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### **Biomarker responses to salinity and temperature gradients in a marine fish**

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#### **Abstract**

Phase transitions in marine fish life history frequently occur simultaneously with changes in habitat use. This is particularly important for fish species with complex life cycles, whose early life involves migrating from spawning grounds to estuarine nurseries. Migration into estuaries requires fish to adapt to a highly dynamic environment characterized by daily fluctuations in water temperature and salinity, which poses additional physiological challenges to juvenile fish.

We performed a controlled laboratory experiment (98 days) to evaluate the biomarker responses of juvenile Senegalese sole (*Solea senegalensis*) to several temperature (16, 21°C) and salinity (5, 18, and 30) combined treatments, which mimic the environmental conditions experienced by sole juveniles during estuarine residency. After the end of the experiment, we retrieved brain, gills and liver from each fish and determined a wide range of biomarkers indicative of oxidative stress (CAT, GPx, SOD, GR, GSht, LPO), neurotoxicity (AChE) and metabolic functions (LDH, IDH).

The observed responses were organ-dependent. Oxidative damage given by LPO was only observed in gills and brain, but only at the lowest temperature tested (16°C). For gills, LPO levels were higher at the extreme salinities (5 and 30), while for brain LPO was higher at brackish salinity (18) when compared with near freshwater conditions (5). The influence of salinity and temperature do not influence AChE activity in brain, demonstrating the inexistence of neurotoxicity.

LDH activity remained constant in all treatments, showing a consistency in liver anaerobic metabolism. In contrast, IDH was temperature-dependent: higher activity at salinity 5 at the warmest temperature (21°C) indicates a higher rate of NADPH recycling, pointing that under hypoosmotic stress there is a higher energetic demand for the defense mechanisms against oxidative stress or fatty acid metabolism.

Our results provide further insights on the influence of temperature and salinity on the physiological processes of fishes in estuaries.

#### **Keywords**

Stress biomarkers, Nursery areas, Salinity, Metabolic function