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 where 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 sport fish goals and management objectives are based on the preservation and restoration of the diversity and natural 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 sport fish from Everglades National Park have been monitored nearly continuously since 1958. The objectives of fisheries monitoring in the park are: 1) to estimate catch rates, relative abundance, age structure, and total harvest, and 2) to estimate boating (and fishing) activity in park waters.

This monitoring program was originally initiated because of concern over greatly 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 a contract with the University of Miami's Institute of Marine Science and were directed at evaluating only the sport fishery.

Under the University of Miami program, measures of catch and catch-per-unit-of-effort (CPUE) were made only from those fishermen operating out of Flamingo. These data covered a major area of the fishery, but largely missed two other major areas: eastern Florida Bay and the lower Ten Thousand Islands.

In 1965, a permitting system was established for commercial fishermen operating in the park. These fisheries included commercial hook & line (primarily spotted seatrout), netting (mullet and pompano), stone crab trapping, and professional guides. Until 1972, these catch data consisted of monthly total harvest, by species, for each fishermen. 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, nor to evaluate the degree to which fishermen complied with the reporting requirements of their permits.

In 1972, the NPS expanded the harvest 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. 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 professional fishing guide complaints of declining stocks. Results of this assessment were incorporated into a document for public review concerning alternative fishery management options for Everglades National Park (Davis 1979b). This assessment summarized the estimated total harvest of fish from park waters by species, by area, and fishermen type for the years 1973-1977. Although recorded catch rates and annual fishing activity were analyzed for trends, no detailed analysis of catch rate response to changes in effort and harvest or to environmental factors were made. Insufficient fish length data also were available in 1979 to evaluate such important parameters as age structure of the catch, mortality rates, and mortality response to changes in fishing effort and harvest.

Recently, a 1985-88 analysis of the fisheries database, provided 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. VPA's are statistical models which use primarily catch (harvest) data to produce relative estimates of how many fish of a given species exist or how many species of a particular age class are surviving yearly to become spawners. Park stock assessments included total mortality estimates, age structure, and a yield-per-recruit analysis for the three most commonly caught sport fish (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 abundances 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 Higher Trophic Level Workshop, November, 1997 as part of the development process for a conceptual model of the interaction between ecosystem dynamics and higher trophic levels in Florida Bay. A poster on the "evaluation of recent trends (1985-96) in the recreational fishery of Florida Bay" was presented at the 1998 Florida Bay Science Conference, University of Miami, Miami, Florida, with an abstract published in the proceedings. Data from 1997-1998 was provided to Florida Marine Research Institute to generate stock assessments for snook, spotted seatrout, and sheepshead. During 1998, draft ecological performance measures were developed using CPUE for snook and spotted seatrout as part of an evaluation of the decision making for the Natural Systems Team/Southern Everglades Restoration Alliance.

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

This report represents the fourth annual fisheries report produced since 1990. Due to severe personnel shortages, only basic data collection activities were maintained from 1991-1994 by two port samplers at Flamingo and Everglades City. Staff loss in 1997 (Mario Alvarado) resulted in the hiring of a temporary port sampler for Flamingo during

1998, until the original position was permanently filled by Gabriel Delgado in early 1999. This report includes a description of the fishery, relative abundance, and for the first time, average size of the four major catch species (1998). In addition annual estimated total catch/harvest, effort, and boating activity from Flamingo and Everglades City for both 1997 (estimations were not completed for the 1998 report) and 1998 are included in this report as well as environmental effects on CPUE.

METHODS

Methods (data collection/recording format) employed to obtain sport fishing monitoring and boating activity data in Everglades National Park 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 include area fished (Figure 1), reported catch (fish kept and released), harvest (kept only), effort (angler hours fished), species preference, angler residence, and fish lengths. Commercial fishermen and professional guides were required to obtain an annual "no-fee" 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 patrol rangers and by port samplers at the boat launch sites. Since the elimination of commercial fishing in Everglades National Park in 1985, only recreational guided and non-guided recreational anglers are permitted to fish within park estuarine and coastal marine 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. Most of the recreational fishermen catch data for Florida Bay and the immediate vicinity has come from interviews conducted at the Flamingo boat ramps (Areas 1-5).

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 success per unit of effort 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 made quarterly during each year 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.

Estimates of total harvest for the guide fishery were obtained by dividing the reported harvest by the estimated percent reporting compliance of fishermen known to be fishing. Not all guides reported their catch as required; therefore, a reporting compliance adjustment was necessary. Reporting compliance estimates as determined through independent field observations of fishing activities was about 42% in 1998.

Statistical differences were found between the mean reported catch rates at Everglades City (Area 6) and at Flamingo (Areas 1-5) (Tilmant et al. 1986). Therefore, total estimated catch and harvest computations were made separately for Everglades City and the Florida Bay region and then added to obtain parkwide estimates.

The seasonal distribution of the number of fishing interviews and fishing effort have not been consistent from year to year. Therefore, all calculations of annual mean catch rates (CPUE), harvest rates (HPUE), and estimated total harvest or effort were calculated by calendar quarters and the four quarters either averaged or summed to obtain comparable annual values. In estimating the average CPUE or HPUE for a calendar quarter, rates of individual trips were calculated after Malvestuto (1983). Only those anglers successful in catching a species were used to calculate a harvest or catch 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 1998 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 in the Everglades City-Chokoloskee boat ramps and marinas.

During 1998, 3,840 boaters were interviewed at Flamingo. Ninety-eight percent of these boating trips were involved in sport fishing activity. Only 6.0% of the anglers did not catch fish.

At Everglades City 3,083 boaters were interviewed. Ninety-five percent of the total boats interviewed were fishing. Only 7.0% of the fishermen did not catch fish.

Description of the Fishery (1998)

Most (83.8%) of the anglers fishing out of Flamingo were south Florida residents (Dade County to Ft. Lauderdale, excluding local residents); 1.7% were local residents (Florida City, Flamingo, and the Florida Keys); 12.9% were from the rest of Florida. Only 1.5% of the anglers came from out of state.

At Everglades City, most (73.0%) of the anglers fishing were Florida residents other than south Florida (Collier, Dade, Monroe Counties) and local residents. South Florida accounted for 14.2% of the anglers, while 10.7% were local (Chokoloskee/Everglades City) residents, and 2.1% came from out of state.

An estimated 28,460 fishing trips, 66,027 anglers, and 29,011 boats made up the boating and fishing activity in Florida Bay. Of these fishing trips, 13.5% were interviewed at the Flamingo boat ramps. The average trip lasted 6.8 hours with an average fishing time of 5.7 hours, and caught an average of 18 fish.

Most anglers interviewed at Flamingo (55.3%) did not try to catch any particular kind of fish. Red drum and snook were the most popular fish, sought by 15.1% and 12.3% of the fishermen, respectively. The next three species preferred were spotted seatrout (10.6%),

gray snapper (1.7%), and tarpon (1.5%). Almost 44% of the fishing parties interviewed reported catching spotted seatrout. The next three species most commonly caught were gray snapper (33.8%), red drum (33.7%), and snook (21.4%).

At Everglades City an estimated 17,166 fishing trips, 39,442 anglers, and 18,069 boats made up the boating and fishing activity. Of these fishing trips, 18.0% were interviewed at the Everglades City boat ramps. The average trip lasted 7.2 hours with an average fishing time of 5.4 hours and caught an average of 13 fish.

Many anglers interviewed at Everglades City (53.2%) did not try to catch any particular kind of fish. Snook was by far the most popular fish, sought by 30% of the fishermen. The next four species preferred were spotted seatrout (4.6%), red drum (4.0%), tarpon (1.0%), and gray snapper (less than 1%). Almost 36% of the fishing parties interviewed reported catching snook. The next four species most commonly caught were spotted seatrout (31.0%), red drum (28.2%), gray snapper (24.5%), and tarpon (1.4%).

An estimated total of 45,626 fishing trips were reported in park waters during 1998, and 47,080 boats made up the fishing and boating activity. The 45,626 fishing trips represent an 8.2% increase in fishing trips compared to the fishing activity in 1996 despite the fact that boats could not launch from the Flamingo boat ramp for a few days in late September because of Hurricane Georges. 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 (45,453 fishing boats) (Figure 2). A decline during 1992 is attributed to the impacts of Hurricane Andrew; the park was closed from September through December. There has been an increasing trend since 1995 with the highest number of fishing boats recorded in Everglades National Park during 1997 with a slight decline in 1998 (Figure 2). The recreational fishing effort (total estimated angler-hours) has followed this trend as well (Figure 3).

Relative Abundance

Catch rate is a function of the number of fish caught for a 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 1998 mean catch and harvest rates for the 11 major species of the recreational (non-guided) fishery in Florida Bay (Areas 1-5) and all of Everglades National Park (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 Everglades National Park (Areas 1-6). The relationships of 1998 catch/harvest rates to past years are presented in Figures 5-6 for the four major species (snook, spotted seatrout, gray snapper, and red drum) caught by non-guided anglers, while the relationships of 1998 guide catch/harvest rates to past years are presented in Figures 7-8.

