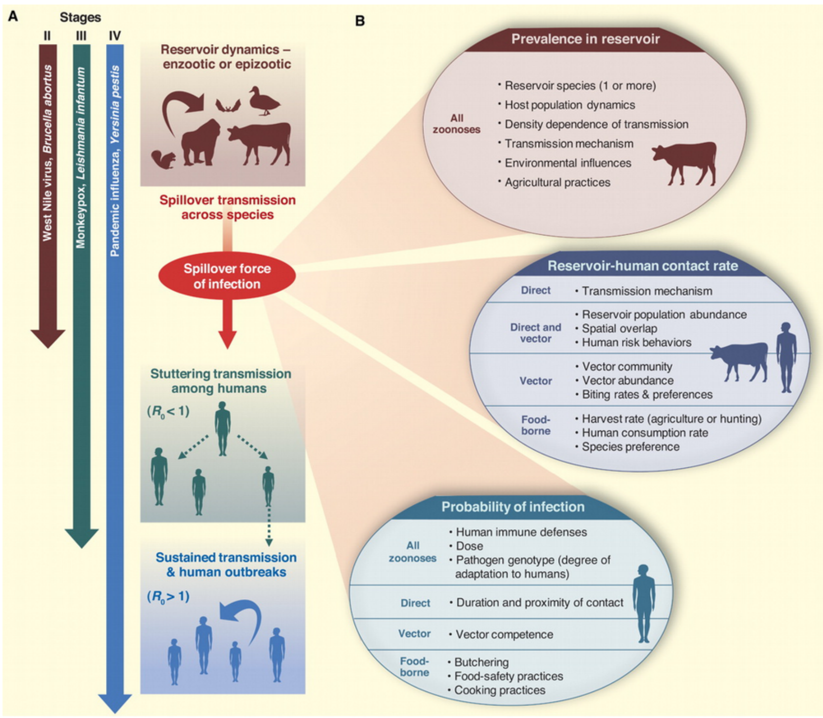
emerging infectious disease

3 April 2023

emerging and re-emerging disease



basically, anything we're worried about

- encounter filter: changing patterns of reservoir host/vector distribution, human contact, ...
- compatibility filter: changes via mutation, recombination, selection for resistance, ...

Do we need to understand *everything*?

- reservoir ecology
- pathogen biology
- human-reservoir interactions

How do we understand? How do we predict?

Batrachochytrium dendrobatidis

- 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?

  Very confusing . . .

- declines occurred in pristine areas (probably not anthropogenic?)
- some species decline in the absence of Bd
- some species stable in the presence of Bd
- **tipping point hypothesis**: in populations all the time, but something happened to increase virulence/reduce tolerance or resistance ($\approx$ compatibility filter)
  - climate change/El Niño ?
  - ultraviolet radiation?
  - pesticides?
  - combination (species $\times$ temperature $\times$ U/V $\times$ pesticide $\times \ldots$)? (Pounds et al., 2006; Rohr et al., 2008; Rohr & Raffel, 2010)
- **novel pathogen hypothesis**: mutation/speciation + dispersal
  - detection in historical specimens: CA/bullfrog, Brazil . . .
  - genomics (challenging!)
  - Asian sampling

  Fisher & Garner (2020)

effects of climate change

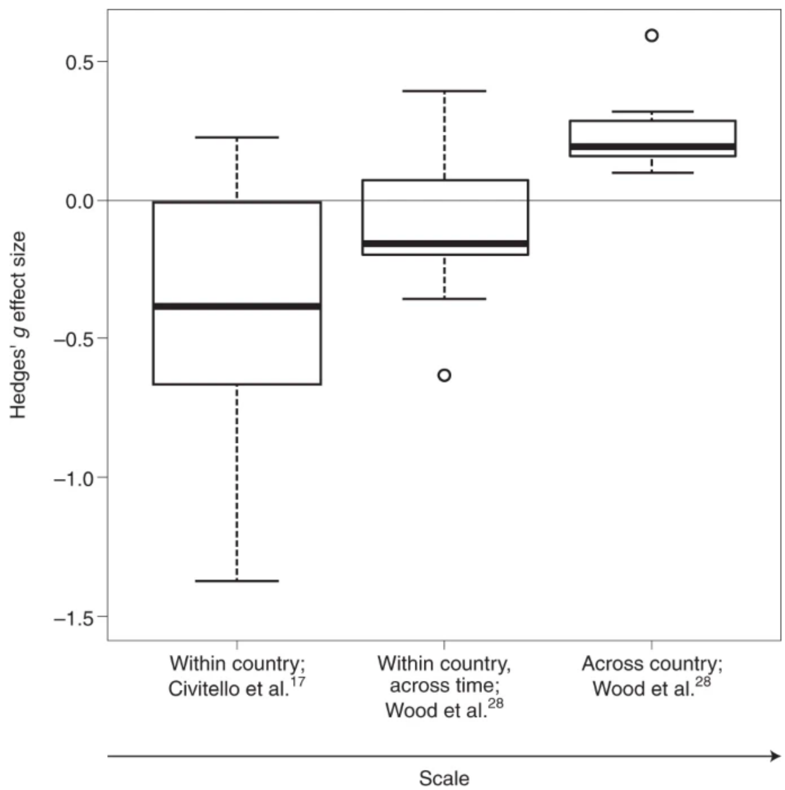
- warming
  - 'good' or 'bad' for pathogens?
  - vector biology
    * extended range
    * higher activity?
    * e.g. Mordecai et al. (2020): shift from *Anopheles gambiae* to *Aedes aegypti*, malaria to arboviruses (dengue, chikungunya etc.)
- changes in seasonality, hydrological cycles
- local landscape change
  - hydrology
  - suburbanization and reforestation: Lyme disease
  - deforestation
    * MacDonald & Mordecai (2019): deforestation increases malaria, but malaria decreases deforestation
- changes in reservoir communities

