

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
Only common tests should be described solely by name; describe more complex techniques in the Methods section.
- ☐ ☒ 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
Give P values as exact values whenever suitable.
- ☒ ☐ 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 Respirometry (oxygen) data was collected using Pyroscience and Presens commercial systems. The MOCNESS net system used to collect animals is a Visual Basic 3.0 program operating on Windows 95.

Data analysis All code is available at:
<https://gitfront.io/r/user-5680682/7b3d1707e82e906f1092e13de9d4a75d8aa106fe/DVM-temp-sensitivity/>

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 availability: All data generated or analysed during this study are included in this published article (and its supplementary information files). World Ocean Atlas temperature and oxygen data (woa18_decav_t00_04.nc and woa18_all_O00_01.nc, respectively) are available at <https://www.ncei.noaa.gov/access/world-ocean-atlas-2018/>. CMIP6 climate projections are available at <https://interactive-atlas.ipcc.ch/39965d78-e97e-42af-b488-b1e1f4d32f75>. NOAA's DOISST v2.1 dataset is available at <https://www.ncei.noaa.gov/data/sea-surface-temperature-optimum-interpolation/v2.1/access/avhrr/>.

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	The goal of the study was to determine "metabolically available habitat", defined as that with temperature and oxygen values sufficient to provide aerobic scope for growth as described in Deutsch et al., 2020 (Nature).
Research sample	Species and sample sizes were based on availability in deep-water trawls conducted during multiple research cruises in the Eastern Pacific. This study measured metabolic traits in diel vertical migrators (euphausiids, n = 4 species) from the Eastern Tropical Pacific. Temperature sensitivity was measured across 2 temperatures for euphausiids and 3 temperatures for squids. Additional euphausiid data and data for squid (<i>Dosidicus gigas</i>) was taken from published literature. The temperature sensitivity of metabolic traits for migrators were compared to that for diverse marine animals from the literature.
Sampling strategy	Sample sizes were limited by time at sea and availability in trawls. No specific sample size calculation was performed as no additional samples were possible within the funded project. We supplemented our samples with additional species from published literature.
Data collection	Respiration measurements were made at sea by students, postdocs and PI of the NSF-funded project.
Timing and spatial scale	Timing of data collection was determined by shiptime availability. The scale was oceanic, comparing populations native to the eastern tropical pacific with species found globally over the shelf (coastal regions of oceans word wide).
Data exclusions	No data were excluded.
Reproducibility	No replication of the experiment was possible due to limitations of ship time and expense.
Randomization	Experiments were run simultaneously at two treatment temperatures using animals collected from the same trawls.
Blinding	Data analysis was performed on trials labeled only by specimen number and were thus blinded from experiment conditions.
Did the study involve field work?	☒ Yes ☐ No

Field work, collection and transport

Field conditions	Environmental parameters in species' habitat were measured and reported in Wishner et al., 2018, Sci. Adv. A month-long research expedition from Manzanillo, Mexico, to San Diego, CA, on the R/V Sikuliaq, cruise number SKQ201701S, occurred from 19 January to 15 February 2017 and was centered at 21.6°N 117.8°W, an area with a strong OMZ.
Location	21.6°N 117.8°W
Access & import/export	The study took place in international waters. No permits were required.
Disturbance	No disturbance was caused by this study.

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

Animals and other organisms

Policy information about [studies involving animals](#); [ARRIVE guidelines](#) recommended for reporting animal research

Laboratory animals	The study did not involve laboratory animals.
Wild animals	Euphausiids (krill, n = 4 species in Table S1) were captured using nets in the Eastern Tropical Pacific. Specimens were incubated in respirometry chambers, subsequently flash frozen or preserved for identification and mass in home laboratory. All other species data is derived from published literature.
Field-collected samples	Animals were captured and immediately incubated in glass respirometry chambers. No additional housing was necessary.
Ethics oversight	No approval is required for invertebrate species in the US.

Note that full information on the approval of the study protocol must also be provided in the manuscript.