Estimated conversion factors for calibrating MRFSS charterboat landings and effort estimates for the Gulf of Mexico in 1981-1997 with For Hire Survey estimates with application to red snapper landings

by

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INTRODUCTION

The Marine Recreational Fishery Statistics Survey (MRFSS) was established to create a reliable data base for estimating catch and effort by the marine recreational fishery (http://www.st.nmfs.gov/st1/recreational/survey/overview.html). In the traditional MRFSS methodology, data are collected by a telephone survey of households in coastal counties and by interviewing anglers at fishing access sites. MRFSS acknowledged that the estimation of effort for the charterboat sector is difficult due to the low incidence of this type of fishing trips by households contacted in the telephone survey. To reduce the effect of small sample sizes on charterboat effort estimation, data from a 5 year period are combined for estimates using the traditional MRFSS method. Pooling data across years provides a larger data set to produce more reliable estimates of effort. However, this approach tends to mask trends in the fishery, annual weather patterns, etc.

To improve the effort estimation procedure for the charterboat mode, MRFSS started testing a new survey protocol named For Hire Survey (FHS) in 1995 (http://www.st.nmfs.gov/st1/recreational/pubs/charter_method.pdf). To implement the new FHS, charterboat directories were created by NMFS and participating state agencies and are maintained by the Gulf States Marine Fisheries Commission. Approximately 10% of the charterboats in the directory are randomly contacted by phone and asked relevant information regarding their fishing activities (e.g., number of trips and anglers, area of fishing, etc.). MRFSS concluded that the FHS produced significantly 'more efficient, precise, and credible charter angler effort estimates than the traditional MRFSS method'. The FHS was officially adopted as the new charterboat method in the Gulf of Mexico in 2000. However, charterboat effort estimates by FHS are available since 1998. The present document provides conversion factors to adjust effort estimates obtained by MRFSS until 1997 to the FHS effort levels 1998-2003. The adjusted effort levels were applied to adjust

historical red snapper landings from the Gulf of Mexico.

METHODS

From 1998 to 2003, the NMFS estimated charterboat effort using both the MRFSS (old) and FHS (new) protocols. Thus, differences in effort estimates for each stratum between both methodologies can be directly compared only for that period of time. Each stratum is defined by a unique combination of state, year, wave, and fishing-area, where wave corresponds to bimonthly periods starting in January. The MRFSS defined fishing areas for most states as: a) Inshore waters, b) < 3 miles, and c) > 3 miles. Note that for Florida fishing areas are defined as: a) Inshore waters, b) < 10 miles, and c) > 10 miles.

For the period 1986-1997, charterboat effort was estimated using only the MRFSS protocol. To calibrate MRFSS charterboat effort estimates (1986-1997) to FHS levels, conversion factors (ratios) between FHS and MRFSS charterboat effort were estimated using 1998-2003 data and applied to the 1986-1997 MRFSS effort estimates.

To estimate the conversion factors, a ratio of FHS/MRFSS effort estimates was calculated for each stratum using only the estimates from the period 1998-2003. Data from Florida were analyzed separately from the other states (AL, LA, MS) because 'fishing area' was defined differently. A generalized linear model with a gamma response probability distribution (GENMOD procedure, distribution=gamma, link=log, lsmeans, SAS Inst.) was used to identify significant factors and to estimate predicted ratios. The factors included in the model were year, wave, fishing area, state and the interaction terms. In the event that a factor was found non-significant ($Pr > 0.05$), it was removed and the regression re-run until all (highest order) model terms were significant (Hocking 1976, Draper and Smith 1981). The predicted ratios are used as the conversion factors.

