Application of the statistical catch-at-age models for red drum to the data for the time period used in the previous assessment, 1986-1998.

Mike Murphy

After the review panel's initial look at the assessment, they determined that it would be useful to apply the current assessment model to those data that fell into the time period used in the last assessment (1986-1998, Vaughan and Carmichael 2000). This would help determine the impact that the data collected since the last assessment has had on stock status.

Methods

The time-shortened data were a subset of the data used in the 1982-2007 base model analysis, excluding several indices of abundance with little or no information during 1986-1998. In the northern region, the North Carolina independent gillnet survey was available for 2001-2007 so the age-specific indices for age-1 and age-2 based on this survey were not used. In the southern region, the time series for the Florida small-seine survey of young-of-the-year (age 1) abundance and for the Florida haul-seine survey of age-2 and -3 abundance both began in 1997 and were not used in the time-shortened analysis. The Georgia gill-net survey for age 1 spanned a period after the final year of the time-shortened analysis, 2003-2007. The breaks in the constant-selectivity time periods remained the same though fewer overall periods were necessary. The selectivity estimates for the recreational live-release fisheries that were based on the northern tagging studies used only those associated with the period 1986-1998.

The estimates of abundance, fishing mortality, and static spawning potential ratio from these short-time-period analyses were compared to those from the full-time-period application of the model. In addition, the sSPR's estimated for the DELTA (a method for estimating the live-release size composition) spreadsheet VPA (Vaughan and Carmichael 2000) were also compared to these findings.

Results

Northern region

Estimated total population abundance in the northern region averaged about 450,000 fish during 1986-1994 then increased to about 1.22 million by 1997 and 1998. This increase was partly due to the increase in recruitment estimated for 1992-1997 but also to the decline in exploitation seen during 1989-1991 to lower and steady levels during 1991-1998 (Fig. 1). Static spawning potential ratios (sSPR) were very low, generally less than 5%, during 1986-1990, then increased to an average of 29% during 1991-1994 and to 42% during 1995-1998 (Fig. 3).

Southern region

Estimated total abundance in the southern region fluctuated without trend around an average of about 1.6 million fish during 1986-1998. Estimates for age-1 abundance after 1995 declined and with the subsequent decline in ages 2 and 3 abundance, the overall population abundance decline after 1995 (Fig. 2). The exploitation rate for ages 1-

3 peaked in 1987 at 48% before declining to 30% in 1989. From 1990 to 1998, exploitation rate slowly increased reaching 37%. The sSPR's were less than 10% during 1987 and 1988 before increasing to about 22% in 1989-1990. Over the last five years, sSPR averaged only 14% (Fig. 3).

Discussion

There was little difference between the time-shortened and full-time-period model estimates of red drum abundance and exploitation in the northern region. The full-time-period model showed a slightly more rapid increase in abundance during 1994-1998 and a resultant greater depression in the exploitation rates for those years. With these lower exploitation rates, the calculated static spawning potential ratios were slightly higher for the full-time-period analysis than for the time-shortened analysis (Fig. 3).

Vaughan and Carmichael's (2000) spreadsheet VPA, using the DELTA method to estimate the live-release size structure, was the most comparable model run to the time-shortened statistical catch-at-age (SCA) model documented here. Though there were numerous differences between the input data and model configuration, e.g., natural mortality rates, selectivity constraints, release mortality rate, ages used to calculate sSPR, method to estimated live-release fishery age structure, their calculated sSPR values for the northern region showed the same sharp increase during 1986-1998 as does the time-shortened SCA. They reported average sSPR's for the periods 1986-1991 and 1992-1997 in the northern region as: 3.7% and 35.1%. These averages were 6.1% and 37.3%, respectively, in the time-shortened SCA.

The southern region time-shortened and full-time-period analyses showed much more significant differences. The time-shortened model estimated lower abundances and no increasing trend in abundance during 1986-1998. It also estimated higher exploitation rates than did the full-time-period analysis. Both models showed a decline in exploitation rates between 1987 and 1989 but the time-shortened model's rates were higher and showed a slow rebound in the level of exploitation after 1990. Given the overall higher exploitation, sSPR levels were considerably less for the time-shortened analysis than for the full-time-period model. When compared to Vaughan and Carmichael's (2000) calculated sSPR, the time-shortened model does not show the increase in sSPR that they found between 1986-1991 and 1992-1997. The comparable averages from their spreadsheet VPA and from the time shortened model were: 1986-1991,V&C2000 2.0% and shortSCA 16.6%; 1992-1997, V&C2000 12.8% and shortSCA 15.5%.

