Mathematical models with non-linear growth rates in population dynamics

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Usually, when modelling population dynamics, e.g. predator-prey systems, the growth rate of a population is assumed to be proportional to the consumption. Its per-capita death rate is often assumed to be constant. Those assumption, however, are plausible from biological point of view in cases when there is sufficient food in the environment. If this is not the case, however, a generalization might be considered, taking into account that a minimal amount of energy intake is required in order for the population to reproduce and not to starve to death. A. Terry studied a predator-prey model with generic birth and death rates for the predator in [1].

In the present work, we consider two main questions, concerning the applicability of this idea. First, we show that introducing such rates might lead to qualitatively richer dynamics of the mathematical model. Also, we compare the classical and the generalized models in terms of their ability to fit experimental data. The latter is accomplished by studying examples of bacterial growth under inhibitory conditions.

References

[1] A. Terry, *A predator prey model with generic birth and death rates for the predator*, Math. Biosci. **248** (2014) 57–66. https://doi.org/10.1016/j.mbs.2013.12.002