

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 our [Editorial Policies](#) 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 Species abundance data were collected by Terry Hughes and colleagues. All other data were collected from published sources outlined in the text.

Data analysis R code was used for all analyses and figures and is available from the Tropical Data Hub (<https://tropicaldatahub.org/> with DOI: 10.25903/5beb6e4173f88).

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 and 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

Data files and computer code for statistical analyses are available from the Tropical Data Hub (<https://tropicaldatahub.org/> with DOI: 10.25903/5beb6e4173f88).

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	This study estimates the population sizes of reef-building coral species at the scale of their geographic ranges using species abundance data collected along a 10,000 km biodiversity gradient, coral cover data from more than 900 locations throughout the study domain as well as data on the availability of coral habitat from 61 reef habitat maps.
Research sample	We collected species abundance data of 318 species. This corresponds to approximately half the total number of species found in the study domain. Species abundance data were collected in three commonly distinguished habitats, the reef crest, slope and flat. In total more than 35,000 individual coral colonies were recorded along a total of 1,800 individual transects.
Sampling strategy	Species abundance data were collected on reef slopes, crests and flats in five regions (Indonesia, Papua New Guinea, Solomon Islands, American Samoa, French Polynesia) along a 10,000 km gradient in species richness. In each region, we selected four sites on each of three islands. At each of the 60 sites, we ran ten 10m line intercept transects on the upper reef slope (6-7m depth), reef crest (1-2m) and reef flat (tidal).
Data collection	All intercepted coral colonies larger than 1cm in diameter were identified to species in-situ by a highly trained team of coral taxonomists. All other data were collected from published sources outlined in the text.
Timing and spatial scale	Species abundance data were collected in five regions along a 10,000 biodiversity gradient. In each region, three islands were surveyed and at each island four sites. Surveys were conducted between 1999 and 2004 and each site was surveyed only once.
Data exclusions	No data were excluded from the analysis.
Reproducibility	All data and code are available to reproduce our analysis and results. Given the preliminary nature of our estimates and the limited availability of ecological data at the scale of our study, we did not test alternative approaches to reproduce our results.
Randomization	Not relevant, our study compiled data from different sources. Species abundance data were collected to sample a 10,000 km gradient in species richness.
Blinding	Blinding was not relevant to this study.
Did the study involve field work?	☒ Yes ☐ No

Field work, collection and transport

Field conditions	Normal
Location	Coordinates where species abundances were surveyed are summarized in Extended Data Table 2. Locations of coral cover measurements and reef habitat maps are shown in Figure 1.
Access & import/export	All data collection was observational, non-extractive.
Disturbance	Data collection was not influenced by disturbances.

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 and archaeology
☒	☐ Animals and other organisms
☒	☐ Human research participants
☒	☐ Clinical data
☒	☐ Dual use research of concern

Methods

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