emerging infectious disease

3 April 2022

## emerging and re-emerging disease

basically, anything we’re worried about

* new mutations
* change in environment
* resistant strains
* species jumps (encounter and compatibility: changes via recombination, mutation)

Do we need to understand *everything*?

* reservoir ecology
* pathogen biology
* human-reservoir interactions

How do we understand? How do we predict?

## *Batrachochytrium dendrobatidis*

**Reminders**

* fungal pathogen
  + most other chytrids are saprophytes, plant pathogens
  + *B. salamandrivorans*: salamander pathogen (more restricted)
* first discoved in poison dart frogs
* caused die-offs in E Australia, Central America, Colorado, California …
* association with high altitude?
* occurred in pristine areas (probably not anthropogenic?)
* pathogenesis via screwed-up osmoregulation

Very confusing …

* some species decline in the absence of Bd
* some species stable in the presence of Bd  
  (Bd may have been there all along?)
* susceptibility:
  + ability to bask
  + antimicrobial peptides

**tipping point hypothesis**: in populations all the time, but something happened to increase virulence/reduce tolerance or resistance

* climate change/El Niño ?
* ultraviolet radiation?
* cooler temperatures? (basking etc.)
* pesticides?
* combination (species × temperature × U/V × pesticide × …)
* Pounds et al. (2006): “chytrid-thermal-optimum hypothesis”
* Rohr et al. (2008): “numerous other variables, including regional banana and beer production, were better predictors of these extinctions”
* Rohr & Raffel (2010)

**novel pathogen hypothesis**: mutation/speciation + dispersal

* “Out of Africa” hypothesis
* earlier/broader detection in historical specimens: CA/bullfrog, Brazil …
* genomics (challenging!)
* Asian sampling

## monkeypox

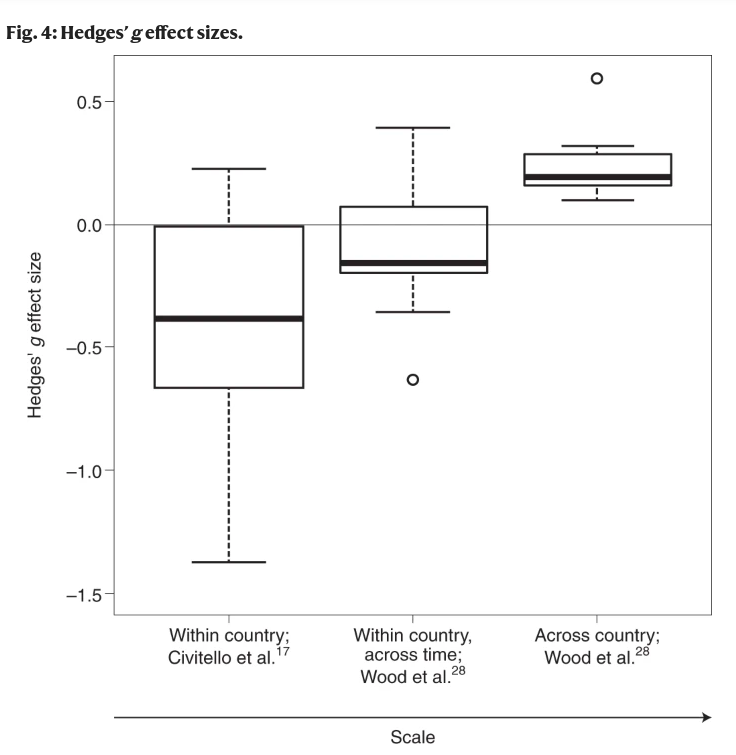
## climate change

* warming
  + ‘good’ or ‘bad’ for pathogens?
  + vector biology
    - extended range
    - higher activity?
* changes in seasonality, hydrological cycles
* local landscape change
  + hydrology
  + land cover (Lyme disease)
  + forest cover
* changes in reservoir communities

