (A).*

### Appearance/Description

- This cichlid has a laterally compressed body which appears somewhat oval.
- The body is generally silvery, with broken yellowish-red stripes along the flanks.
- The fins are also vividly coloured a yellowish-red, with elongated fin rays on the pelvic, dorsal, and the two ends of the caudal fin.
- A small black spot is present in the middle of the body, with blue blotches present below the eye and along the lower jaw. This fish can reach a length of 23 cm.

### Biology

- This fish gets its common name from its feeding habits, which involve taking mouthfuls of fine substratum and filtering it to get food, then expelling the substratum from the gill covers.
- These fish spawn on the substratum, and when the fry hatch, they are guarded in the mouths of their parents.
- These fish are popular with aquarists, and were likely introduced to Singapore via the ornamental fish industry.

### Habitat

- This species lives in large rivers. It has been recorded from the outskirts of the NSSF drainage before.

*In Singapore, it can be found in several reservoirs, including Upper Peirce and Upper Seletar Reservoirs. Its native range is in the Amazon River basin, in Brazil.*

## PHYLUM CHORDATA

CLASS ACTINOPTERYGII

ORDER PERCIFORMES

FAMILY GOBIONELLIDAE

Common name LESSER BUMBLEBEE  
GOBY

Scientific name *BRACHYGOBIUS*  
*SABANUS* INGER, 1958

- LOCAL STATUS – NOT EVALUATED
- INTERNATIONAL THREAT STATUS – DATA DEFICIENT
- INTRODUCED



*Torpedo shaped body with black and yellow bars.*

### Appearance/Description

- This fish has a small, torpedo-shaped body with equally-spaced black and yellow bars.
- It has a short head with an upturned mouth.
- Two dorsal fins are present, while the pelvic fins are modified into a sucker-like structure.
- It can reach sizes of about 3 cm.

### Biology

- It feeds mostly on small invertebrates and organic matter.
- This fish is likely to have been introduced to Singapore via the aquarium industry.

### Habitat

- This fish is found in open streams, freshwater ponds and estuarine areas.
- It can tolerate brackish water, and generally prefers soft substrate with high amounts of organic matter. It has been recorded from the outskirts of the NSSF drainage.

*In Singapore, this fish is known from several reservoirs, including Kranji, Poyan and open country streams. It has also been recorded from the Sungei Buloh Wetland Reserve. Worldwide, it ranges from Thailand down the Malay Peninsula to Borneo.*



## PHYLUM CHORDATA

CLASS ACTINOPTERYGII

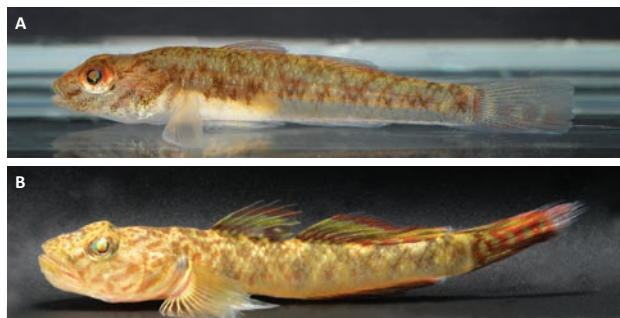
ORDER PERCIFORMES

FAMILY GOBIONELLIDAE

Common name EAST ASIAN RIVER GOBY

Scientific name *RHINOGOBIUS GIURINUS*  
(RUTTER, 1897)

- **LOCAL STATUS – NOT EVALUATED**
- **INTERNATIONAL THREAT STATUS – LEAST CONCERN**
- **INTRODUCED**



*Juvenile goby (A) and adult male (B).*

### Appearance/Description

- This fish has a small and slender, torpedo-shaped body.
- Males generally develop more prominent head and jaws, especially during the breeding season.
- The body is coloured olive and brown with brownish barring or blotches along the sides.
- Males also develop yellow and red bars during the breeding season along the head and the flanks.
- This fish can grow to lengths of 8 cm.

### Biology

- It feeds mostly on small invertebrates and organic matter.
- In the wild, it usually has an amphidromous life cycle, with the larvae being washed downstream into brackish estuaries, where they develop and move upstream as they mature. However, they are capable of reproducing completely in freshwater as well.
- This fish was probably introduced into Singapore as a contaminant in grass and silver carp fingerlings brought in for aquaculture in the 1950s or earlier.

### Habitat

- This fish is highly adaptable, being capable of living in conditions ranging from brackish estuaries to freshwater streams. It has been recorded from the outskirts of the NSSF drainage, and is relatively common there.

*In Singapore, this goby is known from several reservoirs, including Upper and Lower Seletar Reservoirs. Its natural range is Korea, Japan, Vietnam and China.*

## PHYLUM CHORDATA

CLASS ACTINOPTERYGII

ORDER PERCIFORMES

FAMILY CHANNIDAE

Common name GIANT SNAKEHEAD

Scientific name *CHANNA MICROPELTES*  
(CUVIER, IN CUVIER & VALENCIENNES,  
1831)

- LOCAL STATUS – NOT EVALUATED
- INTERNATIONAL THREAT STATUS – LEAST CONCERN
- INTRODUCED



*Juvenile (A) and adult (B) giant snakehead.*

### Appearance/Description

- This snakehead has an elongate but stout body with a series of grey squarish blotches along the dorsum.
- There is a long black stripe extending from the eye to the caudal fin, with a row of white spots within the stripe. The belly is white.
- Sub-adults have two black stripes (which can be broken) along their body from the snout to the tail fin, and are coloured brown above and white below, and reddish yellow between the stripes, while juveniles are bright red with two black stripes on the body.
- They can reach a maximum size of 100 cm.

### Biology

- These fish are ferocious predators, feeding on fishes, amphibians, and anything else that could potentially be food. This species has even been documented to dismember and bite off parts of prey too large for it to swallow.
- Breeding pairs guard their eggs and fry fiercely.
- These fish are prized as food, and are farmed intensively in aquaculture.

### Habitat

- This species is a habitat generalist, but generally prefers locations with deeper water. It has been recorded from the outskirts of the NSSF drainage.

*In Singapore, known from many reservoirs and ponds.* Worldwide, they are distributed from the Mekong drainage to Cambodia, down through Thailand and the Malay Peninsula and to Sumatra, Java and Borneo.

## Key to some common groups of aquatic macroinvertebrates from Nee Soon Swamp Forest

1. Soft, non-segmented body, lacking chitinous exoskeleton, without jointed appendages, and mandibles. Possessing a shell that the body can be withdrawn into ..... (Mollusca: Gastropoda) 2
- Hard, segmented body, possessing chitinous exoskeleton, with jointed appendages and mandibles. Lacking a shell that body can be withdrawn into ..... (Arthropoda) 3
2. Operculum present. Shell elongated or turret-like, not discoidal or coiled in one plane but coiled upwards in a long spire .....  
..... **Mesogastropoda: Thiariidae (snails) (Pg. 72)**
- Operculum absent. Shell not elongated or turret-like, discoidal or coiled in one plane with secondarily flattened spire .....  
..... **Basommatophora: Planorbidae (snails) (Pg. 71)**
3. Body appearing to have two sections with cephalothorax (fused head and thorax covered by a carapace) and abdomen; head with two pairs of antennae and stalked eyes, thorax with five pairs of jointed legs .....  
..... (Crustacea: Malacostraca: Decapoda) 4
- Body divided into three distinct sections: head, thorax and abdomen; head with one pair of antennae and sessile (non-stalked) eyes, thorax with three pairs of jointed legs, OR body less distinctly divided into sections with or without non-jointed prolegs appearing worm-like or maggot-like in appearance ..... (Insecta) 6
4. Abdomen folded beneath thorax. Body rather flattened and rounded. Rostrum reduced or lacking. Tail fan absent .....  
..... **Brachyura (crabs) (Pg. 123–126)**
- Abdomen extended and well developed. Tail fan present. Conspicuous rostrum projecting in front of eyes ..... (crayfish and prawns) 5
5. Lobster-like in appearance. Body relatively more dorso-ventrally compressed. First three pairs of pereopods possess terminal chelae .....  
..... **Astacidea (crayfish) (Pg. 127)**
- Prawn-like in appearance. Body relatively more laterally compressed. First two pairs of pereopods possess terminal chelae, but third pair of pereopods lacks terminal chelae ..... **Caridea (prawns) (Pg. 118–122)**
6. Larvae bearing single, long caudal terminal filament at end of abdomen .....  
..... **Megaloptera: Sialidae (dobsonflies) (Pg. 96)**
- Larvae lacking single, long caudal terminal filament at end of abdomen ..... 7
7. Specialised beak-like rostrum used for piercing and sucking present .....  
..... **Hemiptera (true bugs) (Pg. 91–94)**

--	Larvae lacking a specialised beak-like rostrum used for piercing and sucking absent .....	8
8.	Larvae with elbowed mask-like labium covering mouth ..... ..... <b>Odonata (dragonflies, damselflies) (Pg. 97–104)</b>	
--	Larvae lacking elbowed mask-like labium .....	9
9.	Adults with hard forewings / wingpads (elytra). Larvae with spiracles absent or reduced .....	<b>Coleoptera (beetles) (Pg. 73–77)</b>
--	Adults lacking hard forewings / wingpads (elytra). Larvae with spiracles present, not reduced .....	10
10.	Larvae typically vermiform or grub-like, lacking distinct thorax; jointed thoracic legs absent .....	<b>Diptera (flies) (Pg. 78–86)</b>
--	Larvae not vermiform or grub-like, with distinct thorax; jointed thoracic legs present .....	11
11.	Larvae with abdomen 10-segmented, last segment bearing 2-3 caudal filaments, lacking prolegs .....	12
--	Larvae with 10 segments with both prolegs and jointed thoracic legs. Larvae has a distinct head with a ring of ocelli and hair like spiracles covering the whole body except for the anterior part of the thorax ..... ..... <b>Lepidoptera (snout moths) (Pg. 95)</b>	
--	Larvae with abdomen 9-segmented, last segment lacking caudal filaments, bearing one pair of prolegs .....	<b>Trichoptera (caddisflies) (Pg. 108–117)</b>
12.	Larvae with distinct thoracic gills, two caudal filaments, bearing claws on the end of each leg .....	<b>Plecoptera (stoneflies) (Pg.105–107)</b>
--	Larvae lacking thoracic gills, lateral, paired abdominal gills, three caudal filaments .....	<b>Ephemeroptera (mayflies) (Pg.86–90)</b>

## PHYLUM MOLLUSCA

### CLASS BIVALVIA

#### BIVALVES



*Bivalves have a laterally compressed body enclosed by a shell consisting of two hinged parts.*

Bivalves are marine and freshwater molluscs with laterally compressed bodies that are enclosed by a shell comprised of two hinged parts.

The gills of bivalves are called ctenidia, a specialised organ for feeding and breathing. The majority are filter feeders, however, some bivalves also feed on organic matter in the bottom sediment.

Bivalves are a very diverse and adaptive class and are found in a wide range of habitats, which includes shallow to deep water. They are also often found embedded in sand or mud.

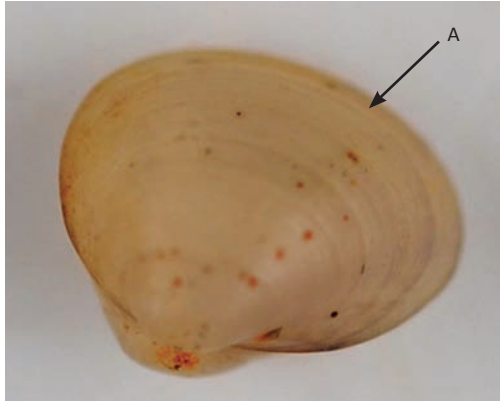
## PHYLUM MOLLUSCA

CLASS BIVALVIA

ORDER VENEROIDA

FAMILY SPHAERIIDAE

PEA CLAMS, FINGERNAIL CLAMS



*Sphaerids are small, thin, fragile, sub-transparent and grey in colour, with one or more growth ridges (A).*

### Appearance/Description

- Sphaerids are typically small (< 5 mm long).
- Their shells are thin, fragile, sub-transparent and grey in colour.
- Often their shells have one or more growth ridges with dark concentric zones.

