



SHARING STORIES WITH AN OLD FRIEND



BIODIVERSITY RESEARCH & MANAGEMENT IN SINGAPORE



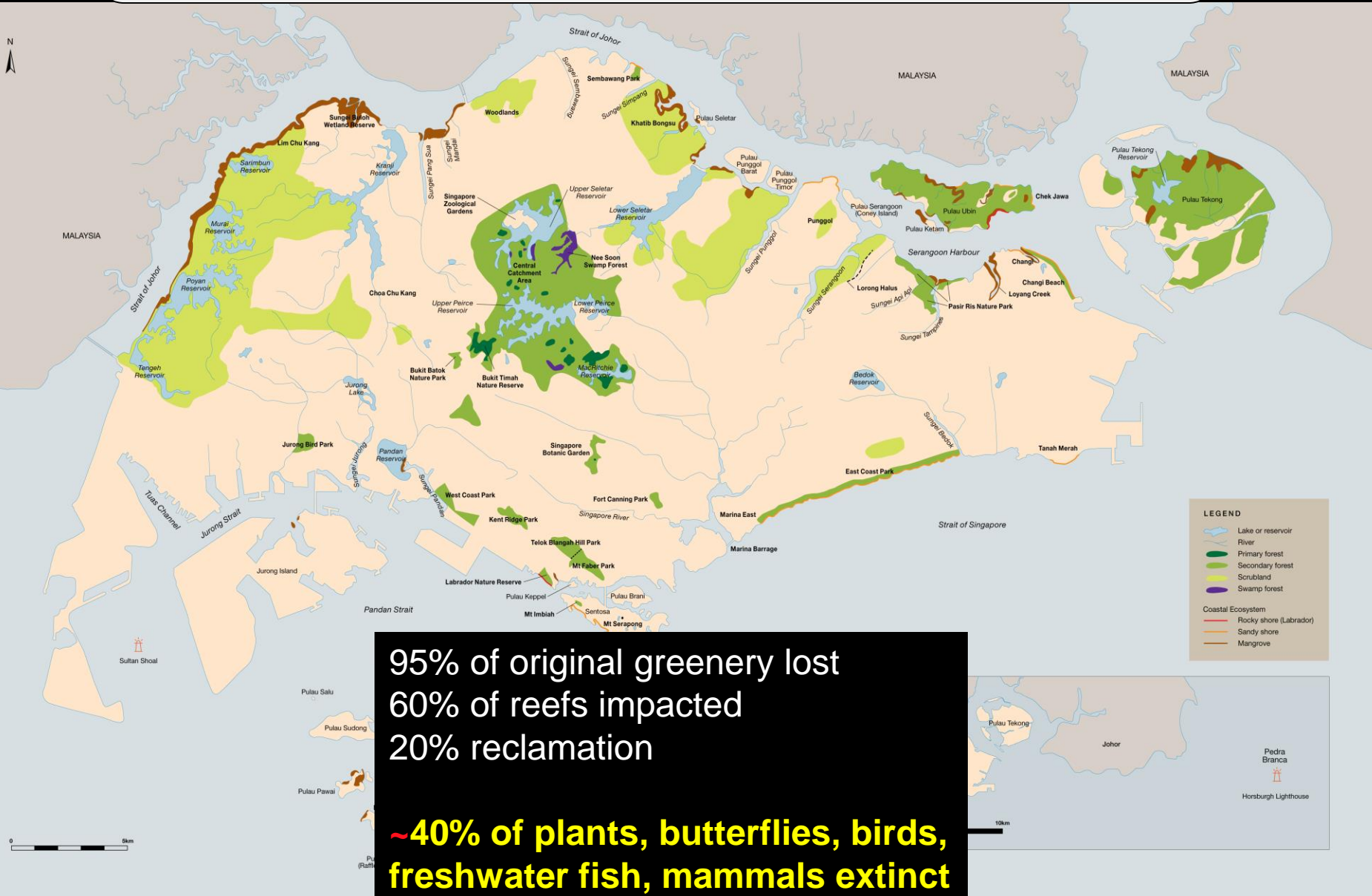
Talk in 2 parts

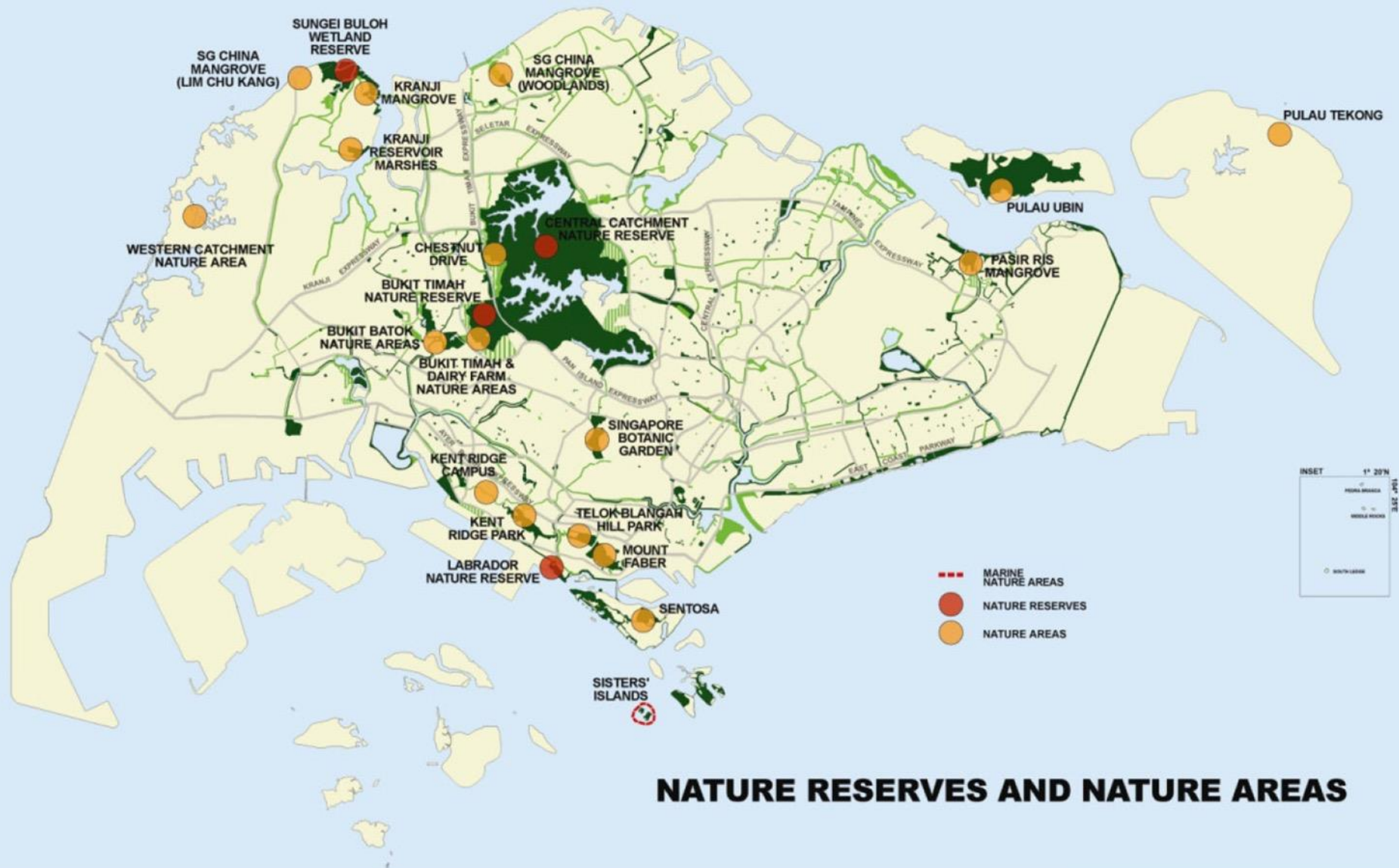


About challenges
facing a small
island

About worries
I have with biodiversity
research

- **Land = 704 sq km (22% reclaimed)**
- **Population = 5.31 m (3.29 m citizens)**





