

## **Ecopath-based simulation and optimization of management options for the Eastern Gulf of Mexico reef fish fishery**

Sherry Larkin\*, Sergio Alvarez\*, Dave Chagaris, Jake Tetzlaff\*, Carl Walters\*\*, Mike Allen\*, Behzad Mahmoudi, Bill Lindberg\*, Bill Pine\*

\*University of Florida, \*\*University of British Columbia

### **Abstract**

Ecological and economic tradeoffs of proposed management actions were assessed using the Ecopath with Ecosim (EwE) and Ecospace software. The model has 70 biomass pools (e.g., detritus, primary producers, invertebrates, fish, dolphins, sea birds), including multiple age-classes of key species. After mass-balancing, the model was driven using observed fishing mortality from 13 fleets (4 recreational, 9 commercial) and foraging behavior was adjusted to fit the model to historic abundance and catch trends. The mixed trophic impacts routine identified the most influential groups (i.e., recreational private boats, small mobile epifauna and sardines-herring). Simulations extended the status quo 20 years and examined the impact of: 1) rebuilding gag grouper, 2) reducing longline effort, 3) increasing baitfish harvests and 4) alternative closed areas. Results highlighted changes in biomass through both competition and predation within the food web. Next, fishing effort was optimized to maximize a weighted four-criterion objective function (profit, jobs, stock size, ecosystem structure). Tradeoff frontiers between profits and reef fish biomass arose. Results indicated the status quo of overfished gag grouper is sub-optimal but policies being considered should move the system closer to the frontier. Sensitivity analysis on the recreational and commercial prices revealed a stable frontier. Lastly, Ecospace predicted spillover effects from marine protected areas (MPAs) that benefit key species and fleets, however, negative effects of lost fishing grounds and subsequent concentration of effort occurred. Results indicated that MPAs would need to be relatively large in order to be effective at preventing overfishing.