### Biology

- Adults are hermaphrodites and brood their young in pouches in their gills.
- Sphaerids are filter feeders.

### Habitat

- They occur in still or flowing, permanent or semi-permanent waters.
- They are often found buried in the sediment.

## PHYLUM MOLLUSCA

CLASS BIVALVIA

ORDER VENEROIDA

FAMILY CORBICULIDAE

BASKET CLAMS



*Corbiculids have thick, oval shells with concentric ribbing patterns (A).*

### Appearance/Description

- The shells of Corbiculidae have concentric ribbing patterns.
- Corbiculid shells are thick, heavy and oval in shape.

### Biology

- Corbiculids are ovoviviparous, brooding internally fertilized eggs in brood pouches.
- They are filter feeders, feeding opportunistically on unicellular algae and plant detritus suspended in the water.

### Habitat

- Corbiculidae are found buried in the soft river or stream sediments.



## PHYLUM MOLLUSCA

### CLASS GASTROPODA

#### SNAILS



*Gastropod shells can either have a clockwise spiral (A) or an anticlockwise spiral (B) when viewed from the top (apex).*

Aquatic snails are soft bodied molluscs with a spiral, coiled disk- or cone-shaped shells. Shells can spiral outwards, from the tip to the opening of the shell, in a clockwise (left-handed spiral or sinistral) or anticlockwise (right-handed spiral or dextral) direction. The soft body of aquatic snails are made up of a muscular foot, head, visceral mass (organs) and a mantle that secretes the shell.

To feed, snails have a unique mouth structure called a radula that is a belt of chitinous teeth stretched over a cartilage base. The radula is used for grinding/rasping plant and algae material.

Aquatic snails can be air-breathers (e.g., Hygrophila) or possess gills to aid breathing (e.g., Cerithimorpha). They populate a wide range of environments such as ephemeral pools, large lakes, small seeps, springs and major rivers.

## PHYLUM MOLLUSCA

CLASS GASTROPODA

ORDER HYGROPHILA

FAMILY PLANORBIDAE

RAM'S HORN SNAILS



*Carinate Amerianna (A) have shells that are elongated, but the coiling is still disc-shaped and on one axis. Ram's horn snails (Indoplanorbis exustus) are so-called because their shells are flattened in a spiral similar to that of the horns of a male sheep (B).*

### Appearance/Description

- Planorbids are air breathing snails that are characterised by their coiled shells which are coiled, sinistral and flat with the spire sunken. Unlike other gastropod shells, which have elevated spires, planorbid shells are coiled flat.
- The foot and head of planorbids are rather small, while their thread-like tentacles are relatively long.

### Biology

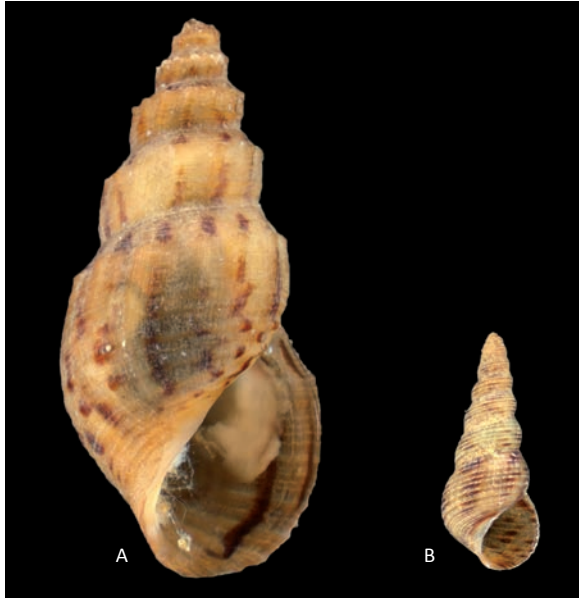
- Planorbids are air breathing snails and can keep a pocket of air in the body cavity to allow them to breath underwater.

### Habitat

- Planorbids occur in slow moving water where they are found amongst macrophytes and algae.

## PHYLUM MOLLUSCA

CLASS GASTROPODA  
ORDER CERITHIMORPHA  
FAMILY THIARIDAE  
THIARIDS



*Thiariids have a turret-shaped shells with a clockwise spiral (A) and the shells can be either smooth (B) or rough (A).*

### Appearance/Description

- Thiariids are gill-bearing snails with elongated turret-shaped shells.
- Their shells can be smooth or rough, coiled in a clockwise spiral that opens to the right.
- They have an operculum, which can cover the opening of the shell completely for protection against predators. Thiariid operculums are coiled.

### Biology

- Thiariid snails graze on periphyton and algae growing on surfaces of rocks and plants.
- Thiariid snails use their gills to draw oxygen from the water.

### Habitat

- Thiariid snails are often found in soft sediments.

## PHYLUM ARTHROPODA

CLASS INSECTA

ORDER COLEOPTERA

BEETLES



*Coleopteran larvae possess respiratory appendages on the last abdominal segment (A).*

Beetles are homometabolous insects, a form of insect development that involves four life stages – egg, larvae, pupa, and adult.

Adult beetles are characterised by their strongly hardened (sclerotised) fore-wings that cover their abdomen.

Beetle larvae have three pairs of thoracic legs and respiratory appendages attached to the last abdominal segment.

True water beetles are diverse and inhabit an expanse of ecological niches; from fresh to brackish water habitats.

## PHYLUM ARTHROPODA

CLASS INSECTA  
ORDER COLEOPTERA  
FAMILY ELMIDAE  
RIFFLE BEETLES



*Elmid larvae are elongate and slender, and their ninth abdominal segment has a clawed operculum with three bunches of retractile anal tracheal gills (A).*

### Appearance/Description

- Elmididae larvae are elongate and slender, with their head often partly retracted into the pronotum, but always visible from above.
- Their mandibles have well-developed prostheca and their ninth abdominal segment has a clawed operculum with three bunches of retractile anal tracheal gills.

### Biology

- Elmididae larvae and adults primarily consume detritus and algae, which are scraped off from the rocks and sediment.

### Habitat

- Elmididae larvae live almost exclusively in lotic habitats, preferring fast flowing reaches.

## PHYLUM ARTHROPODA

CLASS INSECTA

ORDER COLEOPTERA

FAMILY GYRINIDAE

WHIRLIGIG BEETLES



*Gyrinid larvae are long and slender with large gills on their abdominal segments (A).*

### Appearance/Description

- Gyrinid larvae have elongate and narrow bodies, with obvious lateral tracheal gills on abdominal segments 1-9. Segment 10 is small, ventrally pointed and bears four sclerotised hooks.
- Adults have flat and oar-like mid and hind legs, which are shorter than their forelegs.

### Biology

- With the exception of the pupa, all gyrinid life stages are aquatic. The adults spend the majority of their life on the water surface and being partly under water.

### Habitat

- Gyrinids are often found between plants emerging from the water and many species occur only in flowing water.

## PHYLUM ARTHROPODA

CLASS INSECTA

ORDER COLEOPTERA

FAMILY DYSTISCIDAE

DIVING BEETLES



*Dystiscid larvae possess a pair of sickle-shaped mouthparts (A) that are used to hunt prey that is of similar size to itself.*

### Appearance/Description

- Dystiscid larvae have long, sickle-shaped mandibles and their bodies tend to be oval shaped with tapered head and posterior ends.
- Dystiscid larvae legs are long and slender, with forelegs usually being the shortest pair and hind legs the longest.
- The antennae are without a terminal club.

### Biology

- Dystiscid larvae are carnivorous.

### Habitat

- Dystiscid larvae occur in a great variety of habitats with many species found hiding amongst emergent vegetation or submerged plants.



## PHYLUM ARTHROPODA

CLASS INSECTA

ORDER COLEOPTERA

FAMILY SCIRTIDAE

MARSH BEETLES



*Scirtid larvae have long, conspicuous antennae that have many segments (A).*

### Appearance/Description

- Scirtid larvae have an elongated body with nine abdominal segments, which are heavily pigmented or sclerotized both dorsally and ventrally.
- They have long, distinctive antennae, which have many segments (more than 5).

### Biology

- Larvae have specialised filter-feeding adaptations for concentrating suspended small particles of organic matter.

### Habitat

- Larvae are usually found in still waters.

## PHYLUM ARTHROPODA

CLASS INSECTA

ORDER DIPTERA

TRUE FLIES



Aquatic dipteran larvae are found across a wide range of habitats from pristine to heavily polluted water bodies.

In most aquatic environments they are the most diverse and abundant macroinvertebrate taxon. Because of their diversity, identification can be difficult due to a lack of easily identifiable and consistent characteristics. Generally, Dipteran larvae are worm- or maggot-like in appearance and lack wing pads on the thorax. In addition, larvae can be distinguished by a head that is retracted into the body or an external hardened head capsule.

Some taxon such as the Chironomidae have rudimentary prolegs to aid their movement but no aquatic dipteran larvae have the segmented legs found in other aquatic insect orders.

## PHYLUM ARTHROPODA

CLASS INSECTA

ORDER DIPTERA

FAMILY CHIRONOMIDAE

NON-BITING MIDGES, BLOODWORMS



*The primary characteristic features of chironomids are the presence of two pairs of prolegs (A) and the external head capsule.*

### Appearance/Description

- Chironomids are distinguished by long segmented bodies, an external head capsule and the presence of two pairs of prolegs on the first thoracic segment and last abdominal segment.

### Biology

- Many are generalist feeders and feed on debris, bacteria and algae. However, sub-families such as Tanypodinae are carnivorous and feed on other macroinvertebrates.

### Habitat

- Chironomids reside primarily within sediments but also amongst plant debris and aquatic vegetation.
- Some chironomids that live in low oxygen conditions are red in colour because they contain haemoglobin, which allows them to absorb oxygen more readily from the water. The red colouration gives them the common name bloodworms.

## PHYLUM ARTHROPODA

CLASS INSECTA

ORDER DIPTERA

FAMILY CERATOPOGONIDAE

BITING MIDGES



*Ceratopogonidae* with distinctive and well-developed head capsule (A).  
A subfamily of *Ceratopogonidae*, called the *Forcipomyiinae* possess prolegs (B).

### Appearance/Description

- Ceratopogonid larvae are long, slender and worm-like in appearance with distinctive bead like segments.
- They are the only Diptera family with a well-developed head capsule, pharyngeal complex (a large grinding organ inside the head) and lack spiracles.
- Typically, they lack prolegs with the exception of the subfamily, Forcipomyiinae.

### Biology

- Ceratopogonid larvae are predators feeding on other macroinvertebrates.

### Habitat

- Ceratopogonid larvae are found in pools and slow flowing water. They occur both within the stream bed and in the mid-water.

## PHYLUM ARTHROPODA

CLASS INSECTA

ORDER DIPTERA

FAMILY SIMULIIDAE

BLACK FLIES



*Simuliidae larvae have a posteriorly-swollen abdomen.*

### Appearance/Description

- Simuliid larvae have a sclerotized head with paired eyes and an elongated hourglass shaped body.
- Simuliid larvae use special brush-like mouthparts to feed and have a single proleg beneath their head.

### Biology

- Simuliid larvae are filter feeders and thrive in moderate to fast flowing water where they attach themselves to solid, smooth surfaces such as vegetation, rocks and logs.
- Larvae create silk pads which they attach to the substrate. They then attach themselves to these pads using a circlet of hooks on their abdomens.

### Habitat

- Simuliids occur in rocky, moderate to fast flowing water.