## dilution effect (Keesing & Ostfeld, 2021)

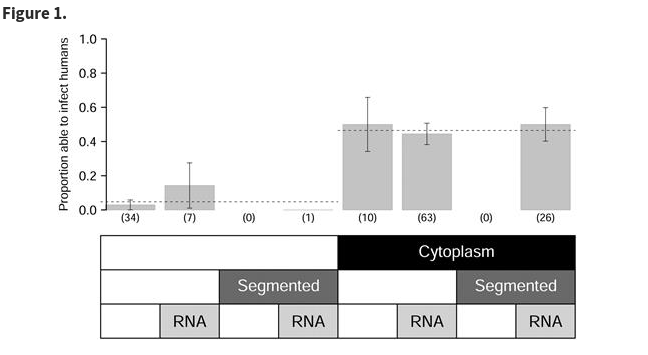
* does increased biodiversity decrease disease?
* variation in reservoir competence
* high-quality hosts decrease with increasing biodiversity
  + encounter reduction; host regulation; vector preferences

Rohr et al. (2020)

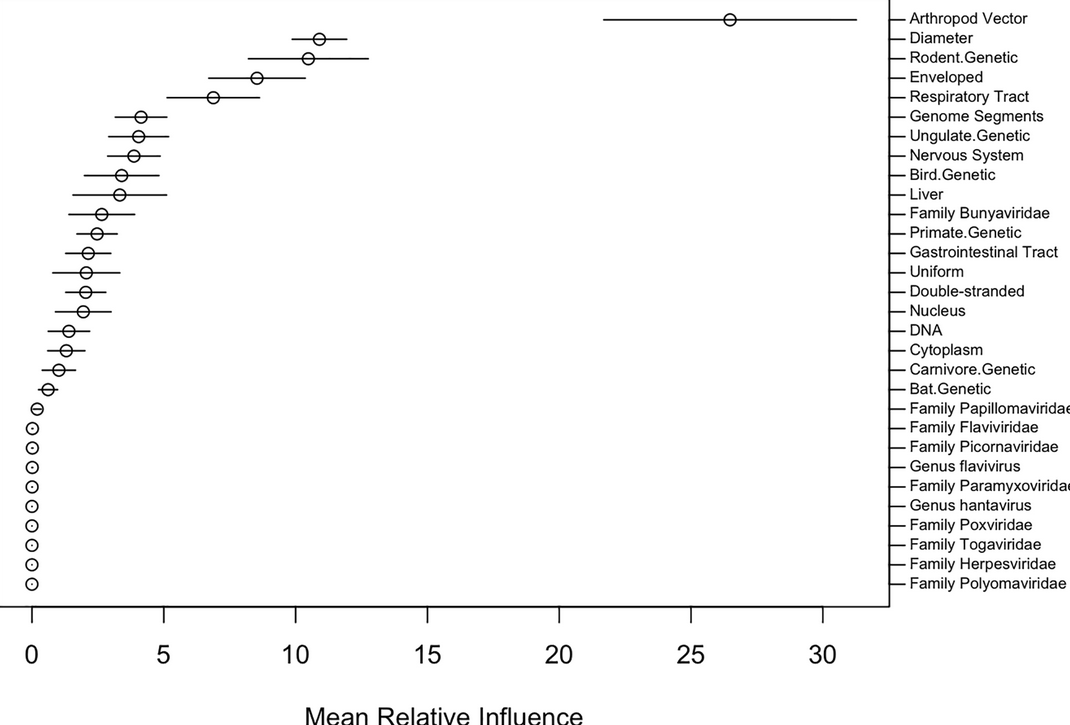


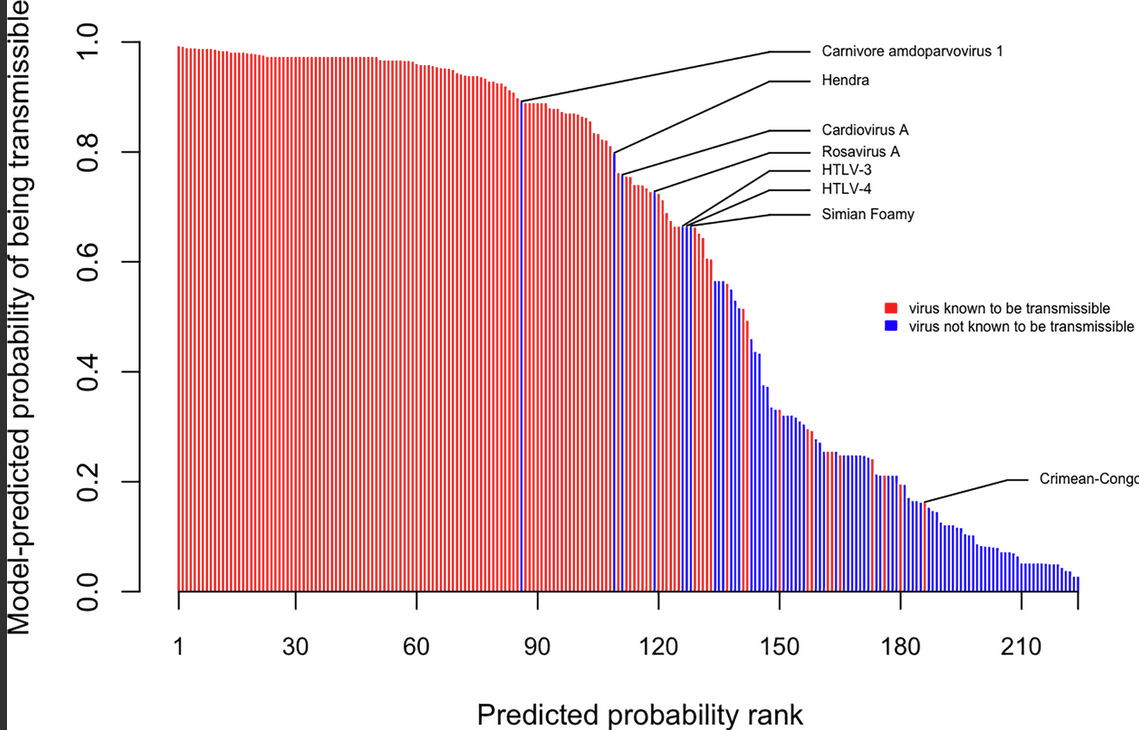
## prediction

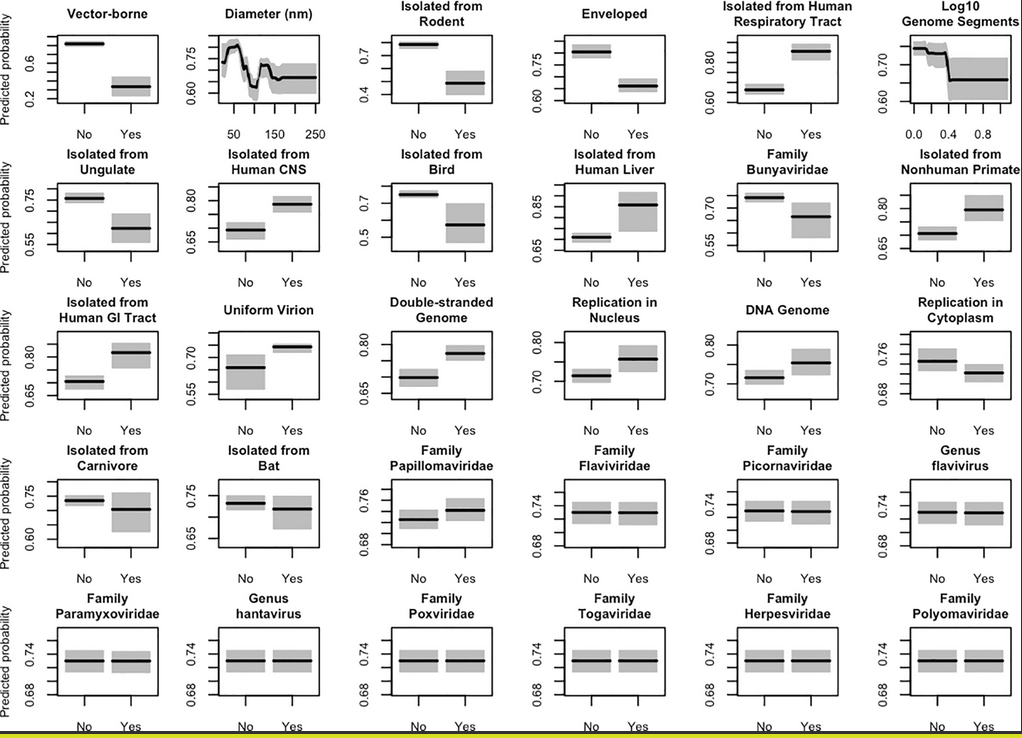
Pulliam & Dushoff (2009)