NATURE RESERVES AND NATURE AREAS



**National Parks Board
Singapore**



**Challenges of
Urban Living**

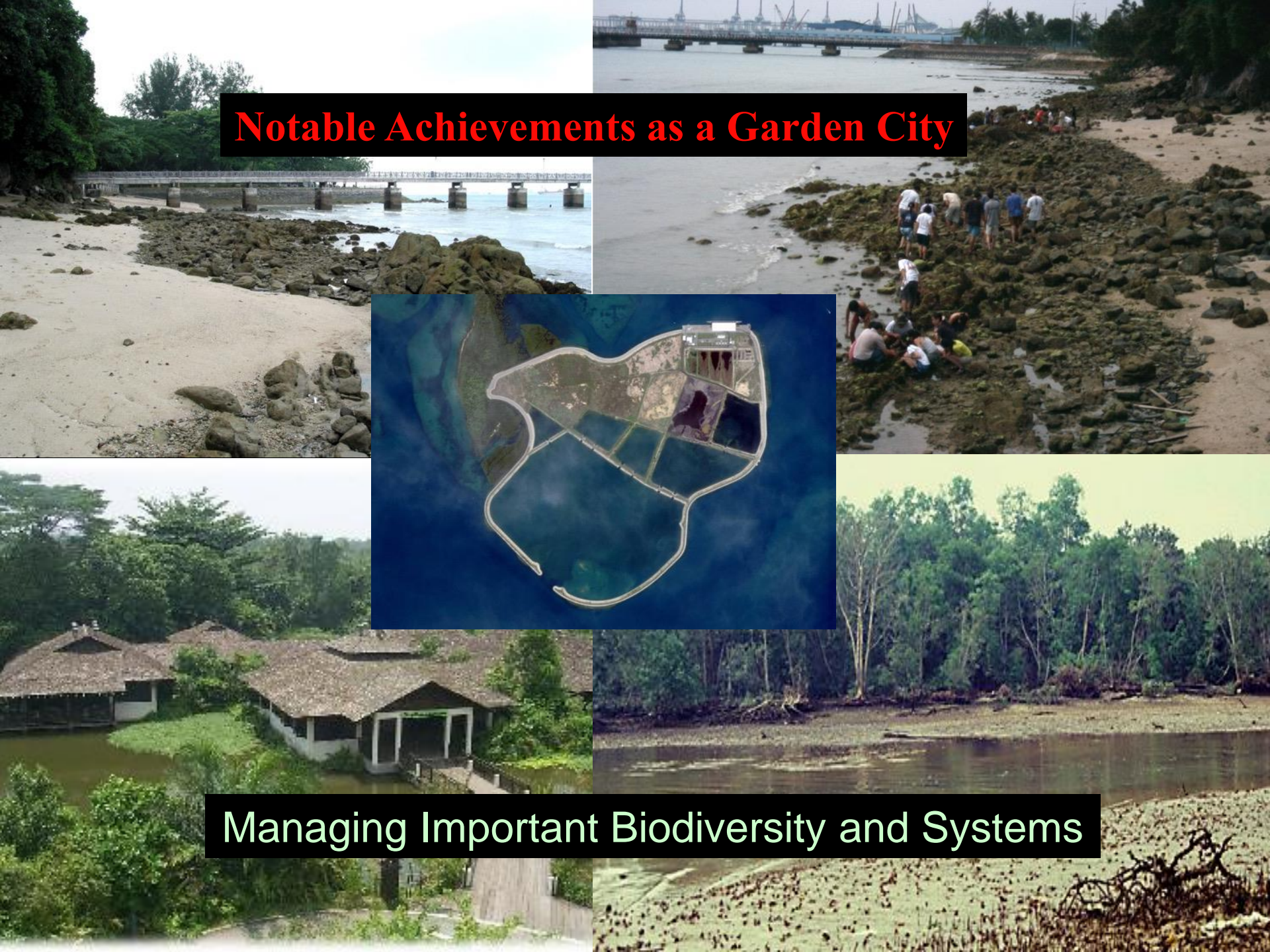
**Small Country but EXCELLENT Showcase for a
Sustainable City ?**



A LIVELY AND LIVEABLE SINGAPORE: STRATEGIES FOR SUSTAINABLE GROWTH



Notable Achievements as a Garden City



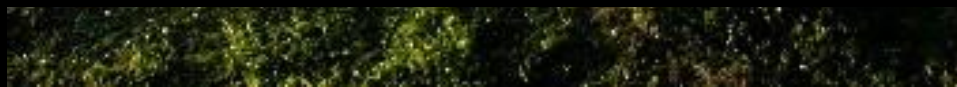
Managing Important Biodiversity and Systems



Always a Balancing Act



**Setting aside plans - game changer:
CHEK JAWA**



RESURRECTIONS OF HABITATS



Illustration courtesy of NParks

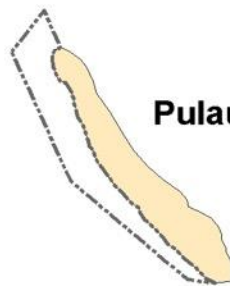
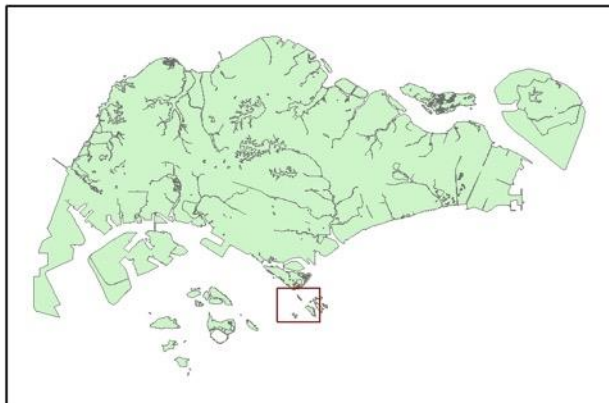


Managing Ground Water

Nee Soon Swamp Forest



Sisters' Islands Marine Park



Pulau Tekukor



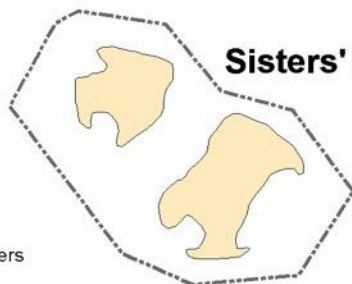
St. John's Island

Legend

----- Marine Park Boundary



0 220 440 880 Meters



Sisters' Islands

Comprehensive Marine Biodiversity Survey

News

New Paper- 1 Jan 2013

DISCOVERY CHANNELS

Scientists find new uniquely Singaporean species in our waters

THE waters off Pulau Ubin are teeming with life, and scientists are just beginning to catalogue uniquely Singaporean species.

More than 10,000 specimens were discovered during the Singapore Marine Biodiversity Workshop at Pulau Ubin between Oct 15 and Nov 2 last year.

The specimens were found in waters around Pulau Ubin, mostly from the East Johor Strait. Some were also found in waters in the West Johor Strait.

Of the new discoveries, Dr Tan Koh Siang of the Tropical Marine Science Institute at the National University of Singapore (NUS) said:

"We are certainly excited about the specimens we have collected since quite a few are either new records for Singapore, or are 're-discovered' after many decades."

"Some may eventually prove to be new science."

About 200 participants were involved in the recent expedition, which was led by the National Parks Board (NParks) and NUS. The participants included 20 scientists from 10 countries, local scientists, conservation officers and volunteers.

The expedition to collect these never-before seen creatures was part of the Comprehensive Marine Biodiversity Survey, which

began in 2010 and is led by NParks.

The five-year study is supported by universities, non-governmental organisations and a small team of volunteers.

The average depth of the Johor Straits ranges from 5m to 20m, and the creatures discovered, which live in a variety of habitats, were collected from the intertidal shore or dredged from the seabed.

