ANNUAL FISHERIES REPORT

EVERGLADES NATIONAL PARK

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INTRODUCTION

National Park Service (NPS) management policies state that recreational fishing is permitted in parks when it is authorized by federal law or is not specifically prohibited, and is in accordance with applicable federal/state laws and regulations. However, the NPS may restrict fishing activities whenever necessary to achieve management objectives. NPS goals and management objectives are based on the preservation of diversity and ecological integrity of fish populations. When harvest is permitted, in no case should it be allowed to reduce the reproductive potential of the population or to radically alter its natural (unfished) age structure. Fishing activity and harvest of sportfish from Everglades National Park (ENP) have been monitored nearly continuously since 1958. The objectives of fisheries monitoring in the park are to estimate catch rates (cpue), relative abundance, age structure, total harvest, and boating and fishing activity.

This monitoring program was initiated because of concern over increased fishing pressure resulting from the construction of a highway, marina facilities, and an access canal to Whitewater Bay in 1958. The first ten years of the park's fishery monitoring program (1958-1969) were conducted through the University of Miami's Institute of Marine Science and were directed at evaluating only the sport fishery. Under this program, measures of catch and cpue were made only from those fishermen operating out of Flamingo. This data covered a large part of the fishery, but missed two other major areas: eastern Florida Bay and the lower 10,000 Islands.

In 1965, a permitting system was established for commercial fishermen operating in ENP. These fisheries included commercial hook & line (primarily spotted seatrout), netting (mullet and pompano), stone crab trapping, and professional guides. Until 1972, this catch data consisted of monthly total harvest, by species, for each fisherman. The harvest reports did not include any measure of fishing effort or specific area of harvest, so it was not possible to monitor populations by ecosystem or management unit, or to evaluate the degree to which fishermen complied with reporting requirements.

In 1972, the NPS expanded the monitoring program to include daily trip ticket reports from commercial permit holders and developed censusing techniques to evaluate total parkwide sport fishing and commercial effort. The primary emphasis of the expanded monitoring was to improve the precision of the catch rate and total fishing effort estimates for both sport and commercial fisheries (Davis 1979a). In 1974, fish size data was added to the information recorded and, in 1980, Chokoloskee-Everglades City boat ramps were added on a routine basis.

In 1978, a second detailed account of the park's fishery database was completed in response to sport fishermen and guide complaints of declining stocks. The results of this assessment were incorporated into a document for public review concerning alternative fishery management options for ENP (Davis 1979b). This assessment summarized the estimated total harvest of fish from park waters by species, by area, and fishermen type from 1973-1977; however, no detailed analysis of catch rate response to changes in effort

or to environmental factors were made. Insufficient fish length data also were available in 1979 to evaluate such important parameters as age structure, mortality rates, and response to changes in fishing effort and harvest.

During the late 1980's, Virtual Population Analysis (VPA) cohort stock assessments for the park's major fish species, based on a 10-year collection (1974-1984) of 40,000 fish length measurements, were conducted. VPA's are statistical models which use catch data to produce relative estimates of how many fish of a given species exist or how many of a particular age class are surviving to become spawners. Park stock assessments included total mortality estimates, age structure, and a yield-per-recruit analysis for the three most commonly caught sportfish: spotted seatrout, red drum, and gray snapper (Tilmant et al. 1986, Rutherford et al. 1989a, 1989b). This review concluded that environmental factors may explain as much of the variability in fish abundance as does fishing pressure.

Most recently, an oral presentation of project results from a historical perspective was given during a Florida Bay Program Management Committee Workshop in March 1999 as part of the development process for a conceptual model of the interactions between ecosystem dynamics and higher trophic levels in Florida Bay. A poster on the evaluation of recent trends (1985-1998) in the recreational sport and guided fisheries of Florida Bay was also presented at the Florida Bay Science Conference, with an abstract published in the proceedings. The sport data was also presented at the 52nd Gulf and Caribbean Fisheries Institute meeting in Key West with a paper to be published in the proceedings. Data from 1997-1999 was provided to the Florida Marine Research Institute (FMRI) (St. Petersburg) to generate stock assessments for snook, spotted seatrout, and sheepshead. Local interagency meetings summarized the status of draft ecological performance measures. Snook and spotted seatrout cpue performance measures were used as part of the evaluation of the decision making for the Natural Systems Team. Also, an assessment of Florida Bay fisheries for 1998 was made and incorporated into a chapter for a draft NPS report on the State of Florida Bay in 1998.

Some of the information found in this report was also discussed at a Florida Fish and Wildlife Conservation Commission forum held at Sebring during November 1999 on possession and size limit exemptions for tournaments. There was a concern that some tournaments were trying to justify exemptions by stating they were gathering scientific data. It is possible to collect usable data from fishing tournaments, but only if it is requested and approved by a fisheries biologist for a specific scientific project. The general consensus was that there should not be any exemptions for fishing tournaments since it could result in a negative impact on the resource.

A health advisory remains in effect for six species of marine fish found in northern Florida Bay. The average mercury level of spotted seatrout, gafftopsail catfish, crevalle jack, ladyfish, and bluefish is in excess of the state limit for human consumption.

This is the fifth fisheries report produced since 1990. Due to severe personnel shortages, only basic data collection activities were maintained from 1991-1994 by port samplers at

Flamingo and Everglades City. This report includes a description of the fishery, relative abundance, and average size of the four major catch species in 1999, as well as comparisons with previous years. In addition, estimated total catch/harvest, effort, and boating activity are included, as well as environmental effects on cpue from 1985-1999.

METHODS

Methods (data collection/recording format) employed to obtain sport fishing monitoring and boating activity data in ENP have been previously presented by Higman (1967), Davis and Thue (1979) and Tilmant et al. (1986), and are briefly discussed below.

Recreational fishermen are interviewed at boat launch sites (Flamingo and Chokoloskee/Everglades City) upon completion of their trip every weekend. Data recorded includes area fished (Figure 1), fish kept and released, effort (in angler-hours), species preference, angler residence, and fish lengths. Professional guides were required to obtain an annual permit from the park and report their monthly catch and effort on a per trip basis via logbooks supplied with the permit. Prior to 1980, reporting was voluntary. Reporting compliance of the guide fishermen is determined from recorded field observations by park rangers and by port samplers at the boat launch sites. Since the elimination of commercial fishing in ENP in 1985, only recreational guided and non-guided recreational anglers are permitted to fish within park waters.

Daily estimates of the total number of fishing boats operating in park waters were made by regressing the daily counts of empty trailers at Flamingo against a known number of boats fishing the same day. Aerial surveys were used to determine the correlation of boat trailers at the Flamingo launch ramp to the total number and distribution of boats within the park. Over 243 flights were conducted using randomly selected weekdays and weekends stratified by month for three sample periods (July 1972 to May 1975; October 1977 to October 1978; and October 1983 to October 1984). Highly significant linear relationships between the number of trailers at Flamingo and total boats observed in the park were obtained during each sampling period. The accuracy of the aerial observers was about 94% (152 known patrol boats on the water, 143 sighted). No significant differences were found among the regression statistics for the three survey periods and therefore all the data were pooled to strengthen the expansion estimates ($r=0.84$, $N=243$, $p<0.01$) (Tilmant et al. 1986). There was no significant difference in the boat count-trailer count regression between weekdays and weekends. The percentage of recreational boats actually fishing was determined from boater interviews.

Flamingo is by far the greatest single access point to Florida Bay and has been used by 50-60% of the total anglers. During 1972-1974 and 1981-1984, additional interviews were obtained at ramp sites along the Florida Keys. However, no significant differences were found in the catch composition or catch rate of these anglers when compared to those anglers fishing the same areas interviewed at Flamingo (Tilmant et al. 1986). Catch data from Area 6 is entirely from Chokoloskee/Everglades City interviews.

Estimates of total recreational catch and harvest of individual fish species for the non-guided fishery were determined by applying the recorded mean catch (or harvest) of that species per successful trip to the estimated total number of fishing trips successful for that species. The estimated total number of recreational fishing trips for a species was determined by applying the proportion of recreational boats, contacted by interviewers, that were successful for the species to the estimated total recreational boats determined by the ramp boat-trailer count. Statistical differences were found between Everglades City (Area 6) and Flamingo (Areas 1-5); therefore, total estimated catch and harvest computations were made separately for the Everglades City and Florida Bay regions and then added to obtain parkwide estimates (Tilmant et al. 1986).

Estimates of total harvest for the guide fishery were obtained by dividing the reported harvest by the estimated percent reporting compliance of guides known to be fishing. Not all guides reported their catch as required; therefore, a reporting compliance adjustment was necessary. The estimate of reporting compliance as determined through independent field observations of fishing activities was about 33% in 1999.

The mean annual catch rates (CPUE) and harvest rates (HPUE) were calculated after Malvestuto (1983). Only those anglers successful in catching a species were used to calculate a catch or harvest rate to avoid bias in the possible change in the proportion of effort applicable to a species each year.

Statistical procedures used in previous years included tests for the assumptions of normality (Kolmogorov-Smirnov test) and homogeneity (Bartlett's Box F). When these assumptions were met a parametric one-way ANOVA or t-test was used to test differences in catch rate by fishery and area. If conditions of homogeneity or normality were not met after transformations, a non-parametric Kruskal-Wallis test was used instead of the ANOVA. After significance was determined ($p<0.05$), a Student-Newman-Keuls test or Dunn's multiple comparison test was used to identify particular differences.

Fish lengths taken from sport (non-guided) anglers in 1999 were analyzed to determine if there were differences among fishing areas and seasons. When the assumption of homogeneity of variances (Levene's test) was met, a parametric one-way ANOVA (f) or a Student's t-test (t) was used to test differences in mean harvest length by area and season. If conditions of homogeneity were not met, a non-parametric Kruskal-Wallis test (X^2) was used in place of the ANOVA and a correction for non-homogenous variances was made for the t-test. If a significant difference was detected for an ANOVA ($p<0.05$), Tukey's multiple comparison test was used to test for particular differences.

RESULTS

All of the non-guided angler catch data for Florida Bay and the immediately adjacent waters (Cape Sable, Whitewater Bay, and Shark River area, hereafter referred to as Florida Bay) has come from interviews conducted at the Flamingo boat ramps. All of the non-guided catch data for Everglades City (Lostman's River to the northwestern boundary of the park near Chokoloskee) has come from interviews conducted at the Everglades City-Chokoloskee boat ramps and marinas.

During 1999, 3,454 boaters were interviewed at Flamingo. Ninety-eight percent of these boaters were involved in sportfishing activity. Only 5.4% of the anglers did not catch fish.

At Everglades City, 2,927 boaters were interviewed. Ninety-three percent of the total boats interviewed were fishing. Only 5.3% of the fishermen did not catch fish.

Description of the Fishery (1999)

Most (79%) of the anglers fishing out of Flamingo were south Florida residents (Dade County to Ft. Lauderdale, excluding local residents); 2% were local residents (Florida City, Flamingo, and the Florida Keys); 18% were from the rest of Florida. Only 1% of the anglers came from out of state.

At Everglades City, most (76%) of the anglers fishing were Florida residents other than south Florida and local residents. South Florida accounted for 10% of the anglers, while 12% were local (Chokoloskee/Everglades City) residents, and 2% came from out of state.

An estimated 27,374 fishing trips, 63,508 anglers, and 27,933 boats made up the boating and fishing activity in Florida Bay. Of these fishing trips, 13% were interviewed at the Flamingo boat ramps. The average trip lasted 7.25 hours with an average fishing time of 5.55 hours and an average of 2.32 anglers on board.

Most anglers interviewed at Flamingo (63%) did not try to catch any one specific kind of fish. Red drum and snook were the most popular fish; each sought by 11% of the fishermen. The next three species preferred were spotted seatrout (10%), tarpon (1.6%), and gray snapper (1.4%). Almost 50% of the fishing parties interviewed reported catching spotted seatrout. The next three species most commonly caught were gray snapper (37%), red drum (28%), and snook (21%).

At Everglades City, an estimated 16,620 fishing trips, 37,894 anglers, and 17,871 boats made up the boating and fishing activity. Of these fishing trips, 18% were interviewed at the Everglades City boat ramps. The average trip lasted 7.29 hours with an average fishing time of 5.54 hours and an average of 2.28 anglers on board.

Most anglers interviewed at Everglades City (57%) did not try to catch any particular kind of fish. Snook was by far the most popular fish, sought by 31% of the fishermen. The next three species preferred were spotted seatrout (7%), red drum (4%), and tarpon (less

than 1%). Almost 38% of the fishing parties interviewed reported catching snook. The next four species most commonly caught were spotted seatrout (41%), red drum (27%), gray snapper (24%), and tarpon (2%).

An estimated total of 43,994 fishing trips were reported in park waters during 1999. This represents a slight decrease from the 45,626 fishing trips in 1998. The drop is partly due to the fact that boats could not launch from the Flamingo ramps for about one week in mid October because of Hurricane Irene. The overall trend in recreational fishing boats since 1972 shows high values in 1973-75, with lows in 1979-80, and a rebound in the mid-80's to the second highest value in 1989 (Figure 2). A decline during 1992 is attributed to the impacts of Hurricane Andrew; the park was closed from September through December. There had been an increasing trend since 1995 with the highest number of fishing boats recorded in ENP during 1997 with a slight declines in 1998 and 1999 (Figure 2). The recreational fishing effort (total estimated angler-hours) has followed this trend as well (Figure 3).

Relative Abundance (CPUE and HPUE)

Catch rate is a function of the number of fish caught per unit of time or effort expended. The number of fish caught for each hour of fishing is used as an index of the abundance of the fish. The 1999 mean catch (CPUE) and harvest rates (HPUE) for the 11 major species of the recreational (non-guided) fishery in Florida Bay (Areas 1-5) and all of ENP (Areas 1-6) are given in Table 1. Table 2 gives the mean catch and harvest rates of the six major species caught by guided anglers in Florida Bay (Areas 1-5) and all of ENP (Areas 1-6). The relationships of 1999 non-guided catch and harvest rates to past years are presented in Figures 5-6 for the four major species (snook, spotted seatrout, gray snapper, and red drum). The relationships of 1999 guided catch and harvest rates to past years are presented in Figures 7-8.

Estimated Total Catch and Harvest

The catches of the interviewed anglers and the reported catches of the guide fishermen are only samples of the total park harvest. Catch rates calculated from interviews are multiplied by the estimated total number of boats fishing for a particular species to yield estimates of total non-guided catch and harvest. For the guided fishery, the total number of fish reported caught/harvested is divided by the percent guide compliance to yield the estimated total catch/harvest by species. The 1999 estimated total non-guided and guided catch/harvest is shown in Table 3. The relationships of 1999 catch and harvest to previous years are shown in Figures 9-10.

Recent Trends (Florida Bay and Parkwide as noted)

Overall, 1999 annual guide and non-guided successful catch rates for snook, gray snapper, spotted seatrout, and red drum were nearly as high or higher than the preceding years. Annual harvest rates for the four major species had decreased steadily since 1985, but seem to be holding steady in recent years. Catch rates may be used as an index of abundance and are directly related to environmental factors, but not directly affected by fishing regulations, while harvest rates most certainly are.

Snook

The popularity of snook has increased dramatically in recent years. Nearly 41% of licensed anglers in Florida have snook stamps (Muller and Murphy, 1999). The percentage of boats catching snook in Florida Bay increased from 9% in 1985 to nearly 27% in 1994, but has suffered a slight decrease in the proceeding years falling to 21% in 1999 (Figure 4).

