Preliminary estimation of red drum fishing mortality rates in the southern and northern regions using the SVPA/FADAPT method employed in the last assessment and comparison of findings between short (1986-1998) and long (1982-2007) time frame runs.

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The last assessment for red drum (Vaughan and Carmichael 2000) included analyses that utilized a separability model (SVPA; Pope and Shepard 1982) to estimate terminal year selectivity and fishing mortality which were then used as initial parameters in a tuned virtual population analysis (FADAPT; Restrepo 1996). Here I report on some preliminary runs using this assessment approach. These analyses were originally envisioned as continuity runs that could be compared with the Vaughan and Carmichael (2000) findings to determine the effect of using additional years of data or for comparison with another modeling technique. However, with extensive changes made to the input data series (DW report SEDAR 18), it was deemed more appropriate to rerun the 1986-1998 analyses using the modern input data, compare this with findings for a full complement of years (1982-2007) and have these available for comparison with the results from alternative modeling approaches.

The SVPA program used here is the same as employed by Vaughan and Carmichael (2000) but a newer version of the FADAPT program (version 4 labeled FADAPT5) was employed, eliminating the problem of incompatibility between the old FADAPT and modern operating systems. The SVPA analysis was confined to the most recent 5-years of data (either 1986-1990 or 2003-2007) and model ages 1-5. It required input data on regional catch-at-age, an estimate of natural mortality (average for ages 1-5; SEDAR 18 DW report), fully recruited fishing mortality (used 0.25, 0.50, 0.75 yr^{-1}), the age at full recruitment (age-2), and selectivity for the oldest age group relative to that of the fully recruited age (assumed 0.05). The FADAPT5 program required input of the regional catch-at-age, indices of abundance and its partial selectivity vector, natural mortality at age (Lorenzen age-specific by region; SEDAR 18 DW report), weights at age (predicted weight at midyear based on SEDAR 18 DW report's growth curves and weight-length functions), terminal-year selectivity (from SVPA and assumed constant for ages 5^+), and a range of guesses for terminal-year F at age (with 'best' guess from the SVPA).

Separable Virtual Population Analysis

Since the purpose of this portion of the analysis was to determine the terminal year selectivities and fishing mortality, I restrict this description of its results to those aspects, though abundance at age is also estimated. There was no apparent effect of using the three different levels of fishing mortality during the estimation of selectivities in either region for the 2003-2007 period (Fig. 1). In both regions, selectivity was full at age 2 then declined at older ages, under the assumption of low selectivity at age 5. For the short time period model (1986-1998), selectivities during its last 5 years, 1994-1998, were estimated only with a fully recruited fishing mortality of 0.25 yr^{-1}, given the insensitivity to different F's found for the long time frame model. These showed the increased vulnerability of small red drum in the southern region and slightly lower vulnerabilities at age 3 in both regions.

The final estimated selectivity vector was very sensitive to the assumed age-5 relative selectivity. Under a fully recruited fishing mortality of 0.25 yr^{-1}, the estimated age at full recruitment shifted from age 2 to age 4 in the southern region and to age 3 in the northern region as the relative selectivity for age-5 fish was assumed to be greater and greater than 0.05 (Fig. 2). This points out the critical need to determine (or come to expert agreement on) the selectivity vector independent of the age-structured model approach. To continue this preliminary analysis below, I used the results from the models that assumed the selectivity of age 5 was 0.05 of the fully selected age.

Untuned and Tuned Virtual Population Analysis

As a first part of the FADAPT5 analysis, the SVPA-determined selectivities and terminal-year fishing mortality were used to begin the sequential calculations needed for a deterministic untuned virtual population analysis. This was conducted for the long-term (1982-2007) models under the three examined levels of terminal F (0.25, 0.50, and 0.75 yr^{-1}). The estimated average F's (unweighted for ages 1-5) in the southern region all showed fluctuations with a low period from about 1988 to 1993 then a gradual rise in average F through 2004 before a sharp drop through 2006 (Fig. 3). The untuned VPA with a lower terminal fully recruited F's consistently showed lower average F's through time without any evidence of convergence in the earliest years. In the northern region, average F estimated from the untuned VPA was highly variable with a peak in 1984, little change in the overall trend from 1985 through about 2003 then a declining trend during 2004-2007 (Fig. 3).