Estimated Total 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 fishing boats fishing for a particular species

to yield estimates of total non-guided harvest. For the guide fishery, the total number of fish reported harvested is divided by the percent of guide compliance to yield the estimated total harvest by species. The 1998 estimated total non-guided and guided harvest is shown in Table 3. The relationship of 1998 catch/harvest to previous years are shown in Figures 9-10.

Recent Trends (Florida Bay and Parkwide as noted)

The annual total non-guided fishing effort increased from 1985 to 1989, dropped slightly from 1990-92, but increased annually after 1993 (Figure 3). The 1992 decline may have been partly due to the closure of the main entrance to the park and Flamingo during the aftermath of Hurricane Andrew. From 1994 to 1995, there was a 30% decline in the number of reported guide fishing trips, resulting in a marked decrease in the numbers of hours fished and total numbers of people fishing. A 3-week closure of the park during the November-December federal government shut-down may have accounted for the small decline in effort reported in 1995 (Figure 3).

Overall, 1998 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 have decreased steadily over the same time period, except for snook rates which seem to be holding steady. The total estimated harvest of the major species are also following a declining trend except for red drum which has been increasing in recent years. Catch rates may be used as an index of abundance and are directly related to environmental factors such as rainfall. However, catch rates are generally not directly affected by fishing regulations, while harvest rates most certainly are.

Snook

The popularity of snook has increased dramatically from 1985 to 1997. 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 (Figure 4).

Catch/Harvest Rates:

Harvest rates for sport and guide fishermen in Florida Bay have been relatively stable since 1980 (Figures 5, 6, and 7). Guide catch rates have been declining since 1992-1993 (Figure 7). However, sport catch rates 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 increase may reflect a stock recruitment of small juvenile snook which were released in prior years because of size restrictions and are now being recruited to the fishery. High recruitment years probably occurred during 1983 and possibly 1991, based on the four year time period 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 also be enhanced by increased rainfall/runoff.

Estimated Total Harvest:
Despite the two fish per person bag limit, 24" minimum size limit, and closed seasons during June, July, August, December, and January placed on this fishery to date, sport fishermen harvest had not been reduced until this year (Figure 9). Guided anglers' harvest had been increasing since 1991, but finally dropped after an all-time high in 1995 (Figure 10). The increases in harvest during the recent past has been credited to the quick recovery of the stocks because of the fishing regulations mentioned above.

Gray Snapper
The percentage of anglers reporting catches of gray snapper has remained quite stable from 1985 to 1998 (Figure 4). The large decline seen in 1991 was due to new regulations which increased the minimum size to 10" with a bag limit of five fish per person.

Catch/Harvest Rates:
Sport and guide harvest rates for gray snapper have shown steady declines since 1980 (Figures 5, 6, and 7). Catch rates have also shown the same general decreasing trend over the same time period, although, at a slower pace (Figures 5, 6, and 7). During 1988-1990, the increase in catch but not harvest may reflect a good recruitment of small juvenile fish to the stock which are being released because of size regulations.

Estimated Total Harvest:
During the 1990's, the annual guide and non-guided estimated total harvest for gray snapper has dropped as low or lower than anytime during the previous record (Figures 9 and 10). The lower harvest may be due to the state 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.

how many inches 6"

Spotted Seatrout
The percentage of boats catching seatrout declined steadily from 1985 to 1989, but increased sharply to a 14 year high in 1992 of almost 65% (Figure 4). Since then, the percentage of anglers catching seatrout has declined to a 14 year low in 1996 of 39% (Figure 4). Seatrout were caught by 44% of the anglers in 1998 (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 (Figure 7). The catch rate of sport fishermen has also been increasing steadily since 1994 in Florida Bay (Figure 5).

There was a slight drop in 1998 to 0.8231 fish per angler-hour. The catch rate in all of ENP has been stable since 1993 (Figure 6). The lack of increase in harvest associated with an increase in catch 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. The reduction in harvest rates may also be due to the increase in catch-and-release practices by fishers.

Estimated Total Harvest:
Annual estimated total harvest data from non-guided fishermen suggests that seatrout harvest has decreased dramatically from highs in 1988 and 1989 to a low in 1996 with a slight rebound in 1997 and 1998 to 25,772 fish (Figure 9). Harvest from guide fishermen had been very stable from 1986 to 1995, but has experienced an all time low in 1996 with a slight rebound to 11,883 fish in 1998 (Figure 10).

Red Drum
The percentage of boats catching red drum 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 decreased slightly in 1998 to 1996 levels.

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 have been increasing steadily since an all time low in 1994 to 0.3842 fish per angler-hour in 1998 (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 declined slowly, but steadily since 1985 to a low in 1998 of 0.3918 fish per angler-hour (Figure 7).

Estimated Total Harvest:
Annual estimated total harvest data from non-guided fishermen suggests that red drum catches had been steadily increasing until a slight drop in 1998 to 7,364 fish (Figure 9). Harvest from guide fishermen has also shown a slow, but steady increasing trend with 2,751 fish harvested in 1998 (Figure 10). These numbers represent their highest values since the mid-1980's when the fishery collapsed (Figures 9 and 10).

Tarpon & Bonefish

The professional guide fishery is largely directed at a few highly prized gamefish species within the park. Two of these species, tarpon and bonefish, are of little food value and are not sought by the majority of the of 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 as a trophy, catch rate is more indicative of the stock than harvest rate. The catch rate 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 slight decline in the following years (Figure 8). The estimated total annual catch for tarpon in 1998 has reached is apparent highest level since 1980, suggesting that more anglers are fishing for, and catching tarpon (Table 3).

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 1995-1998 (Figure 8). Nearly all bonefish are released when caught; therefore, it is highly unlikely that fishing mortality has played any significant role in determining bonefish stock abundance. Although sufficient harvest data are not available to reasonably evaluate the impacts of fishing activity on these two species, reported catch rates of tarpon and bonefish suggest that the stocks are relatively stable.

<u>Fish Lengths</u>

Snook

A comparison of mean length of snook harvested in Areas 1, 3, 4, 5, and 6 (Area 2 was not included in the analyses due to insufficient data) showed that there was no difference in mean length among the five areas (df=716, f=0.482, p>0.70) (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=716, t=0.332, p>0.74) (Figure 12).

A parkwide seasonal comparison of snook lengths showed that there was a significant difference among the four seasons (df=3, X^2=10.6, p<0.015) (Figure 13). The mean size of snook harvested during the summer months (708.0mm) was much larger than during the other three seasons (winter=661.1mm, spring=672.8mm, fall=669.3mm) (Figure 13). Although, it was found that when snook lengths taken only in Florida Bay (Areas 1-5) were compared on a seasonal basis, there was no difference in the length of fish harvested among the four seasons (df=3, X^2=5.34, p>0.14) (Figure 14). Similar results were found in a seasonal comparison of the snook lengths harvested only in Everglades City (Area 6). There was no difference in the length of snook harvested among the four seasons in Area 6 (df=3, X^2=7.63, p>0.05) (Figure 15).

Gray Snapper

There was a significant difference in the length of gray snapper harvested among the six areas of ENP (df=5, X^2=108.8, p<0.0001) (Figure 11). The fish harvested in Area 6 seem to be much smaller with a mean length of 261.3mm (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=614, t=9.66, p<0.0001) than those harvested in Everglades City (mean lengths of 284.2mm and 261.3mm, respectively) (Figure 12).

There was no difference in the size of gray snapper harvested parkwide among the four seasons of 1998 (df=615, f=0.109, p>0.95) (Figure 13). Gray snapper lengths in Florida Bay only (Areas 1-5) did not vary as well (df=3, X^2=2.31, p>0.50) (Figure 14). However, gray snapper harvested in Everglades City (Area 6) were significantly larger during the summer (266.8mm) than those harvested during the rest of the year (winter=256.2mm, spring=257.7mm, fall=264.7mm) (df=3, X^2=9.43, p<0.03) (Figure 15).

Spotted Seatrout

There was no difference in the mean length of spotted seatrout harvested among the six areas of ENP (df=5, X^2=10.1, p>0.07) (Figure 11). However, 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 versus Everglades City (Area 6) it was found that the spotted seatrout harvested in Florida Bay were significantly larger (df=2,260, t=2.07, p<0.04) than those harvested in Everglades City (mean lengths of 429.5mm and 425.7mm, respectively) (Figure 12).

There was no difference in the mean length of spotted seatrout harvested parkwide among the four seasons of 1998 (df=3, X^2=3.14, p>0.37) (Figure 13). A seasonal comparison of spotted seatrout lengths harvested only in Florida Bay (Areas 1-5) showed that fish harvested during the summer (444.3mm) were significantly larger (df=3, X^2=13.8, p<0.003) than those harvested during the rest of the year (winter=425.6mm, spring=430.6mm, fall=429.5mm) (Figure 14). However, there was no difference in the size of spotted seatrout harvested in Everglades City (Area 6) during the four seasons of 1998 (df=1,107, f=1.712, p>0.16) (Figure 15).

