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Case Study 6

Accounting for red tide mortality in stock assessments and management projections in the Gulf of Mexico

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ABSTRACT

Red tides are a harmful algal bloom caused by the toxic dinoflagellate, *Karenia brevis*, that occur almost annually in the Gulf of Mexico. Red tide usually forms during the summer and early fall in nearshore waters along the southwest coast of Florida, but may occur at any time, in offshore waters, and in other regions of the Gulf. Severe red tides can result in massive fish kills, mortality on marine megafauna, persistent hypoxic conditions, respiratory distress in humans, shellfish harvest closures, and loss of fisheries and tourism revenues. These events present challenges for stock assessments that are expected to account for mortality caused by past red tides, and when setting annual catch limits if a red tide bloom is ongoing or occurred during a projection year. Red tide mortality was first incorporated into stock assessment models for gag (*Mycteroperca microlepis*) and red grouper (*Epinephelus morio*) in 2009 after the severe 2005 red tide, which persisted for over a year and extended to offshore waters. Red tides occurring in 2014, 2018, and 2021 were incorporated into later stock assessments of these species. This has been accomplished by adding a pseudo fishing fleet (i.e., dead discard only) and estimating a mortality term for years when red tide was presumed severe enough to impact the stock, with full selectivity across all ages. For the 2021 stock assessment of gag grouper, a spatial ecosystem model of the West Florida Shelf provided estimates of red tide mortality by age, and near-real time estimates for the 2021 bloom were used in catch projections and management advice. These recent advances integrated satellite imagery, *in situ* red tide samples, species distribution patterns, lethal and sublethal responses, and food web effects into the stock assessment and management process. How the Gulf Council deals with future red tides will be guided by the new Gulf of Mexico Fishery Ecosystem Plan (FEP). The Gulf FEP provides a framework for identifying and dealing with fishery ecosystem issues such as red tides, and includes components for stakeholder engagement, data collection, modeling, and management integration.