

Reporting Summary

Nature Research wishes to improve the reproducibility of the work that we publish. This form provides structure for consistency and transparency in reporting. For further information on Nature Research policies, see [Authors & Referees](#) and the [Editorial Policy Checklist](#).

Statistics

For all statistical analyses, confirm that the following items are present in the figure legend, table legend, main text, or Methods section.

- | n/a | Confirmed |
|-------------------------------------|--|
| ☐ | ☒ The exact sample size (n) for each experimental group/condition, given as a discrete number and unit of measurement |
| ☐ | ☒ A statement on whether measurements were taken from distinct samples or whether the same sample was measured repeatedly |
| ☐ | ☒ The statistical test(s) used AND whether they are one- or two-sided
<i>Only common tests should be described solely by name; describe more complex techniques in the Methods section.</i> |
| ☐ | ☒ A description of all covariates tested |
| ☐ | ☒ A description of any assumptions or corrections, such as tests of normality and adjustment for multiple comparisons |
| ☐ | ☒ A full description of the statistical parameters including central tendency (e.g. means) or other basic estimates (e.g. regression coefficient) AND variation (e.g. standard deviation) or associated estimates of uncertainty (e.g. confidence intervals) |
| ☒ | ☐ For null hypothesis testing, the test statistic (e.g. F , t , r) with confidence intervals, effect sizes, degrees of freedom and P value noted
<i>Give P values as exact values whenever suitable.</i> |
| ☒ | ☐ For Bayesian analysis, information on the choice of priors and Markov chain Monte Carlo settings |
| ☐ | ☒ For hierarchical and complex designs, identification of the appropriate level for tests and full reporting of outcomes |
| ☒ | ☐ Estimates of effect sizes (e.g. Cohen's d , Pearson's r), indicating how they were calculated |

Our web collection on [statistics for biologists](#) contains articles on many of the points above.

Software and code

Policy information about [availability of computer code](#)

Data collection

Data were primarily collected from the Global Population Dynamics Database (NERC Centre for Population Biology, Imperial College (2010). <http://www.sw.ic.ac.uk/cpb/cpb/gpdd.html>.) The raw dataset, summary of results, and citations are available at: <http://doi.org/10.5281/zenodo.3470260>

Data analysis

"rEDM" package v0.6.18 (Ye et al. 2018; <https://github.com/ha0ye/rEDM>) of R v3.4.2 (R Core Team 2018) was primarily used to analyze the data. R code is available at: <http://doi.org/10.5281/zenodo.3470260>

For manuscripts utilizing custom algorithms or software that are central to the research but not yet described in published literature, software must be made available to editors/reviewers. We strongly encourage code deposition in a community repository (e.g. GitHub). See the Nature Research [guidelines for submitting code & software](#) for further information.

Data

Policy information about [availability of data](#)

All manuscripts must include a [data availability statement](#). This statement should provide the following information, where applicable:

- Accession codes, unique identifiers, or web links for publicly available datasets
- A list of figures that have associated raw data
- A description of any restrictions on data availability

Code and data to reproduce the analysis can be found on Github: <http://doi.org/10.5281/zenodo.3470260>.

Field-specific reporting

Please select the one below that is the best fit for your research. If you are not sure, read the appropriate sections before making your selection.

☐ Life sciences ☐ Behavioural & social sciences ☒ Ecological, evolutionary & environmental sciences

For a reference copy of the document with all sections, see [nature.com/documents/nr-reporting-summary-flat.pdf](https://www.nature.com/documents/nr-reporting-summary-flat.pdf)

Ecological, evolutionary & environmental sciences study design

All studies must disclose on these points even when the disclosure is negative.

Study description	We studied the presence of nonlinearity, dimensionality, and predictability across a large dataset of animal population time-series. Our study design was not experimental.
Research sample	Data were primarily collected from the Global Population Dynamics Database (NERC Centre for Population Biology, Imperial College (2010). http://www.sw.ic.ac.uk/cpb/cpb/gpdd.html .) The raw dataset, summary of results, and citations are available at: http://doi.org/10.5281/zenodo.3470260 .
Sampling strategy	Time-series were chosen from knowledge of past research using datasets (e.g., GPDD), and by conducting a literature search with keywords such as "time-series". We collected time-series until we subjectively decided that we had enough time-series of species (~50) for each taxonomic classification to conduct a robust statistical analysis.
Data collection	Data was collected by T.C. as aforementioned using existing databases and literature searches.
Timing and spatial scale	Not applicable.
Data exclusions	Data was filtered from our full set because of inconsistencies and ambiguities, such as long repeating non-unique strings of values for population data. Additionally, we only conducted statistical analysis for one randomly assigned time-series for each species, due to multiple time-series for certain species like aphids and moths. The filtering process for our dataset is described in full in Methods and Supplementary Information Methods.
Reproducibility	Time-series observations were not replicated. The analysis can be reproduced using datasets and code made publicly available by the author.
Randomization	Any manipulative experiments were not performed and thus randomization is not relevant to our study.
Blinding	Any manipulative experiments were not performed and thus randomization is not relevant to our study.
Did the study involve field work?	☐ Yes ☒ No

Reporting for specific materials, systems and methods

We require information from authors about some types of materials, experimental systems and methods used in many studies. Here, indicate whether each material, system or method listed is relevant to your study. If you are not sure if a list item applies to your research, read the appropriate section before selecting a response.

Materials & experimental systems

n/a	Involved in the study
☒	☐ Antibodies
☒	☐ Eukaryotic cell lines
☒	☐ Palaeontology
☒	☐ Animals and other organisms
☒	☐ Human research participants
☒	☐ Clinical data

Methods

n/a	Involved in the study
☒	☐ ChIP-seq
☒	☐ Flow cytometry
☒	☐ MRI-based neuroimaging