Red Drum

There was a significant difference in the mean lengths of red drum harvested among the six areas of ENP during 1998 (df=1,029, f=14.4, p<0.0001) (Figure 11). The results from Tukey's multiple comparison test are given in Table 4. 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 540.9mm and 536.2mm, respectively (df=1,028, t=1.28, p>0.20) (Figure 12).

A seasonal comparison of red drum lengths parkwide showed that fish harvested in the summer are significantly larger than those harvested in winter, spring, and fall (df=1,029,

f=7.71, p<0.0001) (Figure 13). The red drum harvested only in Florida Bay (Areas 1-5) during the summer were significantly larger (df=3, X^2=16.2, p<0.001) 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=458, f=3.38, p<0.02) (Figure 15).

Environmental Relationships

Catch rates are directly related to environmental factors such as rainfall, water level, and salinity. The catch rates for sport (non-guided) fishermen versus rainfall, water level, and salinity for 1985 to 1998 are shown in Figures 16-19. Total annual rainfall from 1985 to 1998 was compiled and averaged from five stations within or near ENP (Flamingo, Royal Palm, Everglades City, Tamiami Ranger Station, and Tavernier. Butternut Key replaced Tavernier in 1997 and 1998). Water level data from 1985 to 1998 was obtained from well P-37 in western Taylor Slough. Salinity data from 1985 to 1998 was obtained from three stations in northern Florida Bay (Butternut Key, Taylor River, and Trout Cove).

Missing monthly rainfall values for various time periods were estimated from monthly period of record values for Royal Palm (1992,1995), Tavernier (1986,1995), and Everglades City (1993-95).

Snook

The declines in snook stock size from 1984 to 1988 may have been due to low rainfall and water levels in the upper marsh regions. Schmidt and Alvarado (1998) reported that there was a significant linear relationship between snook CPUE and mean annual water levels recorded at P-37 in western Taylor Slough and mean annual rainfall during the same year from 1985 to 1996; however, the longer period of record (1985-1998) did not substantiate this.

There was a weak correlation between water levels recorded three years before and catch rates from 1985-1998 (r=0.591, N=11, p>0.05). Although, no statistical 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. Schmidt and Delgado (in prep) reported similar increases in catches and catch rates from the early to mid-eighties based on good recruitment following several years of average and above average rainfall during 1982-1984. Other field studies on snook habitat have shown that the greatest number of juvenile snook 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 (1985-1998), a positive (r=0.601, N=14, P<0.03) 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=0.712, N=14, P=0.004),

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 ($r=0.506$, $N=14$, $p>0.06$). Which leads to the theory that increases in gray snapper abundance during the period of 1989-1990 may have been 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 than fish in brackish areas. 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 water level recorded one year before ($r=0.574$, $N=13$, $p=0.04$) and between catch rates and mean annual rainfall recorded three years before ($r=0.778$, $N=11$, $p=0.005$) suggesting that periods of high salinity and/or low rainfall may lead to increased abundance of gray snapper (Figure 17). 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 1985-1998; although, Schmidt and Alvarado (1998) found a significant correlation from 1985-1996. When catch rates were correlated with annual water levels recorded at P-37 from the previous year, a significant negative relationship was found ($r=0.552$, $N=13$, $p=0.05$) (Figure 18). This suggests that increased rainfall/water levels improve recruitment through increased growth and survival of larvae and juveniles. Recently, Thayer et al. (1998) reported increases in the abundance of larval and small juvenile seatrout in northern Florida Bay east of Crocodile Pt., suggesting that lowered salinities in this area may assist in the survival of these young-of-the-year fish. Presumably an increase in coastal rainfall and lower salinity 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 red drum. However, no statistically significant relationships were found between red drum catch rates and any of the environmental variables from 1985-1998 (rainfall, water level, and salinity); although, Schmidt and Alvarado (1998) reported a significant

correlation between an increase in catch and low rainfall from three years earlier from 1985-1996.

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

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 an increase of nearly 70% in numbers of fish taken. However, the number of snook caught in 1998 decreased to 14,641 fish. 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 annual estimated total catch of snook for the sport fishery from was highly correlated with the estimated total effort placed on the stock between 1985 and 1998 ($r=0.901$, $N=14$, $p<0.0001$) (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 are possible. This forecast is supported by Muller and Murphy (1997) who concluded that based on catch rates, harvest levels, age, and size of fish, the snook stocks in south Florida are in good condition. However, it should be noted that snook catches decreased dramatically in 1998 after five years of good catches and all time high in effort in 1997. According to recent National Marine Fisheries Service MRFSS (Marine Recreational Fisheries Statistical Survey) fisheries statistics for Florida, the increase in snook catch/harvest rates over the past 5-10 years appears to be a state wide occurrence, particularly on the east-central coast (Taylor et al. 1996). During 1998, state regulations were revised to sustain a 40% SPR by increasing the minimum size 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). Increased size limits in 1988 and 1990 and imposition of bag limits in 1990 may account for the high number of gray snapper caught and released during those years. The annual estimated total catch of gray snapper was linearly correlated with estimated total effort placed on the fishery between 1985-1998 ($r=0.705$, $N=14$, $p=0.005$), 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 correlation of yearly effort with catch was linear and significant ($r=0.783$, $N=14$, $p=0.001$) (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. A statistically significant linear relationship ($r=0.833$, $N=14$, $P<0.0001$) was found between yearly effort from 1985-98 and the resultant catch, suggesting that the increase in fishing effort did not greatly impact the catch of red drum in the non-guide fishery (Figure 20).

CONCLUSIONS

Cooperative Federal-State Data Collection Programs
The National Marine Fisheries Service, Gulf States Marine Fisheries Commission, Florida's Department of Environmental Protection (FDEP), 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 pilot telephone survey of charter boat operators and a pilot logbook survey. Surveys began in September 1997 and continued through August 1998. An evaluation of the program is scheduled for completion during July 1999. In addition, FDEP 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 provide information on their catch statistics and fish measurements

A Recreational Fisheries Information Network (RECFIN)/Biological Environmental Work Group made recommendations to develop methods for collecting data on fishing tournaments, non-hook and line fisheries, private access points, night fishing activities and evaluate the potential to stratify at finer geographic levels, Within the region, the highest frequency of night fishing trips occurs on the west coast of Florida. RECFIN Biological/Environmental Work Group meetings were cancelled in Puerto Rico due to Hurricane Georges and were rescheduled for Tampa during November.

While the current sport fish monitoring project is evaluating various aspects of catch/harvest rates, relative abundance, total estimated harvest, and fishing/boating activity, additional areas of work are underway or needed. These include: (1) current/updated stock assessments on other major game fish species including black drum, sheepshead, barracuda, and others using separable virtual population analysis

(SVPA), SPR, and sequential population analysis (SPA), (2) new age-length keys for major species, especially resident species such as snook and seatrout (seatrout/snook/red drum otoliths/scales have and will be collected by park cooperators and await analysis at Florida Marine Research Institute; collection and analyses of snook hard parts is underway), (3) analysis of a 12 year non-guide/guide database, including fish length analysis from 1986-1996, done cooperatively by FDEP and ENP is scheduled for completion during June 1999, (4) incorporate the fisheries database into the park's GIS system for spatially oriented ecological applications, (5) a long-term (12 year) Florida Bay CPUE/HPUE stock assessment of major species was completed and updated to reflect 1997-98 catches, (6) develop a new fishery data management handbook, and (7) 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. As a result of updating the fisheries database for the park's ORACLE database, it was determined that commercial/guide data from 1972-85 needed to be re-entered to correct previously computerized catch data errors. This will be done cooperatively by FDEP and ENP.

ACKNOWLEDGMENTS

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Table 1. Recreational catch/harvest rates (per angler-hour) of non-guided anglers in Everglades National Park, 1998.

Non-Guide Anglers (Areas 1-5)				
Species	**CPUE ±95% Conf. Interval**	**HPUE ±95% Conf. Interval**	**Sample Size * CPUE/HPUE**	
Snook	0.2285 ± 0.0220	0.1076 ± 0.0096	822	224
Red Drum	0.3842 ± 0.0357	0.1242 ± 0.0051	1,295	676
Spotted Seatrout	0.8231 ± 0.0612	0.3094 ± 0.0186	1,675	970
Gray Snapper	0.6461 ± 0.0426	0.2632 ± 0.0239	1,296	538
Tarpon	0.1807 ± 0.0257	0.1667	190	1
Black Drum	0.2801 ± 0.0567	0.1806 ± 0.0367	175	123
Sheepshead	0.3515 ± 0.0511	0.1351 ± 0.0209	309	108
Spanish Mackerel	0.0975 ± 0.0271	0.0979 ± 0.0337	23	16
Grouper	0.1887 ± 0.0466	0.1134 ± 0.0456	68	19
Ladyfish	0.3353 ± 0.0283	0.1515 ± 0.0579	936	16
Crevalle Jack	0.4324 ± 0.0215	0.1819 ± 0.0387	2,237	116
Other Species	0.3117 ± 0.0179	0.1617 ± 0.0325	2,962	199
Non-Guide Anglers (Areas 1-6)				
Species	**CPUE ±95% Conf. Interval**	**HPUE ±95% Conf. Interval**	**Sample Size * CPUE/HPUE**	
Snook	0.2858 ± 0.0179	0.1318 ± 0.0097	1,915	654
Red Drum	0.3250 ± 0.0239	0.1274 ± 0.0058	2,165	1,188
Spotted Seatrout	0.7616 ± 0.0456	0.2967 ± 0.0149	2,632	1,555
Gray Snapper	0.5999 ± 0.0322	0.2429 ± 0.0208	2,050	725
Tarpon	0.1658 ± 0.0215	0.1667	234	1
Black Drum	0.2367 ± 0.0430	0.1639 ± 0.0293	239	160
Sheepshead	0.3168 ± 0.0324	0.1369 ± 0.0154	612	201
Spanish Mackerel	0.1811 ± 0.0633	0.1297 ± 0.0383	65	50
Grouper	0.2112 ± 0.0332	0.1437 ± 0.0401	167	35
Ladyfish	0.3459 ± 0.0233	0.1739 ± 0.0397	1,757	83
Crevalle Jack	0.4223 ± 0.0175	0.2057 ± 0.0387	3,738	174
Other Species	0.3007 ± 0.0148	0.3944 ± 0.0928	5,735	503

* Number of fishing parties.

