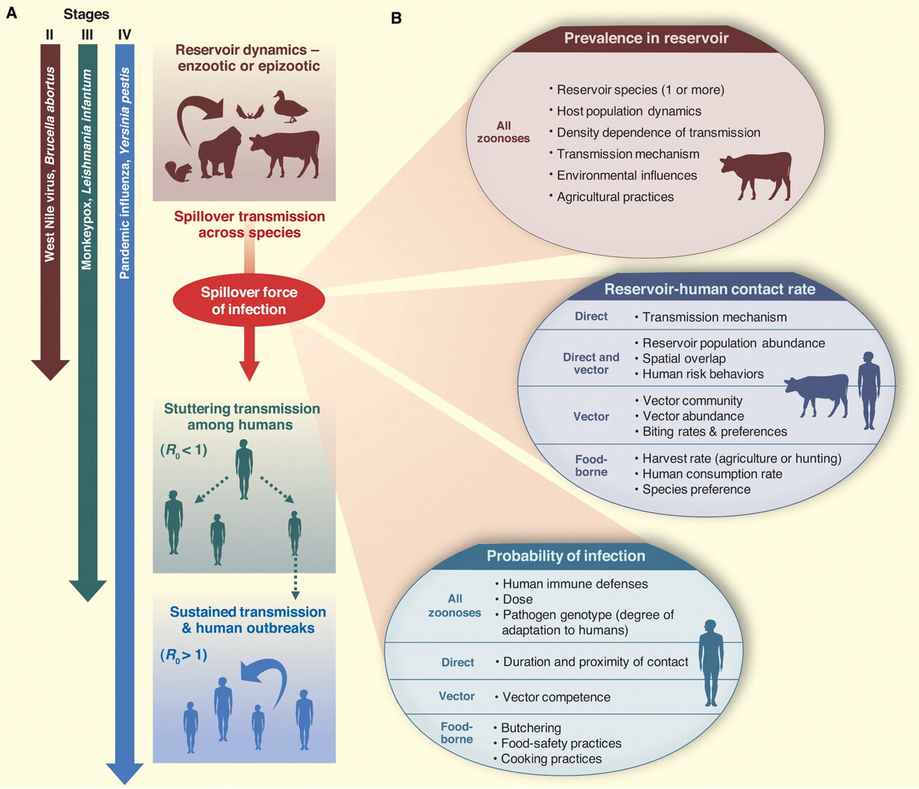
emerging infectious disease

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 ( compatibility filter)
  + climate change/El Niño ?
  + ultraviolet radiation?
  + pesticides?
  + combination (species × temperature × U/V × pesticide × …)? (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

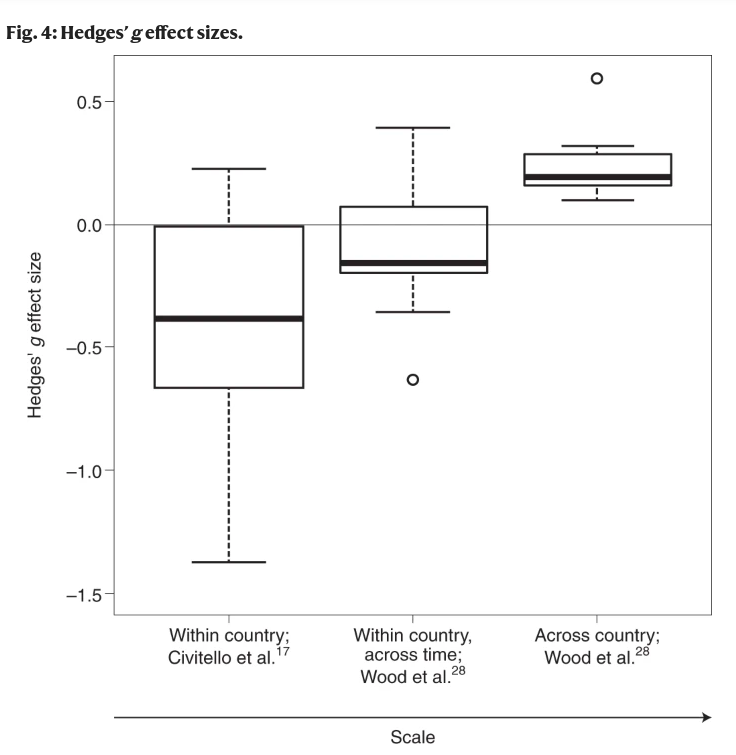
* warming
  + ‘good’ or ‘bad’ for pathogens?
  + vector biology
    - extended range
    - higher activity?
    - e.g. Mordecai et al. (2020): shift from *Anopheles gambiae* to *Aedes aegypti*, malaria to arboviruses (dengue, chikungunya etc.)
* changes in seasonality, hydrological cycles
* local landscape 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)