From 1981 to 1985, MRFSS considered charterboat and headboat as part of single mode. Thus, the conversion factors estimated with 1998-2003 charterboat data (used to calibrate 1986-1997 charterboat effort estimates) can not be used to calibrate the 1981-1985 estimates. To calibrate the 1981-1985 combined charterboat and headboat effort estimates, conversion factors were estimated using 1986-1990 effort estimates instead of 1998-2003 to minimize possible effects of changes in the fishery over time. To do so, headboat (NMFS Headboat Survey) and original (MRFSS) charterboat effort estimates were combined (summed) into one estimate for each year and wave. The same procedure was done with the same headboat estimates and the newly calibrated (FHS) charterboat estimates (estimates obtained after applying conversion factors described above). Ratios of the combined MRFSS charterboat and headboat estimates to FHS charterboat and headboat were calculated for each year and wave. A generalized linear model (log-transformed ratios) was used to identify significant variables and to estimate predicted ratios (GLM procedure, lsmeans, SAS Inst.). The factors included in the model were year and wave. State and fishing area were not included in the model because they were not part of the headboat data set. Note that headboat effort is defined as angler-days while charterboat effort is defined as angler-trips. For the purpose of ratio estimation, both units of effort were considered equivalent.

RESULTS AND DISCUSSION

A ratio greater than 1, the result of the FHS effort estimate being higher than the MRFSS estimate, indicates that the MRFSS effort was underestimated in that particular stratum. Conversely, a ratio less than 1 indicates that the MRFSS effort was overestimated.

The analysis of the charterboat only data from LA, AL and MS (1998-2003) showed that only wave and fishing area had significant effects on the ratios ($Pr<0.0001$). Figures 1a-f show the observed and estimated ratios for each wave and area. In general, MRFSS tended to underestimate effort in waves and fishing areas with highest fishing activity (inshore in all waves and waves 3-4 in other areas) and overestimate it in low fishing activity waves and areas. In the case of FL (Figures 2a-f), MRFSS effort was underestimated in the inshore fishing area in all waves. Conversely, effort was overestimated in the >10 miles fishing area, in all waves. In the < 10 miles fishing area, effort was underestimated in waves 2 and 3 and overestimated in waves 4 and 5, while waves 1 and 6 showed ratios very close to 1. Tables 1a and b show the estimated ratios and associated standard errors.

The results of the analysis of the charterboat-headboat (CB-HB) data combined (1986-1990) showed that 'wave' was the only significant variable of the linear model ($Pr<0.0001$). The results indicated that MRFSS effort estimates for the combined CB-HB mode for the period 1981-85 were underestimated in all waves (Table 2, Figure 3).

Table 1: Predicted ratios and standard errors (in parenthesis) between FHS and MRFSS charterboat effort estimates (to be applied to 1986-1997) for the States of a) AL, LA, and MS combined and b) FL.

a)

	WAVE					
Area	1	2	3	4	5	6
Inshore	1.26 (1.31)	1.54 (1.27)	3.82 (1.26)	4.67 (1.26)	3.28 (1.27)	1.48 (1.28)
< 3 miles	0.74 (1.37)	0.75 (1.26)	1.49 (1.25)	2.28 (1.24)	0.64 (1.28)	0.52 (1.40)
> 3 miles	0.44 (1.28)	0.63 (1.24)	2.23 (1.23)	1.87 (1.24)	1.26 (1.23)	0.53 (1.28)

b)

	WAVE					
Area	1	2	3	4	5	6
Inshore	3.17 (0.16)	5.31 (0.16)	5.71 (0.16)	5.33 (0.16)	3.49 (0.16)	3.70 (0.16)
< 10 miles	0.95 (0.16)	1.10 (0.16)	1.78 (0.16)	0.70 (0.16)	0.48 (0.16)	0.98 (0.16)
> 10 miles	0.38 (0.16)	0.58 (0.16)	0.77 (0.16)	0.73 (0.16)	0.59 (0.16)	0.55 (0.16)

Table 2: Predicted ratios and standard errors (in parenthesis) between FHS and MRFSS effort estimates for the combined charterboat and headboat combined (to be applied to the period 1981-85).

Wave					
1	2	3	4	5	6
1.45 (1.10)	1.31 (1.10)	1.63 (1.10)	1.34 (1.10)	2.67 (1.10)	1.58 (1.10)