Table 2. Recreational catch/harvest rates (per angler-hour) of guided anglers in Everglades National Park, 1998.

Guide Anglers (Areas 1-5)				
Species	**CPUE ±95% Conf. Interval**	**HPUE ±95% Conf. Interval**	**Sample Size * CPUE/HPUE**	
Snook	0.2380 ± 0.0189	0.1105 ± 0.0070	929	358
Red Drum	0.3918 ± 0.0230	0.1240 ± 0.0075	1,557	623
Spotted Seatrout	1.434 ± 0.0692	0.4205 ± 0.0219	1,834	747
Gray Snapper	1.316 ± 0.1165	0.5179 ± 0.0440	525	252
Tarpon	0.2017 ± 0.0222	0.4583 ± 0.5355	570	3
Bonefish	0.2902 ± 0.0362	N/A	299	0
Other Species	0.5060 ± 0.0212	0.1995 ± 0.0150	3,722	677
Guide Anglers (Areas 1-6)				
Species	**CPUE ±95% Conf. Interval**	**HPUE ±95% Conf. Interval**	**Sample Size * CPUE/HPUE**	
Snook	0.3292 ± 0.0147	0.1248 ± 0.0058	2,121	807
Red Drum	0.4320 ± 0.0214	0.1273 ± 0.0047	2,580	1,217
Spotted Seatrout	1.368 ± 0.0570	0.4160 ± 0.0176	2,553	1,192
Gray Snapper	1.200 ± 0.0872	0.4441 ± 0.0343	761	368
Tarpon	0.1893 ± 0.0176	0.4583 ± 0.5355	766	3
Bonefish	0.2902 ± 0.0362	N/A	299	0
Other Species	0.4732 ± 0.0174	0.1939 ± 0.0127	4,913	999

* Number of fishing parties.

Table 3. Total estimated catch/harvest by recreational anglers from Everglades National Park, 1998.

Non-Guide Anglers				
	Florida Bay		Florida Bay & Everglades City	
Species	Catch	Harvest	Catch	Harvest
Snook	14,641	2,326	39,952	5,805
Red Drum	40,366	7,364	51,314	11,593
Spotted Seatrout	109,310	25,772	145,592	36,593
Gray Snapper	77,267	14,147	115,049	16,710
Tarpon	2,417	4	2,812	5
Black Drum	4,689	2,301	4,461	2,636
Sheepshead	12,228	1,614	15,457	2,389
Spanish Mackerel	253	179	947	608
Grouper	1,433	238	3,341	504
Ladyfish	28,700	212	47,688	1,070
Crevalle Jack	88,193	1,871	120,098	2,827
Other species	80,894	3,133	126,427	13,533
Total	460,391	59,161	673,138	94,273
Guide Anglers				
	Florida Bay		Florida Bay & Everglades City	
Species	Catch	Harvest	Catch	Harvest
Snook	6,748	1,335	21,797	3,355
Red Drum	18,440	2,751	34,256	5,411
Spotted Seatrout	73,362	11,833	101,093	18,208
Gray Snapper	20,601	4,141	27,750	5,332
Tarpon	2,624	31	3,513	31
Bonefish	1,553	0	1,553	0
Other Species	52,583	5,533	66,092	7,508
Total	175,912	25,624	256,053	39,844

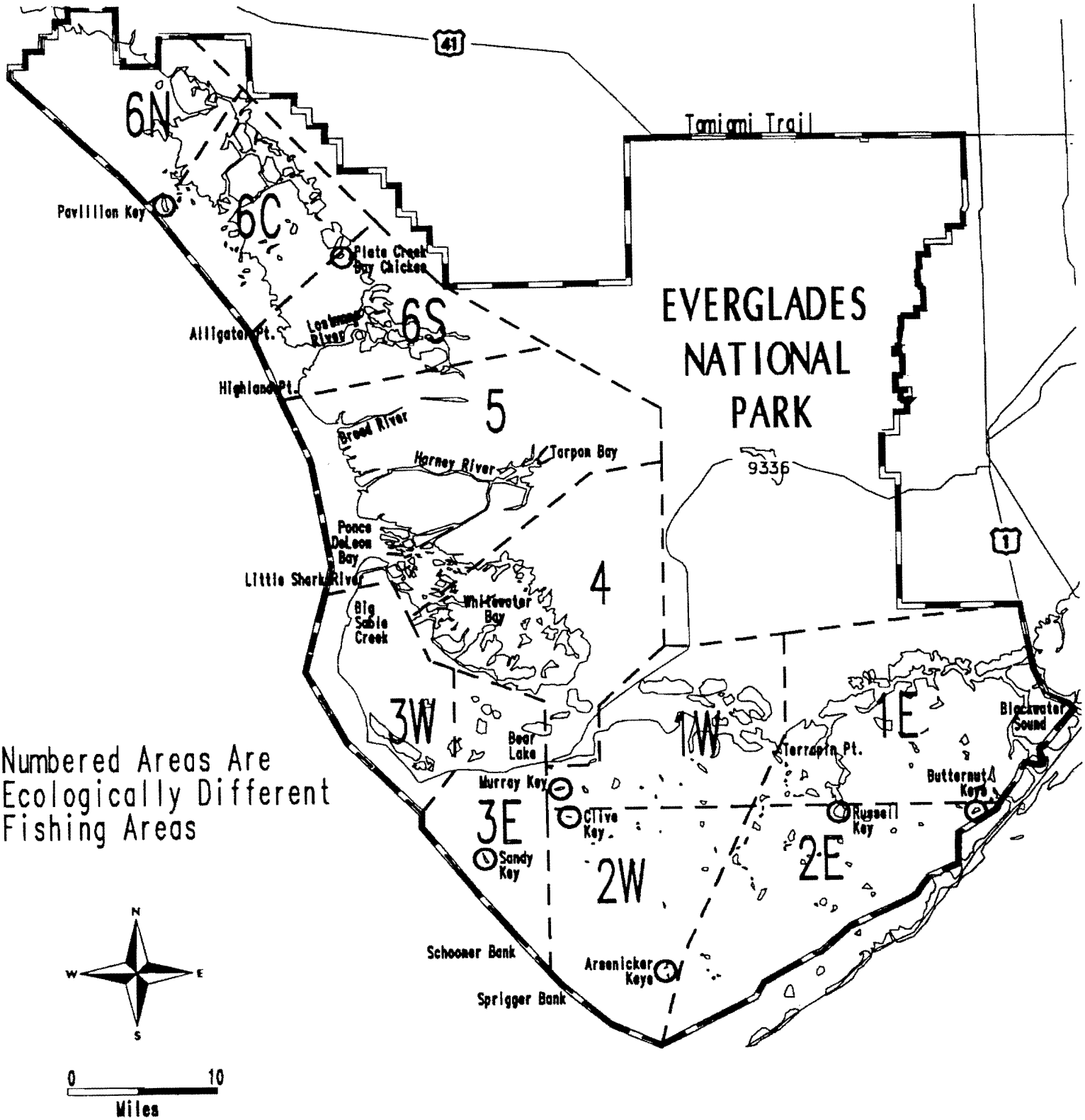
Table 4. The mean length of red drum harvested in each of the six ecologically distinct fishing areas in ENP, and the results of the Tukey multiple comparison tests. Asterisks (**) indicate that the test was significant ($p<0.05$), while "NS" indicates that the test was not significant ($p>0.05$).

