Invasive species and survey methods for herpetofauna in Hong Kong

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Research Assistant Professor
School of Biological Sciences
The University of Hong Kong

Self-introduction

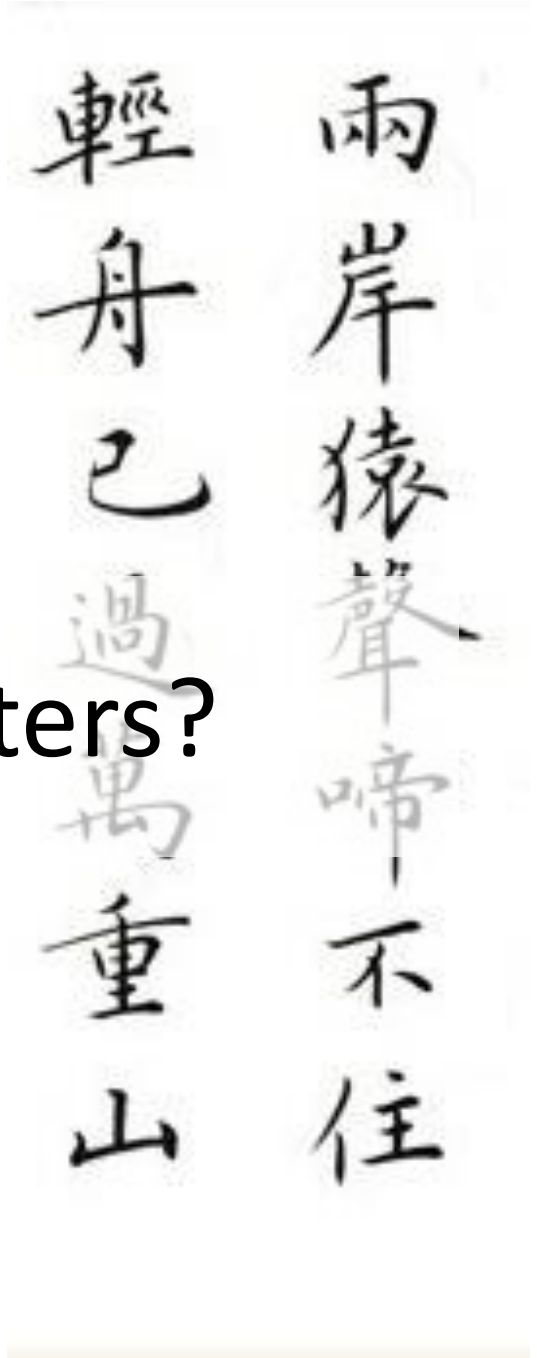
Self-introduction

What is Biodiversity ?

What is Biodiversity?

Why biodiversity matters?

Why biodiversity matters?



Threats to biodiversity?

Threats to biodiversity?


STOP
INVASIVE
SPECIES

Exotic species

- Colonize new places, spread and grow
- Introduced by human
  - Deliberate or accidental
  - Alien, exotic, introduced, non-native species

- Invasive species
  - Pose negative impacts to the natural ecosystem
  - Absence of native competitors, predators, parasites and pathogens

100 OF THE WORLD'S WORST INVASIVE ALIEN SPECIES

A SELECTION FROM THE GLOBAL INVASIVE SPECIES DATABASE

Published by

ISSG Invasive Species Specialist Group

Contribution to the Global Invasive Species Programme (GISP)

IUCN The World Conservation Union

Species Survival Commission

In Association with

bionet

Brown Tree Snake

Source: http://www.snakesofthewhitsundays.com

Cane toad

- Introduced for biological control
  - Grey backed beetle
  - From Central and South America to Australia
  - Control pests which it becomes pests
  - Native frog-eating predators killed by the toxin

Exotic/invasive species in HK


放生鳥


Source: big5.xuefo.net; big5.gmw.cn; chiyunyeh.pixnet.ne

放生變殺生　烏龜最慘
北角碼頭成重災區

AA

北角碼頭是全港最熱門的放生地點，檔主指每天都有人放生。
吳淑義攝

【本報訊】不少人本着好生之德放生，然而不得其法，令生物白白送死，日前大埔船灣淡水湖疑有人亂放生，令大批田雞死亡。保育團體指有善信誤把淡水龜放落鹹水海，形同殺生，呼籲市民放生前三思。

記者：吳淑義

50,000元放生海龜 海南被指「放又補」

海南三亞的南山文化旅遊區內，有一處明碼標價的放生點，除可放生小魚外，還可放生國家二級保護動物海龜，根據海龜大小，放生價格最高可達人民幣50,000元。有遊客近日質疑海龜被當做賺錢工具，「放了又捕，循環利用」。景區工作人員則回應稱，海龜為養殖場採購。

海南放生點放生海龜價格，最高可達人民幣50,000元。（互聯網圖片）

400,000 thousands birds are released every year

Half of the birds released dies in two days (Chan 2006)

RELIGIOUS RELEASE

poses **NEGATIVE** impacts

to local ecosystems

Understanding of exotic/invasive herpetofauna in Hong Kong?

Population status and distribution

Impacts to local ecosystems

Effectiveness of management practices

Chinese Bullfrogs

Predation

Diet items	%F	%V	IRI
Crab (Decapoda)	3.66	34.29	24.32
Millipede (Diplopoda)	4.88	6.69	6.33
Snail (Gastropoda)	13.41	10.46	27.19
Earthworm (Megadrilacea)	1.22	0.73	0.17
Bristletail (Archaeognatha)	1.22	1.90	0.45
Cockroach and termite (Blattodea)	4.88	21.61	20.43
Beetle (Coleoptera)	6.10	11.61	13.72
Earwig (Dermaptera)	6.10	0.82	0.96
Bug (Hemiptera)	1.22	0.47	0.11
Ant and bee (Hymenoptera)	8.54	2.54	4.21
Butterfly and moth (Lepidoptera)	2.44	1.78	0.84
Cricket and grasshopper (Orthoptera)	1.22	0.08	0.02
Fish (Cypriniformes)	1.22	5.31	1.26

Predation

Diet items	%F	%V	IRI
Crab (Decapoda)	3.66	34.29	24.32
Millipede (Diplopoda)	4.88	6.69	6.33
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Earthworm (Megadrilacea)			
Bristletail (Archaeognatha)			
Cockroach and termite (Blattodea)			
Beetle (Coleoptera)			
Earwig (Dermaptera)			
Bug (Hemiptera)			
Ant and bee (Hymenoptera)			
Butterfly and moth (Lepidoptera)			
Cricket and grasshopper (Orthoptera			
Fish (Cypriniformes)	1.22	3.31	1.26

Disease

OPEN ACCESS Freely available online

PLOS ONE

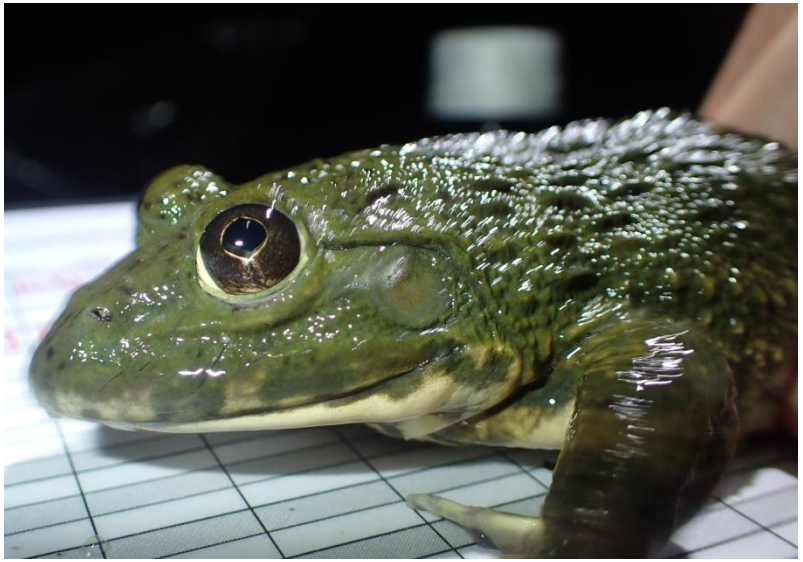
First Evidence of Amphibian Chytrid Fungus (*Batrachochytrium dendrobatidis*) and Ranavirus in Hong Kong Amphibian Trade

Jonathan E. Kolby[1,2]*, Kristine M. Smith[2], Lee Berger[1], William B. Karesh[2], Asa Preston[3], Allan P. Pessier[3], Lee F. Skerratt[1]