effects of biodiversity change: 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

Kain & Bolker (2019)
Rohr et al. (2020)

Fig. 4: Hedges' *g* effect sizes.



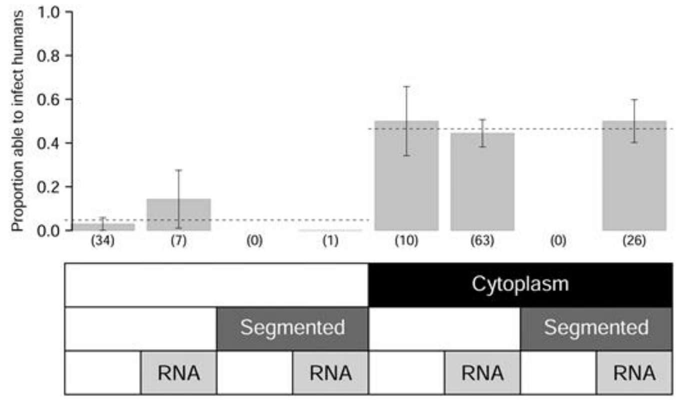
- Carlson et al. (2022): *higher* rodent diversity and climate anomalies drive plague spillover

surveillance and prediction

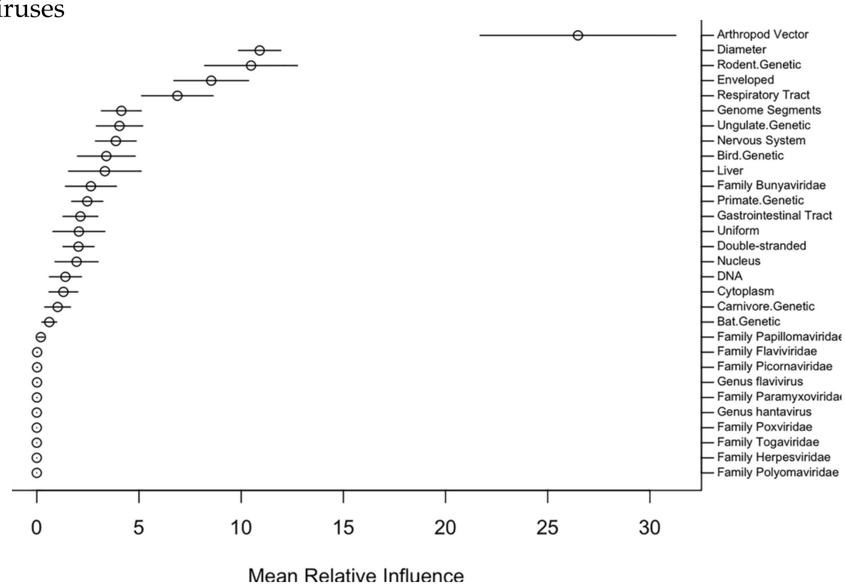
- which viruses will emerge, where, why?

