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Thesis title: Using Natural Analogues of the Future Ocean to Study the Adaptive Potential of Fish Communities to Environmental Changes

Research aim: This study investigated fishes found in unique environments with conditions similar to predicted future ocean conditions under climate change to determine if these fishes can adapt to environmental changes.

Material and method: Our study examined fish assemblages, individual responses, and population responses to environmental changes in fishes found at two unique sites. We examined fish assemblages utilizing environmental DNA and underwater visual census to examine how fish assemblages differ between sites at Bourake, New Caledonia where tidal flows subject the study site to low pH high temperature, and reduced dissolved oxygen. We collected fishes found at Shikine Island, Japan a unique site where underwater CO_2 seeps create an acidified condition similar to predicted future ocean conditions and used transcriptomics to examine the genetic mechanism for adaptation and examined the population structure of fishes found at this site to determine if there was selection for adaptation to future ocean conditions.

Result: In Bourake we found that fish assemblages differed between the unique site and the nearby reef. We found that some species may be avoiding Bourake such as wrasses and parrotfish. In Shikine Island we found that neon damselfish (*Pomacentrus coelestis*) had differentially expressed genes involved with blood oxygen regulation, ion transport, and immune response inside the seep compared to nearby control conditions which are likely involved in adapting to conditions found at the seep. We also found population structure inside the seep as well as many loci under balancing selection suggesting some selection occurring at the seep.

Conclusion: This study highlights the unique opportunity sites such as CO_2 seeps and semi-enclosed bays provide in studying the adaptive potential of fishes to future ocean conditions under climate change. We show that fishes may be able to adapt to these conditions and that these sites may be providing a head start for fishes to adapt to future environmental changes.