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JITMM 2018

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From citizen science to laboratory verification:

Distribution of the newly invasive New Guinea flatworm *Platydemus manokwari* and its role in carrying *Angiostrongylus* nematode larvae in Thailand

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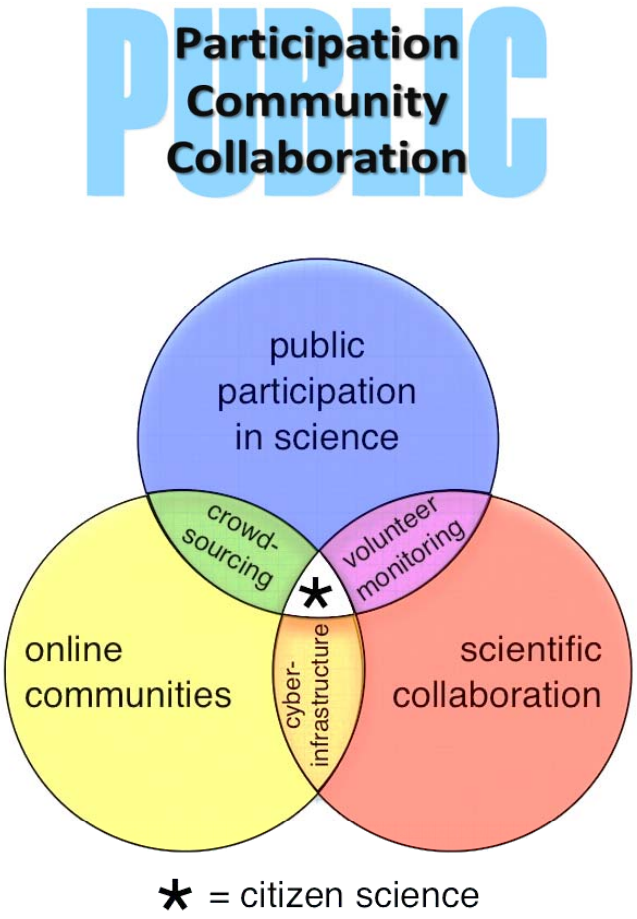
Citizen Science Research



Definition:

"Research **collaborations** between scientists and **participated volunteers**, to expand opportunities for scientific data collection and to provide access to scientific information for **community** members."

- The Cornell Lab of Ornithology-

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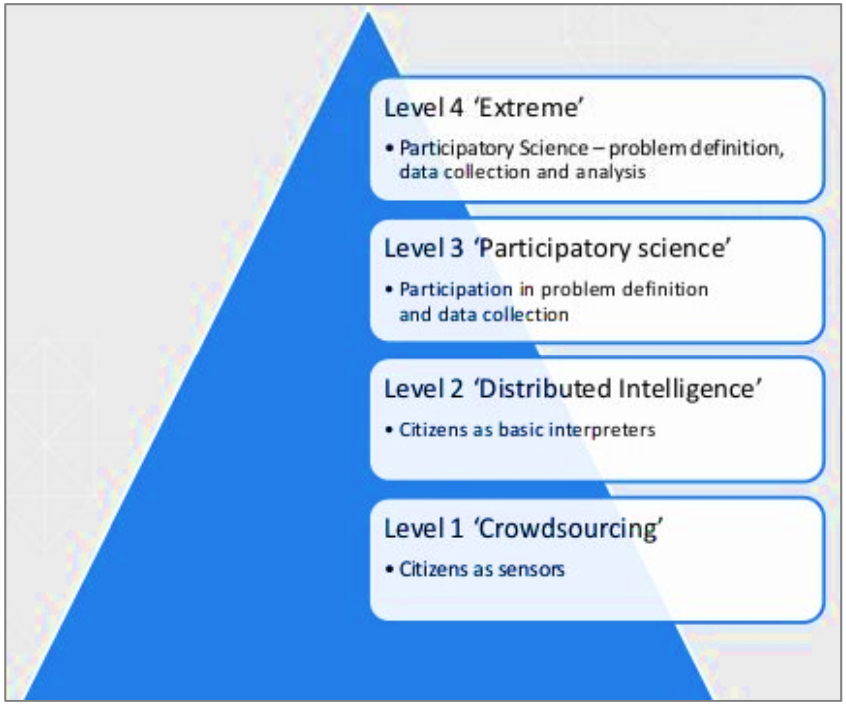
Participatory levels in citizen science



Haklay (2012)

Public Participation in Scientific Research

PPSR models:	Contributory	Collaborative	Co-Created
Define a question/issue	☐	☐	☑
Gather information	☐	☐	☑
Develop explanations	☐	☑	☑
Design data collection methods	☐	☑	☑
Collect samples	☑	☑	☑
Analyze samples	☑	☑	☑
Analyze data	☐	☑	☑
Interpret data/conclude	☐	☐	☑
Disseminate conclusions	☐	☐	☑
Discuss results/inquire further	☐	☐	☑

https://www.slideshare.net/AniKarenina/online-communities-in-citizen-science

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Cyber Citizen Science

Here, we used crowdsourcing approach in observation of a newly invasive species in Thailand.

What is New Guinea Flatworm?

