

A clear question about ecological communities

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Abstract

This example demonstrates a writing workflow for quantitative ecology. We use a familiar population model to show equations, a mathematical statement, a figure and a table, with a separate supplement and bibliography. The text and illustrative results are teaching examples, not findings from a study. Replace them with the biological question, methods, evidence and conclusion of your manuscript.

Keywords: community ecology; population dynamics; quantitative methods

1 Introduction

A manuscript should make its biological question clear before introducing the machinery used to answer it. State what is known, what remains uncertain and why the proposed analysis can resolve that uncertainty. Classic population models offer a convenient example for demonstrating notation and references (Lotka, 1925; May, 1972).

The example question is how density-dependent growth approaches a carrying capacity. Every symbol, assumption and measurement should be defined before it carries an argument. The model below is illustrative; it is not presented as a fitted model or evidence about a real population.

2 Methods

2.1 Model and assumptions

Let $N(t) > 0$ denote abundance, $r > 0$ the intrinsic growth rate and $K > 0$ the carrying capacity.

Logistic growth is written as

$$\frac{dN}{dt} = rN \left(1 - \frac{N}{K}\right). \quad (1)$$

The same model can be written using scaled abundance $n = N/K$ and time $\tau = rt$:

$$\frac{dn}{d\tau} = n(1 - n), \quad (2)$$

$$n(\tau) = \frac{1}{1 + (n_0^{-1} - 1)e^{-\tau}}. \quad (3)$$

Use `\cref` for references such as [equations \(1\) and \(2\)](#); the object name is generated with the number. Use `\citep` for parenthetical citations and `\citet` for narrative citations. For example, May (1972) connects ecological questions with mathematical analysis.

What the example assumes

The environment and parameters are constant, abundance is continuous, and the population is closed. These assumptions determine the scope of the model. Explain their biological meaning before interpreting a result.

2.2 Mathematical statements

Proposition 1. For $n_0 > 0$, the solution in [equation \(3\)](#) converges to 1 as $\tau \rightarrow \infty$.

Proof. The denominator of [equation \(3\)](#) tends to 1 because $e^{-\tau} \rightarrow 0$. It remains positive for $n_0 > 0$ and $\tau \geq 0$, so the solution is well-defined. $\square$

[Proposition 1](#) separates a demonstrated mathematical conclusion from its biological interpretation. Additional derivations belong in [section S1](#).

3 Results

The illustrative trajectories in [figure 1](#) approach the same equilibrium from different initial abundances. They are sampled model trajectories, not observations, fitted estimates or uncertainty intervals. [Table 1](#) keeps notation and units explicit.

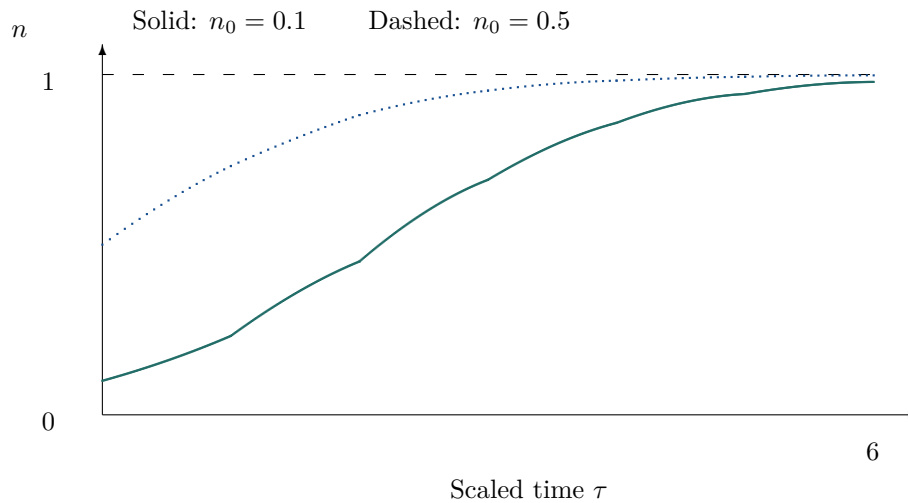


Figure 1. Illustrative logistic trajectories. Scaled abundance is shown against scaled time for $n_0 = 0.1$ (solid line) and $n_0 = 0.5$ (dashed line). The dotted horizontal line marks the equilibrium $n = 1$. Both trajectories follow [equation \(3\)](#); no empirical data are used.

Table 1. Notation in the illustrative model. Units must be compatible with the abundance and time definitions.

Symbol	Meaning	Units
N	Population abundance	Individuals
r	Intrinsic growth rate	Time ⁻¹
K	Carrying capacity	Individuals
n	Scaled abundance, N/K	Dimensionless
τ	Scaled time, rt	Dimensionless

4 Discussion

Explain which conclusion follows from which evidence, distinguish mathematical results from empirical inference, and discuss assumptions that may fail in the system of interest. This sentence demonstrates revision highlighting: blue in the review copy, plain text in the reading copy.

