SEAMAP Trawl Indexes for the SEDAR9 Species

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SUMMARY

The procedures used in SEDAR7 to derive trawl survey indexes of abundance for red snapper (SEDAR7-DW- 1, 2; and the age composition portion of AW-15) were applied to vermilion snapper, gray triggerfish, and greater amberjack. Standard SEAMAP surveys are conducted between 5 and 50 fm, from Mobile Bay to the Mexican border. All three species occur east of the survey area as well; where the rough, live bottom makes standard surveys impractical. Within the survey area, gray triggerfish appear to be abundant and frequent enough for derivation of meaningful indexes. Sporadic observations in the eastern Gulf suggest triggerfish catch rates there may comparable to the survey area, so a substantial fraction of the population probably is covered, even though the total range cannot be. Vermilion snapper appear much less frequently than triggerfish in the trawl survey area, but probably are abundant enough to get useful indexes. However, we know from sporadic research vessel trawling and bycatch observer work that vermilion catch rates in the eastern Gulf are often much higher than they are in the SEAMAP trawl survey areas. Therefore, the SEAMAP trawl surveys may not be indexing a suitably large fraction of the total population. Vermilion snapper also appear to have the most intense patchiness of any species examined to date, leading to large interannual fluctuations that may reflect more or fewer chance encounters with high density patches than real changes in overall abundance. Greater amberjack are not common in the survey catches, and except for possibly looking at frequencies of occurrence over blocks of years, the survey data may not be useful in the amberjack assessment. Size composition data are available for 1987 forward. There often appear to be at least two peaks in the size frequencies for both triggerfish and vermilion snapper, consistent with two year classes. However, compared to red snapper, the separations are not as clean, and there are far fewer fish in the samples. In addition, further consideration of the timing and length of the spawning and settlement periods is needed to decide if availability to the survey is completed by the fall of age 0, or not until the summer of age 1.

INTRODUCTION

A summary of the trawl survey database for SEAMAP and its predecessors was prepared for SEDAR7 (SEDAR7-DW-1). That document covers the survey philosophy, designs, and implementations, as well as descriptions of variables in the database. Six separate time series that are going to be relevant to the SEDAR9 species were identified (see table 1), and ‘Base Indexes’ were reported for red snapper. Details about the Base Index calculations are covered in SEDAR7-DW-1; but in brief, all are weighted arithmetic means of catches per hour from stratified random designs, with the weights being the geographic areas of the strata. There are no adjustments for missing strata in the Base Indexes. Even without adjusting for possible effect of missing stations, a constant ‘q’ within each time series was considered a reasonable assumption. Each index could stand alone as an assessment tuning index, and it is a reasonable option to use them all that way. However, there are potential advantages to linking the indexes analytically to get longer time series. This linking was done for SEDAR7 with a new Bayesian model, which also accounted for missing observations. For red snapper, the Base Indexes and the Bayesian Indexes (within individual time series) were very similar in central tendency. The error structures were different (normal for the Base Indexes; lognormal for the Bayesian), but even so, the spreads of the 95% confidence intervals were similar. The most interesting finding from the Bayesian formulation was that the true cost of covering less than the full range in the earlier surveys became evident. Estimated fractions of the stock in the smaller area covered by the Fall Groundfish survey were quite variable. The Bayesian model took that into account in calculating confidence intervals for the extend time series of Fall SEAMAP plus calibrated Fall Groundfish. Although Fall Groundfish confidence interval within the area surveyed were quite respectable, confidence intervals about the calculations required to make SEAMAP-wide inferences from the Fall Groundfish surveys were not. This SEDAR9 document presents the same analyses for vermilion snapper, gray triggerfish, and greater amberjack.

Analysis of trawl survey data for red snapper continued estimation of age composition, and an estimate of age 1 natural mortality rate (SEDAR7-AW-15). The preliminaries for such analyses are presented here, but getting input from experts on early life and age and growth at the Data Workshop seemed advisable before continuing.

METHODS

Detailed description of the data base and methods for calculating the 'Base Indexes' are available in SEDAR7-DW-1. Database additions since SEDAR7 include the Fall 2003 and 2004, and Summer 2004 SEAMAP trawl surveys. The analyses used to link separate time series are the same as those described in SEDAR7-DW-2. For SEDAR9, I have used only the recommended model, which was model 2 in SEDAR7-DW-2. As with red snapper, the FF index results were combined with FS without further adjustment, and are referred to simply as FS in what follows (per the discussion in SEDAR7-DW-2). For the size / age frequencies, the initial processing and setup for age determination described in SEDAR7-AW-15 have been performed. The ambiguity of size frequency sampling ('young of year problem') documented and corrected for in SEDAR7-DW-16 for red snapper turned out not to be an issue for the SEDAR9 species -- only one (triggerfish) station needed to be adjusted for disproportionate sampling by size fractions of the recorded catch. Completion of the age composition awaits examination by early life and age / growth experts at the Data Workshop. There is a separate 'document' (SEDAR9-DW-18) consisting only of size frequency histograms, for that purposes.

Upon examining results for the Base Indexes for greater amberjack, I concluded there was little potential for useful indexes for that species, at least in the usual sense of interannual variation in catch rate in numbers. For that reason, I did not continue with the Bayesian analysis for greater amberjack.

RESULTS

Figures 1 – 16 alternate the base indexes for catch in numbers and 95% confidence intervals (t-distribution) and the parallel Bayesian index medians and 95% confidence band for the vermilion snapper and gray triggerfish. Figure 17 – 20 plot the Base Indexes for greater amberjack.

For vermilion snapper and gray triggerfish, the central tendencies from the Bayesian and Base Indexes for each time series are plotted against each other in Figures 21-24.

Figures 25 – 28 plot the fraction of the each stock estimated to be in the smaller surveys' geographic areaa for each year in the full SEAMAP surveys.

Table 2 gives the central tendencies and confidence bands for the 'calibration factors' between the surveys.

Figures 29 – 32 show the final, extended time series for summer and fall for vermilion snapper and gray triggerfish, with interquartile ranges and 95% confidence bands. These figures are the end product of the Bayesian analysis.

Size composition results completed thus far are collected in a separate document (SEDAR9-DW-18), consisting only of size-frequency histograms. However, some comments are included in the text that follows here, largely to start discussion needed at the Data Workshop.

DISCUSSION

Both the Base Index and Bayesian Index calculations were completed without indication of serious problems. Compared to the red snapper indexes, there was less agreement between the Base and Bayesian trends for the SEDAR9 species, but this was hardly surprising, given the lower overall abundances. The series of plots of one index against the other show the general agreement, but also illustrates the differences created by the different structural assumptions. For example, Fig. 21, gray triggerfish in Fall SEAMAP shows a fairly linear relationship except for the highest values of the Base Index. Based on the pattern of abundance in other cells, the Bayesian index tends to write off some of the apparent abundance of the high Base Index points as random error to the high side. There is a bit of curvature at low abundances, with points below the 1:1 line in several figures. The clearest case is in Figure 26, where surveys with Base Indexes values of zero (no occurrences that year) are still assigned positive abundances in the Bayesian index. In borrowing information from other years, the Bayesian index interprets "all catches=0" in a year as a random outcome of a low but positive real abundance that year. Vermilion snapper plots of index vs index tend to be more scattered, which probably reflects a greater patchiness in vermilion. This index analysis was done at the same time as the bycatch analysis for the SEDAR9 species (SEDAR9-DW-26). The patchiness of vermilion snapper presented real problems to bycatch estimation. However, because of the many tows and short tow times in the index calculations, any problems with patchiness in the index calculations are probably limited to the higher scatter in the index vs index plots. I decided not to consider alternative distributions like the delta for the index work. (Walter Ingram developed a frequentist version of the delta method for the Data Workshop; SEDAR9-DW- 23.) I did not investigate the scattered points that fall well away the 1:1 line, most evident in the FG surveys. I suspect these are consequences of particular data patterns that the Bayesian structure 'interprets' as lower abundances, but I have no basis for saying whether the Base or the Bayesian is more correct in those cases. In general, I recommend the Bayesian indexes. The structure behind them seems realistic, and the technique allows longer time series to be develop, with the real cost of smaller spatial surveys applied in the confidence intervals.

I have not done much with greater amberjack. It may be possible to put some constraints on recruitment change in the stock assessment models by counting the number of years with positive occurrences in blocks of years over time. However, I am not aware of a standard procedure for that approach, so that can be a topic for the Assessment Workshop.

The indexes for gray triggerfish will almost certainly be useful; the indexes for vermilion snapper may be. They are probably most limited by the eastward extent of each stock beyond the SEAMAP survey area. I cannot estimate the fraction of each stock outside the survey range, but for vermilion snapper, it could be well above the proportion that the spatial area would suggest. Sporadic catch rates in the tens and hundreds per hour have sometimes been reported in observer data; values that high are not common in the western Gulf. Prospects for extending the surveys to the east in the future are not good.

The size distribution plots (SEDAR9-DW-18) show 2 or more apparent modes for vermilion snapper and gray triggerfish, with reasonable separation apparent when all years are plotted together. However, the separations are generally not a clean as they were for red snapper, and there are many fewer fish in the data files. To date, I have identified potential boundaries (without allowing them to change over year), and set up a program to make age composition calculations. I have not yet discussed the boundaries with the growth experts. Timing of recruitment to trawl vulnerability may be a serious issue. Clearly, recruitment of age 0s is not complete by the summer survey for either vermilion or triggerfish, so that cohort is not indexed in summer. Triggerfish in particular peak in the SEAMAP Fall Plankton Surveys (September), so the question is: have they settled out by mid-October to be properly indexed by the October-November Fall SEAMAP trawl survey? This topic in particular needs addressing at the Data Workshop.

LITERATURE CITED

All citations refer to the document lists for the SEDAR7-DW and –AW series.

Table 1. Quick summary of individual time series designations in the trawl surveys data base. More details are available in SEDAR7-DW-1.

FALL:

FS	Fall SEAMAP	1998-2004	Mobile to Mex border	5 – 50 fm	Oct – Nov	W to E
FF	‘First’ Fall	1987	Mobile to Mex border	5 - 50 fm	Oct – Nov	E to W
FG	Fall Groundfish	1972-1986	91 30 to 88 W	5 – 50 fm	Oct – Nov	E to W

SUMMER:

SS	Summer SEAMAP	1987-2004	Mobile to Mex border	5 – 50 fm	Jun -- Jul	W to E
ES	‘Early’ SEAMAP	1982-1986	Mobile to Mex border	5 – 50 fm	Jun – Jul	Night only
TC	Texas Closure	1981	Offshore Texas	5 – 50 fm	July	Night only

Table 2. ‘Calibration factors’ between surveys derived from the Bayesian analysis.

	Median	95% confidence band	
Fall Groundfish to Fall SEAMAP			
Gray triggerfish	1.915	0.414	8.84
Vermilion snapper	2.417	0.256	23.3
Early SEAMAP to Summer SEAMAP			
Gray triggerfish	0.9397	0.579	1.51
Vermilion snapper	1.092	0.516	2.30
TX Closure to Summer SEAMAP			
Gray triggerfish	0.8142	0.317	2.10
Vermilion snapper	1.164	0.329	4.19

Figure 1. Fall SEAMAP Base Index for gray triggerfish.

