



**LIVING JEWELS:** Shield bugs find safety in numbers. With their iridescent bodies, they form living jewels on the leaf. At least eight of this species of plant feeders have been recorded in Singapore. Some of the female shield bugs are known to care for their eggs and even brood over the nymphs.

PHOTOS: CHUA EE KIAM



**ENDANGERED OWL:** The buffy fish owl is one of seven species of owls recorded in Singapore. It is endangered here, threatened by illegal trapping and habitat disturbance and destruction. It usually roosts in a tall tree, emerging at dusk to hunt prey such as large insects, fish, frogs, small birds and mammals. It lays a single egg in bird's nest ferns, tree holes or abandoned nests.



**FOREST DWELLER:** Cave centipedes such as this one are usually found in forests in Singapore. They have a spider-like appearance, with 15 pairs of long legs. The centipedes also groom themselves, coating their bodies with an oily substance that keeps them free of germs and dirt. This particular species can give a painful bite but its venom is not known to be lethal.

# Life in an urban jungle

## New book showcases the more than 40,000 native species of flora and fauna here

**BY CHANG AI-LIEN**  
SENIOR CORRESPONDENT

AGAINST all odds, nature abounds in spectacular diversity in our midst. Urban Singapore is teeming with wildlife, as the country's first biodiversity encyclopaedia shows in bounteous detail.

Filled with photographs, the 552-page book showcases everything from abalone – there are seven species here – to zooxanthellae, single-celled plants living in the tissue of corals.

Sixty-five scientists, nature experts, policymakers and environmental activists produced the mammoth tome, which also chronicles successes, threats and losses in wildlife conservation here.

The book took three years to compile and was brought to life by conservation champions Leo Tan and Peter Ng, professors at the National University of Singapore's (NUS) Faculty of Science, with the help of a chief adviser, Ambassador-at-large Tommy Koh.

"Bit by bit, this story came together, and it was a story worth telling," said Prof Ng, who also heads the Raffles Museum of Biodiversity Research. He was one of the book's editors, together with Professor Richard Corlett and Associate Professor Hugh Tan, his colleagues.

Its chapters cover the environmental scene in the country over the last 200 years, how it has tried to balance the often conflicting needs of economic development, conservation and preservation of natural heritage, and its hopes for the future.



**CONSERVATION CHAMPIONS:** Those involved in producing the biodiversity encyclopaedia, an NUS-led initiative, included (from left) Professor Leo Tan, who chaired the editorial advisory committee, Professor Peter Ng, one of the editors, and Straits Times senior correspondent Chang Ai-Lien, who co-wrote a chapter with Ambassador-at-large Tommy Koh (far right). Prof Koh was also the book's chief adviser. Second from right is university president Tan Chorh Chuan. ST PHOTO: CAROLINE CHIA

Singapore Biodiversity – An Encyclopedia Of The Natural Environment And Sustainable Development also comes with an A to Z guide on virtually every known organism here.

The Republic is home to more

than 40,000 native species of flora and fauna which have survived despite extensive habitat destruction.

Prof Tan noted that even biologists and scientists from overseas found this hard to believe, and were quick to underestimate Singapore's

rich natural treasure trove.

"Then when they are finally convinced to come here to collect specimens, whether insects or crabs or coral, they are surprised time and time again."

He added: "The book also paints

the landscape of Singapore's future and will hopefully inspire young people to play a role in shaping it."

Indeed, some young people will get a chance to do so soon, as a result of the book's publication.

Donations towards producing the encyclopaedia – from ExxonMobil Asia Pacific, Keppel Corp, the Lee Foundation, Ngee Ann Kongsi and businessmen Sam Goi and Oei Hong Leong – were matched by \$1.1 million in government funding, which will go into an endowment fund for a new Bachelor of Environmental Studies degree at NUS.

The undergraduate course is being developed and will be taught by professors from eight faculties, with the first batch of 50 students starting next month.

NUS president Tan Chorh Chuan noted that today's environmental issues are complex, spanning many fields.

The programme would nurture graduates who are able to think deeply and broadly, he said, and help to develop novel solutions for Singapore and beyond.

Prof Leo Tan added: "Each faculty contains experts in their own fields with their own priorities."

"Getting this diverse group together was something of a miracle, but it was necessary because the environment cannot be dealt with by one person or group."

