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## First library of fish DNA from Singapore waters



(Clockwise from top left) The spotted-tail frogfish, the Indian mud moray eel, the whitecheek monocle bream and the papillose flathead. PHOTOS: SINGAPORE MARINE FISHES EXPEDITION TEAM 2019

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Of the 500 species in the database, five were previously not reported in the Republic



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Scientists here are gathering data on the schools of fish that live in the waters of Singapore, and the trove of information on these creatures will be curated for an online archive.

This "fish library" of more than 500 fish species residing in local waters will be made accessible to the public as early as mid-2021.

It is the first such database here.

The specimens were collected by researchers in an expedition that lasted 12 days in August, as part of the larger CodeFish-SG project which seeks to build a comprehensive DNA database of fishes in Singapore.

Both the expedition and the project were funded by the Marine Science Research and Development Programme of the National Research Foundation.

Previous expeditions had been conducted in Singapore but were not for a specific species or animal group.

— ADVERTISEMENT —



Dr Zeehan Jaafar, a lecturer at the National University of Singapore's (NUS) Department of Biological Sciences and co-lead of the project, said that of the more than 500 fish species gathered, five species were previously not reported from the Republic's bodies of water.

These species include those of cardinalfish, filefish, gobies and flatfish, she added.

By keeping a DNA library of these fish species, scientists can find out the types of fish that live in a particular body of water, simply by matching the DNA material present in the water sample to those already present in the database.

# Inhabitants of the sea

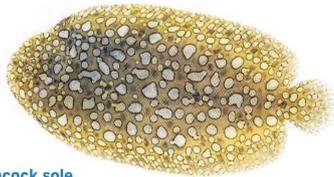
The Singapore Marine Fishes Expedition, carried out in August, was part of the larger CodeFish-SG project that seeks to build a comprehensive DNA database of fishes in Singapore. Here are some of the fish specimens collected by the researchers.



**Riau brotula**  
*Ungusurculus riauensis*  
This elusive species is rarely encountered and lives in the crevices of shallow coral reefs. Unlike most other fish species, females give birth to live young.



**Quoy's halfbeak**  
*Hyporhamphus quoyi*  
The stick-like body shape of the halfbeak helps it escape the radar of predators, which often mistake it for floatsam.



**Peacock sole**  
*Pardachirus pavoninus*  
The peacock sole has glands along the base of its dorsal and anal fins which produce mucus that might be toxic to small fish.



**Blue-spotted pufferfish**  
*Arothron caeruleopunctatus*  
The brown body of the blue-spotted pufferfish is dotted with numerous tiny electric blue spots, with lines of the same colour around its eyes.

### Sites where the survey was conducted

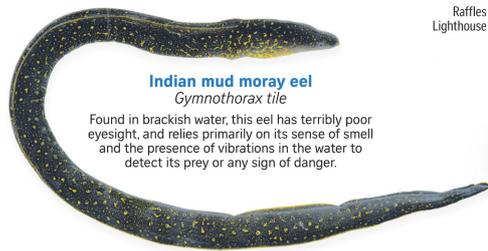


### By the numbers

**12 days**  
Expedition duration

**>300**  
Number of species collected during the expedition

**5**  
Number of species discovered that were not previously reported in Singapore



**Indian mud moray eel**  
*Gymnothorax tile*

Found in brackish water, this eel has terribly poor eyesight, and relies primarily on its sense of smell and the presence of vibrations in the water to detect its prey or any sign of danger.



**Tiny cardinalfish**  
*Ostorhinchus nanus*  
This small and shy species was discovered to exist in the reefs in Singapore only through this project.



**Tiger tail seahorse**  
*Hippocampus comes*

The mouth of the tiger tail seahorse resembles a long tube that feeds on prey through suction feeding.



**Fourlined terapon**  
*Pelates quadrilineatus*

Also known as the fourlined striped grunter, this fish croaks when it is taken out of water. For the fourlined terapon, it is the male that takes on the primary caregiver role for the eggs, guarding them and fanning them to keep them well-oxygenated.



**Longnosed stargazer**  
*Ichthyoscopus lebecki*

The longnosed stargazer is so called because its eyes are on top of its head, seemingly looking up at the stars. This sneaky predator often waits buried in the sand with only its head showing, ambushing unwitting prey as they swim past.



