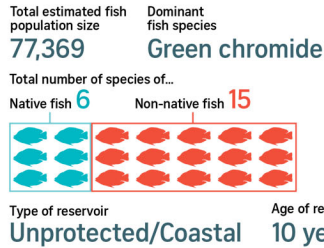
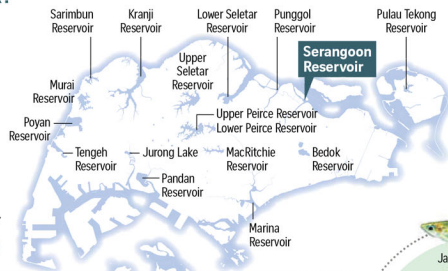


Biodiversity at Serangoon Reservoir

WHAT IS FOUND IN SERANGOON RESERVOIR?



Singapore's 17 reservoirs are teeming with life, each one a unique underwater world boasting a rich biodiversity of fish, aquatic plants and other species. **Cheryl Tan** takes a deep dive into Serangoon Reservoir and reveals what it has to offer.

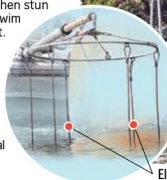


SURVEY TECHNIQUES

Boat electrofishing

Used for catching fishes to depths and distances of up to 3m from the boat.

- This technique entails placing electrodes in the water that discharge pulses of electrical currents, which first attract and then stun the fish as they swim closer to the boat.
- This helps to capture a wide range of species across all sizes that are otherwise difficult to catch using conventional methods.



Electrodes deliver current to the water

Gill netting

Used for catching pelagic fishes in deeper and more open waters.

- This is a vertical panel of netting that hangs in the middle of the water column.
- Depending on the mesh of the net, this is typically designed to allow fish to get caught in the netting material.

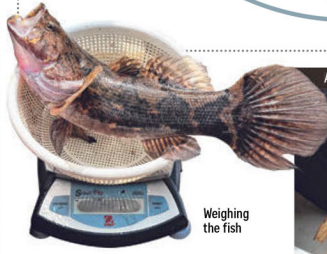
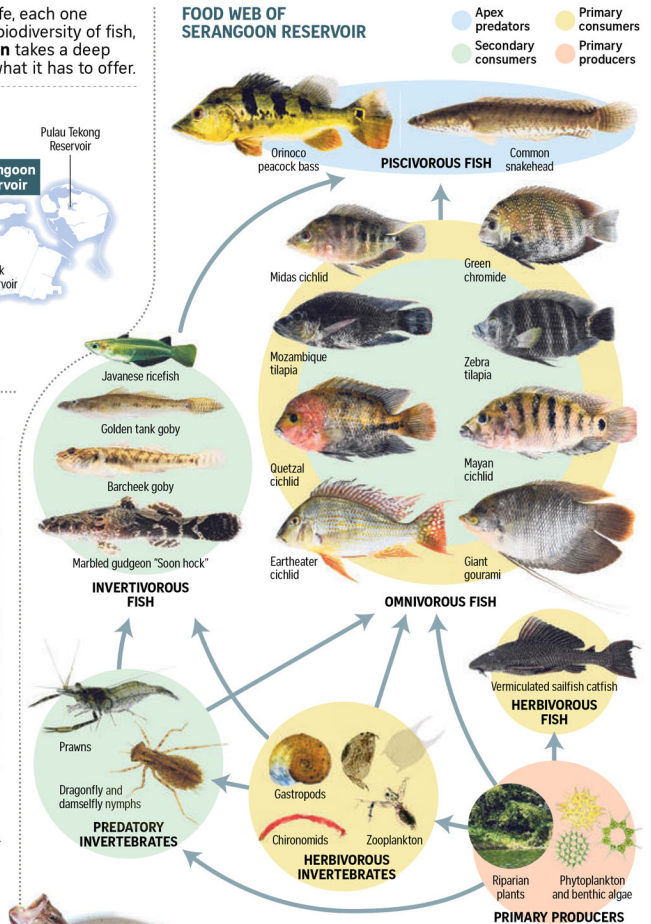


Fish tagging

- The fish that are captured are individually tagged by researchers, and then released back into the water.
- Determining the recaptured proportions of tagged to untagged fishes can give researchers an estimate of the different fish species populations in the reservoir.