	Mean Length (mm)	N
Area 1	562.1	223
Area 2	564.4	22
Area 3	524.7	140
Area 4	510.6	88
Area 5	537.7	98
Area 6	536.2	459

	Area 1	Area 2	Area 3	Area 4	Area 5	Area 6
Area 1	---	---	---	---	---	---
Area 2	NS	---	---	---	---	---
Area 3	**	**	---	---	---	---
Area 4	**	**	NS	---	---	---
Area 5	**	NS	NS	**	---	---
Area 6	**	NS	NS	**	NS	---

Fig. 1:

RECREATIONAL/GUIDE FISHING AREAS EVERGLADES NATIONAL PARK



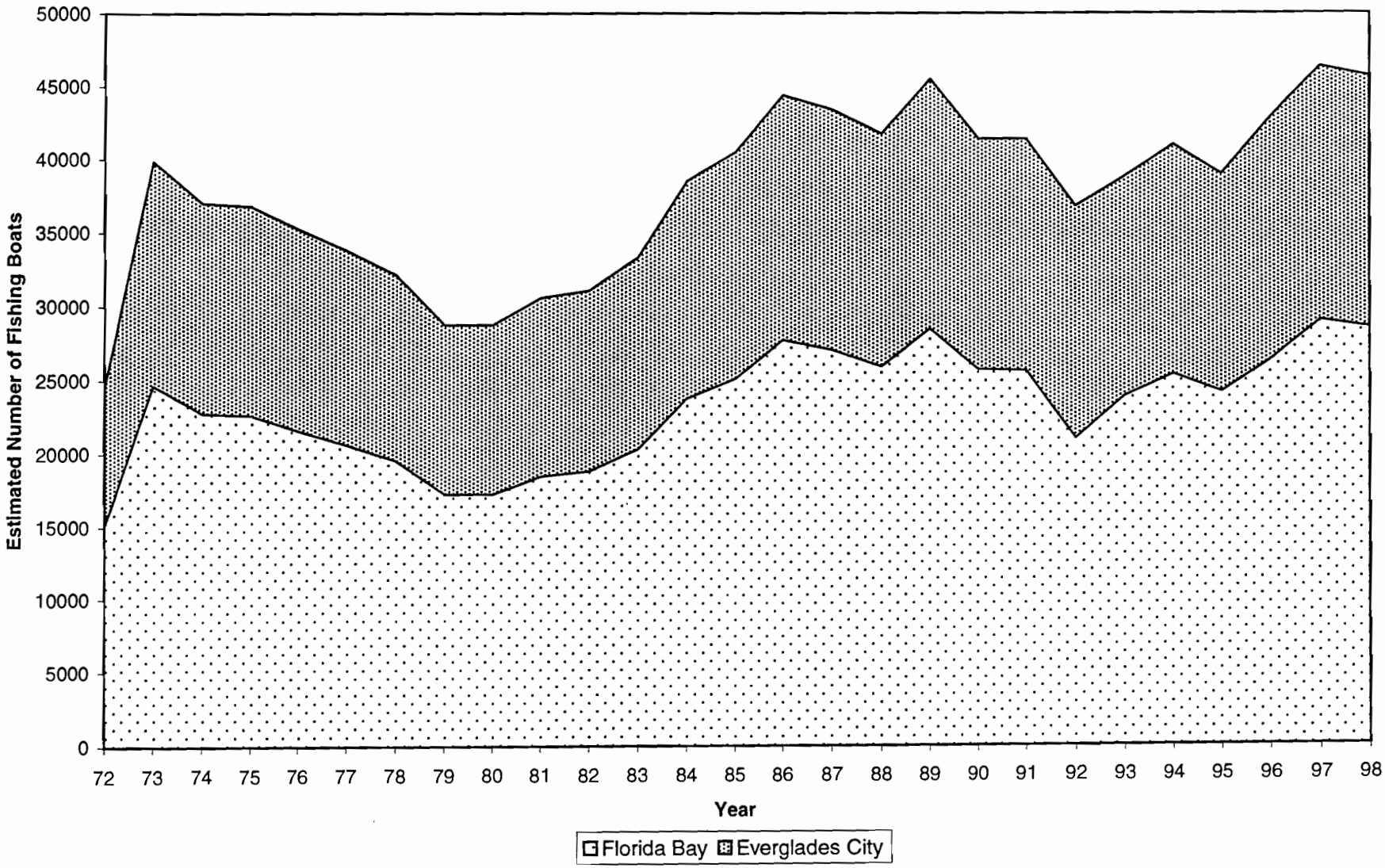


Figure 2. Estimated number of fishing boats within Everglades National Park, 1972-1998.

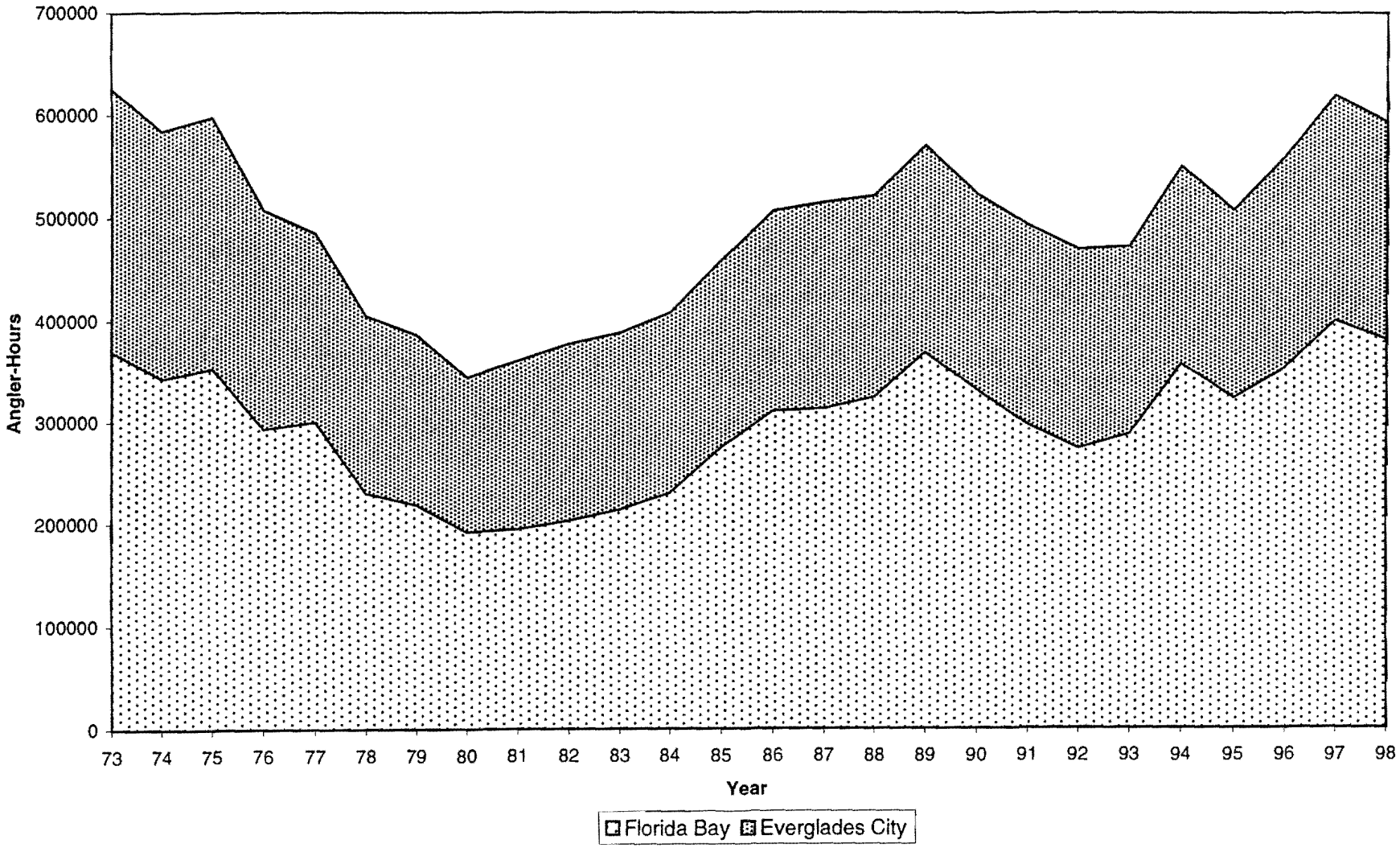


Figure 3. Estimated total effort (Angler-Hours) of non-guided fishermen within Everglades National Park, 1979-1998.

