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GIS analysis of historical cod fisheries in the Gulf of Maine

Nora Hefner, 2016

Gulf of Maine cod fisheries, once essential to Maine's economy and culture, are currently in a state of collapse. Following a long decline throughout the 1800s and two collapses in the 1900s – one in the middle of the century and one in the 1990s, cod populations along the coast exist now as small fractions of their former bounty. Though the connection was largely forgotten in the twentieth century, fishermen in the nineteenth century attributed the decline of the cod fishery to the loss of alewives, an anadromous river herring upon which cod prey. Alewives have been cut off from their spawning and nursery habitat along much of the Gulf of Maine due to the damming of rivers that empty into the Gulf.

My research is a part of an ongoing study that aims to establish the historical relationship between cod and other gadoid groundfish fisheries, their ecosystems, and anadromous alewives using spatial data from geographic information systems (GIS). GIS maps were created with the positions of 466 historical Gulf of Maine cod fishing grounds, identified using a database developed by fisheries scientist Ted Ames (whose work is largely responsible for fisheries scientists' renewed interest in the groundfish-alewife connection). The spatial database generated from these data will be analyzed using a logistical regression to identify characteristics of fishing grounds that define them as fishing grounds, as well as characteristics that determine the relative quality of individual fishing grounds.

The Ames database contains data in two main categories: biophysical (ecosystem characteristics) and socioeconomic (infrastructure). The focus of my research was on generating two specific data sets from historical literature, government reports, and experts in the field, and on mapping that data using GIS software (see Figure 1). The first was a list of rivers that supported annual alewife runs before the mid-twentieth century cod groundfish fishery collapse. Using GIS software, I mapped the locations at which these rivers enter the ocean, creating spatial data that show the point at which cod in the Gulf and alewives in the rivers would meet. The second data set was a list of ports and harbors that supported the groundfish industry, also before the mid-twentieth century collapse. These locations were mapped as the areas from which fishing boats would set out in pursuit of groundfish, again creating a set of spatial data points. Both of these data sets were added to the existing spatial database.

My data and Ames' data will be used to calculate distances between individual groundfish fishing grounds and historic alewife runs and between fishing grounds and ports and harbors. Statistical analyses will determine both whether those two factors have any significant relationship with fishing ground quality and the nature of their effects, if any.

Ultimately, the results of these analyses will contribute to an increasingly detailed picture of the Gulf of Maine as it existed – physically, ecologically, and economically – when it still supported astoundingly large populations of cod and other groundfish. With a better idea of what the system looked like when it worked properly, we can make a more informed and focused attempt to rebuild it.

This research provided me with opportunities to develop practical skills like use of GIS software, contacting and collaborating with scientists, researchers, and government agencies in my field, and data management. I also gained a greater understanding of and appreciation for the complexity and challenge of trying to bring research from the science level to management policy and action.

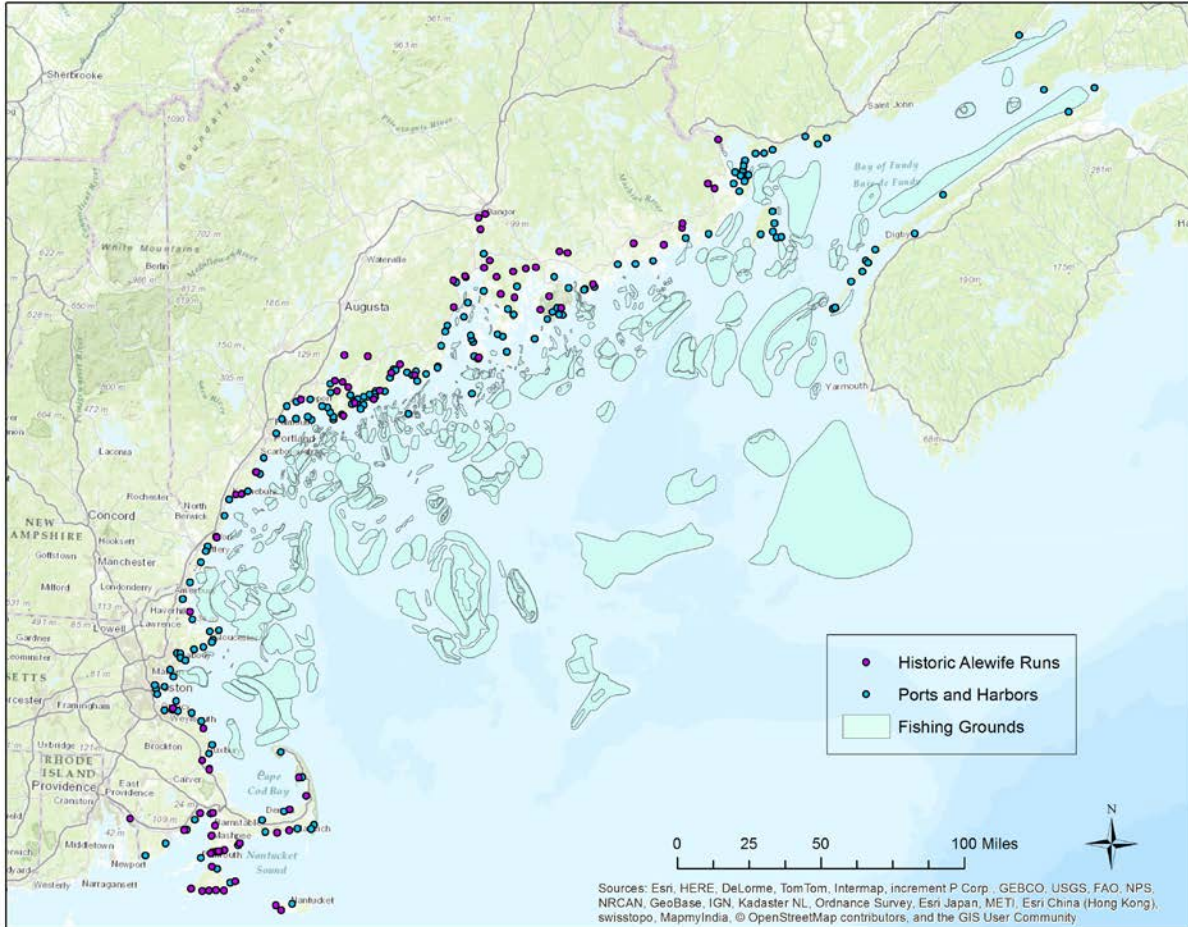


Figure 1: A GIS map of the Gulf of Maine showing fishing grounds from the Ames database, historic alewife runs, and groundfishing ports and harbors.

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