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Putting oxygen and temperature thresholds of marine animals in context of environmental change in coastal seas: a regional perspective for the Scotian Shelf and Gulf of St. Lawrence

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We surveyed the literature in order to compile reported oxygen, temperature, salinity and depth preferences and thresholds of important marine species found in the Gulf of St. Lawrence and the Scotian Shelf regions of the northwest North Atlantic. We determined species importance based on the existence of a commercial fishery, a threatened or at risk status, or by meeting the following criteria: bycatch, baitfish, invasive, vagrant, important for ecosystem energy transfer, and predators and prey of the above species. Using the dataset compiled for the 53 regional fishes and macroinvertebrates, we rank species (including for different lifestages) by their maximum thermal limit, as well as by the lowest oxygen concentration tolerated before negative impacts (e.g. physiological stress), 50% mortality or 100% mortality are experienced. Additionally, we compare these thresholds to observed marine deoxygenation trends at multiple sites, and observed surface warming trends. This results in an assessment of which regional species are most vulnerable to future warming and oxygen depletion, and a first-order estimate of the consequences of thermal and oxygen stress on a highly productive marine shelf. If regional multi-decadal oxygen and temperature trends continue through the 21st century, many species will lose favorable oxygen conditions, experience oxygen-stress, or disappear due to insufficient oxygen. Future warming can additionally displace vulnerable species, though we note that large natural variability in environmental conditions may amplify or dampen the effects of anthropogenic surface warming trends. This dataset may be combined with regional ocean model predictions to map future species distributions.