The book, which was launched on Monday by the university's chancellor, President S R Nathan, is on sale at major bookstores for \$65 (excluding GST).

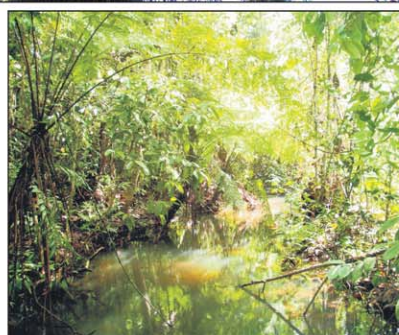
[aillen@sph.com.sg](mailto:aillen@sph.com.sg)



**A REAL NATIVE:** The Johnson's freshwater crab is one of three species of freshwater crab discovered by local biologists and not known to exist anywhere else in the world. The other two are the Singapore crab and the swamp forest crab. PHOTO: KELVIN LIM



**LAND OF THE GIANTS:** The primary forest patches in Bukit Timah Nature Reserve (above) can be seen via Google Earth, because of the giant trees emerging from the upper canopy of the forest. Nee Soon Swamp Forest (right) is the only substantial patch of freshwater swamp left on Singapore island. The water is clear but stained the colour of tea by tannins from slowly decaying plant matter. It is home to half of Singapore's freshwater fish species, seven in 10 of the local amphibians, 28 per cent of reptiles and a third of bird species.  
 PHOTOS: WANG LUAN KENG



## Uniquely Singapore

THE Singapore tarantula and Singapore whiskered bat are some of the island's true blue natives, found nowhere else in the world.

Among the handful of creatures and plants in this category – many of them endangered or extinct – is the cream-coloured giant squirrel.

With a body length of 38cm and a longish tail, it was one of the largest squirrels around, and was named by Sir Stamford Raffles in 1821.

Once abundant in the woods of Singapore, the rodent was trapped for food and its habitats were destroyed. No sightings of the species have been reported for the last 15 years and it is feared to have become extinct.

There are no birds, reptiles or fishes on the list, but there is an amphibian.

The mysterious black caecilian was collected in 1847 after being dug up in a garden in Thomson Road. The snake-like amphibian, now placed at London's Natural History Museum, is the only one of its kind found.

Others are still clinging on.

Three species of freshwater crab, for instance, can still be found in places such as Nee Soon Swamp Forest and Central Catchment Nature Reserve.

One of them, the Singapore crab, was first discovered by crustacean expert Peter Ng in 1986.

Distinguishable by a bright orange band just below the eyes, it does well in hill streams and very clean water.

## Tiny havens for wildlife

BUKIT Timah Nature Reserve and MacRitchie Reservoir are home to some of Singapore's remaining tiny pockets of primary forest.

Nee Soon swamp, next to Upper Peirce Reservoir, is the only freshwater swamp here.

These precious areas of habitat contain some of the country's richest and most diverse wildlife.

In fact, Singapore's biodiversity as a whole remains so rich that more than 100 species completely new to science have been found here in recent years. These range from new species of moss to fishes, spiders, shrimps and barnacles.

Nee Soon Swamp Forest is the last refuge for many local species, including plants, fishes, amphibians and reptiles.

Over at Bukit Timah Nature Reserve – home to what is believed to be among the world's oldest small rainforest reserves – trees tower 80m into the sky.

The area holds 40 per cent of Singapore's native plants, many of which are found nowhere else here.

At Labrador Nature Reserve, its short 300m stretch is a tiny cradle of intertidal biodiversity, including seagrass, molluscs and crustaceans, and rich fish life.

On the eastern tip of Pulau Ubin, Chek Jawa is an oasis for coastal creatures living relatively untouched by urbanisation and offering a glimpse of what the island's shores must have looked like in the 1950s and earlier.

And it is bird heaven at the Sungei Buloh Wetland Reserve.

More than 200 bird species have been recorded in the 130ha plot on the north-western tip of Singapore.

Estuarine crocodiles, monitor lizards and smooth-coated otters have also settled down there.

Marine life is rich, with Singapore waters home to 250 hard coral species, for instance, almost a third of the global total.

They can even thrive alongside man-made developments. Testimony to this is the Keppel Bay marina on the heavily built-up southern coast, where careful planning ensured salt-water denizens such as clown fish, sea fans and cave corals could call it home.