## PHYLUM ARTHROPODA

CLASS INSECTA

ORDER DIPTERA

FAMILY TIPULIDAE

CRANE FLIES



*Tipulidae with spiracular disk featured (A).*

### Appearance/Description

- Tipulids have long worm-like bodies with the heads retracted at least partially into the thorax.
- They are distinguished by a spiracular disk at the end of the abdomen.

### Biology

- Tipulidae is the largest family of Diptera with over 14,000 species described.
- They are some of the largest macroinvertebrates found in the Nee Soon Forest Swamp, measuring up to 50 mm in length.
- Some Tipulidae larvae are predacious whilst others are generalist detritivores.

### Habitat

- Tipulid larvae are benthic dwelling and live in the stream bed.

## PHYLUM ARTHROPODA

CLASS INSECTA

ORDER DIPTERA

FAMILY CULICIDAE

MOSQUITOES



*Culicid larvae have an enlarged thorax (A) and blade-like gills (B).*

### Appearance/Description

- Mosquito larvae have a large head with a fused thorax, both of which are larger and wider than the abdomen.
- The opening to the respiratory system is on the second to last segment of the abdomen.
- On the final segment of the abdomen, mosquito larvae have four blade-like gills and in many species, a long or stout air tube.

### Biology

- Mosquito larvae breathe air and live suspended from the water surface, close to vegetated margins or floating vegetation.
- The larvae feed on bacteria, algae and other microbes on the surface layer through brush like mouth pieces.

### Habitat

- They are found in still water areas such as pools, ponds and tree holes.



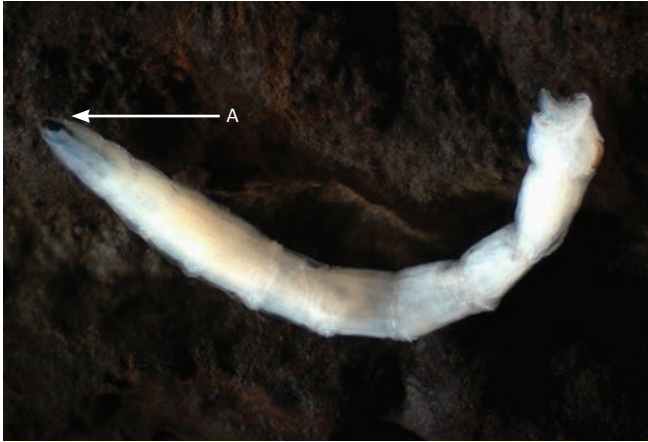
## PHYLUM ARTHROPODA

CLASS INSECTA

ORDER DIPTERA

FAMILY DOLICHOPODIDAE

LONG LEGGED FLIES



*Dolichopodidae with head retracted into the thorax (A).*

### Appearance/Description

- Dolichopodid larvae are generally white/cream coloured with cylindrical bodies.
- The anterior end is tapered with the head retracted into the thorax.
- The palps and antenna are distinguishable as well as a pair of mandibles.
- The anal segment has four pointed, fleshy lobes with the ventral pair more strongly developed.

### Biology

- They are predacious in both larval and adult forms, although some species are recorded as being phytophagous.

### Habitat

- Primary habitat of larvae is in the sediment and plant debris in streams and pools.

## PHYLUM ARTHROPODA

CLASS INSECTA

ORDER DIPTERA

FAMILY ATHERICIDAE

WATER SNIPE FLIES, IBIS FLIES



*Athericidae larvae have elongated prolegs (A) and ventral pairs of prolegs (B).*

### Appearance/Description

- Athericid larvae have ventral pairs of prolegs bearing several hooks along their abdomens.
- Larvae have tubercles which are found both laterally and dorsally along the abdominal segments.
- The final abdominal segment has a single elongated proleg as well as widely separated posterior spiracles (tails).

### Biology

- Larvae are predatory and feed on macroinvertebrates such as chironomids, caddisflies and mayflies.

### Habitat

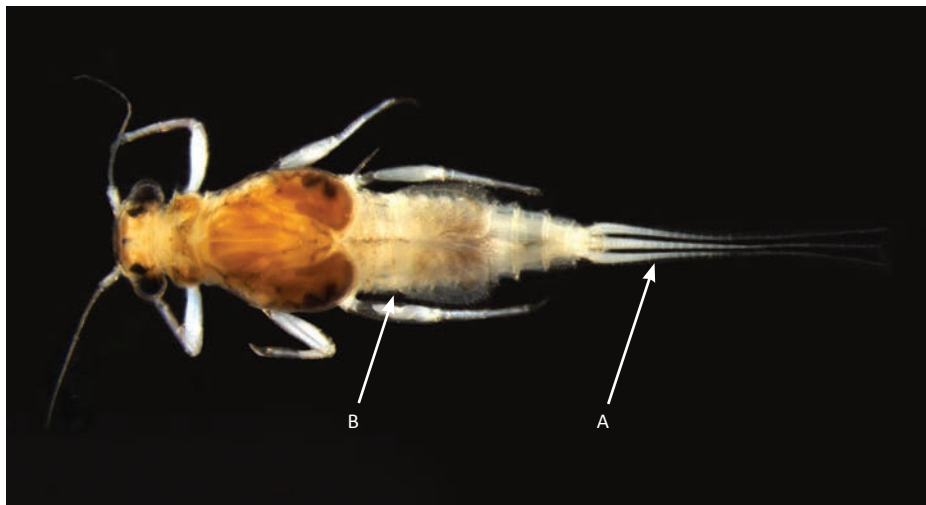
- Athericid larvae are found in moderate to fast flowing aquatic environments such as riffles and glides.

## PHYLUM ARTHROPODA

### CLASS INSECTA

### ORDER EPHEMEROPTERA

### MAYFLIES



*Ephemeroptera* nymphs have three long tail filaments attached to the last abdominal segment (A). Gills on their abdomen (B) allow them to breathe underwater.

Mayfly larvae are found in varying aquatic habitats ranging from standing to running waters. They usually inhabit crevices among stones and gravel at the stream bed or amongst trailing roots of plants along the sides of streams. Because of their sensitivity to oxygen depletion, acidification and other contaminants, mayflies are good bio-indicators of habitat quality.

Most mayfly larvae are herbivorous or filter-feeding detritivores that feed by scraping diatoms and algae off submerged rock surfaces or by filtering detritus carried by water. Some are omnivores and a few are carnivores. In addition, mayflies make up an important food source for fishes and other carnivorous aquatic insects.

The larvae are easily characterized by an 1) unsegmented tarsus, bearing usually a single tarsal claw at the end; 2) a mesothorax that is larger than the prothorax or the metathorax; 3) a ten-segmented abdomen bearing three caudal filaments; and 4) presence of abdominal gills in varying combinations between segments 1 to 7.

## PHYLUM ARTHROPODA

CLASS INSECTA

ORDER EPHEMEROPTERA

FAMILY CAENIDAE

SMALL SQUAREGILL MAYFLIES



*Three different types of gills can be found on a caenid nymph. Reduced gills are found on the first abdominal segment (A), rectangular gills on the second abdominal segment (B), which cover the uniform, plate-like gills on succeeding abdominal segments 3-6 (C).*

### Appearance/Description

- Caenid nymphs are small with flattened bodies and a rectangular head that points downwards.
- Caenid nymphs possess abdominal gills that are different in shape. The gills on the first abdominal segment are fine and reduced in size while the gills on the second abdominal segment are modified into large gills, covering and protecting all the succeeding gills.

### Biology

- Nymphs beat their gills to create water movement over their bodies, allowing them to receive oxygen from the moving water.
- Caenid nymphs feed on fine particulate detritus and micro-organisms growing on the surface of submerged plants.

### Habitat

- They reside at the stream bottom amongst plant material, such as leaf litter and roots.

## PHYLUM ARTHROPODA

CLASS INSECTA

ORDER EPHEMEROPTERA

FAMILY BAETIDAE

SMALL MINNOW MAYFLIES



*Baetid nymphs have streamlined bodies with a head that points downwards.*



*Both sides of the abdomen are lined with leaf-like gills that allow them to breathe underwater (A).*

### Appearance/Description

- Baetid nymphs are small nymphs with a 'hammer' like appearance when viewed side on. They have laterally paired leaf-like gills on the dorsal parts of segments 1-7 or 2-7 and the thorax is somewhat rounded laterally and is strongly humped.

### Biology

- Baetid nymphs scrape algae and fine detritus from submerged rocks, wood and macrophytes.

### Habitat

- Baetids are generally found in crevices amongst stones and gravel in moderate to fast flowing water.

## PHYLUM ARTHROPODA

CLASS INSECTA

ORDER EPHEMEROPTERA

FAMILY LEPTOPHLEBIIDAE

PRONG-GILLED MAYFLIES



*Leptophlebiid larvae have a flattened and slender body, gills which are split or cleft into 2 parts (bifid).*

### Appearance/Description

- Leptophlebiids have slender and bifid gills with caudal filaments that are all similar in length. However, their caudal filaments are fragile and easily broken.
- They are similar in appearance to both caenids and heptagenids. They can be easily distinguished from the heptagenids by the clear view of the sides of the mandibles that are not completely hidden by the head capsule. The difference between leptophlebiids and caenids is the structure of the gills. Leptophlebiids lack a pair of hard overlapping gill plates covering the gills on the abdominal segments 2-6.

### Biology

- The leptophlebiids are not strong swimmers but are active crawlers.

### Habitat

- They are mostly associated with stream bottom sediments or found amongst trailing roots at the banks of streams.

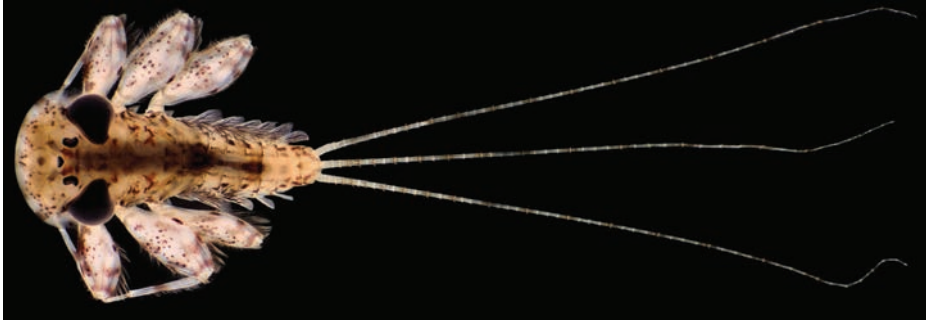
## PHYLUM ARTHROPODA

CLASS INSECTA

ORDER EPHEMEROPTERA

FAMILY HEPTAGENIIDAE

FLAT-HEADED MAYFLIES



*Heptageniid larvae have strongly flattened bodies and heads.*

### Appearance/Description

- Heptageniids have a distinctive flattened appearance and their mouthparts are not visible from above.
- Their gills are plate-like with a tuft of fibrils arising near the base of each plate.

### Biology

- Heptageniids are herbivores and generally feed by scraping algae growing on the surface of stones and boulders in the water.

### Habitat

- They are active crawlers on leaf litter, stones and boulders in the water.



## PHYLUM ARTHROPODA

### CLASS INSECTA

#### ORDER HEMIPTERA

#### TRUE BUGS



*The specialised beak-like mouthpart is adapted for piercing and sucking prey items (A).*

Aquatic Hemiptera belong to the sub-order Heteroptera. They are further divided into infraorders based on the niche they favour and their adaptations.

In the Nee Soon Swamp Forest the infraorders Gerromorpha and Nepomorpha are present. Gerromorpha are semi-aquatic bugs that live on the water surface and have modified legs, which allows them to tread/ skate on the water surface. Nepomorpha are true aquatic bugs that live beneath the water surface and exhibit an array of breathing and swimming strategies.

Aquatic hemipterans are generally predators or scavengers and feed on a variety of living and dead macroinvertebrate prey items. The main distinguishing feature of aquatic hemipterans is their clearly visible mouthpart called a rostrum that is adapted for piercing and sucking (A).