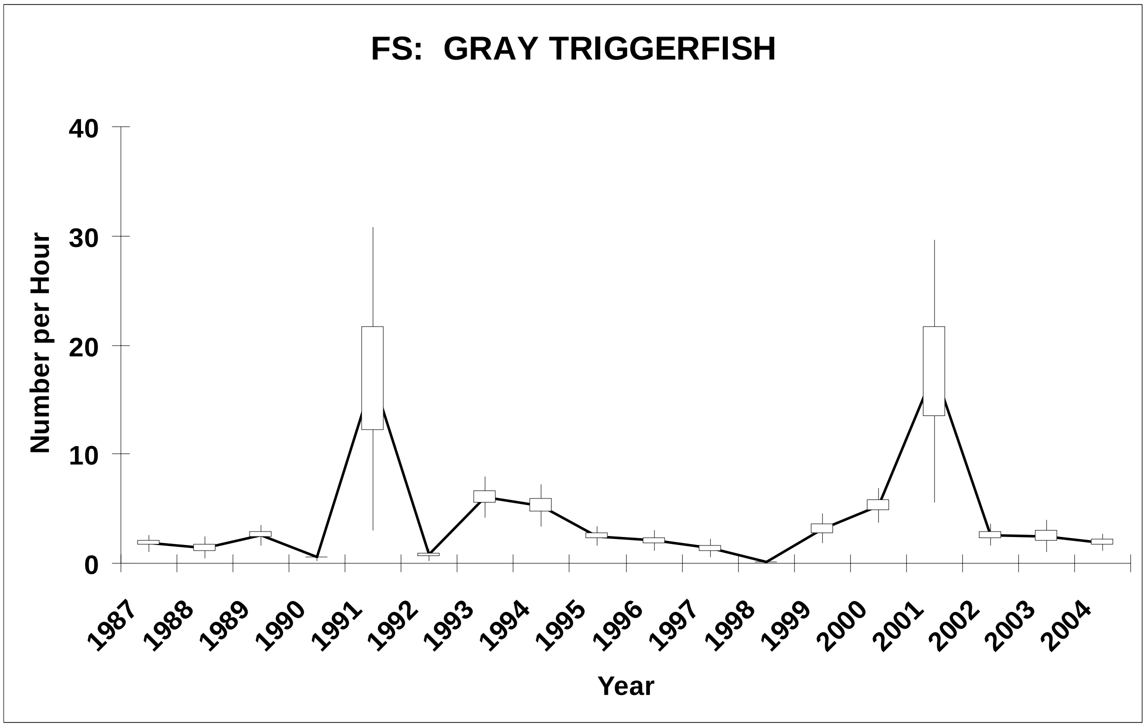

Figure 2. Fall SEAMAP Bayesian Index for gray triggerfish.

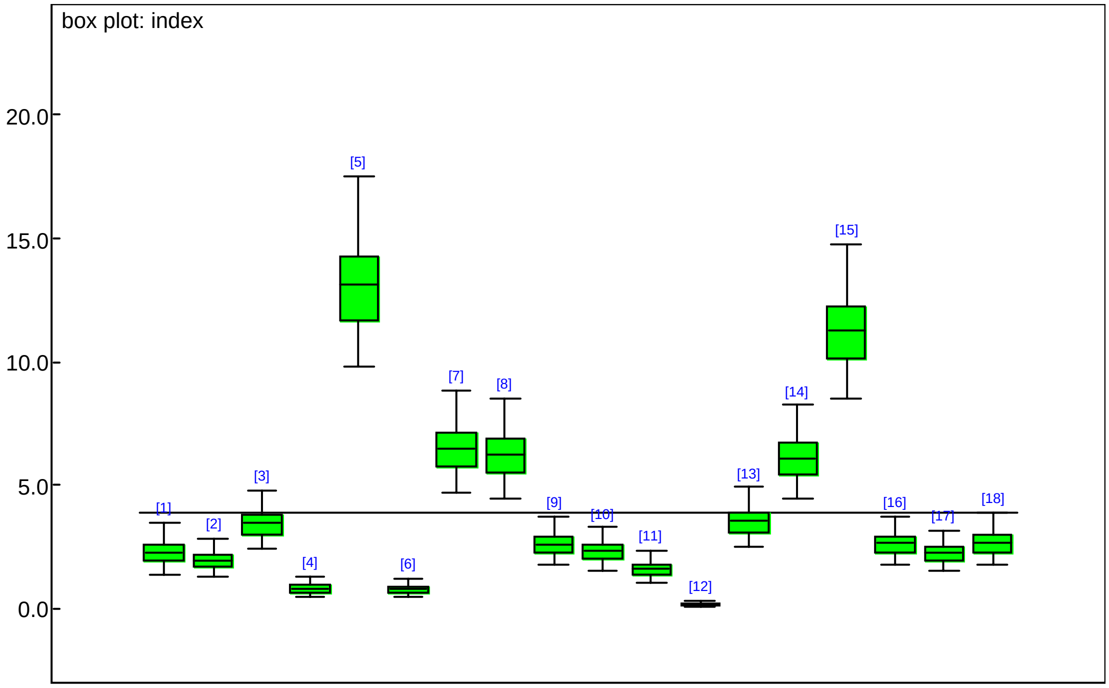

Figure 3. Fall Groundfish Base Index for gray triggerfish.

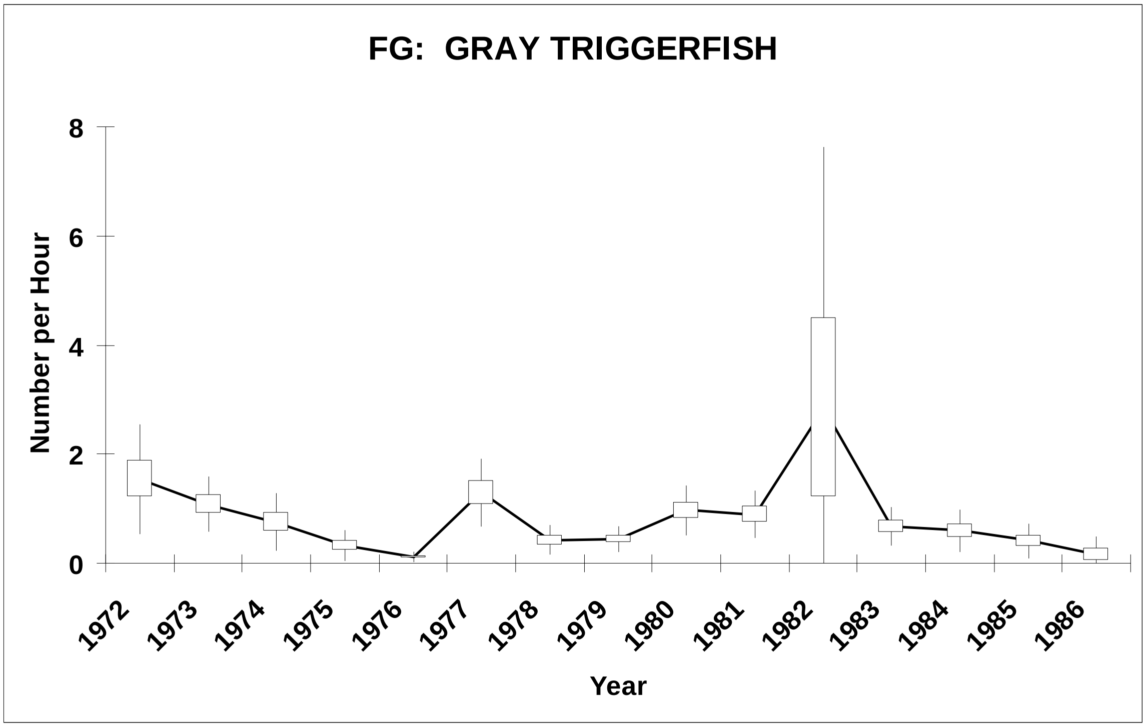

Figure 4. Fall Groundfish Bayesian Index for gray triggerfish.

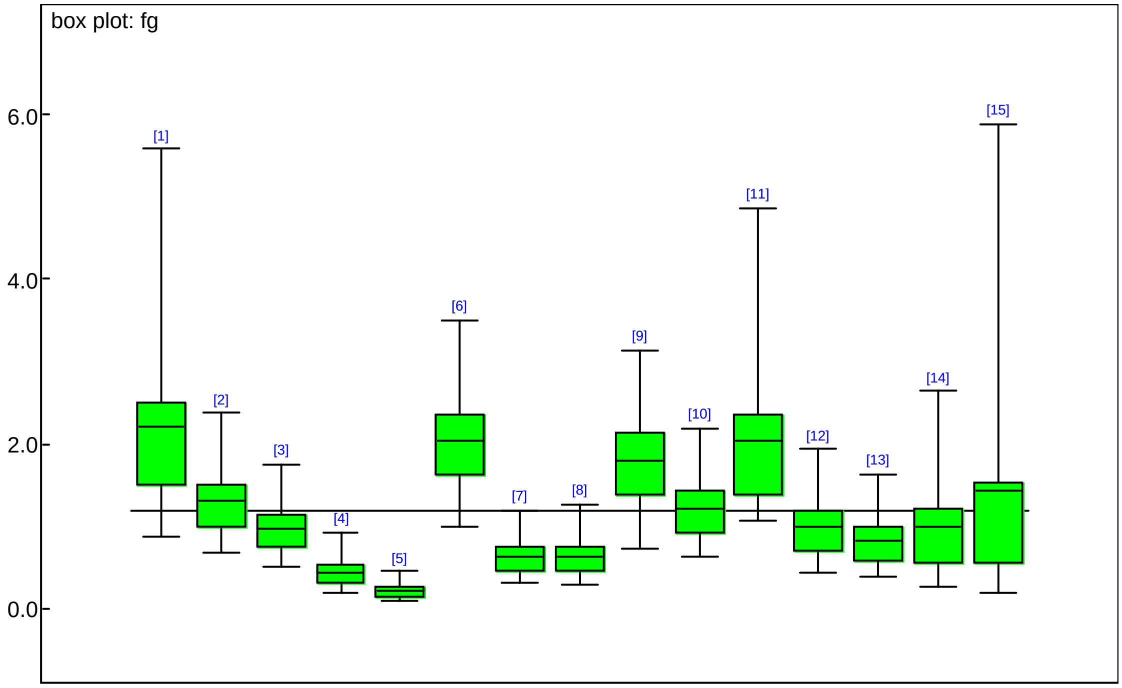

Figure 5. Summer SEAMAP Base Index for gray triggerfish.

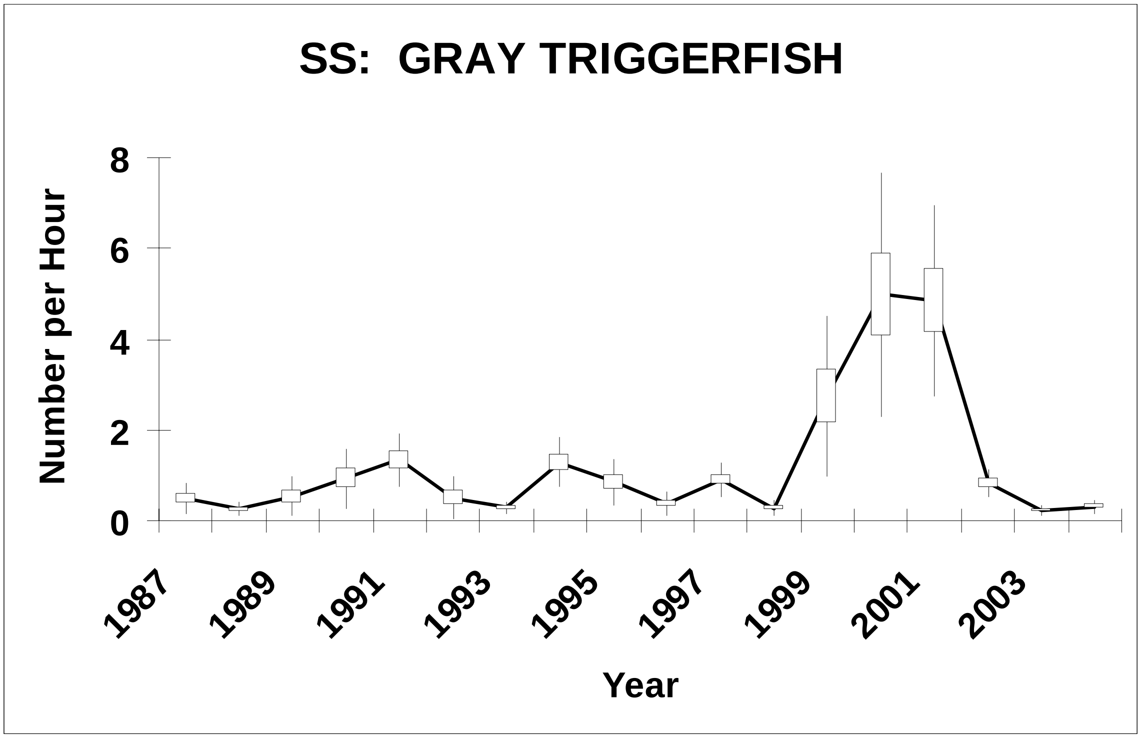

Figure 6. Summer SEAMAP Bayesian Index for gray triggerfish.