A potential explanation for some of the differences seen here between the 1986-1998 and 1982-2007 SCA model runs in the southern region could lie in the contrast added when the high levels of harvest seen prior to 1986 are included. The total harvest (including release mortalities) in the southern region peaked at about 1.0 million fish during 1984 and 1985, and then dropped to just over 0.4 million fish in 1986. Though the total kill increased to just under 0.8 million fish in 1987 it quickly dropped to much lower levels by 1989 and later. The age composition of this harvest also changed prior to 1986 with a significant decline in the proportion of age-1 fish in the catch. It is possible that with the lack of this contrast in fishery catch for the time-shortened model (and lacking any abundance index prior to 1991), significant changes in the population dynamics were missed.

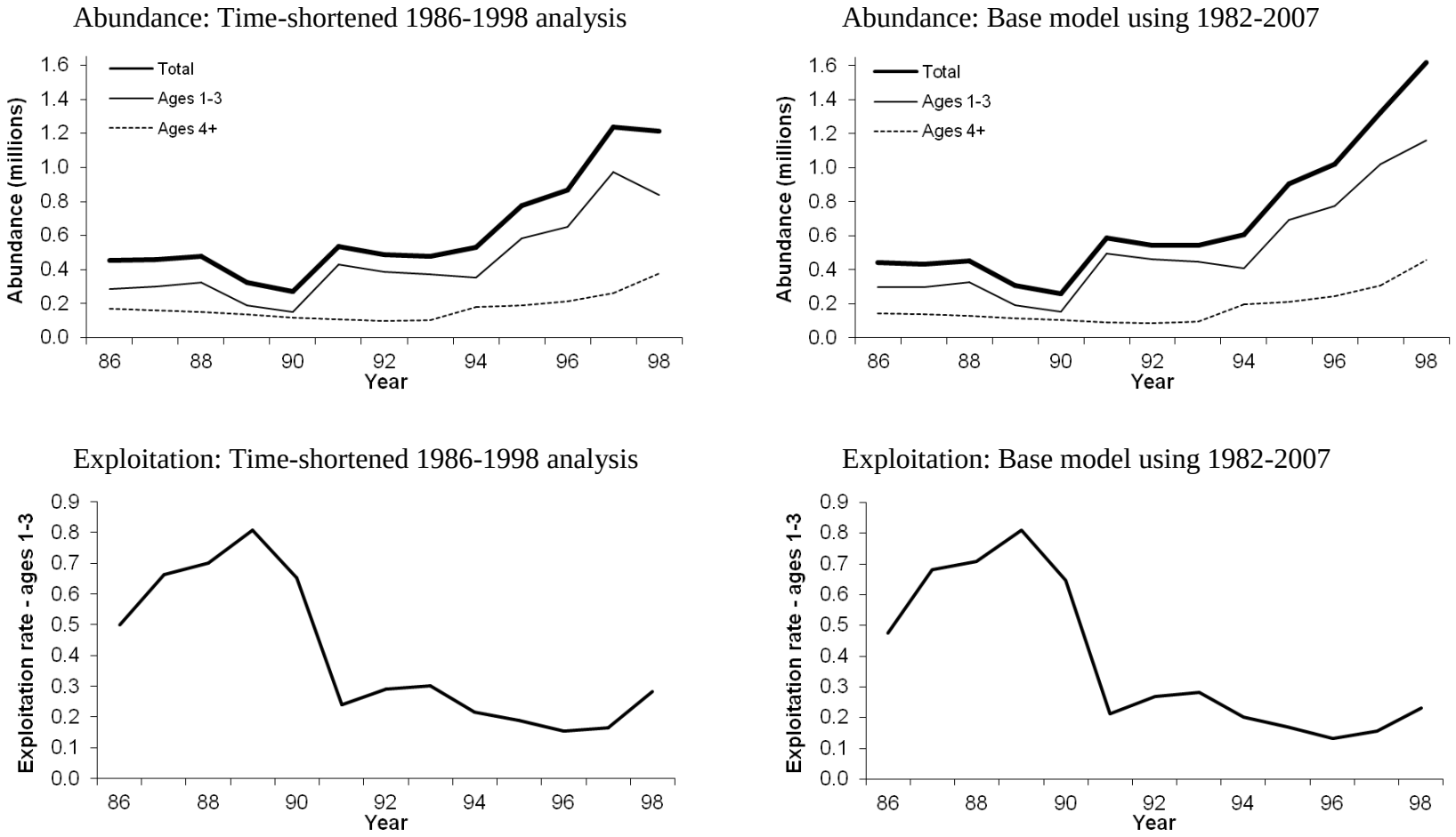


Figure 1. Estimated abundance and exploitation for red drum in the **northern region** during 1986-1998 based on the short time series analysis, 1986-1998, and the full time series analysis, 1982-2007.

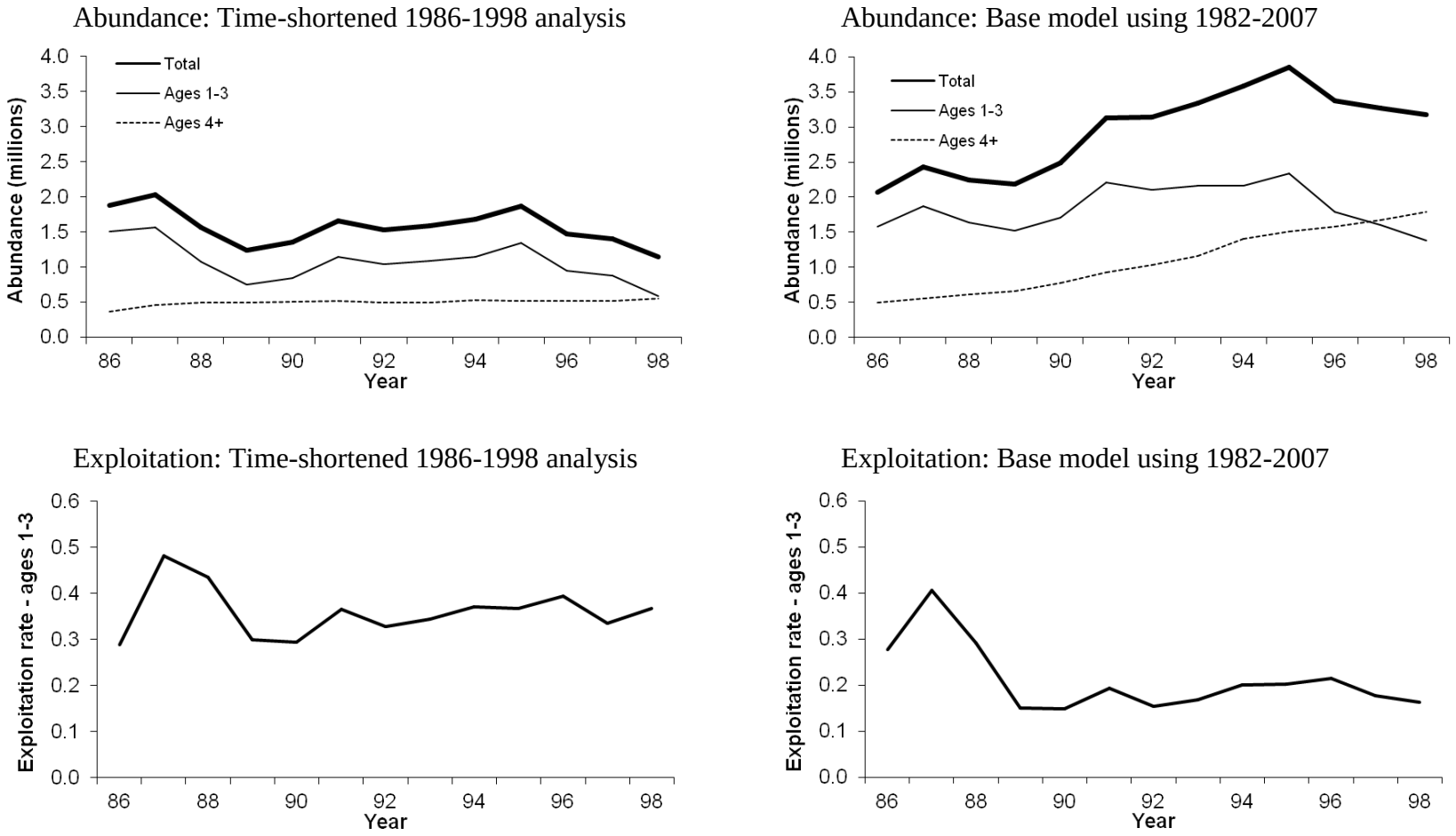
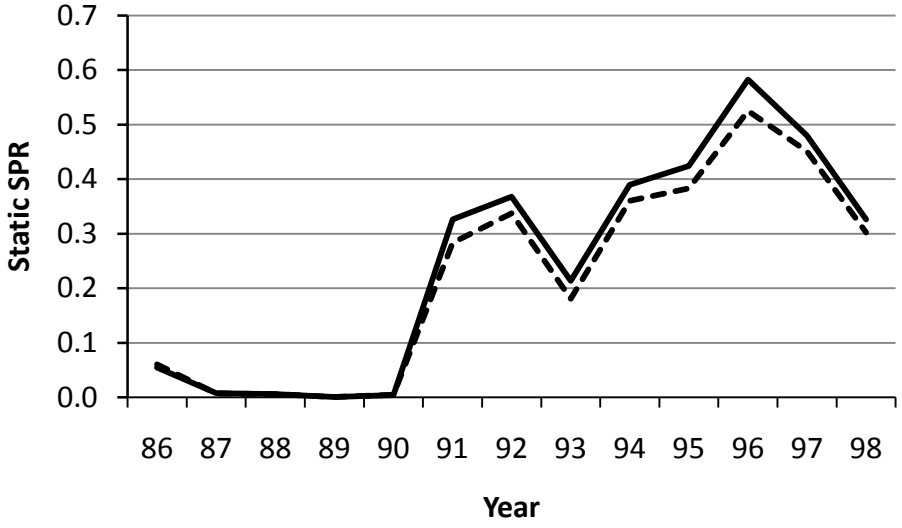


