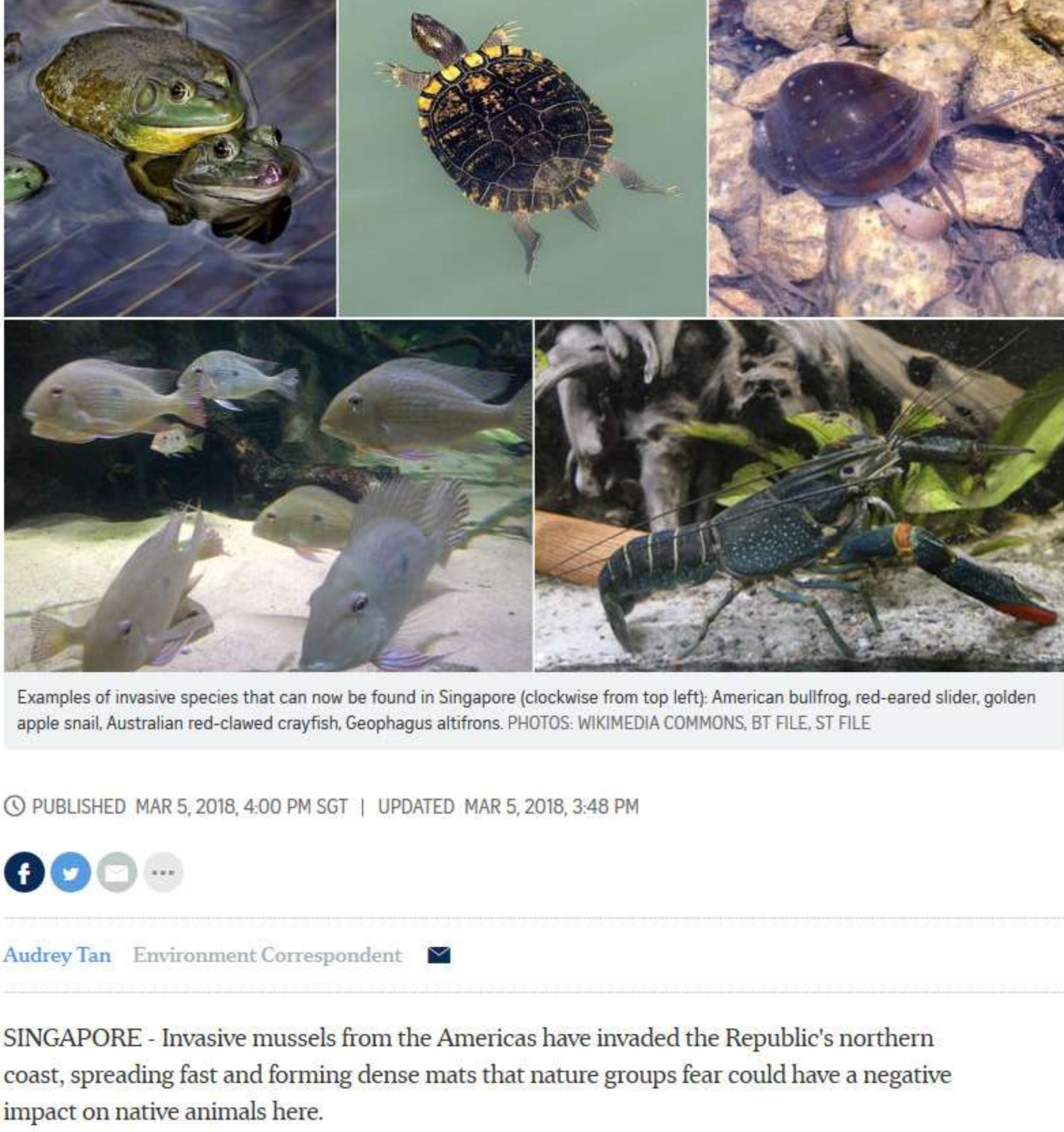
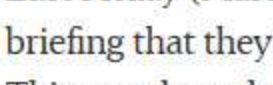


From foreign mussel to American bullfrog: A guide to invasive species in Singapore



Examples of invasive species that can now be found in Singapore (clockwise from top left): American bullfrog, red-eared slider, golden apple snail, Australian red-clawed crayfish, *Geophagus altifrons*. PHOTOS: WIKIMEDIA COMMONS, BT FILE, ST FILE

