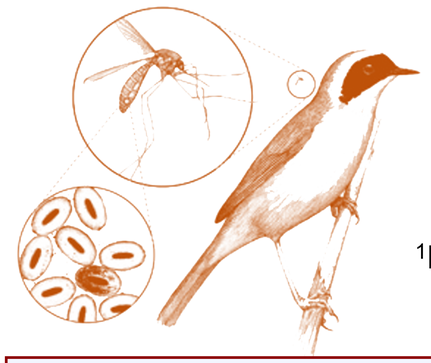

Disease-driven dynamics of evolutionary rescue from a game theoretic perspective

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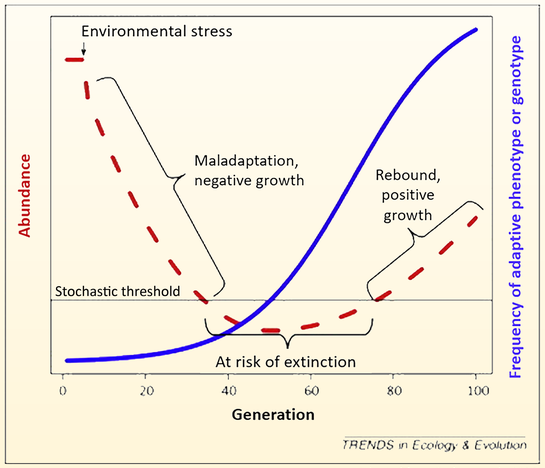
Preliminary Report

OBJECTIVE

Integrate epidemiology with game theory to find conditions and time scales for evolutionary rescue



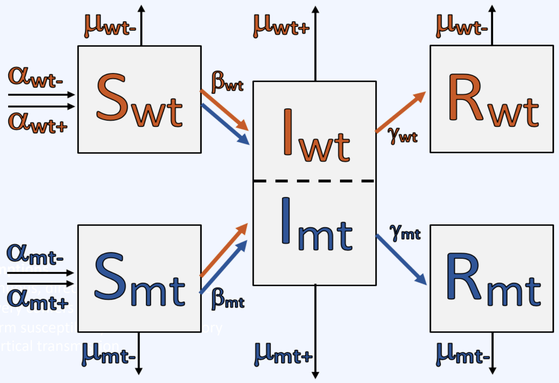
Adapted from Carlson et al., 2014

'Rescue' via adaptive evolution acting on mutation and standing genetic variation

Introduced Pathogen

How might hosts exhibit evolutionary rescue?

Disease Epidemic



SUSCEPTIBLE, INFECTED, RECOVERED FRAMEWORK

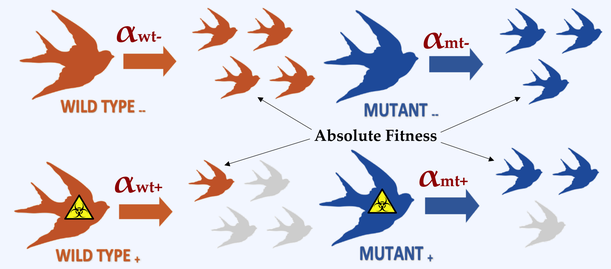
ASSUMPTIONS

- Continuous, direct disease transmission
- Recovery confers immunity
- Uniform susceptibility across life history
- No vertical transmission

μ: Death rate
α: Birth rate
β: Transmission rate
γ: Recovery rate
wt: Wild type
mt: Mutant
- : Noninfected
+: Infected

Disease dynamics affects breeding in the game that periodically replenishes susceptible population