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New Guinea Flatworm

[Justine et al. 2014, PeerJ]

General information

Platydemus manokwari
De Beauchamp, 1963
(Platyhelminthes: Geoplanidae)

- Black/dark brown dorsal, pale grey ventral
- Adult 4 – 10 cm in length
- Predation on snails and other soil-dwelling invertebrates
- Hermaphroditic and able to regenerate
- Sexual reproduction (cross fertilizing), lays 5-10 cocoons) in soil

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New Guinea Flatworm

Ecological Impact

Use as biological control of snails in vegetable farm

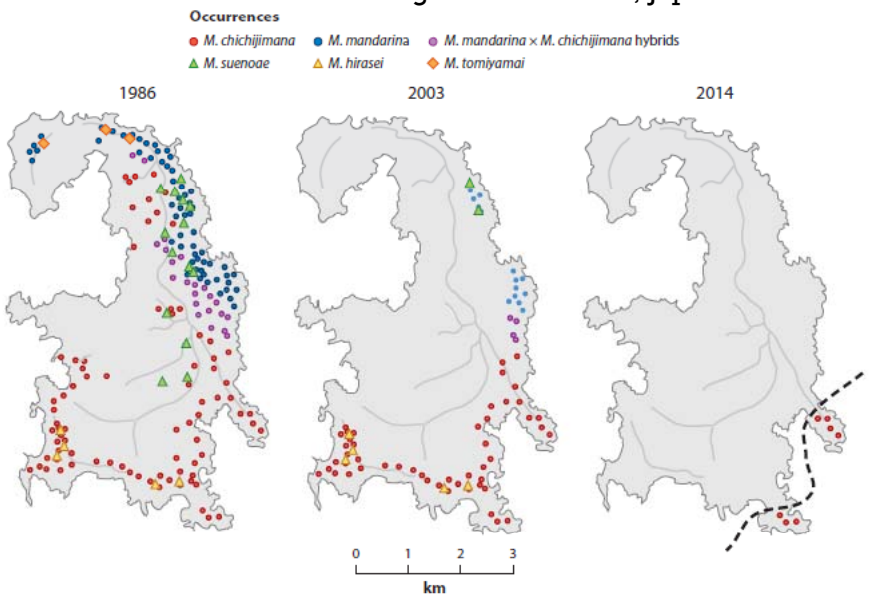
Adverse effects on indigenous gastropod fauna and soil-dwelling community

Evolution and Extinction of Land Snails on Oceanic Islands

Annual Review of Ecology, Evolution, and Systematics
Vol. 47:123-141 (Volume publication date November 2016)
https://doi.org/10.1146/annurev-ecolsys-112414-054331

Satoshi Chiba[1] and Robert H. Cowie[2]

Ogasawara Islands, Japan



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New Guinea Flatworm

IUCN
The World Conservation Union

ISSG
Invasive Species Specialist Group

Species Survival Commission

bionet

100 OF THE WORLD'S WORST INVASIVE ALIEN SPECIES

MICRO-ORGANISM	
avian malaria	*(Plasmodium relictum)*
banana bunchy top virus	*(Banana bunchy top virus)*
rinderpest virus	*(Rinderpest virus)*
MACRO-FUNGI	
chestnut blight	*(Cryphonectria parasitica)*
crayfish plague	*(Aphanomyces astaci)*
Dutch elm disease	*(Ophiostoma ulmi)*
frog chytrid fungus	*(Batrachochytrium dendrobatidis)*
phytophthora root rot	*(Phytophthora cinnamomi)*
AQUATIC PLANT	
caulerpa seaweed	*(Caulerpa taxifolia)*
common cord-grass	*(Spartina anglica)*
wakame seaweed	*(Undaria pinnatifida)*
water hyacinth	*(Eichhornia crassipes)*
LAND PLANT	
African tulip tree	*(Spathodea campanulata)*
black wattle	*(Acacia mearnsii)*
Brazilian pepper tree	*(Schinus terebinthifolius)*
cogon grass	*(Imperata cylindrica)*
cluster pine	*(Pinus pinaster)*
erect pricklypear	*(Opuntia stricta)*
fire tree	*(Myrica faya)*
giant reed	*(Arundo donax)*
gorse	*(Ulex europaeus)*
hiptage	*(Hiptage benghalensis)*
Japanese knotweed	*(Fallopia japonica)*
Kahili ginger	*(Hedychium gardnerianum)*
Koster's curse	*(Clidemia hirta)*
kudzu	*(Pueraria montana var. lobata)*
lantana	*(Lantana camara)*
leafy spurge	*(Euphorbia esula)*
leucaena	*(Leucaena leucocephala)*
melaleuca	*(Melaleuca quinquenervia)*
mesquite	*(Prosopis glandulosa)*
miconia	*(Miconia calvescens)*
mile-a-minute weed	*(Mikania micrantha)*
mimosa	*(Mimosa pigra)*
privet	*(Ligustrum robustum)*
pumpwood	*(Cecropia peltata)*
purple loosestrife	*(Lythrum salicaria)*
quinine tree	*(Cinchona pubescens)*
shoebutton ardisia	*(Ardisia elliptica)*