Red snapper original (MRFSS) charterboat landings (A+B1) were calibrated into the corresponding estimates to FHS levels by simply multiplying the original landings (for each wave and fishing area) by the predicted FHS/MRFSS effort ratios from Tables 1 and 2. Figure 4a shows the original MRFSS estimated landings and the converted landings to FHS levels. Note that 1981-85 landings correspond to the combined mode charterboat-headboat. For the period 1981-85, the underestimation of effort by MRFSS for then combined mode CH-HB translated into larger landings when the estimated ratios in Table 2 were applied. For the period 1986-97, the calibrated landings (FHS) obtained by applying the ratios presented in Tables 1a-b are similar to the original (MRFSS) landings. However, in the period 1998-2003 landing estimates from FHS (original estimate not obtained from applying ratios) were systematically lower than the MRFSS estimated landings. After 1997, MRFSS charterboat landings in the Gulf of Mexico were dominated by the FL landings (Figure 5). During the same period, most charterboat effort and landings in FL were in the >10 miles fishing area (Figures 6 and 7). The facts that MRFSS charterboat effort estimates for this area were overestimated in all waves (see Table 1b, Figure 2f) and that 51% of the total GOM (LA-FL) charterboat landings (1998-2003) are from this area translate into consistently lower FHS estimated landings (Figure 4) for the entire GOM for the period 1998-2003. Figure 4b shows the combined headboat and charterboat landings for the entire time series. The overall impact of replacing MRFSS effort estimates with FHS estimates on the total recreational landings (TXPW+Headboat+MRFSS) is shown in Figure 4c.

