

Murky Waters, Clear Signals: The Behavioral and Epigenetic Responses of Bicolor Damselfish to Increased Turbidity

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Coral reefs in the Florida Keys face increasing challenges from anthropogenic impacts, including bleaching, disease, overfishing, and decreasing water quality. A key element of decreasing water quality is increased chronic and acute turbidity as a result of coastal development, dredging and boating activity, as well as more frequent and stronger storms. While the effects of sediment on corals are relatively well studied, the effects on fishes are poorly understood. Here we use an aquarium experiment to examine the effects of increased turbidity on both the behavior and epigenetics of a common reef fish, bicolor damselfish (*Stegastes partitus*). Epigenetics is the study of heritable changes to gene expression within an organism that do not affect the genotype or nucleotide sequence of the genome. These changes allow the potential for rapid response and adaptation to environmental stimuli and, while the epigenetics of corals is being explored, the epigenetics of fishes is largely unknown. However, in a social and mobile species, epigenetics can provide a rare insight into the underlying molecular mechanisms associated with behavioral changes. In aquarium experiments bicolor damselfish were exposed to either control (0-1 NTU), medium (5-15 NTU), or high (20-30 NTU) turbidity for “pulse” durations of either one, six, or twelve hours. A cohort of 36 damselfish allowed 4 replicates of each treatment, and food consumption, reaction time to food, and maximum distance traveled from shelter were recorded for each fish. These behavioral experiments found that not only was there reduced reaction time to food from the control group compared to any of the medium or high turbidity treatments, but that fish in the high and medium turbidity groups also consistently consumed less food than fish in the control. In the turbid tanks bicolor damselfish also decreased the maximum distance they were willing to swim from shelter, consistent with observations made in the wild. After each trial, damselfish were dissected and tissues preserved for epigenetic analysis that used Methylation-Sensitive Amplification Polymorphism (MSAP) to investigate epigenetic modifications, focusing on three genes associated with stress response, neuroplasticity, and oxygen transport. The results of these analyses, as well as an optimized protocol for utilizing reef fish tissues in MSAP preparations, will be discussed. This research represents one of the first applications of both behavioral and epigenetic responses to a stressor of a reef fish in the Western Atlantic. Epigenetics potentially offers researchers and managers a novel framework for understanding and quantifying rapid environmental adaptation in marine ecosystems. This work underscores the importance of improving water quality in the Florida Keys as the behavioral and epigenetic impacts may affect the fitness of bicolor damselfish as well as many other fish species.