**Salinity Responses of Oyster Reefs to Freshwater Inflow in**

**Apalachicola Bay NERR, Florida**

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***Abstract***

***Introduction***

Outdated water management practices and water usage threaten the ACF River Basin. Managed by the US Army Corps of Engineers, the ACF River Basin could face economic and environmental damage due to this interstate water dispute (Alabama, Georgia, and Florida) ultimately affect Florida’s fisheries located in the Apalachicola Bay, one of the more diverse and productive ecosystems [1]. Thirty-five percent of the nutrient-rich freshwater of the ACF River Basin flows down the Apalachicola River discharging into the Eastern Gulf of Mexico supporting Florida’s multi-billion dollar fisheries as well as the livelihoods of local fishing communities often carried on by multi-generations of fishermen along the Gulf Coast of Panhandle Florida. The excessive water consumption upstream may be a contributing factor to NOAA declaring a fishery disaster on the Apalachicola Bay in 2013; the yields from commercially successful staples of crab, shrimp, finfish, and oysters that usually dominate this region have been declined. Due to water demands, freshwater inflow discharging into the Apalachicola Bay has been kept artificially set at drought levels for extended periods during dry conditions. Hence, the natural flow of the Apalachicola River is affected by the allocation from the dams and locks upstream putting the estuary health at danger. Years of litigation have yet found a way to protect the rivers, floodplains and the Apalachicola Bay.

Affecting the Apalachicola Bay downstream, the ACF River Basin is one of the more endangered river systems in the US due to water management practices. With the change in freshwater inflow, native species living in the estuarine ecosystems of the Apalachicola Bay must be able to respond quickly to drastic changes in salinity in order to survive. These native species usually live in either freshwater or saltwater environments but due to the driving forces that create the mixing of the fresh and ocean waters, several species have to adapt to periods of transition that occur within their estuarine ecosystems. Most species cannot tolerate the rapid changes in salinity that occurs during each tidal cycle in an estuary. Unlike most vegetation within estuarine ecosystems, many animals that live in Apalachicola Bay must change their behavior according to the surrounding waters’ salinity in order to survive. Oysters are among the many that need to do this. Oysters in Apalachicola Bay can live in the brackish waters of estuaries by adapting their behavior to the constantly changing salinity within this environment. During low tides when they are exposed to low-salinity water, oysters close up their shells and stop feeding. Isolated in their shells, oysters switch from aerobic respiration in which they breathe oxygen through their gills to anaerobic respiration, which does not require oxygen. Many hours later, when the high tides return and the salinity and oxygen levels in the water are considerably higher, the oysters open their shells and return to feeding and breathing oxygen [2]. Salinity varies from one location to another within the estuary. They are influenced by tidal effects, volume of fresh water flowing into the estuary as well as contributing wind effects. Estuarine salinity levels are generally highest near the mouth of a river where the ocean water enters, and lowest upstream where freshwater flows in. Salinity levels usually rise during the summer when higher temperatures increase levels of evaporation in the estuary.

Salinity is an important indicator for water quality and ecosystem health. Estuarine organisms have different tolerances and responses to salinity changes. Many bottom-dwelling species such as oysters tolerate some change in salinity, but salinities outside an acceptable range will negatively affect their growth and reproduction, and ultimately, their survival in this sensitive environment. The increase of salinity in the Apalachicola Bay may have major repercussions on this biodiverse estuarine ecosystem. Oyster populations have been an indicator for a healthy ecosystem in coastal regions including assessments for how estuarine ecosystems respond to changes in freshwater inflow. Freshwater inflow into estuaries is a major contributing factor influencing oyster abundance. During periods of low freshwater discharge, estuarine salinity levels increase making oysters more vulnerable to predation and disease. Conversely, it has been suggested that during high freshwater inflow, oyster populations may experience an increase in mortality due to long periods of low salinity. This preliminary study presents an application of the artificial neural network (ANN) to assess salinity variation responding to the multiple driving forces of freshwater inflow, tides, and wind effects into the Apalachicola Bay in Florida at specific locations particularly those in oyster reefs. Parameters in the ANN model were trained until the model predictions of salinity matched well with the observations. Then, the trained model was verified by applying the ANN model to a complementary but independent data set. Though the results indicate that the model is capable of correlating the non-linear time series of salinity to the multiple driving forces, this study suggests that salinity in estuaries such as the Apalachicola Bay are still difficult to model. To validate the results of the ANN model, an optimum range was observed comparing various flow scenarios in response to how salinity may affect oyster productivity. Salinity remains difficult to model even sophisticated three-dimensional numerical models that are available to provide detailed results to environmental problems would need to calibrate and verify large amounts of observation data for ecological applications which takes a large amount of effort under a number of predetermined assumptions [3].

***References***

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