**A RARE BEAUTY:** This rare dragonfly was first recorded here in the Central Catchment Nature Reserve in 2008. Since then, it has been seen only once. PHOTO: TANG HUNG BUN



**SMALL WONDER:** One gem at Labrador Nature Reserve is the pygmy squid, which is only 1cm to 2cm long, and feeds on small crustaceans among the seaweeds and seagrasses. PHOTO: RON YEO



**YELLOW PERIL:** The yellow crazy ant is among the world's top 100 invaders and is common in Singapore. It is so named because of its frenzied movements. A non-forest species which has invaded forests, it forages on the forest floor and canopy. It eats leaves and seedlings, and preys on other arthropods, reptiles and even birds. PHOTO: CHEONG LOONG FAH



**SURVIVOR:** The banded leaf monkey, which has black fur and white bands along the underside of its body and limbs, is one of the rarest mammals in Singapore. A local study found, however, that there are an estimated 40 of the primates here, more than previously thought. PHOTO: ANDIE ANG

## Alien invasion

NOT only have Singapore's native plants and animals lost most of their living space to construction, but they have also had to jostle with alien species.

Being a major trading hub has led to some unwanted immigrants in Singapore, including disease-spreading brown rats and American cockroaches.

Hundreds of such species have made a home here, invading air, water and land. Some of the more common ones include the water hyacinth, guppies and pigeons.

While only a minority of introduced species cause problems, ecologists worry about them all because it is impossible to predict who the trouble-makers will be.

Apart from spreading parasites and dis-

ease, they also compete with native plants and animals for food and space, or damage infrastructure.

And once they take root here, they are usually here to stay. For instance, tens of millions of dollars are spent here every year to control the rat, crow and cockroach populations, and to remove floating plants choking the reservoirs.

Singapore's bustling ornamental fish, plant and pet trade has also seen exotic species such as freshwater stingrays and arowana breeding in the reservoirs.

Even the forest reserves are not immune, and have been hit with the pest plant *Koster's curse* and the aggressive yellow crazy ant.

**FRUITARIANS:** The lesser dog-faced fruit bat can be seen even in urban areas, where it roosts in buildings and feasts on fruits from mango, chiku and rambutan trees. Fruit bats play an important role in dispersing seeds and pollinating trees due to their diet and mobility. PHOTO: BRANDON CHIA



**HOME GROUND:** A family of smooth-coated otters has made Sungei Buloh its home since the late 1990s. Efforts to protect the wetland reserve began at the grassroots. PHOTO: BRANDON CHIA

## Back from the brink of extinction

THE banded leaf monkey is one of many plant and animal species creeping back from the jaws of extinction here.

Once widespread on the island, its numbers shrank to just 10 in the 1980s.

Almost nothing is known about the shy primate, which is about 60cm tall with an even longer tail, making conservation efforts difficult. So National University of Singapore researchers worked with the National Parks Board and Wildlife Reserves Singapore to painstakingly monitor and count the species, and found a ray of hope - its numbers had quadrupled to 40.

Genetic tests on the animals' faeces also showed that the monkeys are the same subspecies as their neighbours in Johor, which means that animals could be translocated from either location to boost populations and ensure their survival.

Efforts to boost biodiversity range from a butterfly trail along Orchard Road to seeding corals in surrounding waters.

With more than half the world's people living in cities and 60 per cent projected to do so by 2030, the nation's success is being used as a template for protecting plants and animals in an urban setting.

The Singapore Index on Cities' Biodiversity, highlighted in a new local nature encyclopaedia launched this week, is a case in point. The tool, proposed by former national development minister Mah Bow Tan, was specially designed to monitor, assess and manage the status of biodiversity in urban areas.

The first index of its kind, it is gaining momentum and is being tested in over 40 cities, which use it to quantify their plants and animals, determine what ecosystems give free "services" such as providing oxygen or absorbing floodwater, and what is being done to preserve them.

Said Dr Lena Chan, deputy director of the National Biodiversity Centre of NParks, which is coordinating the index: "What started out as a simple monitoring tool is now being used all over the world as a diagnostic kit to see where the holes are and which components are weak."

"In Singapore, we're now beginning to apply it in different projects to ensure that biodiversity planning is incorporated into masterplanning guidelines."

Professor Leo Tan, director of special projects at the university's science faculty and chair of the book's editorial advisory committee, added: "Singapore is a good example of what can be done to ensure sustainability. For the first time we have authentic data that can show the successes, threats and losses, and the potential hope for mankind."