Catch/Harvest Rates:

Harvest rates for both sport and guide fishermen in Florida Bay have been relatively stable since 1980 (Figures 5, 6, and 7). Guide catch rates had been declining since 1992-1993, but showed a rebound in 1999 (Figure 7). However, sport catch rates in Florida Bay have shown a cyclical trend every four years (Figure 5). There was a low in cpue in 1980 that increased to a high in 1984. Catch rate then decreased to 0.171 fish per angler-hour in 1988, only to increase to another high in 1992 of 0.326 fish per angler-hour. Another low was reached in 1997 (0.217 fish per angler-hour); catch rate has started to increase yet again in 1998 with a value of 0.229 fish per angler-hour. The trend continued in 1999 with another slight increase in catch rate. These trends are corroborated by stock assessments conducted by FMRI (St. Petersburg) using state and federal recreational fishery statistics (Muller and Murphy, 1999). The increases may reflect stock recruitment of small juvenile snook, which were released in prior years because of size restrictions and were recruited to the fishery four years later; that is the time needed for snook to recruit to the park fishery (Thue et al, 1982). Snook are a relatively non-migratory, inshore species that will make localized movements between estuaries as juveniles and move to nearby offshore areas as adults for spawning. Recruitment may have also been enhanced by increased rainfall and/or runoff.

In a collaborative project with FMRI (Marathon), the monthly mean catch rates from 1985-1998 for each individual area (Areas 1-6 separately) were analyzed using non-parametric trend analysis to detect long-term changes in the catch rate of snook. Snook cpue showed no significant trends in Area 1 and Area 4; however, there were significant increasing trends in Area 3, Area 5, and Area 6. The cause of the increases is yet to be determined, but changing environmental parameters and fishing effort will be investigated. No analysis was done for Area 2 because of insufficient data.

Estimated Total Catch & Harvest:

Despite the two fish per person bag limit, 26" minimum size limit, closed season during June, July, and August for breeding, and closed season in December and January due to the fish's sensitivity to cold water temperatures, sport fishermen harvest had not been reduced until 1997 (Figure 9). Estimated catch and harvest declined in 1998 and 1999 as well (Figure 9). Yet more fishermen are targeting the species than ever before; this would indicate that the Florida Bay stocks may have been overfished in the recent past (Muller and Murphy, 1999). Guided anglers' catch and harvest had been increasing since 1991, but dropped after an all-time high in 1995 (Figure 10). Guided catch and harvest has been somewhat stable in recent years.

Gray Snapper
The percentage of anglers reporting catches of gray snapper in Florida Bay has remained relatively stable from 1985-1999 (Figure 4). The large decline seen in 1991 was probably due to new regulations that established the minimum size at 10" with a bag limit of five fish per person. Recently, the percentage of anglers catching gray snapper has increased from 29% in 1997 to nearly 37% in 1999. This may indicate that the last three years have had good recruitment.

Catch/Harvest Rates:
In general, sport and guide harvest rates for gray snapper have shown steady declines since 1980 (Figures 5, 6, and 7). On the other hand, sport catch rates have been relatively steady; although, there were slight declines during the mid to late 1990's. However, sport cpue jumped to 0.892 fish per angler-hour in 1999, which is the highest value since 1992. During 1988-1992, the increase in catch rate, but not harvest rate of sport anglers may reflect good recruitment of small juvenile fish to the stock. Perhaps the large cpue increase in 1999 is also related to good recruitment.

In a collaborative project with FMRI (Marathon), the monthly mean catch rates from 1985-1998 for each individual area (Areas 1-6 separately) were analyzed using non-parametric trend analysis to detect long-term changes in the catch rate of gray snapper. There were no significant long-term trends in gray snapper cpue in any of the areas.

Estimated Total Catch & Harvest:
During the 1990's, the annual guide and non-guided estimated total catch and harvest for gray snapper has dropped as low or lower than anytime during the previous record (Figures 9 and 10). However, the estimated catch of sport anglers experienced large increases from 1997-1999 (Figure 9). The low harvest is probably due to regulations imposed on the fishery in 1988 and 1990 when the legal minimum size was increased from to 8" and then to 10" with a bag limit of 5 fish per person.

Spotted Seatrout
The percentage of boats catching seatrout declined steadily from 1985-1989, but increased sharply to a 14 year high in 1992 of almost 65% (Figure 4). Since then, the percentage of anglers catching seatrout declined to a 14 year low in 1996 of 39% (Figure 4). The trend has been increasing since 1996 with seatrout caught by 50% of the anglers in 1999 (Figure 4). Fishing regulations may have affected angler strategy as the declining trend in seatrout is associated with increases in red drum and snook. Fishermen may have switched their targeting preference to the latter two species when their numbers increased after changes in regulations.

Catch/Harvest Rates:
Sport fishermen harvest rates for seatrout have been holding steady since 1990 in Florida Bay (Figures 5 and 6). However, guide harvest rates have been almost halved since 1989; yet, guide catch rates have increased over the same time period to 1.77 fish per angler-hour in 1999 (Figure 7). The catch rate of sport fishermen in Florida Bay has also shown

an increasing trend since 1994 to 0.984 fish per angler-hour in 1999 (Figure 5). The catch rate in all of ENP has been stable since 1993 (Figure 6). The lack of increase in harvest rate associated with an increase in catch rate may be due to state regulations imposed on the fishery in 1989 which raised the legal size limit from 12" to 14", and then for the south Florida populations to 15" in 1996. These regulations were meant to reduce harvest to achieve the Florida Marine Fisheries Commission's (FMFC) spawning potential ratio (SPR) objective of 35%. The SPR is the ratio of the spawning stock biomass of the exploited fish population to the spawning stock biomass of the same population in an unfished condition.

In a collaborative project with FMRI (Marathon), the monthly mean catch rates from 1985-1998 for each individual area (Areas 1-6 separately) were analyzed using non-parametric trend analysis to detect long-term changes in the catch rate of spotted seatrout. Seatrout cpue showed no significant trends in Area 1 and Area 3; however, there were significant declining trends in Area 4, Area 5, and Area 6. The cause of these declines is yet to be determined, but changing environmental parameters and fishing effort will be investigated. No analysis was done for Area 2 because of insufficient data.

Estimated Total Catch & Harvest:
Annual estimated total harvest data from non-guided fishermen suggests that seatrout harvest has decreased steadily since 1989, while the estimated catch increased in 1997 and 1999 (Figure 9). Harvest from guide fishermen had been very stable from 1990-1995, but experienced an all time low in 1996 with a rebound to 15,106 fish in 1999 (Figure 10). Meanwhile, the estimated catch of guided fishermen has shown an increasing trend since 1990 (Figure 10). The reduction in harvest with a concurrent increase in catch for both sport and guided anglers may be due to the rise in catch-and-release practices by fishers.

Red Drum
The percentage of boats catching red drum in Florida Bay decreased dramatically from 33% in 1985 to 17% in 1988 when the fishery was closed due to overexploitation (Figure 4). When harvest was reopened, the percentage of anglers catching the species increased steadily to a 14 year high in 1997 of 36% (Figure 4). The percentage of anglers catching red drum has decreased in proceeding years to 28% in 1999.

Catch/Harvest Rates:
Red drum harvest rates for sport fishermen in Florida Bay have remained quite stable since 1989 when bag limits of 1 fish per person were imposed (Figures 5 and 6). Guide harvest rates also seem to be quite stable (Figure 7). Increased size limits (12" to 18") and a closed season imposed on the fishery in September 1985 probably accounted for the large declines in harvest rates after 1985; however, the sharp decline during 1985 suggests the possibility of overharvest or poor recruitment (Figure 5). Meanwhile, sport fishermen catch rates in Florida Bay had been increasing since an all time low in 1994 of 0.290 fish per angler-hour to 0.384 fish per angler-hour in 1998; there was a slight decrease in 1999 to 0.370 fish per angler-hour (Figures 5 and 6). Since the fishery

recovered faster than anticipated, the FMFC allowed year-round fishing in 1996, which may explain the higher catch rates in the late 1990's. However, it should be noted that guide catch rates have shown a steady declining trend since 1985 (Figure 7).

In a collaborative project with FMRI (Marathon), the monthly mean catch rates from 1985-1998 for each individual area (Areas 1-6 separately) were analyzed using non-parametric trend analysis to detect long-term changes in the catch rate of red drum. There were no significant long-term trends in red drum cpue in any of the areas.

Estimated Total Catch & Harvest:
Annual estimated total catch data from non-guided fishermen suggests that red drum catches had been steadily increasing since 1988 until large drops in 1998 and 1999 to 29,678 fish (Figure 9). Estimated harvest has also shown this drop in 1998 and 1999. Harvest from guide fishermen has also shown a slow, but steady increasing trend since 1990 (Figure 10). However, the estimated catch for guides in Florida Bay shows the same declines in 1998 and 1999 as sport fishermen (Figures 9 and 10).

Tarpon & Bonefish
The professional guide fishery is largely directed at a few highly prized gamefish species. Two of these species, tarpon and bonefish, are of little food value and are not sought by the majority of the non-guided anglers. They are the trophy species of the guide fishery. Since harvest of tarpon only occurs for the purposes of mounting the catch, catch rate is more indicative of the stock than harvest rate. The catch rate of tarpon rebounded in 1983, from a low in 1982, but experienced a slow decline in the mid-1980's reaching another low in 1987 (Figure 8). However, the cpue increased to an all-time high in 1995, showing a decline in the following years (Figure 8).

Like tarpon, bonefish are not harvested unless the angler desires to mount the catch. Bonefish catch rates show an almost cyclic trend since 1980, with a low value in 1983, steadily increasing through the late 1980's, reaching another low in 1992 (Figure 8). Guide catch rates for bonefish reached another high in 1994 only to decline again for the period of 1995-1999 with catch rates reaching an all-time low in 1999 (Figure 8). Nearly all bonefish are caught in Area 2 and are released when caught; therefore, it is highly unlikely that fishing mortality has played any significant role in determining bonefish stock abundance. The estimated total annual catch of tarpon and bonefish for guided anglers in 1999 is given in Table 3.

Fish Lengths (1999)
Snook
A comparison of mean harvested snook length in Areas 1, 3, 4, 5, and 6 (Area 2 was not included in the analysis due to insufficient data) showed that there was no difference in mean length among the five areas ($df=527$, $f=1.09$, $p>0.35$) (Figure 11). The lengths for Areas 1-5 were pooled together to determine if there was a difference in the length of snook harvested in Florida Bay versus Everglades City (Area 6). There was no difference in mean snook length between Florida Bay and Everglades City ($df=526$, $t=0.629$,

p>0.52) (Figure 12). These results are consistent with the analysis of 1998 snook lengths.

A parkwide seasonal comparison of snook lengths for 1999, showed that there was no significant difference among the four seasons (df=527, f=1.18, p>0.31) (Figure 13). However, in 1998, snook harvested during the summer were significantly larger. Summer 1999 also had the largest harvested snook, but winter was a close second.

A comparison of snook lengths from Florida Bay only (Areas 1-5) showed that there was no difference in the length of harvested fish among the four seasons (df=217, f=0.463, p>0.70) (Figure 14). Similar results were found in a seasonal comparison of the snook harvested only in Everglades City (Area 6). There was no difference in the length of harvested snook among the four seasons in Area 6 (df=309, f=2.05, p>0.10) (Figure 15). These results are consistent with those obtained from the analysis of 1998 snook lengths.

Gray Snapper

There was a significant difference in the length of harvested gray snapper among the six areas of ENP (df=5, X^2=55.3, p<0.0001) (Figure 11). The fish harvested in Area 6 seem to be much smaller with a mean length of 262.6mm (Figure 11). The lengths for Areas 1-5 were pooled together to determine if there was a difference in the length of gray snapper harvested in Florida Bay versus Everglades City (Area 6). The fish harvested in Florida Bay were significantly larger (df=441, t=6.42, p<0.0001) than those harvested in Everglades City (mean lengths of 279.8mm and 262.6mm, respectively) (Figure 12). These results are consistent with the analysis of 1998 gray snapper lengths

There was a significant difference in the size of gray snapper harvested parkwide among the four seasons of 1999 (df=3, X^2=19.9, p<0.0001) (Figure 13). Gray snapper lengths in Florida Bay only (Areas 1-5) were significantly different among the four seasons as well (df=3, X^2=21.9, p<0.0001) (Figure 14). In both cases, harvested gray snapper were significantly larger during the fall than those harvested during the rest of the year (Figures 13-14). However, in both cases during 1998, there were no differences in the length of harvested gray snapper among the seasons.

Harvested gray snapper in Everglades City (Area 6) showed no seasonal differences in length during 1999 (df=3, X^2=5.50, p>0.13) (Figure 15). However, gray snapper harvested in Area 6 during 1998 were significantly larger during the fall and summer.

Spotted Seatrout

There was no difference in the mean length of harvested spotted seatrout among the six areas of ENP (df=5, X^2=7.19, p>0.20) (Figure 11). Similarly, when the lengths for Areas 1-5 were pooled together to determine if there was a difference in the length of spotted seatrout harvested in Florida Bay (Areas 1-5) versus Everglades City (Area 6) during 1999, no significant differences were found (df=1,737, t=1.37, p>0.17) (Figure 12). However, Florida Bay seatrout were significantly larger in 1998. The large sample size in 1998 was the reason there was a significant difference even though the lengths from the two areas were practically identical.

There was a significant difference in the mean length of spotted seatrout harvested parkwide among the four seasons of 1999 (df=1,738, f=7.21, p<0.0001) with spring and summer having larger fish than fall and winter (Figure 13). However, there were no significant differences among the four seasons during 1998.

A seasonal comparison of spotted seatrout lengths harvested only in Florida Bay (Areas 1-5) showed that fish harvested during the winter (418.1mm) were significantly smaller (df=3, X^2=16.3, p<0.001) than those harvested during the rest of 1999 (spring=434.2mm, summer=433.4mm, fall=435.8mm) (Figure 14). Winter 1998 also had significantly smaller seatrout in Areas 1-5.

There was also a significant difference in the size of spotted seatrout harvested in Everglades City (Area 6) during the four seasons of 1999 (df=1,265, f=4.65, p<0.003) (Figure 15). Ranging the seasons that had the largest to smallest seatrout were spring (437.8mm), summer (434.8mm), winter (428.1mm), and finally fall (425.8mm). Yet, there was no difference in harvested length during the four seasons of 1998.

Red Drum

There was a significant difference in the mean lengths of red drum harvested among the six areas of ENP during 1999 (df=745, f=7.09, p<0.0001) (Figure 11). Red drum harvested from Area 1 and Area 2 were much larger than the red drum taken from the other areas (Figure 11). The lengths for Areas 1-5 were pooled together to determine if there was a difference in the length of red drum harvested in Florida Bay versus Everglades City (Area 6). There was no difference in the size of red drum harvested in Florida Bay or in Everglades City with mean lengths of 532.5mm and 531.7mm, respectively (df=744, t=0.171, p>0.86) (Figure 12). These results are consistent with those obtained from the analysis of 1998 red drum lengths.

A seasonal comparison of red drum lengths parkwide showed that fish harvested in summer 1999 are significantly larger than those harvested in winter, spring, and fall (df=3, X^2=13.1, p<0.004) (Figure 13). The red drum harvested only in Florida Bay (Areas 1-5) during the summer were significantly larger (df=384, f=3.69, p<0.01) than those harvested during the rest of the year (Figure 14). Similar results were obtained for Everglades City (Area 6). Red drum harvested during the summer were significantly larger than those harvested in winter (df=3, X^2=8.92, p<0.03) (Figure 15). These same results were obtained from the 1998 analysis of red drum lengths.

<u>Environmental Relationships</u>

Catch rates are directly related to environmental factors such as rainfall, water level, and salinity. The catch rates for sport (non-guided) fishermen were correlated with rainfall, water level, and salinity from 1985-1999 (Figures 16-19). Total annual rainfall from 1985-1999 was compiled and averaged from five stations within or near ENP (Flamingo, Royal Palm, Everglades City, Tamiami Ranger Station, and Tavernier. Butternut Key has replaced Tavernier since 1997). Water level data from 1985-1999 was obtained from

well P-37 in western Taylor Slough. Salinity data from 1985-1999 was obtained from three stations in northern Florida Bay (Butternut Key, Taylor River, and Trout Cove).

Snook

The declines in snook stocks from 1985-1988 and from 1993-1997 may have been due to low rainfall and water levels in the upper marsh regions. There was a weak correlation between water levels recorded three years before and catch rates from 1985-1999 ($r=0.573$, $N=12$, $p>0.05$); this same result was obtained last year as well when 1985-1998 was analyzed. Although, no statistically significant correlation was found, the trends seen in Figure 16 suggest that a period of generally high salinity leads to a decline in the abundance of snook. Field studies on snook habitat have shown that the greatest number of juveniles are consistently found in shallow, well protected, back-water areas of estuaries that are influenced by freshwater runoff (Fore and Schmidt 1974; McMichael et al. 1987).