LAND PLANT (CONTINUED)	
Siam weed	*(Chromolaena odorata)*
strawberry guava	*(Psidium cattleianum)*
tamarisk	*(Tamarix ramosissima)*
wedelia	*(Sphagneticola trilobata)*
yellow Himalayan raspberry	*(Rubus ellipticus)*
AQUATIC INVERTEBRATE	
Chinese mitten crab	*(Eriocheir sinensis)*
comb jelly	*(Mnemiopsis leidyi)*
fish hook flea	*(Cercopagis pengoi)*
golden apple snail	*(Pomacea canaliculata)*
green crab	*(Carcinus maenas)*
marine clam	*(Potamocorbula amurensis)*
Mediterranean mussel	*(Mytilus galloprovincialis)*
Northern Pacific seastar	*(Asterias amurensis)*
zebra mussel	*(Dreissena polymorpha)*
LAND INVERTEBRATE	
Argentine ant	*(Linepithema humile)*
Asian longhorned beetle	*(Anoplophora glabripennis)*
Asian tiger mosquito	*(Aedes albopictus)*
big-headed ant	*(Pheidole megacephala)*
common malaria mosquito	*(Anopheles quadrimaculatus)*
common wasp	*(Vespula vulgaris)*
crazy ant	*(Anoplolepis gracilipes)*
cypress aphid	*(Cinara cupressi)*
flatworm	*(Platydemus manokwari)*
Formosan subterranean termite	*(Coptotermes formosanus shiraki)*
giant African snail	*(Achatina fulica)*
gypsy moth	*(Lymantria dispar)*
khapra beetle	*(Trogoderma granarium)*
little fire ant	*(Wasmannia auropunctata)*
red imported fire ant	*(Solenopsis invicta)*
rosy wolf snail	*(Euglandina rosea)*
sweet potato whitefly	*(Bemisia tabaci)*
AMPHIBIAN	
bullfrog	*(Rana catesbeiana)*
cane toad	*(Bufo marinus)*
Caribbean tree frog	*(Eleutherodactylus coqui)*
FISH	
brown trout	*(Salmo trutta)*
carp	*(Cyprinus carpio)*
large-mouth bass	*(Micropterus salmoides)*

FISH (CONTINUED)	
Mozambique tilapia	*(Oreochromis mossambicus)*
Nile perch	*(Lates niloticus)*
rainbow trout	*(Oncorhynchus mykiss)*
walking catfish	*(Clarias batrachus)*
Western mosquito fish	*(Gambusia affinis)*
BIRD	
Indian myna bird	*(Acridotheres tristis)*
red-vented bulbul	*(Pycnonotus cafer)*
starling	*(Sturnus vulgaris)*
REPTILE	
brown tree snake	*(Boiga irregularis)*
red-eared slider	*(Trachemys scripta)*
MAMMAL	
brushtail possum	*(Trichosurus vulpecula)*
domestic cat	*(Felis catus)*
goat	*(Capra hircus)*
grey squirrel	*(Sciurus carolinensis)*
macaque monkey	*(Macaca fascicularis)*
mouse	*(Mus musculus)*
nutria	*(Myocastor coypus)*
pig	*(Sus scrofa)*
rabbit	*(Oryctolagus cuniculus)*
red deer	*(Cervus elaphus)*
red fox	*(Vulpes vulpes)*
ship rat	*(Rattus rattus)*
small Indian mongoose	*(Herpestes javanicus)*
stoat	*(Mustela erminea)*

Species were selected for the list using two criteria: their serious impact on biological diversity and/or human activities, and their illustration of important issues of biological invasion. To ensure a wide variety of examples, only one species from each genus was selected. **Absence from the list does not imply that a species poses a lesser threat.**

Development of the *100 of the World's Worst Invasive Alien Species* list has been made possible by the support of the Fondation d'Entreprise TOTAL (1998 - 2000).

For further information on these and other invasive alien species consult The *Global Invasive Species Database*:

www.issg.org/database

r, 2018

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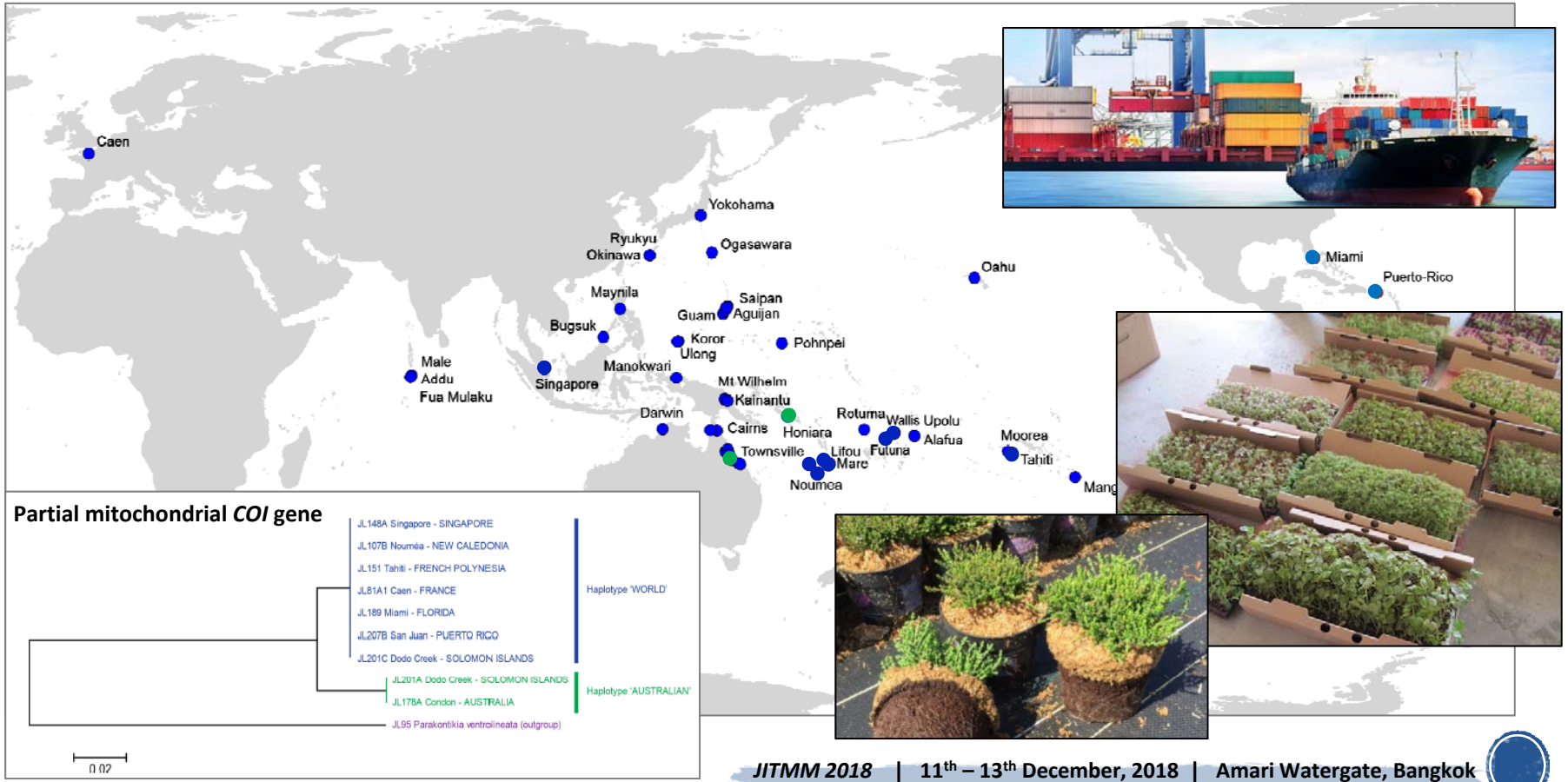
New Guinea Flatworm