In response to The New Paper's queries about the 12 new discoveries featured here, Dr Tan said: "They remain undetermined and have no assigned scientific names at the moment."

— Audrey Tan

SMALL CLAM

This small animal belongs to a unique group of bivalves that have extended their skin to cover the shell. The skin bears club-like protrusions that may have a deterrent function against predators.

SQUID

Squids have a distinct head, bilateral symmetry, a mantle and arms. Many species are popular as food and the type found in Pulau Ubin waters is edible.

CRUSTACEAN

Crustaceans include familiar creatures like crabs, crayfish and shrimps. They are mostly free-living aquatic animals, but some are terrestrial, living in either marine or freshwater environments.

MARINE FLATWORM

The flatworms are bilaterians, which means they have bilateral symmetry. But unlike other bilaterians, they have no body cavity, and no specialised circulatory and respiratory organs. They can often be seen in tidal pools on mudflats, mangroves and coral reefs.

MARINE BRISTLE WORM

Bristle worms are mostly marine. They are segmented worms, generally less than 10cm long. Its iridescent skin colour can be seen in this photograph.

VOLUTE SNAIL

A family of predatory sea snails that are 8mm to more than 50cm long. Some species are harvested as food in Malaysia and Singapore. They feed on other molluscs like clams and snails.

SEA SPIDER

Sea spiders are not related to true spiders. They are found across the tropics to the poles. There are more than 1,300 known species, ranging in size from 1mm to over 90 cm in some deep water species.

BRITTLESTAR

Brittlestars are related to starfish, and grow between 1cm and 10cm long. They crawl beneath the surface of the seabed using flexible arms. They are scavengers that feed on organic particles and are common in Singapore waters.

SEA ANEMONE ON CRAB

Sea anemones are a group of water-dwelling, predatory animals. In this case, it is likely that the sea anemone and the crab have a mutually-beneficial relationship.

MANIS SHRIMP (Tail of Mantis Shrimp)

Mantis shrimps are marine crustaceans. Some species can exceed 30cm long. They are common animals around Pulau Ubin.

SEA CUCUMBER

Sea cucumbers are marine animals with spines or spicules embedded in their skin and an elongated body containing a single, branched gonad. They are found on the sea floor worldwide.

STONEFISH

Stonefishes have venomous spines that can inflict a lot of pain though it is rarely fatal to humans. They are very common in Singapore waters, both in the Johor and Singapore Straits.

PICTURES: DR ARTHUR ANKER OF THE TROPICAL MARINE SCIENCE INSTITUTE AND PHOTOGRAPHS OF THE SINGAPORE MARINE BIODIVERSITY WORKSHOP

INFORMATION PROVIDED BY DR TAN KOH SIANG OF THE TROPICAL MARINE SCIENCE INSTITUTE



Eel Walking Catfish

A dark, elongated fish with long whiskers, resting on a light-colored, textured surface.



Little Warty Catfish

A brown, elongated fish with a prominent, warty bump on its back, resting on a light-colored, textured surface.



Lesser Bamboo Bat

A close-up of a bat's face, showing its mouth and whiskers.



Dwarf Snakehead

A small, dark fish with a long, thin body, resting on a rocky surface.

Mapping, surveying local species; inventories and discoveries



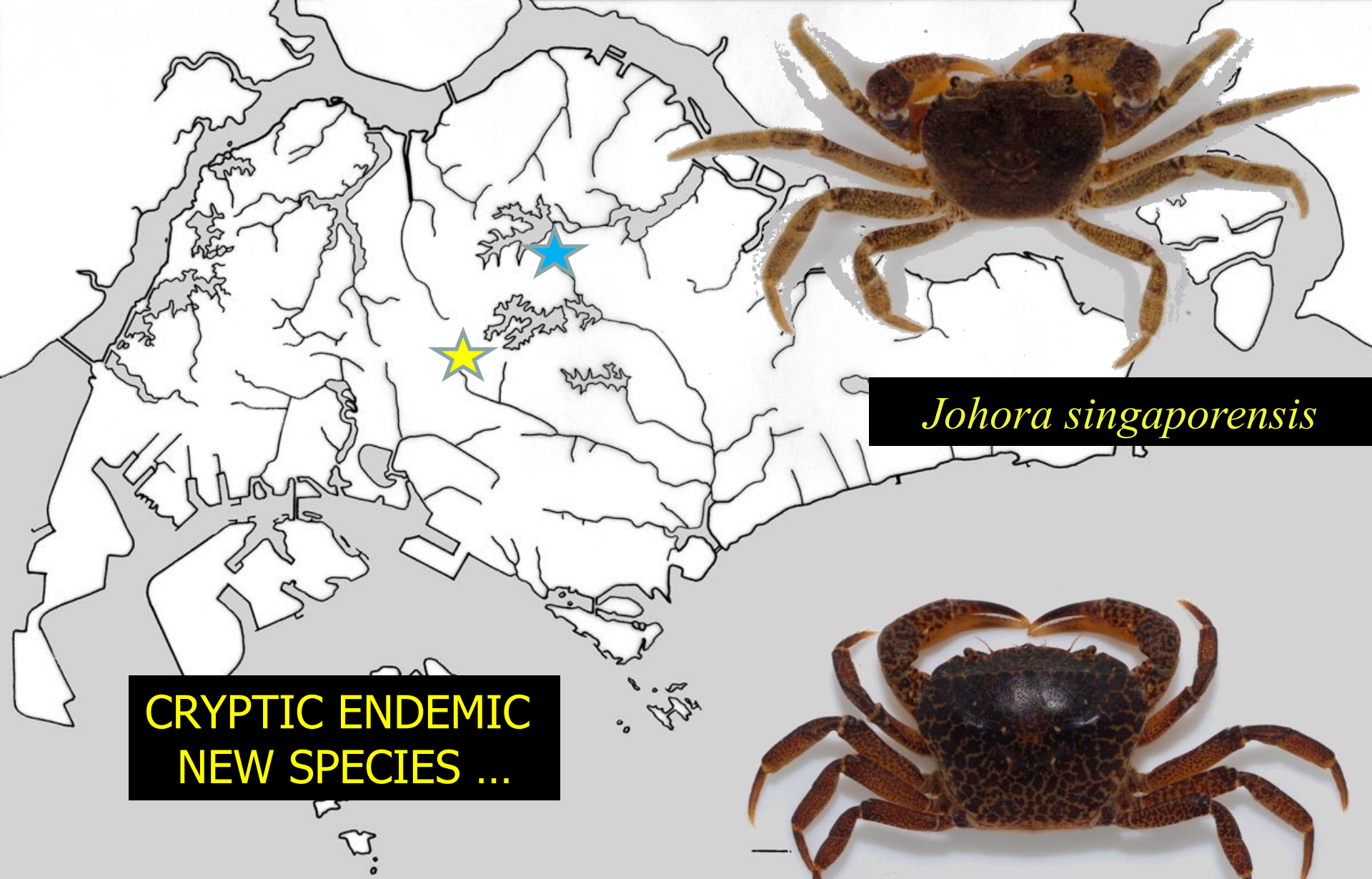
Black Snakehead

A large, dark fish with a long, thin body, resting on a sandy surface.



Flying Lemur

A small, brown, furry animal with large eyes, clinging to a tree trunk.



CRYPTIC ENDEMIC
NEW SPECIES ...



Johora singaporensis



Parathelphusa reticulata

EVEN IN PRESENT DAY SINGAPORE



Dealing with invasives

Alien Invasion

Alien species are plants, animals and micro-organisms that are exotic and non-native. They become invasive when they are able to survive, reproduce, spread and cause a negative impact in areas beyond their native ranges. LIM KAILI takes a look at some of the animals in Singapore which have an invasion history.