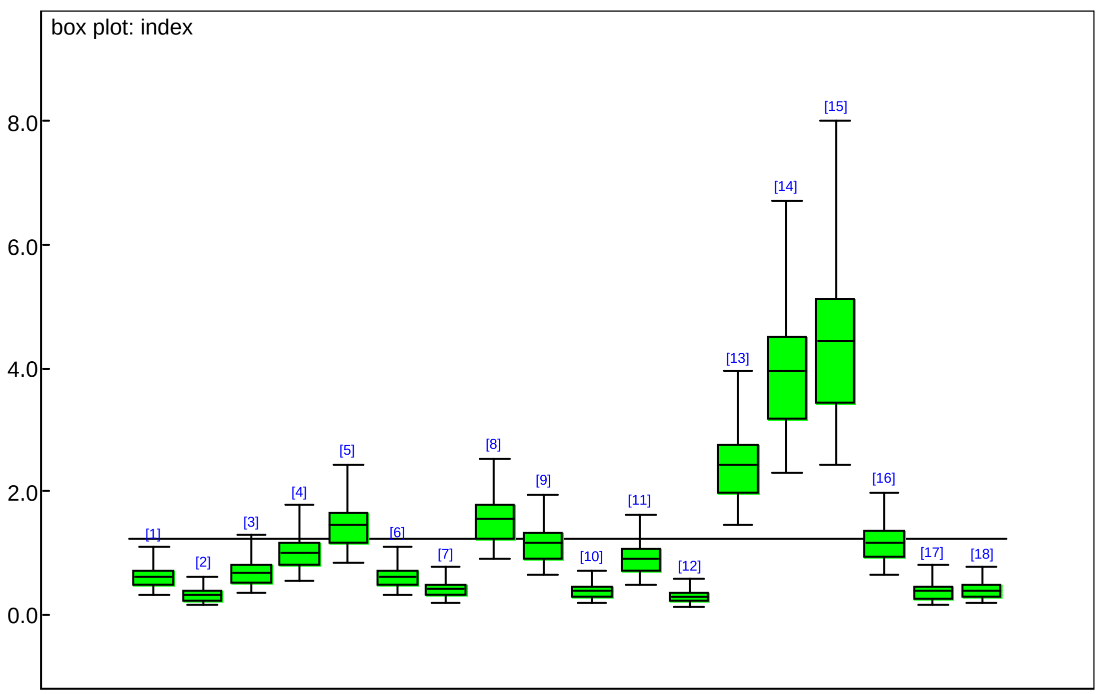

Figure 7. Early SEAMAP Base Index for gray triggerfish.

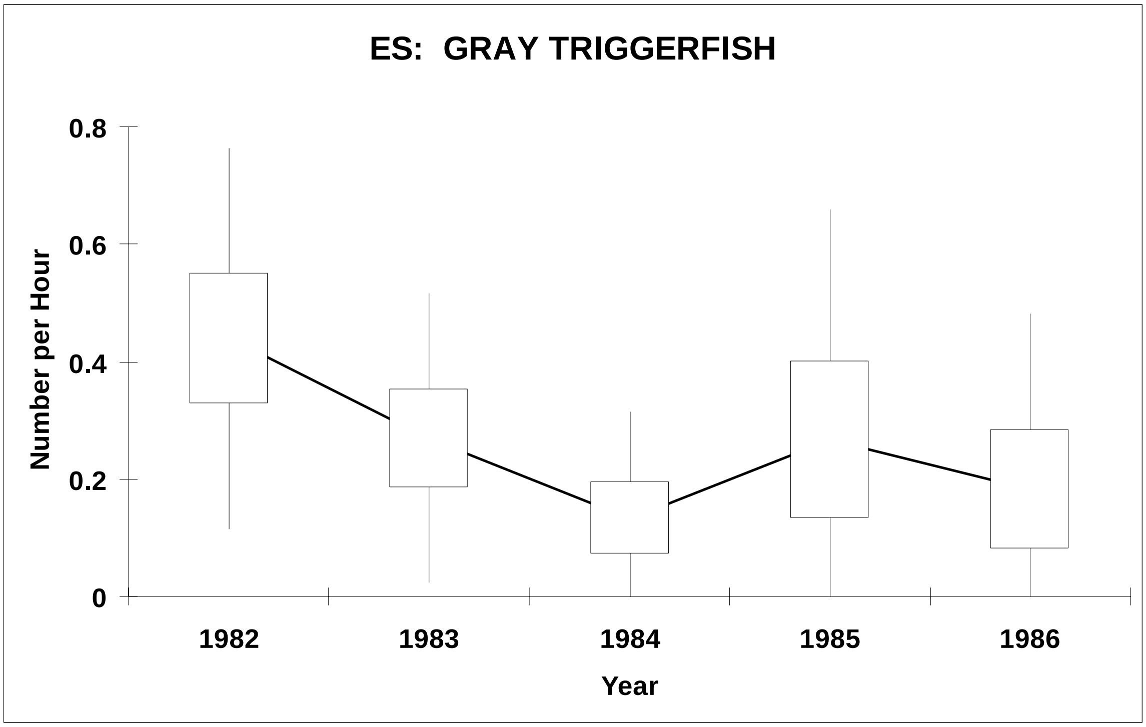

Figure 8. Early SEAMAP Bayesian Index for gray triggerfish.

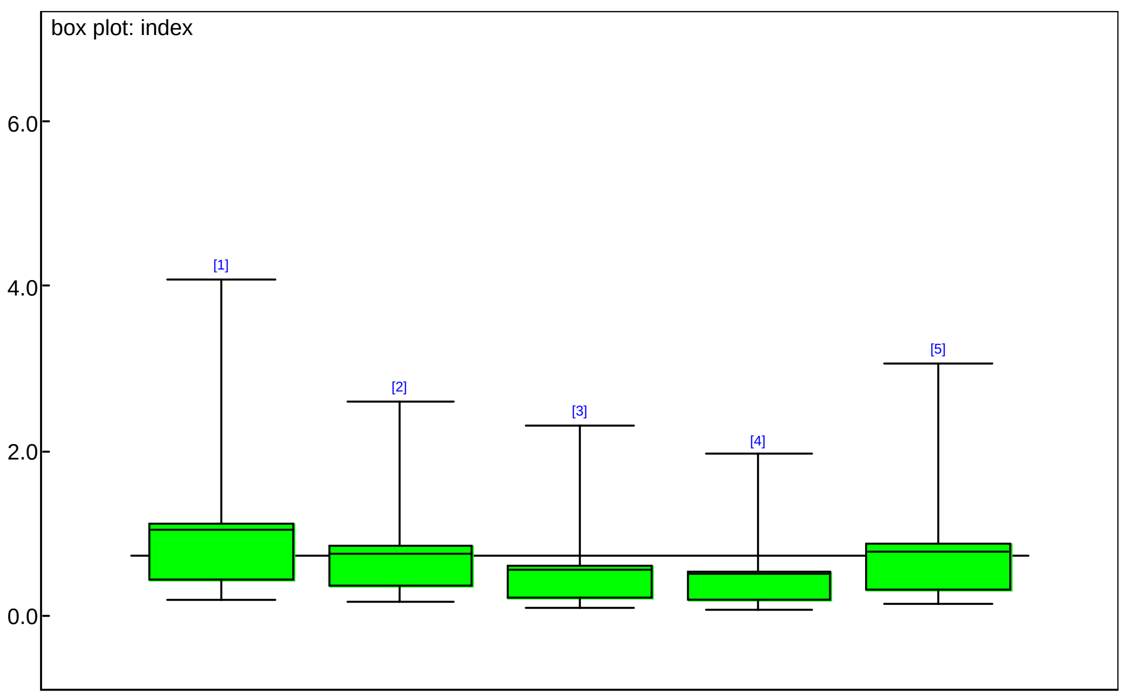

Figure 9.   Fall SEAMAP Base Index for vermilion snapper.

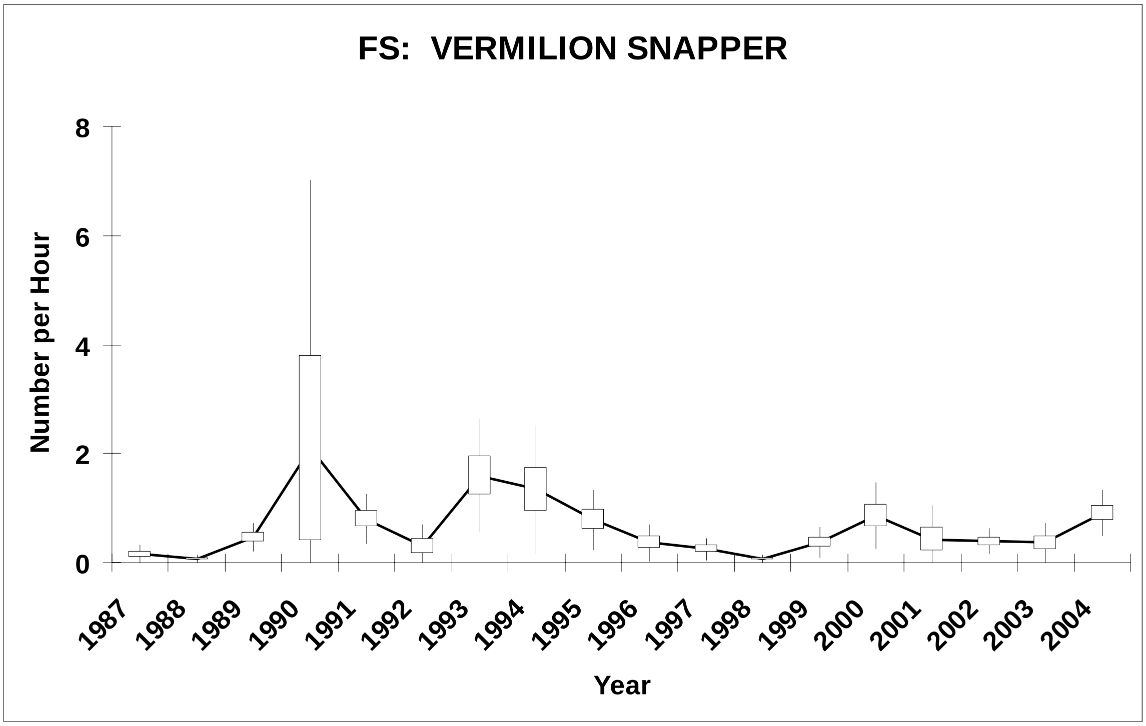

Figure 10. Fall SEAMAP Bayesian Index for vermilion snapper.