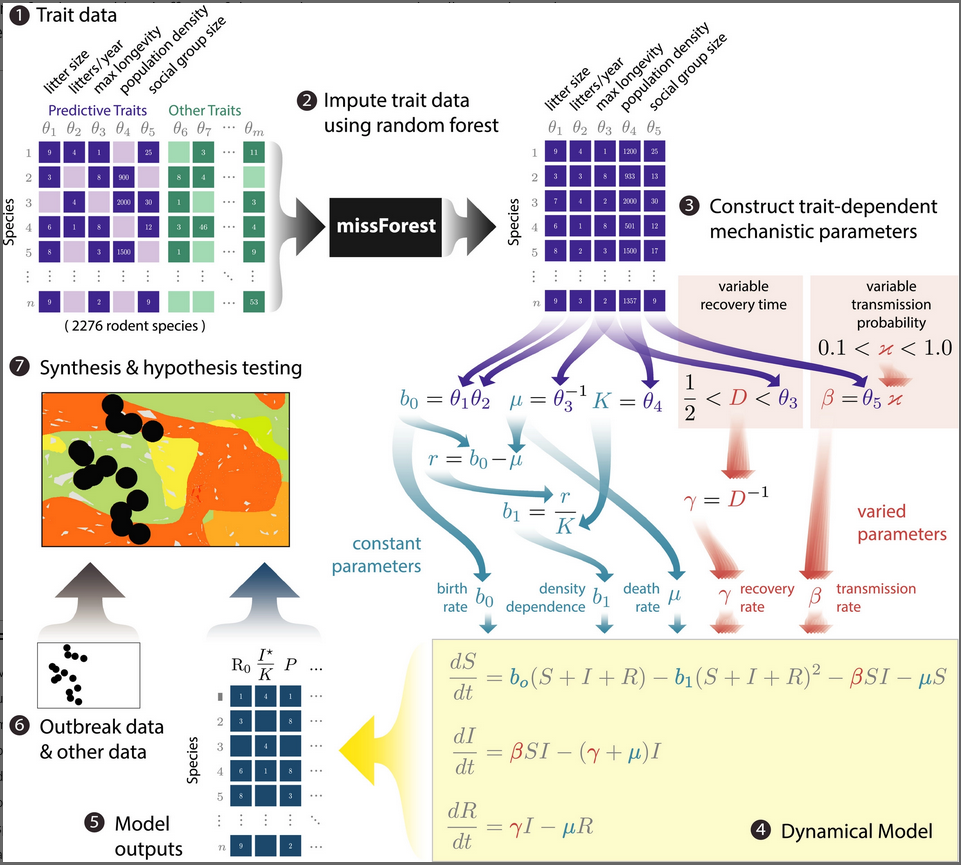
Walker et al. (2018)