## PHYLUM ARTHROPODA

CLASS INSECTA

ORDER HEMIPTERA

INFRAORDER NEPOMORPHA

FAMILY CORIXIDAE

WATER BOATMAN



*The body of a corixid is oblong in shape.*

### Appearance/Description

- Corixids have oblong bodies, which are curved at the back and flat at the front.
- They have modified hind legs for swimming that are flattened and fringed as well as elongated claws that allow corixids to grasp vegetation and debris.
- Corixids have large eyes and very short triangular rostrum (beak) that is without segmentation.

### Biology

- Corixids are generalist feeders and feed on numerous types of food including (but not limited to) macrophytes and mosquito larvae.
- Corixid adults have well developed wings and can easily move from one water body to another and are often amongst the first colonisers of new habitats.
- In order to breathe underwater, corixids have a reservoir of air that they trap between their wings and abdominal surface.

### Habitat

- While not swimming, corixids are hidden amongst floating and aquatic plants.

## PHYLUM ARTHROPODA

CLASS INSECTA

ORDER HEMIPTERA

INFRAORDER NEPOMORPHA

FAMILY MESOVELIIDAE

WATER TREADERS



*Mesoveliid bugs have long and slender legs that allow them to run quickly across the surface of the water.*

### Appearance/Description

- Mesoveliid species are dimorphic and can be either wingless or winged.
- The head of the mesoveliids is large and elongated with the eyes positioned closer to the thorax than the front of the head.
- Both their antennae and rostrum are four-segmented and adults have a scent gland on the third or fourth dorsal abdominal segment.
- The legs of mesoveliids are long and slender and enable them to run quickly across the surface of the water or aquatic vegetation.

### Biology

- Mesoveliids are generally predators or scavengers that feed on a range of macroinvertebrates and micro-crustaceans such as ostracods.

### Habitat

- Mesoveliidae are semi aquatic bugs that are found at the margins of streams and amongst aquatic vegetation.

## PHYLUM ARTHROPODA

CLASS INSECTA

ORDER HEMIPTERA

INFRAORDER NEPOMORPHA

FAMILY GERRIDAE

POND SKATERS



*The forelegs of gerrids are short and are used for feeding whereas the mid and hind legs of gerrids allow them to move on the surface of water.*

### Appearance/Description

- Gerridae nymphs have elongated to ovoid bodies that are covered in hydrophobic hairs that give them a velvety appearance.
- Their heads are short and conical with large globular eyes and a four segmented rostrum.

### Biology

- Gerridae are active predators with excellent eye sight and specialised hydrophobic hairs on their legs that allow them to skate across the water surface.
- They appear to be walking on four stilts because of their extremely long mid and hind legs. In addition to providing buoyancy, the hairs on their legs enable them to detect invertebrate prey through ripples in the water.

### Habitat

- Gerrids are found on the water surface in mainly still or slow flowing streams.

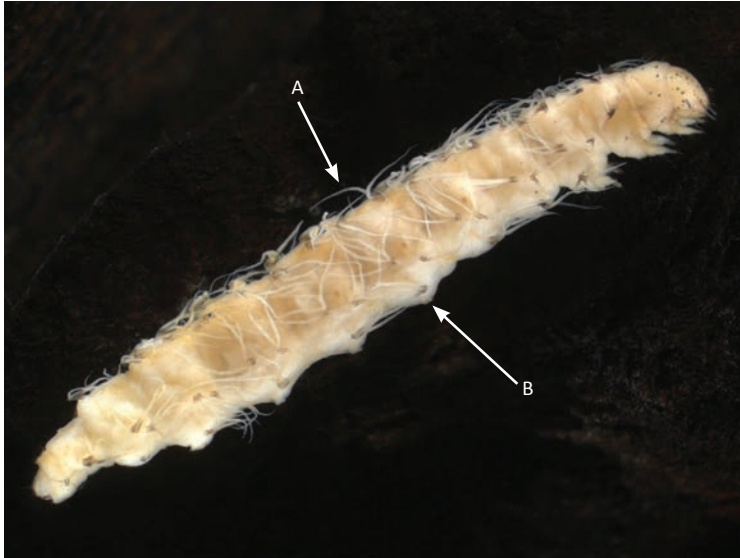
## PHYLUM ARTHROPODA

CLASS INSECTA

ORDER LEPIDOPTERA

FAMILY CRAMBIDAE

SNOUT MOTHS



*Paraponyx* are covered with fine spiracles along the abdomen (A) as well as crochets on the underside of their abdomens (B).

### Appearance/Description

- *Paraponyx* larvae have cylindrical bodies with 'hair' like spiracles covering the whole body except for the anterior part of the thorax.
- They have a distinct head with a ring of ocelli.
- The abdomen has 10 segments with prolegs (or crochets) on segments 3, 4, 5 and 6.

### Biology

- The *Paraponyx* genus is the only member of the Crambidae family found in the Nee Soon Forest Swamp to date.
- *Paraponyx* larvae are generalist herbivores and feed on aquatic macrophytes.

### Habitat

- Aquatic *Paraponyx* larvae are found in still, slow or rapidly flowing streams, where they are found amongst aquatic macrophytes and on rocks.

## PHYLUM ARTHROPODA

CLASS INSECTA

ORDER MEGALOPTERA

FAMILY SIALIDAE

ALDERFLIES



*Sialidae larvae have a single caudal filament at the end of the abdomen (A) and deeply bilobed fourth tarsal segment (B).*

### Appearance/Description

- Sialidae larvae possess strong, sharp mandibles designed for chewing.
- The larvae are elongated and flat and have a single caudal filament at the end of the abdomen.
- Several pairs of abdominal branchial filaments are found laterally along the abdomen.
- The fourth tarsal segment on their legs is dilated and deeply bilobed.

### Biology

- Sialidae larvae are voracious predators feeding on a range of prey items such as chironomid larvae and aquatic worms.

### Habitat

- Sialidae larvae can be found in large rivers or pools in smaller, faster streams where there is abundant silt.

## PHYLUM ARTHROPODA

CLASS INSECTA

ORDER ODONATA

SUBORDERS ZYGOPTERA & ANISOPTERA



Odonate nymphs reside in a variety of aquatic microhabitats, such as amongst aquatic plants and plant debris. The nymphs typically hunt at night and to capture prey, they have an enlarged lower jaw that sits in front of the head called the labrum. Odonate nymphs can rapidly extend out their labrum to capture prey, such as chironomid larvae, crustaceans, aquatic worms, other insect larvae and small fishes.

The Odonates are divided into two suborders, Zygoptera (damselflies) and Anisoptera (dragonflies). Damselfly nymphs have pentagon shaped heads with long tube shaped bodies and three fin-like gills at the end of the abdomen called caudal lamellae. These gills allow damselfly nymphs to breathe underwater and can also be used to swim quickly in water.

Dragonfly nymphs in contrast are broad and stout with rounded heads and have an armoured appearance. The gills at the end of the abdomen have a pyramid shape and are greatly reduced in comparison to damselfly nymphs. Dragonflies lack the large fin-like gills of the damselflies and instead they propel themselves through the water by quickly expelling water through the end of the abdomen.



## PHYLUM ARTHROPODA

CLASS INSECTA

ORDER ODONATA

SUB-ORDER ZYGOPTERA

FAMILY COENAGRIONIDAE

POND DAMSELS



*Coenagrionidae larvae have rounded heads (A) and their gills are leaf-like and nodate with veins radiating out diagonally (B).*

### Appearance/Description

- Coenagrionid nymphs have long slender bodies with flat leaf-like caudal lamellae (gills) that are approximately equal in size and extend from the last abdominal segment.
- The nymphs are typically 5-30 mm in size.
- The caudal lamellae are nodate (i.e. there is a small notch on the side of lamellae half way up) with veins that radiate diagonally outwards from the median line.
- The prementum (i.e. the part of the insect's labium lying in front of the mentum) is stout and triangular with 3-5 pairs of premental setae and 1-7 setae on the palpal lobes, which terminate in one to two hooks.
- The prementum of the labrum lacks a median cleft.

### Biology

- They are ambush predators.

### Habitat

- Coenagrionidae nymphs are most common in vegetation along the margins of streams and ponds.



## PHYLUM ARTHROPODA

CLASS INSECTA

ORDER ODONATA

SUB-ORDER ZYGOPTERA

FAMILY PROTONEURIDAE

THREAD TAILS



*Major features of protoneurids are the hornlike extensions (A), caudal lamellae and structural features of the premental labrum (B, the part of the insect's labium lying in front of the mentum).*

### Appearance/Description

- Protoneurid nymphs have delicate slender bodies and are similar in appearance to Coenagrionidae nymphs.
- Nymphs are typically 5-30 mm in size.
- Unlike Coenagrionidae, the posterior margin of the head of protoneurids form two lateral horn-like extensions (in coenagrionids, this is smooth and round).
- The caudal lamellae in Protoneuridae are thicker and darker at their base before becoming thinner and paler at the distal end.
- They have only one pair of premental setae on the prementum and three setae on the palpal lobes.

### Biology

- They are ambush predators.

### Habitat

- Protoneurid nymphs are most common in vegetation along the margins of streams and ponds.

## PHYLUM ARTHROPODA

CLASS INSECTA

ORDER ODONATA

SUB-ORDER ZYGOPTERA

FAMILY EUPHAEIDAE

SATIN WINGS



*Euphaeid nymphs have sac-like gills (A). Secondary gills are present along the abdomen (B).*

### Appearance/Description

- Euphaeid nymphs are medium sized with flat, robust bodies similar to stoneflies.
- They have three very large saccoid caudal lamellae (gills) and unlike other odonates, euphaeids have filamentous gills on the underside of the abdomen from abdominal segments 2-8.

### Biology

- They are ambush predators.

### Habitat

- Euphaeid nymphs typically occur in fast flowing water.

## PHYLUM ARTHROPODA

CLASS INSECTA

ORDER ODONATA

SUB-ORDER ANISOPTERA

FAMILY GOMPHIDAE

CLUB TAILS



*Key feature of Gomphidae nymphs is the enlarged third segment of the antennae (A).*

### Appearance/Description

- Gomphid nymphs have robust, dorso-ventrally flattened bodies.
- The nymphs are characterised by a pair of short four-segmented antennae of which the third antennal segment is enlarged.
- They have numerous hairs, setae and spines covering their bodies.

### Biology

- They are ambush predators.

### Habitat

- Gomphids are burrowers and typically reside within stream detritus and sediment.

## PHYLUM ARTHROPODA

CLASS INSECTA

ORDER ODONATA

SUB-ORDER ANISOPTERA

FAMILY AESHNIDAE

HAWKERS



*Aeshnidae larvae have hind legs that do not reach the bottom of the abdomen.*

### Appearance/Description

- Aeshnid nymphs are robust with an elongated, cylindrical abdomen and very large eyes.
- Their antennae are filamentous with 6-7 segments and unlike the Gomphidae nymphs, aeshnid nymphs have smooth bodies.
- Aeshnidae are the largest of the odonatan nymphs with some species growing in excess of 5 cm.

### Biology

- When hunting, Aeshnidae can stalk their prey or cryptically hunt by ambush.
- They prey upon the larvae of mayflies, chironomids, and beetles.

### Habitat

- The larvae tend to inhabit well-vegetated still waters and sometimes flowing water.