SCIENTIFIC NAME
Callosciurus fleyssoni
ALSO KNOWN AS
Variable squirrel
ORIGIN
Myanmar, Thailand, Laos, Cambodia and southern Vietnam

- Extremely varied in colour and patterning
- Lives in trees and feeds on a variety of seeds, flowers and fruits
- Strips off tree bark, causing damage to trees
- In recent years, several were spotted in the wild in Singapore

SCIENTIFIC NAME
Padda oryzivora
ALSO KNOWN AS
Java sparrow, Java finch and Java rice bird
ORIGIN
Java, Bali and Sawaian Islands in Indonesia

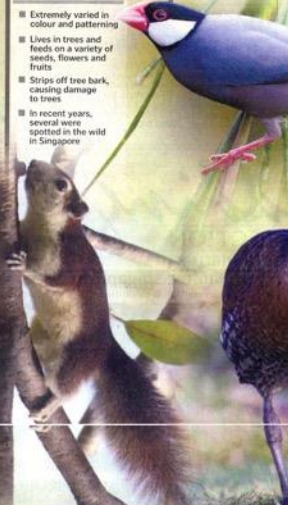
- Very gregarious bird which feeds mainly on grain and other seeds
- Only the males sing and perform a small dance
- First reported in Singapore in the 1940s

SCIENTIFIC NAME
Chorax quadricarinatus
ALSO KNOWN AS
Australian red claw crayfish
ORIGIN
Northern Queensland and the Northern Territory in Australia

- Can transmit disease as it is host to parasitic or symbiotic microbes and invertebrates
- Adapts well to environmental changes
- Very likely to have been introduced here through trade specimen
- Found in Little Gullin Lake in Bukit Batok Town Park and reservoirs

SCIENTIFIC NAME
Pomacea canaliculata
ALSO KNOWN AS
Apple snail
ORIGIN
South America

- voracious appetite for water plants including lotus and water chestnut
- Spreads via the global agricultural, horticultural, aquaria and pet trades
- It has also spread by hitchhiking lifts in ballast water and on ships' hulls



SCIENTIFIC NAME
Dendrocygna arcuata
ALSO KNOWN AS
Wandering whistling duck
ORIGIN
Australia, the Philippines, Indonesia, Papua New Guinea and the Pacific Islands

- Makes loud whistling calls and wings make whistling noise during flight
- Feeds on grasses, water lilies, water plants and occasionally insects and aquatic animals
- Found in Kent Ridge Park, Singapore Botanic Gardens and Sungei Buloh Wetland Reserve



SCIENTIFIC NAME
Parachanna mullus
ALSO KNOWN AS
Red bellied parrot
ORIGIN
Native to the Rio Orinoco and Amazon basins in Colombia, Venezuela, Peru, Bolivia and Brazil

- As juveniles, they look like the Red Belly Piranha
- Powerful jaws and teeth allow them to crush fruit, nuts and seeds
- Released by pet owners into ponds and reservoirs
- Males develop a large hump on the forehead
- Released by pet owners into ponds and reservoirs

INTRODUCTION OF ALIEN SPECIES VIA TWO MEANS

- Unintentional**
 - Release of unwanted pets and aquarium animals into the wild
 - Brought in to control pests
- Intentional**
 - Through various modes of transportation like cars, trucks, boats, airplanes or ships
 - Tourists and their luggage/equipment

HARMFUL EFFECTS OF ALIEN SPECIES

- Threaten survival of animals by competing for resources
- Alter ecosystem functions
- Spread easily if not managed properly
- Costly to control
- Endanger human health if organisms harbour foreign pests and diseases
- Hybridise with native species, resulting in negative genetic impacts

The 'attack' of exotic flora and fauna

Some are concerned that alien species may threaten native species

By VICTORIA VAUGHAN

ALIENS are among us, curling their tendrils around the edges of our forests, peering out of ponds and skittering up trees. But they are not from outer space. They are plants and animals from across the world that have become permanent residents in Singapore.

Alien species refer to plants and animals which are non-native or exotic to a country.

And their numbers are growing, according to a recent study, *Introduced Species in Singapore: An Overview*, by Assistant Professor Darren Yeo of the National University of Singapore and Ms Cheryl Chia of National Parks Board (NParks).

The study recorded 142 alien species here - an 84 per cent jump from a previous study in 2003. However, this seemingly huge increase is likely to reflect the fact that little attention has been paid to these visitors until now.

Prof Yeo, 39, adds: "Concern about alien species has been growing worldwide and we are catching up now."

More than 60 per cent of these "aliens" are from Asia and 10 per cent are from Central and South America. More than 70 per cent have made Singapore home, the study found.

But not all alien species are considered invasive.

Invasive species - a major cause of the loss of biodiversity - are defined by experts as those which become self-sustaining in an ecosystem, changing it and threatening native plant and animal life.

Still, scientists say alien species which are considered invasive.

Some of the alien species are not yet established in Singapore. They have a history of being invasive and posing a threat to the local species and ecosystems elsewhere.

There are eight such species here and they should be monitored closely because there can be a delay before an alien species becomes established and/or turns invasive, says Prof Yeo.

The pet and live food trade is one route of their introduction; the release of unwanted pets or meter releases especially around Vesak Day, a Buddhist festival, is another.

Some alien species hitch a ride in the ballast tanks of container ships which take on water at foreign ports to balance the weight of the ship and then dump it in other ports.

The majority of the "aliens" here are found in man-made habitats such as parks, gardens, wasteland, canals, reclaimed land and ponds.

Many of the non-native fish find their way into reservoirs and drains as they prefer the water there which is less acidic than natural forest streams.

While some of the alien species are not yet established in Singapore, there are also 54 potentially invasive plant species that were brought here as ornamental plants.

Some of the alien species are not yet established in Singapore. They have a history of being invasive and posing a threat to the local species and ecosystems elsewhere.

There are eight such species here and they should be monitored closely because there can be a delay before an alien species becomes established and/or turns invasive, says Prof Yeo.

The pet and live food trade is one route of their introduction; the release of unwanted pets or meter releases especially around Vesak Day, a Buddhist festival, is another.

near Nee Soon Swamp Forest - an important refuge for native biodiversity.

Prof Yeo suggests a broadening of the definition of invasive species to include nuisance or pest species such as the African giant land snail, the Javan mynah, the house crow and the American cockroach.

His paper also recommends studies on the alien species here and risk assessments to manage potentially invasive species.

Mr Alan Oo Yong, chairman of the bird group Nature Society of Singapore, pointed out that non-native birds, such as the Javan mynah and white-crested laughing thrush from Java, introduced but ranging from Nepal to northern peninsula Malaysia, and the house crow found across Asia, have caused problems for the local species.

The white-crested laughing thrush, which was brought in as a pet in 1925 and has since bred in the wild, has been competing with native species such as babblers, which also live and feed in the lower branches and on the ground.

"It obviously competes with native birds that are near the ground," said Mr Oo Yong. "But these birds are not as aggressive as the Javan and Indian mynahs which are not afraid of humans and push other birds away."

NParks is also keeping a close watch on alien plant species.

Mr Wong Tuan Wah, director of conservation at NParks, said the authorities are mindful of the potential adverse impact of these species.

"Our urban environment comprises many introduced species. These species include trees and ornamental plants that make up our Garden City, such as the rain tree, originally from the tropical American region," he said.

"For example, the *Dioscorea zamburiana* (Zambur yam), a fast-growing climber, can potentially smother the forest canopy if allowed to invade and proliferate in our rainforests."

NParks manages the situation by actively clearing certain introduced plant species from the nature reserves in Singapore. It has also introduced community outreach programmes to encourage the public not to release non-native animals here or take native flora and fauna out of the country.

The Agri-Food and Veterinary Authority of Singapore also has regulations on import, export and transshipment of plants and animals.

vva@nparks.gov.sg

Dangerous aliens lurk in the waters of Singapore



By CHRISTOPHER TAN
Senior Correspondent

THE Government's plans to open up Singapore's reservoirs for sporting activities may run into a thorny issue.

Freshwater stingrays abandoned by fish hobbyists are believed to be breeding in at least one reservoir: the Seletar.

These fish, native to South America, can inflict serious wounds with sharp serrated spines on their tails. "We have had occasional sightings," said National Parks Board (NParks) spokesman Jean Lee. "They are rare, but we've seen them."