Tuned VPA's were run using the three age-specific terminal F's estimated for age 2 (associated with fully recruited F's of 0.25, 0.50, and 0.75 yr^{-1}) as best guesses to initialize the parameter. These three runs showed that there was very little observable difference between the estimated F's for these analyses so the following describes the tuned analyses using the fully-recruited-F-equals-0.50 initialization. In both regions, the tuned VPA estimated higher average fishing mortality rates and their trends over time were, in general, quite similar to the untuned VPA results during the time frame when most of the indices were available (1990 onward). A notable exception was the trend in F's in the northern region during 2005-2007 where there was a much greater increase than seen for the untuned VPA estimates.

There is a striking difference in the estimated F's between the tuned VPA run using all of the currently available data (1982-2007) and the tuned runs using only the data for the shortened time period (1986-1998). In both regions, the estimates of F from the full-time-frame models showed some variability but little trend during the years covered by the short-time-frame model. However, the estimated F's from the short-time-frame model showed a steeply declining trend in F, with lower F's during the mid 1990's especially in the southern region (Fig. 4). The short-time-frame model also estimated higher F's than the long-time-frame model during the late1980's and early 1990's.

The fits of the tuned VPA's to the observed indices are shown in Figures 5 and 6.

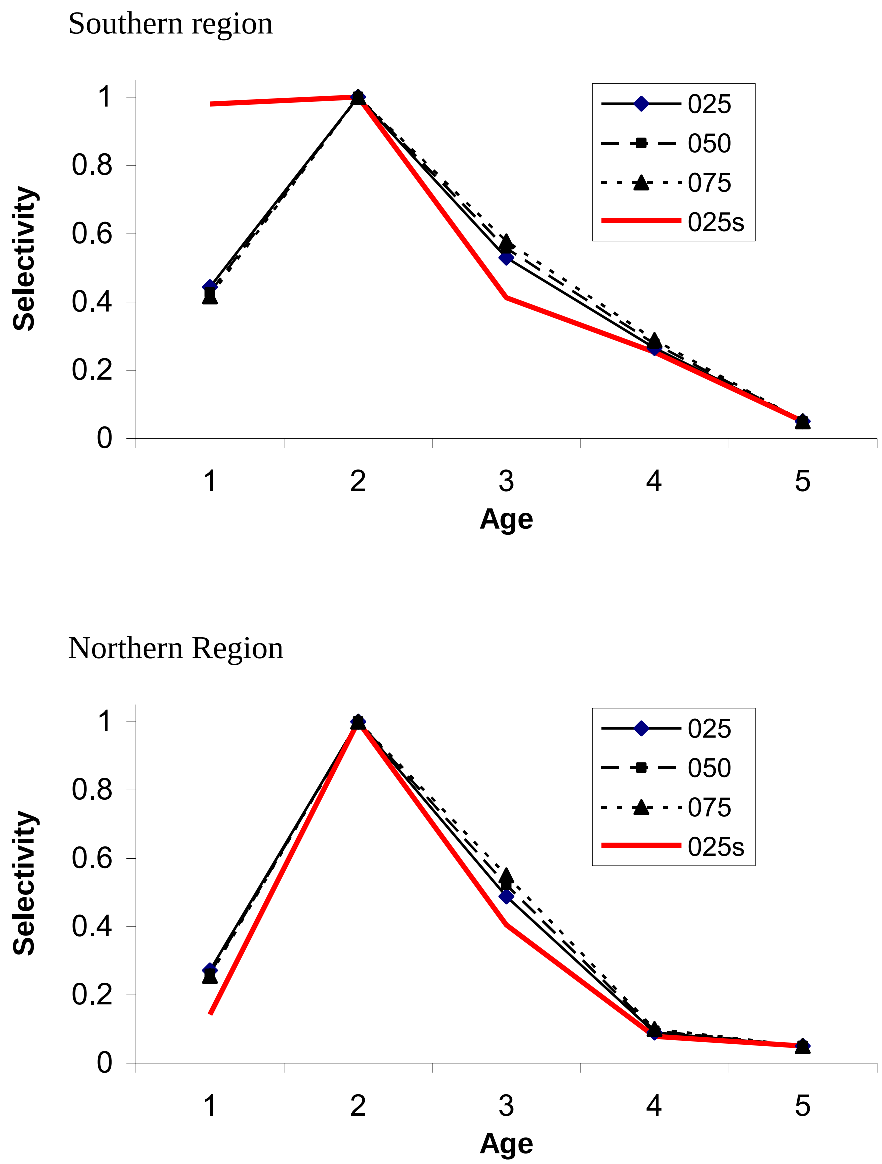
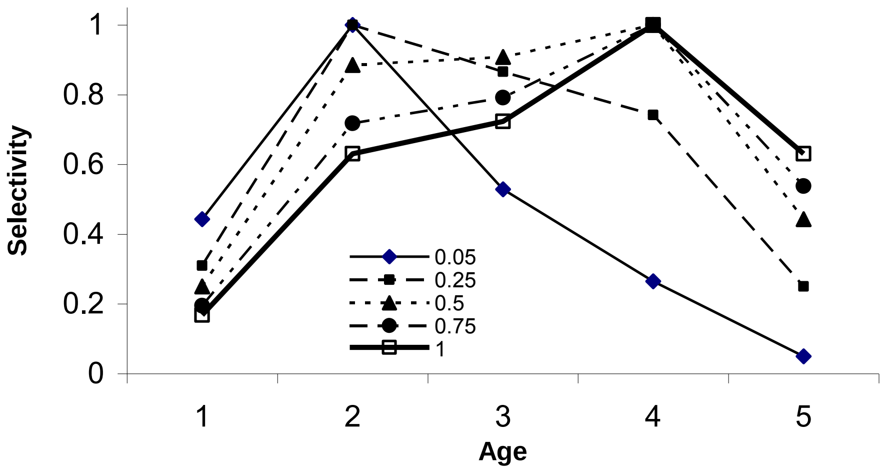