Platydemus manokwari Map of Distribution Records



Partial mitochondrial *COI* gene

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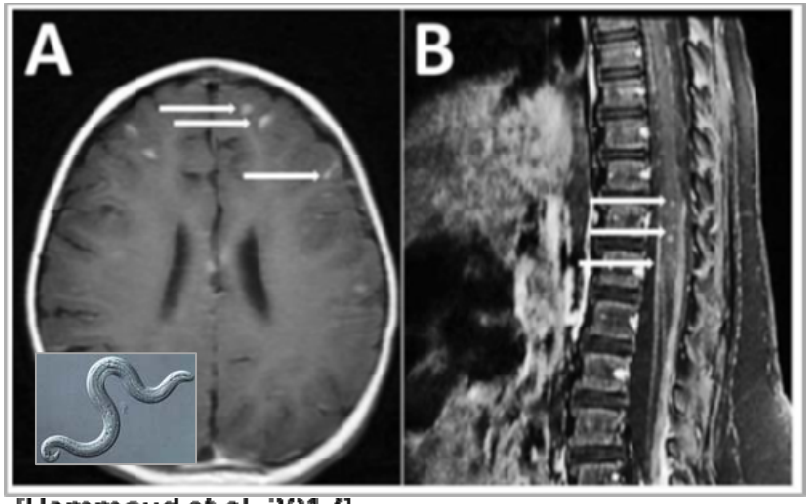
Potential Public Health Impact

Potentially acts as a **paratenic (transport) vector** of rat lungworm **(*Angiostrongylus spp.*)** causing eosinophilic meningoencephalitis (angiostrongyliasis) in human.



[Hammoud et al. 2017]

Changing Epidemiology of Angiostrongyliasis Cantonensis in Okinawa Prefecture, Japan

Ryuji Asato*, Katsuya Taira, Masaji Nakamura, Jun Kudaka, Kiyomasa Itokazu and Masanori Kawanaka[1]

Okinawa Prefectural Institute of Health and Environment, Okinawa 901-1202 and [1]Department of Parasitology, National Institute of Infectious Diseases, Tokyo 162-8640

Jpn. J. Infect. Dis., 57, 2004

Detection of Rat Lungworm in Intermediate, Definitive, and Paratenic Hosts Obtained from Environmental Sources

Yvonne Qvarnstrom PhD; Henry S. Bishop BS; and Alexandre J da Silva PhD

HAWAI'I JOURNAL OF MEDICINE & PUBLIC HEALTH, JUNE 2013, VOL 72, NO 6, SUPPLEMENT 2

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New Guinea Flatworm

The report in Thailand: October 31st, 2017

New Guinea flatworm was found in front yard of a house in Lamlukka district, Pathum Thani Province

siamensis.org
Thailand Nature Explorer

Thailand Biodiversity Conservation Group

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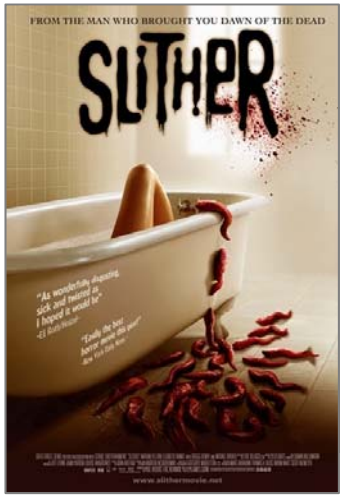
Social Media Panic

Creepy-crawly



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Some initial questions:

Are they really New Guinea Flatworm?

How far have they spread in the country?

Do they potentially impact human health?