FOOD WEB OF SERANGOON RESERVOIR



Source: PUB PHOTOS: JASON QUAH, COURTESY OF ROCHELLE CHAN, RAYSON LIM, CLAUDIA TAN, MAXINE MOWE AND TAN HEOK HUI STRAITS TIMES GRAPHICS: LIM YONG

Adjusting number of fish species to fight algal blooms, midge fly surge

To combat midge fly infestations and reduce the abundance of blue-green algae found in reservoirs here, researchers are studying the possibility of biomanipulation – that is, adjusting the number of fish species in the ecosystem.

Ms Tricia Poh, a biologist at PUB's water quality department, said midges cannot be eradicated as they serve as food for fish and birds and are part of the aquatic ecosystem.

Within the reservoirs, the population of midges is kept in check by natural predators: invertivorous (invertebrate-eating) fish such as Javanese ricefish and Siamese glassfish.

“However, under favourable environmental conditions such as hot weather, midges can reproduce very quickly and overwhelm their predators, leading to an explosion of midges that swarm in large numbers,” said Ms Poh.

Occasional swarms of midges have been recorded near Pandan and Bedok reservoirs in the past, causing nuisance to the residents living nearby, though they do not bite or cause disease.

To tackle this, PUB conducts daily monitoring of the eggs, larvae and adult numbers of the midges, implementing mitigating measures when necessary, such as increasing the frequency of fogging along reservoir embankments during the peak emergence period of the midges, said Ms Poh.

Similarly, PUB routinely monitors the growth rate of blue-green algae, or cyanobacteria, in reservoirs as they can grow rapidly in favourable conditions such as warm and calm water, and where there is sufficient sunlight and nutrients.

The algal blooms can then form a concentrated green layer on the water surface known as scum. When photosynthesis stops at night, respiration of large quantities of algae may deplete dissolved oxygen in the water, killing fish and other aquatic organisms in the process.

To mitigate this, surface aerators are used to disperse the algal scum, and algacide is applied to reduce the abundance of cyanobacteria, said Ms Poh.

“But the current measures taken to mitigate the algae and midge issues address the symptoms of the problem and not the root cause,” she added.

Therefore, in biomanipulation trials, the numbers of planktivorous (plankton-eating), invertivorous or piscivorous (fish-eating) fish are adjusted, which may help create a sustainable and balanced ecosystem while also reducing occurrences of algae and midge issues, said Ms Poh.

Biomanipulation trials at Serangoon Reservoir and Lower Seletar Reservoir are expected to start next year.

Cheryl Tan

Reimagining the Merlion

With the head of a lion and tail of a fish, the mythical Merlion is an apt symbol for Singapore – a city that roared its way from a tiny fishing village to a thriving metropolis. This National Day, **AUDREY TAN** and **CHNG CHOON HIONG** speak to experts to piece together the anatomy of the Merlion, based on established science. We learn how even the unlikely of creatures can beat the odds, just as Singapore did.

Experts

Dr Tan Heek Hui
Fish scientist,
Lee Kong Chian Natural
History Museum,
National University of
Singapore (NUS)

Mr Marcus Chua
Mammalian scientist,
Lee Kong Chian
Natural History
Museum, NUS

Name: Merlion

(*Leoaquatus singaporensis*)

- The scientific name of a species, which is always italicised, allows people of all tongues to refer unambiguously to an animal.
- Scientific names are in Latin and usually reference a physical trait of the creature, where it was found, or the person who discovered it.
- If *Leoaquatus singaporensis* was truly the scientific name for the Merlion, it would literally translate to 'aquatic lion from Singapore'.



COLOUR

- Grey. But turns red under threat in a startle display.
- Like the mosaic reef crabs native to Singapore, its colour warns predators of its poison and to stay away.