Tropical fish traders say locally caught rays have been turning up regularly in shops here for the past three years. They are supplied by a small group of trappers, who catch them with hook and line.

"If you order 20 fish, they can get them for you within a week," said the owner of a tropical fish shop. "That's how plentiful they are."

Another aquarium shop owner said he sells between five and eight local rays a month. They cost anywhere from \$40 for a 10cm wide fish to \$120 for a 60cm adult. That is half the price of rays imported from South America. But they are popular with hobbyists for another reason.

The managing director of public-listed fish import-export group Qian Ha Corp, Mr Kenny Yap, said, "Locally-caught stingrays are usually more hardy than imported ones because they have been conditioned to our environment."

Although freshwater rays have been available for sale here since the 1980s, they are, in fact, illegal. The Agri-Food & Veterinary Authority (AVA) bans fish which are

CONTINUED ON PAGE 2

Dangerous aliens lurk in waters of S'pore

venomous or have "sharp appendages that can cause injury". AVA spokesman Goh Shih Yong said pet shops are not allowed to sell stingrays as they may pose a danger to the public.

"Action will be taken if a pet shop is found displaying or selling stingrays," he added.

That is good news to zoologist Peter Ng, who up till recently did not know rays were illegal.

"These fish are nasty," said Professor Ng, who is director of the Raffles Museum of Biodiversity Research. "In South America, they are more hazardous than piranhas. People have had limbs amputated because of stingray injuries."

People are usually stung when they wade near rays or step on them accidentally. They can also be stung while handling caught rays. In Colombia, more than 2,000 cases of stingray injuries are reported a year.

The rays may not be the only exotic fishes in our waters.

Prof Ng said there are probably others - either dumped because they outgrew home aquariums, or introduced unintentionally by anglers who want new and more challenging prey.

He does not rule out electric eels, electric catfish, anthurus and arapaima (one of the world's largest freshwater fish) - all of which are available at aquarium shops here. Although these can survive here, they are unlikely to breed.

In any case, Prof Ng said these fish do not pose as big a danger to humans as rays.

"Electric eels may give you a shock, but they are unlikely to kill you," he said. "Unless you have a pacemaker."

Threats associated with alien species - a term for animals or plants which are not native to a particular ecosystem - go beyond stings and shocks. As alien species can have a disastrous impact on local life forms.

The Nile perch, a big game fish, was introduced into Lake Victoria in East Africa in the 1950s. It caused the extinction of some 200 species in the area.

In recent years, giant snakeheads - called toman here - grabbed headlines when introduced specimens bred and caused havoc in Maryland in the United States.

US media dubbed them "Franken-fish" because of their hardness and ability to get from pond to pond by crawling for short distances on land.

In Singapore, the toman is one of several dozen alien fish which have established themselves in reservoirs and ponds. Although an expensive



PHOTO: DESMOND LIM

UNWELCOME: Stingrays are breeding in at least one reservoir, and may not be the only alien fish that are found here.

READY SUPPLY

"If you order 20 fish, they can get them for you within a week. That's how plentiful they are."

THE OWNER OF A TROPICAL FISH SHOP, on the ready availability of freshwater stingrays at fish shops here

CLEAR THREAT

"These fish are nasty...People have had limbs amputated because of stingray injuries."

ZOOLOGIST PETER NG, director of the Raffles Museum of Biodiversity Research, on the danger posed by stingrays

food fish and a prized catch for anglers, toman are aggressive carnivores which outcompete local species for food. Often, the locals end up as food.

Several years ago, they were in the news when swans in the Botanic Gardens pond were attacked by them.

Dr Tan Hock Hui, curator of fish at the Raffles Museum of Biodiversity Research, said: "These are foreign talent we don't need."

He said another big alien has recently arrived: the African walking catfish. Brought in as fingerlings to feed labian fish a few years ago, some were dumped and ate some part of the fauna here. The catfish can grow to one metre in length and has a voracious appetite.

The threat of aliens is something NParks grapples with constantly. On its list of 68 freshwater fish here, 31 are alien - including gup-

pies and mollies. Two of them - the shap and mosquito fish (introduced to control mosquito breeding) - are on the World Conservation Union's list of most invasive species.

NParks spokesman Mr Lee said the list is by no means exhaustive.

Both Prof Ng and Dr Tan do not know what the current count is, but suspect there are more aliens now. They will get a chance to find out.

The Straits Times understands the Public Utilities Board (PUB), which is responsible for Singapore waterways, is commissioning an extensive census of alien aquatic species here.

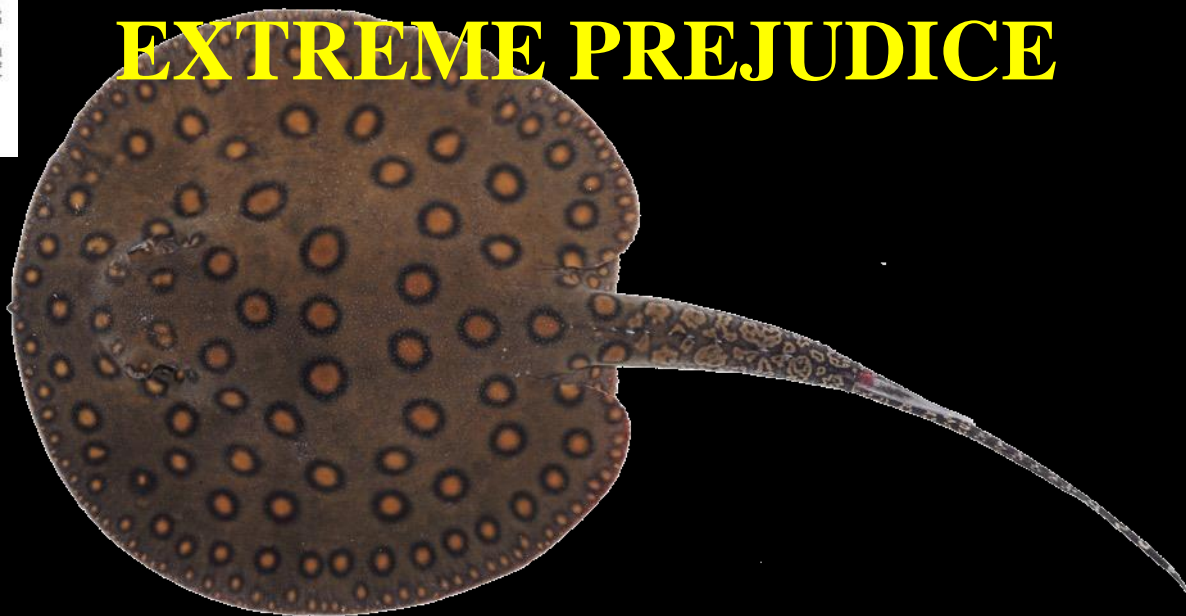
The study, said to span three years and cost more than \$1 million, is believed to be the first of its scale here. The PUB would not comment for this report.

Meanwhile, NParks is on to its yearly awareness programme to remind people that releasing animals into the wild is not an act of kindness.