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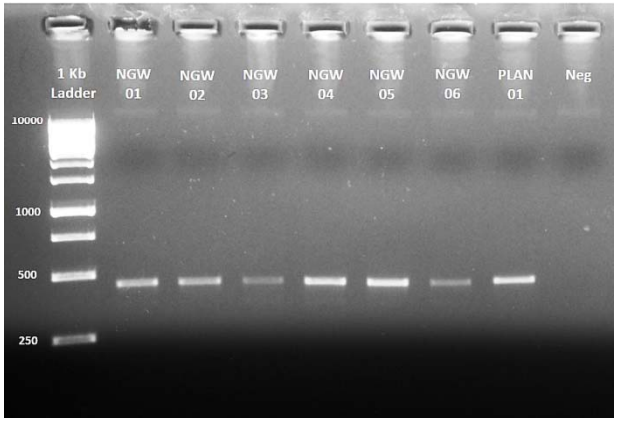
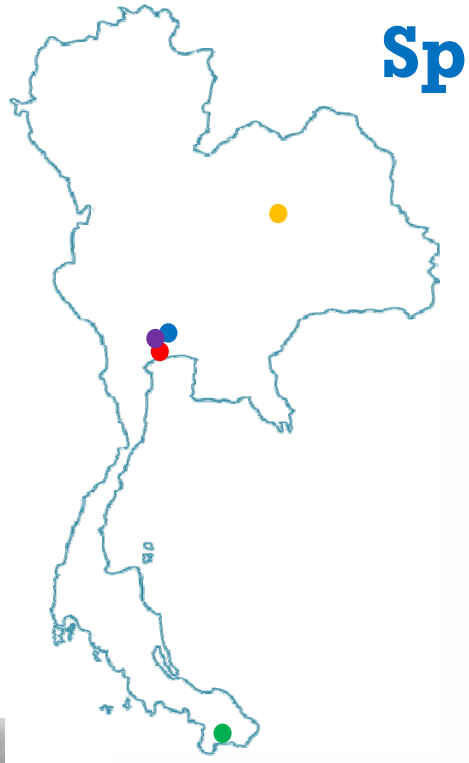
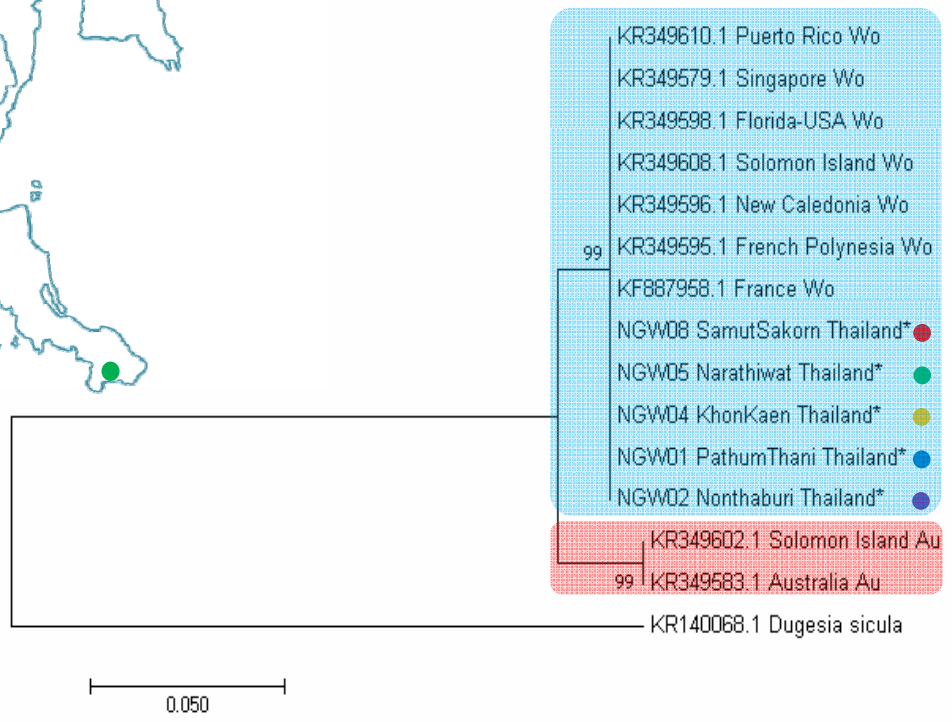
Species confirmation

The flatworm specimens were collected from various places in Thailand





Specimens collected from several places were certainly confirmed as *Platydermus manokwari* by mitochondrial *CO*I DNA sequence (424 bp).



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"Citizen Science"
Online Social Network Portals

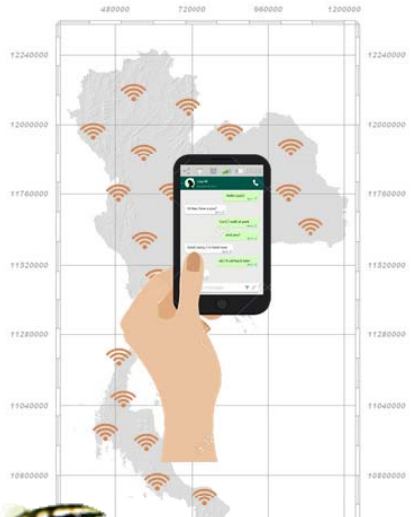

Photo or VDO clip evidences

Record

siamensis.org
Thailand Nature Explorer
กลุ่มอนุรักษ์ความหลากหลายทางชีวภาพเพื่อสิ่งแวดล้อม

Database construction:
- Date of report
- Reporter name
- Address (or GPS coordinates)
- Habitat information

Plotting distribution map

Species verification by the admin team and terrestrial flatworm experts: Dr. Jean-Lou Justine and Dr. Leigh Winsor

siamensis.org Facebook page
New Guinea Flatworm Line ID @sde5284v
Thailand Biodiversity Conservation Group
Nation-wide Social Network Portals