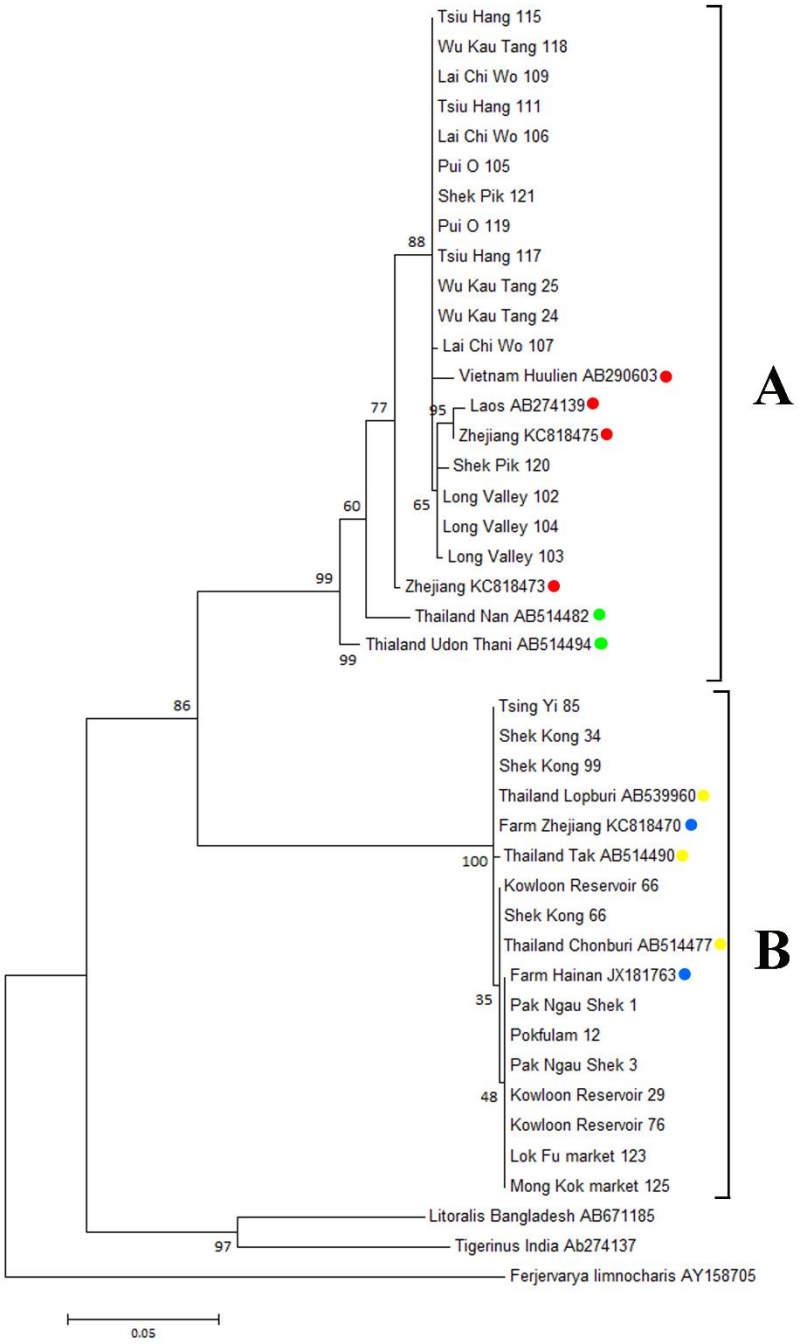
1 One Health Research Group, School of Public Health, Tropical Medicine, and Rehabilitation Sciences and One Health Research Group, James Cook University, Townsville, Queensland, Australia, **2** EcoHealth Alliance, New York, New York, United States of America, **3** Amphibian Disease Laboratory, Institute for Conservation Research, San Diego Zoo Global, San Diego, California, United States of America

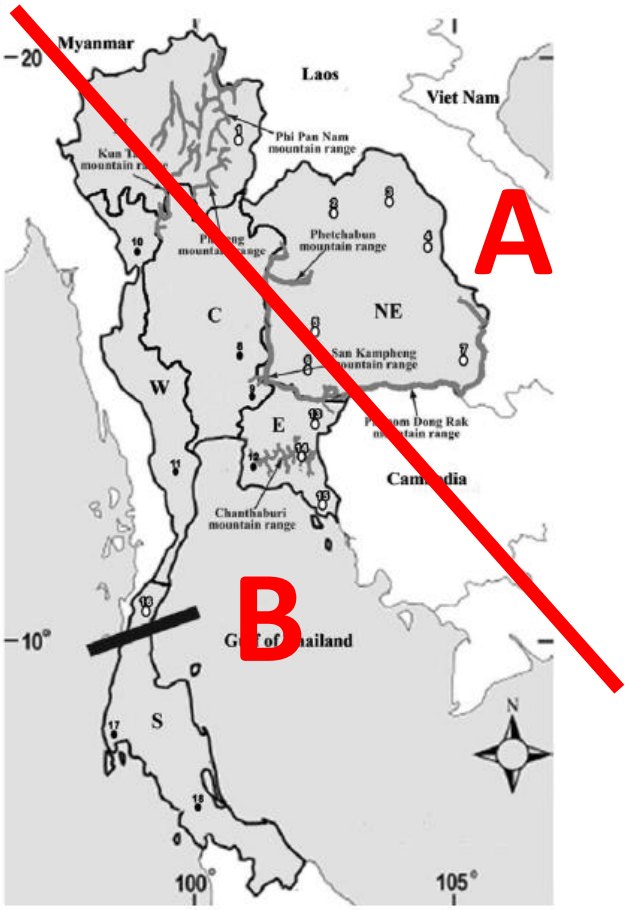

Source: National Geographic

Released? Native?



Genetic pollution

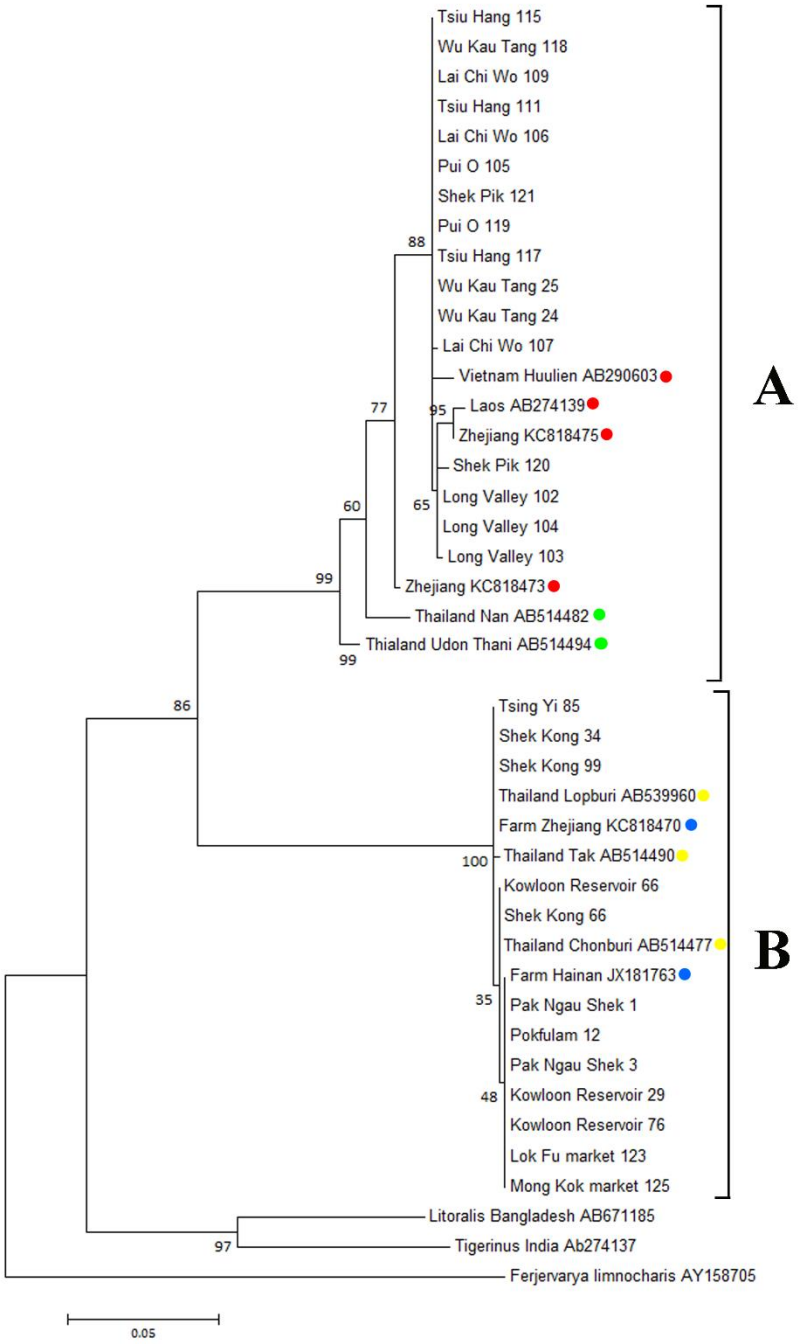




ZOOLOGICAL SCIENCE **29**: 54–59 (2012)

Phylogenetic Relationships among *Hoplobatrachus rugulosus* in Thailand as Inferred from Mitochondrial DNA Sequences of the Cytochrome-*b* Gene (Amphibia, Anura, Dicroglossidae)

Anusorn Pansook[1,2], Wichase Khonsue[2], Sanit Piyapattanakorn[3], and Putsatee Pariyanonth[2*]



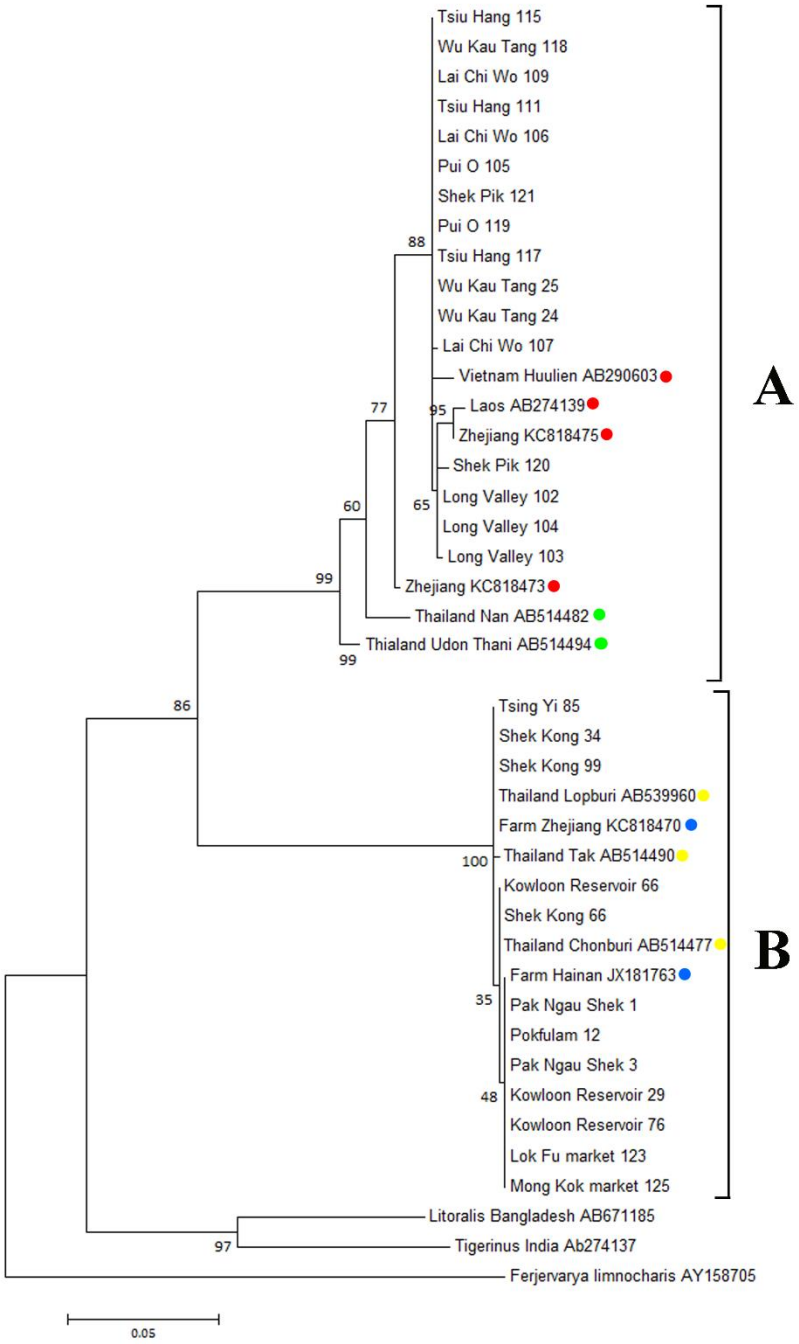
Genetic pollution ?

