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Abstract

Nocturnal Hypoxia Reduces Aerobic Scope and Telencephalon Size in Cleaner Wrasse Despite Enhanced Inhibitory Control †

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Abstract

Ocean deoxygenation is intensifying globally, and hypoxia is increasingly documented on tropical coral reefs; yet, its consequences for the physiology and social functioning of reef fishes remain poorly understood. Here, we experimentally exposed the bluestreak cleaner wrasse (*Labroides dimidiatus*) to two repeated nocturnal severe hypoxia events (<2 mg O_2 L^{-1}), reflecting the upper range of currently observed reef conditions. We quantified aerobic performance using intermittent flow respirometry across three phases: baseline (n = 24, prior to exposure), post-hypoxia (n = 24, the morning following the first hypoxia event), and post-recovery (n = 22, three days later). Control fish were followed over the same time frame and tested with the same protocol to account for handling or timing effects. Cooperative performance (n = 22) was assessed separately using an ecologically relevant Feeding Against Preference (FAP) task conducted after the second hypoxic night, allowing us to test whether inhibitory control is sensitive to acute oxygen limitation. Brain morphology (n = 12) was subsequently quantified in a subset of individuals to assess potential changes in relative brain size and regional investment. Repeated hypoxia was associated with persistent reductions in aerobic performance. Maximum and resting metabolic rates declined across phases in hypoxia-exposed fish, resulting in reduced absolute and factorial aerobic scope relative to controls. Hypoxia also altered performance in the FAP task, with exposed fish feeding more often against their food preference, a result consistent with enhanced inhibitory control. In contrast, hypoxia exposure was associated with a significant reduction in relative telencephalon size, while other brain regions and overall brain size were unaffected. These findings suggest that severe nocturnal hypoxic events can impose lasting constraints on aerobic capacity and selectively alter brain structure, while also modifying self-control during cooperative interactions. Together, these results indicate that oxygen limitation can affect cognition both directly and through underlying physiological and neural mechanisms. As hypoxic events intensify under ongoing climate change, such constraints may have important implications for the stability of cleaner–client mutualisms, which could ultimately affect broader reef-level ecosystem stability.

Keywords: *Labroides dimidiatus*; climate change; deoxygenation; metabolism; physiology; behaviour; coral reefs; tropical fish

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