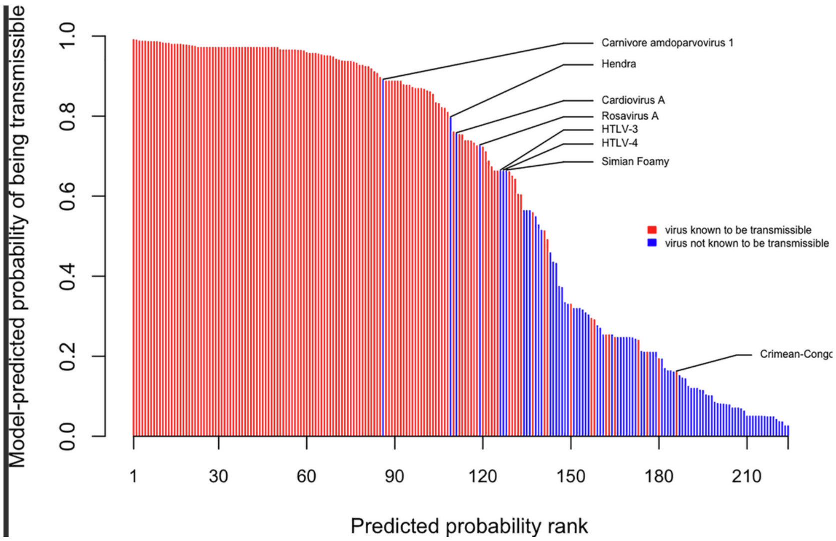
Pulliam & Dushoff (2009): predict zoonotic transmission of livestock viruses

Figure 1.

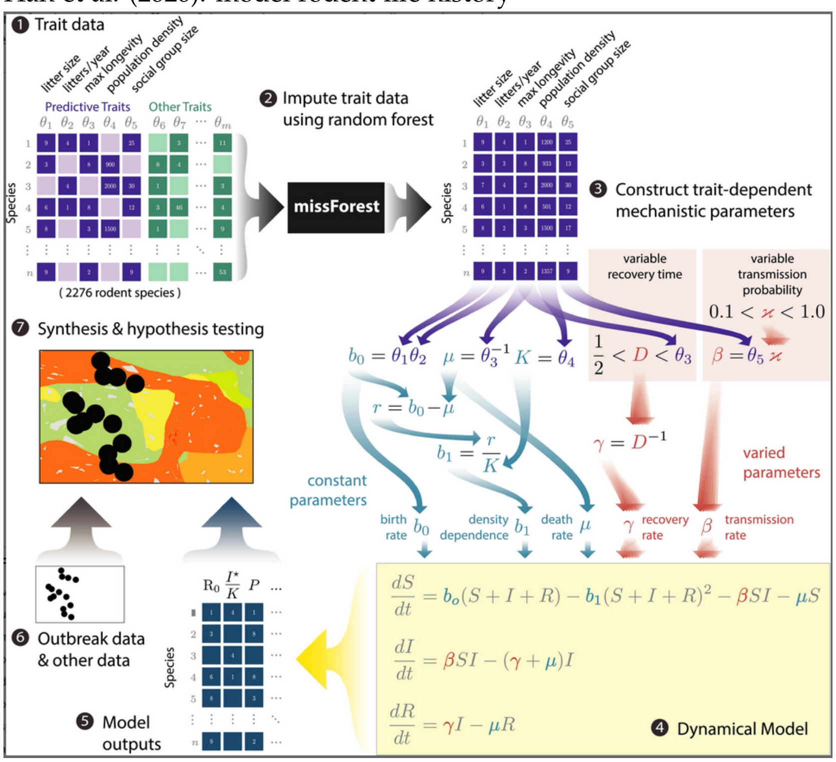


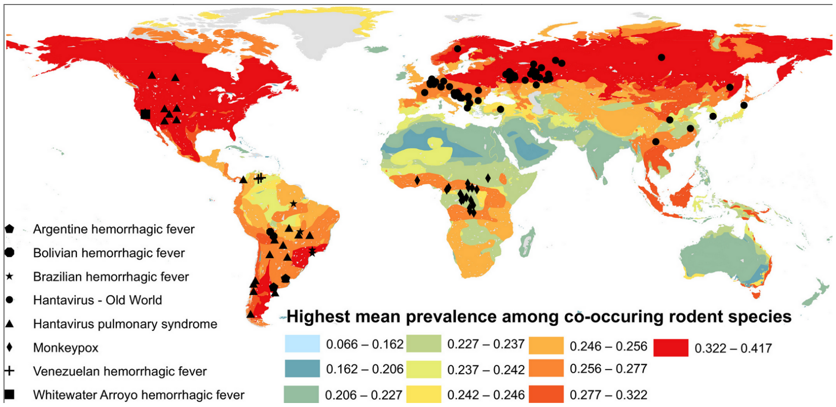
Walker et al. (2018): predict human transmission ability of zoonotic viruses





Han et al. (2020): model rodent life history





Evans et al. (2023): 2017-2020 sample: 12% of 693 individuals sampled in Myanmar were seropositive for sarbecovirus, more likely if they were loggers/hunters or had been exposed to bats ...

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