A strange case



TERMINATE WITH EXTREME PREJUDICE



Motoro Freshwater Stingray (Potamotrygon motoro)



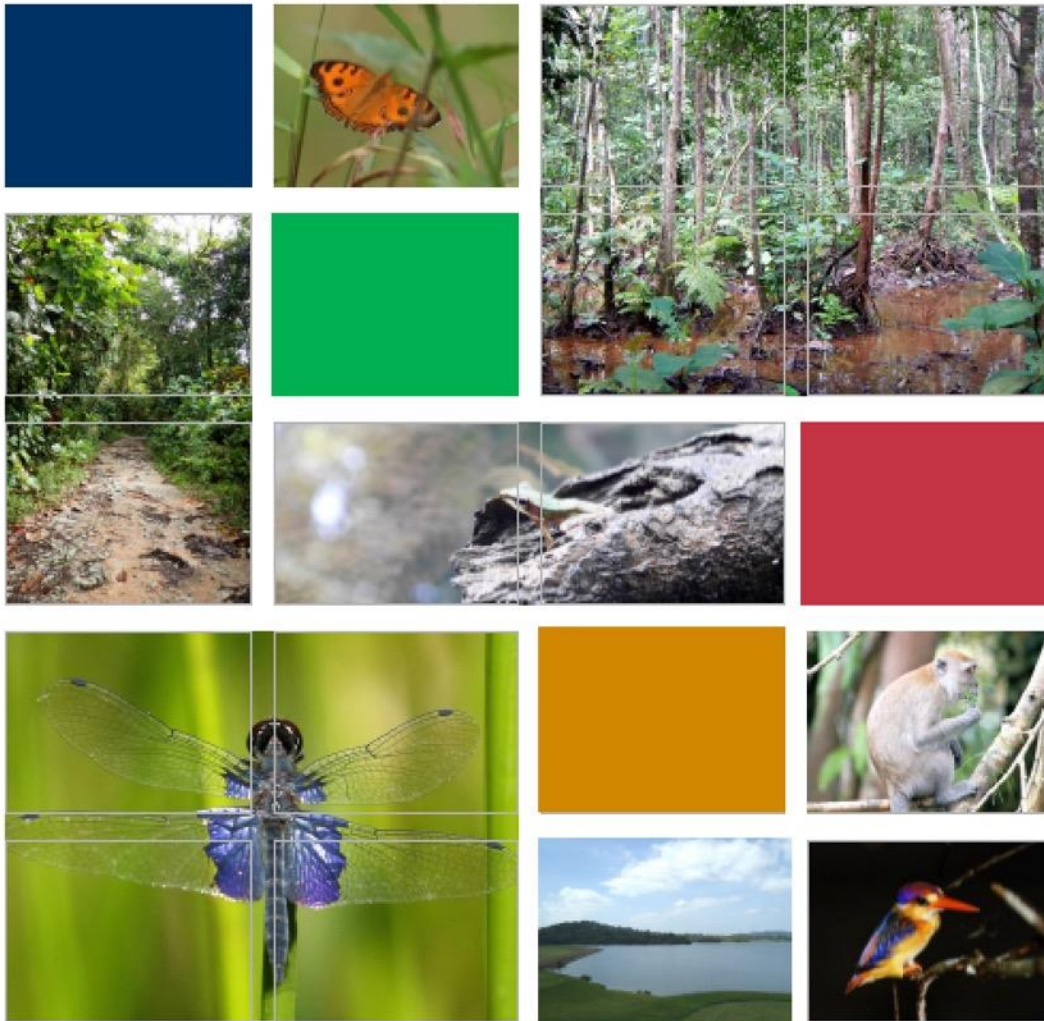
Human – Animal Conflicts



Roadkills etc.



Managing Extant Native and Dealing with Alien species ...
balancing act



Land Transport  Authority

**Environmental Impact Assessment
on Central Catchment Nature
Reserve for the Proposed Cross
Island Line**

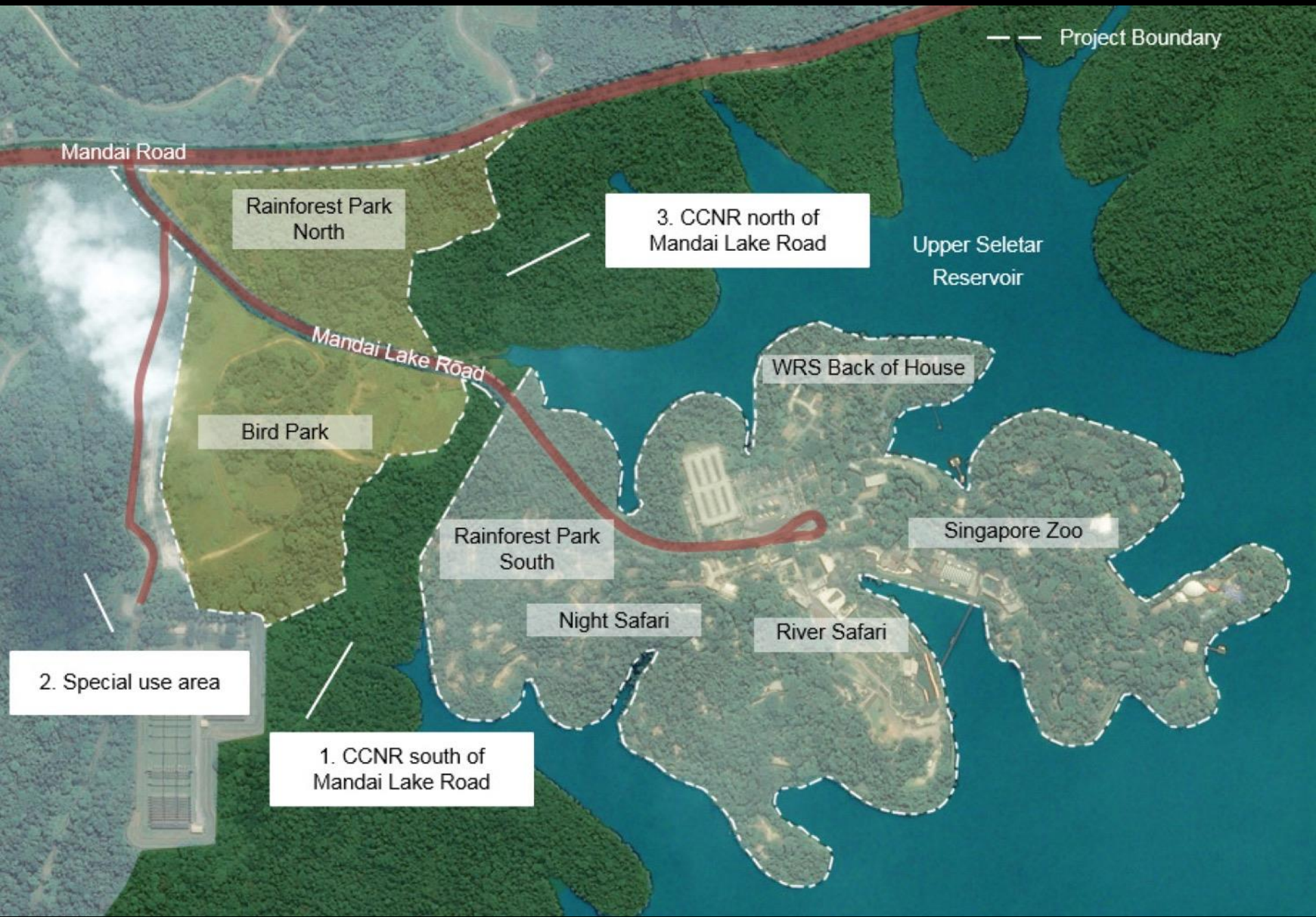
**SITE INVESTIGATION ENVIRONMENTAL IMPACT
ASSESSMENT REPORT – VOLUME I**

01 February 2016

Transparency:

EIA Report is
now a a public
document

A NEW ZOO – MANDAI SAFARI PARK ?



PLANNING AHEAD FOR 2030

The birth rate of Singaporeans is falling, and the population is ageing at the same time. In the past three weeks, the Government announced a slew of measures to tackle the country's population problems, including a White Paper on the issue.

SCENARIO 1 Status quo with 5m population

- Population ages
- Workforce shrinks
- Businesses face difficulties finding workers
- Investors may be put off, leading to fewer jobs

SCENARIO 2 Grow rapidly as in past 30 years

- This is what employers prefer
- Younger workforce with immigrants
- Population will mushroom well past White Paper figures
- Pressure on land, infrastructure

SCENARIO 3 Middle way: Moderate, sustainable growth

- Growth slows to 2-3 per cent
- Workforce grows by just 1 per cent a year, much less than in the past
- Inflow of foreigners slows, but door remains open
- Younger workers available to help run economy
- Singaporeans remain at core of economy; two-thirds will be professionals
- Plans should be worked out to provide for housing, transport, healthcare and other needs
- Population will be around 6.5m to 6.9m, consisting of:
 - 3.6m to 3.8m citizens
 - 500,000 to 600,000 PRs
 - 2.3m to 2.5m non-residents (including foreign domestic workers, Work Permit, S Pass and Employment Pass holders, dependants and students)

How to cope with the larger population?

