

A Modified Catch Survey Analysis for Assessing Northern Gulf of Mexico Blue Crabs

Un Análisis de Encuesta Captura Modificado para la Evaluación de Cangrejos Azules del Norte del Golfo de México

Une Analyse de Sondage mis à Jour le Catch pour Évaluer les Crabes Bleus Nord du Golfe du Mexique

GLEN SUTTON¹, WADE COOPER², JOE WEST³, ROBERT LEAF⁴, RALF RIEDEL⁴, and STEVE VANDERKOOY⁵

¹Texas Parks and Wildlife Department, Coastal Fisheries, 1502 FM 517 East, Dickinson, Texas 77539 USA.

²Fish and Wildlife Research Institute, St. Petersburg, Florida 33702 USA.

³Louisiana Department Wildlife Fisheries, Baton Rouge, Louisiana 70803 USA.

⁴Gulf Coast Research Laboratory, 703 East Beach Drive, Ocean Springs, Mississippi 39564 USA.

⁵Gulf States Marine Fisheries Commission, Ocean Springs, Mississippi 39564 USA.

EXTENDED ABSTRACT

Blue crab *Callinectes sapidus* (Rathbun) is an economically important coastal species distributed throughout the Gulf of Mexico (GOM), and from New England in the United States to northern Argentina. Established commercial fisheries exist in most of the Atlantic and all GOM seaboard states. Landings in the GOM peaked in 1987 - 1988, but a general downward trend starting in 2000 has continued (VanderKoooy and Perry, in prep.). In response to ongoing trends, the Gulf States Marine Fisheries Commission's (GSMFC's) Blue Crab Technical Task Force (TTF) decided to assess the status of these stocks in the GOM.

The TTF identified two regional GOM stocks for the assessment: a Florida or "Eastern GOM stock" occurring along the west Florida coast from the southern tip to Apalachicola Bay, and a "Western GOM stock" occurring from Apalachicola Bay to southwest Texas. The Western GOM stock was centered in Louisiana. This separation was based on a genetic study by Darden (2004) who conducted phylogenetic analyses in multiple locations in the GOM. Darden found that gene flow was restricted among western GOM locations, particularly among Louisiana and Texas bays, whereas the Eastern GOM stock, from Goodland to Apalachicola Bay, showed no significant population structuring.

Stock assessments were implemented via the GSMFC's Gulf Data, Assessment, and Review (GDAR) program developed for regional assessments of nearshore stocks. The program was designed to facilitate the assessment through three developmental workshops. The initial Data Workshop compiled all available data from the commercial fishery, the recreational fishery, and the individual state agencies' fishery independent sampling programs for blue crabs. The Assessment Workshop developed alternate assessment models using the available data. The Review Workshop used expert peer review to critique the model.

Two modeling approaches were selected during the Assessment Workshop. These include:

- i) A two-stage model (catch-survey analysis/modified Delury model) adapted from the 2011 Chesapeake blue crab assessment (Miller et al. 2011), and
- ii) A surplus production model (ASPIC).

The two-stage model was selected as the base model, due to the preference for this modeling approach from previous blue crab assessments (Chesapeake, Louisiana, Florida, and Delaware), while the ASPIC model was used as support. Catch-Survey Analysis (CSA) is a stage-based assessment approach often used when age structure or catch-at-length information are unavailable. The model partitions an exploited population into pre-recruited (unavailable to fishery) and post-recruited (available to fishery) stages and fits observed time series data of these stages to estimated catch numbers in order to estimate abundance and fishing mortality. Miller et al. (2011) modified this to include a stock recruitment (S/R) function and estimate management reference points internally in the model, thus exempting the previously required assumption of no observational error in catch data. The model was modified further in this assessment to include stage specific natural mortality (M) and an option to force the S/R relationship and/or M using an environmental time series. Results include:

- i) Management reference points MSY , SPR , F_{MSY} , U_{MSY} for the Western and Eastern Gulf of Mexico blue crab stocks, and
- ii) Test for improved model fits when incorporating environmental forcing.

Neither stock was found to be "overfished" or undergoing "overfishing", although the western stock was found to be in a depressed state and approaching an overfishing limit (Figures 1 and 2). Better model fits were achieved using precipitation to force S/R in the eastern stock and M in the western stock. The reviewers found the models and approach used herein to

provide a sound scientific basis for management. However, a precautionary approach was advised based on possible misrepresentations of stock definition and geographic extent. Existence of smaller scaled regional stocks could easily negate the broader regional findings. The final GDAR01 Assessment Report with supporting ADMB code and the GDAR01 Reviewers' Report (VanderKooy 2013) are available at the Gulf States Marine Fisheries Commission's website as downloadable Adobe PDF files at <http://www.gsmfc.org/publications/GSMFC%20Number%20215.pdf>.