Figure 1. Region-specific selectivity for red drum during 1994-1998 (025s) with fully recruited F of 0.25 yr^{-1} or during 2003-2007 with fully-recruited fishing mortalities of 0.25 (025), 0.50 (050), and 0.75 (075) yr^{-1}. All estimates were made under the assumption that the selectivity at age 5 was 0.05 of the selectivity at the assumed age at full recruitment (age 2).

Southern region



Northern Region

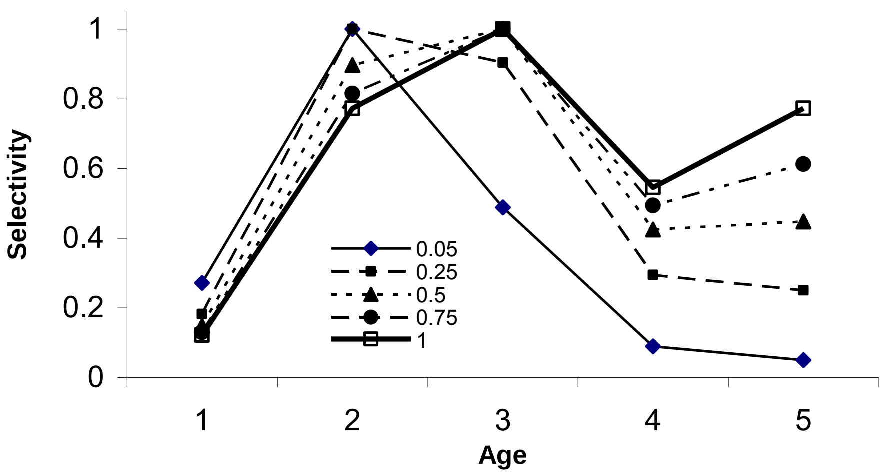
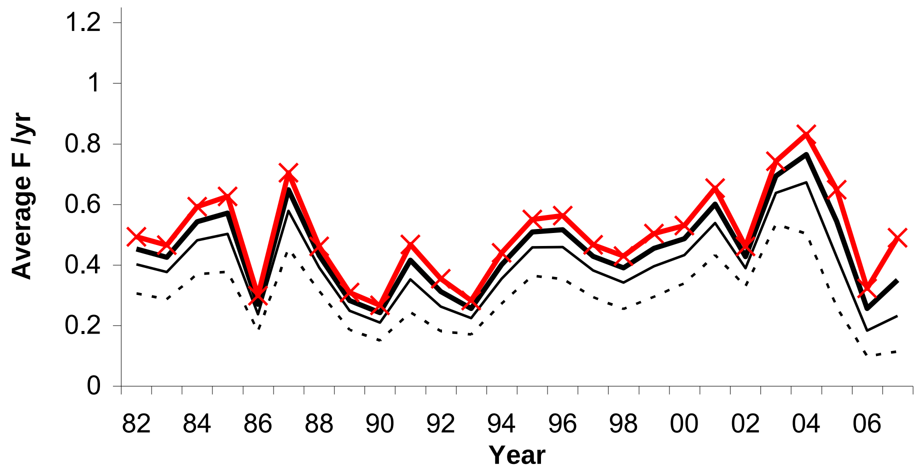