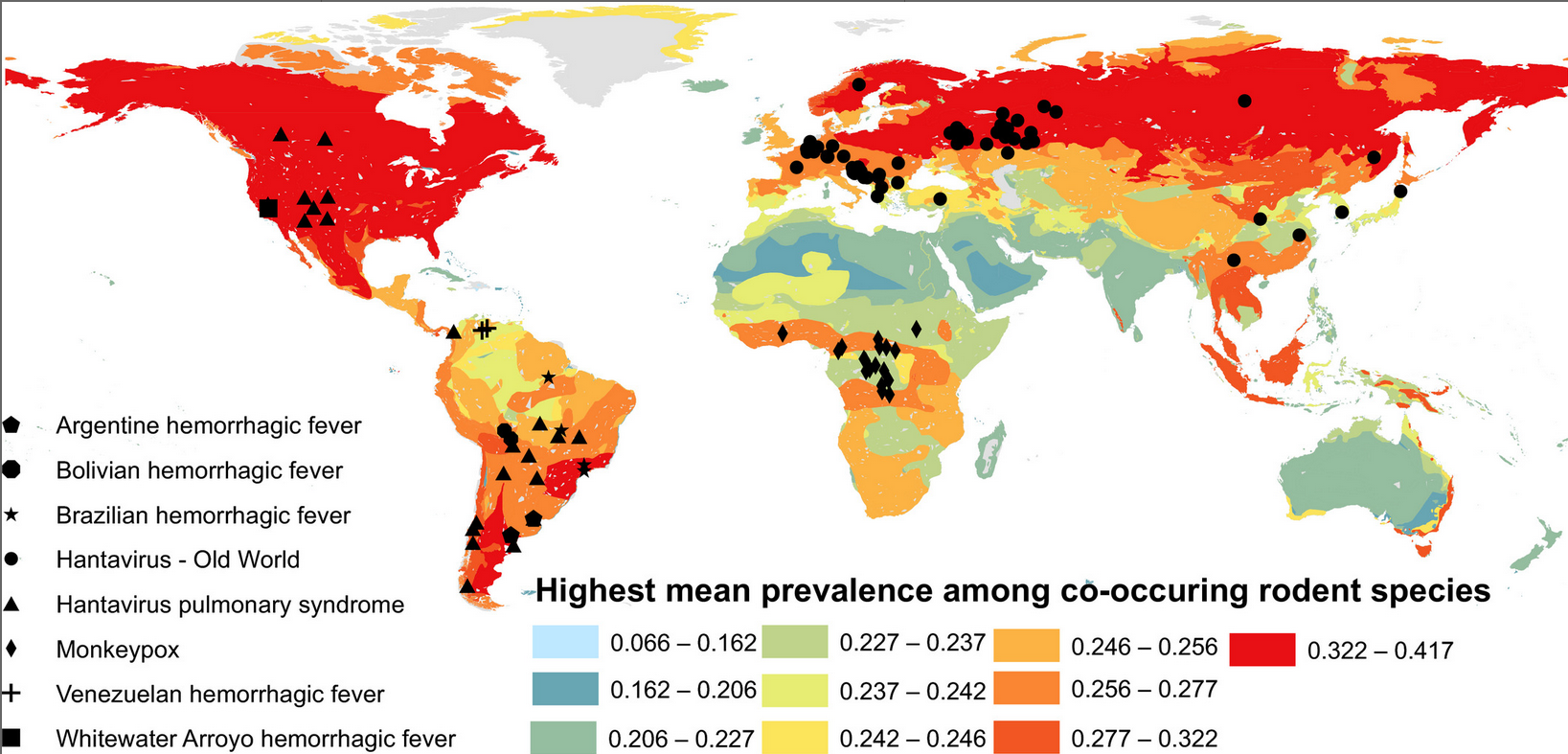






Han et al. (2020)





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