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Assessing Health of Fish Stocks Through Physiology: Effects of Increases in Temperature and Pollution

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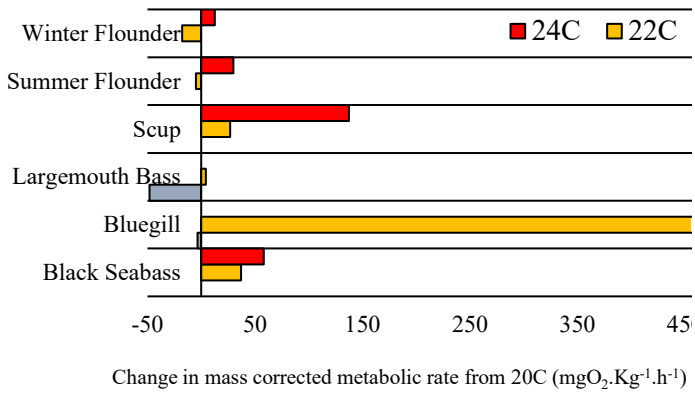

Figure 1 – Mass corrected metabolic rate is increased in Bluegill and Scup but depressed in Flounder species and relatively unchanged in Largemouth Bass and Black Seabass with increased temperatures.

Increased water temperatures have plagued most of the globe in the last decades and stressed fish populations worldwide. Concurrently, we have also seen a global increase in pollutants in the water, especially microplastics and pharmaceuticals. Cumulative negative effects of different stressors have been shown in individual fish in the laboratory settings in both freshwater and saltwater fish species. In order to correctly manage fish stocks, more modeling at the species level with information on how these stressors affect fish is required. Narragansett Bay and its watershed located in the northeast Atlantic United States have some of the most complete long term datasets in terms of physical properties and fish abundance making it ideally to study such impacts. Combined studies from the lab, field abundance and modelling have enabled accurate measures of fluxes in the Bay and to measure direct effects to stocks of by manipulating lab conditions and measuring physiological responses in local fish species.

We used a integrative approach to measure the effects of rising temperatures on fish physiology by measuring metabolic rate, RNA:DNA, growth and muscle properties in both freshwater and saltwater fish species. We have shown that the effects of rising temperatures affect different species very distinctly (Figure 1) and we have partnered with modelers to show how this information can be used to feed into predictive models. Some fish species like the Black Seabass have muscle properties that are improved with temperature but most of others see a decrease in muscle activity when the temperatures increase (Bluegill, Largemouth bass, Flounder species). We are now investigating the effects of pollutants such as pharmaceuticals and microplastics on fish physiology and how we can use information from the field and lab experiments to predict bioaccumulation in the food web by sampling fish across trophic levels. Fish were collected across Narragansett Bay and its watershed and we sampled tissue from muscle and liver as well as whole stomach and intestine. Preliminary analysis using Nile Red staining has revealed microplastics in the multiple Silversides' tissues and in half of the Scup stomachs analyzed (Figure 2).

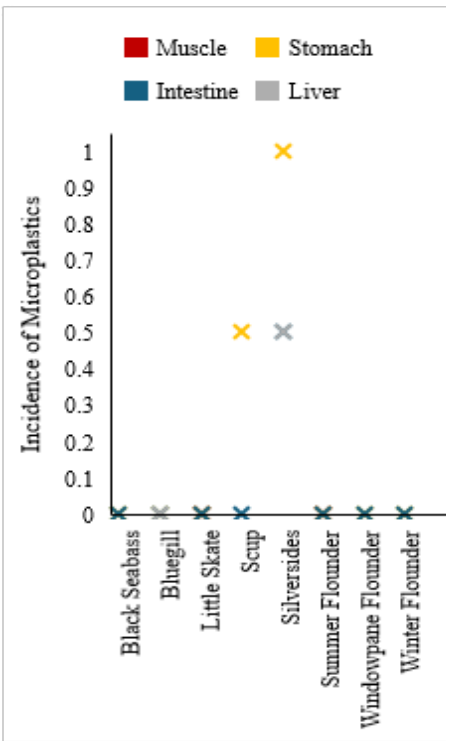

Figure 2 – Incidence of microplastics was higher for Scup and Silversides.