## PHYLUM ARTHROPODA

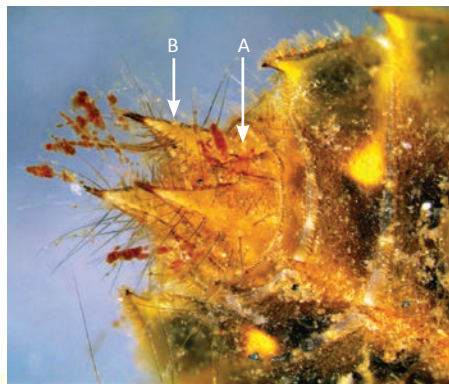
CLASS INSECTA

ORDER ODONATA

SUB-ORDER ANISOPTERA

FAMILY LIBELLULIDAE

SKIMMERS



*The cerci of Libellulidae nymphs (A) are less than half the paraprocts in the anal pyramid (B).*

### Appearance/Description

- Libellulid larval bodies are short and stout with the labrum appearing spoon shaped while at rest.
- Unlike corduliids, the cerci of libellulids are less than half the size of the paraprocts (lobes or sclerites adjacent to the anus) found in the anal pyramid.
- Libellulids are softer bodied than corduliids.

### Biology

- They are both ambush and active predators.

### Habitat

- Libellulid nymphs reside within a range of stream habitats including detritus and aquatic vegetation.

## PHYLUM ARTHROPODA

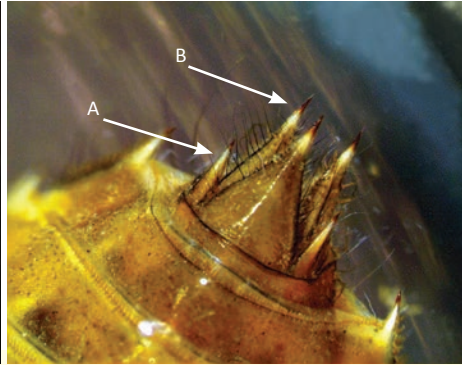
CLASS INSECTA

ORDER ODONATA

SUB-ORDER ANISOPTERA

FAMILY CORDULIIDAE

EMERALDS



*The cerci of corduliid nymphs (A) are more than or equal to half the size of the paraprocts in the anal pyramid (B).*

### Appearance/Description

- Corduliidae are similar in appearance to the Libellulidae.
- Their bodies are short and stout with the labrum appearing spoon-shaped while at rest.
- Unlike corduliids, libellulid nymphs are firmer bodied, usually larger in size, and their cerci are more than half the size of the paraprocts in the anal pyramid.

### Biology

- They are both ambush and active predators.

### Habitat

- Corduliids reside within a range of stream habitats including detritus and aquatic vegetation.



## PHYLUM ARTHROPODA

CLASS INSECTA

ORDER PLECOPTERA

STONEFLIES



Plecoptera larvae are recognised by two claws at the end of each leg. In addition, mature larvae have wing pads and an abdomen terminating in two long, segmented filaments. To discriminate between families, characters such as wing pad shape, gill presence and location as well as labium shape can be used. Their nine-segmented abdomen is fleshy and pale.

Most species of Plecoptera are restricted to habitats with high levels of dissolved oxygen and are therefore, very sensitive to changes in environmental conditions. Stoneflies are typically either predators or shredders.

Plecopteran larvae are often found in running water and are associated with coarse substrata such as cobble, leaf packs and large woody debris.

## PHYLUM ARTHROPODA

CLASS INSECTA

ORDER PLECOPTERA

FAMILY LEUCTRIDAE

ROLLED-WINGED STONEFLIES



*Leuctrids have long and slender wing pads (A).*

### Appearance/Description

- Leuctridae larvae are small stoneflies. They are slender and often yellowish in colour.
- The rear wing pads in leuctrids are shorter than the front wing pads.
- These stoneflies also have a fold on their abdomen, which extends from segment 1 to 7.

### Biology

- Leuctridae larvae are herbivorous, feeding on organic matter.

### Habitat

- They are often found in running waters and are associated with leaf packs and large woody debris.



## PHYLUM ARTHROPODA

CLASS INSECTA

ORDER PLECOPTERA

FAMILY PERLIDAE

GOLDEN STONEFLIES



*Perlidae larvae have thoracic gills (A) and two long cerci (B).*

### Appearance/Description

- Perlid larvae are large, robust stoneflies, with yellow to brown coloration.
- Prominent dark patterns are seen on the dorsal surface of the head and thorax.
- Thoracic segments in perlids are wider than long and ventral thoracic gills are profusely branched.
- Gills are often found on the sides and the center of the thorax.

### Biology

- Perlid larvae are carnivorous, feeding on a variety of aquatic invertebrates including midges and mayfly and caddisfly nymphs. However, early instars may be collector-gatherers.

### Habitat

- Perlid larvae are found in a wide range of lotic habitats and are typically found under large stones in streams and rivers.

## PHYLUM ARTHROPODA

CLASS INSECTA

ORDER TRICHOPTERA

CADDISFLIES



*Trichopteran larvae have three pairs of thoracic legs (A) and a pair of prolegs (B). Some trichopteran larvae make cases by gluing sand, silt and plant materials together (C).*

Trichopteran larvae have sclerotized (hardened) heads that point downwards. At minimum, the first thoracic segment of these larvae is hardened with a plate, whilst some groups have plates on two or all three thoracic segments. Their nine-segmented abdomen is fleshy and pale. Trichopteran larvae have three pairs of jointed legs attached to the thorax and a pair of prolegs on the last abdominal segment.

Trichopterans undergo a four-stage life cycle: eggs, larvae, pupae and adult. Some trichopteran larvae make cases that protect them against predation. The cases are also used as a retreat for ambushing prey and/or to increase the circulation of aerated water over their bodies. During the pupal stage, case-making trichopterans seal the ends of the cases to protect the non-feeding pupae.

Trichopteran larvae either burrow into loose sandy or silty substrate or are found hidden amongst vegetation.

## PHYLUM ARTHROPODA

CLASS INSECTA

ORDER TRICHOPTERA

FAMILY ECNOMIDAE

CASELESS CADDISFLIES



*An ecnomid larva with three hardened thoracic segments (A). Ecnomid larvae also bear a large curved claw on their prolegs (B).*

### Appearance/Description

- Ecnomidae larvae have long abdominal prolegs; each bearing a large, curved claw.
- All three thoracic segments of ecnomid larvae are sclerotized.
- The gills on segments 2-6 lie beneath a pair of hard gill covers, which prevents the gills from becoming clogged by fine particles in the water.

### Biology

- Ecnomid larvae feed on a variety of food.
- Young larvae are detritivores that feed on fine organic particles, while older larvae are predators that feed on invertebrates, such as midge larvae, other trichopteran larvae and zooplankton.
- They do not construct a case.

### Habitat

- Ecnomid larvae are free-living in the benthos and are found within debris.

## PHYLUM ARTHROPODA

### CLASS INSECTA

### ORDER TRICHOPTERA

### FAMILY POLYCENTROPODIDAE

### TUBE-MAKER CADDISFLIES



*The long prolegs on the last abdominal segment bears a large hook-shaped claw (A) and only the first thoracic segment is hardened (B).*

#### Appearance/Description

- The first thoracic segment is sclerotized, whilst the second and third thoracic segments remain fleshy, appearing similar to the abdominal segments.
- Polycentropodid larvae have long prolegs on their last abdominal segment, each bearing a single large and hook-shaped claw.

#### Biology

- Some polycentropodid larvae are predators, feeding on other invertebrates, in particular midge larvae, while other polycentropodid larvae are filter-feeders, feeding on small food particles in the water.
- They do not construct a case.

#### Habitat

- Polycentropodid larvae live amongst gravel and pebbles or plant material at the bottom of the water body.

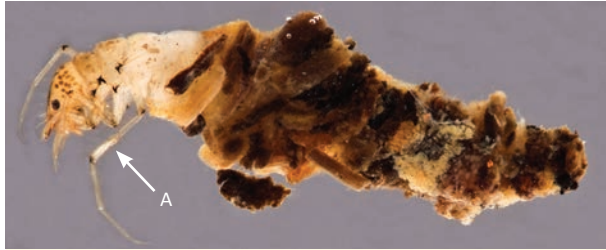
## PHYLUM ARTHROPODA

### CLASS INSECTA

### ORDER TRICHOPTERA

### FAMILY LEPTOCERIDAE

### LONG-HORNED CADDISFLIES



*Leptocerid larvae reside in cases from which two long hindlegs protrude out further than the fore-and midlegs (A).*



*Larvae have reduced prolegs on the last abdominal segment (B).*

#### Appearance/Description

- Leptocerid larvae have hind legs that are longer than their fore and mid legs.
- Only the first segment of the thorax is hardened; the second and third thoracic segments are not.
- Leptocerid larvae have reduced prolegs on the last abdominal segment.

#### Biology

- They are detritivores or herbivores, feeding on a variety of debris.

#### Habitat

- Leptocerid larvae reside at the bottom of the water body and are found amongst debris or aquatic plants.

## PHYLUM ARTHROPODA

CLASS INSECTA

ORDER TRICHOPTERA

FAMILY HYDROPTILIDAE

MICROCADDIS



*Hydroptilid larvae possess a fine grained case (A) and greatly enlarged abdomen (B).*

### Appearance/Description

- Hydroptilid larvae have a greatly enlarged abdomen that may appear swollen in comparison to the rest of the body.
- All three thoracic segments of hydroptilid larvae are hardened.
- A pair of reduced prolegs is present on the last-abdominal segment, each bearing a small claw.
- Hydroptilid larvae are small, typically between 4 and 6 mm in length.

### Biology

- They feed on filamentous green and red algae, epilithic microalgae, periphyton and diatoms.
- They form cases before developing into a pupa.
- The cases formed are translucent and purse-like, formed by a glue-like substance the larva produces.

### Habitat

- Hydroptilid larvae live at the bottom of the water body, on the surfaces of rocks and boulders, or hidden amongst algae of plants.

## PHYLUM ARTHROPODA

CLASS INSECTA

ORDER TRICHOPTERA

FAMILY HYDROPSYCHIDAE

NET SPINNING CADDISFLIES



*Larvae have branched gills running along the ventral surface (A).*

### Appearance/Description

- Hydropsychid larvae have a fully sclerotized thoracic dorsum.
- They possess branched gills, running along the ventral surface of their abdomen.
- Hydropsychid larvae have large anal prolegs equipped with hooks which allow them to grasp the side of rocks in river and stream beds.

### Biology

- The larvae of most species of this family are filter-feeders, spinning filter nets near the anterior, upstream end of the shelter.
- The net or sieve is made of fine silk and debris.
- Hydropsychid larvae are omnivorous and the fine silk net or sieve is used to trap algae, detritus and smaller invertebrates.
- Larvae build fixed retreats, incorporating plant detritus and mineral particles on the upper surface or side of stable substrata.

### Habitat

- Larvae are often found in moderate to fast flowing waters, living on rocks, boulders or submerged logs.

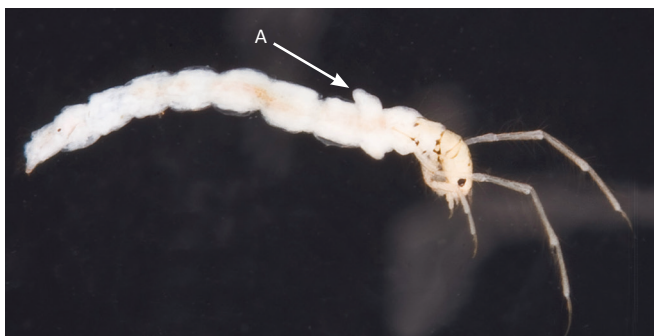
## PHYLUM ARTHROPODA

CLASS INSECTA

ORDER TRICHOPTERA

FAMILY CALAMOCERATIDAE

SLEEPING BAG CADDISFLIES



*A pair of lateral humps and a dorsal hump is present on abdominal segment one (A).*

### Appearance/Description

- Calamoceratid larvae have a labrum bearing a central transverse row of approximately 12 long setae.
- Forelegs are shorter than the other legs, whilst hind legs are much longer and thinner.
- Abdominal gills are single or branched.
- Typically found in a flattened case made from two pieces of leaf.

### Biology

- Calamoceratid larvae are shredders feeding on coarse plant detritus.
- Larvae construct a dorso-ventrally flattened case from two pieces of leaves that resembles a bag.