Clade A

- China (wild)
- Vietnam and Laos
- Northeast Thailand

Clade B

- China (farms)
- South Thailand



Genetic pollution

Hybridization?

Chinese Water Dragons

Predation

Source: http://www.jungledragon.com


Short-legged Toad
Endemic frog species

Complete eradication?

The Potential Conservation Value of Non-Native Species

MARTIN A. SCHLAEPFER,*† DOV F. SAX,‡ AND JULIAN D. OLDEN§

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†INRA, Ecologie et Santé des Ecosystèmes, 35042 Rennes, France
‡Department of Ecology and Evolutionary Biology, 80 Waterman Street, Brown University, Providence, RI 02912, U.S.A.
§School of Aquatic and Fishery Sciences, University of Washington, Box 355020, Seattle, WA 98195, U.S.A.

Limited knowledge about the native population status of Chinese Water Dragons

Nature Conservation 26: 1–14 (2018)
doi: 10.3897/natureconservation.26.21818
http://natureconservation.pensoft.net

RESEARCH ARTICLE

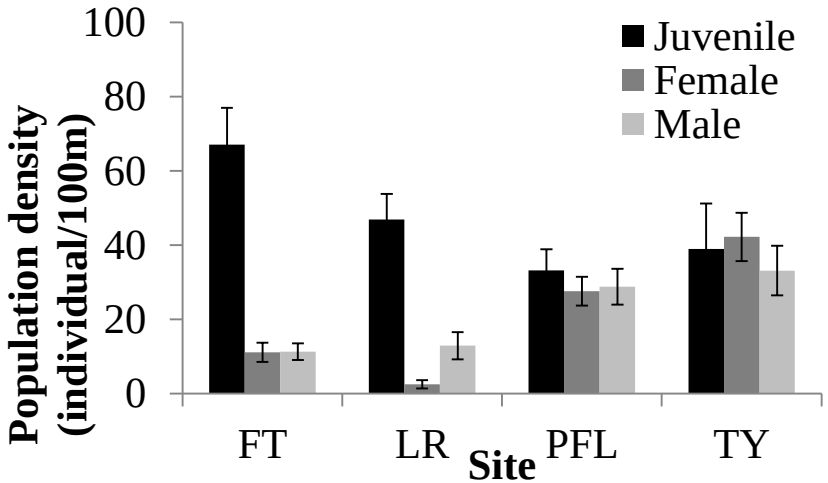
A peer-reviewed open-access journal
Nature Conservation
Launched to accelerate biodiversity conservation

First population assessment of the Asian Water Dragon (*Physignathus cocincinus* Cuvier, 1829) in Thua Thien Hue Province, Vietnam

Truong Quang Nguyen[1,2], Hai Ngoc Ngo[3], Cuong The Pham[1,2], Hoang Nguyen Van[4], Chung Dac Ngo[4], Mona van Schingen[5,6], Thomas Ziegler[6,7]

Abstract

The Asian Water Dragon, *Physignathus cocincinus* Cuvier, 1829, was originally described from southern Vietnam. Wild populations of this species are strongly affected by harvesting, particularly in central Vietnam, while potential negative impacts are not yet foreseeable. This study provides the first population size estimation using a capture-recapture approach and *P. cocincinus* in Thua Thien Hue Province, central Vietna known occurrences of the species in Thua Thien Hue dur mated population size of the species amongst these sites abundance varied from 1.98–2.64 individuals/100 m alon activities for local food consumption and to supply the pet living individuals per year from Vietnam into the EU were the level of negative impacts on different sub-populations the incidence of adults. This finding indicates that rising



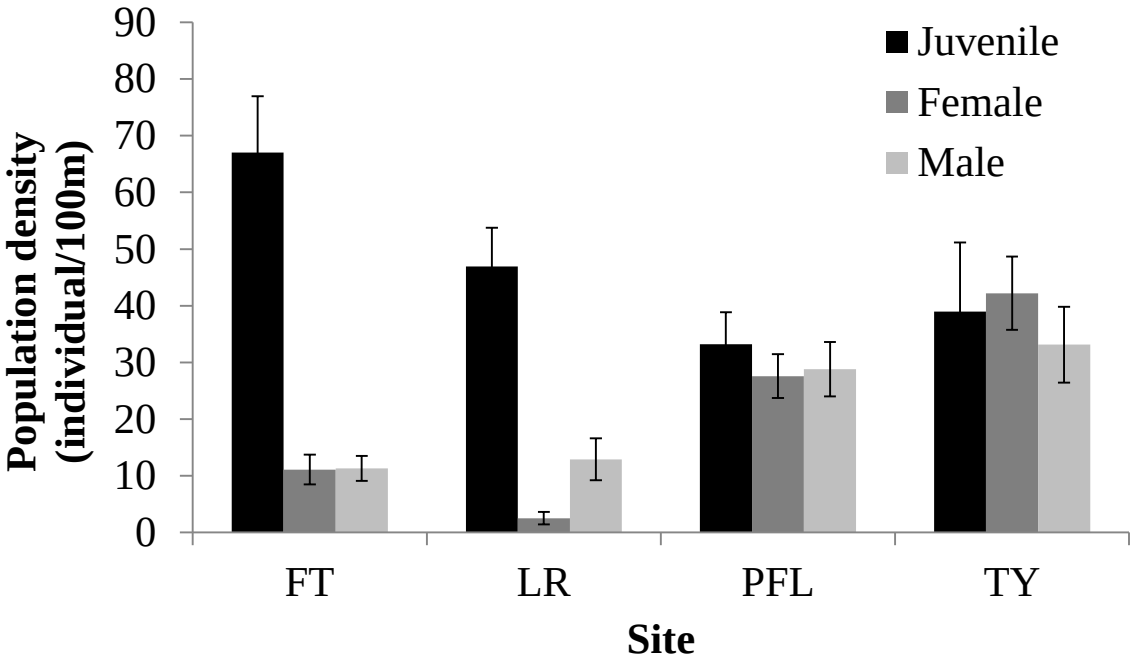
Yellow-crested Cuckatoo

Chinese Water Dragons

- Basic ecological information
  - Mark-recapture study
  - Diet analysis
  - Radio-tracking

Chinese Water Dragons

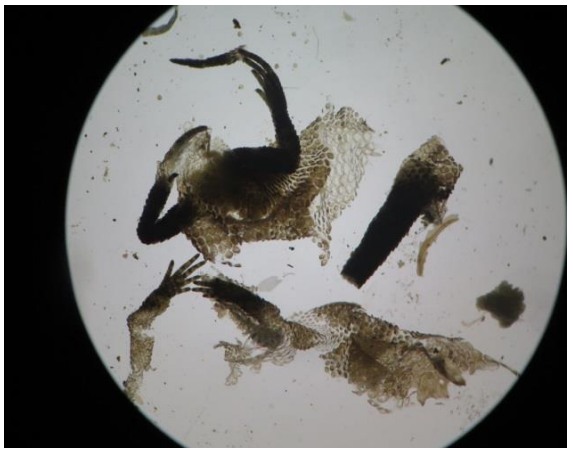
- Mark-recapture study



Chinese Water Dragons

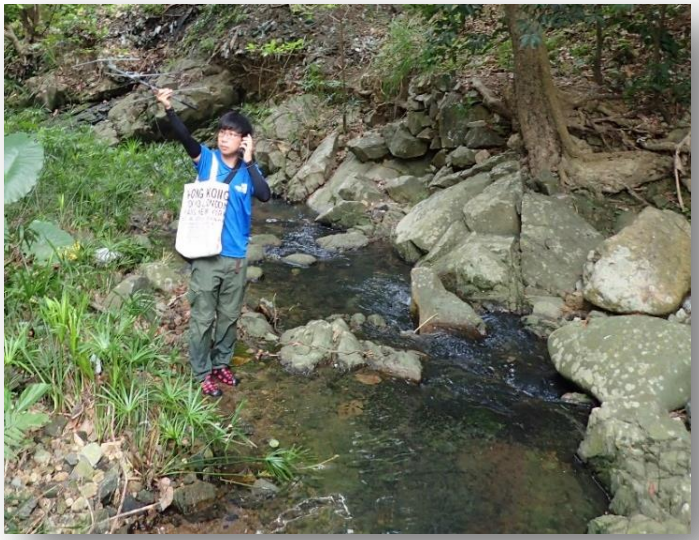
- Diet analysis
  - Very diverse diet
  - > 200 morphospecies

