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Dear Editor

Please find enclosed a research article entitled, “Long-term shifts in Atlantic Cod and Yellowtail Flounder distributions on Georges Bank”, co-authored by Dr. David Keith, Jessica Sameoto, Freya Keyser, and Irene Andrushchenko, which we would like to submit for publication in *ICES Journal of Marine Science*.

Accounting for spatially and temporally variable processes has long been recognized as a challenge in fisheries science. Many traditional fisheries methods that are still operationalized today require assumptions about underlying spatial processes; these assumptions generally result in models that treat stocks as spatially homogeneous entities. Due in part to the lack of spatial context provided by traditional stock assessments, indices were developed to quantify changes in spatial patterns (e.g. Gini index). These indices are an additional source of information for assessing stock health, and while they describe how distributions (e.g. abundance or biomass) have changed over time they are unable to provide a detailed understanding of the spatial changes in these distributions.

Species distribution models (SDMs) were one of the earliest modeling frameworks developed to better understand how environmental factors influenced the distribution of a population. Historically, SDMs often did not explicitly consider temporal changes in the relationship between the environment and the response of the species; these SDMs provided a snapshot in time based on available data. However, more sophisticated SDM frameworks have been developed that allow the underlying relationships to vary in time and space. This has led to dynamic models that better utilize the latent spatio-temporal information contained in the data

In this manuscript, we used the R-INLA statistical framework to develop spatio-temporal SDMs for two depleted groundfish stocks on Georges Bank (Atlantic Cod and Yellowtail Flounder). The models were developed with data from three groundfish surveys and a suite of 22 static environmental layers. These SDMs provide insight into how the distributions of both stocks have steadily shifted towards Canadian waters. Given the habitat constraints faced by both stocks, further shifts in environmental conditions will likely put both stocks at increased risk of extirpation in the U.S. portion of Georges Bank and, eventually, all of GB irrespective of any fisheries management action.

The authors fully participated in the development of this original manuscript, approve of its submission, and accept responsibility for its contents. This is an exclusive submission to *ICES Journal of Marine Science.*

Thank you very much for considering our manuscript for publication. We look forward to hearing from you in due course.

Sincerely,

Dr. David Keith Jessica Sameoto,

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