MASSEY UNIVERSITY
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UNIVERSITY OF NEW ZEALAND

Wild animals as reservoirs of novel and emerging paramyxoviruses.

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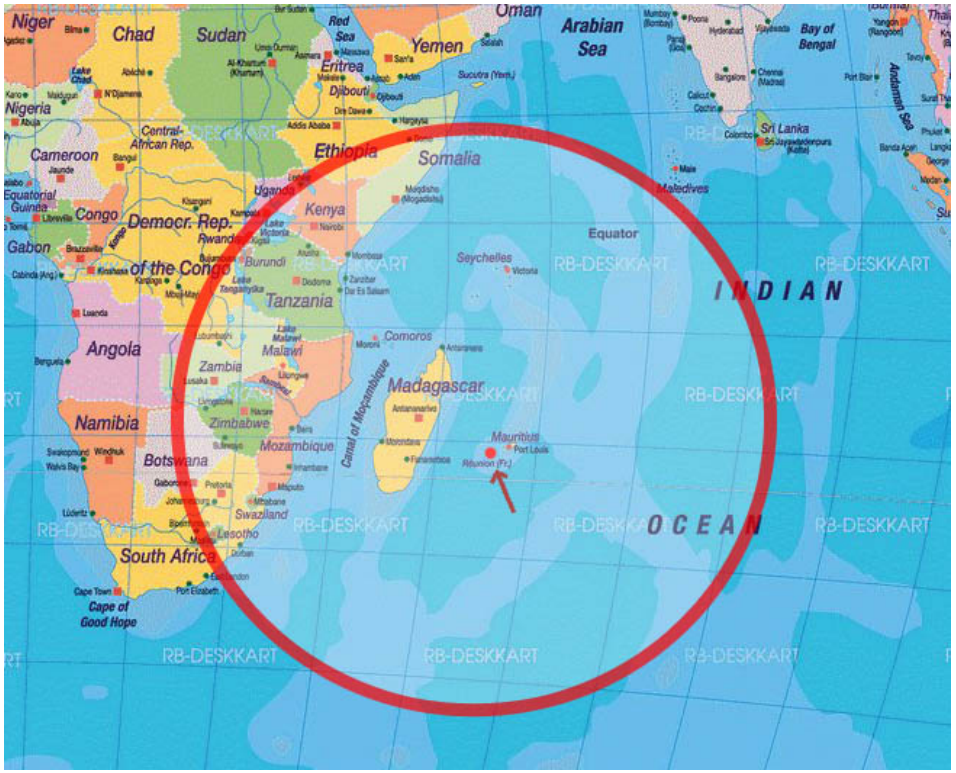
mEpiLab

La Reunion Island

- French Overseas Department
- Southwestern Indian Ocean
- Approx. 60km Diameter
- Population 850,000



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Chikungunya Virus

(that which bends up)

- *Alphavirus* (*Togaviridae*)
- Arbovirus

- Causes fever, and severe joint pains
- Low mortality, but symptoms can last for months or years

- Indian ocean lineage E1-E226V mutation
  - 50-100 fold increased vector efficiency *Aedes albopictus*