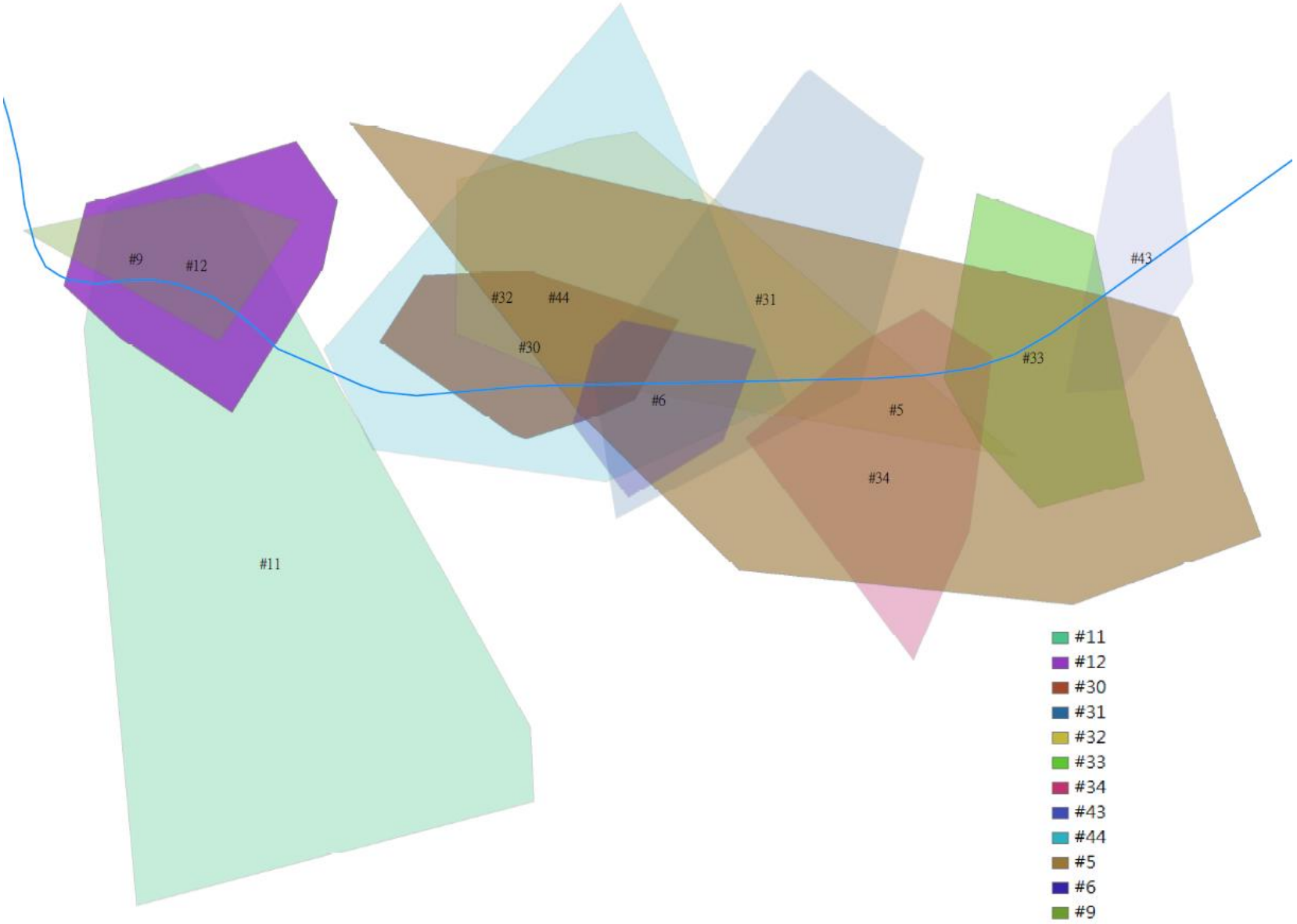
Diet items	%F	%V	IRI
Spider (Araneae)	13.51	2.52	1.17
Centipede (Chilopoda)	16.22	4.96	2.76
Crab (Decapoda)	2.70	0.36	0.03
Millipede (Diplopoda)	16.89	3.51	2.03
Snail (Gastropoda)	23.65	8.51	6.89
Earthworm (Megadrilacea)	16.89	6.24	3.61
Nematode (Nematoda)	0.68	0.01	0.00
Cockroach and termite (Blattodea)	14.86	5.30	2.70
Beetle (Coleoptera)	29.73	9.31	9.49
Earwig (Dermaptera)	1.35	0.05	0.00
Fly (Diptera)	5.41	2.81	0.52
Bug, cicada and froghopper (Hemiptera)	20.27	3.24	2.25
Ant and bee (Hymenoptera)	60.14	12.88	26.55
Isopod (Isopoda)	3.38	0.08	0.01
Butterfly and moth (Lepidoptera)	50.00	10.91	18.69
Mantis (Mantodea)	4.05	3.97	0.55
Cricket, katydid and grasshopper (Orthoptera)	23.65	8.31	6.74
Stick insect (Phasmatodea)	3.38	2.47	0.29
Lizard (Squamata)	0.68	0.18	0.00
Ficus Fruits	4.73	6.13	0.99



Chinese Water Dragons

- Radio-tracking

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Chinese Water Dragons

What to do next?

環境資訊中心 TEIA
Taiwan Environmental information Center

外來種斑腿樹蛙威脅生態 再移除9蛙

建立於 2017/04/12　上稿編輯： 吳俊德

What to do next?

12th December

Letters: Respect all squirrels, regardless of colour

Letters

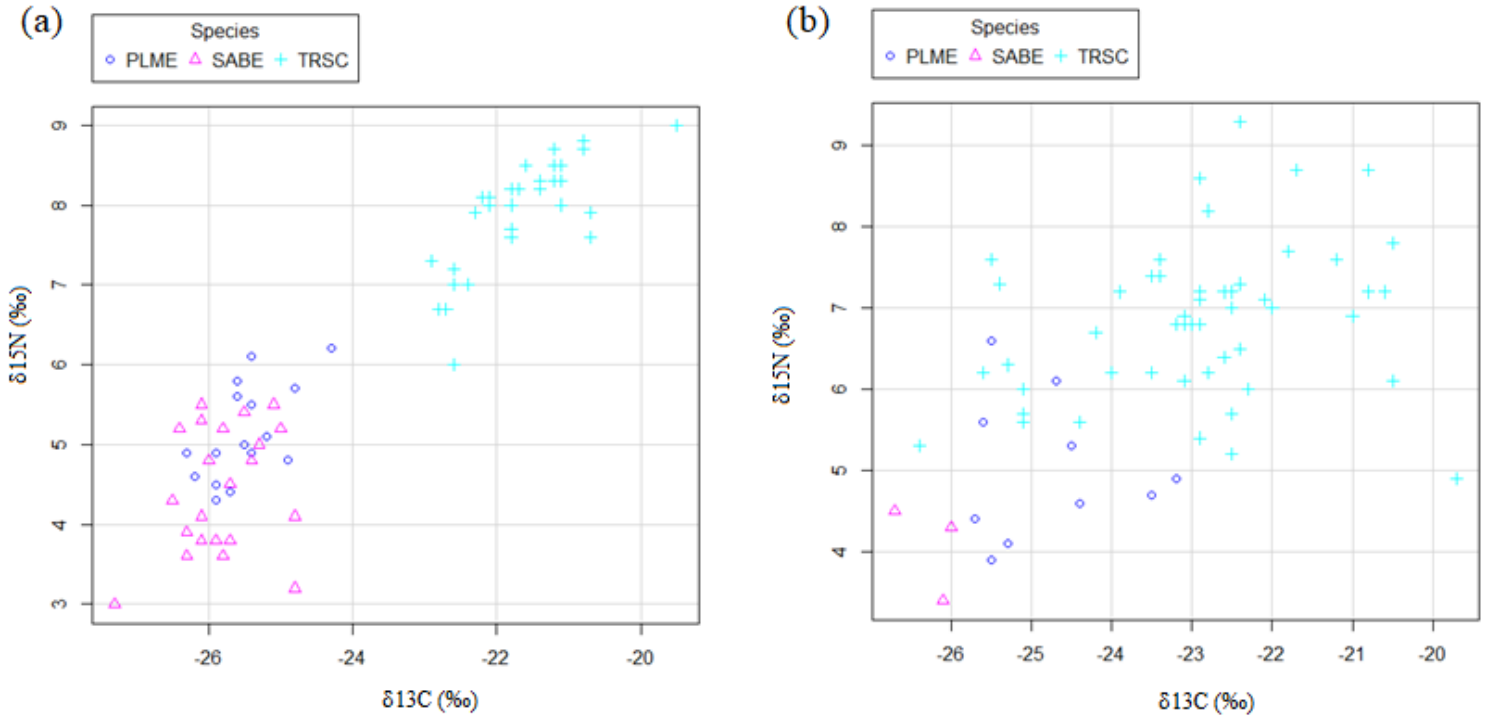
Most popular | Most commented

1. Hampden Park: An open letter by former Celtic owner Fergus McCann
2. Scot who had bowling ball-sized tumour removed hunts for 14 others with the cancer
3. Angelina Jolie reveals drama of how she tried to hire a hitman to kill her
4. Davidson hints at move to Westminster after next Holyrood election

Red-eared Sliders

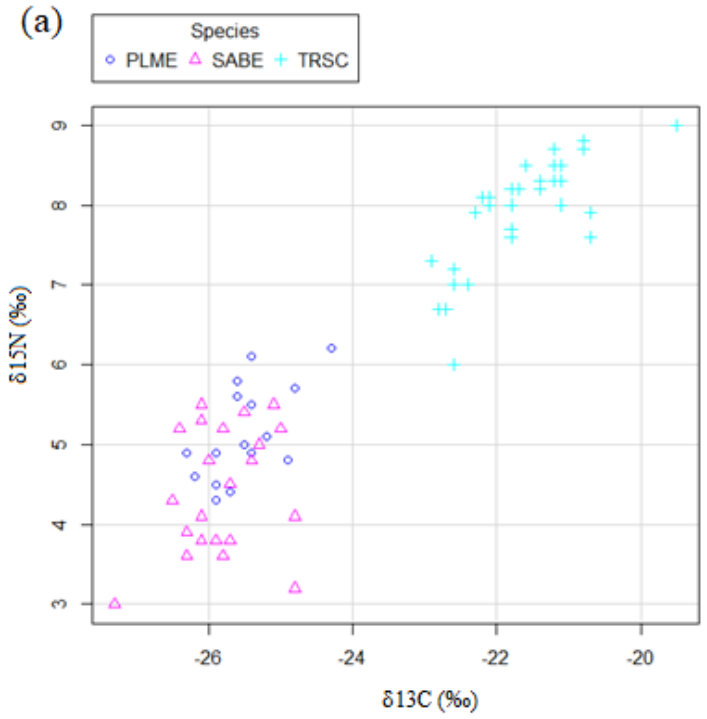
Red-eared Sliders

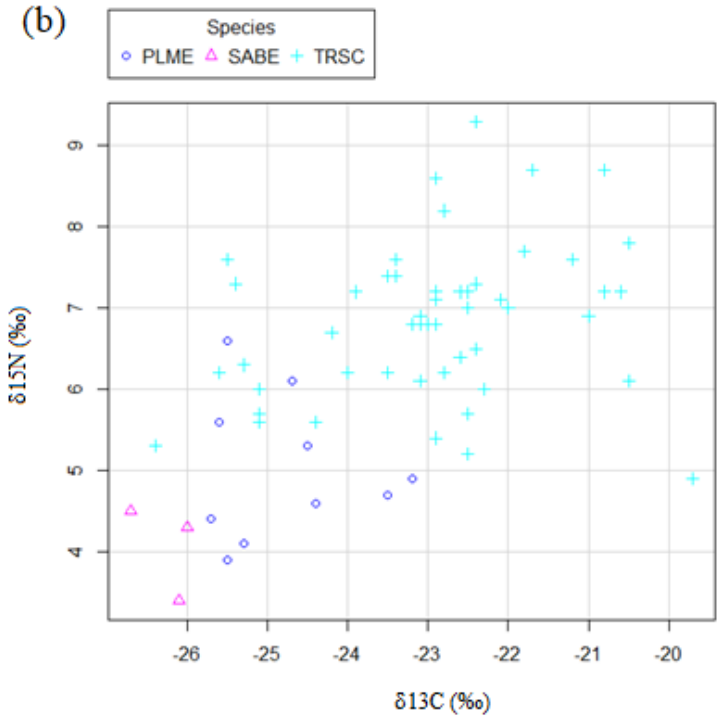
Competition for food is not obvious between red-eared sliders and native turtles