Figure 2. Selectivity for red drum during 2003-2007 estimated assuming a fully-recruited fishing mortalities of 0.25 yr^{-1} and varying levels of selectivity (0.05, 0.25, 0.50, 0.75, 1.0) at age 5.

Southern region



Northern region

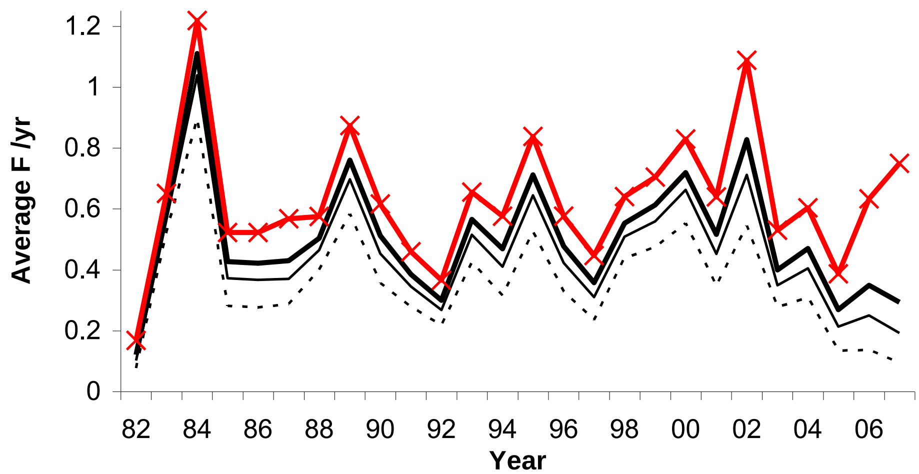
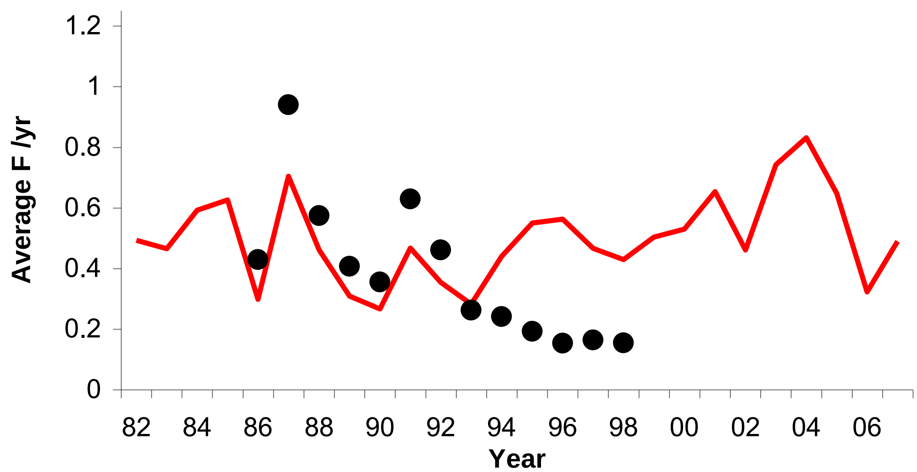


Figure 3. Average annual F's (unweighted for ages 1-5) on red drum as estimated from untuned VPA's run with terminal fully recruited F's of 0.25 (dashed), 0.50 (thin line), and 0.75 (medium black line) and from the tuned VPA (medium red line 'X' symbols) in the southern and northern regions for the period 1982 to 2007.