Professor Peter Ng, director of the Raffles Museum of Biodiversity Research and the Tropical Marine Science Institute, noted that the book added to this effort because it not only charted the local environmental landscape over the last 200 years, but also did some "crystal ball gazing".

"Balancing the often conflicting needs of economic development, conservation and preservation of a country's natural heritage is never easy, and in Singapore's case, it has been a monumental challenge."

"To reach the next lap, Singaporeans must not only know their past, but also appreciate their present and have hope in their future, and I hope the book will be a catalyst for this."

## A future of green and blue

SINGAPORE'S green and blue heritage - its verdant havens of flora and sparkling waterways - looks bright.

This is thanks to an ambitious billion-dollar plan to improve energy efficiency, lift recycling levels, expand green spaces and open up reservoirs and other waterways.

The main strategy is to stick to the Singapore approach in other fields: pursue long-term growth coupled with far-sighted planning, flexibility and a good measure of common sense.

Singapore has been spreading its green mantle since the 1960s, when then-Prime Minister Lee Kuan Yew envisioned tree-lined expressways to impress investors.

Today, agencies such as the National Parks Board, PUB and researchers here play key roles in research, public education, reforestation and clean-up projects.

The PUB's Active, Beautiful, Clean Waters programme, for instance, conserves freshwater life in and around the drainage system while getting the public involved in the effort.

A Park Connector Network used by cyclists, joggers and walkers links people to parks and nature sites around the island, providing not only recreation but also eco-links for animal and plant life.

Farther afield, the Pulau Semakau landfill has received international acclaim for being a wildlife haven rich in mangrove swamps, forests and coral beds.

In recent years, more and more Singaporeans have begun to share Mr Lee's passion for greening the environment.

Non-governmental organisations have also had a strong voice in protecting native biodiversity, with the Nature Society (Singapore) leading an ever-growing pack that includes new groups, online communities, websites and blogs.

More people are volunteering time to make a contribution to conservation. Others are making environmentally conscious choices such as buying energy-efficient appliances as well as recycling household waste.

And between 2008 and last year, more than 270 companies contributed more than \$6 million to projects ranging from coral nurseries to planting trees.

Former national development minister Mah Bow Tan laid out this vision for Singapore.

"Our blue and green spaces will be seamlessly integrated, as we landscape



**WATER COLOUR:** This beautiful sea slug is one of Singapore's colourful and flamboyant underwater denizens. In Singapore, several families of this type of sea slug, called nudibranchs, have been recorded. They are found mostly in seagrass meadows, coral rubble and reefs. PHOTO: TOH CHAY HOON

our waterbodies to create active, beautiful and clean waters," he said.

"There will be more skyscraper greenery, covering our built environment with a lush, vertical green mantle. We will create an environment where biodiversity can thrive, and where our natural heritage can be safeguarded."



**OUT TO LUNCH:** The blue-throated bee eater with a tasty morsel. This species digs burrows in sandy banks where it lays three to five white, glossy eggs. Between October and April, it is absent in Singapore, possibly migrating south to Sumatra. PHOTO: FOO SAI KHON



**YOU, ME AND UV:** The Singapore jumping spider uses ultraviolet reflectance - reflected rays invisible to people - and UV-induced fluorescence to communicate during courtship rituals. PHOTO: LI DAIQIN

## Did you know?

HERE are some interesting nuggets from the book:

■ Fish expert Francois de Castelnau recorded that after an earthquake and heavy rains in Singapore in 1861, locals reported catfish raining from the sky.

■ During excavation works in Jalan Besar four years ago, contractors dug up large giant clam shells which had never been recorded in Singapore. How they got here is a mystery.

■ Based on satellite imaging studies, green cover here has increased from 238 sq km in 1986 to 340 sq km in 2007. This is mainly the result of national efforts to

increase green space.

■ Renowned naturalist David Attenborough came to Singapore in 2006 to film the documentary on reptiles and amphibians titled *Life In Cold Blood* because of the rich diversity here.

■ The Singapore jumping spider uses ultraviolet reflectance - reflected rays from light which are invisible to people - and UV-induced fluorescence to communicate during courtship rituals.

■ Oriental pied hornbills, once extinct in Singapore, have made a comeback here with a little help from nesting boxes set up for them.