Gray Snapper

Overall (1985-1999), a positive ($r=0.523$, $N=15$, $p<0.05$) relationship was found between catch rates of gray snapper and mean annual salinities found in northern Florida Bay (Figure 17), suggesting that periods of high salinity may lead to increased abundance of gray snapper. Average annual water levels recorded at P-37 were significantly inversely related to gray snapper catch rates during the same year ($r=0.629$, $N=15$, $p<0.02$), indicating that during periods of reduced water levels in the upper Taylor Slough abundance of gray snapper increased. Rainfall was also inversely correlated with gray snapper catch rates, although, not significantly. Similar correlation results were obtained last year when 1985-1998 was analyzed. This leads to the theory that increases in gray snapper abundance may be related to low yearly rainfall in the ENP area and periods of high salinities in Florida Bay. A series of low rainfall years from 1985-1990 resulted in increased hypersaline conditions in Florida Bay. Rutherford et al. (1983) reported larger fish in areas of higher salinity. Thus, if during low rainfall years, sub-adult fish remain in Florida Bay longer under high salinity conditions, then gray snapper abundance (catch rates) should increase and the fish would become increasingly available to the angler. During the 1993-1995 period, water levels/rainfall increased, especially from Tropical Storm Gordon in November 1994, resulting in salinity reductions in northern Florida Bay with a notable decrease in gray snapper catch rates (Figure 17).

There was also a significant inverse relationship between catch rates and mean annual rainfall recorded three years before ($r=0.734$, $N=12$, $p=0.007$), which also suggests that periods of high salinity and/or low rainfall may lead to increased abundance of gray snapper (Figure 17). Again this was the same result that was obtained last year when only 1985-1998 was analyzed. Catch rates increased as salinity increased to a high in 1990, but as salinity declined in the proceeding years, CPUE also decreased (Figure 17).

Spotted Seatrout

Spotted seatrout catch rates and salinity seem to follow the same trend (Figure 18); as salinity increased to a high in 1990, seatrout catch rates increased and as salinities

dropped in the proceeding years, catch rates also decreased; however, there was no statistically significant relationship between the two variables from 1985-1999. Rainfall and water levels also had no correlation with seatrout cpue. These are the same results as last year when environmental parameters were correlated with cpue from 1985-1998. However, recent studies have suggested that increased rainfall/water levels improve recruitment through increased growth and survival of larvae and juveniles (Thayer et al. 1998). Presumably an increase in coastal rainfall (and thus lower salinities) results in an increase in larval recruitment and/or juvenile survival (Rutherford et al. 1989a).

Red Drum

The reduced abundance of red drum during the late 1980's may have been due to a combination of prior intense fishing pressure and increased rainfall. Previous studies (Higman, 1967) have shown that low rainfall may lead to an increase in the abundance of juvenile red drum. However, no statistically significant relationships were found between red drum catch rates and any of the environmental variables from 1985-1999 just as there were no significant correlations last year when only 1985-1998 was analyzed (Figure 19).

Effort-Catch Relationships

It is not always sufficient to know if catch rates are declining to determine if a fishery is in trouble. If both catch and catch rate are in decline, then there is a need to assess the amount of effort being placed on the fishery. In Figure 20, estimated total catch and estimated total effort of the four major species are correlated to determine if fishing effort impacted the stock.

Snook

Annual fishing effort of sport anglers catching snook in Florida Bay ranged a low of 26,775 angler-hours in 1985 to a high of 107,825 angler-hours in 1997 (Figure 20). The total estimated catch of snook from the sport fishery in Florida Bay increased from a low of 6,538 fish in 1986 to a high of 22,581 fish in 1994 (Figure 20) representing a 70% increase in the number of fish taken. This was due to the concurrent increase in effort. However, the number of snook caught in 1999 decreased to 14,093 fish. This number is roughly equivalent to the catch in 1991 and in 1992; however, the effort placed on snook stocks in 1999 is twice that in 1991 and 1992. Despite this, the annual estimated total catch of snook for the sport fishery was highly correlated with the estimated total effort placed on the stock between 1985 and 1999 ($r=0.892$, $N=15$, $p<0.0001$) (Figure 20). Total catch appeared to increase linearly over the entire range of annual effort, suggesting that current catches do not greatly impact the Florida Bay stock and that additional increases in catch may be possible. However, it should be noted again that snook catches decreased dramatically in 1998 and 1999 after five years of good catches and all time high in effort in 1997. During 1998, state regulations were revised to prevent further overfishing by increasing the minimum size from 24" to 26" and prohibiting the possession of snook over 34" while maintaining a two fish bag limit.

Gray Snapper

Annual estimated effort for the non-guided gray snapper fishery ranged from a high of

168,239 angler-hours in 1994 to a low of 96,311 angler-hours in 1985 (Figure 20). The yearly catches of gray snapper were lowest in 1985 (61,859) and 1987 (58,401) and highest in 1989 (123,707) and 1990 (122,327) (Figure 20). Effort barely increased from 138,807 angler-hours in 1998 to 140,705 angler-hours in 1999; however, the catch increased quite dramatically during the same time span from 77,267 fish in 1998 to 96,641 fish in 1999 (this is the third highest value during the period of record) indicating a good recruitment class. The annual estimated total catch of gray snapper was linearly correlated with the estimated total effort placed on the fishery between 1985-1999 ($r=0.714$, $N=15$, $p=0.003$), suggesting that the maximum potential catch of gray snapper in Florida Bay has not been reached (Figure 20).

Spotted Seatrout

Total estimated effort for spotted seatrout ranged from a high of 202,383 angler-hours in 1990 to a low of 147,882 angler-hours in 1995 (Figure 20). The effort in 1998 and 1999 were 175,269 and 182,281 angler-hours, respectively. The correlation of yearly effort with catch was linear and significant ($r=0.786$, $N=15$, $p=0.001$) (Figure 20). There was no decrease in total catch with increasing effort, indicating yearly fishing effort did not severely impact the fishery.

Red Drum

The total estimated recreational fishing effort for red drum in Florida Bay ranged from a low of 58,093 angler-hours 1988 to a high of 154,227 angler-hours in 1997 (Figure 20), which represents an increase of about 2.5 times the fishing effort in 1988. Effort dropped in 1998 to 134,608 angler-hours and decreased again in 1999 to 105,367 angler-hours. A statistically significant linear relationship ($r=0.826$, $N=15$, $p<0.0001$) was found between yearly effort from 1985-1999 and the resultant catch, suggesting that the increase in fishing effort did not greatly impact the catch of red drum in the sport fishery (Figure 20). However, it should be noted that red drum catch decreased dramatically in 1999 to 29,678 fish after three years (1996-1998) of very good catches due to high fishing effort.

FUTURE WORK/MEETING RESULTS

While the current sportfish monitoring project is evaluating various aspects of catch/harvest rates, total estimated catch/harvest, and fishing/boating activity, additional areas of work are underway or are needed. These include: (1) updated in-house and FMRI stock assessments on major game fish species including snook, black drum, jewfish, and sheepshead, (2) a collaborative study with FSU focusing on the diet and age/growth rates of snook and red drum; ENP has collected 213 snook and 354 red drum to date for the study (3) incorporating the fisheries database into the park's GIS system for spatially oriented ecological applications, (4) develop a new fishery data management handbook, (5) the non-guide fishing area locator map was revised, as recommended, to reflect a finer resolution in "area fished" as in the guide logbooks and incorporated into the non-guide sampling frame, and (6) as a result of increased computing power, a minor adjustment to catch and harvest rates will be done (catch and harvest rates will be calculated by fishing area, not interview location). A draft data collection proposal was prepared and submitted

to SFNRC to begin a creel census program at Dry Tortugas National Park.

As a result of updating the fisheries database for the park's ORACLE database, it was determined that commercial/guide data from 1972-1985 needed to be re-entered to correct previously computerized catch data errors. This is being completed by FMRI (St. Petersburg) and ENP.

FMRI (Marathon) and ENP are also working together on an evaluation of the spatial, temporal, and environmental factors that affect sport fishing for snook, gray snapper, spotted seatrout, and red drum. The park's sport database is being analyzed using non-parametric trend analysis to detect long term changes in catch rate by individual fishing area. Some of the preliminary results from this study were presented earlier in this report.

The National Marine Fisheries Service, Gulf States Marine Fisheries Commission, FMRI, and the NPS (ENP) worked cooperatively to develop the Gulf Charter Boat Survey Research Program. The Program is developing methods for more efficient data collection and more precise estimation of fishing effort by charter (guide) boat anglers. The program consists of two surveys - a telephone survey of charter boat operators and a logbook survey. Surveys began in September 1997 and continued through August 1998. An evaluation of the program is scheduled for completion during July 1999. A summary report is currently under peer review. In addition, FWC field intercept surveys are underway to provide information on shore for hire and private anglers to estimate angler catch using the existing NMFS estimates. Guide parties fishing in park waters have been interviewed at Chokoloskee to obtain information on their catch and fish measurements.

As a committee member, the semi-annual Fisheries Information Network (FIN), Recreational Information Network (RECFIN), Commercial Information Network (ComFin), and Biological/Environmental Work Group meetings were attended in La Parguera Puerto Rico, April, 1999. Issues addressed included: NMFS/NPS surveys, night fishing particularly along Florida's SW Coast, tournament fishing, getting better data for stock assessments, establishing a central Gulf data processing center in Mississippi, metadata development, and acquiring funding for Gulf-wide data collection, processing, and dissemination.

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Table 1. Recreational catch/harvest rates (fish per angler-hour) of non-guided (sport) anglers in Everglades National Park, 1999.

Non-Guide Anglers (Areas 1-5)				
Species	**CPUE ±95% Conf. Interval**	**HPUE ±95% Conf. Interval**	**Sample Size *** CPUE/HPUE	
Snook	0.2228 ± 0.0201	0.1120 ± 0.0150	697	165
Red Drum	0.3701 ± 0.0336	0.1250 ± 0.0068	935	529
Spotted Seatrout	0.9836 ± 0.0721	0.3383 ± 0.0204	1,676	1,003
Gray Snapper	0.8924 ± 0.0627	0.3333 ± 0.0320	1,238	557
Tarpon	0.1864 ± 0.0477	N/A	143	N/A
Black Drum	0.2439 ± 0.0405	0.1839 ± 0.0450	169	98
Sheepshead	0.3698 ± 0.0640	0.1684 ± 0.0332	236	112
Spanish Mackerel	0.3354 ± 0.1024	0.3204 ± 0.1018	108	73
Grouper	0.2651 ± 0.0593	0.1172 ± 0.0404	100	18
Ladyfish	0.4873 ± 0.0348	0.2012 ± 0.0687	1,425	32
Crevalle Jack	0.5350 ± 0.0323	0.2065 ± 0.0351	2,066	123
Non-Guide Anglers (Areas 1-6)				
Species	**CPUE ±95% Conf. Interval**	**HPUE ±95% Conf. Interval**	**Sample Size *** CPUE/HPUE	
Snook	0.3195 ± 0.0225	0.1307 ± 0.0116	1,735	482
Red Drum	0.3176 ± 0.0227	0.1229 ± 0.0061	1,656	925
Spotted Seatrout	0.8892 ± 0.0523	0.3199 ± 0.0153	2,782	1,672
Gray Snapper	0.7828 ± 0.0496	0.3053 ± 0.0268	1,886	712
Tarpon	0.1871 ± 0.0392	0.0952	201	1
Black Drum	0.2190 ± 0.0326	0.1692 ± 0.0350	233	141
Sheepshead	0.3222 ± 0.0431	0.1688 ± 0.0291	445	199
Spanish Mackerel	0.3300 ± 0.1474	0.2497 ± 0.0744	253	171
Grouper	0.2458 ± 0.0450	0.1106 ± 0.0325	165	23
Ladyfish	0.4827 ± 0.0366	0.1925 ± 0.0402	2,422	102
Crevalle Jack	0.5048 ± 0.0230	0.2033 ± 0.0287	3,509	179

* Number of fishing parties.

Table 2. Recreational catch/harvest rates (fish per angler-hour) of guided anglers in Everglades National Park, 1999.

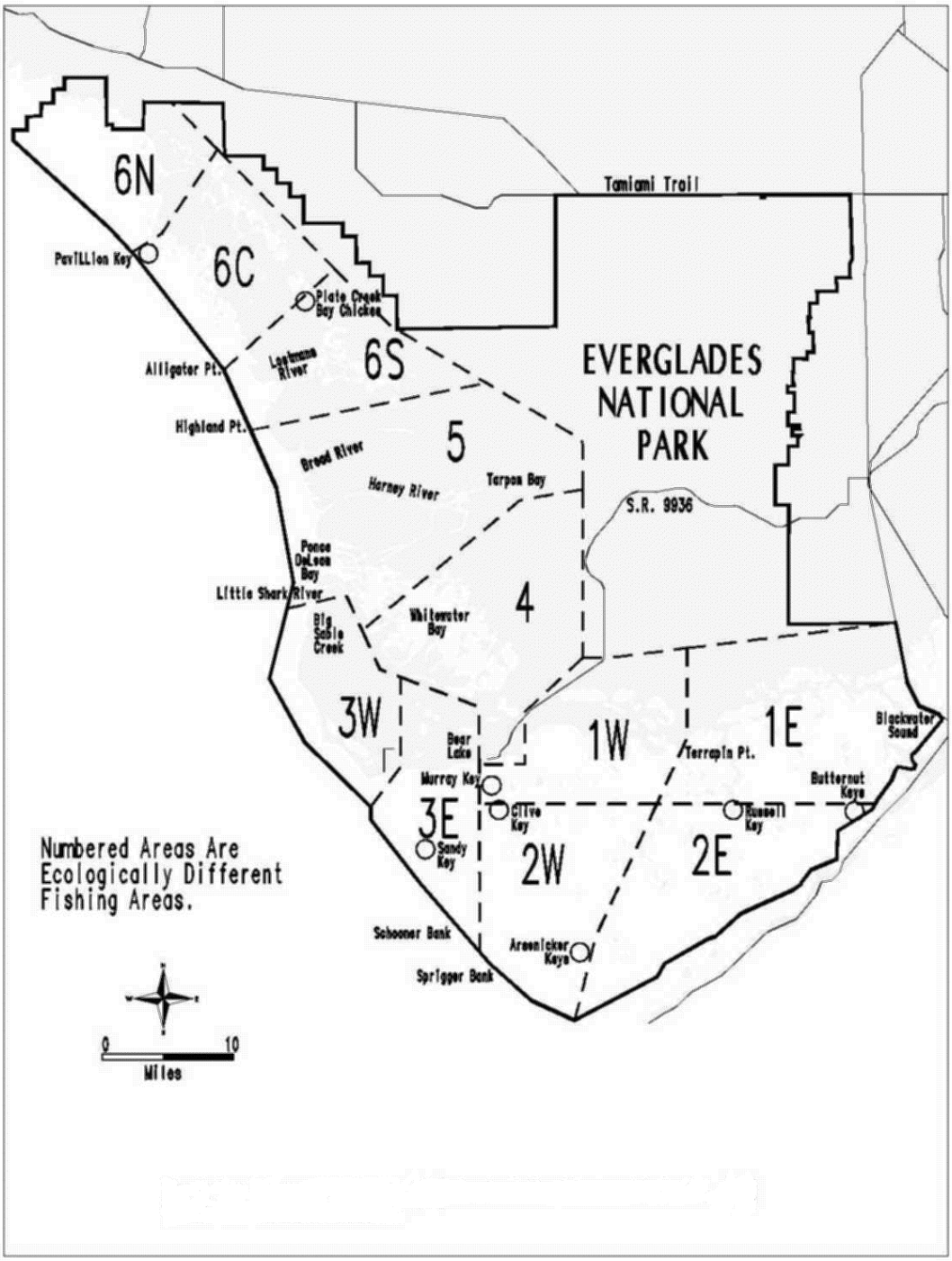
Guide Anglers (Areas 1-5)				
Species	**CPUE ±95% Conf. Interval**	**HPUE ±95% Conf. Interval**	**Sample Size *** CPUE/HPUE	
Snook	0.2918 ± 0.0272	0.1277 ± 0.0096	750	277
Red Drum	0.3986 ± 0.0281	0.1213 ± 0.0084	1,199	440
Spotted Seatrout	1.77 ± 0.0889	0.4735 ± 0.0230	1,522	726
Gray Snapper	1.34 ± 0.1275	0.4196 ± 0.0441	424	183
Tarpon	0.1835 ± 0.0177	0.1458 ± 0.2042	483	2
Bonefish	0.2357 ± 0.0327	N/A	195	N/A
Guide Anglers (Areas 1-6)				
Species	**CPUE ±95% Conf. Interval**	**HPUE ±95% Conf. Interval**	**Sample Size *** CPUE/HPUE	
Snook	0.4328 ± 0.0256	0.1316 ± 0.0066	1,799	579
Red Drum	0.3838 ± 0.0211	0.1201 ± 0.0059	1,975	834
Spotted Seatrout	1.66 ± 0.0685	0.4990 ± 0.0178	2,286	1,252
Gray Snapper	1.15 ± 0.0876	0.3369 ± 0.0314	688	296
Tarpon	0.1822 ± 0.0151	0.1389 ± 0.1187	700	3
Bonefish	0.2357 ± 0.0327	N/A	195	N/A

* Number of fishing parties.