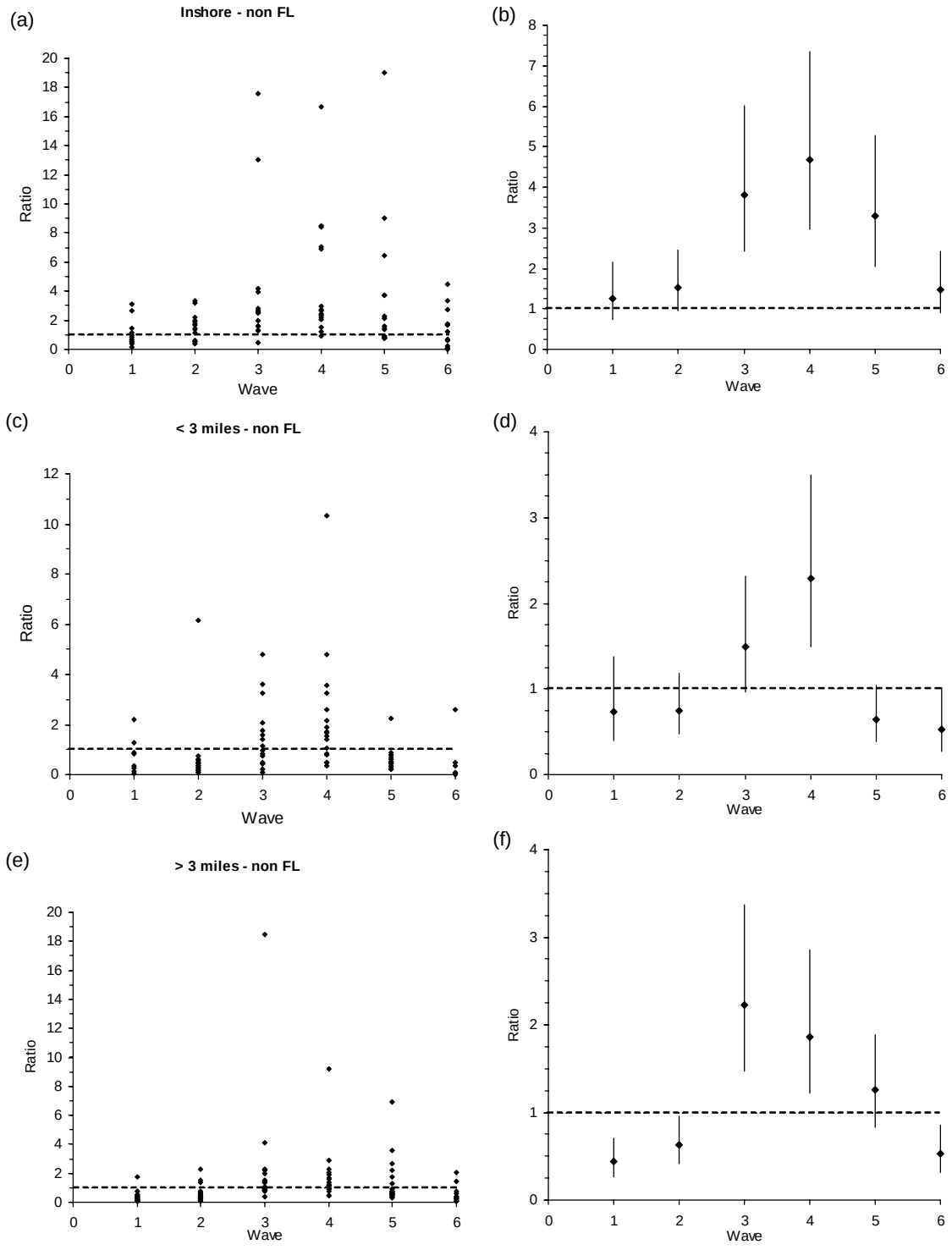


Figure 1: Observed (a, c, e) and estimated ratios (b, d, f) for each area and wave for the LA, AL, and MS data combined (1998-2003). Vertical lines on the right panels correspond to the 95% confidence interval of the estimated ratios. Dashed horizontal line indicates a ratio=1.

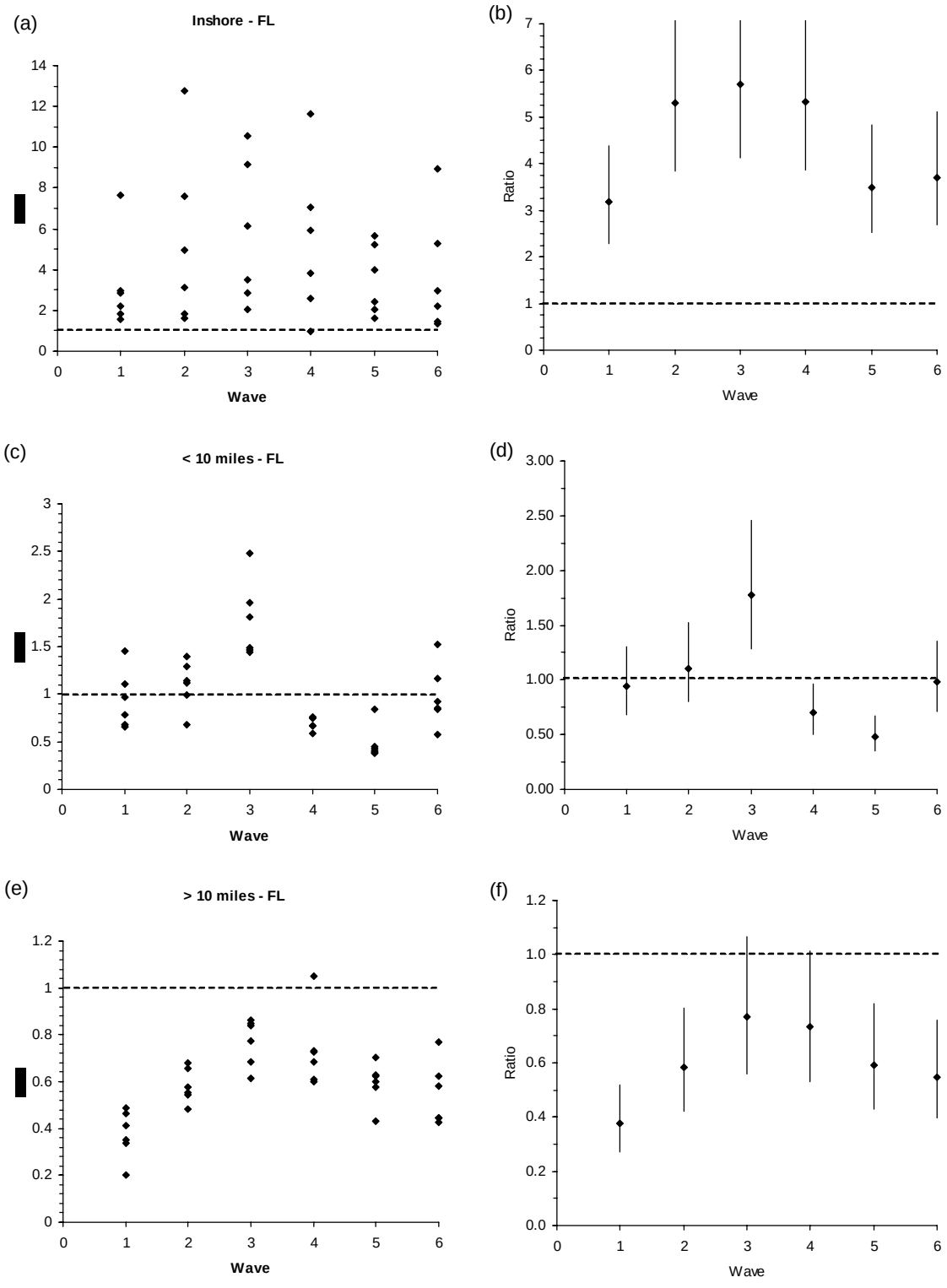
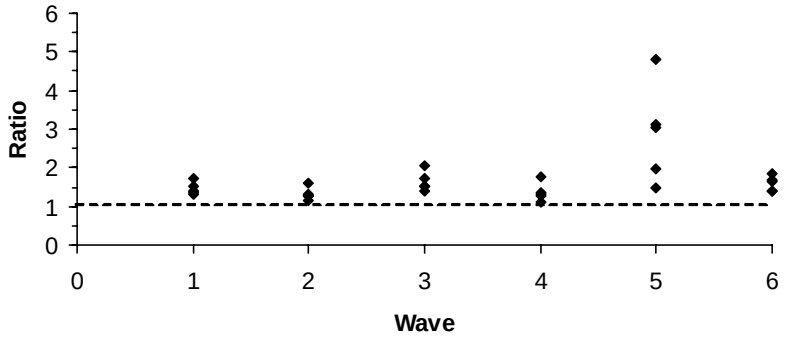


