S E D A R

Southeast Data, Assessment, and Review

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History of Red Drum Assessments of the U.S. South Atlantic

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3. Assessment History

3.1 Coastwide Assessments

The most recently completed assessment of the status of the Atlantic stock was documented in **Vaughan and Carmichael (2000)**. This assessment of red drum was conducted using recreational and commercial data from 1986 through 1998, and updates data and analyses from the 1989, 1991, 1992 and 1995 stock assessments on Atlantic coast red drum **(Vaughan and Helser, 1990; Vaughan 1992; 1993; 1996)**. Using available length-frequency distributions and age-length keys, recreational and commercial catches were converted to catch in numbers at age. Separable and tuned virtual population analyses were conducted on the catch in numbers at age to obtain estimates of fishing mortality rates and population size (including recruitment to age 1). In turn, these estimates of fishing mortality rates combined with estimates of growth (length and weight), sex ratios, sexual maturity and fecundity were used to estimate yield per recruit, escapement to age 4, and static (or equilibrium) spawning potential ratio (static SPR, based on both female biomass and egg production).

Three virtual analysis approaches (separable, spreadsheet, and FADAPT) were applied to catch matrices for two time periods (early: 1986-1991, and late: 1992-1998) and two regions (Northern: North Carolina and north, and Southern: South Carolina through east coast of Florida). Additional catch matrices were developed based on different treatments for the catch and-release recreationally-caught red drum (B2-type). These approaches included assuming 0% mortality (BASE0) versus 10% mortality for B2 fish. For the 10% mortality on B2 fish, sizes were assumed the same as caught fish (BASE1), or positive difference in size distribution between the early period and the later period (DELTA), or intermediate (PROP). Hence, a total of 8 catch matrices were developed (2 regions, and 4 B2 assumptions for 1986-1998) to which the three VPA approaches were applied. The question of when offshore emigration or reduced availability begins (during or after age 3) was to be a source of bias that tended to result in overestimates of fishing mortality. Additionally, the continued assumption **(Vaughan and Helser, 1990; Vaughan 1992; 1993; 1996)** of no fishing mortality on adults (ages 6 and older), causes a bias that results in underestimates of fishing mortality for adult ages (0 versus some positive value). Because of emigration and the effect of the slot limit for the later period, a range in relative exploitations of age 3 to age 2 red drum was considered. Tuning indices were developed from the MRFSS, and state indices for use in the spreadsheet and FADAPT VPAs.

The SAFMC Red Drum Assessment Group (Appendix A in **Vaughan and Carmichael 2000**) favored the FADAPT approach with catch matrix based on DELTA and a selectivity for age 3 relative to age 2 of 0.70 for the northern region and 0.87 for the southern region. In the northern region, estimates of static SPR increased from about 1.3% for the period 1987-1991 to approximately 18% (15% and 20%) for the period 1992-1998. For the southern region, estimates of static SPR increased from about 0.5% for the period 1988-1991 to approximately 15% for the

period 1992-1998. Population models used in this assessment (specifically yield per recruit and static spawning potential ratio) are based on equilibrium assumptions: because no direct estimates are available as to the current status of the adult stock, model results imply potential longer term, equilibrium effects. Because current status of the adult stock was unknown, a specific rebuilding schedule could not be determined. However, the duration of a rebuilding schedule should reflect, in part, a measure of the generation time of the fish species under consideration. For a long-lived, but relatively early spawning, species as red drum, mean generation time would be on the order of 15 to 20 years based on age-specific egg production. Maximum age is 50 to 60 years for the northern region, and about 40 years for the southern region. The ASMFC Red Drum Board's first phase recovery goal of increasing %SPR to at least 10% appeared to have been met.

