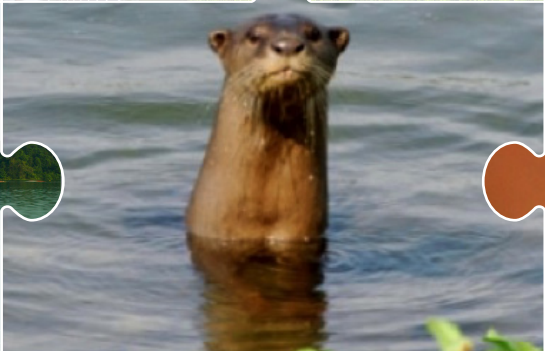
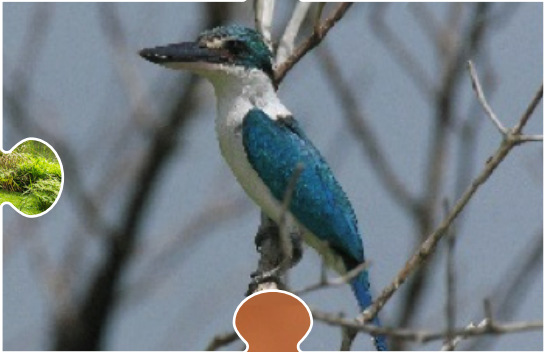
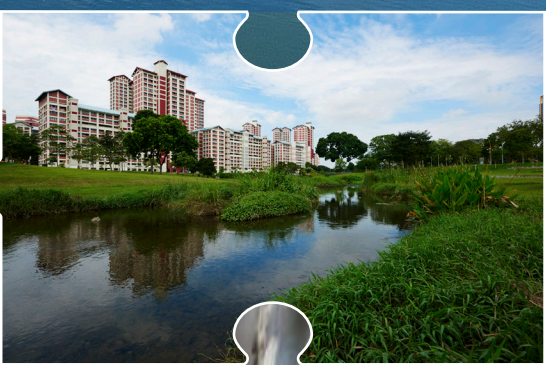
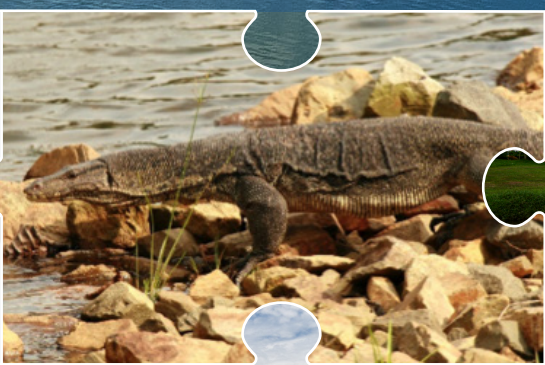
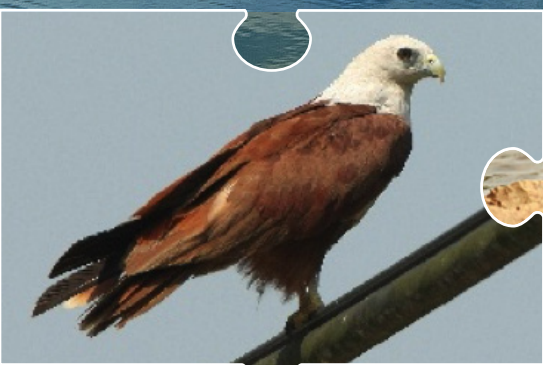


BIODIVERSITY OF OUR RESERVOIRS & WATERWAYS



Biodiversity of our Waterways and Reservoirs

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1. NATIVE SPECIES IN OUR FRESHWATER ENVIRONMENTS

Decades of rapid development have extensively changed Singapore's natural landscape. In our highly urbanised city today, reservoirs and reservoir parks are important habitats for a wide variety of freshwater flora and fauna. These organisms in turn influence their freshwater habitats, and the complex processes that occur within them.

So, who are these inhabitants who share this island state with us?

Johnson's freshwater crab

- *Irmengardia johnsoni*

Johnson's freshwater swamp crab is currently classified as an endangered species. It has been found in the freshwater streams of Upper Seletar Reservoir. It is one of the few crabs which is also "uniquely Singaporean" (i.e. endemic), found only on our island and nowhere else in the world.



Black-eyed Litter Frog

- *Leptobrachium nigrops*

The black-eyed litter frog loves leaf litter in rainforests. It has unusually big black eyes and a call that sounds like a machine-gun. It may also be found in other parts of South-east Asia.



Malayan pygmy rasbora

- *Boraras maculatus*

The malayan pygmy rasbora is the smallest rasbora species in Singapore. It may be found in shaded and slow-flowing freshwater streams and swamps.