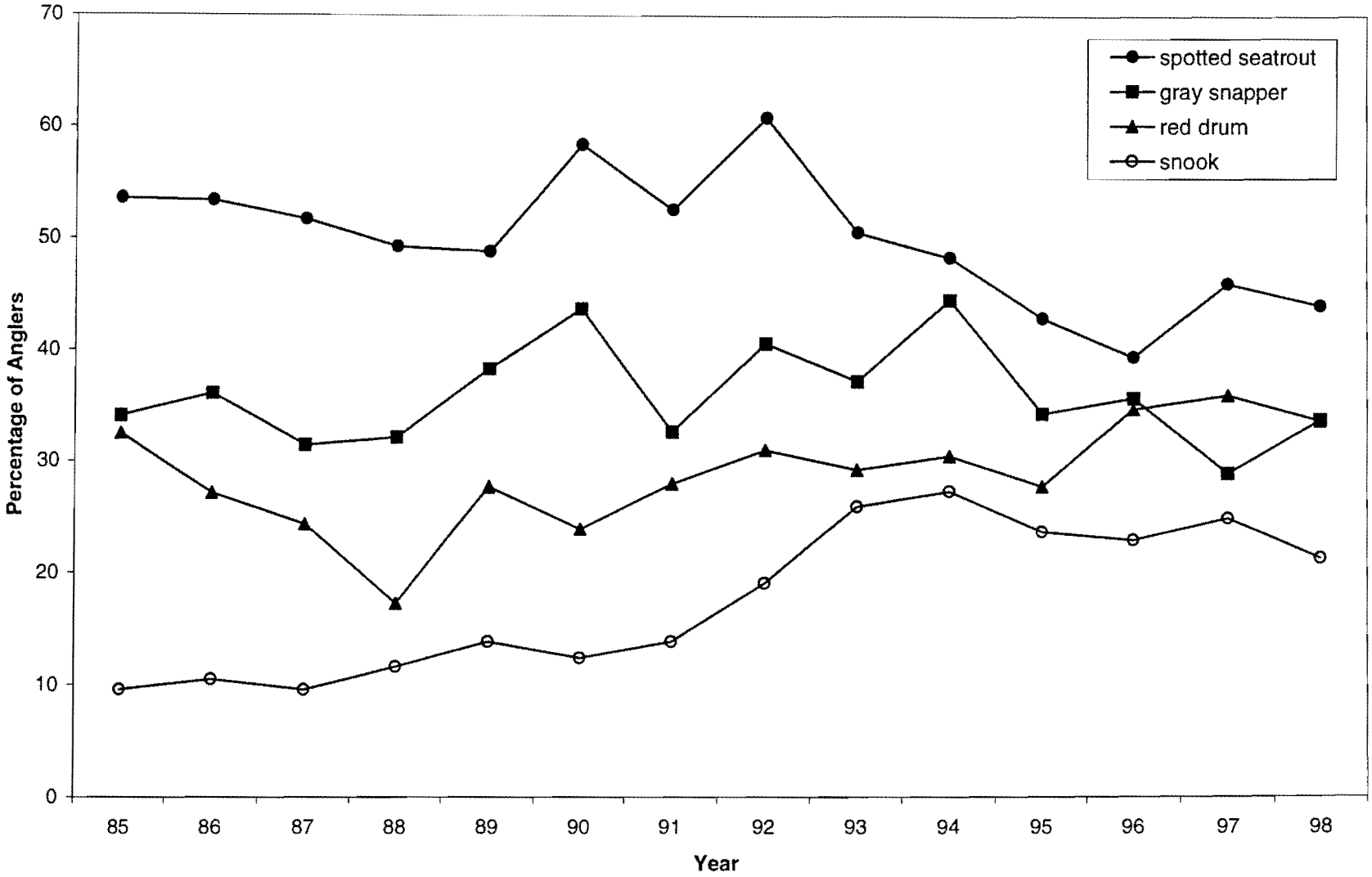


Figure 4. Percentage of anglers interviewed at Flamingo (Areas 1 to 5) catching spotted seatrout, gray snapper, red drum, and snook from 1985 to 1998.

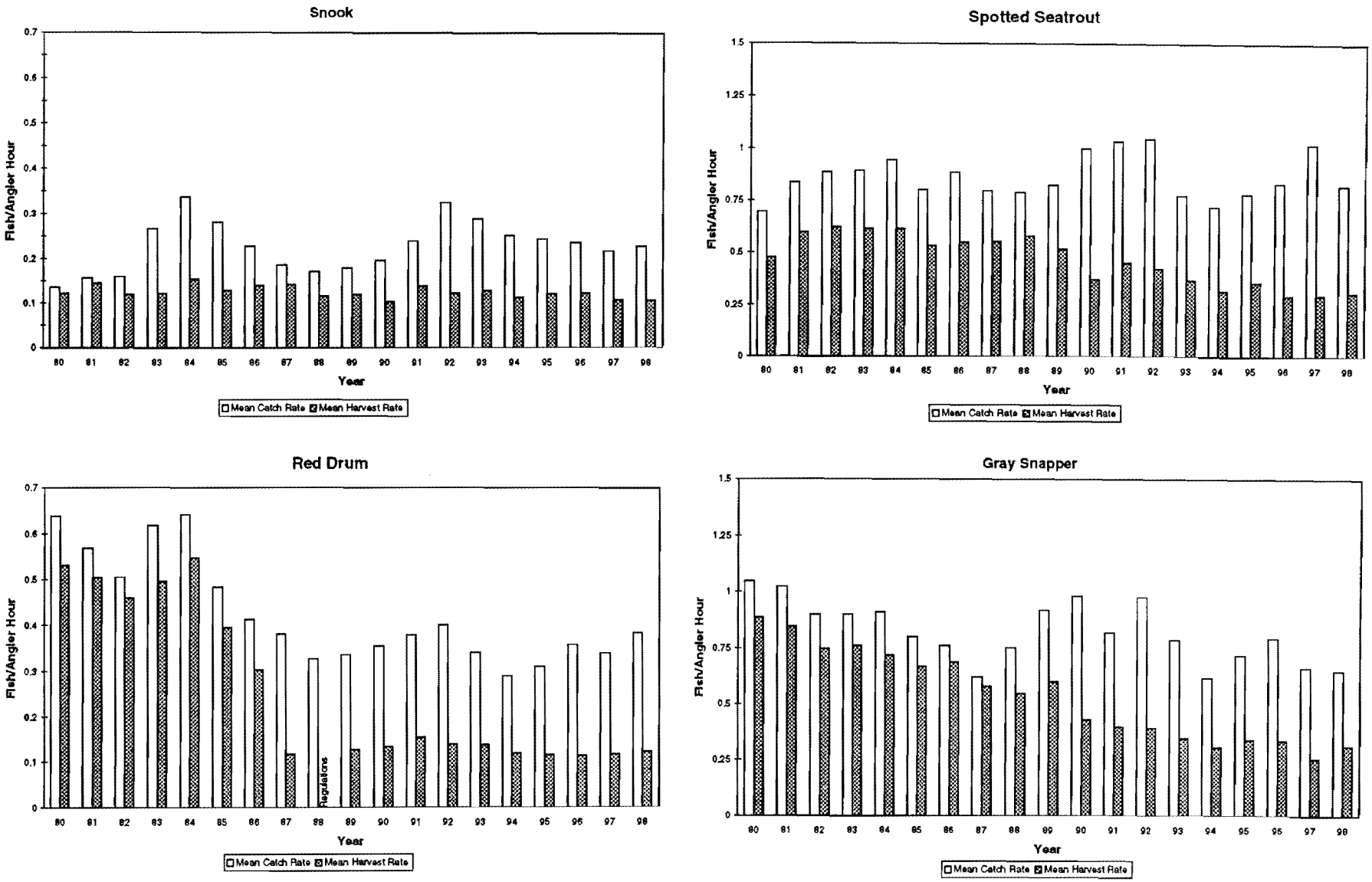


Figure 5. Recreational non-guided catch and harvest rates for the four major species of game fish in Everglades National Park (Areas 1-5), 1980-1998.

