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

Results 1

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- Currently, the PIs are deriving possible connectivity scenarios from a Lagrangian stochastic individual-based model (IBM).
- Due to the life history of Caribbean spiny lobster, only recruitment dispersion will be considered in deriving connectivity matrix. Therefore, in this project connectivity is defined as the proportion that lobster recruits migrate from patch to the others, which is represented by a *n* by *n* matrix.

$$c = \begin{bmatrix} c_{1,1} & c_{1,2} & \cdots & c_{1,j} & \cdots & c_{1,n} \\ c_{2,1} & c_{2,2} & \cdots & c_{2,j} & \cdots & c_{2,n} \\ \vdots & \vdots & \cdots & \vdots & \cdots & \vdots \\ c_{i,1} & c_{i,2} & \cdots & c_{i,j} & \cdots & c_{i,n} \\ \vdots & \vdots & \cdots & \vdots & \cdots & \vdots \\ c_{n,1} & c_{n,2} & \cdots & c_{n,j} & \cdots & c_{n,n} \end{bmatrix}$$

Elements c_{ij} corresponds to the proportion of individuals migrate from patch *i* to patch *j*.

- A meta-population framework includes nine sub-stocks from eight countries in addition to the southeast U.S. sub-stock.
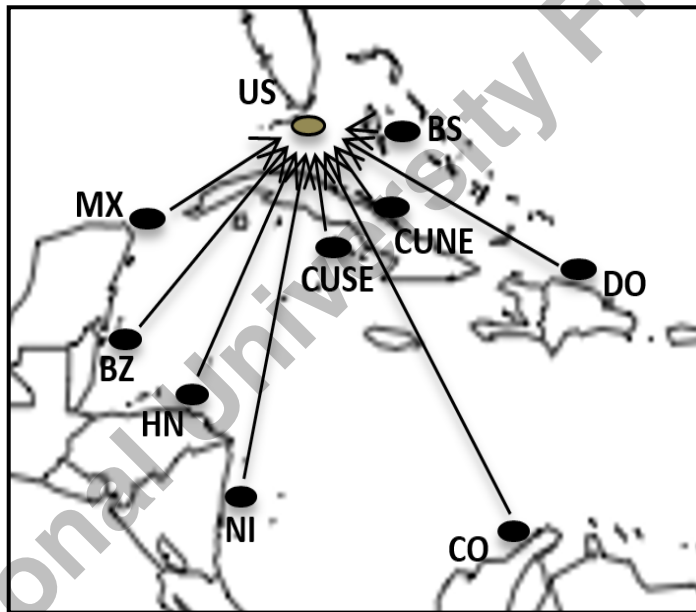

BS:	Beverton-Holt Stock-Recruitment Model
	State-space stock assessment model
BZ:	Age-based Cohort Analysis
CUNE:	Virtual Population Analysis
CUSE:	Virtual Population Analysis &
	Statistical Catch-at-Age Model
MX:	Dynamic Age-Structured Model
NI:	Trends Estimated

US: Integrated Catch-at-Age Model &
Modified DeLury Model
Others: limited information available

- In the IBM, the time step of the is one day. From early-1990s to present, a large number of pseudo spiny lobster larvae (e.g. 2,000) start their journeys from the original stocks during every spawning season, and experience the planktonic stage for 6-9 months. It can be assumed that the hatching egg will be released in June every year, when the peak spawning occurs. The locations of the pseudo lobsters in the next time step will be determined by the water speeds in the current locations, and also independently subject to the random walk term. All predicted trajectories will be recorded, therefore, the annual and/or seasonal connectivity among different sub-stocks can be summarized.
- IBM Video Example 1, 6-1-1996 ~ 3-27-1997, 300 days; assuming all lobster recruits are in the 2-meter-depth layer.
- According to Rimmer and Phillips (1979), and Yeung and McGowan (1991), in this project, vertical distribution of phyllosoma larvae of spiny lobster is assumed as: daytime (25 - 75 m), and nighttime (<25 m).

Vertical distribution
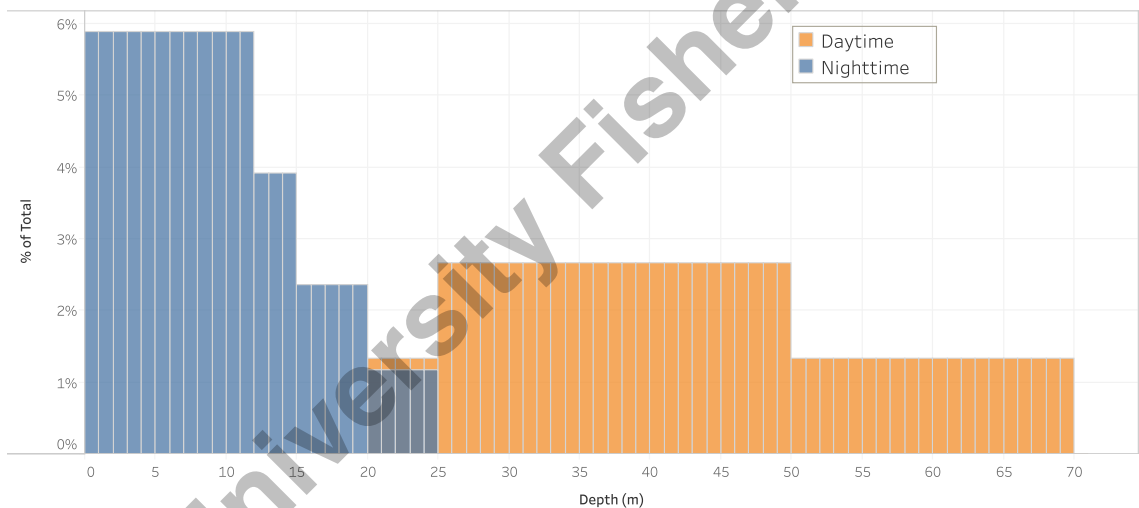
- IBM Video Example 2, 6-1-1996 ~ 3-27-1997, 300 days; assuming vertical migration.
- Both the biophysical modelling, and the experiment methods (please see Results 2) provides evidence that Florida's spiny lobster stock receives recruits from multiple source populations outside of Florida, in addition to self-recruitment, and distinct temporal pattern can be found for spiny lobster recruits.
- The operating models in the management strategy evaluation generally indicate that minimum stock spawning biomass of Florida, final year SSB of Florida, and final year SSB of entire metapopulation increase with the minimum size and the length of closed season; while Florida landing variation, total landings of both the Florida and metapopulation display reversely.
- The management scenarios with female protection performed better than the others in almost all measures, except the landing variation.