Figure 2: Observed (a, c, e) and estimated ratios (b, d, f) for each area and wave for the state of FL (1998-2003). Vertical lines on the right panels correspond to the 95% confidence interval of the estimated ratios. Dashed horizontal line indicates a ratio=1.

a)



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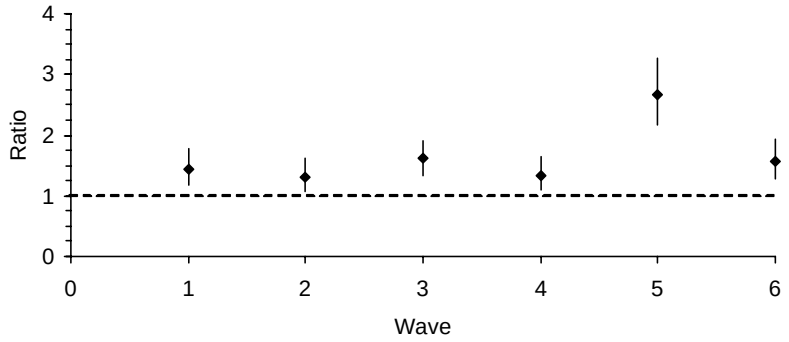
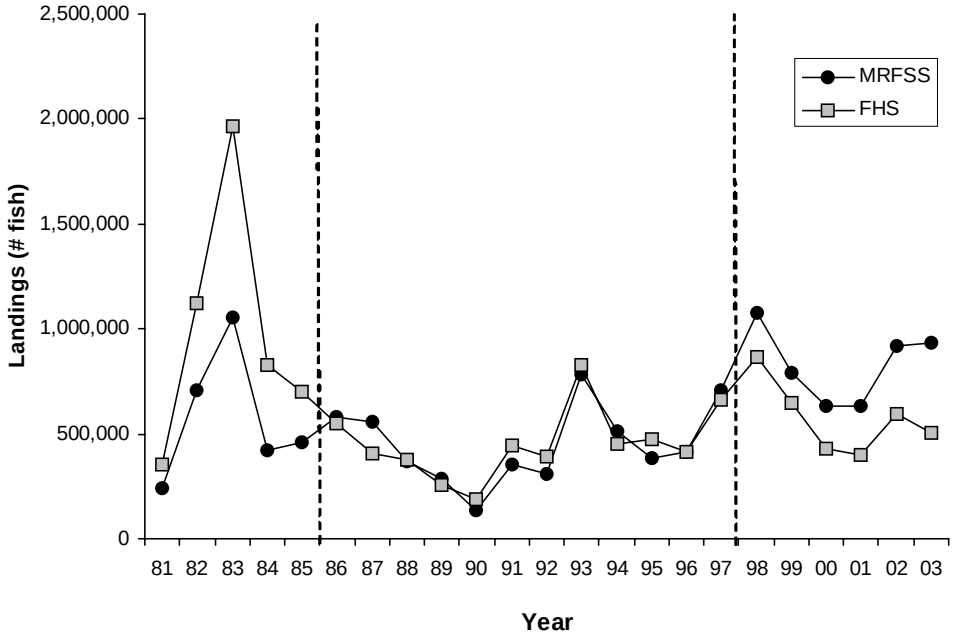