- Nearly **300,000 cases** in La Reunion

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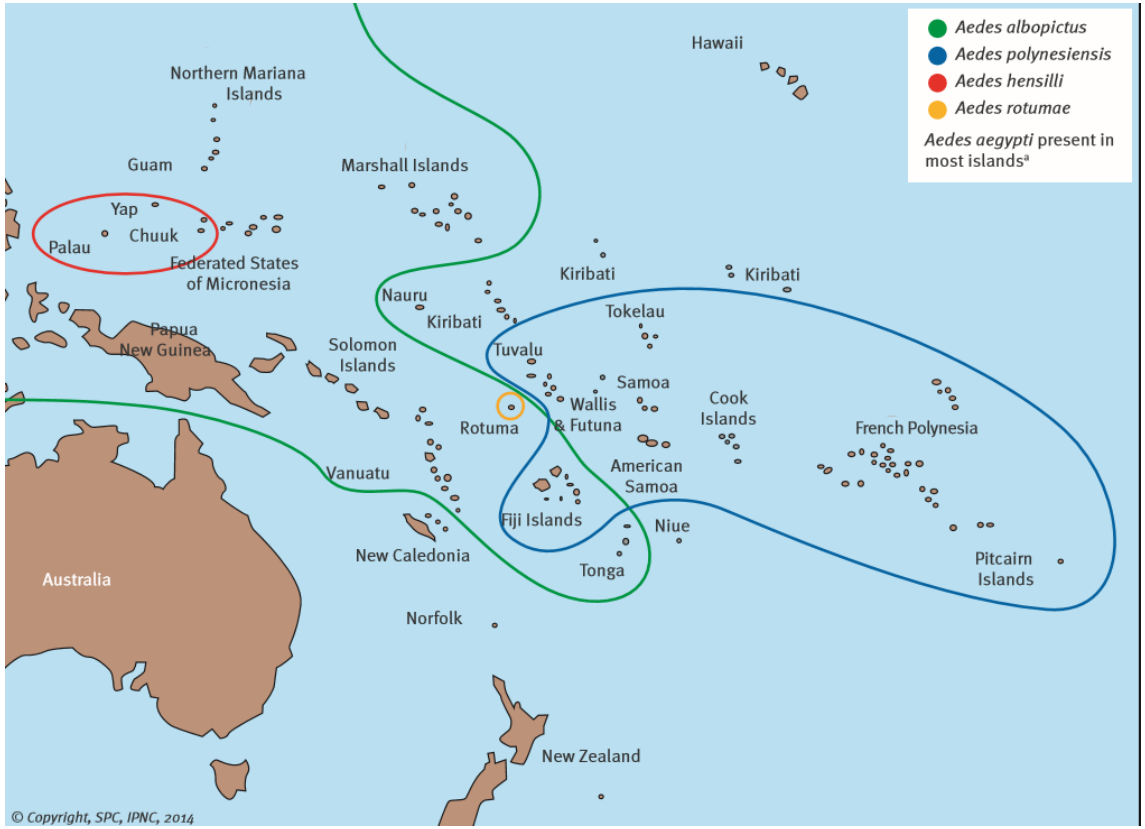
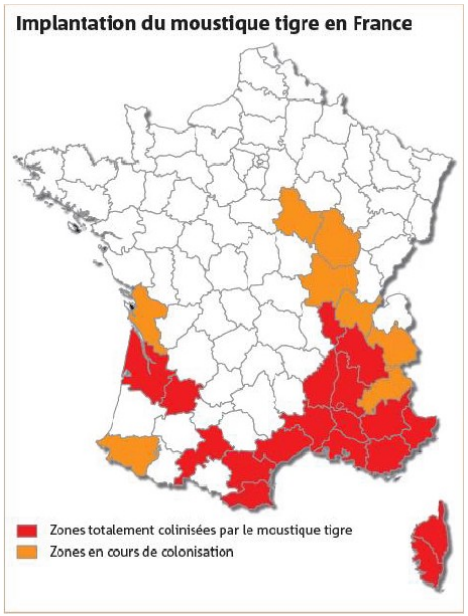
Concurrent outbreaks of dengue, chikungunya and Zika virus infections – an unprecedented epidemic wave of mosquito-borne viruses in the Pacific 2012–2014

A Roth (adamr@spc.int)[1], A Mercier[1], C Lepers[1], D Hoy[1], S Duituturaga[1], E Benyon[1], L Guillaumot[2], Y Souarès[1]
1. Secretariat of the Pacific Community, New Caledonia
2. Institut Pasteur de Nouvelle-Caledonie, Noumea, New Caledonia





Biosecurity is extremely important to keep NZ free of these diseases.

As a result of chikungunya.

- Construction of a new research building – CYROI, St-Denis.
- **FP7 REGPOT – RUN EMERGE:** "Supporting the research potential on emerging infectious diseases on La Reunion island, an EU outer-most region in the South Western Indian ocean.
- **FEDER:** *Inventaire des Agents Infectieux Associés à la Faune Sauvage dans le Sud-ouest de l'Océan Indien : biodiversités animale et microbienne dans des écosystèmes insulaires*.

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Stamp collectors

- Identify wild animal reservoirs of infectious agents.
- Describe new animal-associated microbes that may or may not be associated with disease.

- Why?
  - Interest in the tree of microbial life
  - Risk assessment for managing disease reservoirs
  - Get a head start on future emerging agents

Microbes:

Viral Agents:

Influenza, Filoviruses, Lassa virus, Coronaviruses, Lyssaviruses, Hantaviruses, Alphaviruses, Hepatitis viruses, Paramyxoviruses.