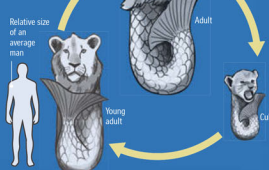
"In a world where the big fish eat small fish and the small fish eat shrimps, Singapore must become a poisonous shrimp."

—FOUNDING PRIME MINISTER
LEE KUAN YEW

REPRODUCTION

"As smaller forms look identical to large ones, it can be assumed that the young are identical in form to the adults, and the Merlion has no larval stage or does not undergo metamorphosis."

—MR CHUA



- There is not enough information to determine if the young are born live, like most mammals, or if they hatch from eggs, similar to fish.

Did you know?

Metamorphosis is a biological process of change, through a series of life stages, from caterpillar to butterfly, for instance.

FEEDING

- It could bite off chunks of larger prey, feeding like a killer whale, or go after small fish or land animals by sweeping them up in its jaw after "shooting" them with water jets.
- Many whales and dolphins also suck a bountiful amount of prey such as squid into their mouths. "If that is true, marine trash is certainly a threat to the Merlion," said Mr Chua.

Did you know?

Plastic debris was found in the gut of a sperm whale found dead in Singapore waters in 2015.



THREATS

- Marine trash (due to suction feeding)
- Poaching (for scales)
- Coastal development (due to habitat preference)
- Covid-19 and other pathogens from human contact (tourism)

EARS

- Large external ears are unusual for marine animals, which usually have tiny ones to reduce heat loss, or none at all.
- This suggests that Merlions live in tropical waters, and that they make sounds above water like otters – perhaps to establish territory or call to mates.

EYES

- The ability of an organism to produce its own light is common in deep sea creatures. Merlions with bioluminescent eyes – like the one that once stood on Sentosa – can probably hunt for food in deeper waters.

"The large eyes in front of the head of the Merlion probably give it good binocular vision where each eye sees an overlapping image of the other eye. This gives it a good depth perception like that of humans and wolves. Useful when judging distance of prey when hunting."

—Mr Chua

NOSE

- Nostrils on the tip of its nose close to the top of its head mean it can submerge itself almost totally while still breathing air, just like a crocodile.



SNOUT

- Whiskers fulfil a sensory function that helps it navigate the murky waters around Singapore or aids night movement.

Did you know?

Whiskers are a thicker type of the same hair that covers the bodies of mammals. They often grow in places that enhance the function of sensitive nerves.

WATER SPOUT

There are a few hypotheses as to why the Merlion spouts like a fountain from its mouth.

- Predatory:** The jet can be aimed at prey, similar to how archerfish hunt.
- Defence:** Just like other native marine creatures such as giant clams, the Merlion may spout water to ward off predators.
- Movement:** It may use it to propel itself through water, like an octopus.



Did you know?

Archerfish are surface-dwelling fish that have been recorded using water streams to bring down prey from above the water surface, such as land insects on branches. There are two archerfish species native to Singapore – *Toxotes jaculator* and *Toxotes chatareus*.

TAIL

- It is possible that the Merlion hooks its tail around seaweed or coral to prevent it from being swept away by a current, like a seahorse.

Did you know?

Animals use their tails for different purposes. Kangaroos, for instance, use theirs to maintain their balance, while seahorses use them as an anchor.



POSTURE

The Merlion is likely to move around in an upright posture, similar to the seahorses in Singapore's intertidal areas.

"The Merlion probably has a good sense of balance."

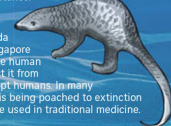
—DR TAN

BODY

- Covered in large scales, similar to those on fish like sea bass or the pangolin, the world's only scaly mammal.
- Overlapping scales could confer protection and reduce water resistance.

Did you know?

The scales of the Sunda pangolin native to Singapore are made of keratin like human fingernails, and protect it from most predators – except humans. In many countries, this animal is being poached to extinction for its scales, which are used in traditional medicine.



Sources: BBC, INFOPEA, MARCUS CHUA, NED AND TODD (2010), TAN HECK HUI, STRAITS TIMES GRAPHICS