PhD Dissertation
Department of Environmental Science and Policy
George Mason University

Candidate: Tunde Adebola
Defense Date and Time: August 9, 2017 @ 10:00am-12:30pm
Defense Location: David King Hall, Rm 3006
Title: Investigating Anthropogenic Impacts in Nigerian Coastal Waters Using Fisheries Ecosystem Modeling Approaches

Dissertation Director: Dr. Kim de Mutsert
Committee: Dr. Chris Kennedy, Dr. Esther Peters, Dr. Howard Townsend

ABSTRACT

Nigeria has two fishing subsectors in the inshore fishing area of the coast. Artisanal fisheries comprising of more than one million fishermen operating small fishing crafts and gears along an 853-km coastline in waters up to 40-meters deep, and about 250 industrial fish trawlers operating in deeper waters beyond the 5NM allocated to artisanal fisheries. Depletion of the target species - *Penaeus notialis* in deeper waters (50m) led to changes in target species (from *Penaeus notialis* to *Penaeus monodon*), and in the spatial attributes of the fisheries. This study investigates the hypothesis that ecosystem impacts increase as industrial fleets increase fishing in shallower nearshore waters. Impacts of the high fishing intensity and increased spatial overlap in fishing areas for the fishing subsectors in NCW (Nigerian coastal waters) need to be quantified from ecosystem fisheries perspectives. Important questions about fisheries impacts on energetic flows, the resulting food web structure, and spatial distribution of fisheries resources need to be investigated and understood to improve information needed for fisheries management and policy in Nigeria. This research provided a holistic understanding of human impacts through fishing in an integrated framework. Ecopath with Ecosim (EwE), a mass balanced trophic model that accounts for fishing impacts on food webs was used to evaluate and inform how the ecosystem in Nigerian coastal waters is likely to have responded to changes in fishing and coastal management practices. Measures that reflect impacts of fishing in NCW such as the Mean Trophic Level and the Maximum Mean Length of Catch declined rapidly in the

1980s and these were accompanied by a geographical expansion of fisheries due to increasing Fishing in Balance Index during the same period. Network analysis in Ecopath showed increased ecosystem degradation in NCW between 1985 and 2000 as evidenced by increased homogenization, less energetic flows, reduced production and shorter cycles/higher recycling of organic matter. Spatial simulations in Ecospace suggest restricting trawling outside the first 5NM of the coastal waters will especially benefit large demersal predator species but biomass of other functional groups changed very little based on Ecospace simulations with this spatial management strategy. These results suggest the importance of limiting the amount of fishing effort exacted in NCW ecosystem by providing alternative means for self-support for coastal dwellers in NCW. It is a first attempt to provide a fisheries ecosystem management model for Nigeria, and has contributed to fisheries ecology by furthering our understanding of the coastal food web and ecological responses especially in a highly perturbed ecosystem such as NCW.