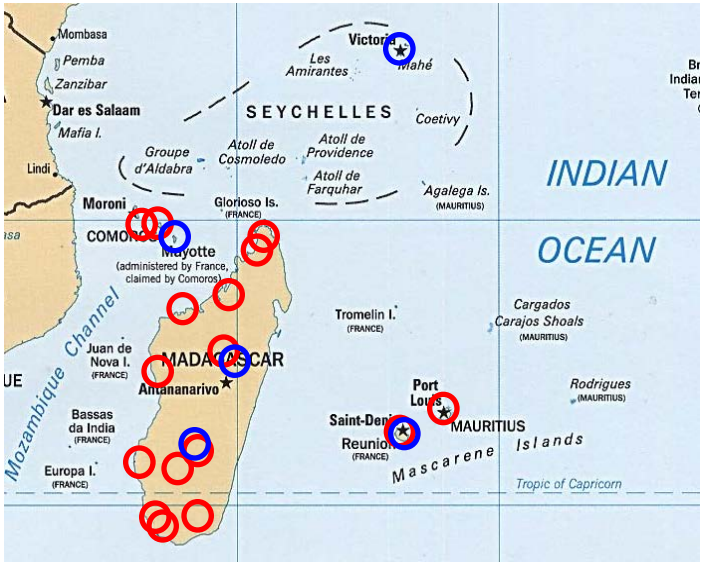
Bacteria Agents:

Bartonella, Rickettsia, Coxiella, Yersinia, Leptospira.

Animal Hosts:

Bats, Rodents, Tenrecs, Shrews

BIRDS



Ectoparasites:

Ticks, Fleas, Bat Flies, Mites

ENDEMIC VS. INTRODUCED

ANIMAL BIODIVERSITY – PATHOGEN BIODIVERSITY?

Detection:

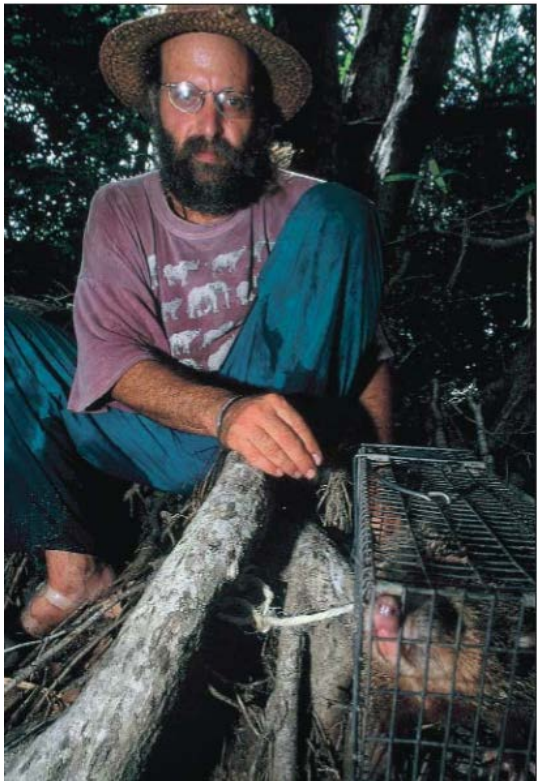
Serology, Molecular detection (PCR/qPCR), Next-Generation Sequencing

Prof Steven M Goodman
Field Museum, Chicago
Vahatra Institute, Madagascar

Profile Steve Goodman

Madagascar Tames the Bohemian of Biology

After a career that makes him sound like a biological Indiana Jones, Steve Goodman may have settled down, but he is still fighting to save this island's unique wildlife



Wild animals as reservoirs of novel and emerging paramyxoviruses.

Paramyxoviridae Disease Associations

Sub-family	Genus	Animal Disease	Human Disease	Animal Reservoir
Pneumovirinae	Metapneumovirus	Avian metapneumovirus	✱Human metapneumovirus	
	Pneumovirus	Murine pneumonia virus ✱Bovine RSV	✱Human RSV	
Paramyxovirinae	Avulavirus	✱Newcastle Disease Virus Pigeon Paramyxoviruses		Avian paramyxoviruses (many)
	Aquaparamyxovirus	✱Atlantic Salmon paramyxovirus ✱Pacific Salmon paramyxovirus		
	Ferlavirus	Ferdelance Virus		Reptile paramyxovirus
	Henipavirus	✱Hendra Virus ✱Nipah Virus	✱Hendra virus ✱Nipah virus	Hendra virus Nipah virus Cedar virus
	Morbillivirus	Canine Distemper Virus Phocine Distemper Virus Feline Morbillivirus Dolphin Morbillivirus ✱PPR virus ✱Rinderpest virus	✱Measles virus	
	Rubulavirus	Tioman virus	✱Mumps virus ✱Human parainfluenza 2,4,5	Achimota virus 1,2,3 Tuhoko virus 1,2,3 Tioman virus
	Respirovirus	Swine parainfluenza	✱Sendai virus ✱Human parainfluenza 1,3	
	Unclassified	✱Salem Virus Beilong Virus Tailam virus J-virus		Mossman virus Nariva virus Tupaia virus Henipa-related viruses Morbilli-related viruses Sunshine virus