Red-eared Sliders

Competition for food is not obvious between red-eared sliders and native turtles





Red-eared Sliders

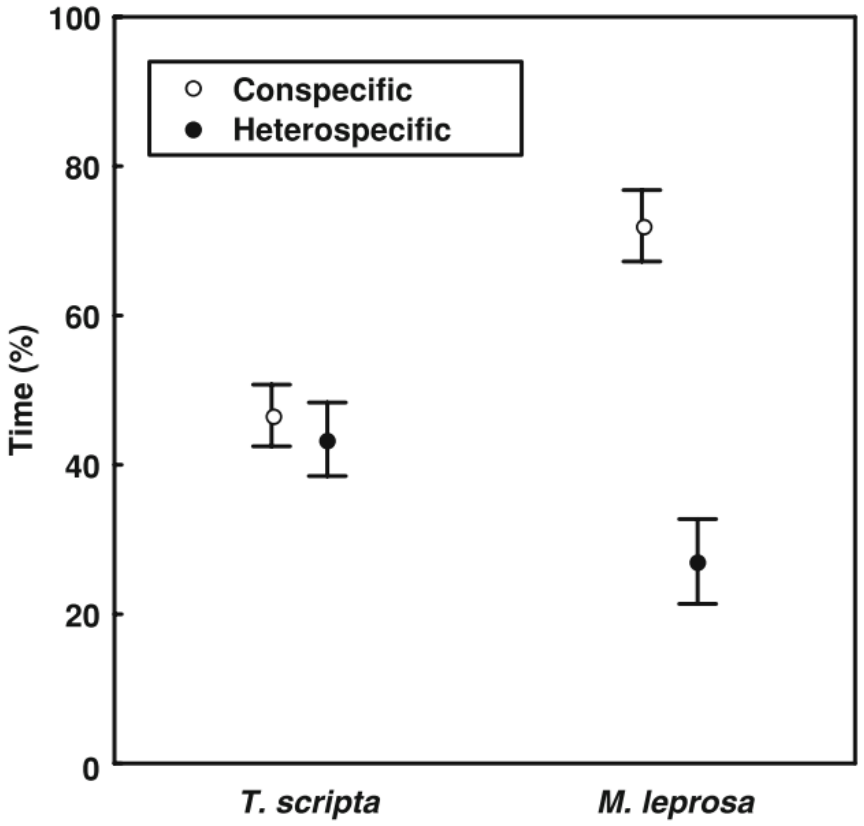


Fig. 2 Percent time $(\overline{X} \pm \mathrm{SE})$ spent by *T. scripta* and *M. leprosa* in pools with water with chemical cues stimuli from conspecific or heterospecific donor turtles

Biol Invasions (2009) 11:431–440
DOI 10.1007/s10530-008-9260-z

ORIGINAL PAPER

Interspecific differences in chemosensory responses of freshwater turtles: consequences for competition between native and invasive species

Nuria Polo-Cavia · Pilar López · José Martín

Greenhouse Frogs

Introduction of *Eleutherodactylus planirostris* (Amphibia, Anura, Eleutherodactylidae) to Hong Kong

Wing Ho Lee[1], Michael Wai-Neng Lau[2], Anthony Lau[3], Ding-qi Rao[4], Yik-Hei Sung[5,*]

Journal of Herpetology, Vol. 49, No. 4, 586–593, 2015

Diet of the Nonnative Greenhouse Frog (*Eleutherodactylus planirostris*) in Maui, Hawaii

RODRIGO B. FERREIRA,[1] KAREN H. BEARD,[1,2] RYAN T. CHOI,[1] AND WILLIAM C. PITT[3,4]

[1]*Department of Wildland Resources and the Ecology Center, Utah State University, Logan, Utah 84322 USA*
[3]*U.S. Department of Agriculture/Animal and Plant Health Inspection Service/Wildlife Services/National Wildlife Research Center, Hawaii Field Station, Hilo, Hawaii 96721 USA*

Biology and Impacts of Pacific Island Invasive Species. 8. *Eleutherodactylus planirostris*, the Greenhouse Frog (Anura: Eleutherodactylidae)[1]

Christina A. Olson,[2] Karen H. Beard,[2,4] and William C. Pitt[3]

Density up to 12500 per ha

Consume 129000 invertebrates per ha per night

Diversity and Distributions, (Diversity Distrib.) (2005) **11**, 427–433

BIODIVERSITY RESEARCH

Potential consequences of the coqui frog invasion in Hawaii

Karen H. Beard[1,*] and William C. Pitt[2]

Food sources for endemic birds

Citric acid is not effective in eradicating populations

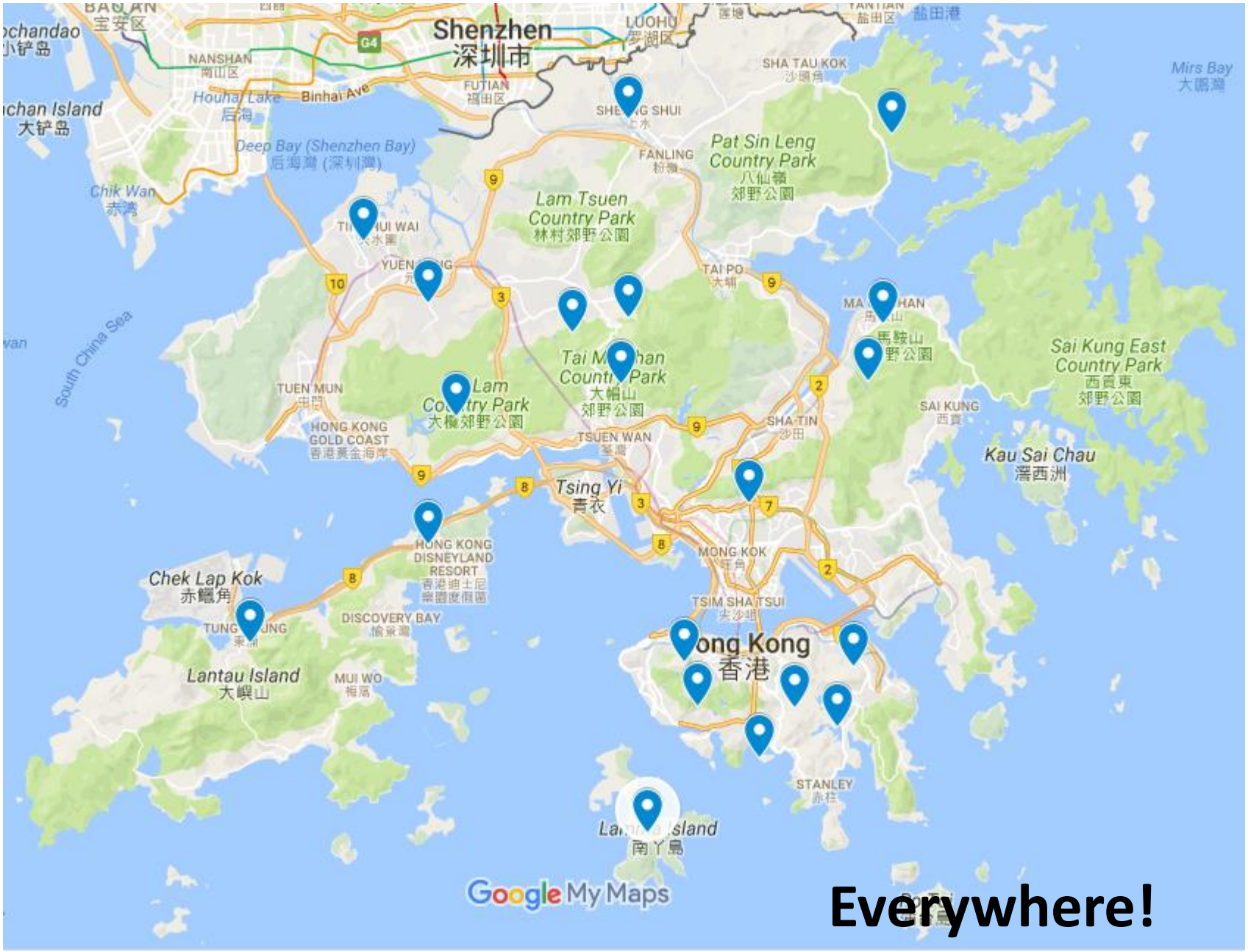
Direct development – NO tadpole stage

Introduced via plant trade

Greenhouse Frogs

Introduction of *Eleutherodactylus planirostris* (Amphibia, Anura, Eleutherodactylidae) to Hong Kong

Wing Ho Lee[1], Michael Wai-Neng Lau[2], Anthony Lau[3], Ding-qi Rao[4], Yik-Hei Sung[5,*]


Shenzhen
深圳市
Hong Kong
香港
Lantau Island
大嶼山
Chek Lap Kok
赤鱲角
Tsing Yi
青衣
Kau Sai Chau
滘西洲
Lam Tsuen Country Park
林村郊野公園
Pat Sin Leng Country Park
八仙嶺郊野公園
Sai Kung East Country Park
西貢東郊野公園
Lam Country Park
大欖郊野公園
Tai Mo Shan Country Park
大帽山郊野公園
Deep Bay (Shenzhen Bay)
后海灣 (深圳灣)
South China Sea
Mirs Bay
大鵬灣
HONG KONG DISNEYLAND RESORT
香港迪士尼樂園度假區
HONG KONG GOLD COAST
香港黃金海岸
DISCOVERY BAY
愉景灣
TUEN MUN
屯門
TSUEN WAN
荃灣
SHA TIN
沙田
TAI PO
大埔
SAI KUNG
西貢
MONG KOK
旺角
TSIM SHA TSUI
尖沙咀
STANLEY
赤柱
MUI WO
梅窩
SHA TAU KOK
沙頭角
FANLING
粉嶺
YUEN LONG
元朗
NANSHAN
南山区
FUTIAN
福田区
LUOHU
罗湖区
Houhai Lake
后海
Binhai Ave
G4
Google My Maps

Everywhere!