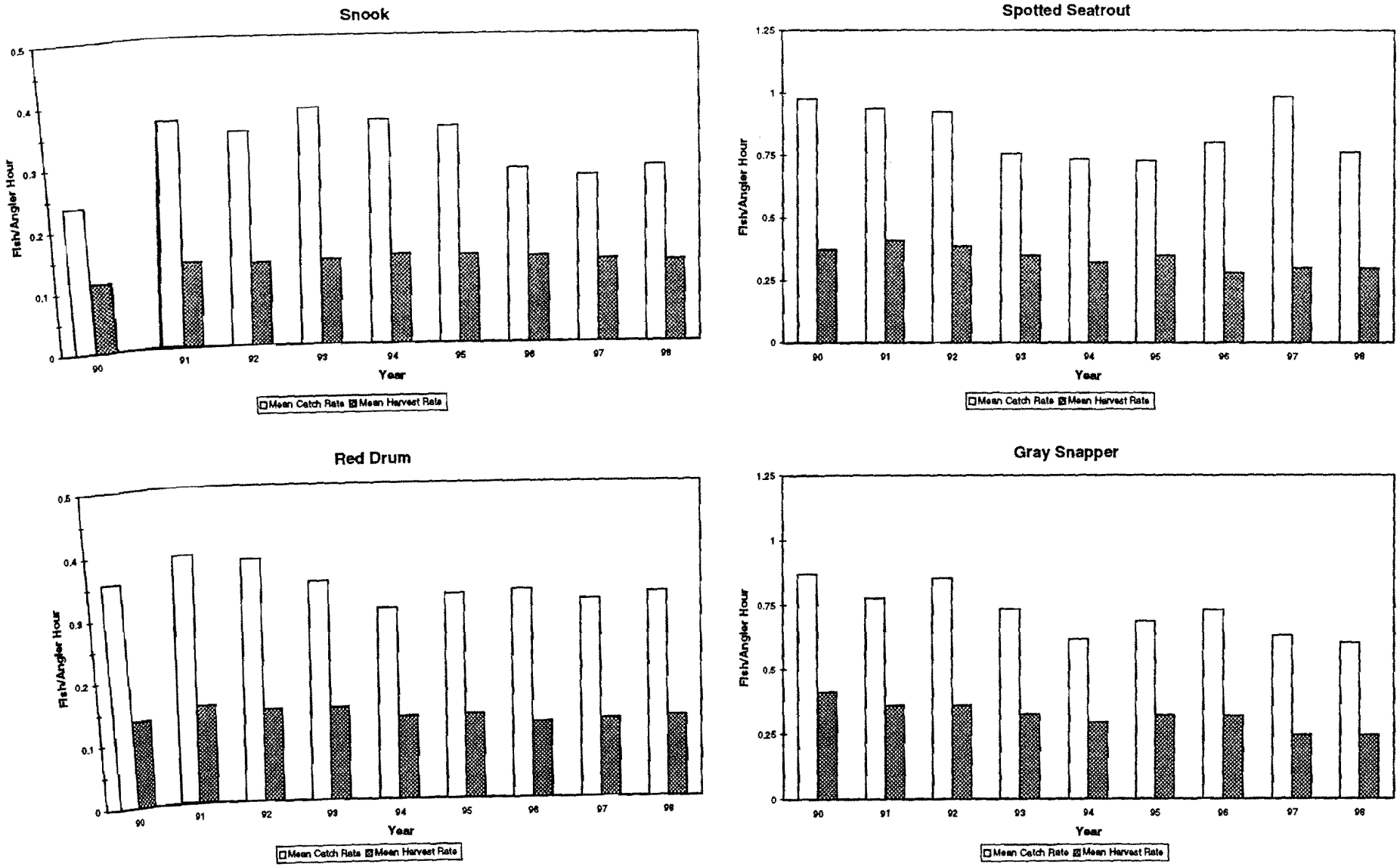


Figure 6. Recreational non-guided catch and harvest rates for the four major species of game fish in Everglades National Park (Areas 1-6), 1990-1998.

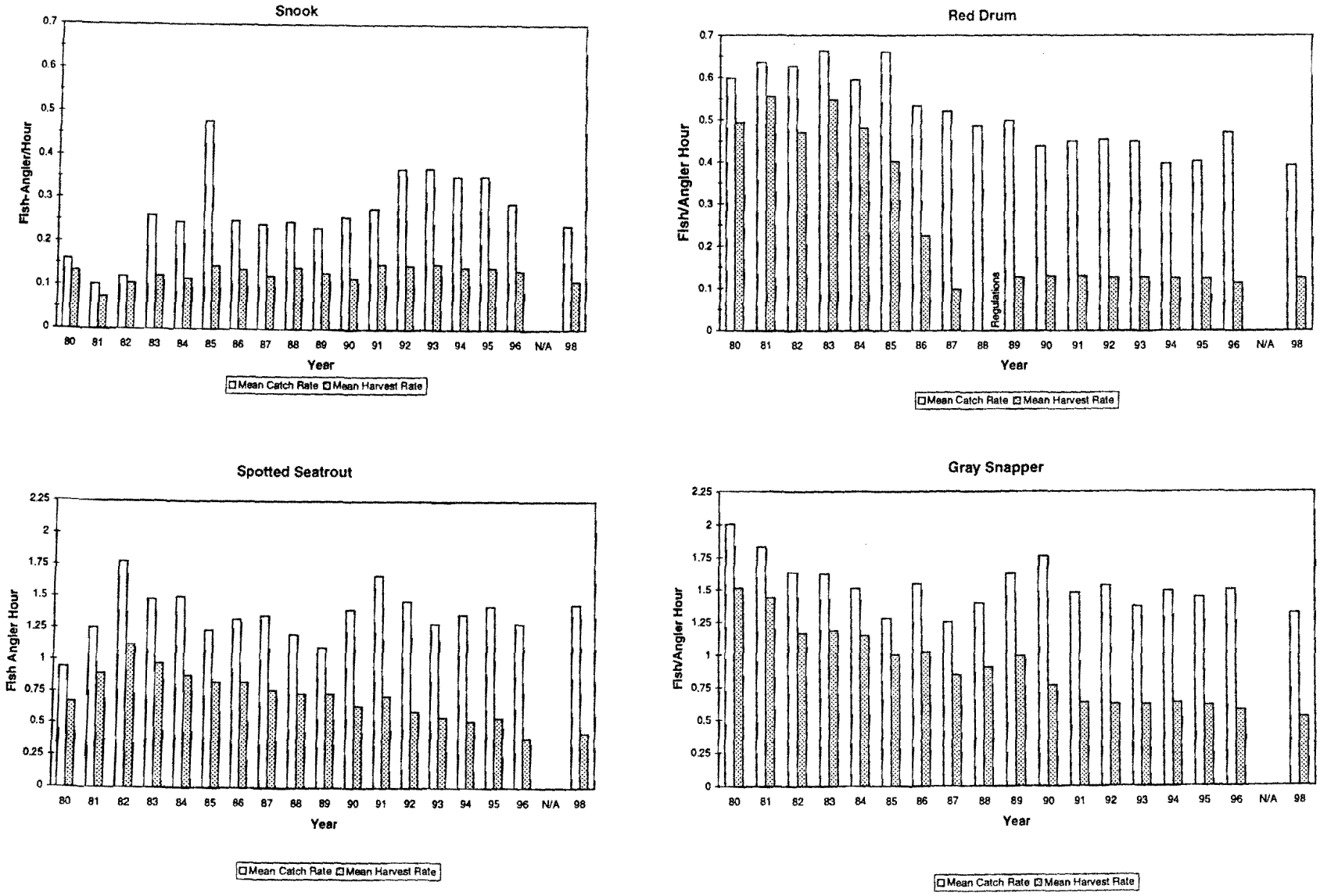


Figure 7. Recreational guide catch/harvest rates for the four major game fish species in Florida Bay (Areas 1-5), 1980-1996, 1998.

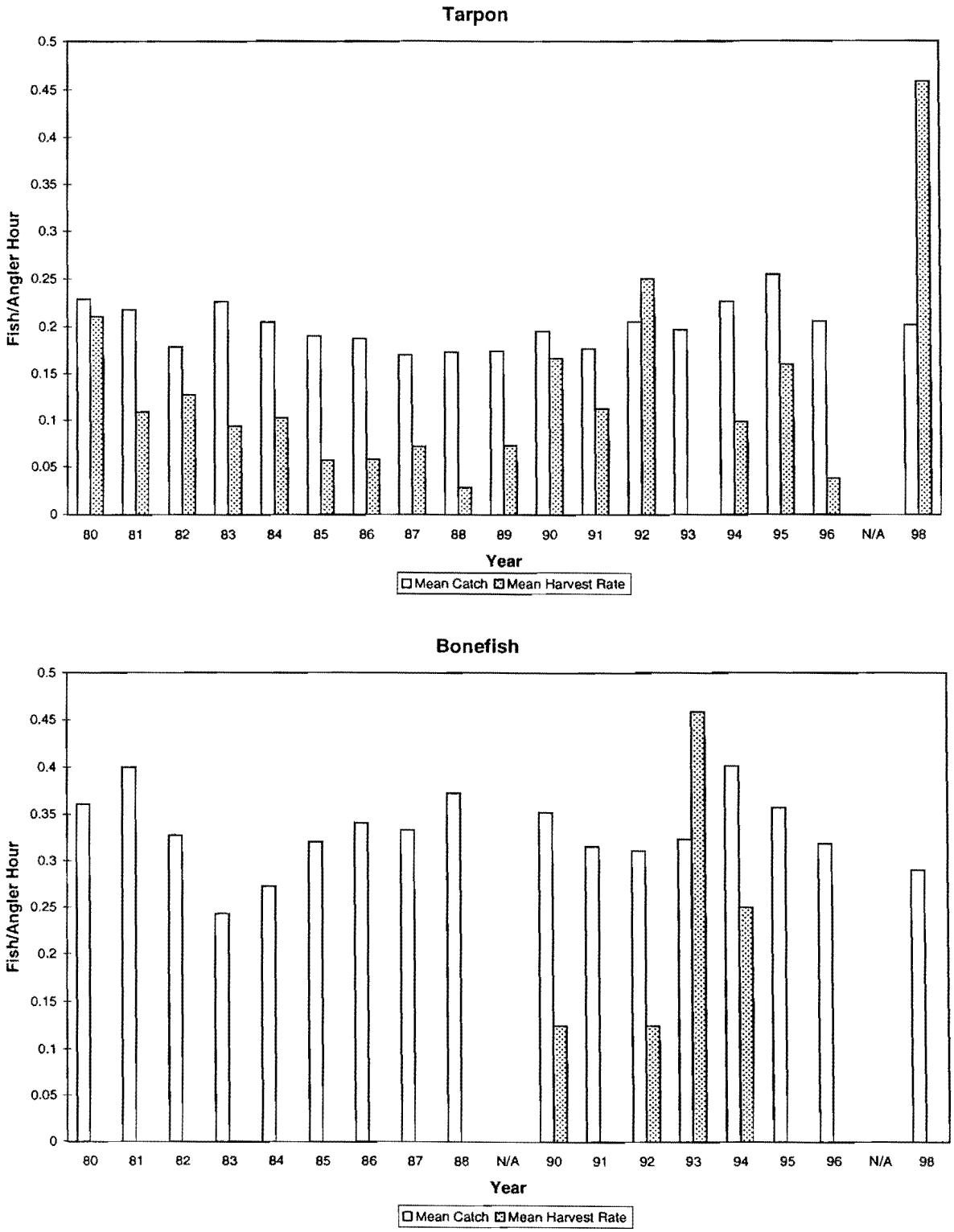


Figure 8. Recreational guide catch/harvest rates for tarpon and bonefish in Florida Bay (Areas 1-5) 1980-1996, 1998.