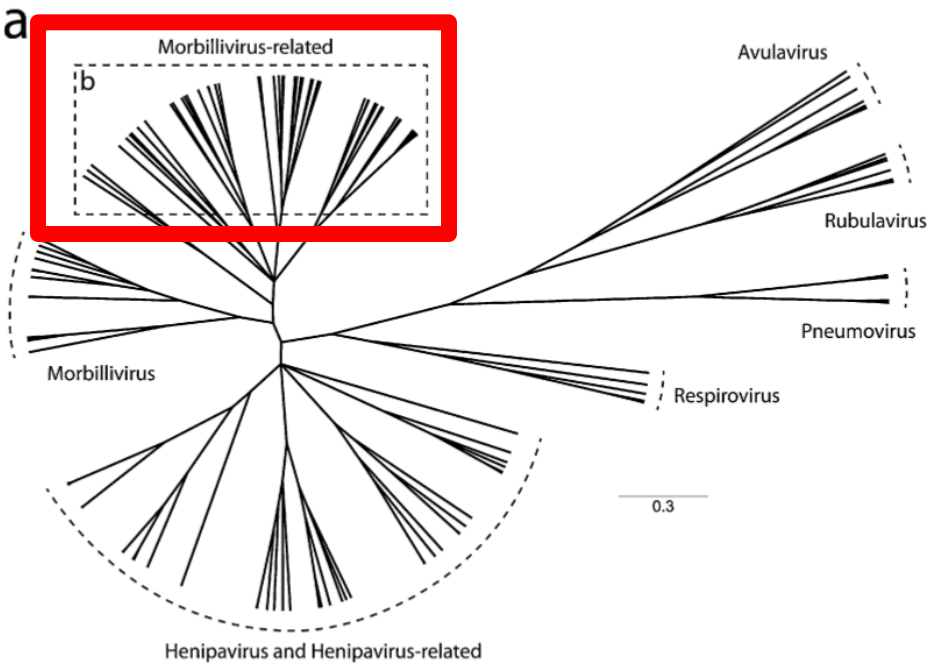
☐ High Mortality
✱ Socioeconomic importance

Remarkable numbers

- Up to 60% prevalence of detection by PCR in some mammalian populations.

- Paramyxoviruses detected in almost ALL genera tests.

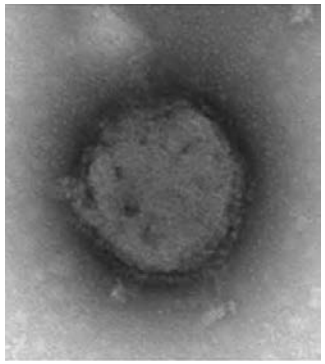
Paramyxoviruses in the SWIO



- The viruses present are new, uncharacterized members of the *Paramyxoviridae* family.
- We called them Uncharacterised Morbilli-Related Viruses (UMRVs)

Wilkinson DA et al. 2012, Virus Research

Do we believe our own results?



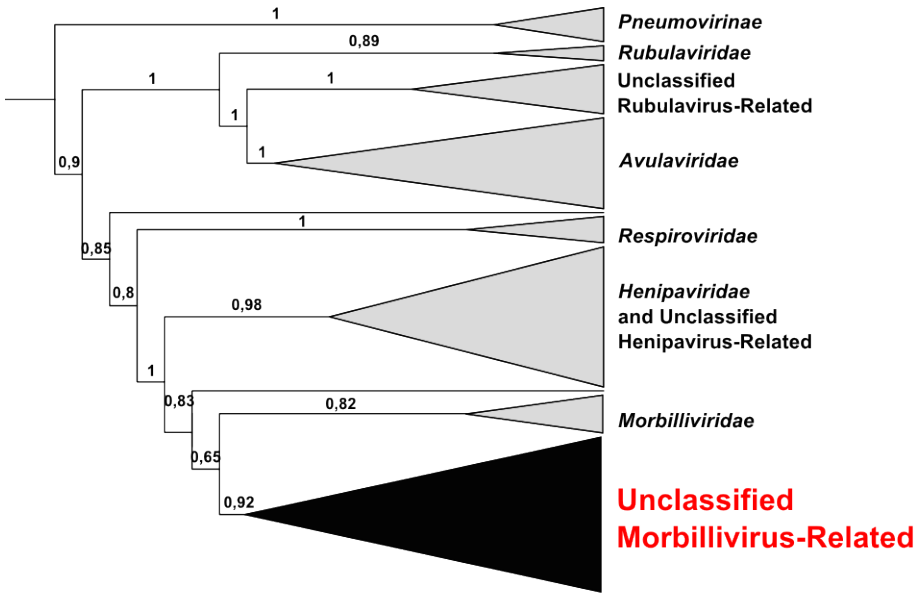
- LOTS of controls.
- Viruses isolated.
- Whole genomes sequenced
  - Agreement with our PCR results.
- Seroneutralisation assays established
  - Some (few) aninmals have virus neutralising sera.

