Evidence of climate-driven ecosystem reorganization in the Gulf of Mexico

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The Gulf of Mexico is one of the largest and most valuable marine ecosystems in the world, and is affected by a unique combination of natural and anthropogenic phenomena such as hurricanes, terrestrial runoff, oil spills, and fishing activities. These complex and interacting stressors, together with the highly dynamic nature of this ecosystem, present challenges for effective management of its resources. In a collaborative effort between AOML and SEFSC, we analyzed a compilation of over 100 indicators representing physical, biological, and economic aspects of the Gulf of Mexico. The analyses suggest that an abrupt, ecosystem-wide reorganization occurred in the mid-1990s. Analysis of landings composition indicates a major shift in the late-70s, which is aligned with significant changes in management regulations in the region, and again a significant shift in the mid-90s and also the mid-60s. The latter shifts are aligned with changes in a major mode of climate variability in the Atlantic: the Atlantic Multidecadal Oscillation (AMO). Our analyses highlight the challenges in parsing apart anthropogenic versus climate drivers, particularly in a system where the two interact in complex and nonlinear ways.
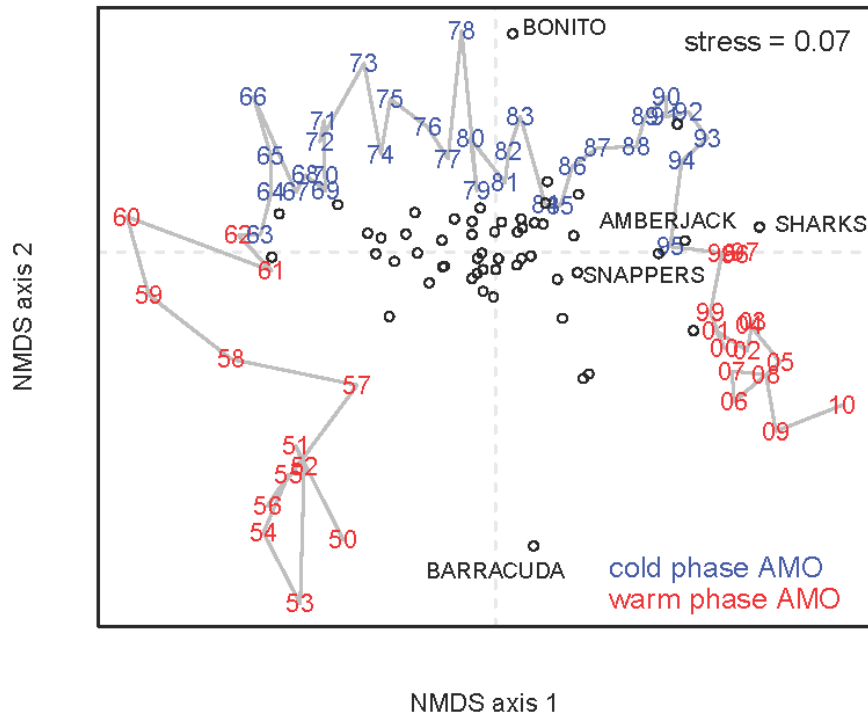

Figure: Non-metric multidimensional scaling analysis of Gulf of Mexico landings groups from 1950 – 2010, with year labels color coded by AMO phase. Species loadings appear as dots, with major contributors to first and second axis labeled.