**Starry triggerfish**  
*Abalistes stellatus*

The starry triggerfish can be recognised from the white blotches against its blackish back and yellowish spots on a white background over the rest of the body.



**Milkfish**  
*Chanos chanos*

This sought-after fish is not native to Singapore but many have escaped into its marine areas from fish farms.



**Coral catshark**  
*Atelomycterus marmoratus*

This small, tropical shark with cat-like eyes and white spots is often found in the nooks and crannies of a reef.



**Spotted-tail frogfish**  
*Lophiocharon trisignatus*

Resembling an algae-covered stone, this inconspicuous-looking fish has a lure at the top of the head to attract prey such as small fish within striking distance. It then opens its huge mouth to suck the prey into its mouth, in the blink of an eye.



**Whitecheek monocle bream**  
*Scolopsis vosmeri*

This medium-sized fish lives near coral reefs. Although not favoured by anglers due to its small size, the flesh is sometimes used to make fishballs.



**Papillose flathead**  
*Sunagocia carbunculus*

The body pattern of the papillose flathead camouflages well with the seabed. The fish lies still and waits for passing prey. It feeds on a variety of small fish, crustaceans and molluscs.



**Butterfly whiptail**  
*Pentapodus setosus*

The butterfly whiptail forms small groups and lives near coral reefs. This species is relatively common in near-shore habitats of Singapore.



**Masked shrimpgoby**  
*Amblyeleotris gymnocephala*

This species likes to burrow in sand, coral pieces, shells and small pieces of broken-up shells.

SOURCE AND PHOTOS: SINGAPORE MARINE FISHES EXPEDITION TEAM 2019 STRAITS TIMES GRAPHICS

Such DNA material includes scales and mucus shed by fishes.

About 3 litres of water is needed for this method - known as environmental sampling - to work.

Knowing the species present in a body of water can help in the management of such areas and the conservation of rare species.

For this expedition, the scientists gathered samples in the areas around the Southern Islands, Pulau Hantu and Pulau Semakau by employing a variety of methods, such as using nets, hooks and lines, as well as by scuba diving.

After the fish specimens were collected, tissue samples were extracted before they were photographed.



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The fish were then preserved using diluted formaldehyde for fixation, and subsequently placed in ethanol for long-term storage at the Lee Kong Chian Natural History Museum.

From the extracted tissue, researchers sequenced the CO1 gene, also known as the barcode gene, and the 12S gene, both used to identify the species.

These works were carried out at the Temasek Life Sciences Laboratory (TLL) at the Kent Ridge campus of NUS by other members of the team, led by principal investigator at TLL, Dr Henning Seedorf, who is also co-lead of the project.

The entire core team of six, made up of scientists from NUS, TLL and the National Parks Board (NParks), then analysed and reviewed these sequences to ensure that they were error-free and that the identifications of the specimens matched the sequences.

The library will allow scientists to distinguish cryptic species - or two different species that appear similar - by looking at their DNA.

"For fishes that are small and with brown or grey colouration, it's difficult to tell them apart. This is when the DNA barcode sequences can be used to differentiate them," said Dr Jaafar.

This also works to distinguish species that change their appearance drastically with age. For instance, some species of groupers, seabass, parrotfish and anemonefish can undergo gender change as they mature.

"The largest one in a colony of anemonefish is usually female, and all other smaller ones are male. When the female dies, the next largest individual will become female and so on," noted Dr Jaafar.

The gender changes that these fish species undergo are, at times, accompanied by physical transformations, such as drastic changes in shapes, patterns and colours at different life stages, while their DNA remains the same.



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The library also helps to foster food security, said Dr Jaafar.

It could potentially help the Singapore Food Agency ensure that fish products imported from other countries are of the species they claim to be, by checking them against the database.

Dr Jeffrey Low, senior manager of the coastal and marine department at the NParks' National Biodiversity Centre, said the fish library will assist in crafting policies to protect habitats, help develop management strategies and set conservation targets.

"(The fish DNA library) would also be able to assist in the detection and management of alien invasive species into our waters," he added.

There are about 36,000 species of fish in the world, more than the sum total of species of mammals, birds, reptiles and amphibians put together.

Dr Jaafar said there are plans to record species in the region to expand the library.

"We plan to continually add to the database and to look into other aspects of fish biology and ecology, such as the life histories, larval ecology and distribution patterns."

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