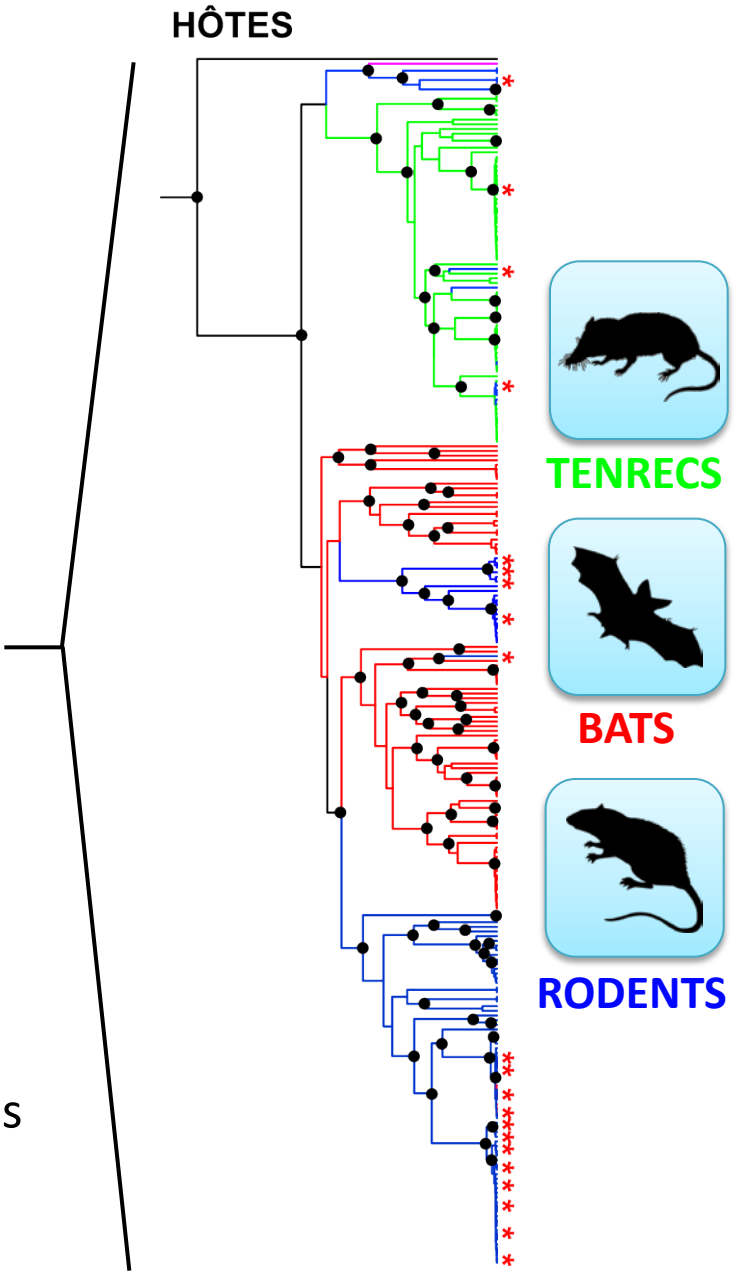
- Other people seem to agree with us.