Acknowledgements

Replace this example with acknowledgements and funding information.

Author contributions

Specify who designed the study, developed the theory, collected or curated data, performed analyses and wrote the manuscript. Use the target journal's requested taxonomy.

Open research statement

This demonstration uses no empirical data. Its figure follows the equation printed in the text. For your study, replace this paragraph with the actual data and code locations, access conditions, licenses and version identifiers.

References

- Lotka, A. J. (1925). *Elements of Physical Biology*. Baltimore: Williams and Wilkins.
- May, R. M. (1972). "Will a Large Complex System be Stable?" In: *Nature* 238, pp. 413–414. DOI: [10.1038/238413a0](https://doi.org/10.1038/238413a0).

Supplementary information

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S1 Derivation of the solution

The supplement has its own section, equation, figure, table, theorem and page numbering. Its bibliography includes only references cited in this reference section. A reference can appear in both bibliographies when cited in both parts (Lotka, 1925).

Separating variables in equation (2) yields

$$\int \frac{dn}{n(1-n)} = \int d\tau. \quad (\text{S1})$$

Integrating gives $\log[n/(1-n)] = \tau + C$ when $0 < n < 1$; the initial condition determines C . This produces equation (3). For $n_0 > 1$, an absolute value inside the logarithm yields the same final expression. The equilibrium case $n_0 = 1$ is handled directly.

Lemma S1. *The scaled solution is constant when $n_0 = 1$.*

Proof. Substitute $n_0 = 1$ into equation (3). □

S2 Reporting checks

A reproducible analysis should identify data provenance, the model version, units, random seeds where relevant and the software environment. A concrete example of a simulation protocol for ecological models is described by Grimm et al. (2006).

Table S1. Example supplement checklist. Replace each item with the information needed to reproduce your study.

Item	What to record
Inputs	Source, version, access conditions and units
Model	Equations, assumptions and parameter values
Analysis	Code version, environment and numerical tolerances
Outputs	Figure scripts, intermediate products and uncertainty definitions

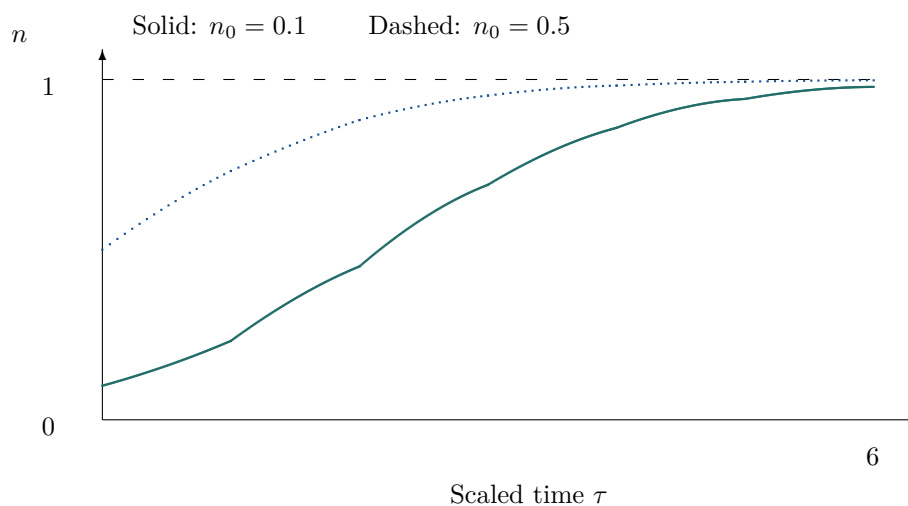


Figure S1. A repeated demonstration to verify supplementary figure numbering. In a real manuscript, include additional evidence or diagnostics here rather than repeating a main-text figure.

Supplementary references

- Grimm, V., U. Berger, F. Bastiansen, S. Eliassen, V. Ginot, J. Giske, J. Goss-Custard, T. Grand, S. K. Heinz, G. Huse, A. Huth, J. U. Jepsen, C. Jørgensen, W. M. Mooij, B. Müller, G. Pe'er, C. Piou, S. F. Railsback, A. M. Robbins, M. M. Robbins, E. Rossmanith, N. Rüger, E. Strand, S. Souissi, R. A. Stillman, R. Vabø, U. Visser, and D. L. DeAngelis (2006). "A standard protocol for describing individual-based and agent-based models". In: *Ecological Modelling* 198.1–2, pp. 115–126. DOI: [10.1016/j.ecolmodel.2006.04.023](https://doi.org/10.1016/j.ecolmodel.2006.04.023).
- Lotka, A. J. (1925). *Elements of Physical Biology*. Baltimore: Williams and Wilkins.