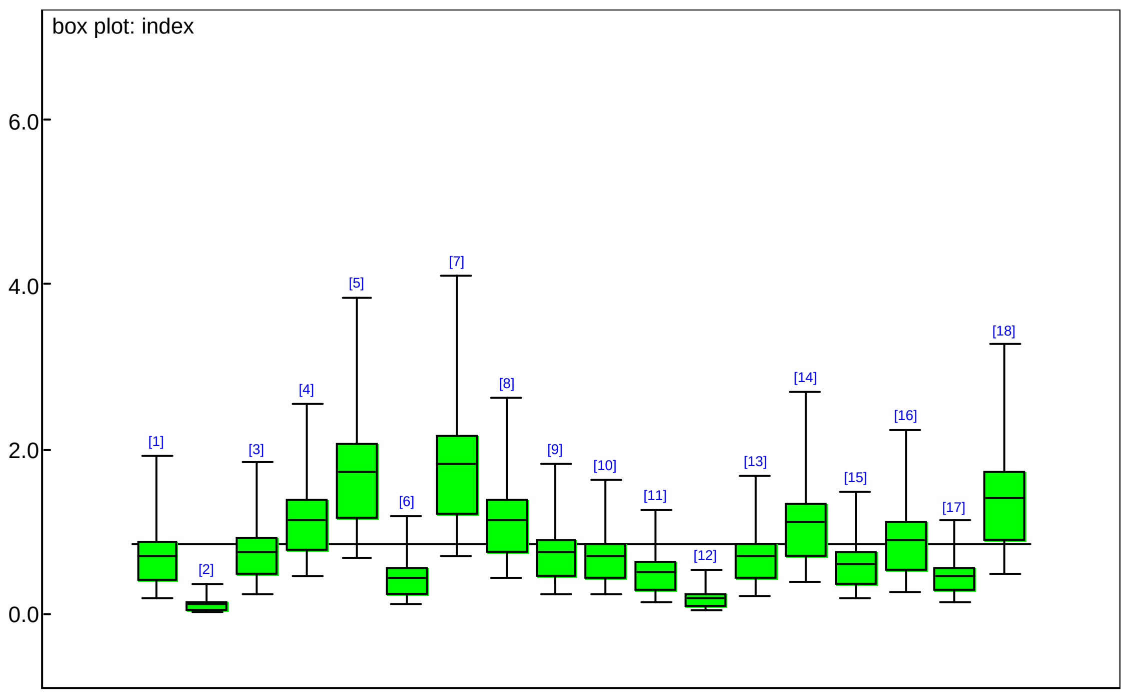

Figure 11. Fall Groundfish Base Index for vermilion snapper.

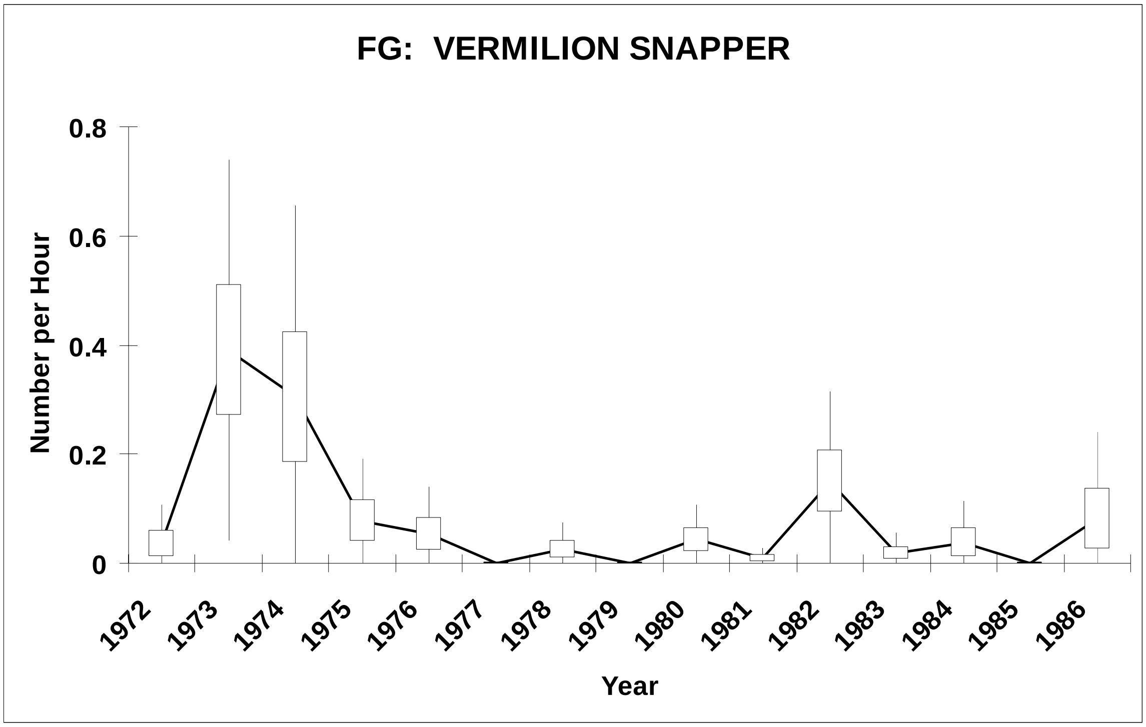

Figure 12. Fall Groundfish Bayesian Index for vermilion snapper.

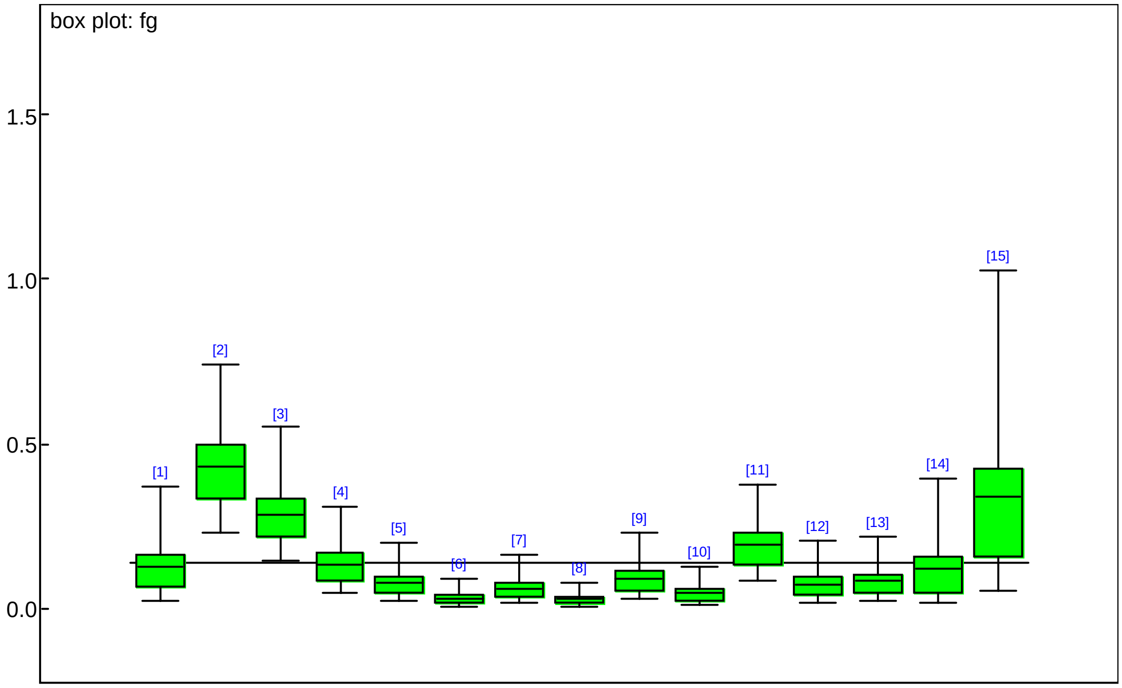

Figure 13. Summer SEAMAP Base Index for vermilion snapper.

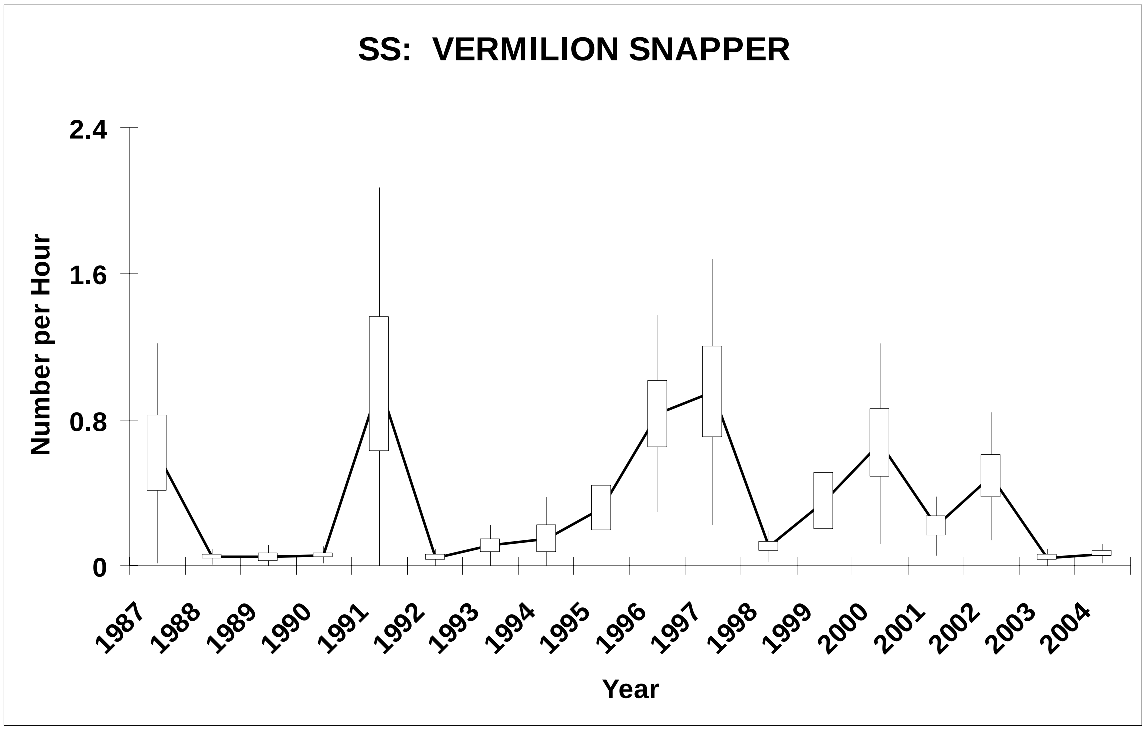

Figure 14. Summer SEAMAP Bayesian Index for vermilion snapper.

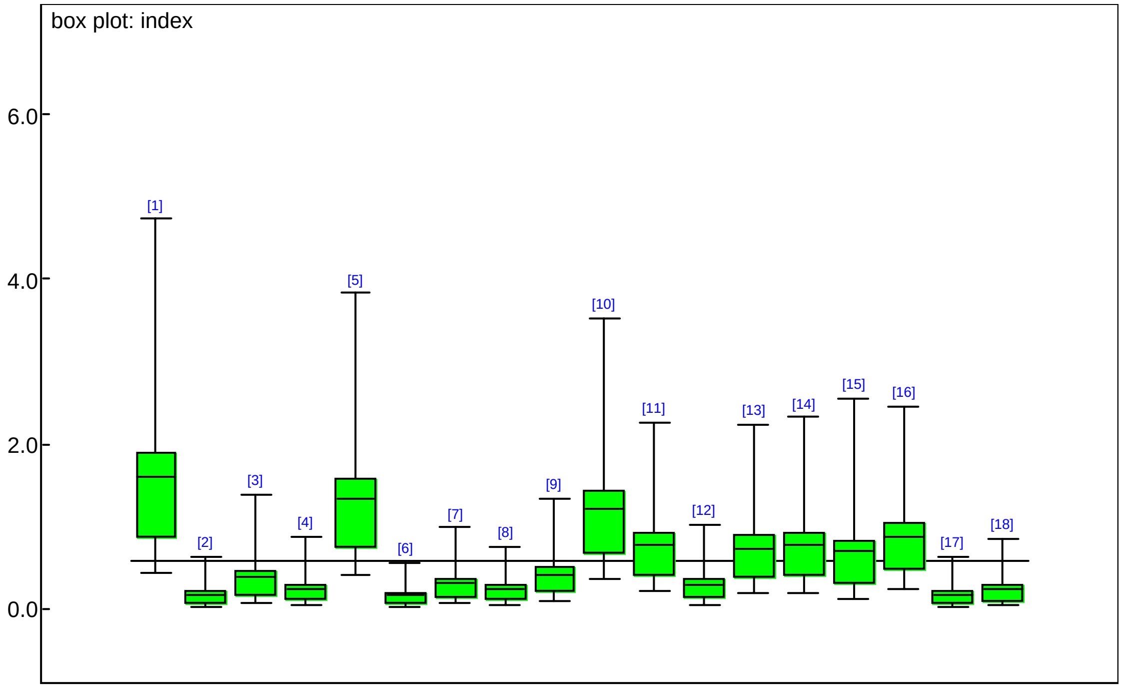

Figure 15. Early SEAMAP Base Index for vermilion snapper.