Bats host major mammalian paramyxoviruses

Drexler JF et al. Nature Communications, 2012

Paramyxoviruses in the SWIO





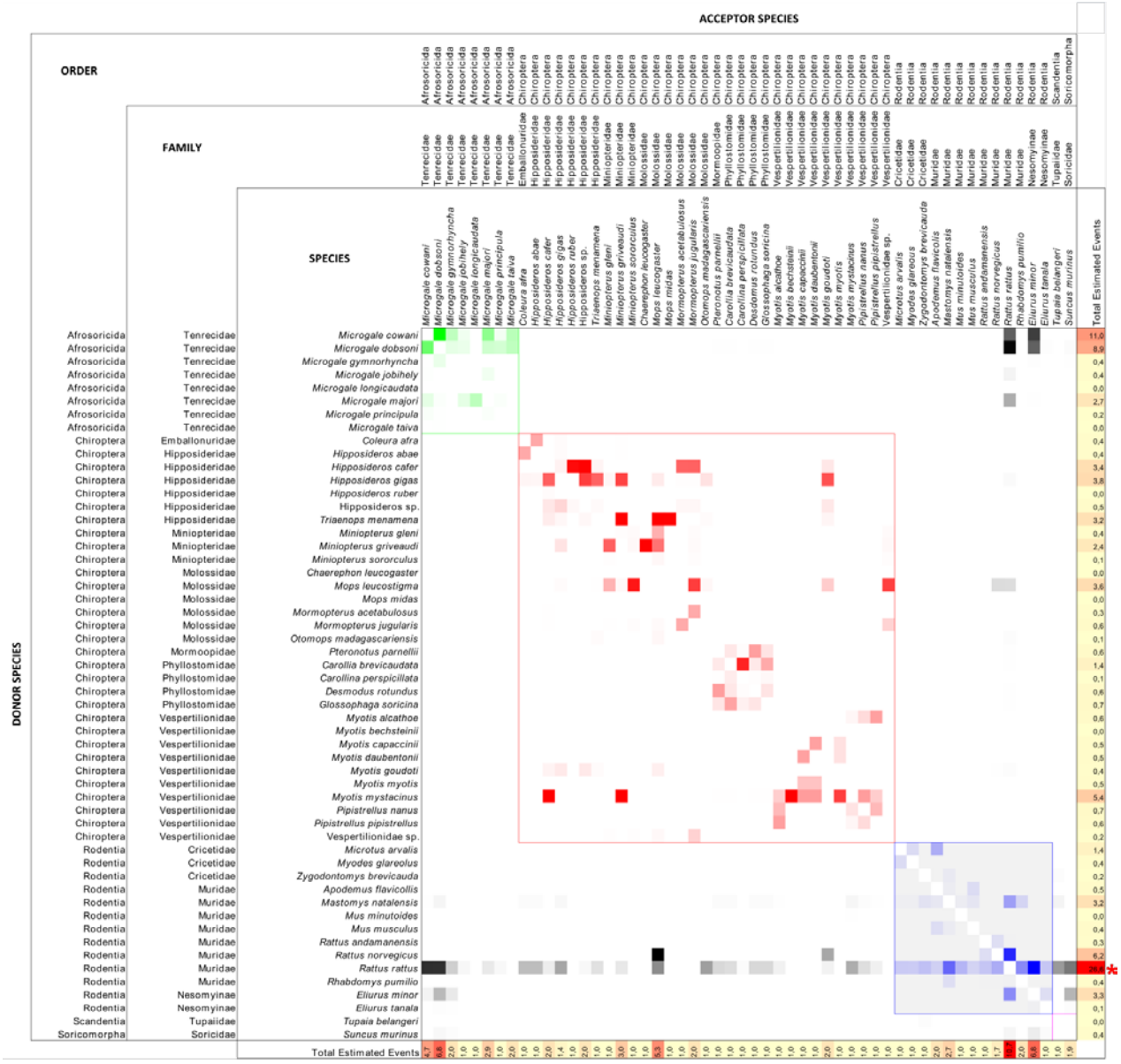
- The viruses present are new, uncharacterized members of the *Paramyxoviridae* family.

- Viruses display a level of host specificity, however switching events between host species seem common.

