Ranaviruses and Amphibians: outside the box of host-parasite relationships.

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From a small virus to a big problem!

Condition-dependent expression of ranaviral infection and life history trade-offs

Life-history stage susceptibility

Genotype x Genotype x Environment interactions

Perspectives and future work

Global Distribution of Ranavirus Die-offs

11 Families: Ranidae, Hylidae, Bufonidae, Leptodactylidae, Dendrobatidae, Discoglossidae, Rhacophoridae, Myobatrachidae, Ambystomatidae, Salamandridae, Hynobiidae
**Condition-dependence of Rv expression**

- Pathogens have important effects on host life-history traits.
- Magnitude of these effects is often strongly context-dependent.
- Outcome of an interaction between a host and an infectious agent is often associated with the level of stress experienced by the host.

![Diagram showing high and low density tanks with different doses and controls.](image)

**Ranavirus virulence is density-dependent**

![Graph showing dose increase/decrease fitness and high density effect on fitness disappear.](image)
Beneficial infection?


Stage susceptibility

- Amphibian immune system is stage dependent.
- Wild egg masses are often used in lab experiments as ‘naïve’ individuals.
Mortality reflects infection scenarios

\[ \chi^2 > 43.3, \ p < 0.001 \]

Species Comparison

Note: Across 7 Species

Genotype by genotype interactions

- Coevolution of host resistance and parasite infectivity/virulence

Complex Gene: matching allele

Species

Strains

Temperature

Carius et al. 2001 Evolution

Temperature interaction (F1,385 = 11.96; p = 6.249 x 10^-6)

Temperature * Strain (F7,385 = 11.96; p = 8.11 x 10^-14)

Species * Strain (F11,385 = 11.96; p = 6.249 x 10^-6)

1 - Tads smaller in cold

2 - Strain effect is contingent of Temperature

- Control do always better (cold or warm)
- In cold, no diff between virus strains
- Strongest effect of Wt in warm.

3 - Strain effect is contingent of Species

- Control do always better
- No genotypic difference for WF1-2
- Strongest effect of Wt in LF only
Strain effects are conditional of both Temperature and Species:
- Overall effect of infection in cold, regardless of Species or Strain
- Strongest effect of Wt in LF only in Warm

Outside the host-pathogen box

- Key role of the environment (density, temperature)
  ➔ infection may be beneficial in stressful environments

- Key role of the timing of infection
  ➔ conservation and experimental implications

- Considerable variation in life history traits in response to environmental variation (temperature, host, viral strain)
  ➔ coevolution and frequency-dependent selection
What’s next

• Transmission
  ➢ Vertical vs. Horizontal

• Landscape genetics of an infection
  ➢ Gene flow vs. Disease dynamics
  ➢ Phylogeography of Ranavirus

• Metal-Induced Immunosuppression
  ➢ Health-related trade-offs

Thanks for your attention

"The gates of hell are open night and day; Smooth the descent, and easy is the way: But to return, and view the cheerful skies, In this the task and mighty labor lies."

Virginia Arden