LITERATURE CITED

Darden, R.L. 2004. *Population Genetics of the Blue Crab in the Gulf of Mexico*. Ph.D. Dissertation. The University of Southern Mississippi, Hattiesburg, Mississippi USA. 175 pp.

Miller T.J., M.J. Wilberg, A.R. Colton, G.R. Davis, A. Sharov, R.N. Lipcius, G.M Ralph, E.G. Johnson, and A.G. Kaufman. 2011. *Stock Assessment of Blue Crab in Chesapeake Bay*. 2011. University of Maryland Center for Environmental Science Chesapeake Biological Laboratory, Solomons, Maryland USA.

VanderKooy, S. (ed.). 2013. *Gulf Data, Assessment, and Review GDAR 01 Stock Assessment Report Gulf of Mexico Blue Crab*. Gulf States Marine Fisheries Commission Publication Number 215. Ocean Springs, Mississippi USA.

VanderKooy, S and H. Perry (eds.). [In preparation]. *The blue crab fishery of the Gulf of Mexico, United States: a regional management plan*. Gulf States Marine Fisheries Commission, Ocean Springs, Mississippi USA.

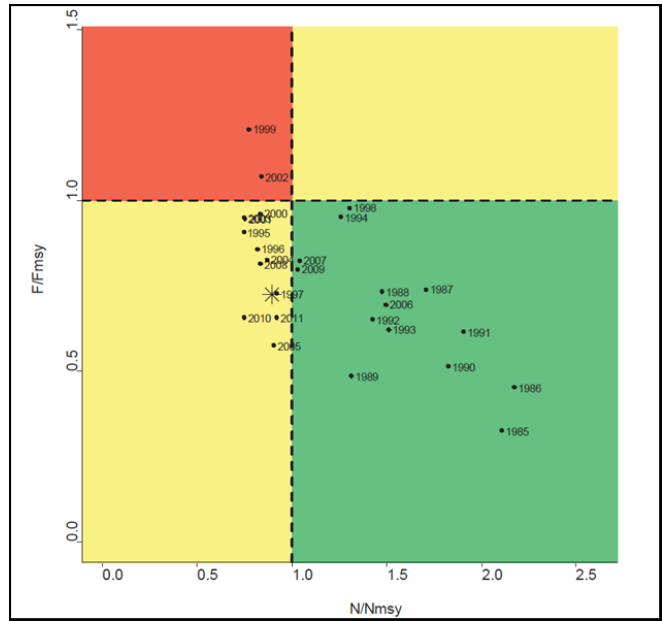


Figure 1. Status of the Western stock in relation to F/Fmsy and N/Nmsy. The asterisk (*) denotes the current status based on average landings from 2009 through 2011.

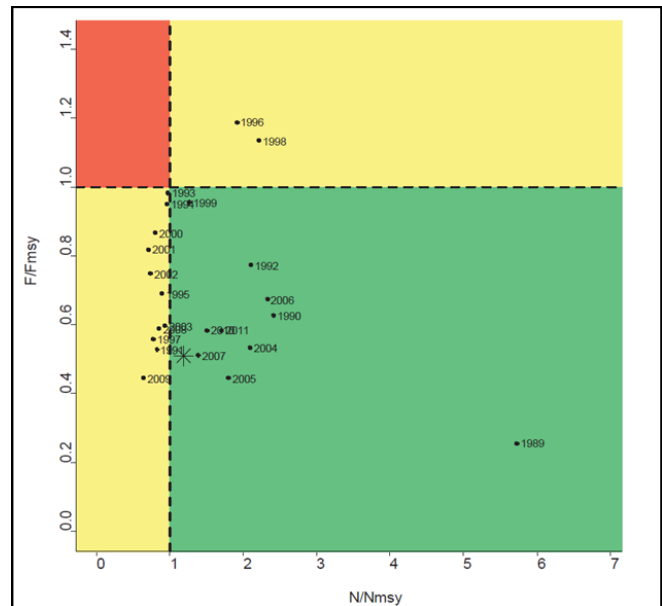


Figure 2. Status of the Eastern stock in relation to F/Fmsy and N/Nmsy. The asterisk (*) denotes the current status based on average landings from 2009 through 2011.