Singapore shadowdamsel

- *Drepanosticta quadrata*

The Singapore shadowdamsel was first found in Singapore in the Central Catchment Nature Reserve and was subsequently also spotted in Johor. You can identify it by a blue patch at the end of its abdomen which is much more obvious in the male.



Grey heron - *Ardea cinerea*

The grey heron is a common resident in our reservoirs. They enjoy the fishes in the reservoir as food and wetlands as their nesting sites. At times, you may also observe them resting on floating wetlands. They are one of the largest birds you will find in Singapore!



Brahminy kite - *Haliastur indus*

The brahminy kite, sometimes referred to as the Singapore Bald Eagle, is the most commonly sighted raptor in Singapore. They catch prey by skimming the water surface and snatching their prey with their talons. In addition to hunting, they are also scavengers and can be spotted scavenging from food waste.



Malayan water monitor - *Varanus salvator*

The Malayan water monitor is a common type of monitor lizard found in some of our reservoirs. Due to their large size (they can grow up to 3m long!), they are often mistaken for estuarine crocodiles (*Crocodylus porosus*).

Monitor lizards do not prey on humans and mainly feed on small prey such as insects, crabs, snakes, fish, birds and small mammals. They also play an important role in the food web as scavengers.

Unlike crocodiles, monitor lizards have the following features:

- i. A forked tongue that flicks in and out of the mouth
- ii. Smooth, leathery skin without ridges
- iii. A long, slender tail
- iv. A small, conical head with a short snout

Monitor lizards are also non-confrontational in nature and tend to shy away from humans and moving objects unless they are provoked or cornered. Remember, the golden rule is to leave all wild animals alone and keep a respectful distance from them.



Find out more about what to do when you encounter a monitor lizard from AVA’s advisory [here](#).

Collared kingfisher - *Todiramphus chloris*

The collared kingfisher is the most common kingfisher in Singapore. One of the reasons for their ubiquity is because of their ability to feed on a wide range of food sources- fish, crabs, lizards, earthworms, beetles and more. You may identify these native birds by their loud and sharp calls. Did you know that it was featured on the ten-dollar notes of Singapore’s “Bird series” currency notes issued from 1976 to 1984?



Smooth-coated otters - *Lutrogale perspicillata*

The smooth-coated otter is the largest otter in Southeast Asia and one of 13 species worldwide. They are named after their smooth coat which has short, water-repellent hairs that give it its velvety look. They have a very varied diet, feeding on most fishes, amphibians and crustaceans that are readily available. When they hunt, they can swim underwater for more than a couple of minutes in one breath!

These otters are territorial in nature and move in family units. To promote bonding and motor skills, otters often play with one another. In fact, a few families of these sociable mammals have been frequently spotted playing along various waterways and reservoirs in Singapore.



Find out more about what to do when you encounter an otter from a joint inter-agency advisory [here](#).

2. IMPACT OF NON-NATIVE SPECIES ON OUR WATERWAYS AND RESERVOIRS

Non-native or non-indigenous species are plants and animals that are not originally from the natural local environment but have been released, either accidentally or intentionally, into the environment.

While not all non-native species show adverse impacts on our freshwater ecosystems, some non-native animals and plants may have serious and lasting negative ecological impacts.

a. Ecology and Water Quality

Non-native species may compete with native species for food and habitat and even prey on native species. Non-native species may also survive better in the absence of natural predators when introduced to a new environment. This results in unregulated proliferation and consequently more competition with native species for resources.

Non-native species may also introduce novel parasites and diseases into our native environment. Native species may be susceptible to these new pathogens which they have not been exposed to. In Singapore, the pathogenic chytrid fungus has been found in local amphibians and is thought to have spread from amphibians in the commercial trade that are tolerant to the pathogen.

While the specific impacts of non-native organisms on our water bodies is often complex and little-understood, non-native species have great potential to cause changes to the ecosystem and water quality.

Here are some examples of non-natives species in Singapore and their impact on our freshwater ecosystem:

Water hyacinth - *Eichhornia crassipes*

Water hyacinth is an aquatic plant infamous for its invasiveness – it has the potential to double its mass within just 1-2 weeks! This fast growth may lead to problems associated with large-scale decomposition when it dies. However, this same rapid-growing characteristic may be utilised as an effective bioremediation tool as their high nutrient uptake during growth may help reduce algal blooms. In Singapore, it was rampant in the 1970-1990s but after extensive mechanical harvesting, its population has since been brought under control.