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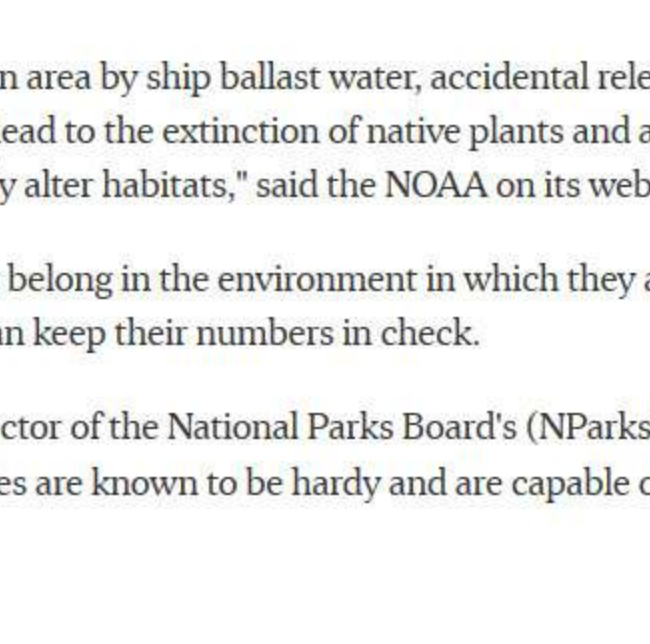


Audrey Tan Environment Correspondent

SINGAPORE - Invasive mussels from the Americas have invaded the Republic's northern coast, spreading fast and forming dense mats that nature groups fear could have a negative impact on native animals here.

Rare horseshoe crabs and the Asian green mussel are among the native species that could be muscled out by the American brackish-water mussel.

Last Friday (March 2), scientists at the National University of Singapore (NUS) said at a media briefing that they had uncovered the identity of this strange mussel first observed here in 2016. This was done through genetic work and comparisons of the mussel with museum specimens around the world. They found this was the first time that *Mytella strigata* has been recorded in Singapore waters.



WHAT ARE INVASIVE SPECIES, AND WHAT HARM DO THEY CAUSE?

These are animals or plants from another region of the world that do not belong in their new environment, according to the United States' National Oceanic and Atmospheric Administration (NOAA).

"They can be introduced to an area by ship ballast water, accidental release, and most often, by people. Invasive species can lead to the extinction of native plants and animals, destroy biodiversity, and permanently alter habitats," said the NOAA on its website.

Since invasive species do not belong in the environment in which they are introduced, they lack natural predators that can keep their numbers in check.

Mr Lim Liang Jim, group director of the National Parks Board's (NParks) National Biodiversity Centre, said most alien species are known to be hardy and are capable of establishing quickly in new environments.

Spreading fast in Singapore

A new species of mussel – *Mytella strigata* – that could have come from as far away as the Americas has since 2016 been spreading rapidly along Singapore's northern coast.



WHERE ARE THE MUSSELS FOUND

1 Gedong Buoy	8 Serangoon Buoy
2 Lim Chu Kang	9 Pasir Ris
3 Sungei Buloh	10 Changi Fish Farm
4 Kranji	11 CAAS Buoy
5 Sembawang	12 Sungei Jurong
6 Punggol	13 Republic of Singapore Yacht Club
7 Pulau Ubin	

DISTRIBUTION (Based on published sources)