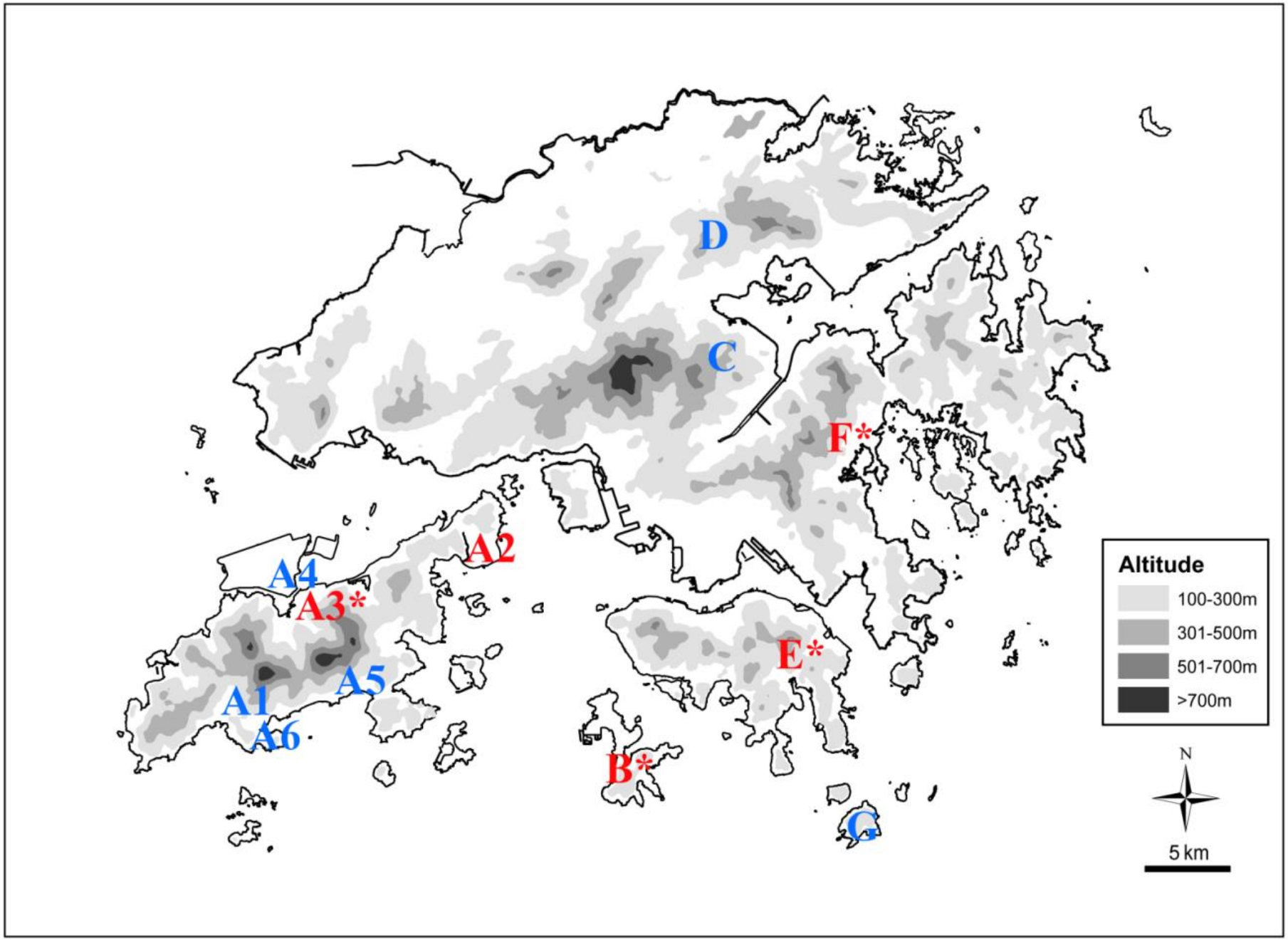
Romer's Tree Frogs

Endemic to Hong Kong

Competition with Greenhouse Frogs?

Diet analysis

Diet items	%F	%V	IRI
Mite (Acariformes)	0.18	0.01	0.25
Spider (Araneae)	0.07	0.03	0.44
Isopod (Isopoda)	0.18	0.07	2.46
Millipede (Diplopoda)	0.04	0.02	0.10
Snail (Gastropoda)	0.05	0.00	0.01
Earwig (Dermaptera)	0.03	0.00	0.00
Beetle (Coleoptera)	0.19	0.02	0.79
Fly (Diptera)	0.07	0.01	0.15
Bug (Hemiptera)	0.07	0.03	0.38
Ant and bee (Hymenoptera)	0.74	0.68	93.94
Butterfly and moth (Lepidoptera)	0.03	0.02	0.08
Cricket and grasshopper (Orthoptera)	0.06	0.11	1.39


D
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Altitude
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501-700m
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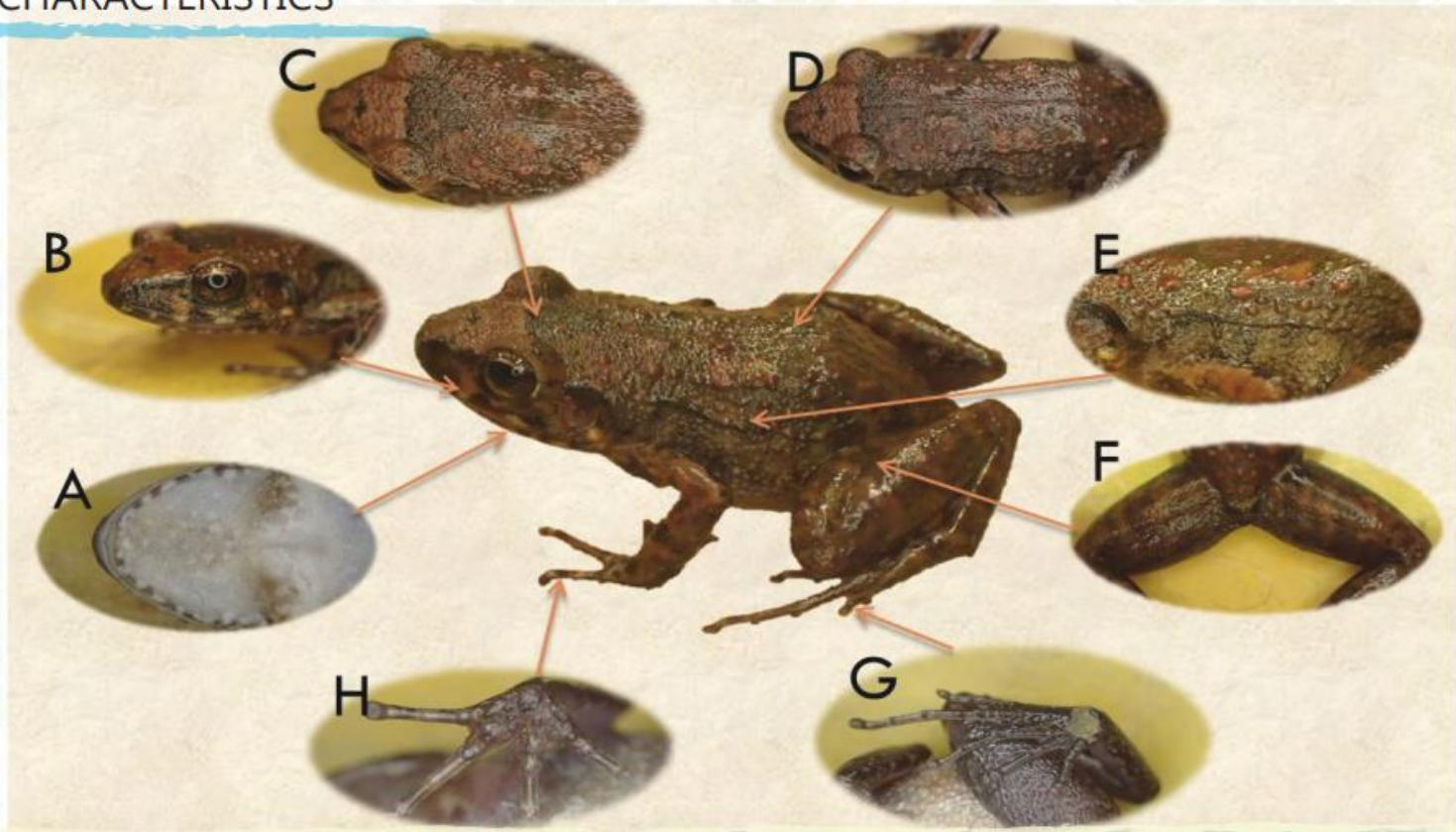
N
5 km

特徵 CHARACTERISTICS



溫室蟾的雄蛙約1.5-2.1cm, 雌蛙約2.8-3.2cm
A.下頜邊緣有點狀花紋
B.吻端有3-4條黑紋
C.雙眼間有三角形黑斑
D.背上有背中線,身上佈滿圓形的疣粒
E.背兩側具一對棒狀疣
F.四肢上有環帶,腿間並無花紋
G & H. 指、趾端有吸盤

The Green house frogs male SVL around 1.5-2.1cm long , the female 2.8-3.2cm.
A.The jaw edge dark spots
B. Lip with 3-4 black vertical bars
C. Dark triangular marking between the eyes
D. Dorsal midline, body surface with numerous round granules
E. Dorso-lateral with are pair of rod-shaped granules
F. Banding on all limbs
G. All digits with suction discs

Survey techniques for amphibians and reptiles

Amphibians

Technique	Target	Information gained	Time cost	Financial cost	Personnel requirement
1. Visual encounter survey	Forest understory anurans, salamanders	Relative abundance	Low	Low	Low
2. Audio strip transect	Reproductively active species which produce calls	Relative abundance	Medium	Medium	Low
3. Quadrat sampling	Amphibians in the forest litter where species occur at high densities, aquatic/ forest-floor/ streamside amphibians	Density	High	Low	Medium
4. Transect sampling	Patchy distribution of salamander and the anuran species with low mobility	Density	High	Low	Medium
5. Patch sampling	Species with patchy discrete microhabitat within the broader environment	Density	High	Low	Medium
6. Pitfall traps with drift fences	Species that are surface dwelling	Relative abundance	High	High	High
7. Survey at breeding site	Amphibians that breeds in aggregations, both adult and larvae	Relative abundance	Medium	Low	Medium
8.Quantitative sampling of amphibian larvae	Aquatic larvae	Density or relative abundance	Medium	Medium	Medium

Heyer, W.R., Donnelly, M.A., McDiarmid, R.W., Hayek, L.C., & Foster, M.S. 1994. Measuring and monitoring biological diversity: standard methods for amphibians. Smithsonian Institute Press, Washington, D.C.