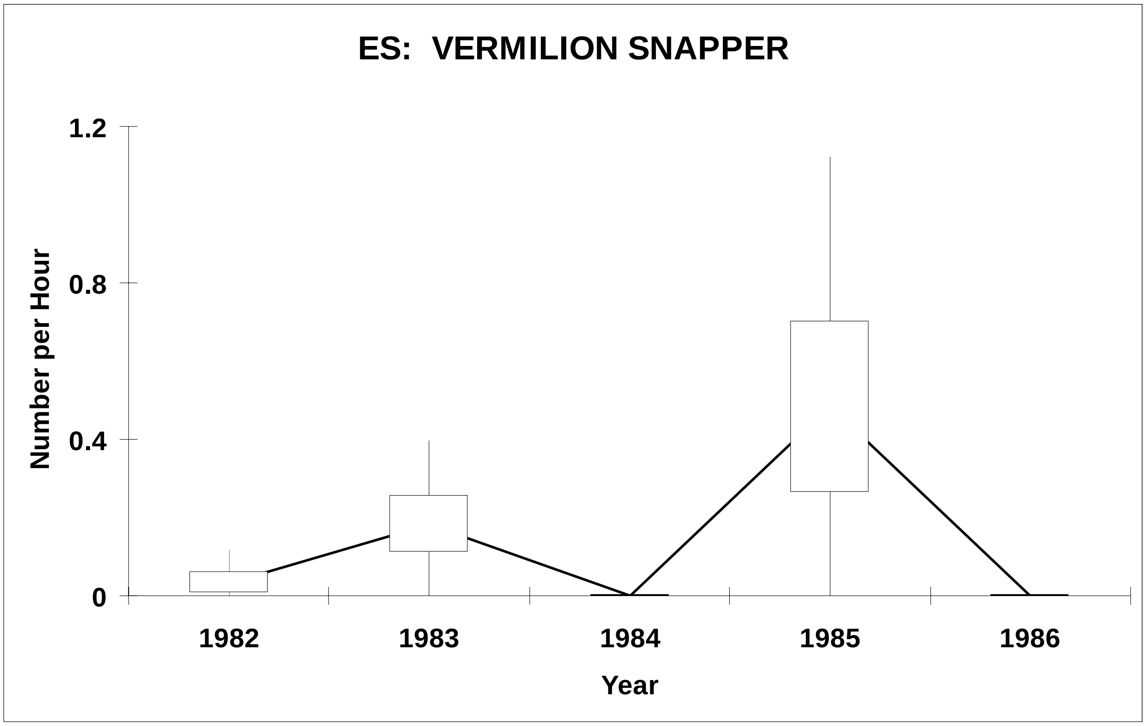

Figure 16. Early SEAMAP Bayesian Index for vermilion snapper.

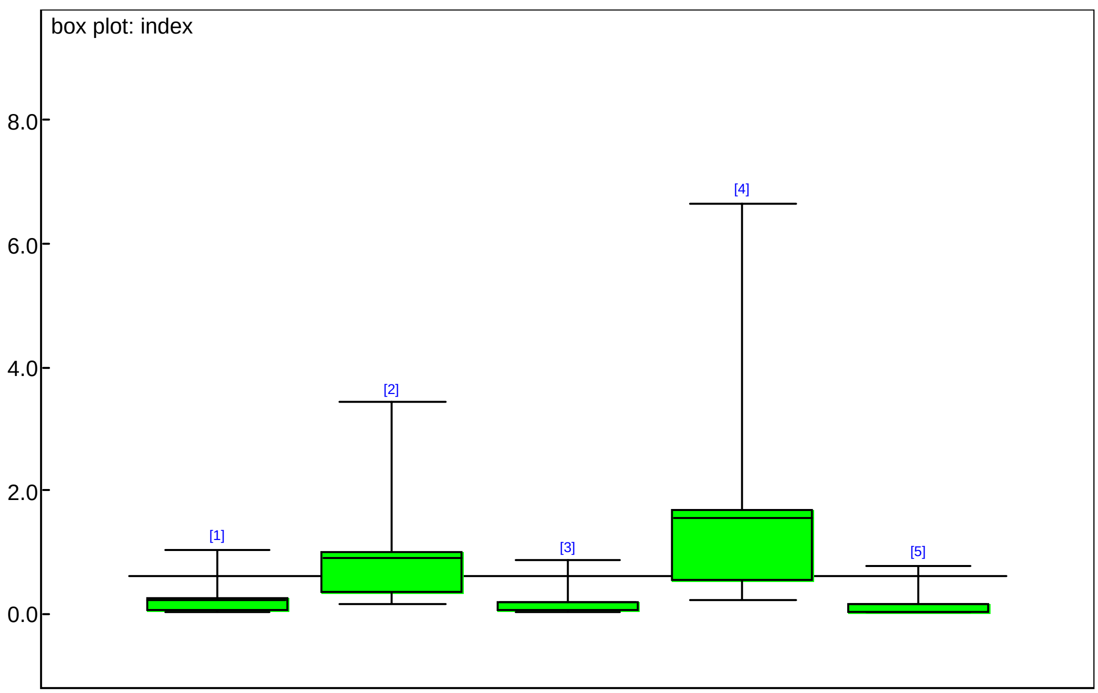

Figure 17. Fall SEAMAP Base Index for greater amberjack.

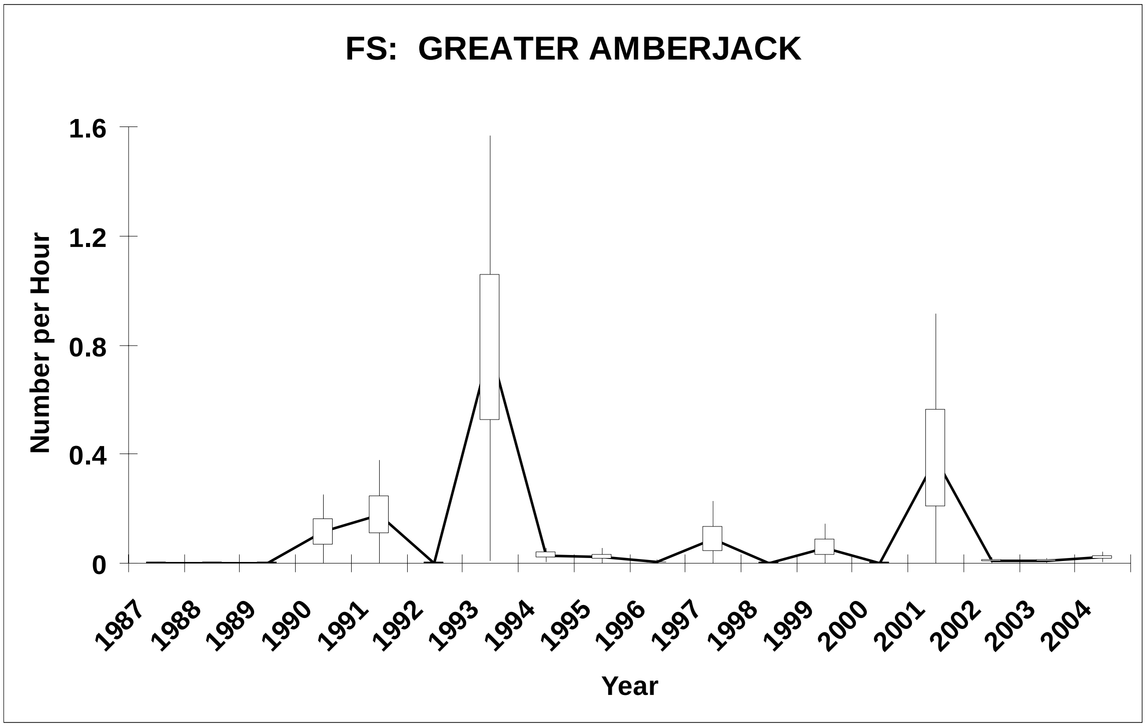

Figure 18. Fall Groundfish Base Index for greater amberjack.

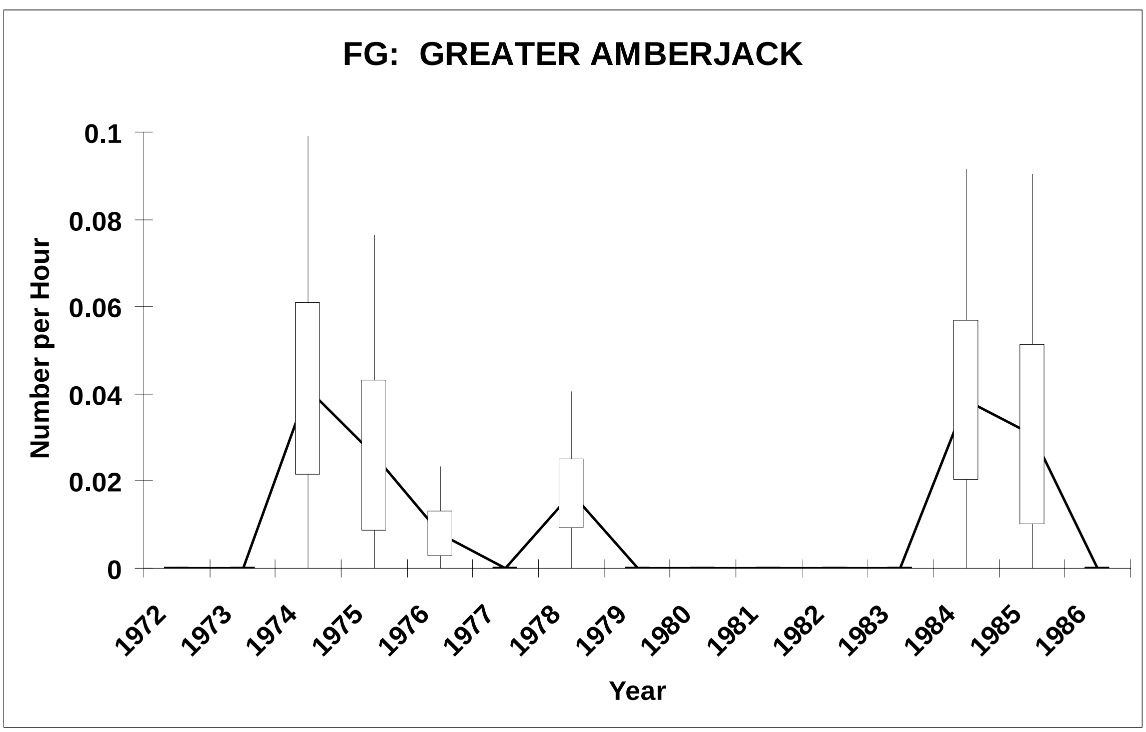

Figure 19. Summer SEAMAP Base Index for greater amberjack.