Native populations Non-indigenous populations



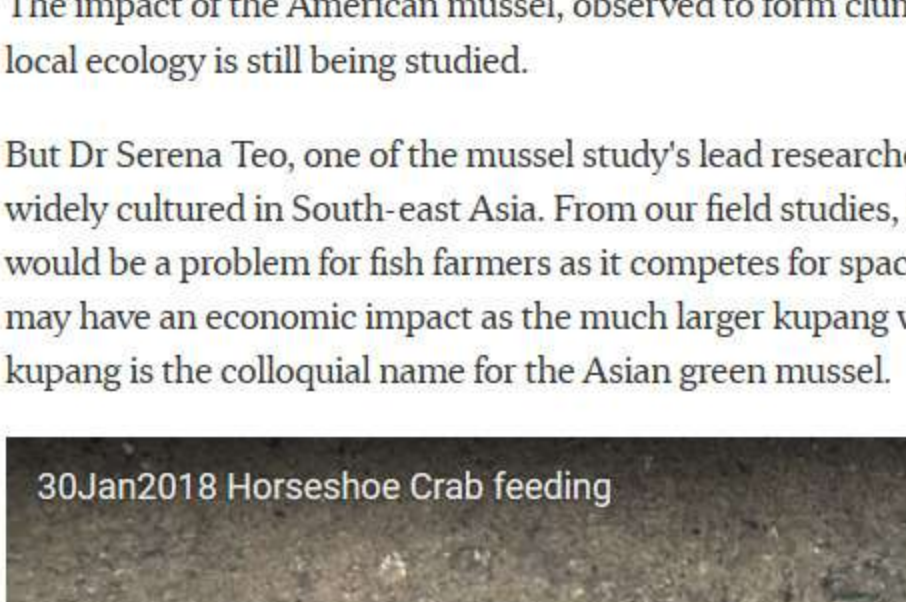
ABOUT THE MOLLUSC

Wide variation in external shell colours – from almost entirely bright green to shades of orange, grey, brown and black.

The largest individuals collected from Singapore measured in excess of 5cm.

- Its presence in Singapore is likely to **persist and spread to other similar habitats in the Singapore Strait.**
- Singapore has the **highest invasion risk among the world's ports.**
- It is believed that viable and reproducing individuals were **already present in the Strait of Johor in late 2015.**
- The invasive nature of this species outside its native range was first reported in 1986 when a large population of *Mytella* was seen inside seawater intake pipes at a power plant in Florida.

WHY ITS PRESENCE IS OF CONCERN



- Observed in clumps of up to 10,000 individual shellfish (above), the invasive American brackish-water mussel has been clogging up nets in fish farms here, and displacing the Asian green mussel native to Singapore.
- It has also been forming dense mats at the Kranji mudflats – home to rare horseshoe crabs – and the appearance of the mussels in these ancient creatures' habitat has made it difficult for them to burrow into the sand.

PHOTOS AND SOURCES: ST JOHN'S ISLAND NATIONAL MARINE LABORATORY, TROPICAL MARINE SCIENCE INSTITUTE, NATIONAL UNIVERSITY OF SINGAPORE, RIA TAN/WILDSINGAPORE.COM, STRAITS TIMES GRAPHICS

"They can multiply rapidly and compete with native species for resources such as food and shelter. In some cases, this can result in the disruption of native ecosystems. Alien species often pose a threat to native species which tend to have more specific niches," Mr Lim told The Straits Times.

The impact of the American mussel, observed to form clumps of up to 10,000 individuals, on local ecology is still being studied.

But Dr Serena Teo, one of the mussel study's lead researchers, said: "The Asian green mussel is widely cultured in South-east Asia. From our field studies, it appears that *Mytella strigata* would be a problem for fish farmers as it competes for space on mussel recruitment nets. This may have an economic impact as the much larger kupang would fetch a better price." The kupang is the colloquial name for the Asian green mussel.



However, Dr Teo, a senior research fellow at NUS' Tropical Marine Science Institute, pointed out that the Asian green mussel is a hardy species, and is considered an aggressive invasive species in the Americas. "It is unlikely to be easily trampled out," she said.

HOW DO WE MANAGE INVASIVE SPECIES?

Following news of the invasive mussel from the Americas, many readers wanted to know if they can be eaten. The NUS researchers do not recommend eating them as a way of reducing their numbers. For one, there is no way of knowing how much toxins are in them. Mussels are filter feeders and toxins they take in could accumulate.

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Mussel calamity: Shellfish from the Americas carpeting Singapore shores, could muscle out local species

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Tracking non-native animal species here

Invasive species can also be introduced into local environments through the pet trade. NParks tries to reduce this route by educating people against releasing animals or unwanted pets into parks and nature reserves.

Mr Lim said NParks works with various agencies and non-government groups, including volunteers, to deal with this threat.

He said: "Conservation management, legislation and public education are the key measures used to deal with this threat. The most effective way to deal with the impact of invasive species is to prevent invasions before they even occur."

Those caught releasing animals can be fined up to \$50,000 under the Parks and Trees Act.

WHAT OTHER INVASIVE SPECIES ARE THERE IN SINGAPORE?