Figure 3: a) Observed and b) estimated ratios for each area and wave for the combined headboat-charterboat MRFSS and FHS effort estimates (refer to text for detailed explanation). Vertical lines correspond to the 95% confidence interval of the estimated ratios. Dashed horizontal line indicates a ratio=1.

a)



b)

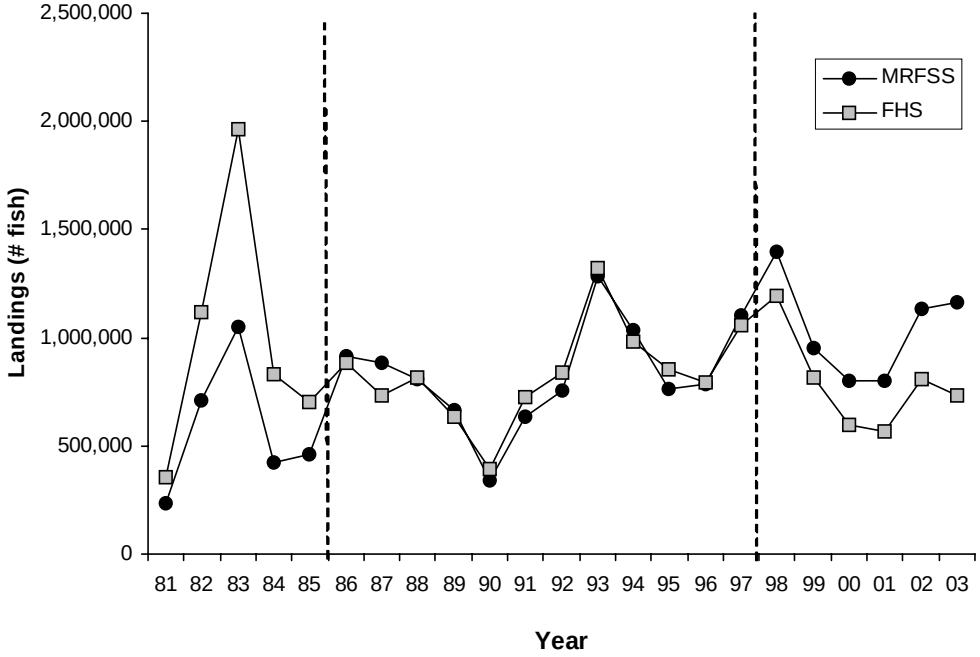
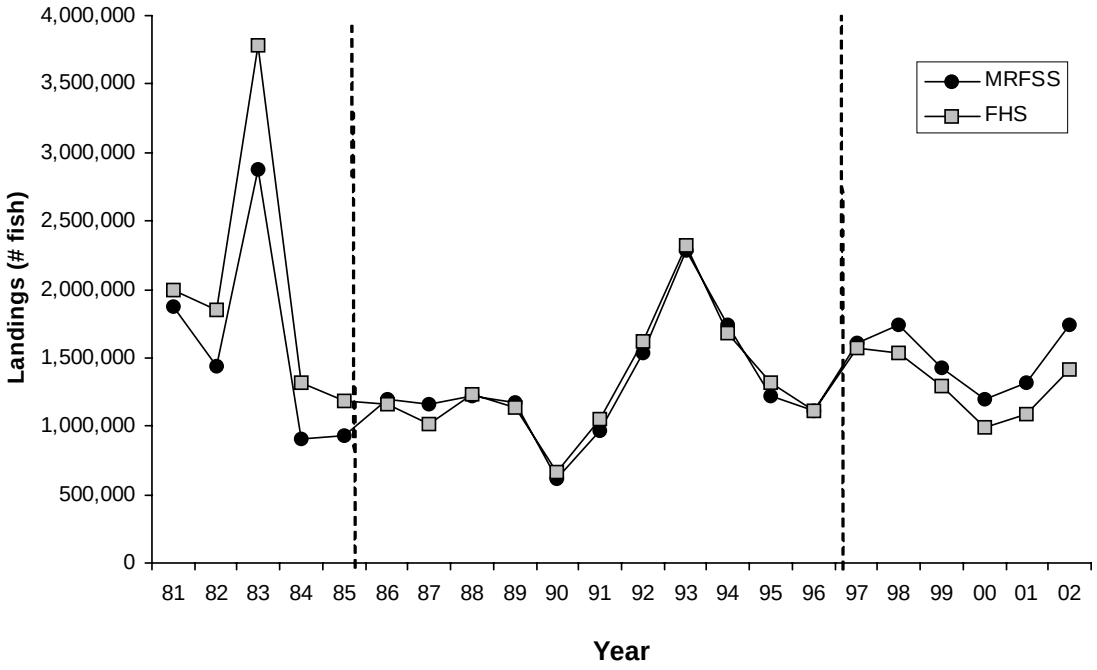


