Reporting summary Nature Comms:

1.

• We tested differences in small, bottom-dwelling (‘cryptobenthic’) fish assemblages across two locations, the extremely hot and variable southeastern Arabian Gulf and the thermally-moderate northwester Gulf of Oman. Initial comparisons were based on in situ collections of entire communities at three distinct reefs in both locations, with three samples taken per reef (total N = 18).

• We then tested temperature tolerances of species occurring in both locations and the environmentally-benign Gulf of Oman only using critical thermal tolerance trials. For cold tolerance trials, we tested 62 individuals across six species and for heat tolerance trials, we tested 60 individuals across the same six species.

• We also examined the prey ingestion of a subset of individuals obtained from the community-samples in both locations using a DNA metabarcoding approach of tissues retained in the gastro-intestinal tract. Specifically, we tested 88 individuals across six species using both cytochrome oxidase I (COI) and 23S primers.

• We also tested for differences in body condition (indicated by length-weight relationships) in populations of three species across the two locations. For this analysis, we included all individuals obtained from the community samples and individual collections, resulting in 394 (*Enneapterygius ventermaculus*), 148 (*Coryogalops anomolus*) and 245 (*Ecsenius pulcher*) samples, respectively.

2. A list of all species present in the sampled communities is provided as a Supplementary Table 1. Specific test (physiological and DNA metabarcoding) and analyses were performed on samples of:

• *Ecsenius pulcher* (Blenniidae – Arabian Gulf population)

• *Ecsenius pulcher* (Blenniidae – Gulf of Oman population)

• *Coryogalops anomolus* (Gobiidae – Arabian Gulf population)

• *Coryogalops anomolus* (Gobiidae – Gulf of Oman population)

• *Enneapterygius ventermaculus* (Tripterygiidae – Arabian Gulf population)

• *Enneapterygius ventermaculus* (Tripterygiidae – Gulf of Oman population)

• *Antennablennius adenensis* (Blenniidae – Gulf of Oman population)

• *Eviota guttata* (Gobiidae – Gulf of Oman population)

• *Hetereleotris vulgaris* (Gobiidae – Gulf of Oman population)

• *Helcogramma fuscopinna* (Tripterygiidae – Gulf of Oman population)

3. For community samples, we determined sufficient coverage of samples by assessing rarefaction curves. For critical temperature trials, we obtained the greatest numbers possible. Low sample sizes are taken into account in the statistical approach implemented, preventing false conclusions due to limited sample coverage. For DNA gut content metabarcoding, sample size was determined by costs of the molecular analyses; however, we again assessed adequacy of the number of samples by examining rarefaction curves of prey sequences found across the sampled population (Supplementary Figure 1).

4. Community samples were obtained in the field using 3-4 SCUBA divers (SJB, JMC, JLJ, and LT) and a technique described in detail by Brandl et al. 2019 (Science). All samples obtained were processed in the evening of collection in the laboratory. All temperature trials were performed by JLJ in. the facilities of NYUAD. All laboratory work for sample preparation for DNA gut content metabarcoding (dissection and DNA extraction) was performed by SJB and LT, while post-extraction laboratory processing and bioinformatics were performed by Jonah Ventures (Boulder, CO; <https://jonahventures.com/about/>).

5. All field samples were collected between April 24th and May 8th 2018. Physiological trials took place between May8th and May 12th. Molecular analyses were initiated in February 2019, using the preserved specimens. The spatial extent of the collections includes the following sites:

**Arabian Gulf:**

Dhabiya: 476 24.36383º, 54.10121º

Ras Ghanada: 24.84743º, 54.69235º

Saadiyat: 24.65771º, 477 54.48691º

**Gulf of Oman:**

Dibba Rock: 25.55378º, 56.35694º

Sharm Rock: 25.48229º, 480 56.36695º

Snoopy Rock: 25.49210º, 56.36401º

6. One data point was excluded from the length-weight relationship analysis of *Coryogalops anomolus* (n = 149) due to an unrealistic weight estimate that must have been falsely recorded. The exclusion is clearly highlighted in the accompanying script.

7. We undertook no attempts to reproduce the results by repeating data collection. We have ensured full reproducibility of the data analysis and provide fully accessible code and data to allow reproduction of our findings.

8. Individual fishes were chosen randomly from holding tanks for the physiological trials. For the molecular analyses, we chose individuals to maximize spatial spread across the samples and with preference for the largest animals to ensure sampling of adult specimens.

9. No blinding was performed.

10 Conditions were benign and constant throughout the sampled period. No specific assessments of environmental factors were performed.

All collections were performed with approval from the Environment Agency Abu Dhabi (TMBS/18/L/179) and Dibba Municipality 1084 (unnumbered). Sample export to the University of Washington was performed under the UAE Ministry of Environment and Climate Change tissue export permit (AUD-Q-22-1110520).

A full list of species sampled in the course of the study is provided in Supplementary Table 1. All individuals were either euthanized immediately after collection or transported in enclosed containers with oxygen supply to the animal husbandry facilities at NYUAD, where they were kept until trials were run. Individuals were euthanized using a clove-oil overdose immediately after conclusion of the trials. All work involving live fishes was performed under NYUAD IACUC approval 18-0003.