Table 3. Total estimated catch and harvest by recreational anglers from Everglades National Park, 1999.

Non-Guide Anglers				
	Florida Bay		Florida Bay & Everglades City	
Species	Catch	Harvest	Catch	Harvest
Snook	14,093	1,743	42,211	4,238
Red Drum	29,678	6,147	39,106	8,993
Spotted Seatrout	132,961	29,909	187,510	43,575
Gray Snapper	96,641	16,482	112,780	17,011
Tarpon	1,765	0	2,300	10
Black Drum	3,875	1,597	4,192	1,801
Sheepshead	8,528	2,076	12,660	3,252
Spanish Mackerel	3,178	2,004	5,675	3,269
Grouper	2,518	209	3,201	240
Ladyfish	60,219	584	89,820	1,445
Crevalle Jack	92,720	2,729	137,744	3,015
Other species	92,767	4,784	140,692	11,257
Total	538,943	68,264	777,891	98,106
Guide Anglers				
	Florida Bay		Florida Bay & Everglades City	
Species	Catch	Harvest	Catch	Harvest
Snook	8,338	1,370	28,916	3,045
Red Drum	17,459	2,369	29,677	4,639
Spotted Seatrout	93,472	15,106	139,447	28,049
Gray Snapper	20,679	3,364	30,264	4,568
Tarpon	2,667	6	4,018	9
Bonefish	1,094	0	1,094	0
Other Species	60,092	5,711	79,810	8,682
Total	203,800	27,926	313,226	48,992

Figure 1: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Highland Pt.
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Ponce DeLeon Bay
Little Shark River
Big Sable Creek
Whitewater Bay
Bear Lake
Murray Key
Citrus Key
Sandy Key
Terrapin Pt.
Russell Key
Butternut Keys
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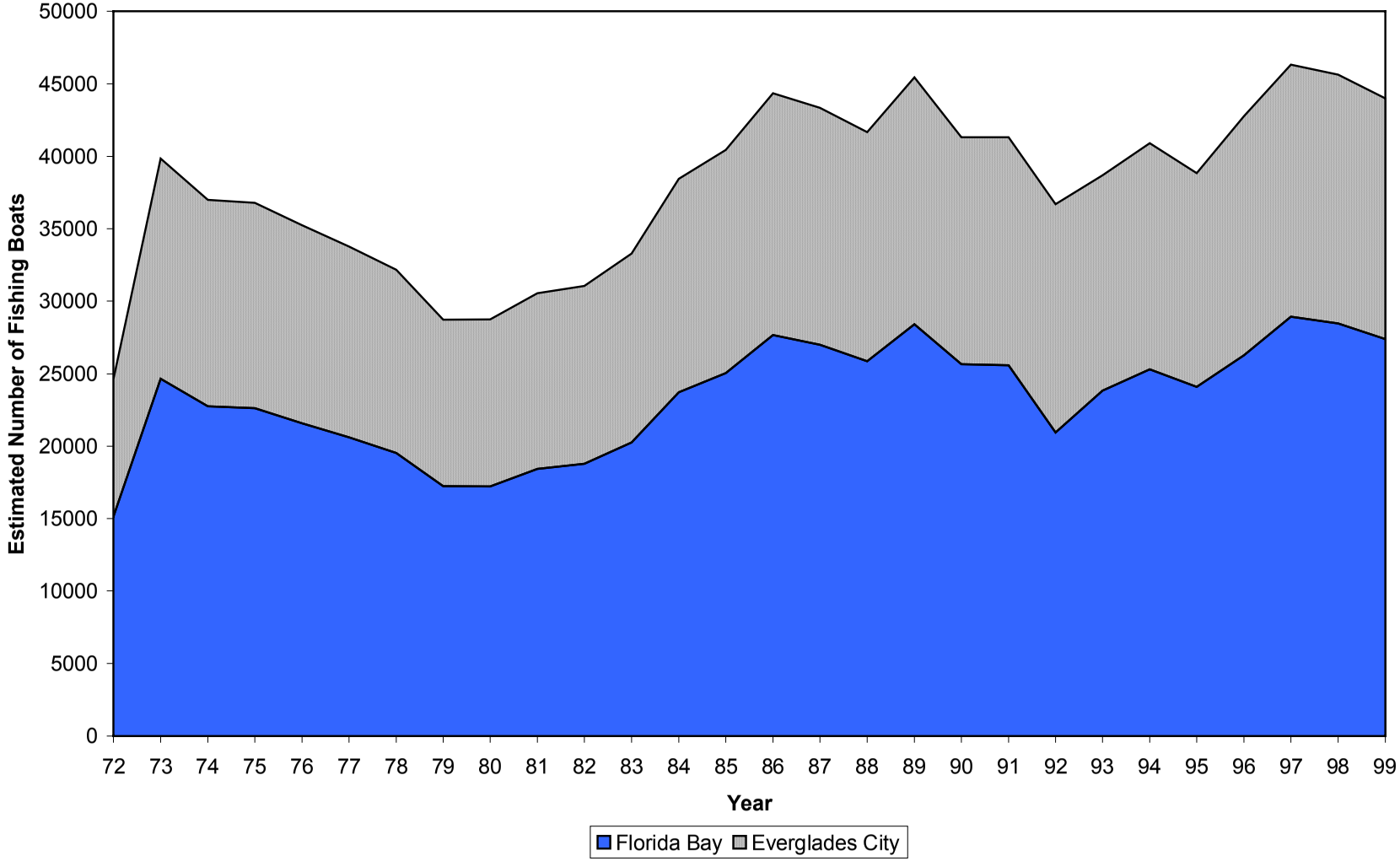


Figure 2. Estimated number of fishing boats within Everglades National Park, 1972-1999.

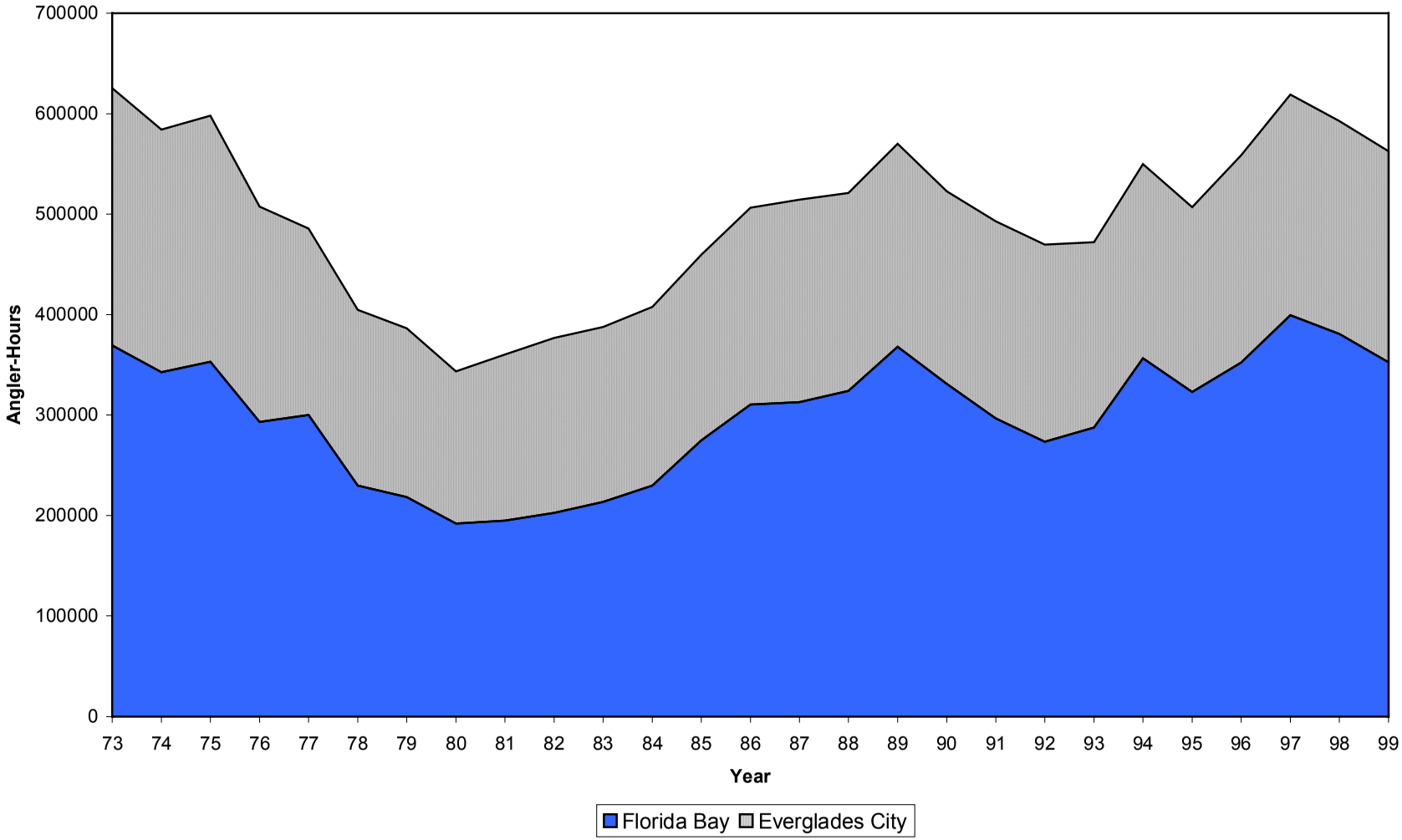


Figure 3. Estimated total effort (angler-hours) of non-guided fishermen within Everglades National Park, 1973-1999.

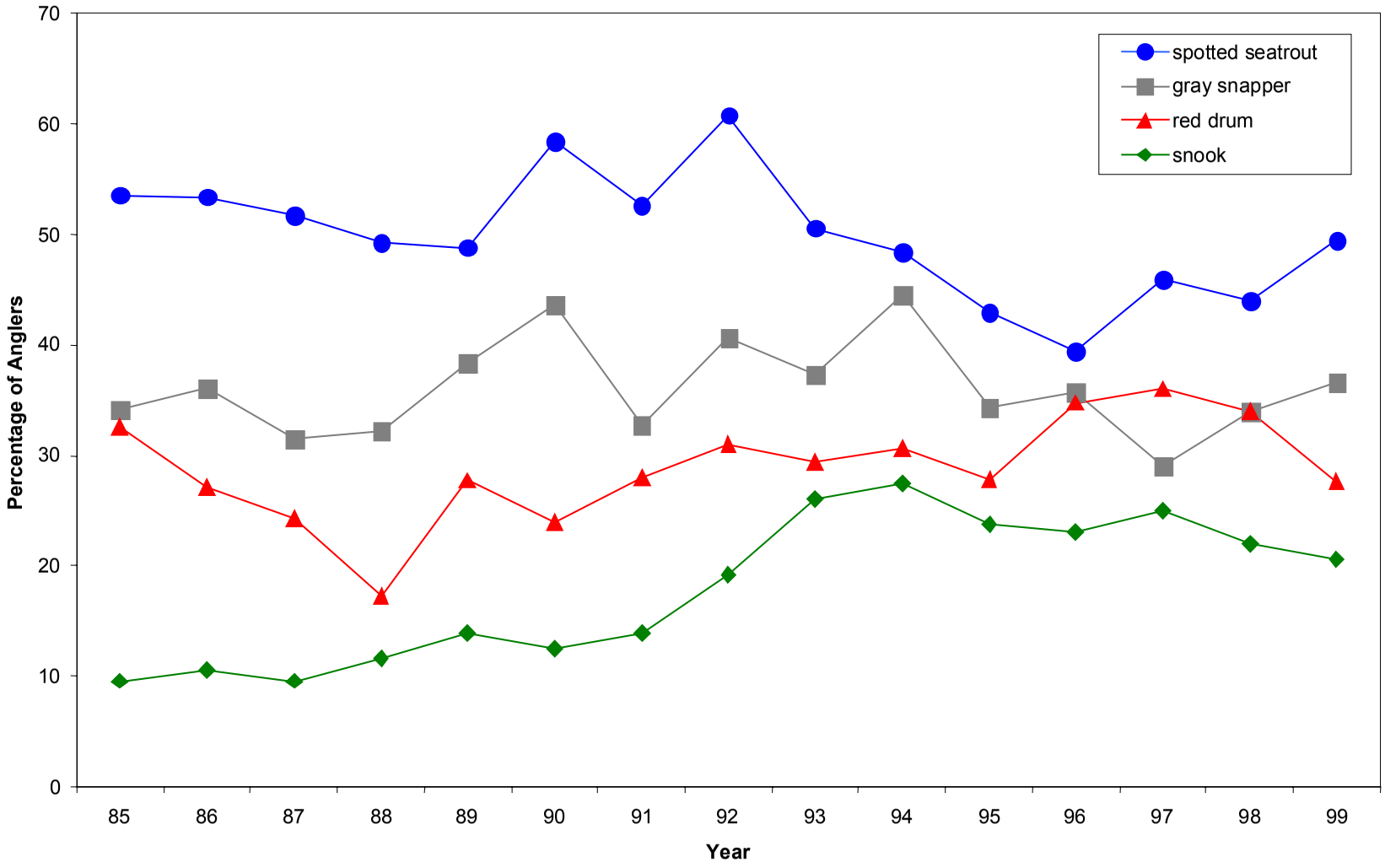


Figure 4. Percentage of anglers interviewed at Flamingo (Areas 1 to 5) catching spotted seatrout, gray snapper, red drum, and snook from 1985-1999.

