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Coastal corridors, mangroves key to horseshoe crabs' conservation: Study

NUS researchers come up with strategies tailored to protect each species

Zachary Lim

Protecting and restoring mangroves, as well as establishing "coastal corridors" in areas where intensive development is ongoing, could help with the conservation of two of Asia's mysterious seabed-dwelling organisms.

The mangrove and coastal horseshoe crabs are prehistoric-looking marine animals that can be found in Singapore and other parts of South-east Asia, such as Malaysia, Indonesia and Thailand.

Such conservation efforts can help these species better cope with threats to their existence, such as climate change and habitat loss, a new study by biologists from the National University of Singapore (NUS) found.

"To protect and conserve these species, it is crucial that we first cover the basics – understanding their population structure, evolutionary histories and climate change-driven vulnerabilities," said Associate Professor Frank Rheindt from the Department of Biological Sciences in the NUS Faculty of Science, who led the team of researchers.

"This foundational knowledge will enable us to develop targeted conservation strategies and prioritise habitats critical for their survival," he added.

The research, which used genetic analyses to identify how different species of horseshoe crab populations have changed over time, also looked into how the different species coped with environmental change.

This enabled the researchers to come up with conservation strategies tailored to each species.

For example, the researchers found that the mangrove horseshoe crab – found in places like the Mandai mangrove and wetlands and Sungei Buloh Wetland Reserve in Singapore – tends to stay in a more confined area throughout its lifetime, compared with the more mobile coastal horseshoe crab.

The coastal species can be found in the beaches of East Coast Park.

This prompted the researchers to recommend the protection and restoration of mangrove habitats as a tailored conservation measure for the mangrove horseshoe crab.

For the coastal horseshoe crab, the study found that a major threat to its survival is habitat fragmentation.

A tour guide showing where eggs are found in a mangrove horseshoe crab near Desaru, Malaysia. ST PHOTO: LIM YAOHUI

Tracking and monitoring Asian horseshoe crabs can be challenging. They spend most of their lives on the seabed, making them difficult to observe. To fill in knowledge gaps, researchers embarked on the first comprehensive population genomic study of all three Asian horseshoe crab species.

This occurs when a habitat gets divided into isolated segments, usually due to human activities like landscape modifications for coastal development, for example.

When this happens, coastal horseshoe crabs face the risk of becoming locally extinct – when a species disappears from a particular area. The researchers recommended that "coastal corridors" be safeguarded between populations of coastal horseshoe crabs to reduce their vulnerability to fragmentation.

Overall, the researchers analysed the genetic information of three species of horseshoe crabs that can be found in Asia.

Other than the mangrove and coastal horseshoe crabs, the tri-spine horseshoe crab can also be found in Asia – mainly in the eastern coastal areas of the continent, including Hong Kong and Taiwan.

The Asian species make up three out of four horseshoe crab species found globally.

The researchers said the most-studied species is the Atlantic horseshoe crab, which can be found along the Atlantic coast of the US and the Gulf of Mexico.

This species is considered vulnerable, with a major driver of extinction being habitat loss and overharvesting.

Much less is known about the three Asian species of horseshoe crabs, however, which makes taking action to conserve them challenging, said the NUS researchers.

For example, the information on mangrove and coastal horseshoe crabs is so scant that international scientific assessments are unable to determine how threatened they are with extinction.

The tri-spine horseshoe crab is considered endangered, with a major driver of population decline being habitat loss and overharvesting, similar to the Atlantic species.

Presently, the Atlantic horseshoe crab and tri-spine horseshoe crab are the main species of horseshoe crabs being harvested for their blue-tinted blood, which is used to test vaccines and screen for toxins.

But tracking and monitoring Asian horseshoe crabs can be challenging.

For one thing, these animals spend most of their lives on the seabed, making them difficult to observe.

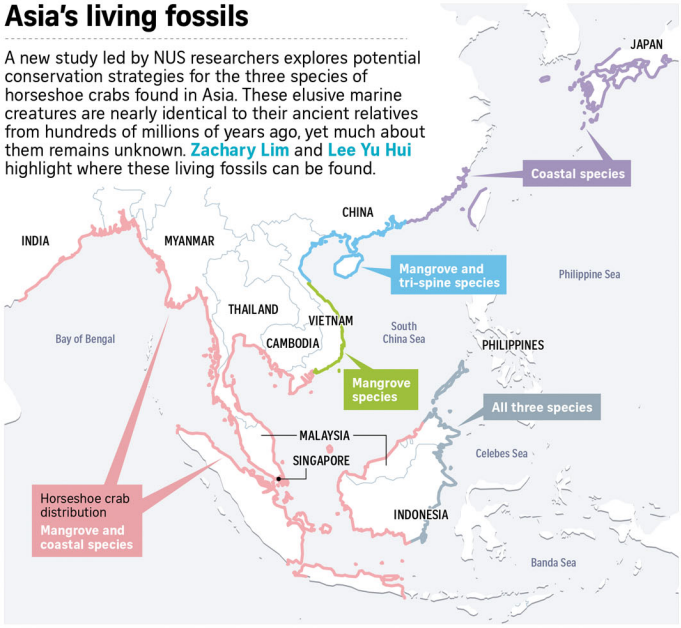
To fill in knowledge gaps, the researchers embarked on the first comprehensive population genomic study of all three Asian horseshoe crab species.