According to NParks, these are some other examples of invasive species that can now be found in Singapore:

RED-EARED SLIDER (*TRACHEMYS SCRIPTA ELEGANS*)

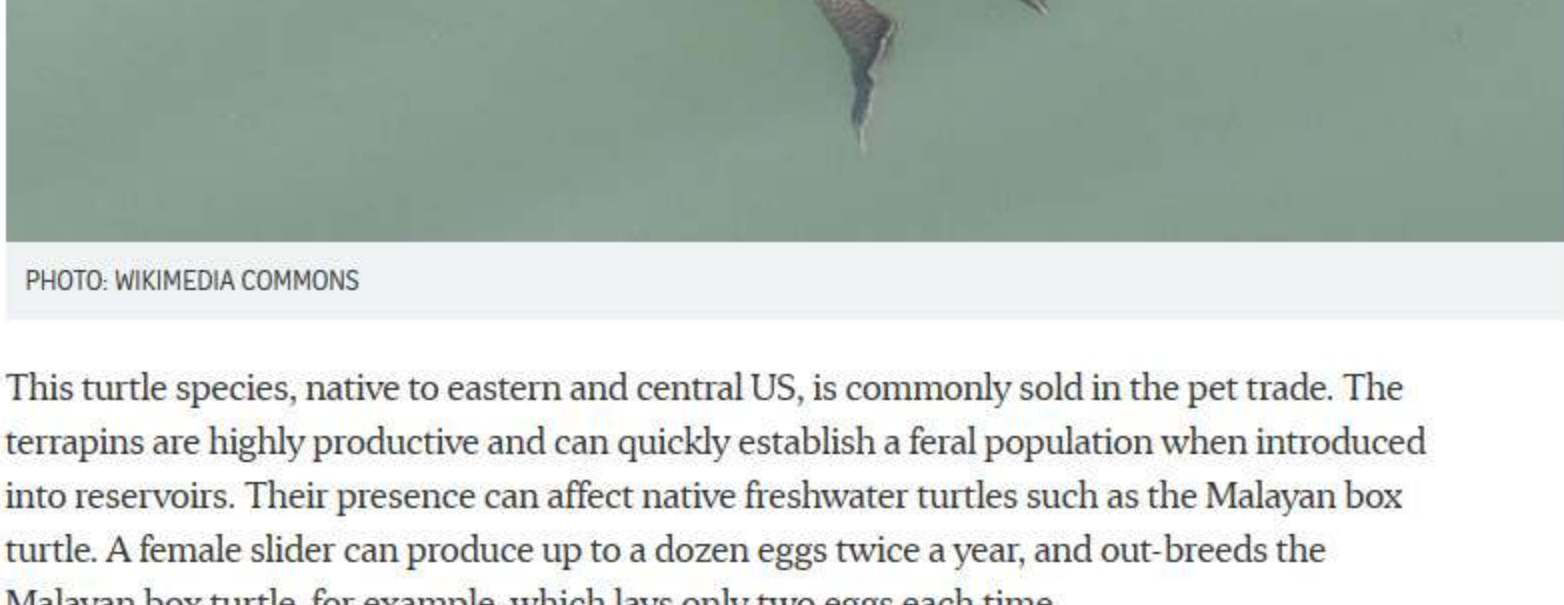


PHOTO: WIKIMEDIA COMMONS

This turtle species, native to eastern and central US, is commonly sold in the pet trade. The terrapins are highly productive and can quickly establish a fertile population when introduced into reservoirs. Their presence can affect native freshwater turtles such as the Malayan box turtle. A female slider can produce up to a dozen eggs twice a year, and out-breeds the Malayan box turtle, for example, which lays only two eggs each time.

