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TBA, 2020

Dr. Patrick Goymer

Chief Editor

Nature Ecology & Evolution

Dear Dr. Goymer,

We wish to submit our manuscript “**Energetic requirements of extreme temperatures reduce biodiversity and functioning in cryptobenthic coral reef fish communities**” for consideration as an Article in *Nature Ecology & Evolution.*

In an era of intensifying anthropogenic influence, understanding nature’s responses to changing conditions is critical. Altered abiotic conditions primarily affect organismal physiology, but may cascade through levels of biological organization to ultimately shape community assembly and ecosystem functioning.

Coral reefs supply services to more than 500 million people globally. While reef-building corals are highly susceptible to rising temperatures, recent research has suggested that reef fishes, the primary fisheries resource that reefs provide, may be able to cope with warmer oceans through transgenerational adaptation. Instead, the loss of live coral habitat is generally cited as a primary reason for concern.

**Here, we show that cryptobenthic reef fishes, a critical group that underpins coral reef fish productivity, are unable to cope with the energetic demands of increasing temperatures, which jeopardizes the productivity of reef fish assemblages in warming oceans.**

Specifically, by using field surveys of cryptobenthic reef fish communities from the hottest reefs on Earth, the southeastern Arabian Gulf, and the nearby thermally benign Gulf of Oman, and combining this with organismal physiology, gut-content DNA metabarcoding, and population modeling, we show that:

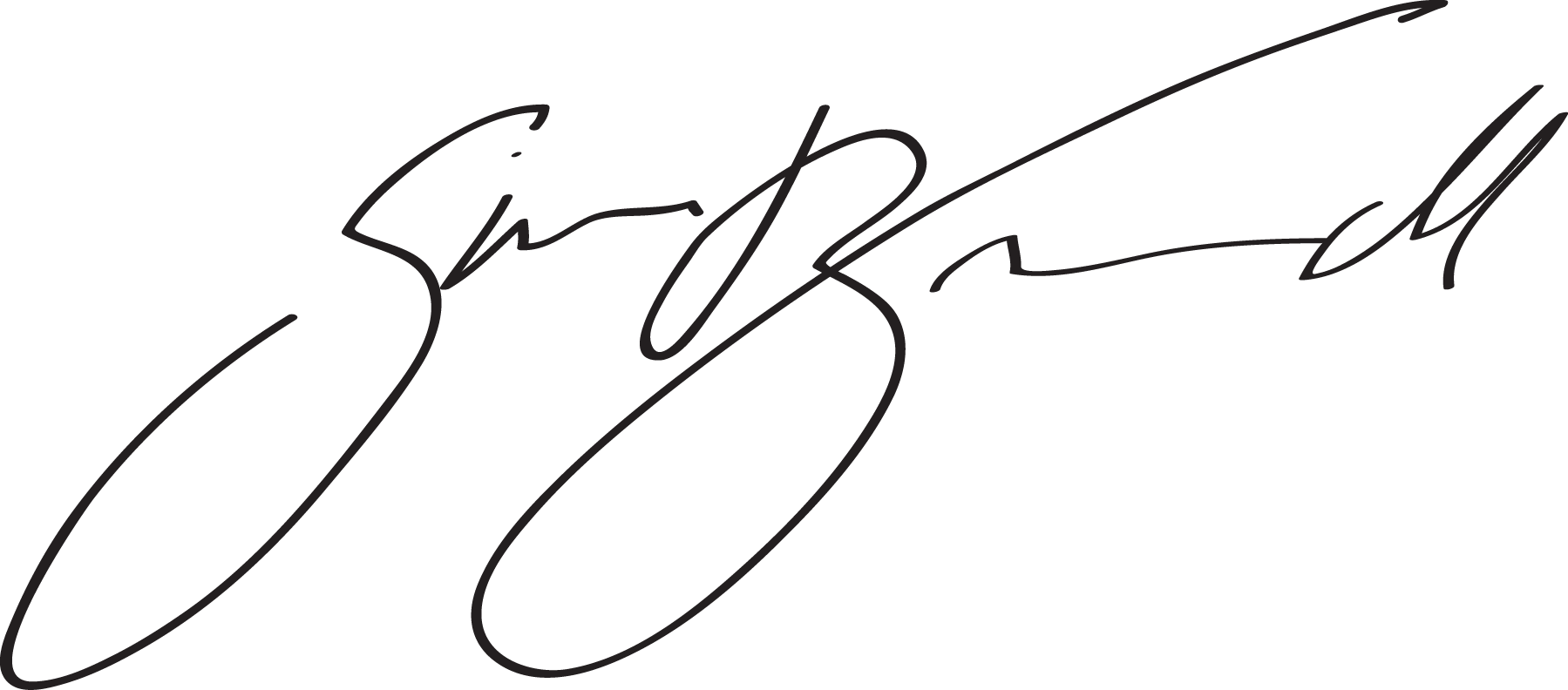
1. Cryptobenthic reef fish assemblages from the Arabian Gulf are highly depauperate, comprising half the species and less than 25% of individuals compared to the Gulf of Oman.
2. This pattern is not driven by species-specific critical thermal tolerances, as species present in both locations are able to withstand short-term exposure to temperatures well beyond the extremes reached in the southeastern Arabian Gulf.
3. Instead, stark intraspecific differences in diet and body condition between populations in the two locations suggest an energetic double jeopardy that precludes the persistence of most cryptobenthic species: extreme temperatures increase the costs of growth and homeostasis, while a different and narrower suite of dietary resources exacerbates the satisfaction of these increased energetic requirements
4. The energetic filtering effect of high-temperature reefs stymies the production, transfer, and renewal of cryptobenthic fish biomass, suggesting that climate change may erode a critical building block of the fast-paced dynamics that underpin coral reef functioning

By integrating across levels of biological organization, our findings offer a critical new glimpse into the effects of rising temperatures on coral reefs. Recent research has suggested that reef fishes will be relatively resilient to the direct and indirect effects of climate change, thus providing a sustained resources for humanity on rapidly changing reefs. Our results challenge this assumption by revealing the far-reaching effects of warming oceans on the energy budgets of the smallest, most-diverse marine vertebrates. For these species, small body size may set a hard, insurmountable border on their potential to adapt to changing conditions, possibly leading to substantial losses in biodiversity and functioning on coral reefs.

Our unique approach to trace the effects of extreme temperatures from individuals to ecosystems is made possible by the combination of field-surveys, physiological trials, molecular dietary analyses, and theoretical modeling. As such, our paper provides not only critical insights into ecological dynamics on warming reefs, but also offers a blueprint for rigorous integrative ecology in a time of rapid environmental change. Therefore, we believe that our manuscript is ideally suited for the prime exposure afforded by *Nature Ecology & Evolution*. We hope you agree.

No related manuscripts or materials presented in the paper are currently under consideration or published and no colleagues have provided comments on the manuscript. All collections were performed in accordance with ethics and collection permits listed in the paper. All raw data and the code necessary to replicate the paper are accessible with our submission. We provide a list of potential reviewers for our manuscript below. Thank you for your consideration.

Sincerely,



Dr. Simon J. Brandl (on behalf of all authors)

Suggested reviewers:

1. Moises Bernal, Auburn University: [mab0205@auburn.edu](mailto:mab0205@auburn.edu)
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