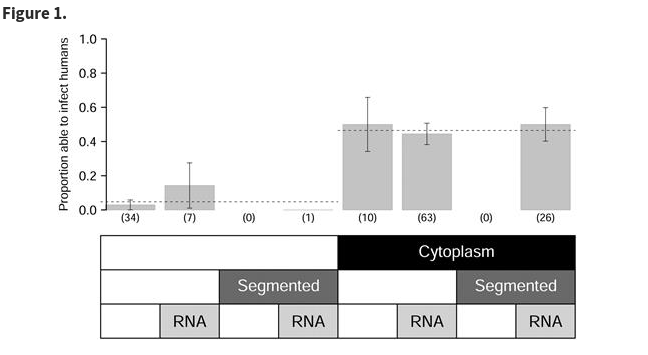


* Carlson et al. (2022): *higher* rodent diversity and climate anomalies drive plague spillover

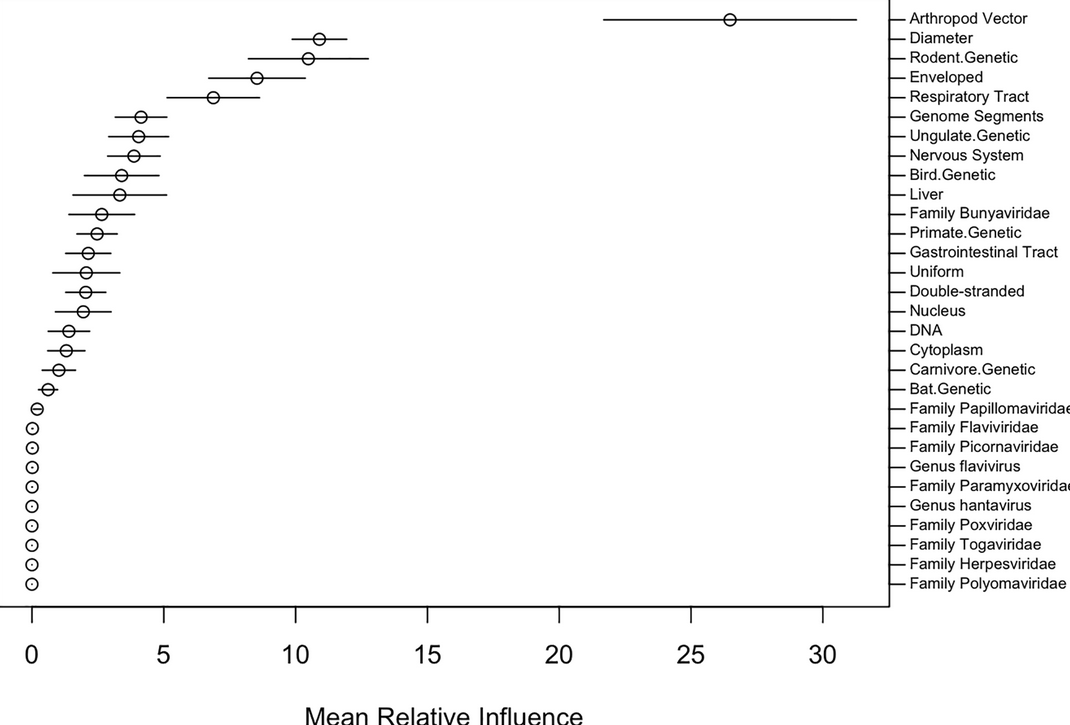
## surveillance and prediction

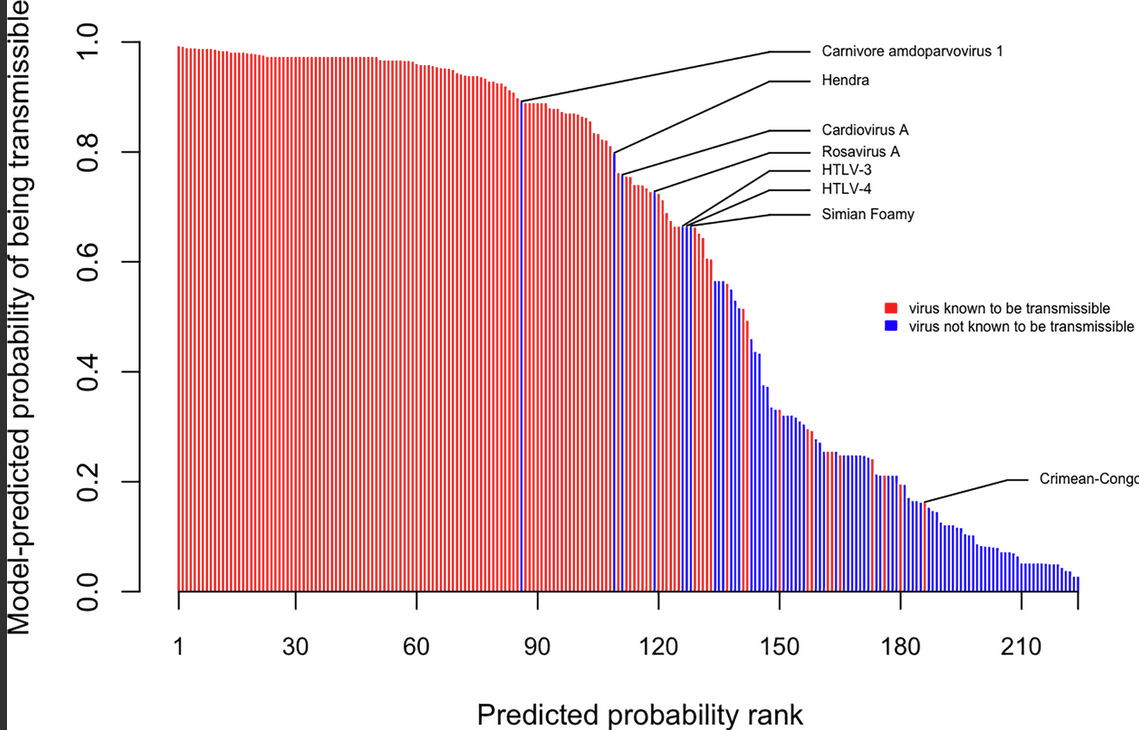
* which viruses will emerge, where, why?