Automated audio recorder

Reptiles

Technique	Target	Time	Cost	Personnel requirement
1. Visual encounter survey	All reptiles	Low	Low	High
2. Artificial refuges or cover board	Lizards and snakes	High	High	Low
3. Funnel trapping (+drift fence)	Lizards and snakes	High	High	Low
4. Pitfall traps (+ drift fence)	Lizards and small snakes	High	High	Low
5. Mesh minnow traps	Aquatic snakes	High	High	Low
6. Cage traps	Turtle	High	High	Low

Heyer, W.R., Donnelly, M.A., McDiarmid, R.W., Hayek, L.C., & Foster, M.S. 1994. Measuring and monitoring biological diversity: standard methods for amphibians. Smithsonian Institute Press, Washington, D.C.

Survey techniques

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EVALUATION OF THE EFFECTIVENESS OF THREE SURVEY METHODS FOR SAMPLING TERRESTRIAL HERPETOFAUNA IN SOUTH CHINA

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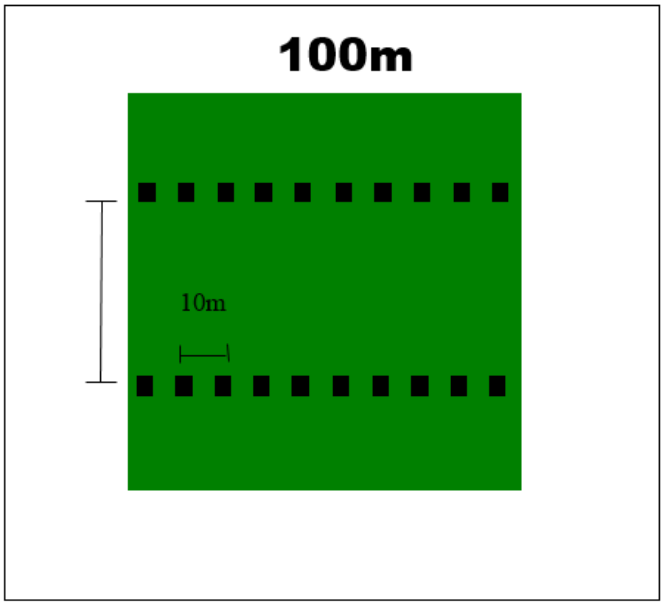
***Abstract.*—Southeast Asia exhibits high herpetofaunal biodiversity, yet many areas and taxa in the region remain understudied. Extensive surveys are needed to fill information gaps, yet at present we have little knowledge about the effectiveness of different herpetofaunal survey methods in the region. We conducted field studies to examine the effectiveness of three survey methods for sampling terrestrial amphibians and reptiles in Hong Kong. Transect surveys were the most effective at sampling species richness and drift fences with pitfall traps and funnel traps were the most efficient in capturing high numbers of reptiles. We recommend the use of transect surveys for rapid biodiversity assessment and the combination of transect surveys and pitfall traps for comprehensive species inventories. Pitfall traps represent an excellent tool for surveys or population monitoring of leaf litter species. The results of this study will aid researchers in assessing the feasibility of and in choosing herpetofaunal survey methods**

Survey techniques

- Transect survey/active searching
  - Searching suitable microhabitat
  - Fixed length or time
  - Seen and heard

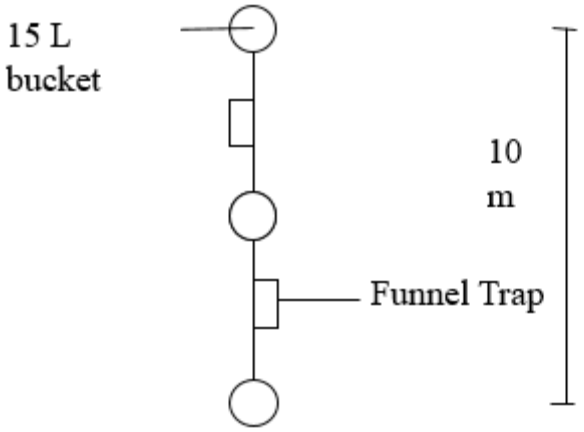
Survey techniques

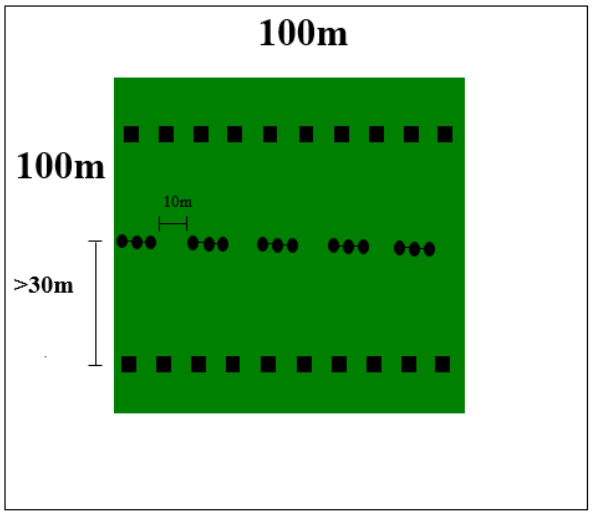
- Coverboard, artificial refugia
- Plywood 0.66m x 0.66m
- Mimic a fallen log



Survey techniques

- Pitfall trap with drift fence





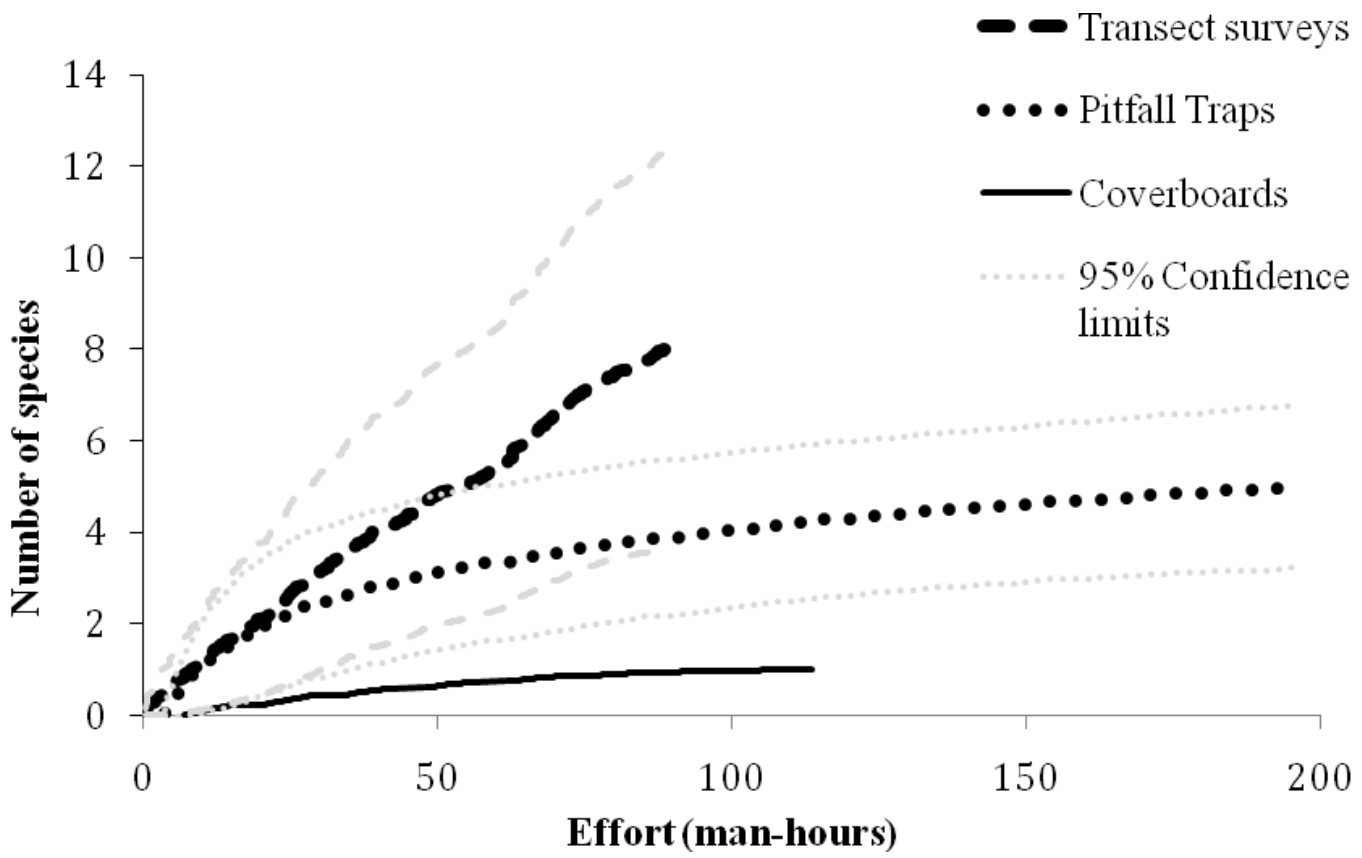
Survey techniques

- No single method is effective to get all species in a community

	Coverboards	Pitfall traps	Transect surveys	ANOVA
Mean person-hours spent each site (hours)	14.25 ± 0.25	24.17 ± 2.10	11.12 ± 0.76	n.a.
Amphibian captures (captures/ person-hour)	0.03 ± 0.02	0.20 ± 0.05	0.25 ± 0.11	$F_{2,21}$=3.114, p = 0.065
Reptile captures (captures/ person-hour)*	0.15 ± 0.05	1.65 ± 0.38	0.94 ± 0.41	$F_{2,21}$=14.085, $p < 0.001$