Southern region



Northern region

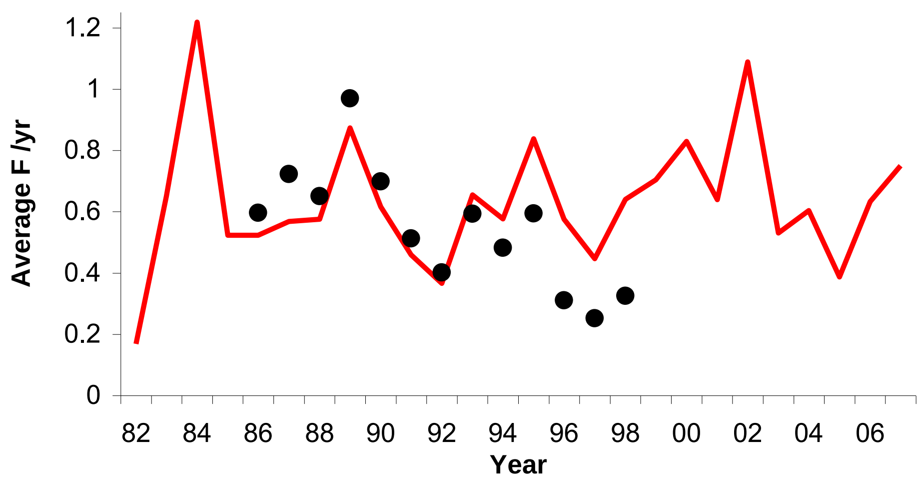


Figure 4. Average annual F's (unweighted for ages 1-5) on red drum as estimated from the 1982-2007 tuned VPA (medium red line) and the short-time-period (1986-1998, points) tuned VPA in the southern and northern regions for the period 1982 to 2007.