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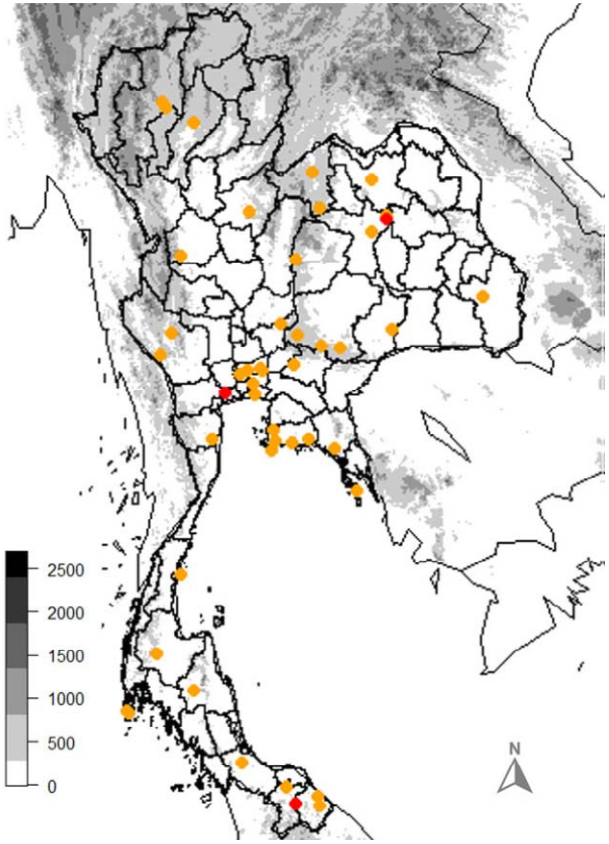
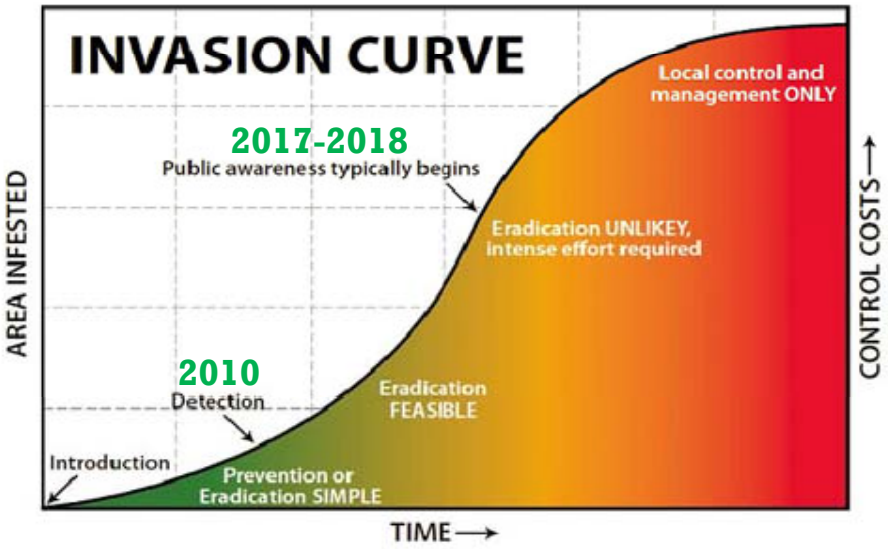
Distribution of New Guinea Flatworm in Thailand



**From Oct 2017 – June 2018,
there were 66 verified cases (N = 109)
in 40 districts of 31 provinces in Thailand.**

The oldest photographic evidence of *Platydermus manokwari* occurrence in Thailand (credit: Chayajit Deekrachang, 2010).



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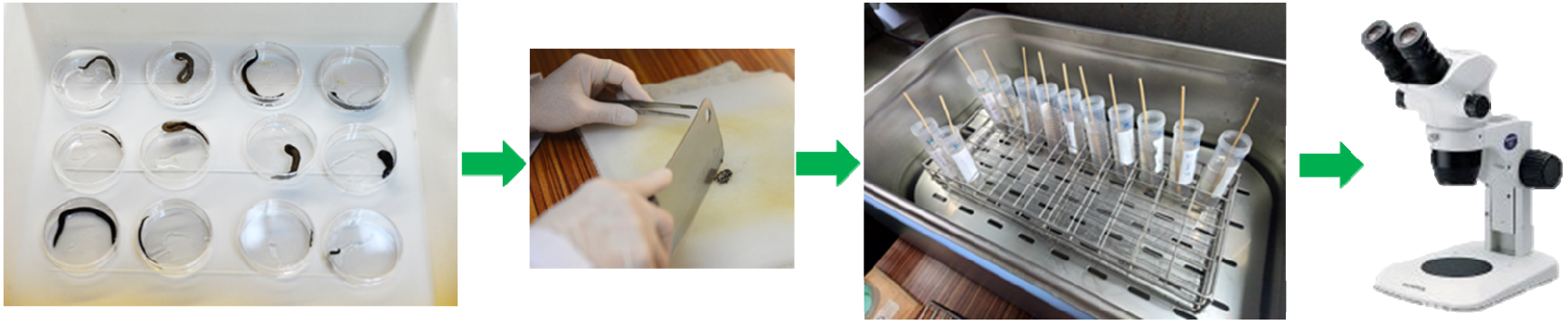
Public Health Concern

Evidence of Zoonotic Nematode (*Angiostrongylus* spp. larvae) Infection in New Guinea Flatworm Collected in Thailand



Artificial digestion experiment (1% Pepsin-HCl)