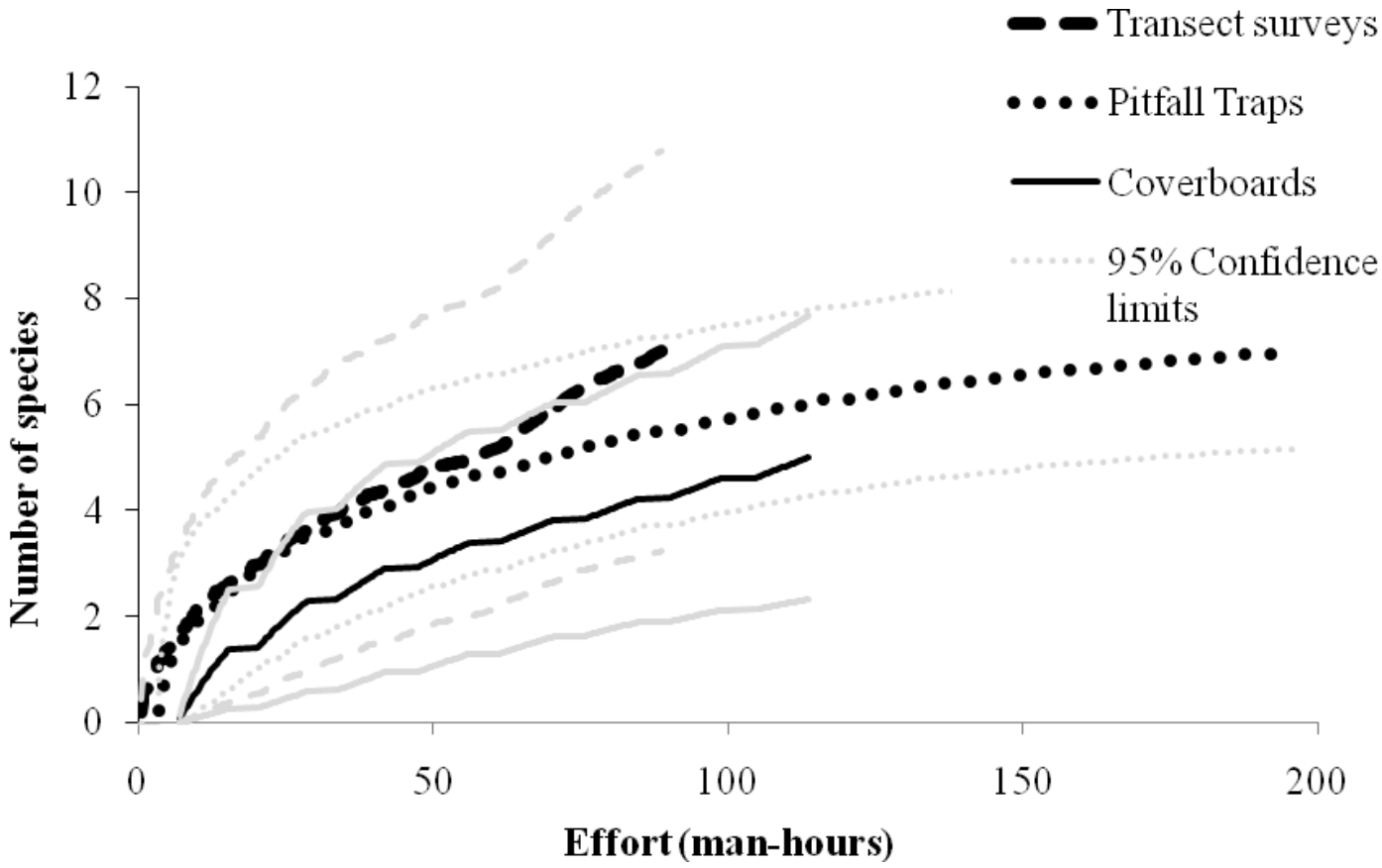
Survey techniques

- Amphibian

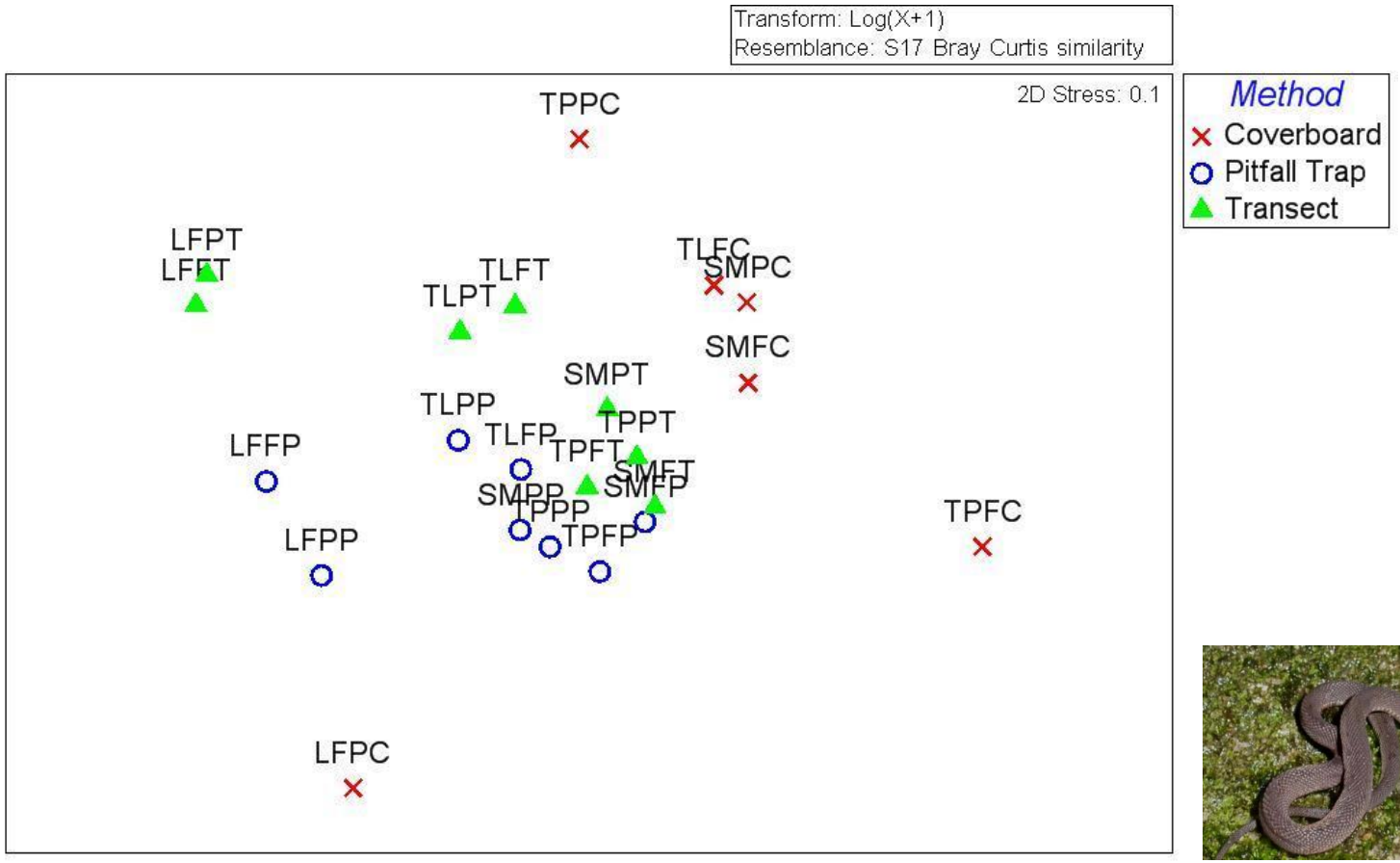


Survey techniques

- Reptiles



Survey techniques



Group	Species	Coverboards	Pitfall traps	Transect surveys
Amphibians				
Order Caudata	*Paramesotriton hongkongensis*	3	6	3
Order Anura	*Duttaphrynus melanostictus*		31	13
	Hylarana guentheri			3
	Hylarana latouchii			1
	Leptolalax liui		1	2
	Odorrana chloronota			1
	Polypedates megacephalus		1	1
	Xenophrys brachykolos		1	1
Reptiles				
Suborder Lacertilia	*Achalinus rufescens*	1		
	Ateuchosaurus chinensis	1	28	1
	Calotes versicolor		1	
	Gekko chinensis	7	2	8
	Scincella modesta		7	18
	Sphenomorphus indicus	7	318	61
Suborder Serpentes	*Rhabdophis subminiatus*			1
	Sibynophis chinensis	1	3	1
	Trimeresurus albolabris		1	1

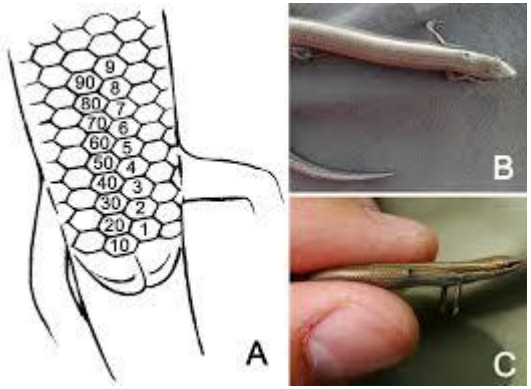



Survey techniques

- Relative abundance vs population estimation
  - Capture rate affected by detection probability
  - Detection probability affected by
    - Species
    - Seasonality
    - Time of the day
    - Habitat structure
    - Weather condition
    - Observers

Survey techniques

- Mark-recapture to estimate population size
  - Toe-clipping
  - Shell-notching
  - Passive integrated transponder tags
  - Visible implant tags
  - Pattern mapping
  - Branding



Summary

Religious release poses negative impacts to local ecosystems

Management of exotic species require scientific evidence, and consider social factors

We understand little about the impacts of exotic species

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