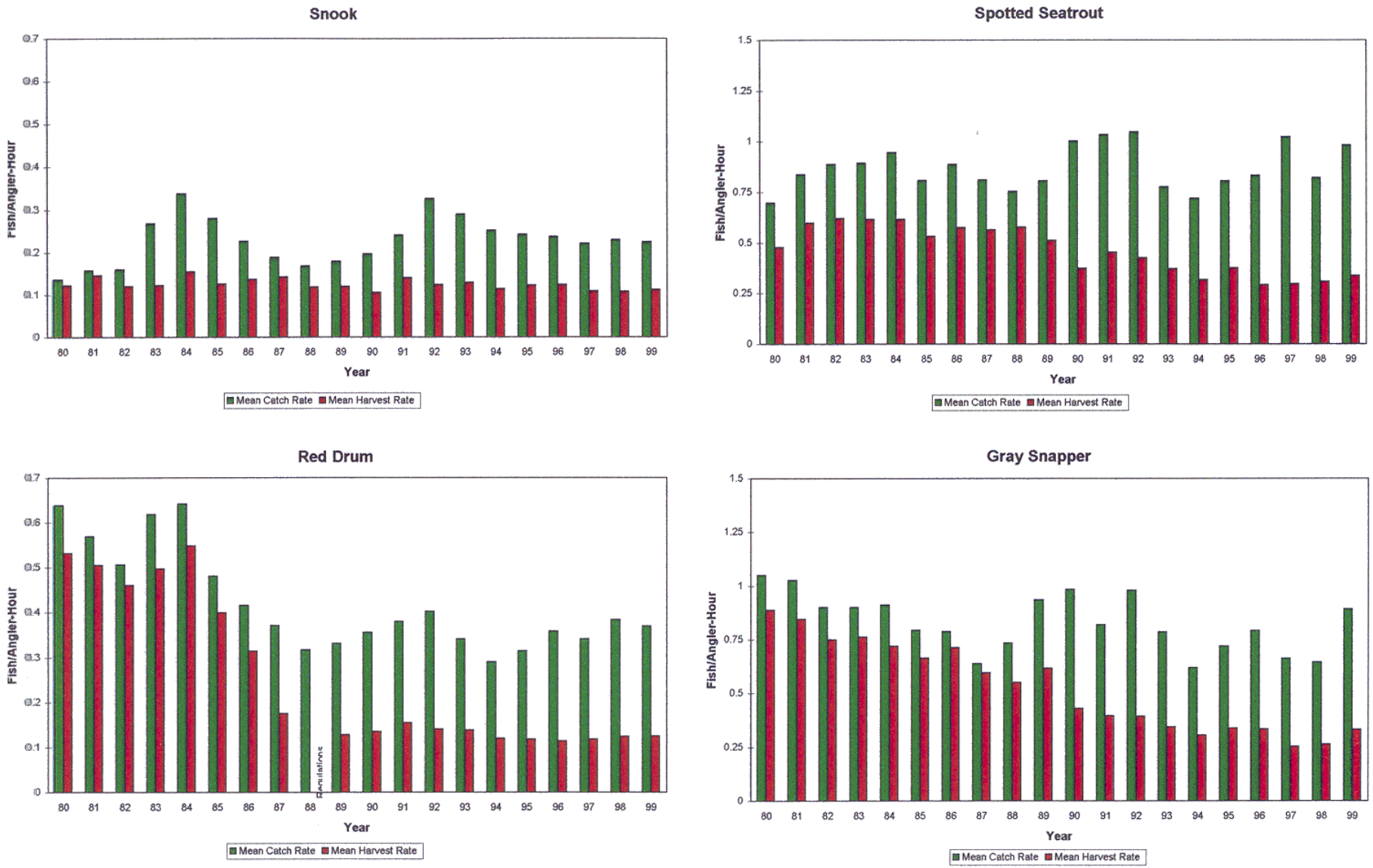


Figure 5. Recreational non-guided (sport) catch and harvest rates for the four major species of gamefish in Everglades National Park (Areas 1-5), 1980-1999.

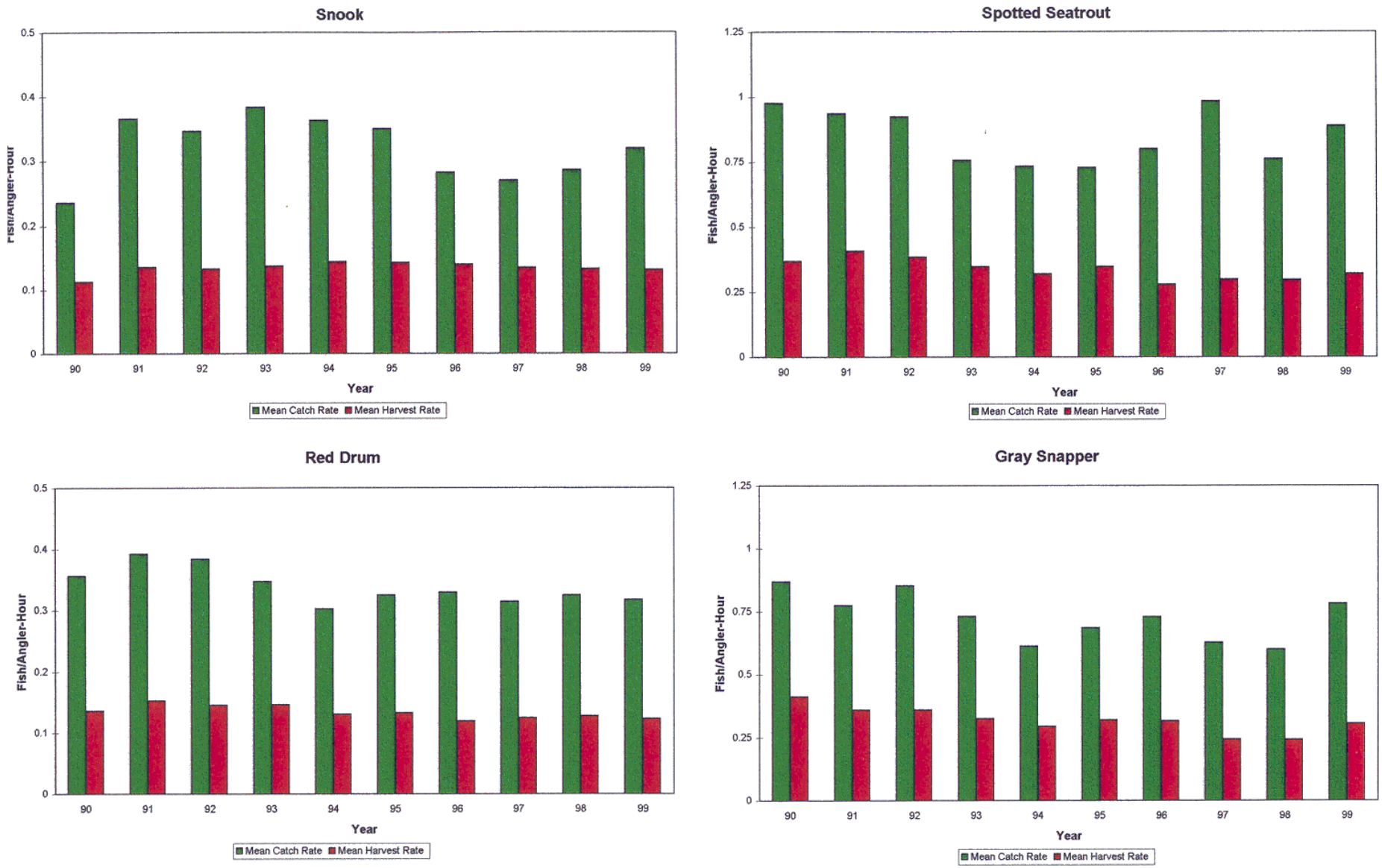


Figure 6. Recreational non-guided (sport) catch and harvest rates for the four major species of gamefish in Everglades National Park (Areas 1-6), 1990-1999.

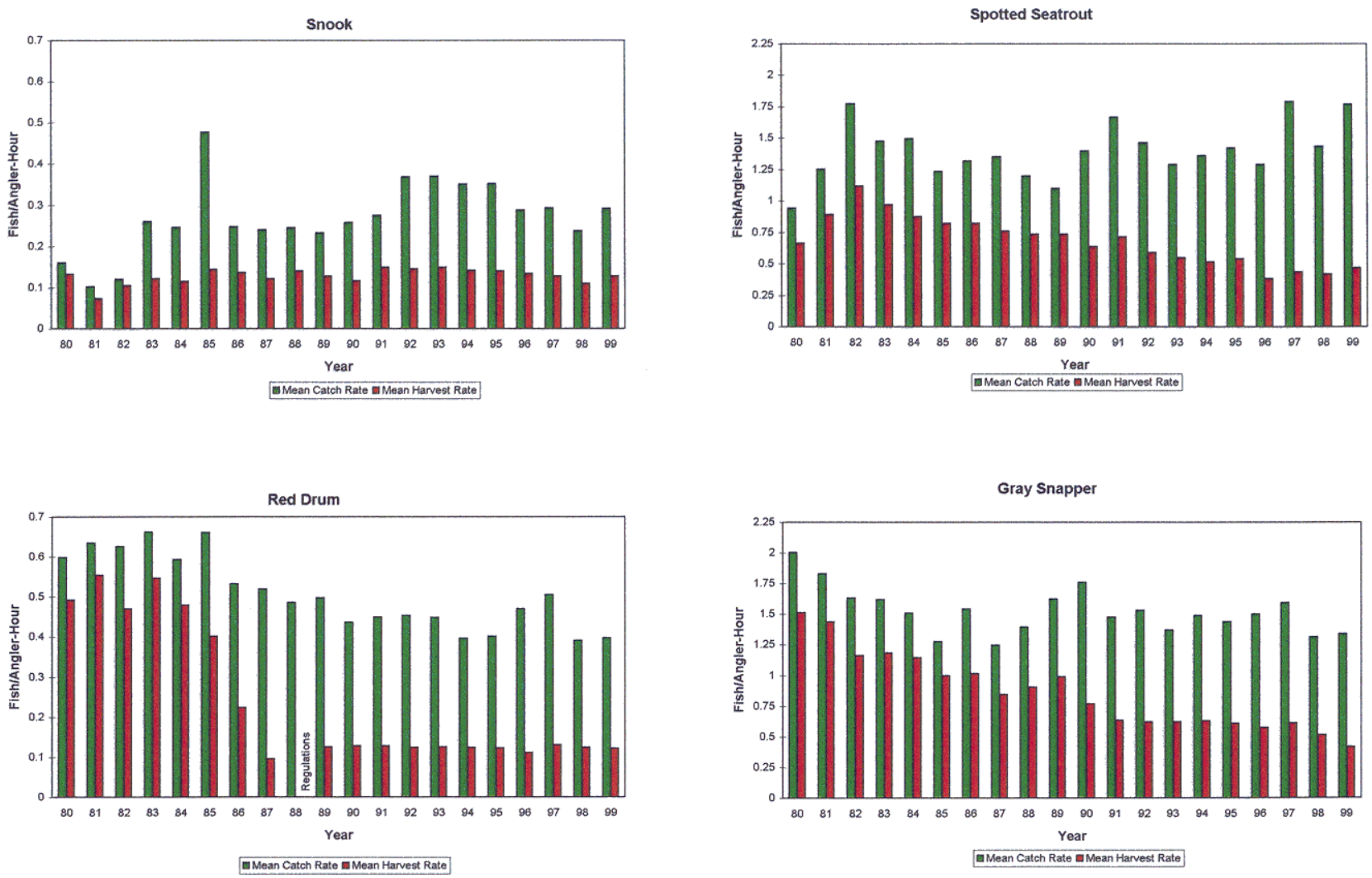
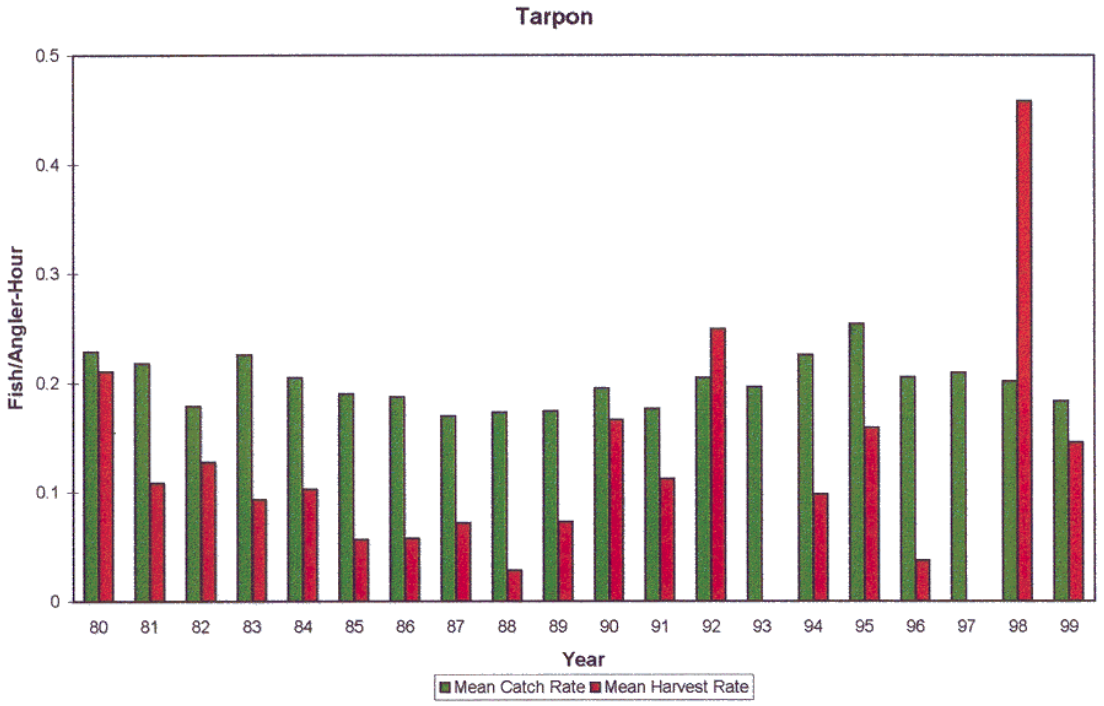


Figure 7. Recreational guide catch/harvest rates for the four major gamefish species in Florida Bay (Areas 1-5), 1980-1999.



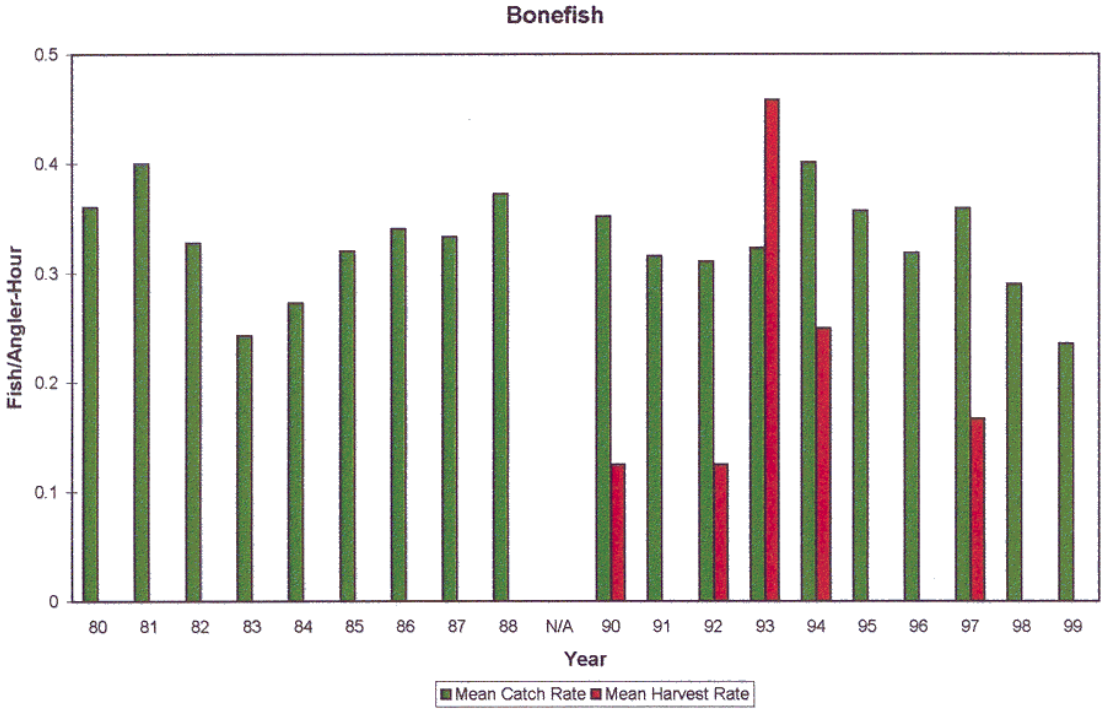


Figure 8. Recreational guide catch and harvest rates for tarpon and bonefish in Florida Bay (Areas 1-5) 1980-1999.