Based on the joint Red Drum Technical Committee's (SAFMC/ASMFC) selection of the most appropriate catch matrix (incorporating an assumption on size of recreationally-released fish), selectivity of age 3 relative to age 2, and virtual population analysis (FADAPT), a bag and size limit analysis was conducted **(Vaughan and Carmichael 2001)**. Given gear- and age-specific estimates of fishing mortality (F) for the 1992-1998 period, analyses were made of potential gains in escapement through age 4 and static spawning potential ratio (SPR) from further reductions in fishing mortality due to changes in slot and bag limits. Savings from bag limits were calculated given a particular slot size for the recreational fishery, with no savings for the commercial fisheries in the northern region due to their being managed primarily through a quota. Relative changes in catch-at-age estimates were used to adjust age-specific F and hence calculated escapement through age 4 and static SPR. Adjustment was made with the recreational savings to account for release mortality (10%, as in the stock assessment). Alternate runs for the northern region commercial fishery considered 25% release mortality for lengths outside the slot (instead of 0% for the base run), and 0% vs. 10% gain or loss across legal sizes in F. These results were summarized for ranges of bag limits with increasing minimum size limit (for fixed maximum size), and with decreasing maximum size limit (for fixed minimum size limit). For the southern region, a bag limit of one-fish per angler trip would be required to attain the stated target of 40% static SPR if the current slot limit were not changed. However, for the northern region, a bag limit of one-fish per angler trip appears to be insufficient to attain the stated target of 40% static SPR while maintaining the current slot limit. A peer-reviewed version of these analyses as applied to the Southern Region was prepared **(Vaughan and Carmichael 2002)**.

3.2 State Assessments

State-specific assessments have also be conducted, including those by Florida Fish and Wildlife Conservation Commission and North Carolina Division of Marine Fisheries:

The stock assessments for Florida red drum have changed considerably over time. Early assessments utilized localized tag-recapture information and assumptions about tag retention and angler reporting rates to infer fishing mortality rates (**Murphy *et al.* 1990**). These were

combined with life history information to establish estimates of static spawning potential ratios and conduct yield-per-recruit analyses. As annual age sampling increased, especially from fishery-independent surveys, assessments moved toward more age-structured analyses. Initially un-tuned catch-at-age analyses (cohort analyses) were used in assessments that employed *ad hoc* estimates of terminal-year fishing mortality and selectivity patterns (**Murphy 1994**). Trends in angler and fishery-independent-monitoring catch rates were first used in 1998 as indices of abundance in a tuned age-structured assessment (**Murphy 1998**). More recently, a more flexible age-structured analysis was developed that could potentially capture more of the uncertainty inherent in the analysis (**Murphy 2002**), though important information on the sizes of red drum released by anglers were unavailable until the most recent assessment (**Murphy 2005**). Results reported in the last assessment indicated a persistent decrease in year-class-specific escapement rates through the late 1990's on the gulf coast and through 2003 on the Atlantic coast. Gulf coast escapement rates appeared to have leveled off between 1998 and 2003 at levels near the 30% target. Atlantic coast estimates of escapement in 2003 were about 34%.

The assessment conducted by North Carolina Division of Marine Fisheries (**Takade and Paramore 2007**) included data provided by Virginia Marine Resouces Commission to update the earlier assessment by **Vaughan and Carmichael (2000)** for the northern red drum stock. This new red drum assessment indicates that F has decreased and escapement and static SPR have increased for the red drum northern stocks during the current (late) management period. The results from the 2000 stock assessment indicated that overfishing was occurring, with static SPR values well below the threshold SPR. The current model estimates are all above 30% static SPR and, therefore, indicate that overfishing is no longer occurring. It appears that the condition of the northern red drum stock has improved and that the more restrictive management measures implemented during the late period (1999-2005) have aided in that improvement. The northern red drum stock was assessed using commercial, recreational, and independent data from 1986 to 2005. Results were broken into three regulatory periods with relatively uniform regulations (early: 1986-1991, mid: 1992-1998, and late: 1999-2005). A major assumption in this assessment was assigning an accurate length distribution to released fish from the recreational fishery. While several assumptions on the length distribution of recreational releases were calculated, the preferred matrix (Tagging) used length frequencies estimated from modeling of North Carolina Division of Marine Fisheries (NCDMF) tag returns. Late period age-3 selectivity was estimated to be 0.48 of fully selected fish (age-2), and was estimated from modeling of NCDMF tag returns. Two models were used: a backward calculating virtual population analysis (VPA) and a forward calculating spreadsheet catch-at-age model. Both models were updated from the **Vaughan and Carmichael (2000)** assessment. Fishing mortality (F) estimated from FADAPT ranged from 0.50 to 0.49, with escapement ranging from 40.6% to 41.0% and static spawning potential ratio (SPR) ranging from 40.4% to 40.8%. The spreadsheet catch-at-age model F estimates ranged from 0.66 to 0.63, with escapement estimated at 32.8% and static SPR estimated at 32.3%. All estimated runs using the TAGGING matrix from both models were above the threshold of 30% static SPR and the FADAPT estimates were above the target of 40% static SPR. All runs showed improvements in escapement and SPR from the previous regulation period (1992-1998).