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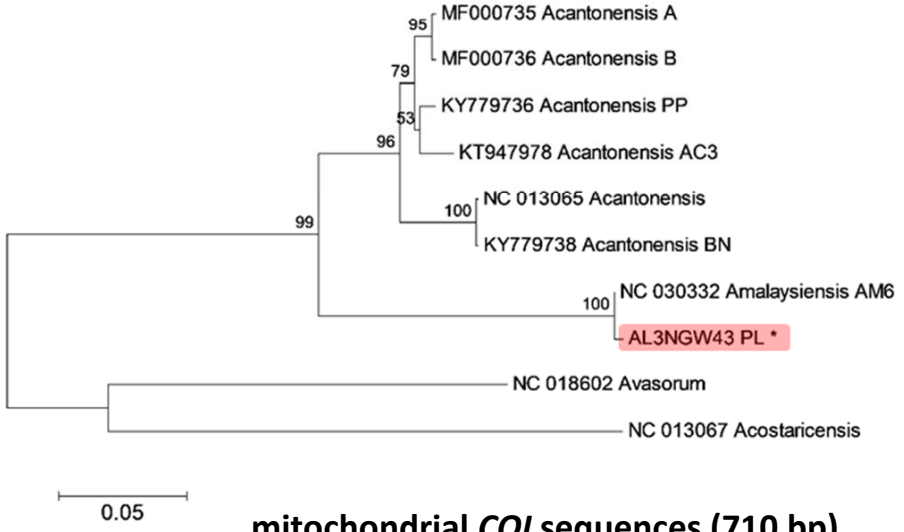
Public Health Concern

Infective stage larvae of parasitic nematode *Angiostrongylus spp.*

12.4% (15 infected out of 121 examined) of the flatworm harbored the parasitic nematode.

Intensity of infection ranges from **1 – 81 larvae.**



mitochondrial *COI* sequences (710 bp)

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Public Health Concern

Study of *Angiostrongylus* larvae in *P. manokwari* secretion

L3-positived *Biomphalaria glabrata* snail

Experimental infection of L3 *Angiostrongylus* larvae to *P. manokwari* via feeding

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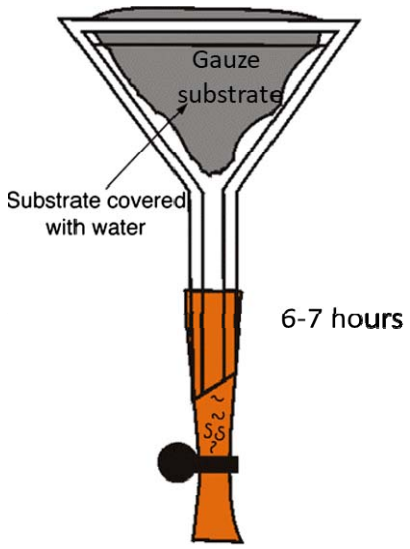
Public Health Concern

***P. manokwari* able to shed L3 larvae through secretions!!**

L3-positive *P. manokwari* stayed in clean substrate (gauze) for 1 week.