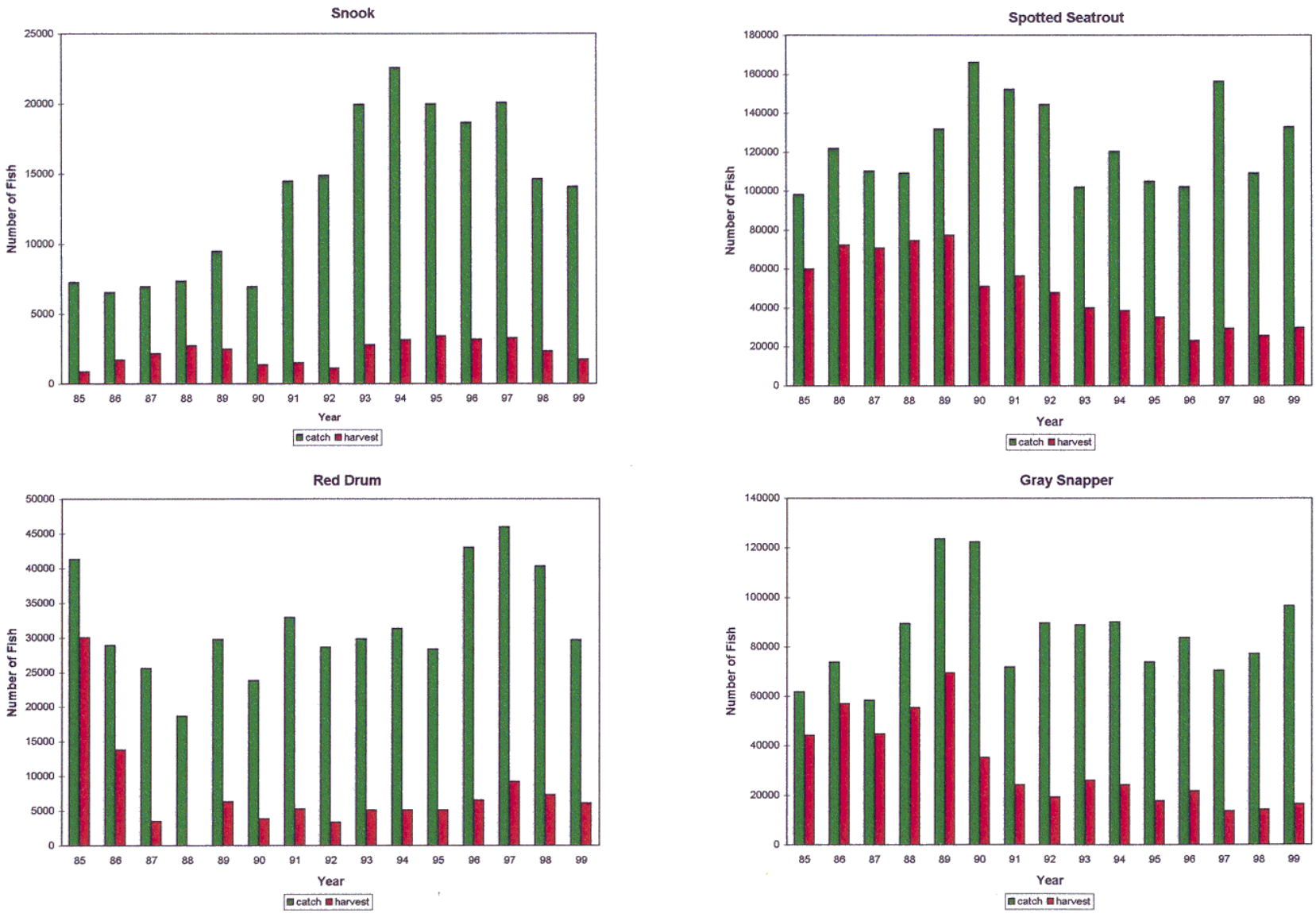


Figure 9. Estimated total catch and harvest for the four major species of gamefish by non-guided (sport) anglers in Florida Bay (Areas 1-5), 1985-1999.

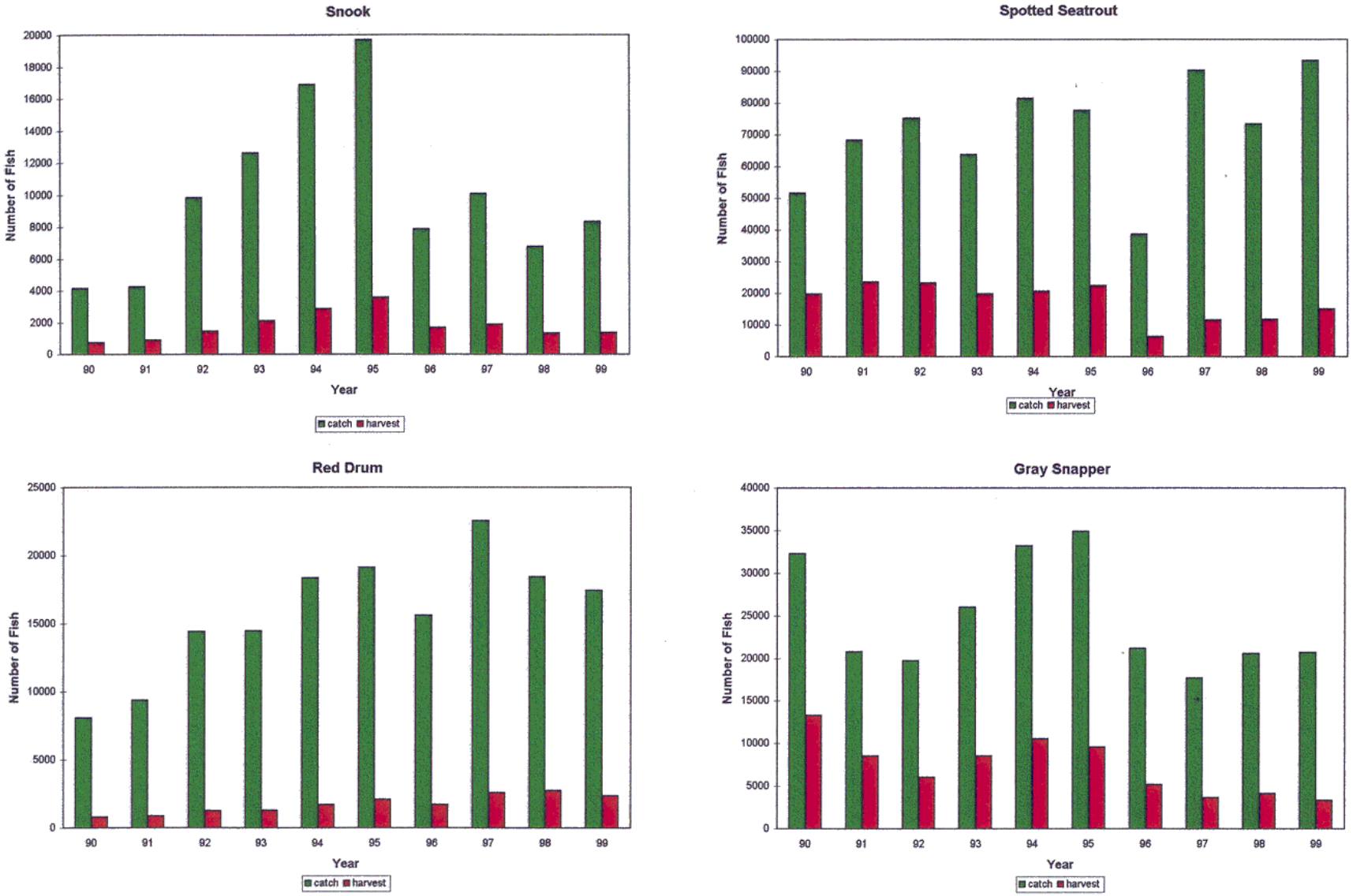


Figure 10. Estimated total catch and harvest of the four major species of gamefsh by guided anglers in Florida Bay (Areas 1-5), 1990-1999.

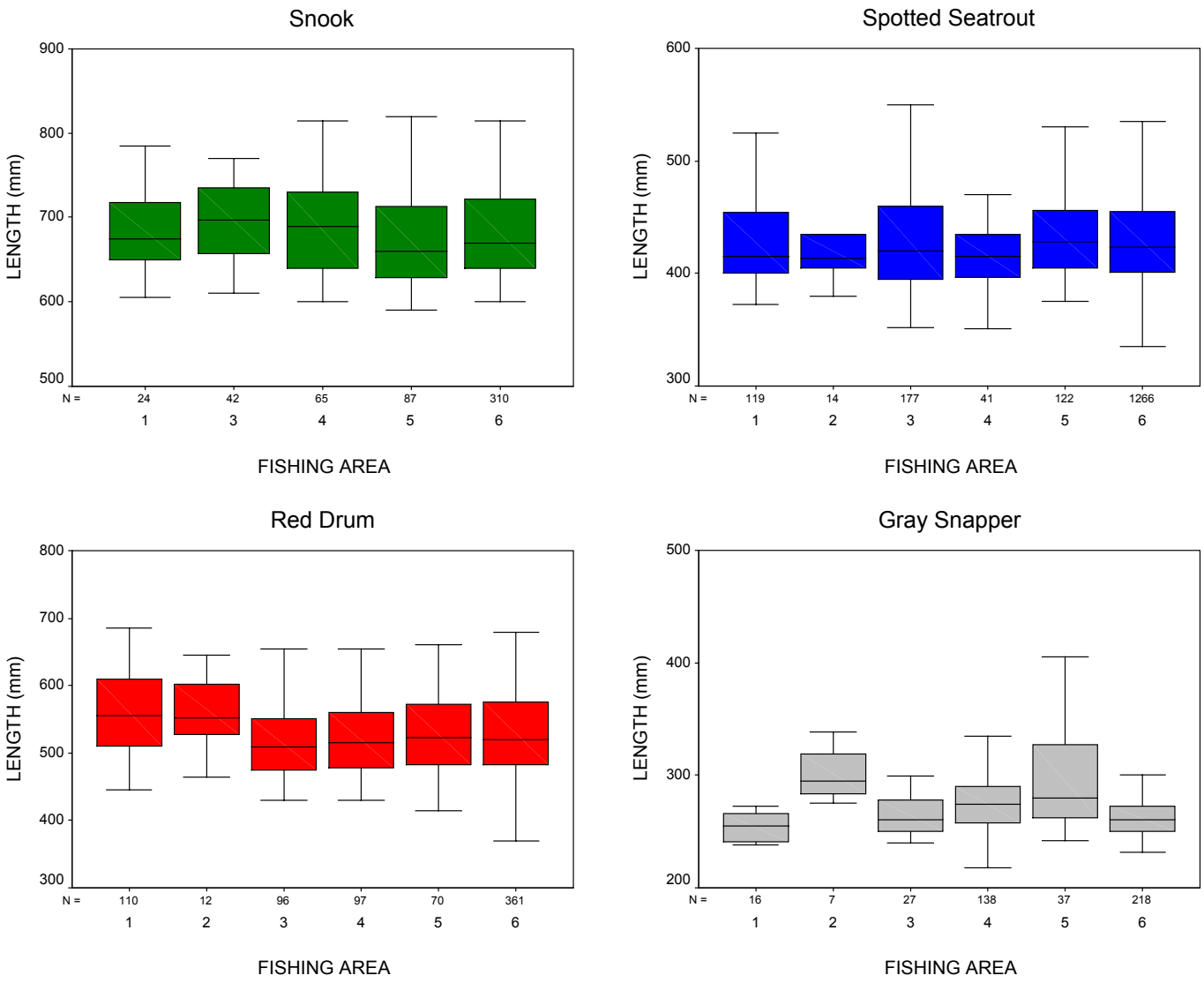


Figure 11. The lengths of the four major species of fish caught by recreational (non-guided) anglers in the six ecologically distinct fishing areas within Everglades National Park during 1999. The "box" represents the interquartile range; the horizontal line in the "box" represents the median; N represents the number of fish measured in each area.

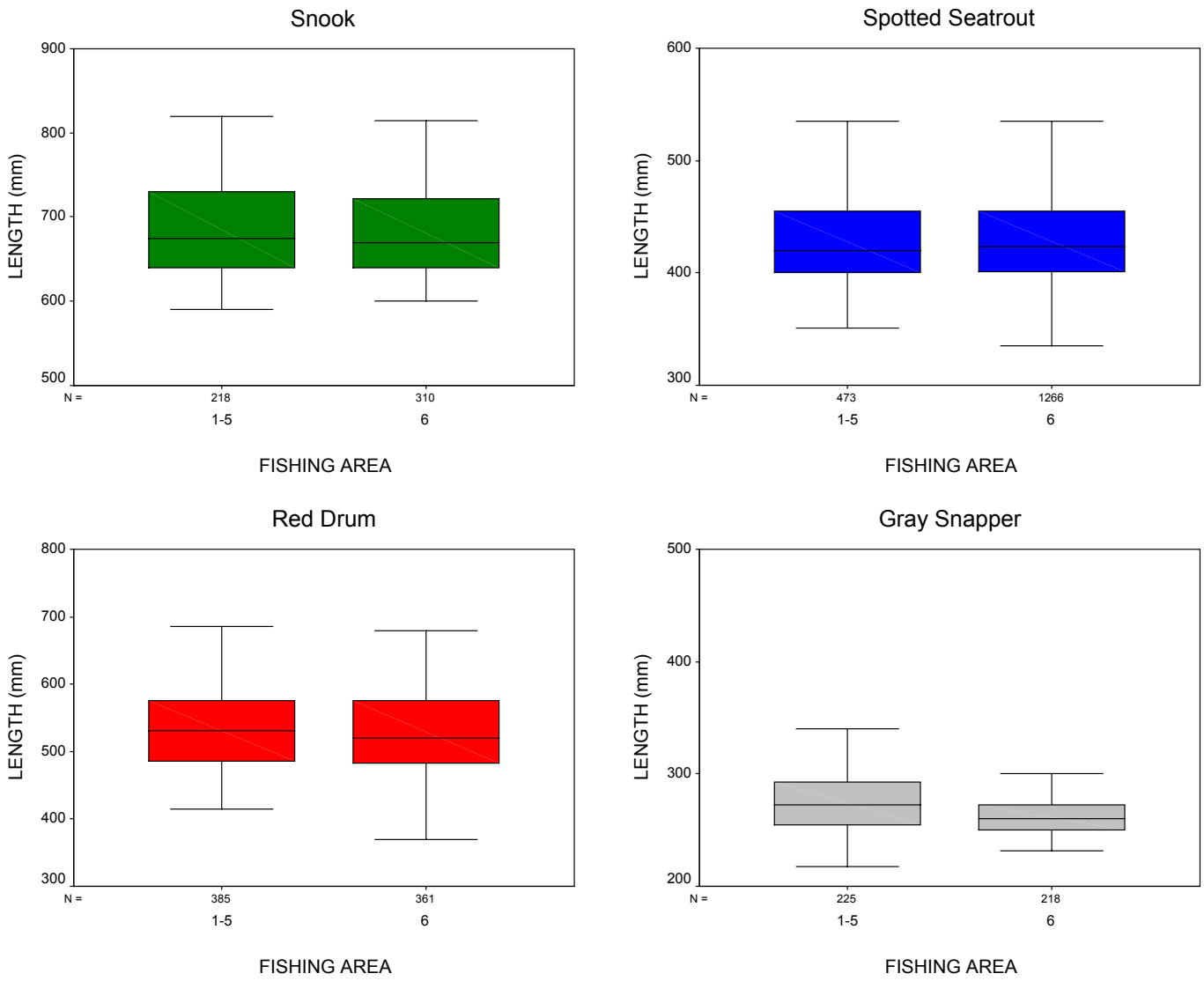


Figure 12. The lengths of the four major species of fish caught by recreational (non-guided) anglers in Florida Bay (Areas 1-5) and Everglades City (Areas 6) during 1999. The "box" represents the interquartile range; the horizontal line in the "box" represents the median; N represents the number of fish measured in each area.