Figure 1. Estimated abundance and exploitation for red drum in the **southern region** during 1986-1998 based on the short time series analysis, 1986-1998, and the full time series analysis, 1982-2007.

Northern region



Southern region

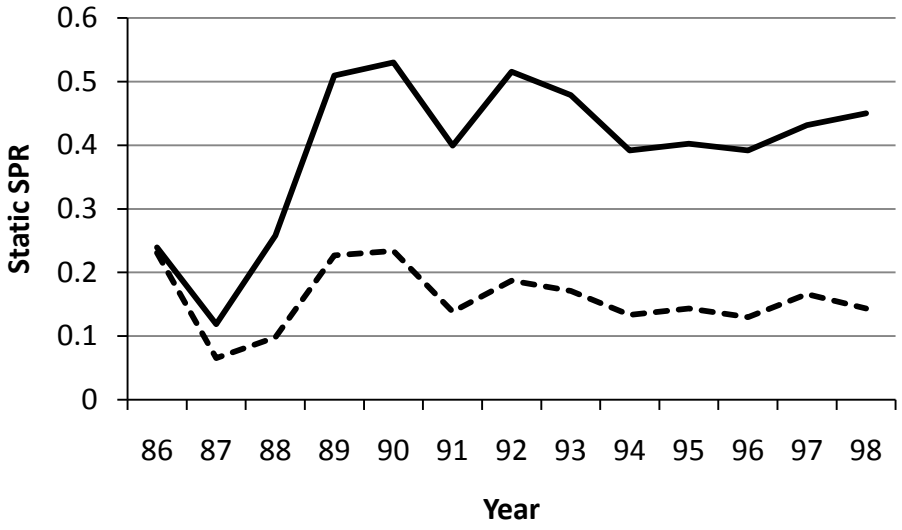


Figure 3. Estimated static spawning potential ratios for the northern and southern red drum stocks during 1986-1998. The solid line shows the estimates using the 1982-2007 data and the dashed lines show the estimates using the 1986-1998 subset of these data.