### Habitat

- Calamoceratid larvae are often found in stream pools.
- The larvae are often found in areas where detritus accumulates. The pupae are commonly found attached to rocks but some may be found in leaf litter.



## PHYLUM ARTHROPODA

### CLASS INSECTA

### ORDER TRICHOPTERA

### FAMILY ODONTOCERIDAE

### STRONG-CASE MAKER CADDISFLIES



*Nee Soon odontocid larvae have a distinctive 'tiger stripe' head pattern and are usually found in their portable cases (A). Without their cases odontocid larvae have a long transparent abdomen (B).*

#### Appearance/Description

- In the Nee Soon Swamp Forest, odontocid larvae can be readily identified by the distinctive bandings on their head.
- Numerous secondary setae are found on the thorax and legs of the odontocid larvae.
- Two lateral spacing humps are found on segment 1 of the abdomen.
- Segment 1 lack gills and secondary setae, whilst branched gills are present on segments 2 to 6, 7 or 8.

#### Biology

- Odontocid larvae are omnivorous and can feed on organic detritus, vascular plants, moss and algae as well as other aquatic arthropods.
- Their cases are made of sand grains and larger fragments, which when reinforced by a silken mortar applied by the larvae become very strong/resistant to crushing.

#### Habitat

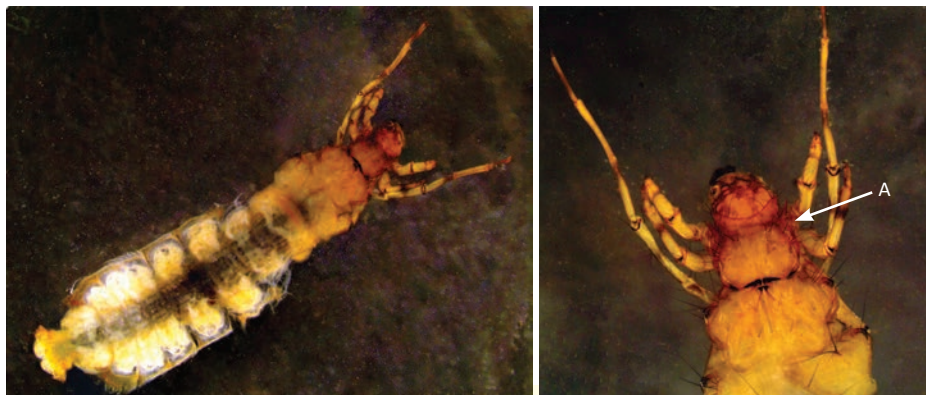
- Odontocid larvae live in slow to fast-flowing streams sprawling on top of sandy sediments or burrowing in them.

## PHYLUM ARTHROPODA

CLASS INSECTA

ORDER TRICHOPTERA

FAMILY XIPHOCENTRONIDAE



*Xiphocentronidae* larvae have a sclerotised pronotum (A).

### Appearance/Description

- In Xiphocentronidae, only the pronotum is sclerotised whilst the rest of the thorax is membranous.
- Their hind legs are longer than their fore and mid legs.

### Biology

- Larvae are herbivorous, grazing on organic particles and periphyton.
- Xiphocentronid larvae build fixed tubes of sand and silk on rocks below the water surface. The tubes frequently extend several centimetres above the stream bed.

### Habitat

- Xiphocentronidae larvae are mainly found in running waters with slow to moderate flow.

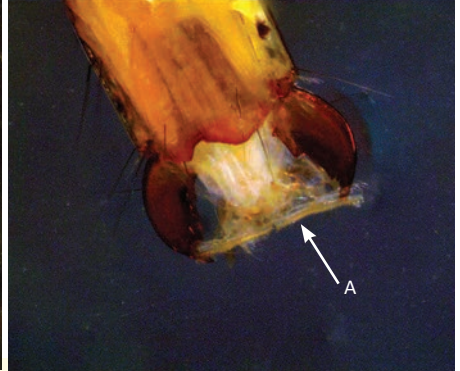
## PHYLUM ARTHROPODA

CLASS INSECTA

ORDER TRICHOPTERA

FAMILY PHILOPOTAMIDAE

FINGER-NET CADDISFLIES



*Philopotamid larvae have a membranous 'T' shaped labrum (A).*

### Appearance/Description

- Philopotamid larvae have a sclerotized head.
- The pronotum in philopotamid larvae is orange-brown in colour.
- Philopotamid larvae have a membranous labrum whilst the abdomen is white or yellowish, and abdominal gills are present.

### Biology

- Philopotamid larvae are typically omnivorous. They feed on algae, fine plant and animal detritus, which they sieve from flowing water with a silk net.
- The larvae are not case making, but do construct silken tubes or sack-like nets.

### Habitat

- Philopotamid larvae mainly occur in running waters with moderate to fast flow.

## PHYLUM ARTHROPODA

CLASS MALACOSTRACA

ORDER DECAPODA

FAMILY PALAEMONIDAE

Common name MALAYAN FRESHWATER  
PRAWN

Scientific name *MACROBRACHIUM*  
*MALAYANUM* (ROUX, 1934)

- LOCAL STATUS – NOT EVALUATED
- INTERNATIONAL THREAT STATUS – LEAST CONCERN
- NATIVE



*Straight, robust rostrum (A).*

### Appearance/Description

- This prawn can be distinguished by its straight, robust rostrum with 8–12 teeth on dorsal portion of rostrum and 3–6 on the ventral side, as well as the triangular carpus.
- Both sexes have chela covered with short, fine hairs, with males tending to have larger chela. It can grow up to 20 mm carapace length (CL).
- This prawn tends to be translucent or a light brown, with several darker stripes, but is known to have highly variable colouration such as red or orange. Gravid females are observed to be darker than the others.

### Biology

- This species is the most common prawn in the Nee Soon Swamp Forest, being widespread and found in large numbers throughout the whole swamp forest.
- It is an omnivore, feeding mostly on debris and organic matter as well as small invertebrate prey.

### Habitat

- It lives in forest stream water with a wide range of acidity, both shaded and open.
- It thrives in both fast flowing water and slow-moving pools, with various substrata.

*In Singapore, it can be found in the Central Catchment Nature Reserve, Bukit Timah Nature Reserve, and some of the forested nature areas. Worldwide, it can be found in the Malay Peninsula, Sumatra and Borneo.*

## PHYLUM ARTHROPODA

CLASS MALACOSTRACA

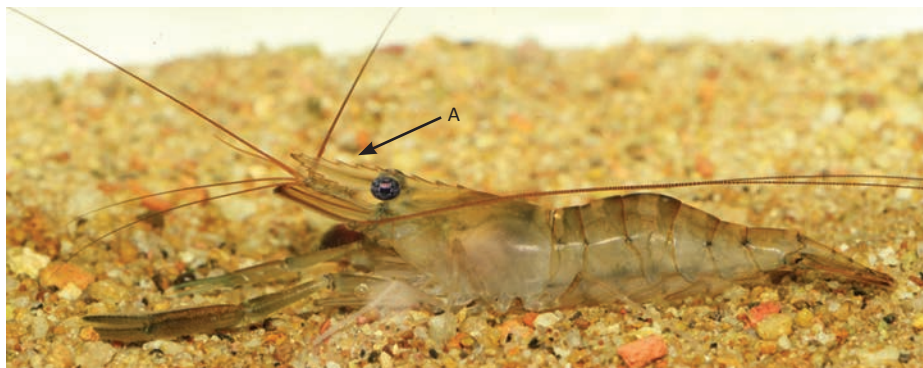
ORDER DECAPODA

FAMILY PALAEMONIDAE

Common name SUNDA FRESHWATER  
PRAWN

Scientific name *MACROBRACHIUM*  
*SUNDAICUM* (HELLER, 1862)

- LOCAL STATUS – NOT EVALUATED
- INTERNATIONAL THREAT STATUS – LEAST CONCERN
- NATIVE



*Upcurved rostrum (A).*

### Appearance/Description

- This prawn can be identified from its long, thin carpus, which appears tubular.
- The rostrum of this species displays a noticeable upward-pointing curve with 9–13 teeth on the dorsal side and 3–5 teeth on the ventral side.
- This species usually possesses black or brown stripes which are clearly separated from each other on a light brown body.
- However, colours in the wild can be highly variable.
- It can grow up to 21 mm CL.

### Biology

- This prawn is widespread but uncommon within the Nee Soon Swamp Forest.
- It is a fast-swimming omnivore, feeding mainly on organic debris and small invertebrates.

### Habitat

- It can generally be found in shaded, acidic forest streams with plenty of leaf litter.
- It is more elusive than *Macrobrachium malayanum* and often resides in dense aquatic vegetation and trailing roots.

*In Singapore, this prawn can be found in the Central Catchment Nature Reserve and Bukit Timah Nature Reserve. Worldwide, it is distributed from the Malay Peninsula to Sumatra and Borneo.*

## PHYLUM ARTHROPODA

CLASS MALACOSTRACA

ORDER DECAPODA

FAMILY PALAEMONIDAE

Common name TORRENT PRAWN

Scientific name *MACROBRACHIUM*

*PLATYCHELES* OU & YEO, 1995

- **LOCAL STATUS – CRITICALLY ENDANGERED**

- **INTERNATIONAL THREAT STATUS – LEAST CONCERN**

- **NATIVE**



Short, stubby rostrum (A) and small, triangular carpus (B)

### Appearance/Description

- This prawn is identifiable by its short and stubby rostrum, as well as its flat chela, triangular-shaped carpus and bulging merus. The chelae are covered with short, velvety hairs as well.
- The prawns have black or brown patches over a translucent body.
- Unlike *Macrobrachium sundaicum*, the patches are sometimes merged together.
- This species is the smallest among the four *Macrobrachium* prawns found in Nee Soon. It can grow up to 12 mm CL.

### Biology

- This species is widespread but uncommon within the Nee Soon Swamp Forest and restricted to shaded forest streams.
- It probably feeds on small invertebrates and organic debris. This species is the least abundant out of five prawn/shrimp species in Nee Soon Swamp Forest.

### Habitat

- It prefers fast-flowing and clear streams with slightly acidic conditions, as well as vegetated banks.

*In Singapore, only found in the Nee Soon Swamp Forest, Central Catchment Nature Reserve. Worldwide, it is also found in the Malay Peninsula.*



## PHYLUM ARTHROPODA

CLASS MALACOSTRACA

ORDER DECAPODA

FAMILY PALAEMONIDAE

Common name ORIENTAL RIVER PRAWN

Scientific name *MACROBRACHIUM*

*NIPPONENSE* (DE HAAN, 1849)

- **LOCAL STATUS – NOT EVALUATED**
- **INTERNATIONAL THREAT STATUS – LEAST CONCERN**
- **INTRODUCED**



Orange bands on the joints of limbs (A).

### Appearance/Description

- This prawn can be distinguished by the orange bands present on the joints of the chelipeds and legs.
- The chelipeds are slender and long with sparse hairs.
- Young specimens have a translucent body with reddish-brown speckles.
- Full adults can grow up to 27 mm CL.

### Biology

- *Macrobrachium nipponense* is an introduced species in Singapore, originating from East Asia.
- It feeds on organic debris and small invertebrates and often resides in dense aquatic vegetation such as *Hydrilla* sp.
- It is farmed as a food source for both humans and for aquaculture, and was likely inadvertently introduced into Singapore via the aquarium fish trade.
- This species is currently restricted to the outskirts of Nee Soon Swamp Forest.

### Habitat

- It is generally found in more open, fast-flowing waters, at least within Singapore.

*Within Singapore, it is established in reservoirs and streams.* Worldwide, its native range is China, Japan, Korea, Taiwan and Myanmar, but it has been introduced to many other places worldwide, including but not limited to Malaysia, Singapore, the Philippines, Iran, Iraq and Laos.