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

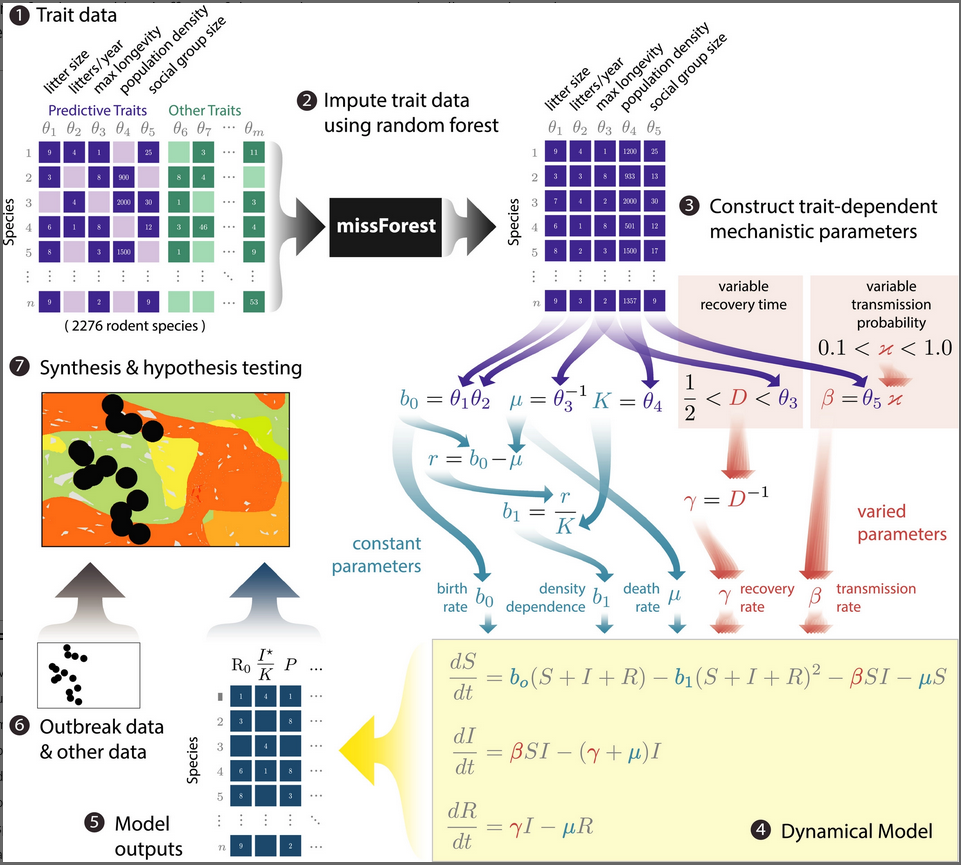


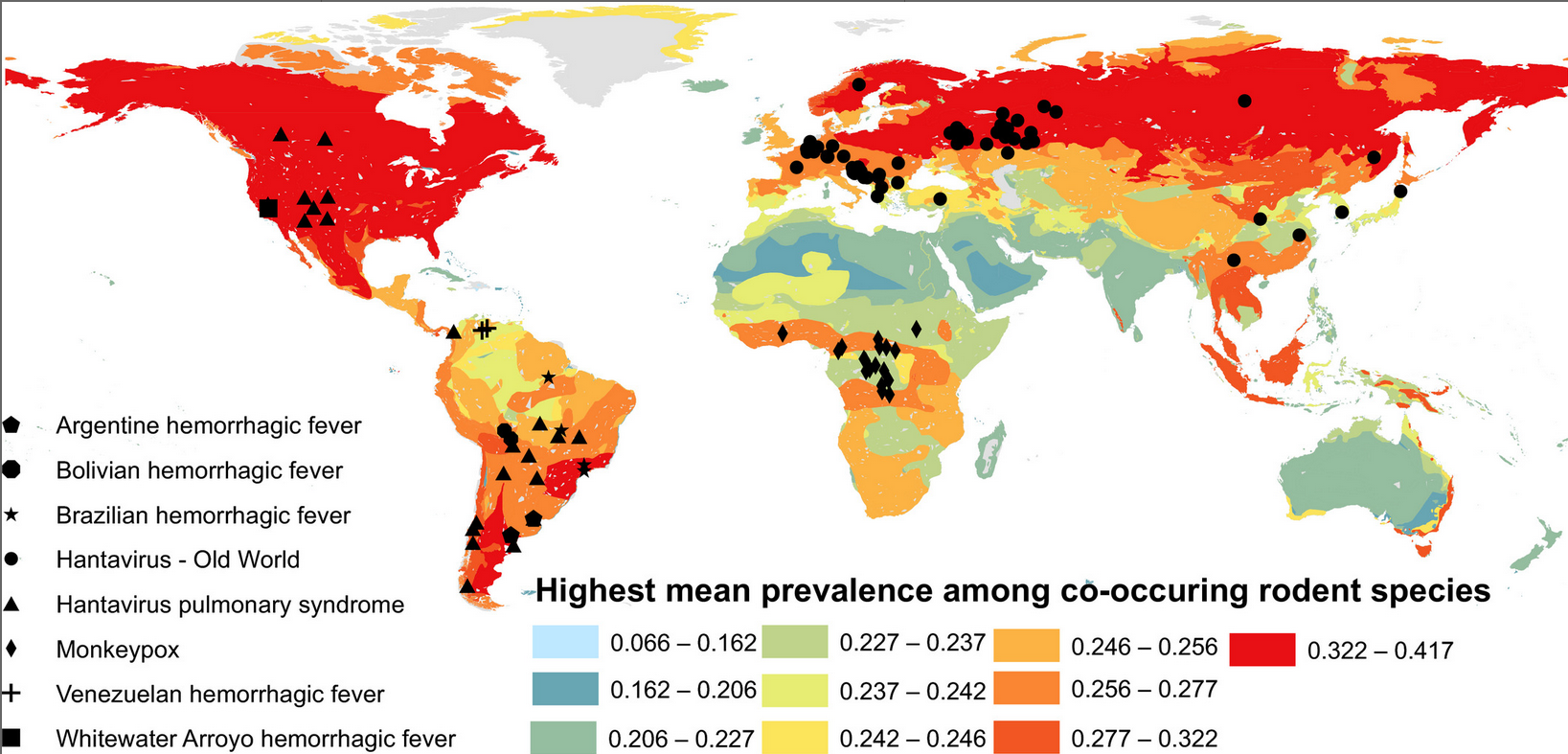
Walker et al. (2018): predict human transmission ability of zoonotic viruses





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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