Build strong Singapore core

Housing

- Priority for married couples with children under 18 buying first HDB flat

Managing costs

- Subsidies for fertility treatments at public hospitals raised to 75 per cent, capped at \$6,300
- Baby bonus increased to \$6,000 for first and second child, and \$8,000 for third and fourth child

Child care

- Extra subsidies for lower- and middle-income families, resulting in child-care fees as low as \$3 for poor families

Time for family

- Parents with children aged seven to 12 get two days of child leave a year
- Married women who adopt children get four weeks of adoption leave
- Working women who do not qualify for maternity leave get cash payout
- Working fathers get one week of paternity leave

Health care

- \$1,000 medivac grant for newborns
- Medisave covers congenital and neonatal conditions
- Medifund Junior for large hospital bills of lower- and middle-income families with children up to age 18

New citizens

- 15,000 to 25,000 foreigners to become citizens a year



Possible sites for building new homes



Photos: GOOGLE MAPS

How to fit them on the island?

While there will be more people, major efforts will be made to provide more land and beef up infrastructure

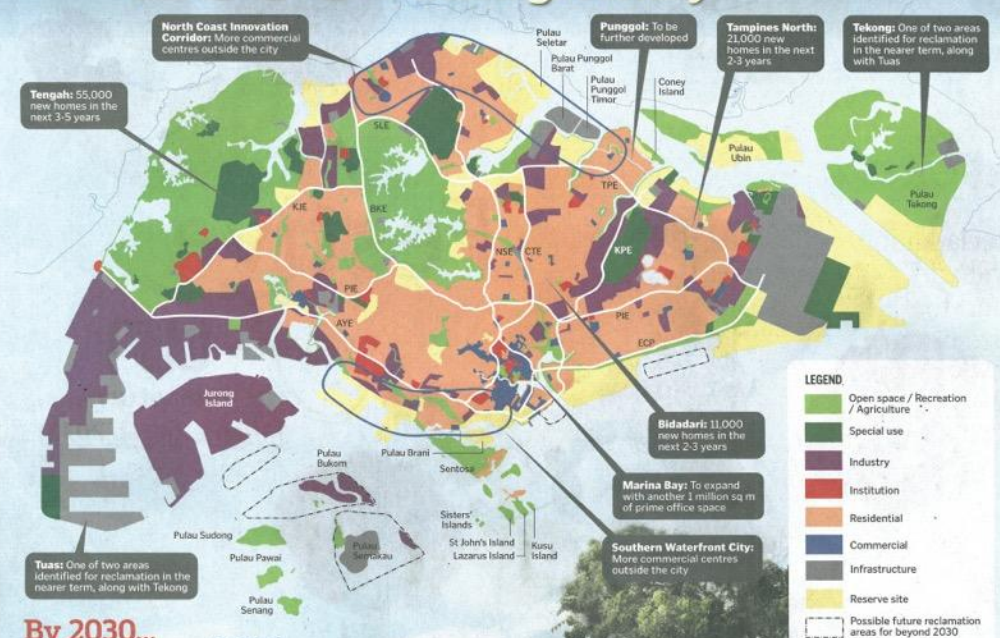
Singapore's land area through the years



PARLIAMENT WILL BEGIN DEBATING THE WHITE PAPER TODAY

LAND USE PLAN

2030: More land, more homes, more greenery



By 2030...

Singapore land requirements to go up from 71,400 ha now to

76,000ha

85% of S'poreans to live within 10-15 minutes' walk of a park

8 in 10 homes within a 10-minute walk of MRT station

900ha of reservoirs

100km of waterways opened up by 2030

Park connectors extended from 200km to

360km

Other future developments

- More integrated hospitals, 4,100 more beds by 2020
- Adding 40 new bus services and 800 buses over next five years
- Long-term plan to extend cycling networks in HDB towns
- 700,000 homes: 200,000 by 2016 - 110,000 public, 90,000 private; and 500,000 - a mixture of private and public, to be calibrated as needed

BELOW: Punggol will grow to triple its size with 96,000 homes.



GRAPHICS: MIKE W. BAZZIN; © CHANUJASAS AND LIM FONG PHOTO: POC

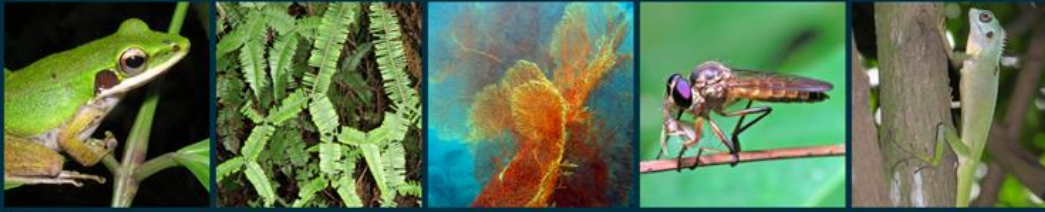
BALANCE or BREAK-POINT ?



NUS
National University
of Singapore

edn

Supported by



SINGAPORE BIODIVERSITY

—An Encyclopedia of the—
Natural Environment and Sustainable Development



RESEARCH:

Universities,
NGOs
Government

THE SINGAPORE RED DATA BOOK

THREATENED PLANTS & ANIMALS OF SINGAPORE

Edited by
G.W.H. Davison, P.K.L. Ng and Ho Hua Chew



SECOND EDITION

• The SINGAPORE RED BOOK

Written by men and
women to guide
Ironies of the
double edged sword

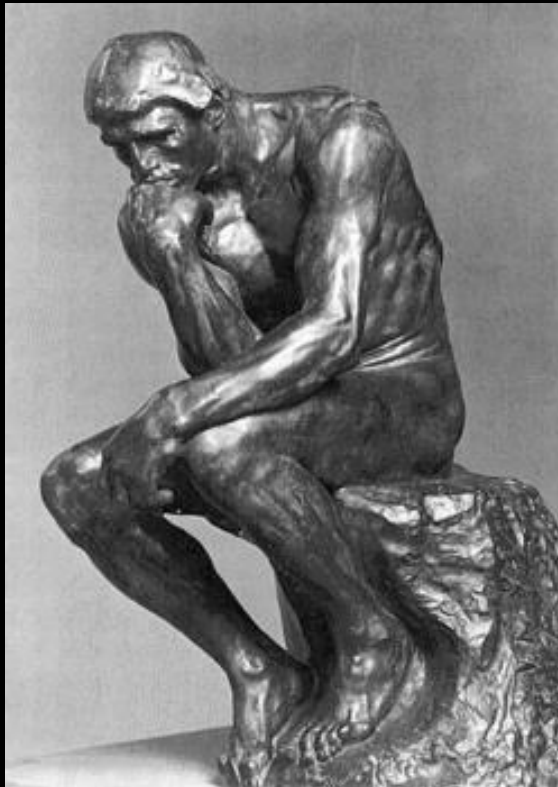
RAFFLES MUSEUM -----> LEE KONG CHIAN NATURAL HISTORY MUSEUM



COURTESY NATURAL HISTORY MUSEUM

**Mission --- Biodiversity and Conservation Research, and
National Depository**

TWO PASSING “FRUSTRATIONS”



ZEALOUS OVER-MANAGEMENT



LETTERS



Edited by Jennifer Sills

Brazil's government attacks biodiversity

To address the rapid and massive loss of biodiversity worldwide, scientific research must inform agile decision-making. The political leaders of Brazil, the country with the planet's greatest biological wealth (1), continue to undermine this goal. In 2001, citing the laudable objective of preventing biopiracy, the government created the Genetic Heritage Management Council (CGen) (2), making established biodiversity research activities illegal overnight by imposing severe limitations on access and shipment of specimens and samples. After 5 years of pressure from the academic community, the government finally resolved to exempt several areas of basic research from the restrictive policy (3). Now, after severe budget cuts (4, 5) and legal maneuvers directly affecting biodiversity (6), the Brazilian Federal Government has reversed its position once again with the so-called New Law on Biodiversity (7, 8), striking a potentially fatal blow to biodiversity.

