

Does Evolution Favor a Semelparity-annual or an Iteroparous-perennial Life History Strategy?

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Abstract

A classic question concerning life history strategies of biological populations involves reproductive timing and output and, specifically, the option between semelparity (one reproductive event only in an individual's life, e.g. annual plants) and iteroparity (multiple reproductive events, e.g. perennial plants). Under what circumstances will evolution favor one of these strategies over the other? While early investigations suggested semelparity should be favored by evolution [1], subsequent studies have shown there is no simple answer to this question and that many factors can be in play, including density dependence, variable environmental conditions, and many others. Recent studies have further proposed, on the basis of an extensive review of the biological literature concerning the observed reproductive strategies of biological populations across many taxa, that reproductive parity should not be binary, but instead should be a continuous variable [3]. Darwinian dynamic (evolutionary game theoretic) modeling methodology is suitable for this approach. In this talk I formulate Darwinian dynamic versions of some standard discrete time population models and discuss their implications with regard to this question. A particular focus is on the role of density dependent reproduction and survival. The mathematical analysis revolves around equilibrium bifurcations and stability and involves multiple attractor scenarios. I obtain conditions under which semelparous-like equilibria and iteroparous-like equilibria exist and are stable and conditions under which they either are or are not ESS equilibria (i.e. are equilibria with evolutionarily stable strategies) [2].

References

- [1] L. C. Cole, *The population consequences of life history phenomena*, The Quarterly Review of Biology, 29, No. 2, June 1954), 103-137
- [2] J. M. Cushing, Discrete time Darwinian dynamics and semelparity versus iteroparity, to appear in *Mathematical Biosciences and Engineering*, 2019
- [3] P. W. Hughes, *Between semelparity and iteroparity: Empirical evidence for a continuum of modes of parity*, Ecology and Evolution 7 (2017), 8232-8261, DOI: 10.1002/ece3.3341

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