Wilkinson DA et al. 2014, J.Virol

Paramyxovirus Host switching

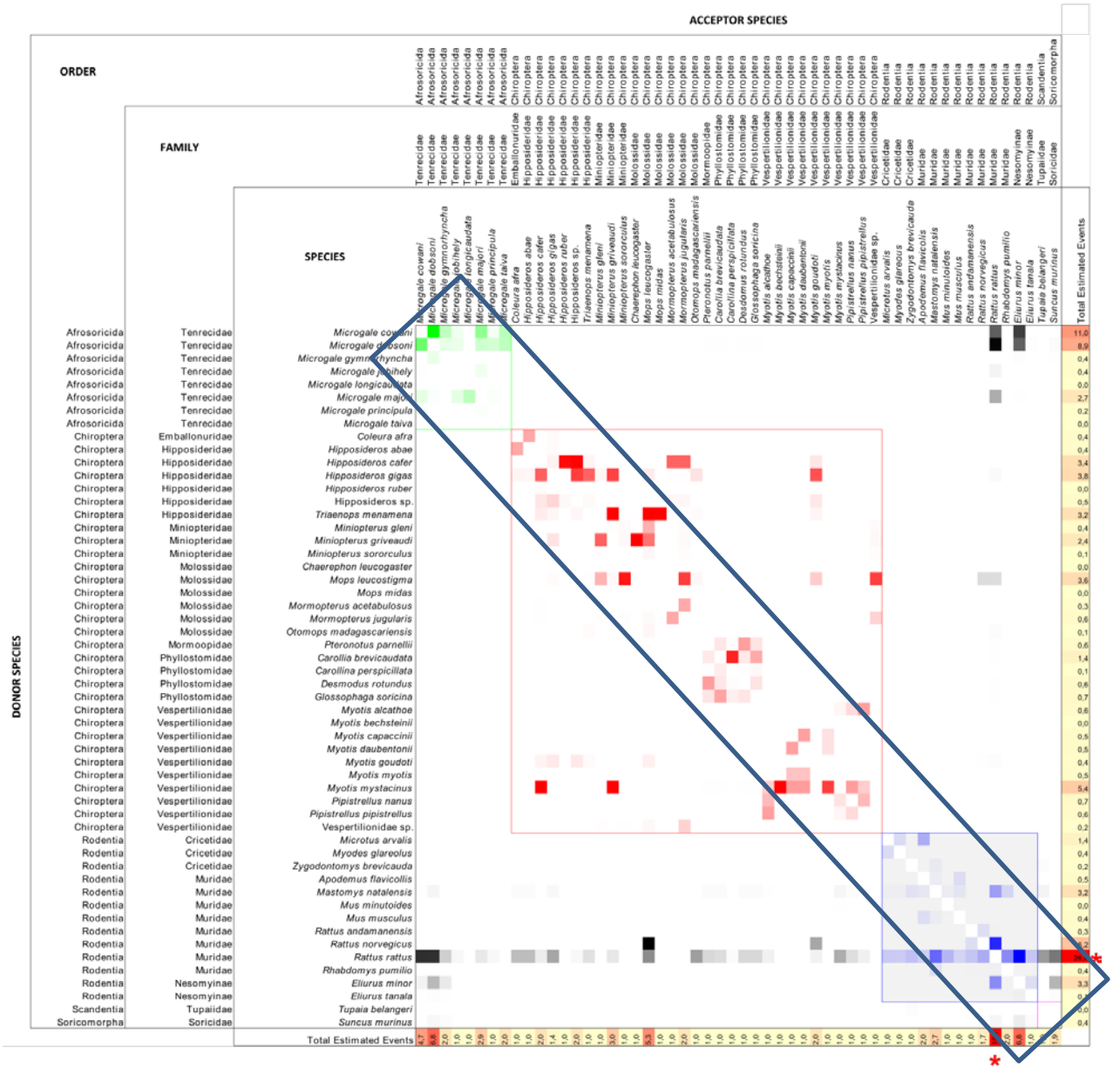
- Results of the analysis of probabilities of host switch events.



Wilkinson DA et al. 2014, J.Virol

Paramyxovirus Host switching

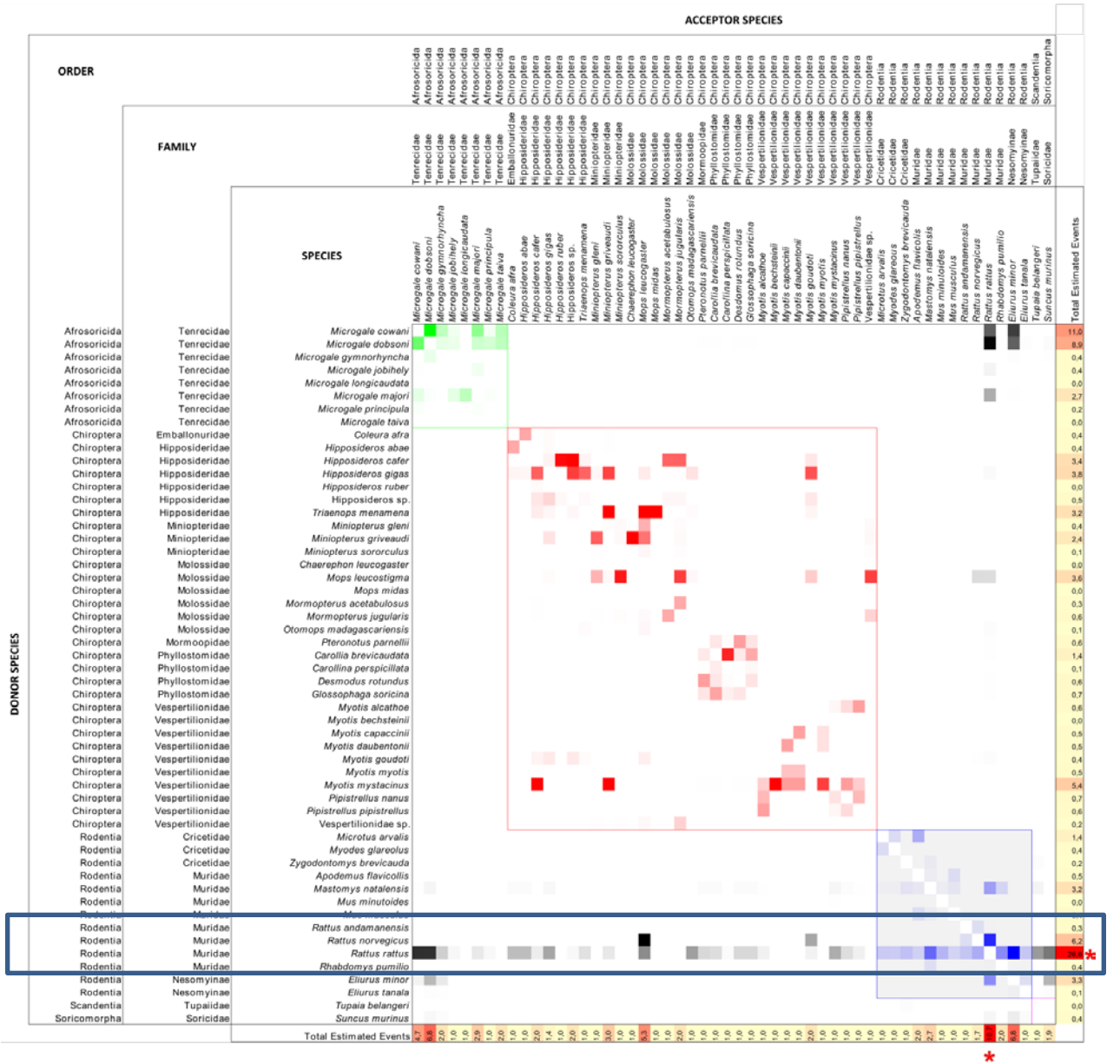
- Results of the analysis of probabilities of host switch events.
- Host switching occurs most commonly between closely-related species (host-specificity).