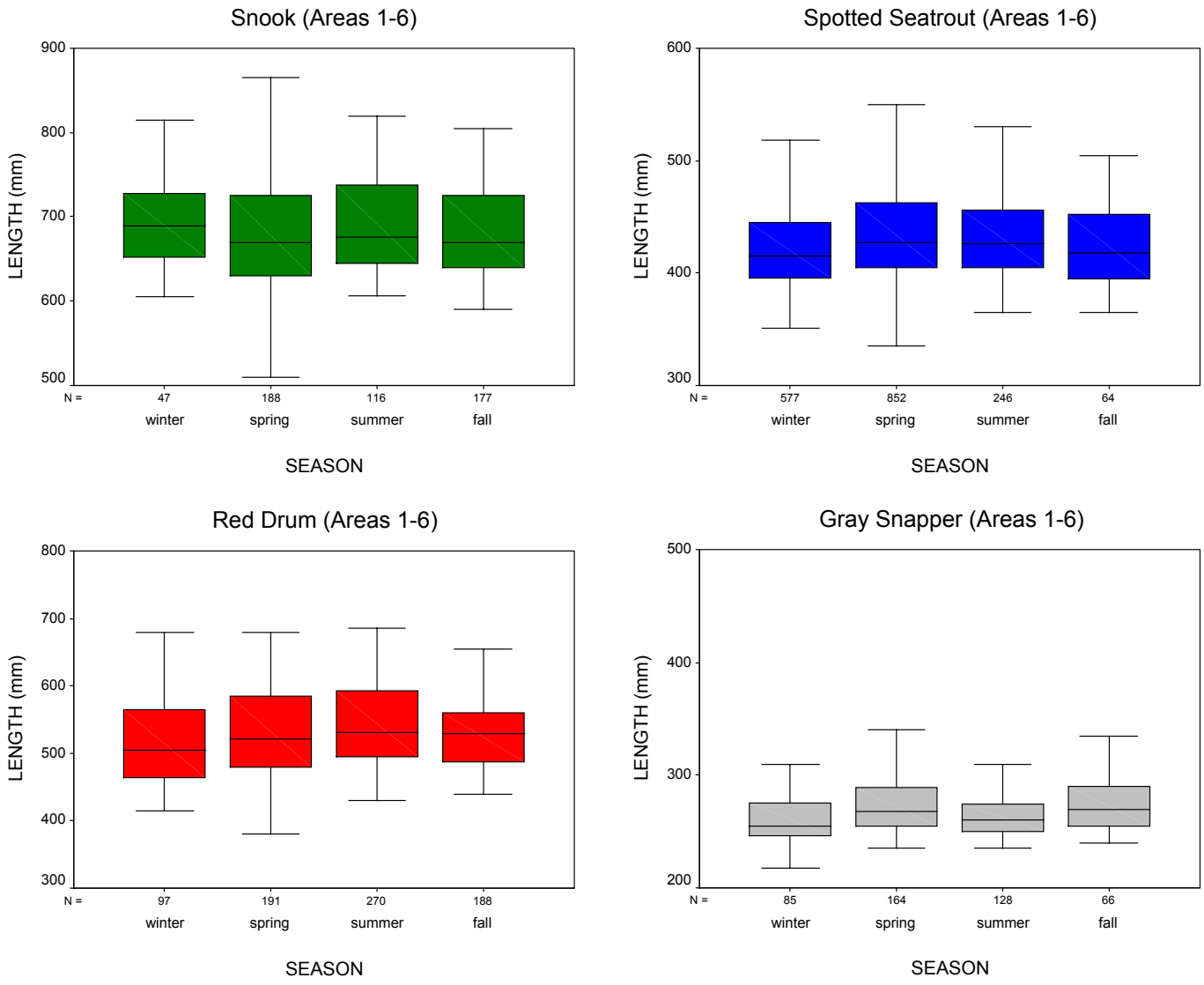


Figure 13. The lengths of the four major species of fish caught by recreational (non-guided) anglers in Everglades National Park during the winter, spring, summer, and fall of 1999. The "box" represents the interquartile range; the horizontal line in the "box" represents the median; N represents the number of fish measured in each area.

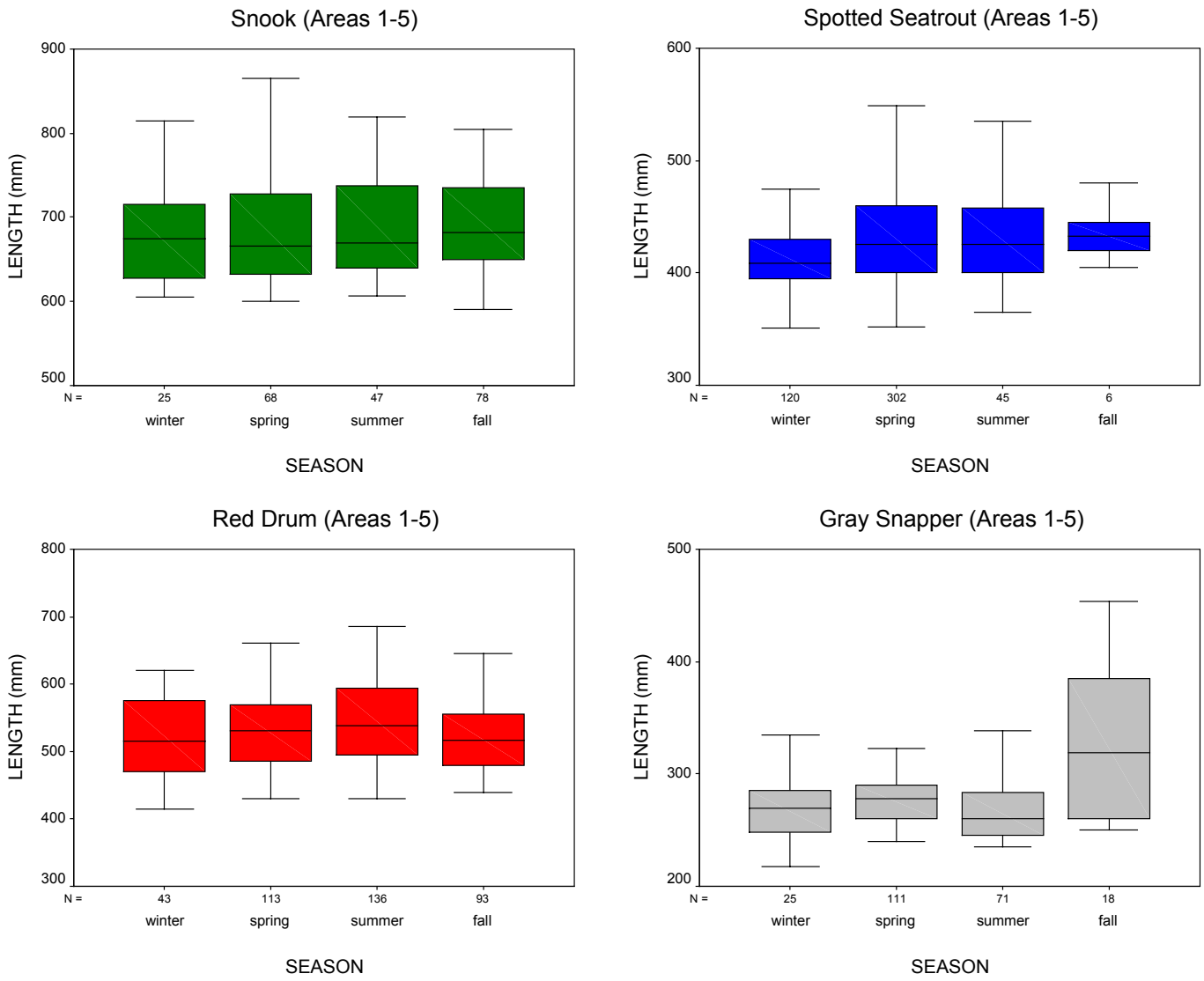


Figure 14. The lengths of the four major species of fish caught by recreational (non-guided) anglers in Florida Bay (Areas 1-5) during the winter, spring, summer, and fall of 1999. The "box" represents the interquartile range; the horizontal line in the "box" represents the median; N represents the number of fish measured in each area.

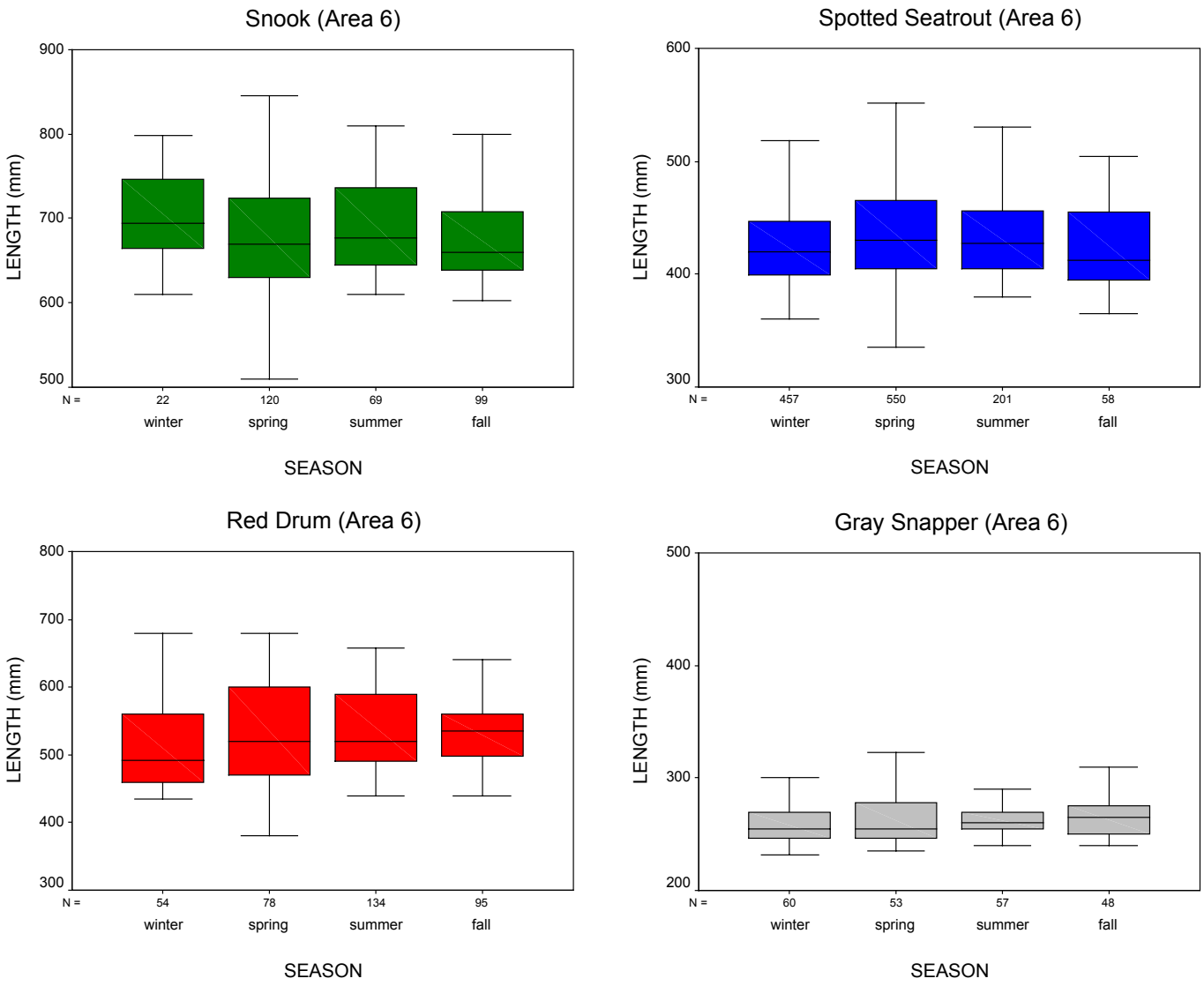


Figure 15. The lengths of the four major species of fish caught by recreational (non-guided) anglers in Everglades City (Area 6) during the winter, spring, summer, and fall of 1999. The "box" represents the interquartile range; the horizontal line in the "box" represents the median; N represents the number of fish measured in each area.

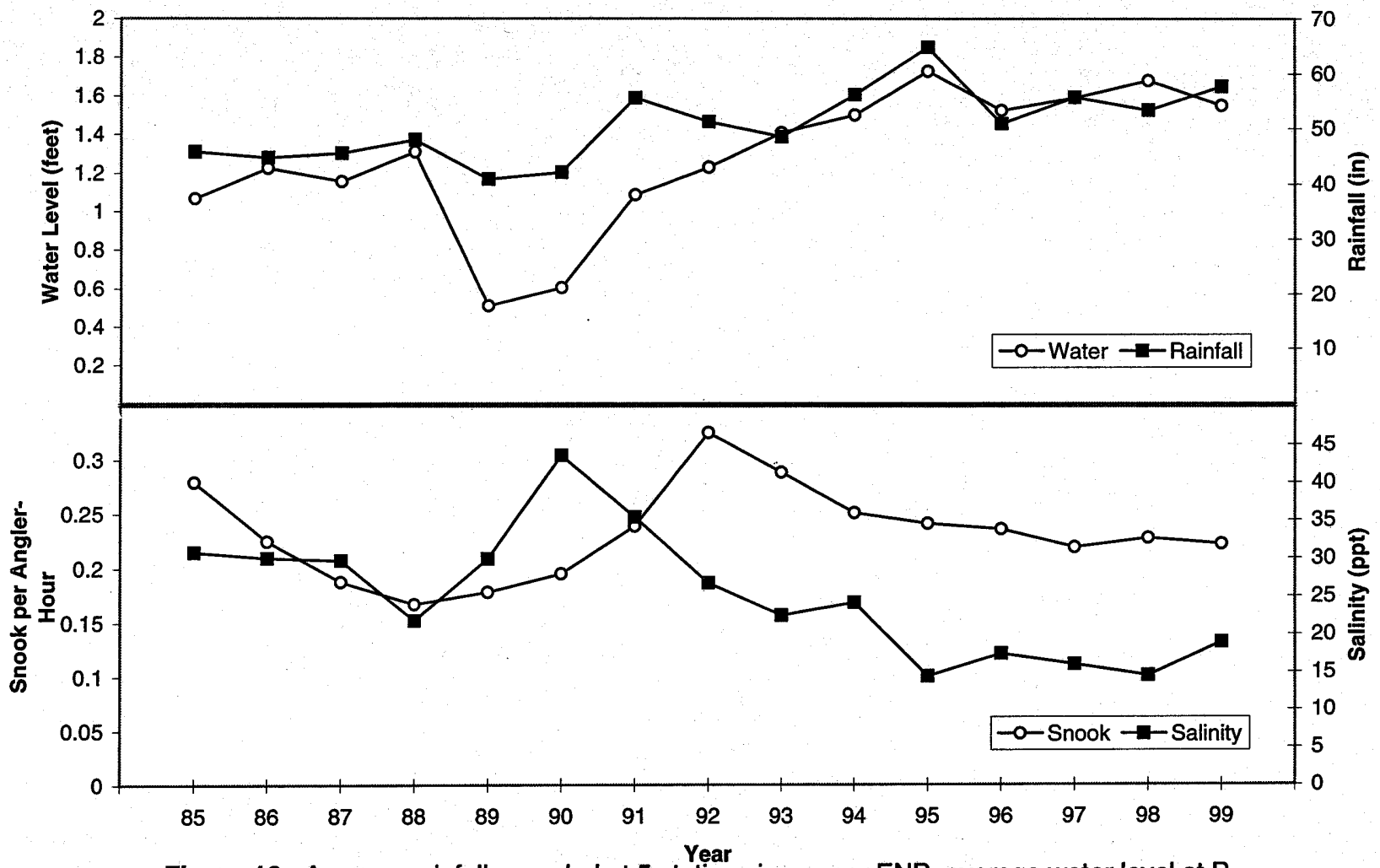


Figure 16. Average rainfall recorded at 5 stations in or near ENP, average water level at P-37 in Taylor Slough, average salinity at 3 stations in northern Florida Bay, and non-guide catch rates of snook in Florida Bay (Areas 1-5) from 1985-1999.