## PHYLUM ARTHROPODA

CLASS MALACOSTRACA

ORDER DECAPODA

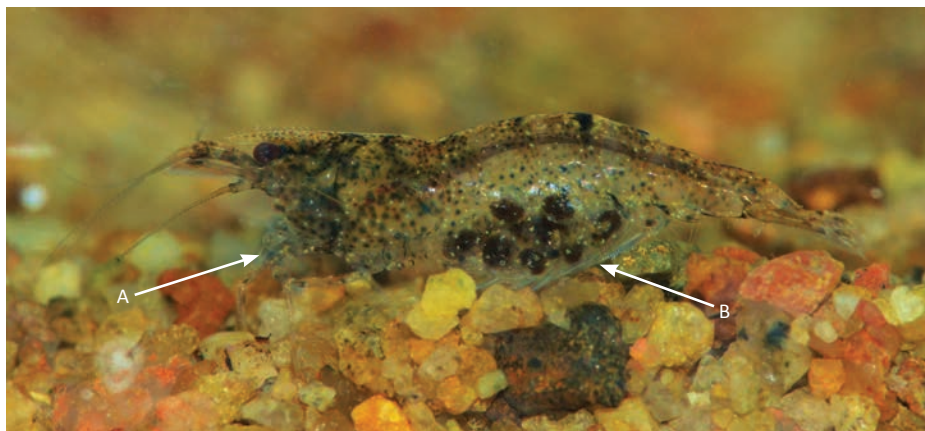
FAMILY ATYIDAE

Common name MALAYAN SHRIMP

Scientific name *CARIDINA MALAYENSIS*

CAI, NG & CHOY, 2007

- **LOCAL STATUS – NOT EVALUATED**
- **INTERNATIONAL THREAT STATUS – LEAST CONCERN**
- **NATIVE**



*Chelae are small and tufted at the end (A). This particular specimen is also gravid (B).*

### Appearance/Description

- This shrimp is identifiable by its small size and by its short, small chela with tufts of hair at the end.
- It is semi-translucent with a black or brown band that runs through the dorsal side of its body and can be speckled as well.
- The eyes are small and the rostrum is relatively short.
- It can grow up to 18 mm body length.

### Biology

- It mostly feeds on organic debris.
- It tends to hide in leaf litter and submerged vegetation.
- The shrimps are observed to be gregarious in behaviour and females are often larger in size than the males.

### Habitat

- This species lives in acidic forest streams and black water peat swamps.
- It is uncommon within the NSSF.

*In Singapore, found only in the Nee Soon Swamp Forest, Central Catchment Nature Reserve. Worldwide, it is found in the southern Malay Peninsula as well as the Riau Islands.*



## PHYLUM ARTHROPODA

CLASS MALACOSTRACA

ORDER DECAPODA

FAMILY SESARMIDAE

Common name PERACCA'S LAND CRAB

Scientific name *GEOSESARMA PERACCAE*  
(NOBILI, 1903)

- **LOCAL STATUS – VULNERABLE**
- **INTERNATIONAL THREAT STATUS – NOT EVALUATED**
- **NATIVE**



*Large, protruding eyes (A).*

### Appearance/Description

- This semi-terrestrial crab has a small, squarish carapace.
- Males have reddish-orange chela and reddish carapaces, while females have brown carapaces and reddish-brown chela.
- The eyes of this species are comparatively large and protruding.
- This species is the smallest among the four crabs found in Nee Soon Swamp Forest.
- It can grow up to 11.5 mm CL.

### Biology

- Peracca's land crab is a semi-terrestrial crab, which means it spends much of its time out of the water. However, it still needs to be near a source of moisture.
- It digs burrows in the soil to hide during the day, and emerges to forage for food during the night. They also have been reported to be found around pitcher plants, and even inside the pitcher itself.
- They mostly feed on detritus and small invertebrates.

### Habitat

- Within Nee Soon, this species roams around areas with decaying logs and dense moist leaf litter near swampy areas or streams. It is relatively uncommon.

*In Singapore, this species can be found in the Central Catchment Nature Reserve and the Bukit Timah Nature Reserve. Worldwide, it can be found in the southern Malay Peninsula.*

## PHYLUM ARTHROPODA

CLASS MALACOSTRACA

ORDER DECAPODA

FAMILY GECARCINUCIDAE

Common name JOHNSON'S

FRESHWATER CRAB

Scientific name *IRMENGARDIA*

*JOHNSONI* NG & YANG, 1985

- **LOCAL STATUS – ENDANGERED**
- **INTERNATIONAL THREAT STATUS – VULNERABLE**
- **NATIVE**



*Smooth, rounded carapace without any epibranchial teeth (A).*

### Appearance/Description

- This crab has a squarish carapace, which is coloured reddish-brown.
- Individuals with mottled and occasionally reticulated patterns have also been observed.
- Males have large and round orange-brown chela, while females have smaller, more delicate ones.
- These crabs lack any epibranchial teeth on their carapace; resulting in a smooth and rounded carapace.
- It can grow up to 20 mm CL.

### Biology

- They feed on organic debris such as leaf litter and small invertebrates.

### Habitat

- This species tends to prefer slower flowing water.
- They are commonly found in shallow, acidic and muddy forest streams, living in the leaf litter. In the NSSF, they are widespread but uncommon.

*In Singapore, this crab can be found in the Central Catchment Nature Reserve and the Bukit Timah Nature Reserve. Worldwide, this crab is endemic to Singapore and is found nowhere else in the world.*

## PHYLUM ARTHROPODA

CLASS MALACOSTRACA

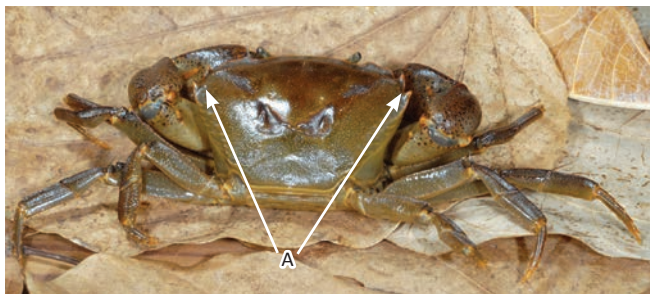
ORDER DECAPODA

FAMILY GECARCINUCIDAE

Common name LOWLAND FRESHWATER CRAB

Scientific name *PARATHELPHUSA MACULATA* DE MAN, 1879

- **LOCAL STATUS – NOT EVALUATED**
- **INTERNATIONAL THREAT STATUS – LEAST CONCERN**
- **NATIVE**



*Two distinct epibranchial teeth at the upper corners of the carapace (A).*

### Appearance/Description

- This large crab has a trapezoidal carapace as well as two epibranchial teeth on each of the upper corners of the carapace.
- The carapace is coloured a dull brown in adults, with the chela and legs mottled. The underside of the crab is light yellow to orange-brown.
- Juveniles can be mottled all over the body.
- The males tend to have larger chelae than the females.
- This species is the largest among the four crabs found in Nee Soon Swamp Forest.
- It can grow up to 60 mm CL.

### Biology

- It feeds on organic debris and small invertebrates, as well as scavenging whatever it can find.
- It is primarily nocturnal.

### Habitat

- It can tolerate a wide range of water conditions, but tends to prefer lowland streams with abundant leaf litter.
- It can be found in both pristine and disturbed streams, and is known to inhabit rice fields as well.
- It is both very common and widespread within the NSSF.

*In Singapore, this is a common and widespread crab, and can be found in rural and scrub streams throughout the island as well as in the nature reserves. Worldwide, it is found throughout the Malay Peninsula and the southern part of Sumatra.*

## PHYLUM ARTHROPODA

CLASS MALACOSTRACA

ORDER DECAPODA

FAMILY GECARCINUCIDAE

Common name SWAMP FOREST CRAB

Scientific name *PARATHELPUSA*

*RETICULATA* NG, 1990

- LOCAL STATUS – ENDANGERED
- INTERNATIONAL THREAT STATUS – CRITICALLY ENDANGERED
- NATIVE



*Distinctive mottling all over carapace.*

### Appearance/Description

- It can be recognized by the distinctive mottling found on its carapace, which distinguishes it from its more abundant relative, the lowland forest crab (*Parathelphusa maculata*).
- Juveniles are often spotted on the entire body and the spots gradually develop into characteristic reddish-brown reticulations in the adults.
- It shares similar characteristics with *P. maculata* such as the trapezoidal shape of the carapace and the pair of epibranchial teeth on each upper corner of the carapace.
- It can grow up to 40 mm CL.

### Biology

- It usually buries itself in leaf litter during the day, while emerging to forage at night.
- It appears to primarily feed on detritus and whatever organic matter it can scavenge.

### Habitat

- One of the three freshwater crab species endemic to Singapore, the swamp forest crab lives in heavily shaded, acidic forest streams with muddy substrate and slow-moving shallow water.
- Within NSSF, it is limited to a few areas and is relatively rare.

*In Singapore, it can only be found in the Nee Soon Swamp Forest, Central Catchment Nature Reserve.* Worldwide: This crab is endemic to Singapore and is found nowhere else in the world.

## PHYLUM ARTHROPODA

CLASS MALACOSTRACA

ORDER DECAPODA

FAMILY PARASTACIDAE

Common name AUSTRALIAN REDCLAW  
CRAYFISH

Scientific name *CHERAX QUADRICARINATUS*  
(VON MARTENS, 1868)

- **LOCAL STATUS – NOT EVALUATED**
- **INTERNATIONAL THREAT STATUS – LEAST CONCERN**
- **INTRODUCED**



*Males have distinct red patches on the sides of both chelae.*

### Appearance/Description

- This crayfish has a long, blue-green body, with red or maroon highlights on the side.
- Mature males have a distinctive red patch on the outer surface of their chelae.
- It can reach a maximum size of 25 cm, with males usually larger than females.
- They can be distinguished from other crayfish species by the four long ridges on the dorsal surface of their cephalothorax, and the red patch on the chelae in males.

### Biology

- It is an omnivorous species, and will readily consume both vegetable and animal matter.
- Females incubate fertilised eggs under the abdomen for 6 to 8 weeks.
- This species is popular worldwide for both aquaculture purposes as well as the pet trade, and is commonly traded.

### Habitat

- In the wild, this species lives in a wide range of habitats, but appears to prefer the slower moving upper reaches of rivers, as well as lakes and lagoons.
- This species has not yet been recorded from the NSSF or its buffer zone, but has the potential to establish itself due to its adaptability.

*In Singapore, it can be found in several reservoirs, including Upper and Lower Seletar Reservoirs and Upper and Lower Peirce Reservoirs. Worldwide: Its native range is tropical northern Australia and Papua New Guinea. Besides Singapore, it has successfully established feral populations in Ecuador, Israel, Mexico, Jamaica, Paraguay, Puerto Rico, South Africa, Thailand, and Zambia.*

## ADDITIONAL READINGS

There are numerous other texts available to provide further information on the freshwater community in Singapore. Here are some recommended readings:

### Freshwater Life

Ng, P.K.L. (1992). *Freshwater Life in Singapore*, Revised Edition. Singapore Science Centre, Singapore.

Quek, A., Tan, LY., Clews, E., Wang, LK. (2014). *A Guide to Freshwater Fauna of Ponds in Singapore*.

Tan, H.T.W., Yeo, D.C.J., Chou, L.M. and Ng, P.K.L. (2010). *The Natural Heritage of Singapore*, 3rd ed. Prentice Hall, Singapore.

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### Macroinvertebrates

Blakely, T.J., Harding, J.S., Clews, E. and Winterbourn, M.J. (2010). *An Illustrated Guide to the Freshwater Macroinvertebrates of Singapore*. University of Canterbury, Christchurch, New Zealand.

Tang, H.B., Wang, L.K. and Hamalainen, M. (2010). *A Photographic Guide to the Dragonflies of Singapore*. The Raffles Museum of Biodiversity Research, Singapore.