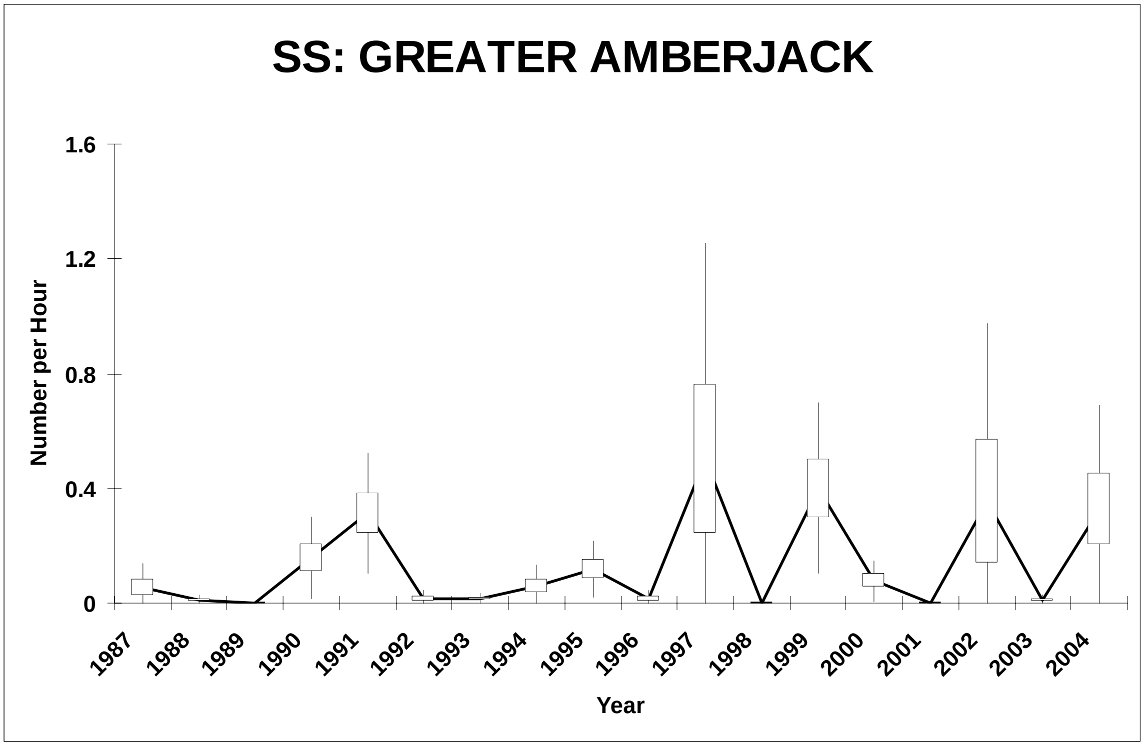

Figure 20. Early SEAMAP Base Index for greater amberjack.

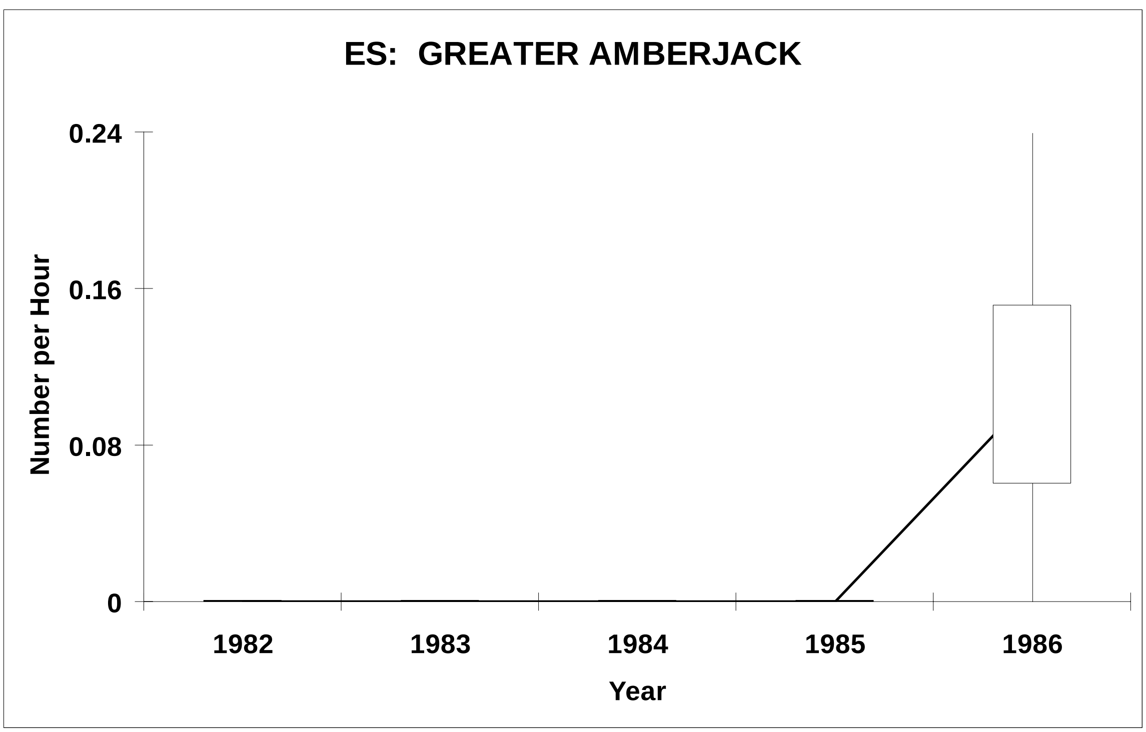

Figure 21. Fall SEAMAP: Base vs Bayesian for gray triggerfish.

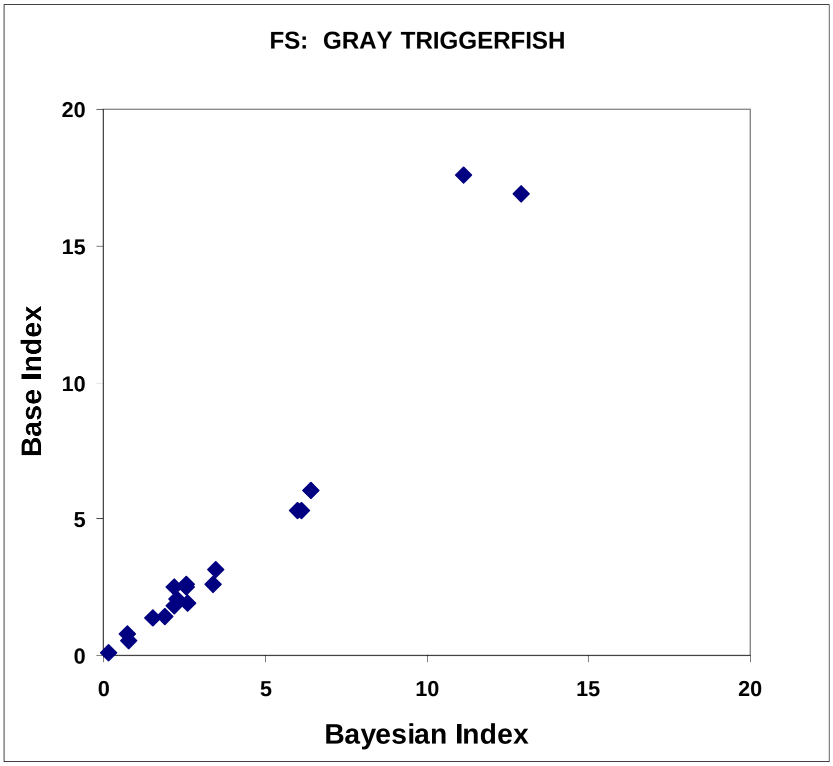

Figure 22. Fall Groundfish: Base vs Bayesian for gray triggerfish.

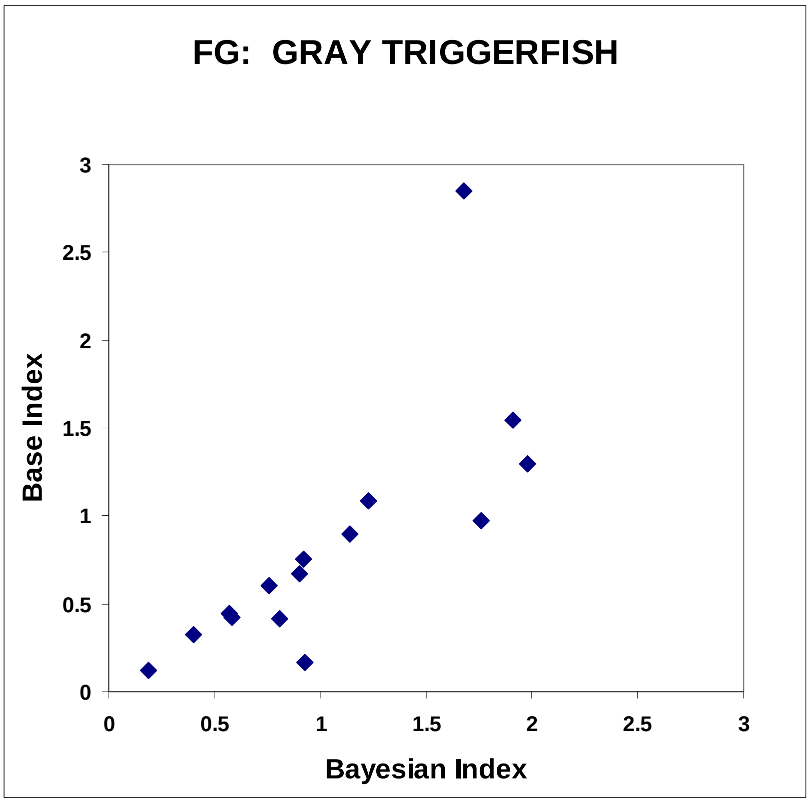

Figure 23. Summer SEAMAP: Base vs Bayesian for gray triggerfish.

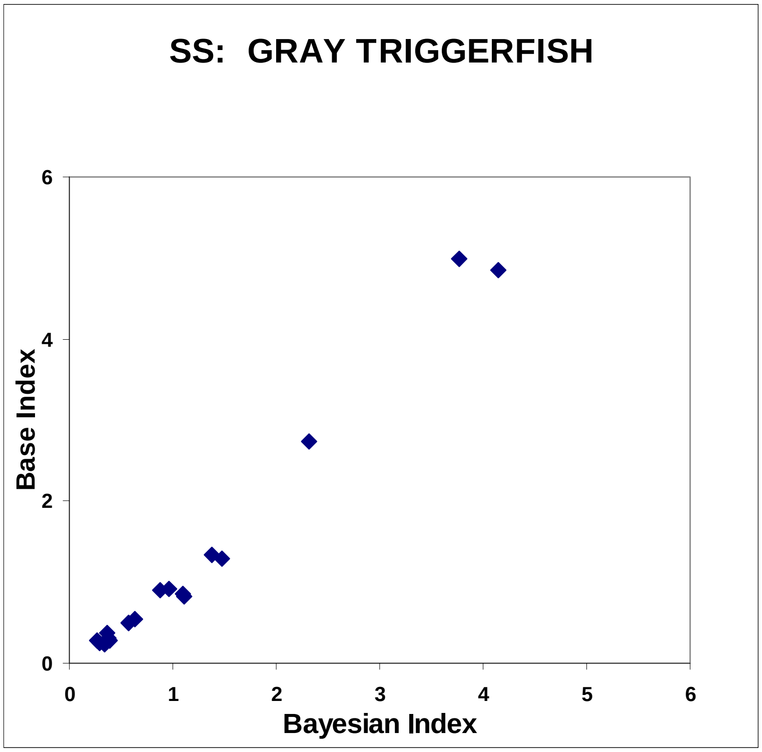

Figure 24. Early SEAMAP: Base vs Bayesian for gray triggerfish.