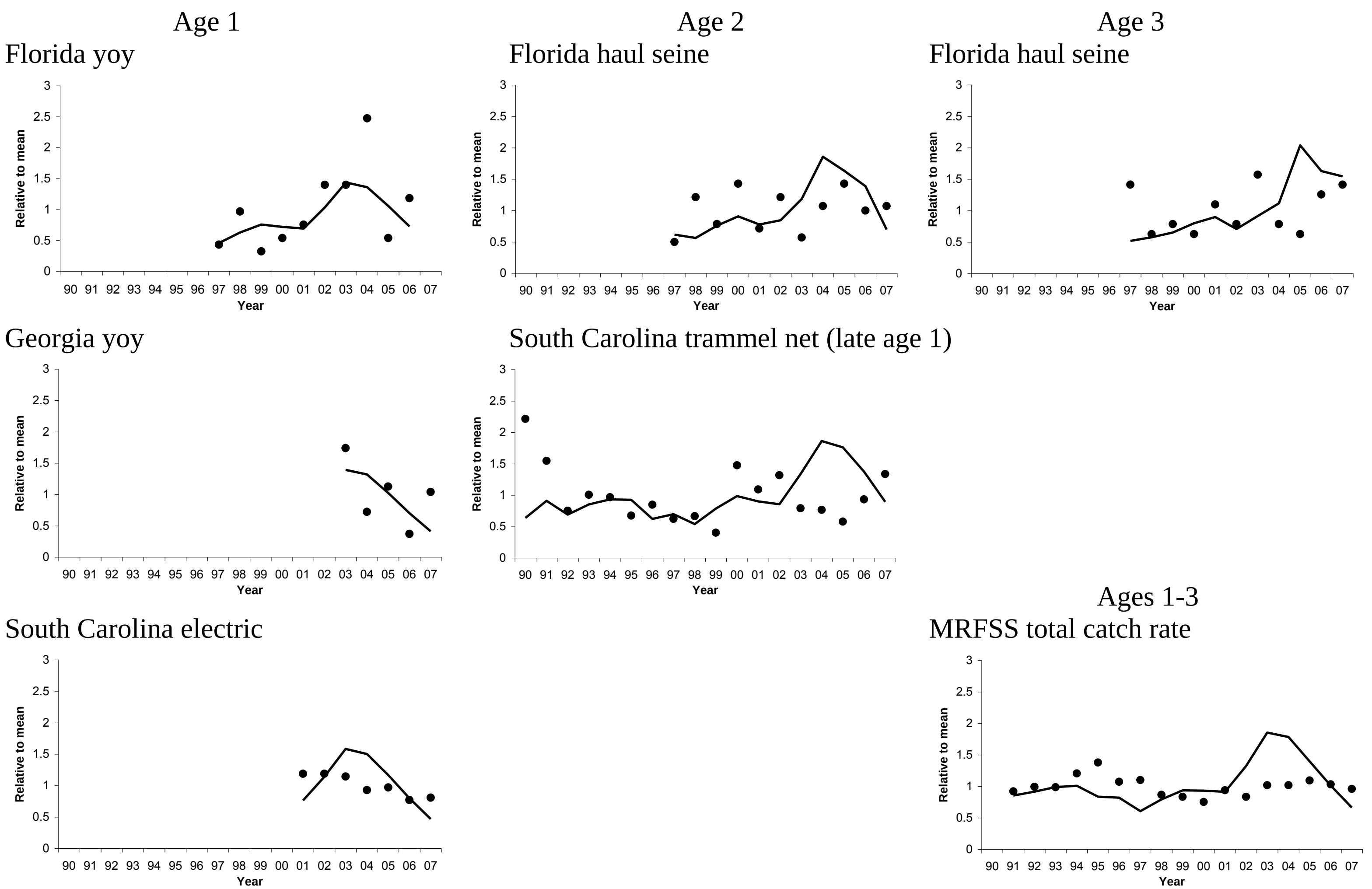
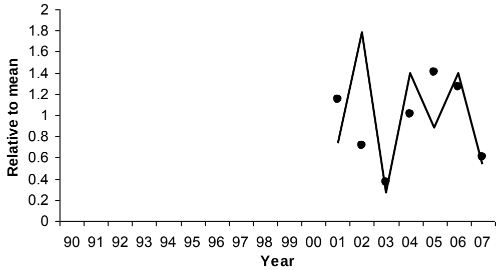


Figure 5. Fits of the predicted relative abundance and observed relative abundance for red drum in the southern region. Predicted values are from the tuned VPA results.

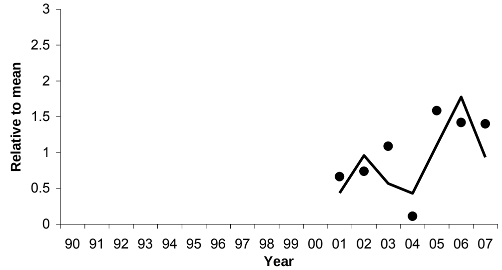
Age 1

North Carolina gillnet yoy

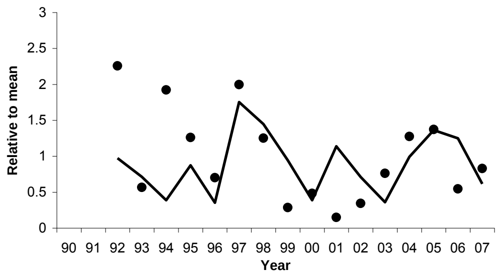


Age 2

North Carolina gillnet



North Carolina JAI



Ages 1-3

MRFSS total catch rate

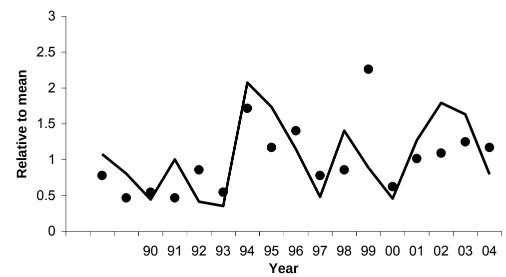


Figure 6. Fits of the predicted relative abundance and observed relative abundance for red drum in the northern region. Predicted values are from the tuned VPA results.