Disguised as a milestone of progress for scientific research and endorsed by some scientific sectors (9), this law constitutes a monumental setback. According to the law, which is retroactive to 2000 or 2015, depending on the area of research (8), and technically applies to researchers at both Brazilian and foreign institutions (10), virtually every research activity on Brazilian biodiversity—even nongenetic studies in taxonomy, ecology, physiology, and behavior—must be registered in the National System of Genetic Resource

Management and Associated Traditional Knowledge (SisGen), which was created to assist the CGen. The deadline for meeting these draconian rules is 5 November 2018 (9, 11). Failure to comply, including the unregistered dissemination of scientific results, even if based only on public databases like GenBank or previously published data or results, will result in heavy fines (7). A lecture given by the coordinator of the Academic Sectorial Board of the CGen, titled "How not to be fined," highlights the punitive spirit of the law (10). Paradoxically, commercial activities involving Brazilian biota, such as export of ornamental fishes, plants, grains, and other marketable products, remain unaffected by the law (7).

NEXTGEN VOICES: SUBMIT NOW

Broad interests: Benefits for science

Add your voice to Science! Our new NextGen VOICES survey is now open:

How do broad interests benefit your science? Describe one non-science interest or hobby, and explain how it has made you a better scientist.

To submit, go to www.sciencemag.org/nextgen-voices

Deadline for submissions is 1 June. A selection of the best responses will be published in the 6 July issue of Science. Submissions should be 150 words or less. Anonymous submissions will not be considered.

The pumpkin toadlet is just one example of the diverse fauna endemic to Brazil.

If not repealed or substantially overhauled, this Byzantine labyrinth of unnecessary demands and threats will decimate scientific research on Brazilian biodiversity by requiring scientists to divert an inordinate amount of already limited resources from research to the time-consuming process of registering every specimen, DNA sequence, photograph, and any other observation of Brazilian biodiversity before publication, presentation at scientific meetings, or dissemination to media outlets. Scientists must take back the reins of their own activities by demanding that the Brazilian government implement laws that facilitate international collaboration and encourage biodiversity research instead of stifling it. Otherwise, a substantial part of the world's biodiversity and its benefits may silently vanish behind a wall of bureaucracy.

Flávio Alineo Bockmann,^{1*} Miguel Trefaut Rodrigues,² Tiana Kohlsdorf,³ Lorian Cobra Straker,⁴ Taran Grant,⁵ Mário César Cardoso de Pinna,⁶ Fernando Luis Medina Mantelatto,⁷ Aléssio Datovo,⁸ José Perez Pombal Jr.,⁹ John Campbell McNamara,¹ Eduardo Andrade Botelho de Almeida,¹ Wilfried Klein,¹ Annie Schmalz Hsiou,¹ Milton Groppo,¹ Ricardo Macedo Corrêa e Castro,¹ Dalton de Souza Amorim¹

¹Department of Biology, Faculdade de Filosofia, Ciências e Letras de Ribeirão Preto, Universidade de São Paulo, Ribeirão Preto, SP 14040-901, Brazil.

²Department of Zoology, Instituto de Biociências, Universidade de São Paulo, São Paulo, SP 05508-090, Brazil.

³Museu de Zoologia da Universidade de São Paulo, São Paulo, SP 04263-000, Brazil.

⁴Department of Vertebrates, Museu Nacional, Universidade Federal do Rio de Janeiro, Rio de Janeiro, RJ 20940-040, Brazil.

⁵*Corresponding author.

Email: fabockmann@fclrp.usp.br

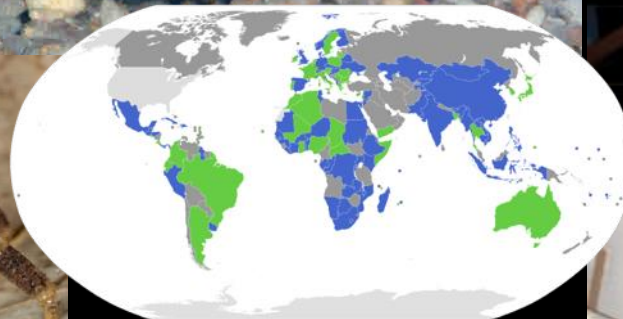
REFERENCES

1. R. A. Mittermeier, C. G. Mittermeier, P. R. G. E. O. Wilson, *Megadiversity: Earth's Biologically Wealthiest Nations* (CEMEX, 1997).
2. Medida Provisória No 2.186-36, (23 August 2001): www.planalto.gov.br/ccivil_03/amp/2006/08/2006_08_23/0001.htm [in Portuguese].
3. Resolução Nº 21 (31 August 2006): www.mma.gov.br/estruturas/sdb_dof/arquivos/res21cons.pdf [in Portuguese].
4. H. Escobar, *Science* **310**, 1126 (2015).
5. C. Angillet, *Nature* **503**, 303 (2016).
6. W. T. Pinheiro et al., *Science* **350**, 1043 (2015).
7. Lei Nº 13.123 (20 May 2015): www.planalto.gov.br/ccivil_03/_ato2015-2018/2015/lei/13123.htm [in Portuguese].
8. Decreto Nº 8.772 (21 May 2016): www.planalto.gov.br/ccivil_03/_ato2015-2018/2016/decreto/08772.htm [in Portuguese].
9. M. da Silva, D. R. de Oliveira, *Braz. J. Microbiol.* **49**, 1 (2018).
10. Audiotutorial IB-USP: "Lei da Biodiversidade e Plataforma SisGen: Como não ser multado." (In: *Maneira da Silva*) (2018): <https://youtu.be/vdArKARkEs> [in Portuguese].
11. D. R. Oliveira, M. da Silva, F. do Carmo, R. Angillet, *J. Clin. Sci.* **572**, 1 (2017).

10.1126/science.aat7540



Ever tightening Laws



Nagoya Protocol 2010



WHEN THE SCIENTIST IS THE CRIMINAL – Basic Science Under Threat

In an age when so many things (science included) are global,
CBD laws contribute to the difficulty in doing good science

CBD versus Basic Research?

What do the taxonomists do?

“The great tragedies of history occur not when right confronts wrong, but when two rights confront each other.”

Henry Kissinger



COMMODITISATION OF SCIENCE



The Nature of Market Forces: where Science is a commodity and Education just a transaction

The Usefulness of Useless Knowledge



ABRAHAM FLEXNER

With a companion essay by
ROBERT DIJKGRAAF

Lawrence Busch

Knowledge for Sale

**The Neoliberal Takeover
of Higher Education**

An Unhealthy Obsession with Ranking



WHAT RESEARCH SHOULD WE DO?


Basic Science

Applied Science

High-Impact Science

National Science

Data Science



**Prioritising, measuring and
benchmarking per se is not bad ...
But we must not go too far !**

**LONG TERM NEEDS
versus
SHORT TERM DELIVERABLES**



In science and research

NOT ALL THINGS THAT COUNT CAN BE COUNTED

What ARE we measuring ?

Education and Science

I thought science was supposed to be curiosity driven ...

And university professors are supposed to be training minds

Forgive me for my naivety

What is the Future we want?



A close-up photograph of a snail, *Amphidromus atricallosus temasek*, resting on a green leaf. The snail's body is a light, mottled yellowish-brown color with a distinct yellow line running along its side. Its long, thin antennae are extended upwards. The shell is a pale yellow color with a smooth, glossy finish. The background is a solid black, which makes the snail and the leaf stand out.

THANK YOU

Amphidromus atricallosus temasek