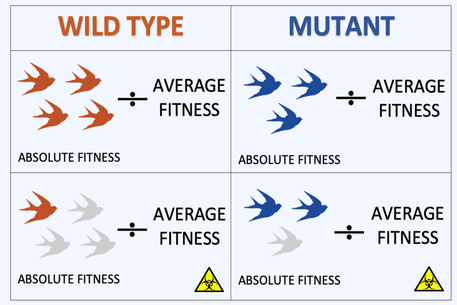
Evolutionary Game



RELATIVE PAYOFFS: $\alpha_{wt-} > \alpha_{mt-} > \alpha_{mt+} > \alpha_{wt+}$

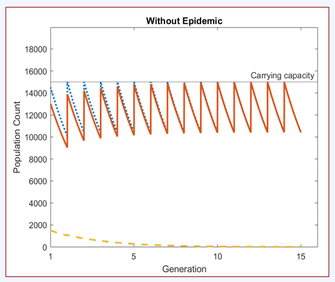
ASSUMPTIONS

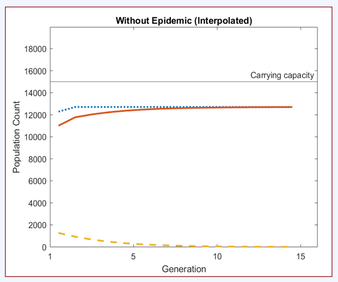
- Discrete, symmetric, simultaneous games
- Homogeneous, well-mixed population
- No intermediate phenotypes and mutations
- Iteroparous hosts

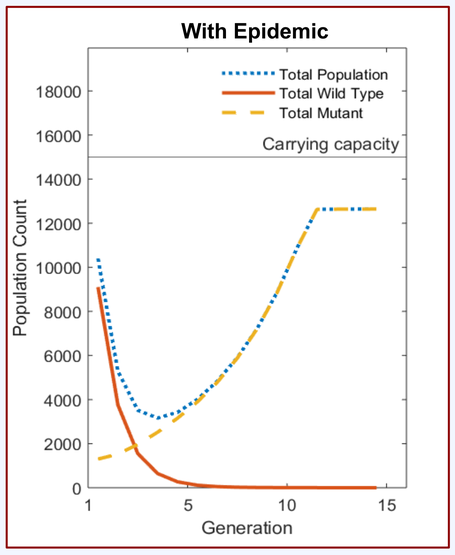


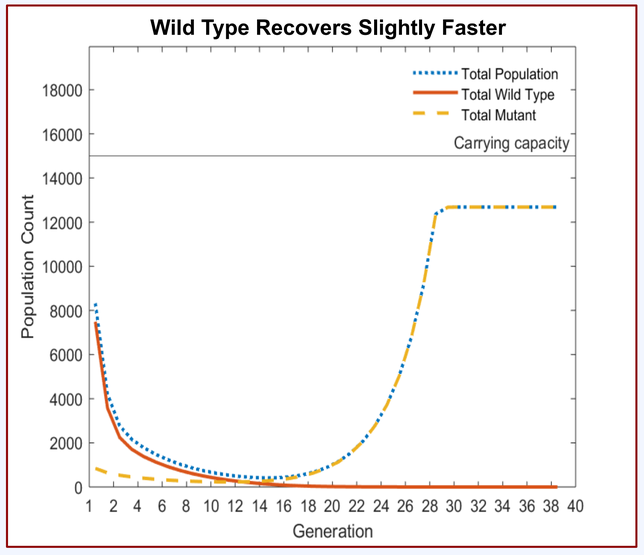
Results

In the presence of a highly virulent disease, there exists the possibility for a population with biologically plausible parameters to undergo evolutionary rescue.









CONCLUSIONS

1. Evolutionary rescue can occur given our relative payoffs and selected parameters
2. How well a disease persists impacts whether evolutionary rescue can occur and its time scale

FUTURE WORK

- Bifurcation analysis to predict regime shifts
- Add disease vectors, life history, and dynamic carrying capacity to test effects of coevolution and climate change
- Add intermittent outbreaks, predator-prey dynamics, genotypic strategies, and gene flow

SELECTED REFERENCES

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Keeling MJ, Rohani P (2008) Modeling Infectious Diseases in Humans and Animals. Princeton Univ Press, NJ.
Boots et al. (2009) The role of ecological feedbacks in the evolution of host defence: what does theory tell us? Phil Trans R Soc B 364: 27-36

Acknowledgements

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