Hydrilla - *Hydrilla verticillata*

Hydrilla is a submerged plant that was likely introduced through the aquarium trade. It has the potential to grow rapidly as it can propagate from small stem fragments. When it breaks the water surface, it may trap rubbish and algal scum, deeming it unsightly to some. Similar to the water hyacinth, Hydrilla also takes up a lot of nutrients from the water. In our reservoirs, regular harvesting is carried out to control its population at densities optimal to water quality.



Golden apple snail - *Pomacea canaliculata*

The golden apple snail is a pest that is ranked amongst the top 100 most invasive species in the world. It arrived in the region via the aquarium trade and is believed to out-compete native apple snails throughout Southeast Asia. Its bright pink eggs are often spotted on plants and structures emerging from the water surface.



American bullfrog - *Lithobates catesbeianus*

The American bullfrog originates from the United States of America. Brought into Singapore as part of the food and pet trade, this frog is commonly sold at restaurants and markets for consumption while smaller individuals are sold as pets. The American bullfrog is known to have a voracious appetite, and is only limited by the size of its mouth.



Red-eared slider - *Trachemys scripta elegans*

Red-eared sliders originate from the United States of America and are commonly sold as pets. They are opportunistic carnivores that can prey on small fish and crustaceans. They are one of the most common species released into the wild, as pet owners often abandon them when they grow too large to maintain. This non-native species may compete with native freshwater terrapins such as the Malayan box terrapin (*Cuora amboinensis*) and the spiny terrapin (*Heosemys spinosa*).



Australian red-claw crayfish - *Cherax quadricarinatus*

In Singapore, the Australian red-claw crayfish is commonly sold as an ornamental aquarium species. Populations of *Cherax quadricarinatus* thrive in several of our reservoirs. This invasive crayfish has also established itself in several other tropical and subtropical countries. Locally, the impacts of these crayfish have yet to be identified but they are known to be potential carriers of diseases and have the potential to infect other species. When they spread to forest streams, they may outcompete with the native freshwater crustaceans there.



Peacock bass - *Cichla* sp.

The peacock bass originates from Central and South America and is thought to have been released by anglers for their game fish fighting qualities. These fishes breed quickly and are commonly found in our reservoirs. Being large voracious and territorial predators, these fish could potentially cause damage to the local ecology if they spread to the natural forest streams where native species take refuge.



Earthheater Cichlids (e.g. *Geophagus* sp.)

Commonly released cichlids such as the earthheater (*Geophagus altifrons*) stir up the sediment when they forage the bottom for food. This increases the turbidity of the water and may cause nutrient-release from the sediment, encouraging algal growth and affecting reservoir ecology.



b. Animal welfare

Releasing pets into the wild is detrimental to their well-being. Pets may die soon after release, as they do not have the natural instincts and ability to forage for food or fend for themselves in the wild. Animals have specific habitat requirements and are more susceptible to diseases and predators when placed in a new environment. For example, saltwater fish released into the reservoirs will not survive because they have different physiological adaptations for living in saline conditions.

On the other hand, when large numbers of these animals are released, the habitat may not have sufficient food or resources to support the animals.

We should also consider the consequences to both the released organisms and the habitats into which they are released. Released species may either have low survivorship or outcompete and displace other species in the new environment.

c. Human safety

Introduced animals may potentially injure people who have access to reservoirs. One such species is the **giant snakehead (*Channa micropeltes*)**, a non-native fish from Southeast Asia that is sold as food fish or aquarium fish. It is a territorial and aggressive creature and may attack humans during its breeding season when protecting its young.



3. HOW YOU CAN HELP

a. Do not release animals

You can play your part as a responsible pet owner by not releasing animals into our local environment, including our canals and reservoirs. In Singapore, a significant number of documented freshwater fauna originate from the aquarium trade. Of these, most are likely to be from releases of unwanted animals.

The release of pets is an offence under the Animals and Birds Act, as it is considered as abandonment which is an act of animal cruelty. Pets are used to being looked after and will not do well if left to fend for themselves. The release of animals into waterways and reservoirs within the Central Catchment Nature Reserve is also an offence under the Parks and Trees Act and the Public Utilities Act.

Instead of releasing pets into the environment, pet owners should explore alternatives such as re-homing, surrendering them to various animal welfare groups, or returning them to pet shops.

For frequently asked questions about pets, please visit the [Pet Central webpage](#) by the Agri-Food & Veterinary Authority of Singapore (AVA).

b. Keep our waterways clean

You can also play your part by not polluting our catchment, waterways and reservoirs which are habitats for these flora and fauna.

[Download](#) brochures on how you can play a part in Keeping Our Waters Clean.

Acknowledgments: Species lists and photographs are obtained from ecological surveys done in partnership with the National University of Singapore's Department of Biological Sciences