Figure 4: Estimated a) MRFSS charterboat and b) charterboat+headboat and c) all recreational combined MRFSS and FHS red snapper landings (number of fish) for the entire Gulf of Mexico (LA-FL). Landings for the period 1981-85 correspond to the combined mode charterboat-headboat. FHS landings for the period 1981-97 were estimated using effort ratios (See Tables 1 and 2). MRFSS and FHS landings for the period 1998-2003 are the original MRFSS and FHS landings estimates (no effort ratios were applied). Note that the time series for the combined recreational landings only covers until 2002 since no 2003 landings were available from TXPW

Figure 4 (continued)

c)



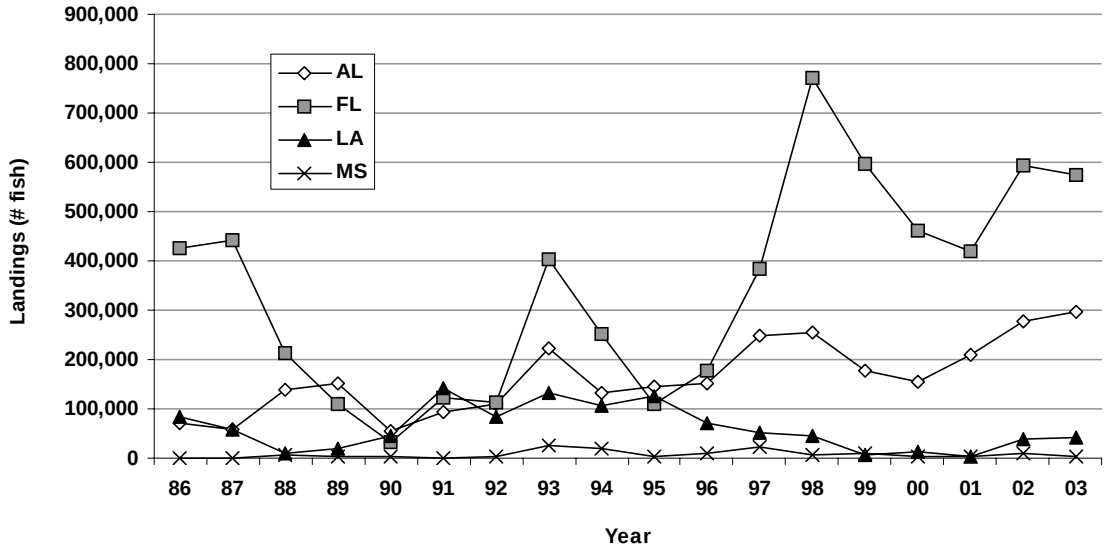


Figure 5: MRFSS estimated charterboat landings by state for the period 1986-2003.