Yule, C.M. and Yong, H.S. (2004). *Freshwater Invertebrates of the Malaysian Region*. Academy of Sciences Malaysia, Kuala Lumpur, Malaysia.

### Decapods

Ng, P.K.L. (1988). *The freshwater crabs of Peninsular Malaysia and Singapore*. Department of Zoology, National University of Singapore.

Ng, P.K.L. (1990). Freshwater crabs and prawns of Singapore, in: *Essays in Zoology. Papers Commemorating the 40th Anniversary of the Department of Zoology, National University of Singapore*. Department of Zoology, National University of Singapore, Singapore, pp. 189–204.

### Fishes

Baker, N. and Lim, K.K.P. (2012). *Wild Animals of Singapore: A Photographic Guide to Mammals, Reptiles, Amphibians and Freshwater Fishes*, 2nd Edition. Draco Publishing and Nature Society (Singapore), Singapore.

Larsen, H.K. and Lim, K.P.P. (2005). A Guide to Gobies of Singapore. Singapore Science Centre, Singapore.

Lim, K.K.P. and Ng, P.K.L. (1990). A Guide to the Freshwater Fishes of Singapore. Singapore Science Centre, Singapore.

### **Alien Species**

Yeo, C.J. and Chia, C.S.W. (2010). Introduced species in Singapore: an overview. *Cosmos*, 06, No. (1), 23-37.

### **Nee Soon Swamp Forest**

Corner, E.J.H. (1978). The freshwater swamp-forest of south Johore and Singapore. *Gardens' Bulletin Singapore*, Supplement 1.

Ng, P.K.L. and Lim, K.K.P. (1992). The conservation status of the Nee Soon freshwater swamp forest of Singapore. *Aquatic Conservation: Marine and Freshwater Ecosystems*, 02, No. (3), 255–266.

Turner, I.M., Boo, C.M., Wong, Y.K., Chew, P.T., Ibrahim, A., 1996. Freshwater swamp forest in Singapore, with particular reference to that found around the Nee Soon Firing Ranges. *Gardens' Bulletin Singapore*, 48, No. (1), 129–157.

## GLOSSARY

<b>Abdomen:</b>	The area of the body behind the head and the thoracic segments.
<b>Acuminate:</b>	Tapering to a point.
<b>Adipose fin:</b>	A fat-filled fin, usually found on the dorsal area of some fishes.
<b>Alluvial:</b>	Loose sediments which have been shaped and deposited by water.
<b>Amphidromous:</b>	Possessing a life cycle which begins in freshwater habitats, then reaches adulthood in saltwater or brackish habitats, and finally spawning again in fresh water.
<b>Anal fin:</b>	The fin found at the anal region of a fish.
<b>Anal pyramid:</b>	A pyramidal structure comprised of cerci and paraprocts that is found at the base of the abdomen in Anisoptera (dragonfly) nymphs.
<b>Anterior:</b>	At or towards the front or head end of the body. See posterior.
<b>Apterous:</b>	Lacking wings.
<b>Barbels:</b>	Feeler-like organs found around the mouths of some fishes.
<b>Blackwater habitats:</b>	Aquatic habitats which generally have a low pH, and contain large amounts of tannins and plant materials, which stain the water the colour of tea.
<b>Bifid gills:</b>	Slender gills which appear forked.
<b>Borneo:</b>	Biogeographic term which includes the Malaysian states of Sabah and Sarawak, Brunei Darussalam and Kalimantan (Indonesia), all of which are located on the island of Borneo.
<b>Carapace:</b>	The hard upper section of the exoskeleton of certain crustaceans (e.g., crabs).
<b>Carpus:</b>	The third segment from the base on the limbs of decapods.
<b>Caudal fin:</b>	The tail fin of a fish.
<b>Caudal peduncle:</b>	The narrow portion of the body directly in front of the tail fin in a fish.
<b>Caudal lamellae:</b>	Plate or leaf like appendages found at the base of the abdomen.
<b>Cerci:</b>	(singular cercus) paired appendages on the rear-most segments of many Arthropoda
<b>Chela:</b>	The pincer-like organ found on the end of certain decapod limbs. Commonly referred to as the 'claw'.
<b>Chelipeds:</b>	Decapod limbs which bear chela on their tips.
<b>Chitin:</b>	The primary component of arthropod exoskeletons.
<b>Congeners:</b>	Organisms classified within the same genus.



<b>Crochet:</b>	A circular ring of hooks found on the ventral part of the abdomen in some macroinvertebrates.
<b>Decapods:</b>	A group of crustaceans possessing a total of ten limbs.
<b>Detritus:</b>	Fine, decaying organic matter.
<b>Detritivore:</b>	An organism that feeds exclusively on detritus.
<b>Distal:</b>	The section of a segment or appendage furthest away from the body of an organism.
<b>Dorsal:</b>	The top or upper surface of an organism. See Ventral.
<b>Dorsal fin:</b>	The fin found on the upper surface of a fish.
<b>Dorsal hump:</b>	A single wart-like structure found on the top of the first abdominal segment. It may be very prominent or appear as only a slight mound. Best seen in side view.
<b>Dorso-ventrally compressed:</b>	Flattened from top to bottom.
<b>Endemic:</b>	Only found in a certain location.
<b>Ephemeral:</b>	Temporary or seasonal.
<b>Epibranchial teeth:</b>	Spike-like structures found on the upper corners of the carapace of some crabs.
<b>Epilithic:</b>	Grows on rocks.
<b>Exotic species:</b>	Any organism which is not native to a particular area and was brought in via human activity.
<b>Fibril:</b>	A small or fine fibre or filament.
<b>Filamentous:</b>	Stringy or rope-like.
<b>Fry:</b>	The young of fishes.
<b>Gill:</b>	A respiratory organ that allows an organism to breathe underwater. They are variable in length and form and can be thread-like or plate-like.
<b>Glossa:</b>	One of a pair of small appendages near the middle of an insects' mouth.
<b>Gravid:</b>	Currently carrying eggs.
<b>Hard water:</b>	Water containing high amounts of dissolved minerals. See Soft water.
<b>Herbivorous:</b>	Organisms that feed primarily on plant material.
<b>IUCN:</b>	The International Union for Conservation of Nature
<b>Labium:</b>	Single structure, although it is formed from two fused secondary maxillae. Can be described as the floor of an insect's mouth.
<b>Labrum:</b>	A flap-like structure that lies immediately in front of the mouth.

<b>Lamellae:</b>	Plate- or leaf-like appendages.
<b>Laterally compressed:</b>	Flattened from side to side.
<b>Lateral line:</b>	A system of organs found in fishes which allows them to sense movement and vibration in the water.
<b>Macrophyte:</b>	An aquatic plant.
<b>Macropterous:</b>	Wings present.
<b>Malay Peninsula:</b>	Refers to southern Thailand below the Isthmus of Kra, Peninsular Malaysia, and Singapore as a single biogeographical unit.
<b>Mandibles:</b>	Pair of appendages near the insect's mouth that are typically used to grasp, crush or cut the insect's food. Its function is also to defend against predators or rivals.
<b>Maxilla:</b>	One of the first or second pair of mouthparts posterior to the mandibles.
<b>Maxillary palp:</b>	One of a pair of segmented appendages located between the mandibles of insects.
<b>Merus:</b>	The second segment from the base on the limbs of decapods.
<b>Metasternum:</b>	The ventral sclerotized plate of the thoracic segment.
<b>Metathorax:</b>	Posterior of the three segments in the thorax of an insect.
<b>Mesonotum:</b>	The middle sclerotized plate on the top of the thoracic segments.
<b>Mesothorax:</b>	Middle of the three segments in the thorax of an insect.
<b>Nymph:</b>	The immature or larval stage of some macroinvertebrates.
<b>Nodate:</b>	A small notch found in the lamellae of damselflies.
<b>Ocellus (plural ocelli):</b>	Also referred to as 'simple eye', it is a type of eye form or optical arrangement that contains a single lens.
<b>Operculum:</b>	The gill covers of a fish or a structure resembling a lid or a small door that opens and closes.
<b>Omnivorous:</b>	An organism that feeds on both animals and plants.
<b>Palpal lobes:</b>	Lobes found at the end of the premental of the labrum in odonates.
<b>Paraproct:</b>	Any of several differentiated lobes or sclerites adjacent to the anus.
<b>Pectoral fins:</b>	The pair of fins found on the sides of a fish, usually behind the operculum.
<b>Pedichel:</b>	Second segment of antennae.
<b>Pelvic fins:</b>	The pair of fins found on the underside of a fish. May be missing in some species.
<b>Periphyton:</b>	Refers to a complex mix of algae.
<b>Phytophagous:</b>	An organism (particularly insects) that feed on plants.

<b>Premental:</b>	Located on the prementum of the labrum (See prementum)
<b>Prementum:</b>	Distal part of the fused, central section of the labium, separated from the rest of the mentum by a transverse mental line.
<b>Pneumatophores:</b>	Short, conical or pencil-like roots sticking out above the surface of the soil, used to absorb oxygen from the air.
<b>Posterior:</b>	At or towards the hind or tail end of the body. See anterior.
<b>Proleg:</b>	A fleshy, unsegmented, leg-like or lobe-like structure. They can be single but often occur in pairs and can be located under the thorax, along the abdomen or at the end of the abdomen. The proleg often bears terminal claw(s).
<b>Pronotum:</b>	The top surface of the first, most anterior thoracic segment.
<b>Prostheca:</b>	A small sclerite articulated to the base of the mandible
<b>Predaceous:</b>	Feeding or preying on other animals.
<b>Reticulated:</b>	Arranged in a net-like pattern.
<b>Rostrum:</b>	A structure which extends from the cephalothorax above and beyond the eyes of some crustaceans (e.g., shrimp) or the piercing mouthparts of the order Hemiptera
<b>Tracheal Gills:</b>	Gills that occur laterally along the abdomen of some macro-invertebrates.
<b>Saccoid:</b>	Typically referring to the gills of certain damselfly nymphs, which appear inflated or sack-like.
<b>Sclerotised:</b>	Hardened and usually darkened, pertaining to the body wall.
<b>Secondary setae:</b>	Usually small setae that cover the exoskeleton of some macro-invertebrates.
<b>Segment:</b>	A subdivision of the body.
<b>Setae:</b>	Hair-like structures that can be found on various parts of the macroinvertebrates body. They may be single, in rows, or in clusters.
<b>Soft water:</b>	Water which does not contain large amounts of dissolved minerals. See hard water.
<b>Spiracular Disk:</b>	The anal appendages of tipulid larvae. Characterised by four or more lobes from a disk like appendage at the end of the abdomen.
<b>Sternum:</b>	The ventral portion of an arthropod's body segment.
<b>Substrate:</b>	Soil or sand found at the bottom of a water body.
<b>Tannins:</b>	Organic chemicals found in plants, which are used for many different purposes including protection.
<b>Tarsal:</b>	The last segments of the leg. Often divided into two to five tarsal segments.

<b>Tergum:</b>	The dorsal portion of an arthropod's body segment other than the head.
<b>Trochantin:</b>	A separate, small, plate-like appendage of caddisfly larvae located anteriorly at the base of the foreleg.
<b>Ventral:</b>	The bottom or lower surface of an organism. See Dorsal.
<b>Vermiculate:</b>	Marked with sinuous or wavy lines resembling the form or the tracks of a worm.
<b>Wing pads:</b>	The encased undeveloped wings of nymphs.

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## ABOUT THE GUIDEBOOK

The Nee Soon Swamp Forest Guidebook is part of a holistic and multi-pronged project and provides an introductory resource for the collection/survey and identification of freshwater macroinvertebrates and fishes found in the Nee Soon swamp forest. Additionally, brief ecological notes are provided which explore the roles of these organisms in their habitat as well as briefly discussing the ecosystem itself and its importance to biodiversity in Singapore. For detailed morphological images/diagrams of the aquatic macroinvertebrates, please refer to the texts provided in the Additional Readings and the Glossary sections.