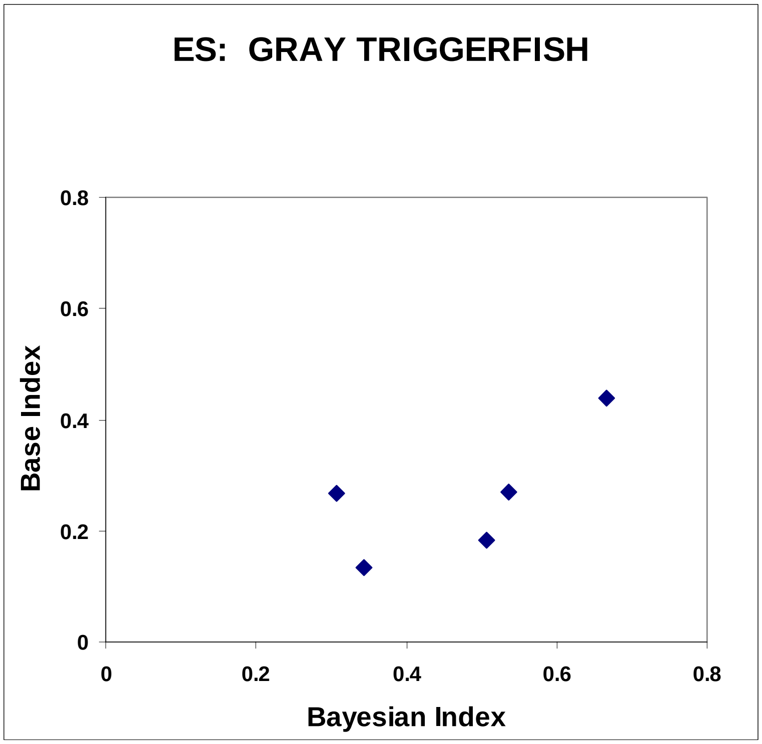

Figure 25. Fall SEAMAP: Base vs Bayesian for vermilion snapper.

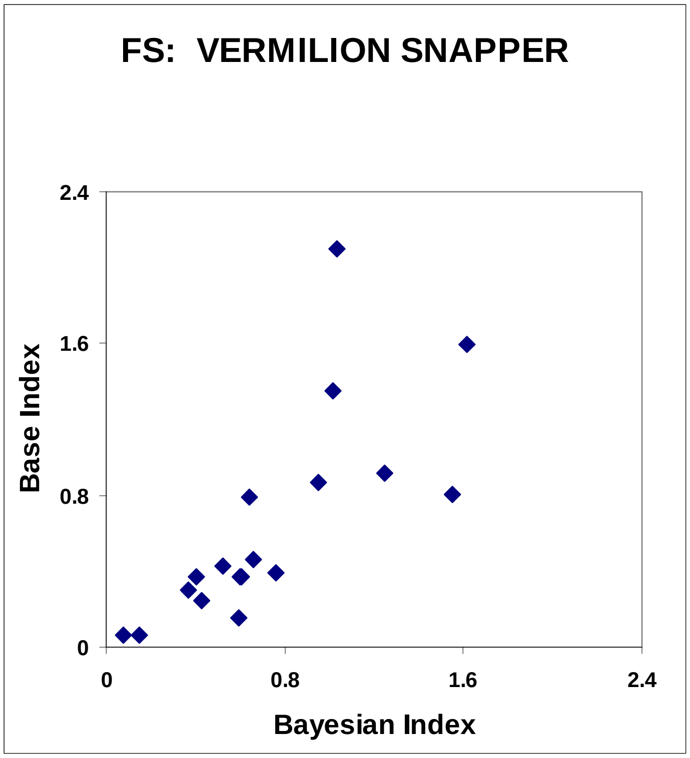

Figure 26. Fall Groundfish: Base vs Baysian for vermilion snapper.

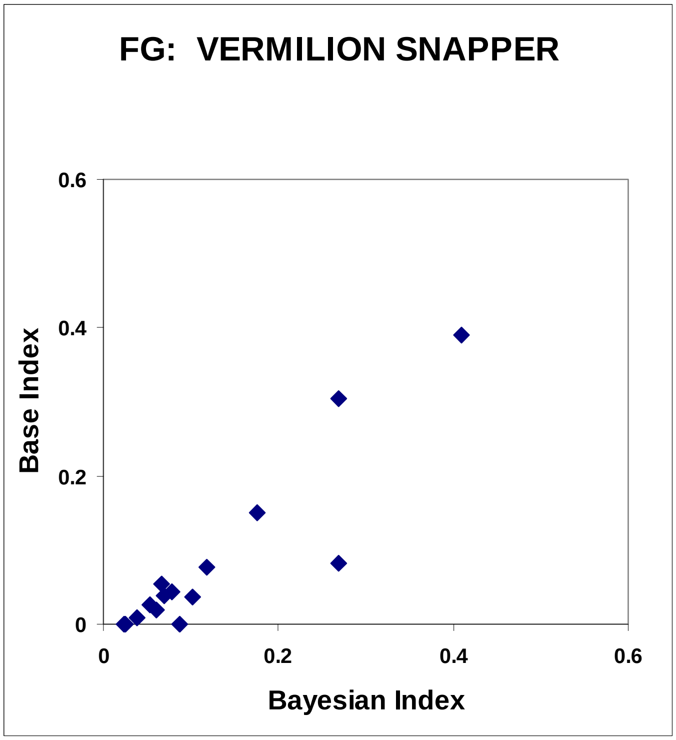

Figure 27. Summer SEAMAP: Base vs Bayesian for vermilion snapper.

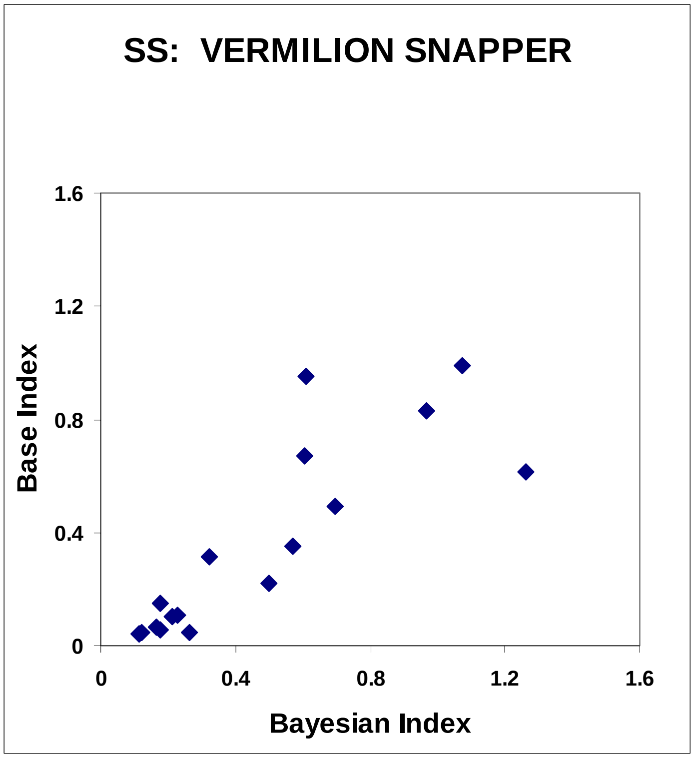

Figure 28. Early SEAMAP: Base vs Bayesian for vermilion snapper.

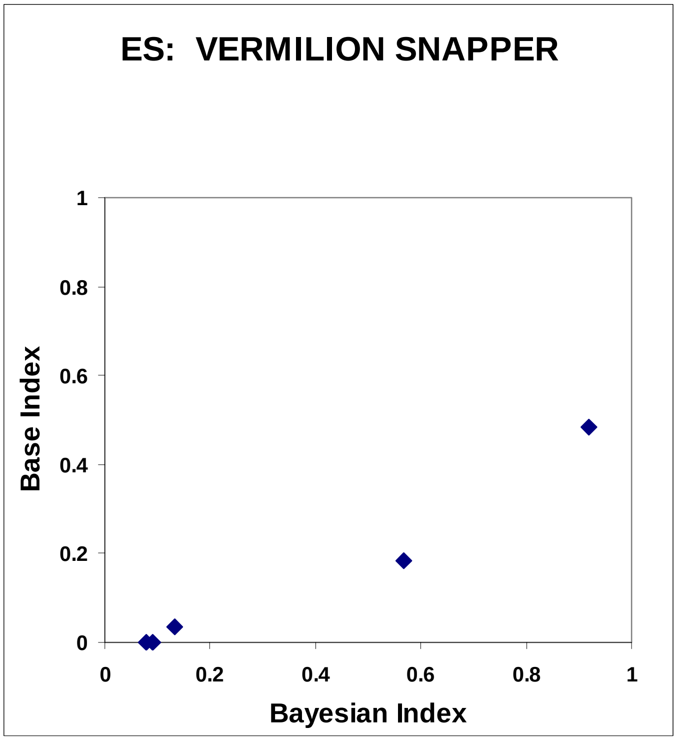

Figure 29. Percent of stock in Groundfish Primary Area during Fall SEAMAP surveys: gray triggerfish (By year).

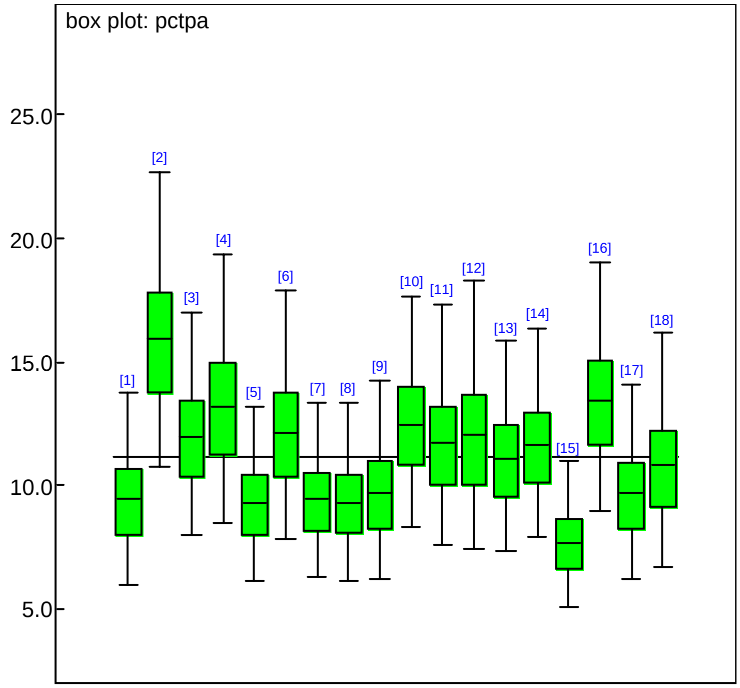

Figure 30. Percent of stock in Groundfish Primary Area during Fall SEAMAP surveys: vermilion snapper.

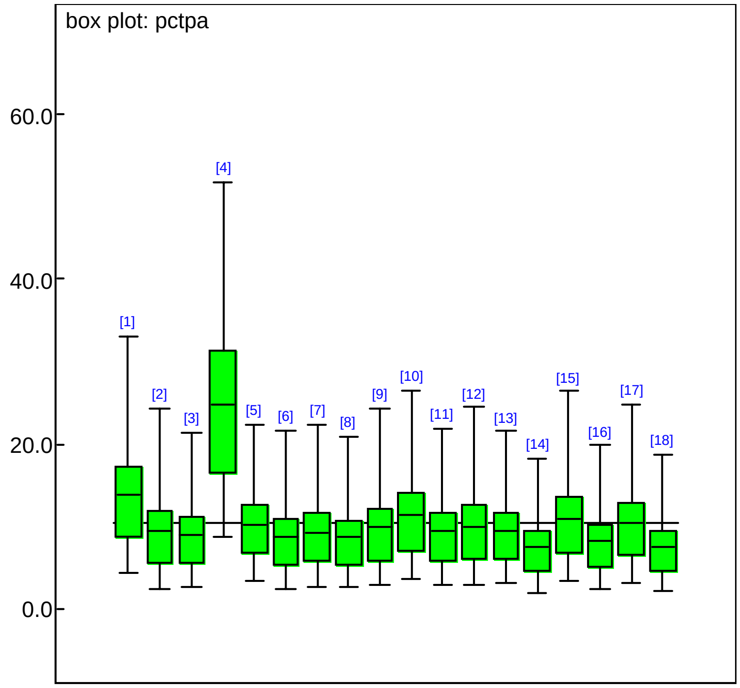

Figure 31. Percent of stock in Texas during Summer SEAMAP surveys: gray triggerfish. (The % sometimes exceeds 100% because the Texas abundance was calculated from night samples only, whereas the total was calculated from day and night.)