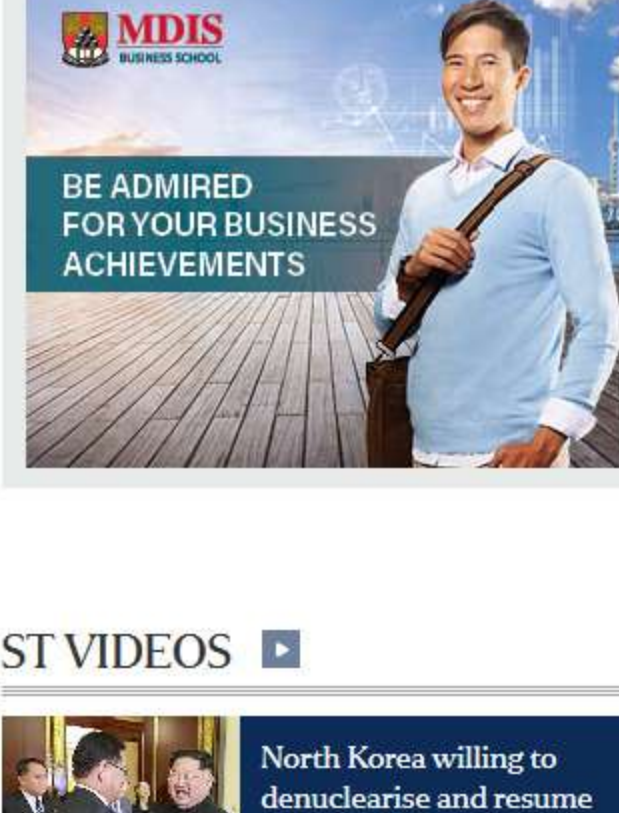
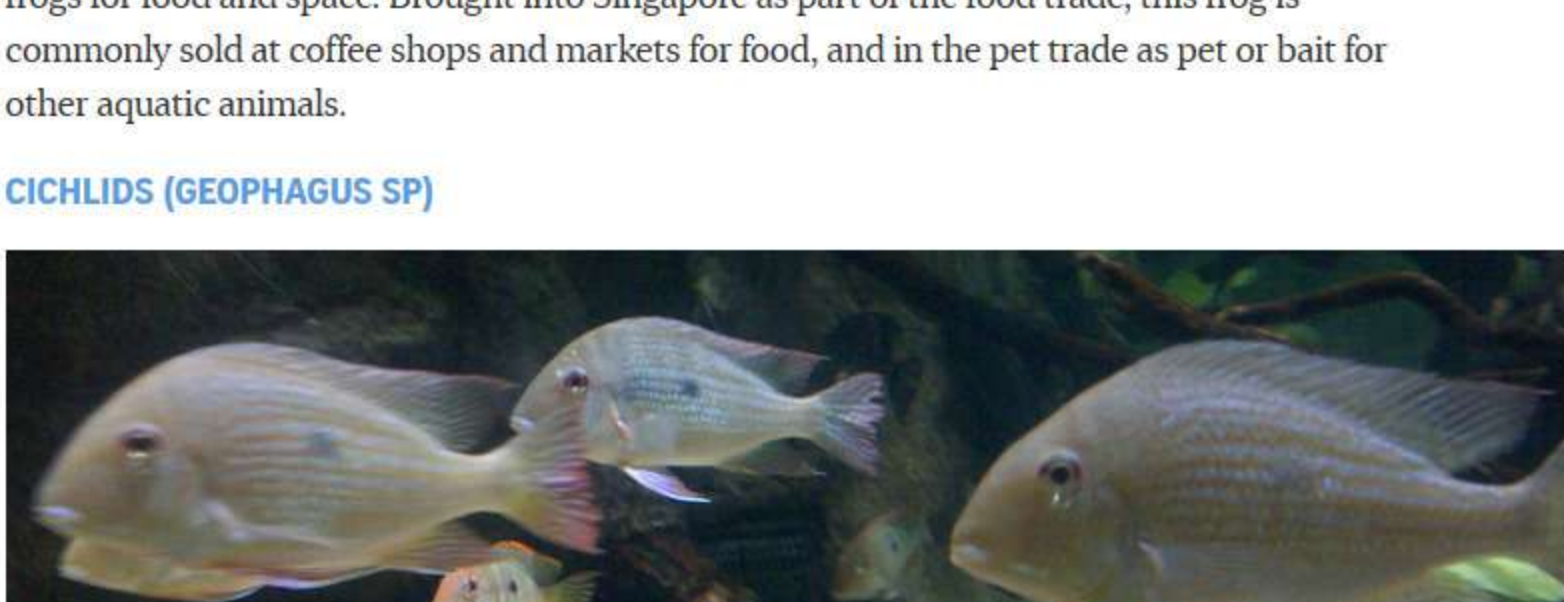
AMERICAN BULLFROG (*LITHOBATES CATESBEIANUS*)



PHOTO: BT FILE

These bullfrogs from the Americas are known to breed prolifically and compete with local frogs for food and space. Brought into Singapore as part of the food trade, this frog is commonly sold at coffee shops and markets for food, and in the pet trade as pet or bait for other aquatic animals.

CICHLIDS (*GEOPHAGUS SP*)



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