Wilkinson DA et al. 2014, J.Virol

Paramyxovirus Host switching

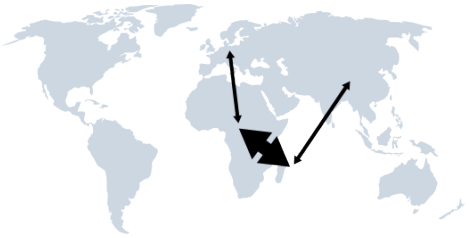
- Results of the analysis of probabilities of host switch events.
- Host switching occurs most commonly between closely-related species (host-specificity).
- *Rattus rattus* is only species to be implicated in host switching events between multiples different species, from different taxonomic orders.

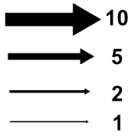


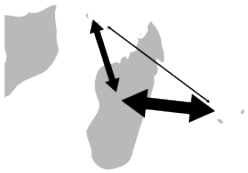
Wilkinson DA et al. 2014, J.Virol

Geographical distribution

	AFR	ASIA	AUS	EUR	S.AM	SWIO
AFR		0,51	0,69	2,63	0,55	1,90
ASIA	0,24		0,21	0,01	0,25	1,38
AUS	0,36	0,10		0,14	0,19	0,04
EUR	0,93	0,17	0,68		0,00	0,68
S.AM	0,34	0,14	0,19	0,00		0,17
SWIO	8,59	1,65	0,21	0,64	0,84	







	COM	RUN	MAD	MAU	SEY
COM		1,07	0,46	0,00	0,38
RUN	2,07		2,58	0,00	0,04
MAD	4,60	6,35		1,00	0,33
MAU	0,00	0,00	0,00		0,00
SEY	0,38	0,03	0,13	0,00	

•Arrival and dissemination of paramyxoviruses within the SWIO has occurred independently on several occasions

•Exchange betweeen Africa and the SWIO occurs frequently.

•Exchange between Islands of the SWIO occurs frequently.

Conclusions

- High diversity of unidentified zoonotic viruses.
  - Do we underestimate this?
  - Is it a risk?
- To understand how these viruses circulate (and thus risk), we need to understand evolutionary timescales.
  - Do molecular clock methodologies work for RNA viruses?

Epidemiological questions?

- How do we explain high levels of PCR-based detection vs. low seroprevalence?

Biosecurity

- In addition to potentially devastating environments by physical mechanisms and competition, introduced species can bring microbes and disease, or the potential for disease transmission with them.

- Really good at this in NZ

- Less good in developing countries.
  - STOP-RATS program

Many Thanks

MASSEY UNIVERSITY
TE KUNENGA KI PŪREHUROA
UNIVERSITY OF NEW ZEALAND

m EpiLab

UNIVERSITE DES COMORES

Institut Pasteur de Madagascar

The Field Museum

SEPTIEME PROGRAMME-CADRE

UNIVERSITÉ DE LA RÉUNION
S'ouvrir aux mondes

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ISLAND CONSERVATION SOCIETY

La Réunion
Parc National

LAHATRA