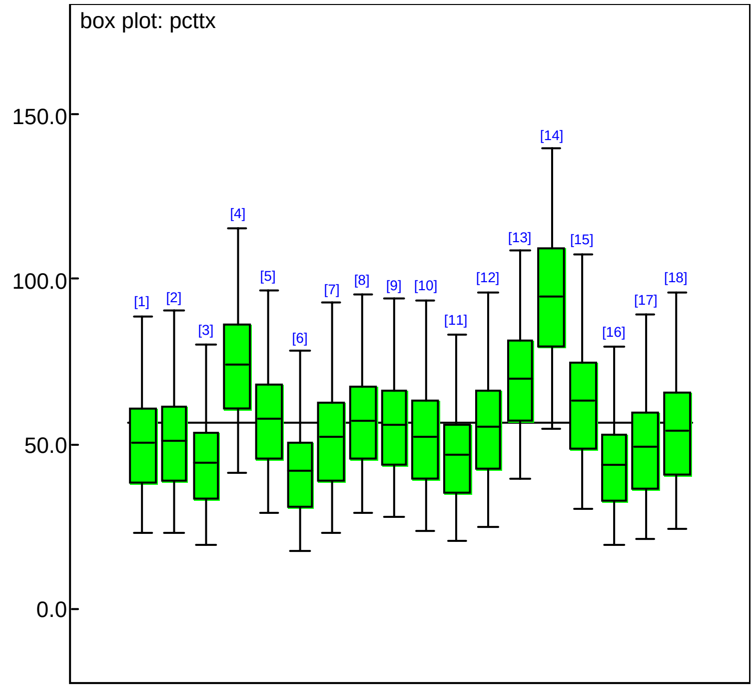

Figure 32. Percent of stock in Texas during Summer SEAMAP surveys: vermilion snapper.

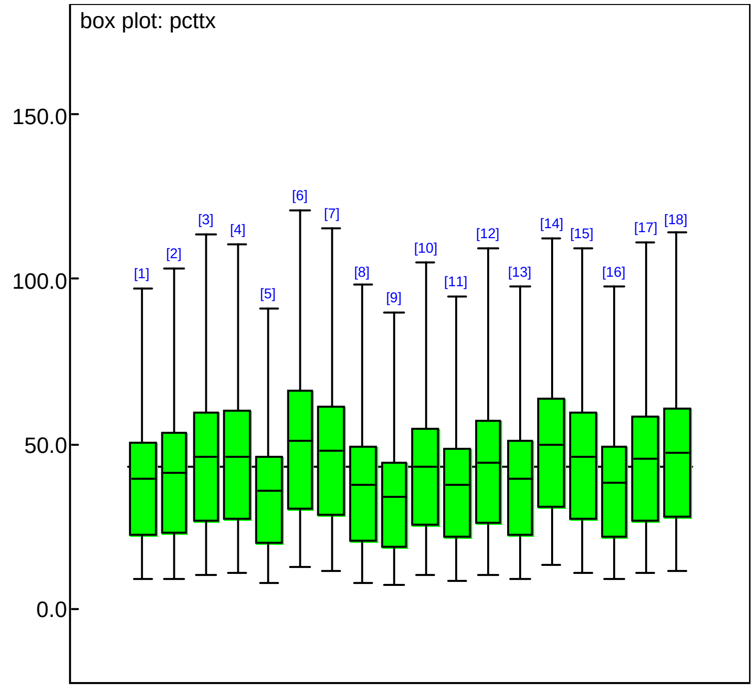

Figure 33. Combined Fall Index for gray triggerfish.

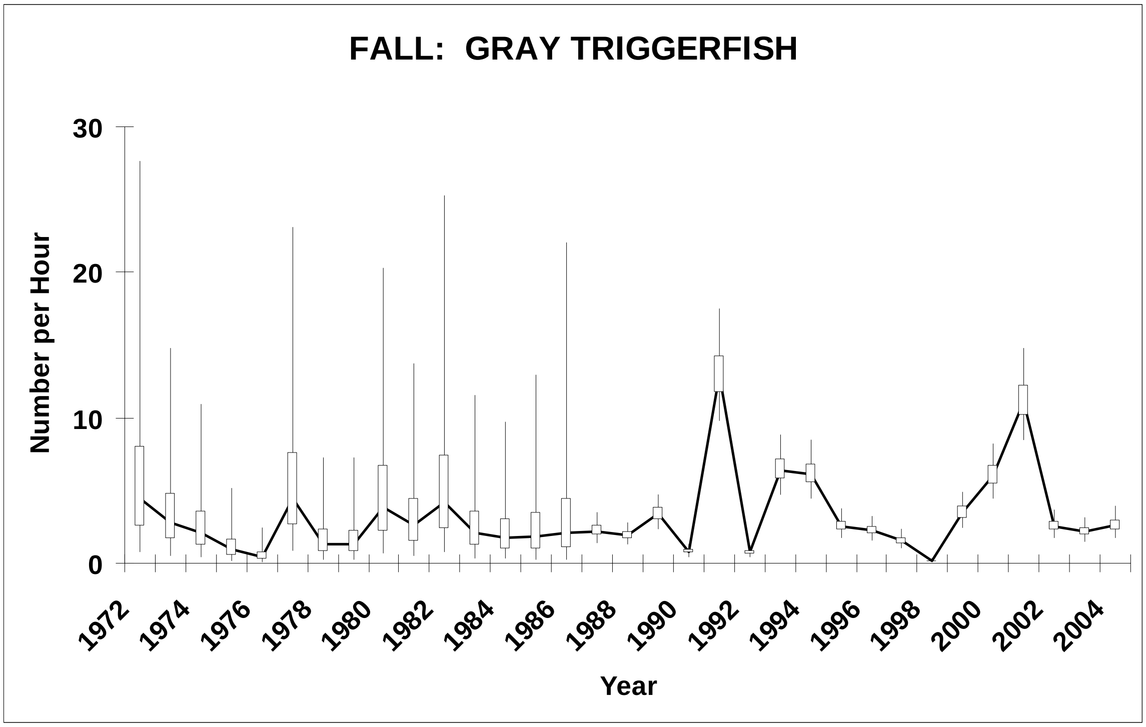

Figure 34. Combined Summer Index for gray triggerfish.

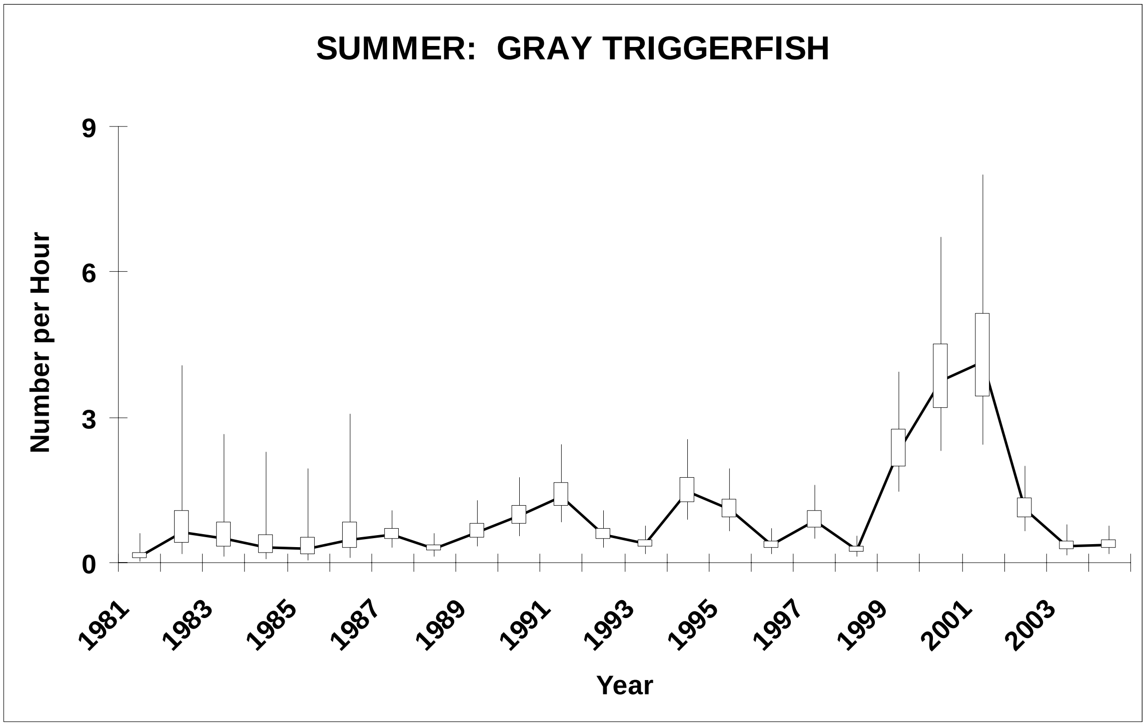

Figure 35. Combined Fall Index for vermilion snapper.

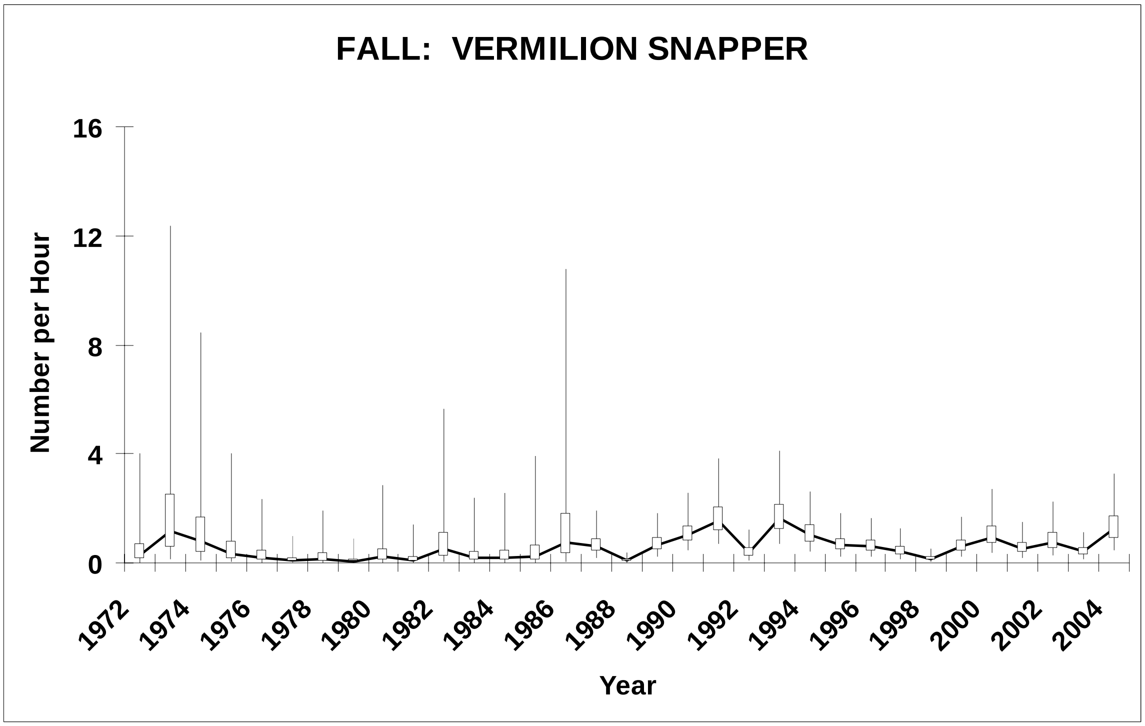

Figure 36. Combined Summer Index for vermilion snapper.