For the study, genetic data from tissue samples of 251 horseshoe crabs – collected across 52 sites in 11 countries – was analysed.

Dr Tang Qian, study lead author who embarked on the research while he was a researcher at NUS, said the study used genetic information and models to map out the horseshoe crabs' habitat availability and determine how they have been responding to their ever-changing environments.

Asia's living fossils

A new study led by NUS researchers explores potential conservation strategies for the three species of horseshoe crabs found in Asia. These elusive marine creatures are nearly identical to their ancient relatives from hundreds of millions of years ago, yet much about them remains unknown. **Zachary Lim** and **Lee Yu Hui** highlight where these living fossils can be found.



Mangrove horseshoe crab
(Carcinoscorpius rotundicauda)

- These horseshoe crabs are commonly found in mangroves, including those in Singapore.
- Researchers have discovered that these creatures are sensitive to temperature changes and have limited mobility, making them extremely vulnerable to global warming.
- To better conserve this species, researchers say it is crucial to protect and restore mangrove habitats, which are essential for the species' survival. Migrating south towards cooler waters is also a potential survival strategy.

Coastal horseshoe crab
(Tachypleus gigas)

- A horseshoe crab species found mostly on sandy beaches, including in Singapore, it has a migration path largely influenced by the propulsion of the currents.
- Coastal horseshoe crabs face threats such as pollution and coastal development, which can disrupt their dispersal patterns.
- To safeguard this species, researchers recommend protecting coastal corridors to maintain connectivity between populations and support their migration and reproduction.

Tri-spine horseshoe crab
(Tachypleus tridentatus)

- This species, found mainly in China, is distinguished by the three lines of tiny spines running down the rear of its shell and thrives in colder waters better than the other two Asian species.
- The blood of the tri-spine horseshoe crab is used in vaccine testing. The species also faces threats from habitat loss and overfishing.
- Researchers recommend implementing sustainable fishery regulations and restoring coastal habitats, particularly in areas with a history of intensive development.

Source: NUS PHOTOS: LESTER TAN, TANG QIAN STRAITS TIMES GRAPHICS

Horseshoe crabs are often referred to as "living fossils", as their appearance has not changed in more than 400 million years.

The researchers found that the Asian horseshoe crabs also managed to hang on even in the face of fluctuations in sea levels.

"The study underscores the importance of South-east Asia's Sunda shelf, a shallow-marine region, as a critical coastal marine habitat," noted the researchers.

Modern-day climate change is caused by the release of planet-warming emissions from human activities, such as burning of fossil fuels and cutting down of forests. This warming is causing ocean temperatures and sea levels to rise.

The study highlighted that future climate change poses varying levels of risk to the three species of Asian horseshoe crabs.

But they also found that the tri-spine horseshoe crab faces a more pressing threat: harvesting and habitat loss.

To safeguard this species, the researchers recommended that sustainable fishery regulations be implemented and coastal habitats restored, especially in areas with a history of intensive development, such as Japan, Taiwan and China.

Mr Lester Tan, chair of the Marine Conservation Group at Nature Society Singapore, who was not involved in the latest study, stressed that habitat loss has been an ongoing threat across all species of horseshoe crabs, especially with coastal developments.

"It is crucial (for governments) to work with various non-governmental organisations, neighbouring countries and local communities to raise awareness and establish an action plan towards conserving and protecting these important areas – especially mangroves," he added.

Given that two species of horseshoe crabs can be found in Singapore, the Republic can also take steps to safeguard the existence of the mangrove and coastal horseshoe crabs.

"One possible approach is to design recreational coastal areas to incorporate wildlife-friendly features to mimic their natural habitat while minimising disruption from human activities," said Dr Tang, who is now a research associate at the Rowland Institute at Harvard University.

"In addition, small pockets of nature reserves and some mangrove restoration on the southern islands can be helpful to create corridors connecting the habitats of the major horseshoe crabs, thereby reducing habitat fragmentation," he added.

zachlim@sph.com.sg