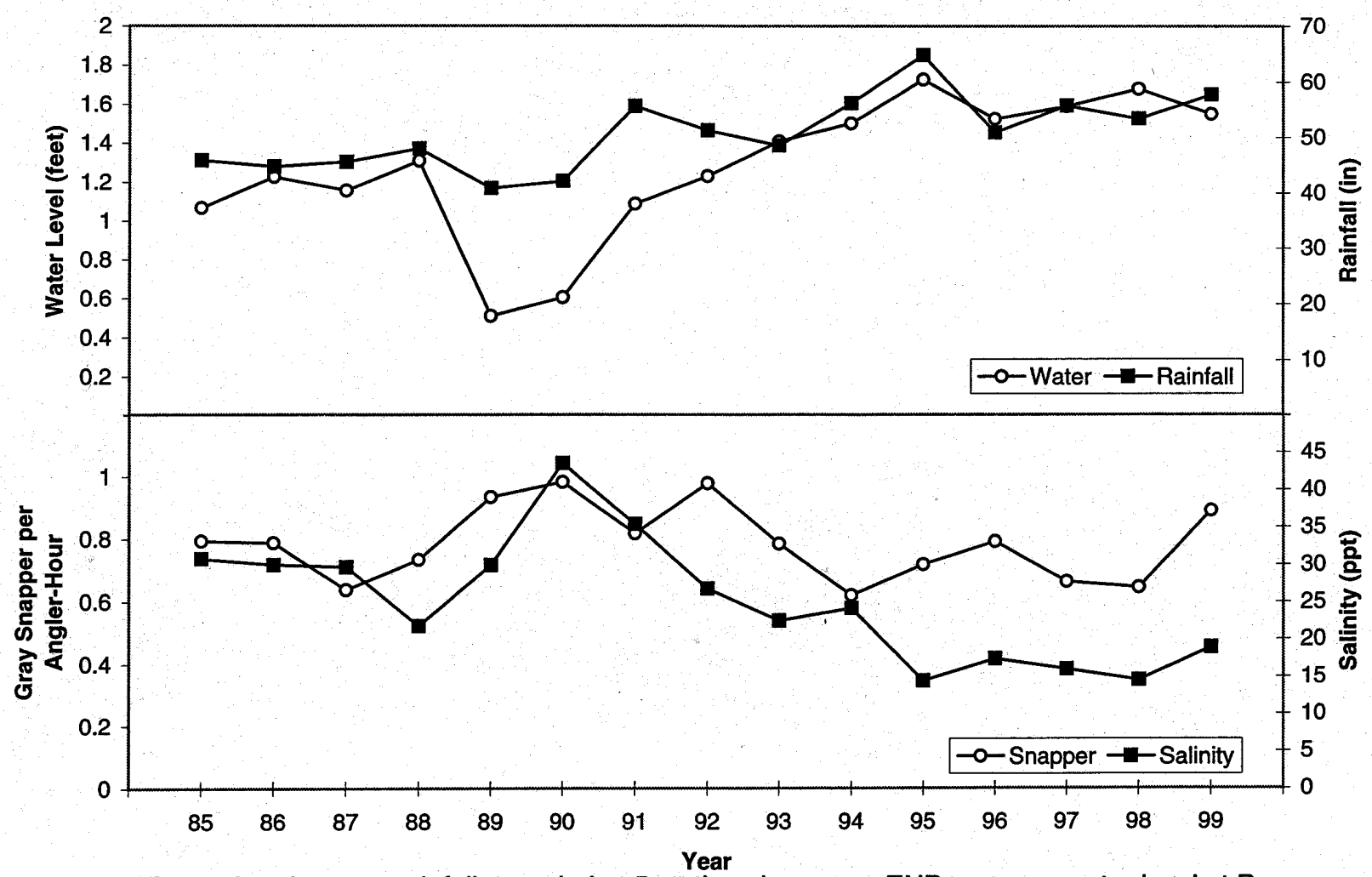


Figure 17. Average rainfall recorded at 5 stations in or near ENP, average water level at P-37 in Taylor Slough, average salinity at 3 stations in northern Florida Bay, and non-guide catch rates of gray snapper in Florida Bay (Areas 1-5) from 1985-1999.

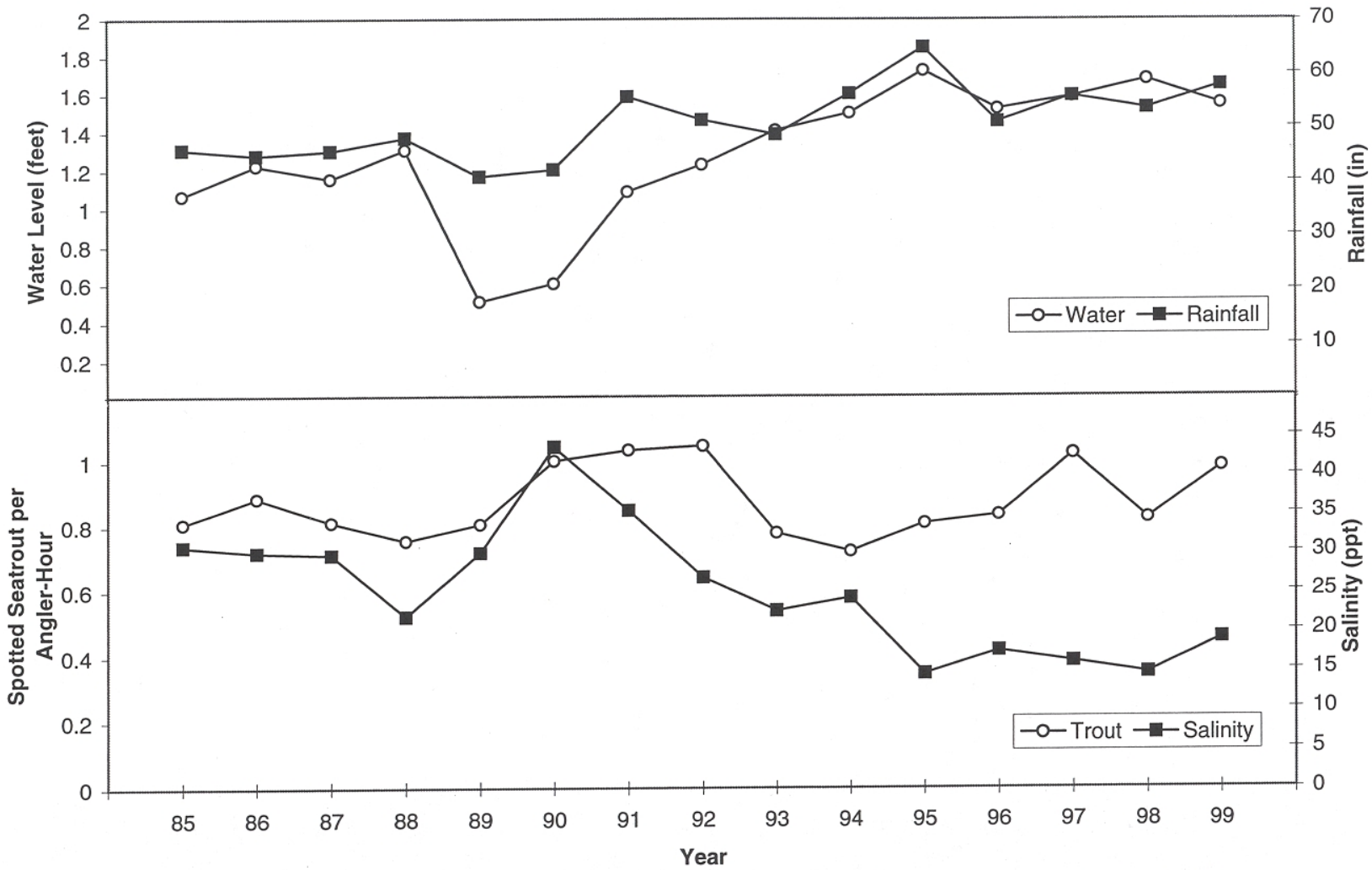


Figure 18. Average rainfall recorded at 5 stations in or near ENP, average water level at P-37 in Taylor Slough, average salinity at 3 stations in northern Florida Bay, and non-guide catch rates of spotted trout in Florida Bay (Areas 1-5) from 1985-1999.

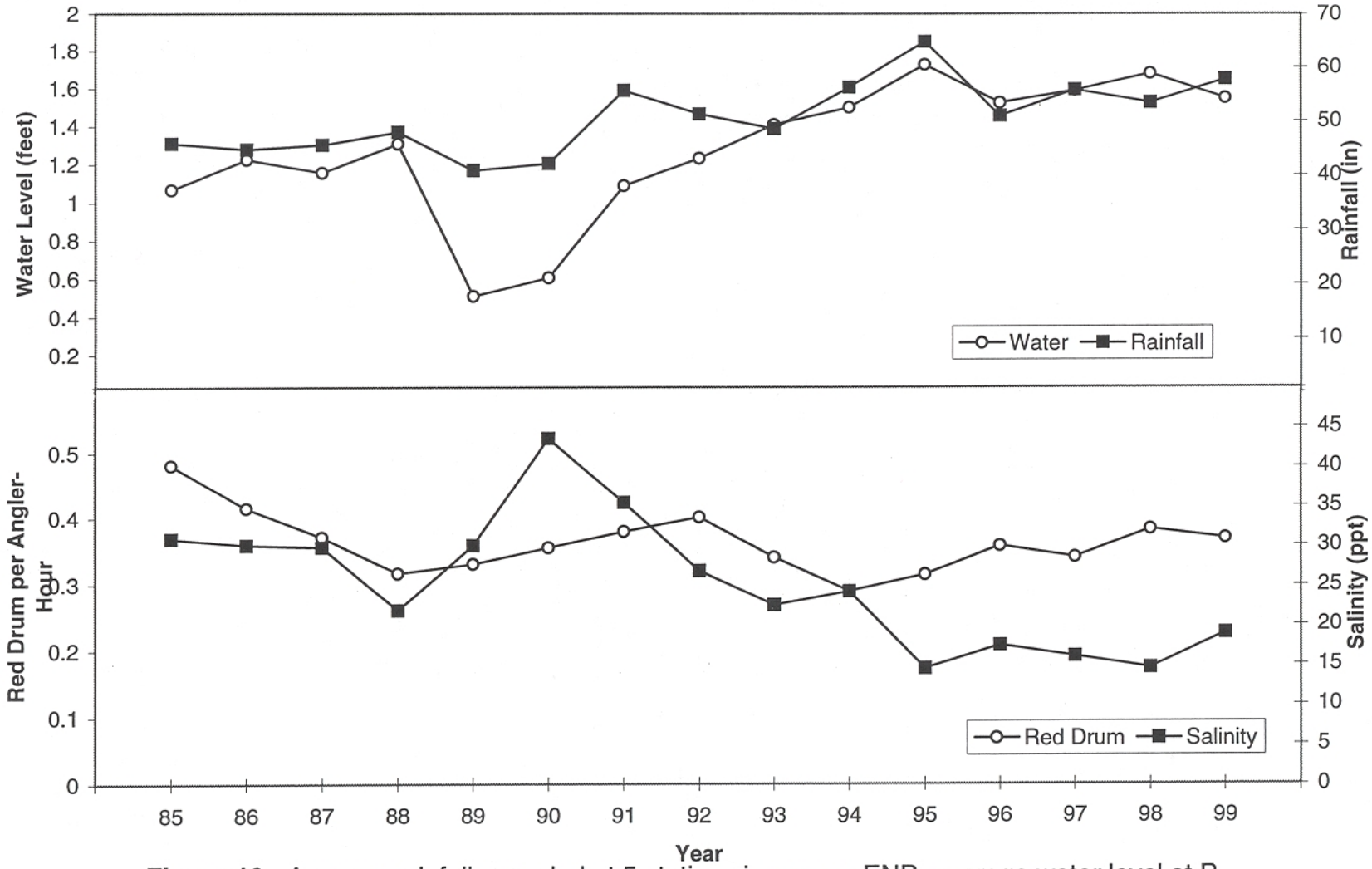


Figure 19. Average rainfall recorded at 5 stations in or near ENP, average water level at P-37 in Taylor Slough, average salinity at 3 stations in northern Florida Bay, and non-guide catch rates of red drum in Florida Bay (Areas 1-5) from 1985-1999.

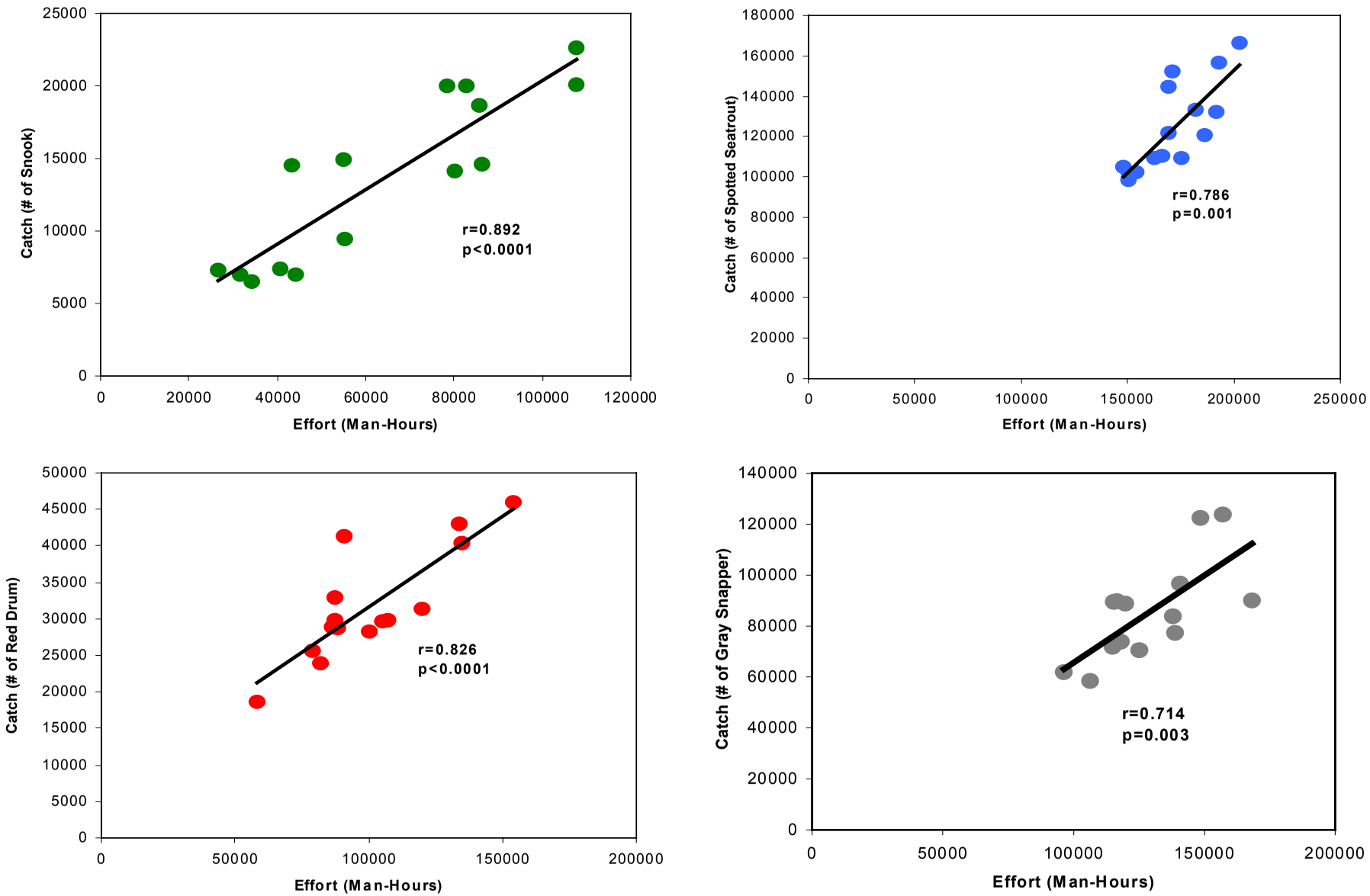


Figure 20. Correlation of total estimated catch and total estimated effort for snook, gray snapper, spotted seatrout, and red drum in Florida Bay (Areas 1-5), 1985-1999.