3.3 References

Murphy, M. D. 1994. A stock assessment of red drum *Sciaenops ocellatus* in Florida. Report to the Florida Martine Fisheries Commission from the Florida Department of Environmental Protection, Florida Marine Research Institute, St. Petersburg. FWRI In-House Report 1994-004.

Murphy, M. D. 1998. A stock assessment of red drum, *Sciaenops ocellatus* in Florida: status of the stocks through 1997. Report to the Florida Marine Fisheries Commission from the Florida Department of Environmental Protection, Florida Marine Research Institute, St. Petersburg. FWRI In-House Report 1998-006.

Murphy, M. D. 2002. A stock assessment of red drum, *Sciaenops ocellatus* in Florida: status of the stocks through 2000. Report to the Florida Fish and Wildlife Conservation Commission from the Fish and Wildlife Research Institute, St. Petersburg. FWRI In-House Report 2002-016.

Murphy, M. D. 2005. A stock assessment of red drum, *Sciaenops ocellatus* in Florida: status of the stocks through 2003. Report to the Florida Fish and Wildlife Conservation Commission from the Fish and Wildlife Research Institute, St. Petersburg. FWRI In-House Report 2005-006.

Murphy, M.D., B. Mahmoudi, J.J. Kimmel, R.H. McMichael, Jr., R.G. Muller, F.S. Kennedy, Jr., and D.E. Roberts, Jr. 1990. Assessment of the current status of red drum in Florida. Report to the Florida Marine Fisheries Commission from the Florida Marine Research Institute, Florida Department of Environmental Protection, St. Petersburg, FL. October 22, 1990. FWRI IN-House Report 1990-002.

Takade, H.M. and L.M. Paramore. 2007. Stock status of the northern red drum stock. North Carolina Division of Marine Fisheries, Morehead City. [S18-RD42]

Vaughan, D. S. 1992. Status of the red drum stock of the Atlantic coast: Stock assessment report for 1991. **NOAA Technical Memorandum NMFS-SEFC-297**, Beaufort Laboratory, Beaufort, North Carolina 28516, 117 p. [S18-RD49]

Vaughan, D. S. 1993. Status of the red drum stock on the Atlantic coast: Stock assessment report for 1992. **NOAA Technical Memorandum NMFS-SEFC-313**, Beaufort Laboratory, Beaufort, North Carolina 28516, 65 p. [S18-RD50]

Vaughan, D. S. 1996. Status of the red drum stock on the Atlantic coast: Stock assessment report for 1995. **NOAA Technical Memorandum NMFS-SEFC-380**, Beaufort Laboratory, Beaufort, North Carolina 28516, 50 p. [S18-RD51]

Vaughan, D. S., and J. T. Carmichael. 2000. Assessment of the Atlantic red drum stock for 1999: Northern and southern regions. **NOAA Technical Memorandum NMFS-SEFC-447**, Beaufort Laboratory, Beaufort, North Carolina 28516. [S18-RD52]

Vaughan, D. S., and J. T. Carmichael. 2001. Bag and size limit analyses for the red drum in northern and southern regions of the U.S. Atlantic. **NOAA Technical Memorandum NMFS-SEFC-454**, Beaufort Laboratory, Beaufort, North Carolina 28516. [S18-RD53]

Vaughan, D.S., and J. T. Carmichael. 2002. Estimating improvement in spawning potential ratios for South Atlantic red drum through bag and size limit regulations. **North Am. J. Fish. Manage.** 22:895-906. [S18-RD30]

Vaughan, D. S., and T. E. Helser. 1990. Status of the red drum stocks of the Atlantic coast: Stock assessment report for 1989. **NOAA Technical Memorandum NMFS-SEFC-263**, Beaufort Laboratory, Beaufort, North Carolina 28516, 117 p. [S18-RD48]