Data-Driven Predictive Mathematical Model of Fish Population Dynamics

Rossi, Eleanor (School: Jamestown High School)

Studying population dynamics is key to protecting vital aquatic ecosystems and the economic activities they support, such as those of the Chesapeake Bay. Mathematics is a powerful tool that can be used to better understand intrinsic interactions between species and forecast their future population trends. This study leveraged multi-species mathematical models alongside the gauseR package in R to fit a predator-prey model to real-time data of fish species found in the Chesapeake Bay, the largest estuary in the United States. After deriving the model's ecological parameters, including growth and predation rates, from the real time series data, the model was employed to project the future population dynamics of these fish populations over an extended timeframe. Climate change is impacting aquatic life in many ways and it is imperative to begin to understand the long term effects it will have on fish populations. The model was also used to assess some of the potential effects of escalating seawater temperatures on fish growth and predation rates on their long term sustainability. This study stands out for its innovative utilization of multi-species dynamical systems and real observation data, offering a nuanced perspective on the intricate interplay among environmental factors, climate variables, and species viability. By providing valuable insights into the long-term sustainability of these ecologically and economically significant fish populations in the Chesapeake Bay area, this project paves the way for more informed conservation and management strategies (such as fishing regulations, that are currently based on singular species population models).

Awards Won:

NC State College of Engineering: Scholarship to attend NC State Engineering Summer Camp