2016 Florida Sea Grant: Impacts of stock spatial structure and connectivity on the stock assessment and management of Caribbean spiny lobster stocks

Methods

Meta-population framework

In this project, the PIs will develop a meta-population framework that integrates multiple Pan-Caribbean spiny lobster sub-stocks as a regional stock pool. The initial plan is to include nine sub-stocks from eight countries in addition to the southeast U.S. sub-stock: Bahamas, Belize, Colombia, Cuba southeast, Cuba northeast, Dominican Republic, Honduras, Mexico, and Nicaragua. These sub-stocks are chosen because they are either spiny lobster nursery areas, or potentially correlate to the southeast U.S. sub-stock (Tringali *et al.*, 2008; Truelove *et al.*, 2011; Kough *et al.*, 2013). The number of sub-stocks may be reduced after a detailed discussion with Caribbean spiny lobster fisheries scientists and managers. Each of these sub-stocks will be treated as a patch in the regional stock pool.

Bias and uncertainty of stock assessment models can be evaluated using the developed framework. A "true" Caribbean spiny lobster population dynamic will be simulated via an operating model based on the latest stock assessment results, as well as the determined spatial structure and connectivity scenario. Alternative management strategies will be applied and their consequences on Caribbean spiny lobster fisheries especially the southeast U.S. fishery, will be carefully measured and compared. Both input and output controls will be used, i.e. biological reference point, size limit, temporal fishing closure, and so on.

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Connectivity

In the "meta-population" spatial structure, connectivity is represented by an $n \times n$ matrix: $C = (c_{ij})$, where n is the number of patches, elements c_{ij} correspond to the proportion of individuals migrate from patch i to patch j (Artzey-Randrup and Stone, 2010). Due to the life history of Caribbean spiny lobster, only recruitment dispersion will be considered in deriving connectivity matrix. Therefore, the dimension of connectivity matrix will be greatly reduced.

Adopting the Lagrangian stochastic IBM in the project is to derive some possible demographic connectivity and test performance of stock assessment models under different connectivity scenarios. However, it is necessary to point out that deriving connectivity is not among the key objectives of this project. Selecting bio-physical oceanography modeling method doesn't mean to exclude other methods. When more alternative connectivity scenarios are available in the future, they could be deployed to assess the potential risk of ignoring spatial structure and connectivity in the fishery management.