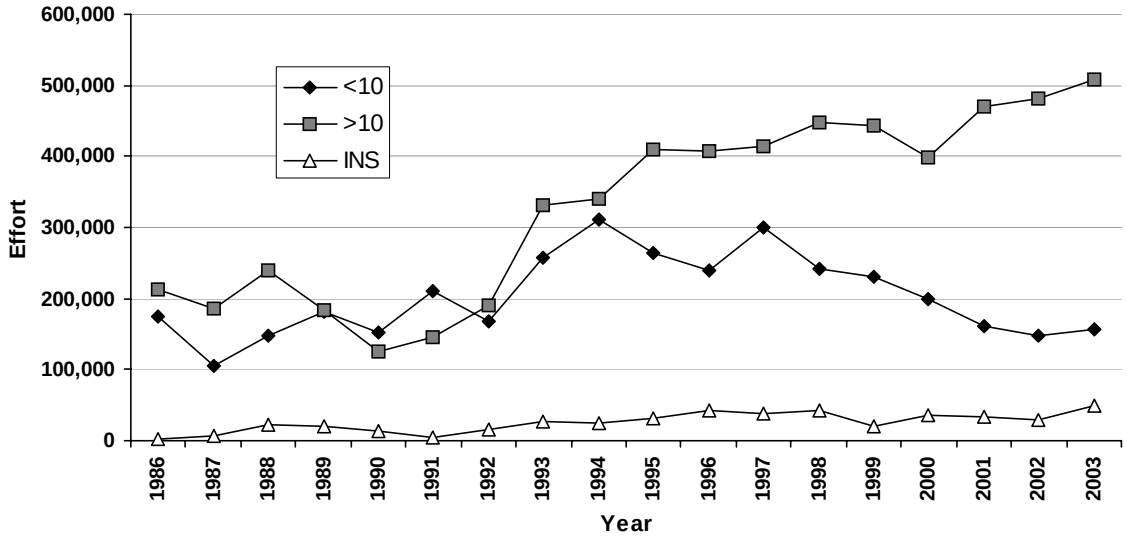


Figure 6: MRFSS estimated charterboat effort for each fishing area in FL for the period 1986-2003.

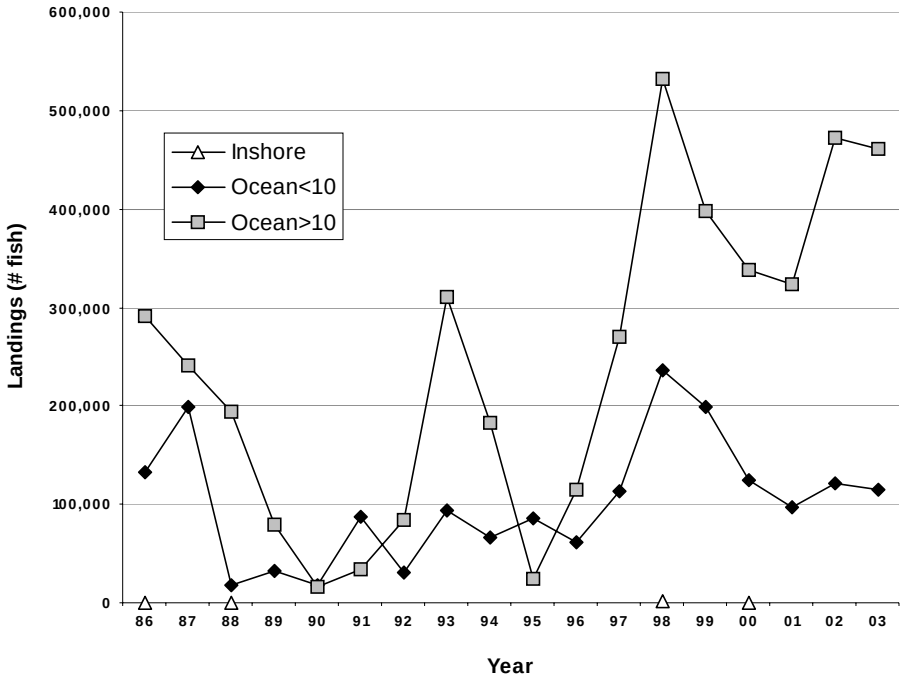


Figure7:MRFSS estimated red snapper charterboat landings (number of fish) for each fishing area in FL for the period 1986-2003.