Baermann isolation technique

Numbers of L3 found in the substrates

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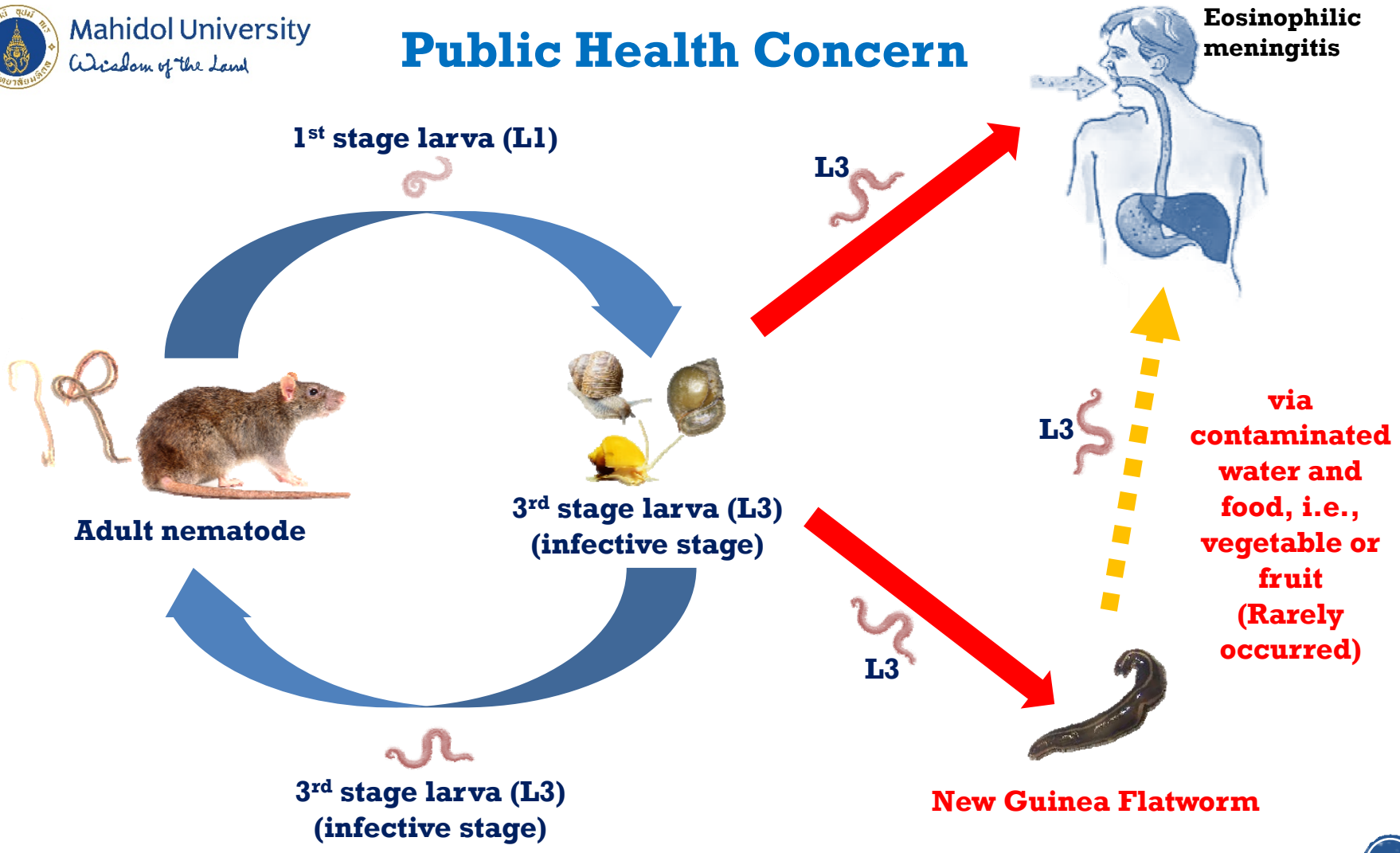
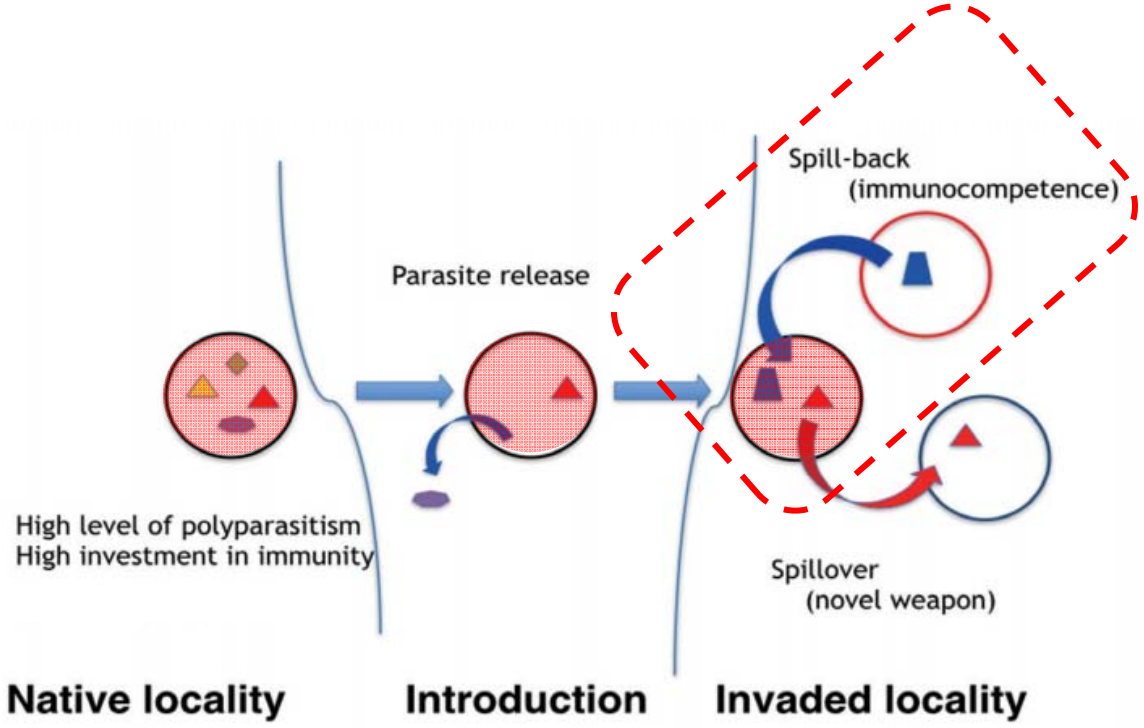


Parasite in the invasion process



Parasite spill-back:
a native parasite (*Angiostrongylus*) infects competent invasive host species *(P. manokwari)*, which produces a wider host range that promotes parasite survival

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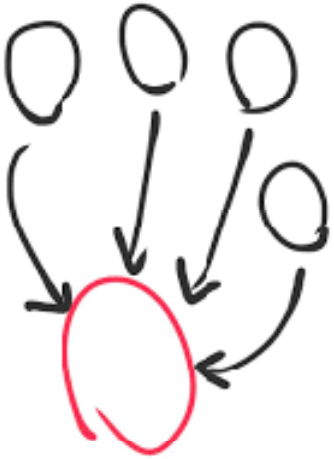
Conclusions



- With benefit of Citizen Science approach, this can help researchers to maximize the amount of data collected on a project, and help in long term monitoring system.
- We reported the global invasive flatworm *P. manokwari* for the first time in Thailand.
- The flatworms were also harboured infective stage larvae of *Angiostrongylus* nematode potentially causing eosinophilic meningitis in humans.
- We emphasize role of invasive species in the life cycle of a parasitic nematode.
- This could alerts awareness about impacts of invasive species in biodiversity conservation.

Acknowledgement

Financial support: Internal research budget of the Dept Helminthology, Fact. Trop Med, Mahidol University.

Peer reviewing and species verification of *P. manokwari* photos

Prof. Jean-Lou Justine
Muséum National d'Histoire Naturelle, Paris

Prof. Leigh Winsor
College of Marine and Environmental Biology
James Cook University, North Queenland

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Sample and data collection

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Chayajit Deekrachang
Mongkol Untachai
Saran Sittisamran
Pathai Sricharoon
Preeda Poomchan

Other Siamensis.org members and local collaborators