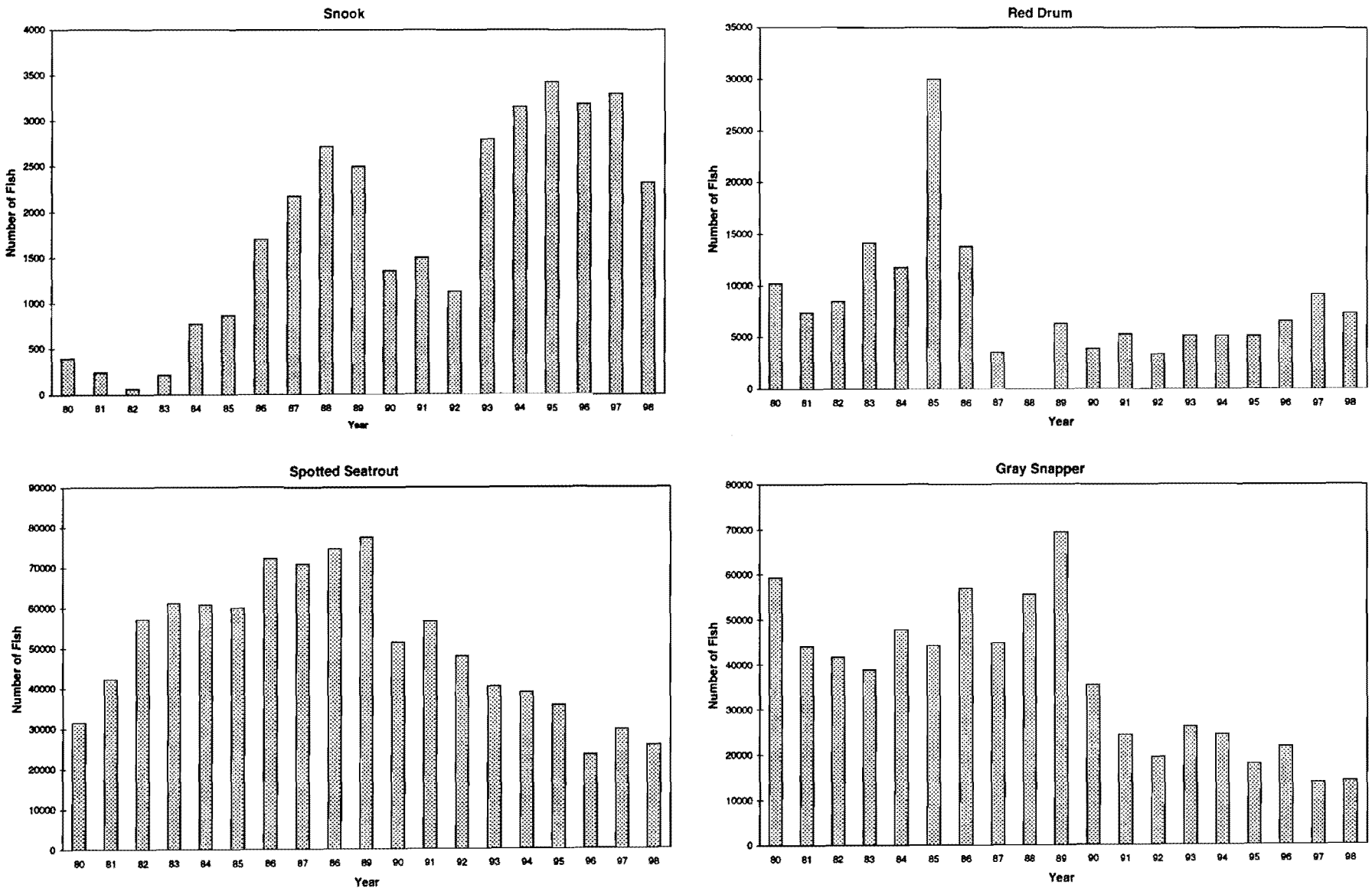


Figure 9. Estimated total harvest of snook, red drum, spotted seatrout, and gray snapper by non-guided anglers in Florida Bay (Areas 1-5), 1980-1998.

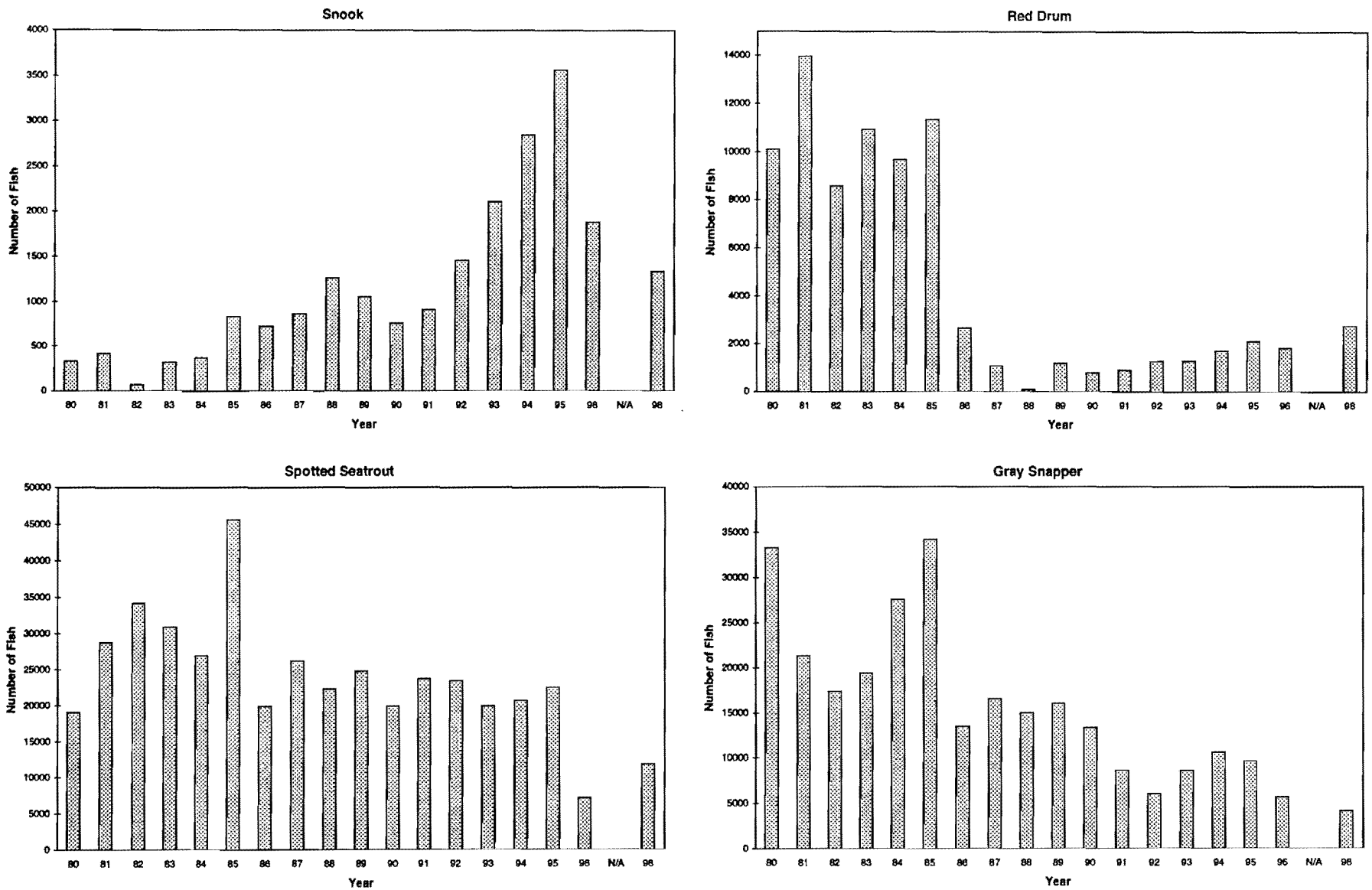


Figure 10. Estimated total harvest of snook, red drum, spotted seatrout, and gray snapper by guide anglers in Florida Bay (Areas 1-5), 1980-1996, 1998.

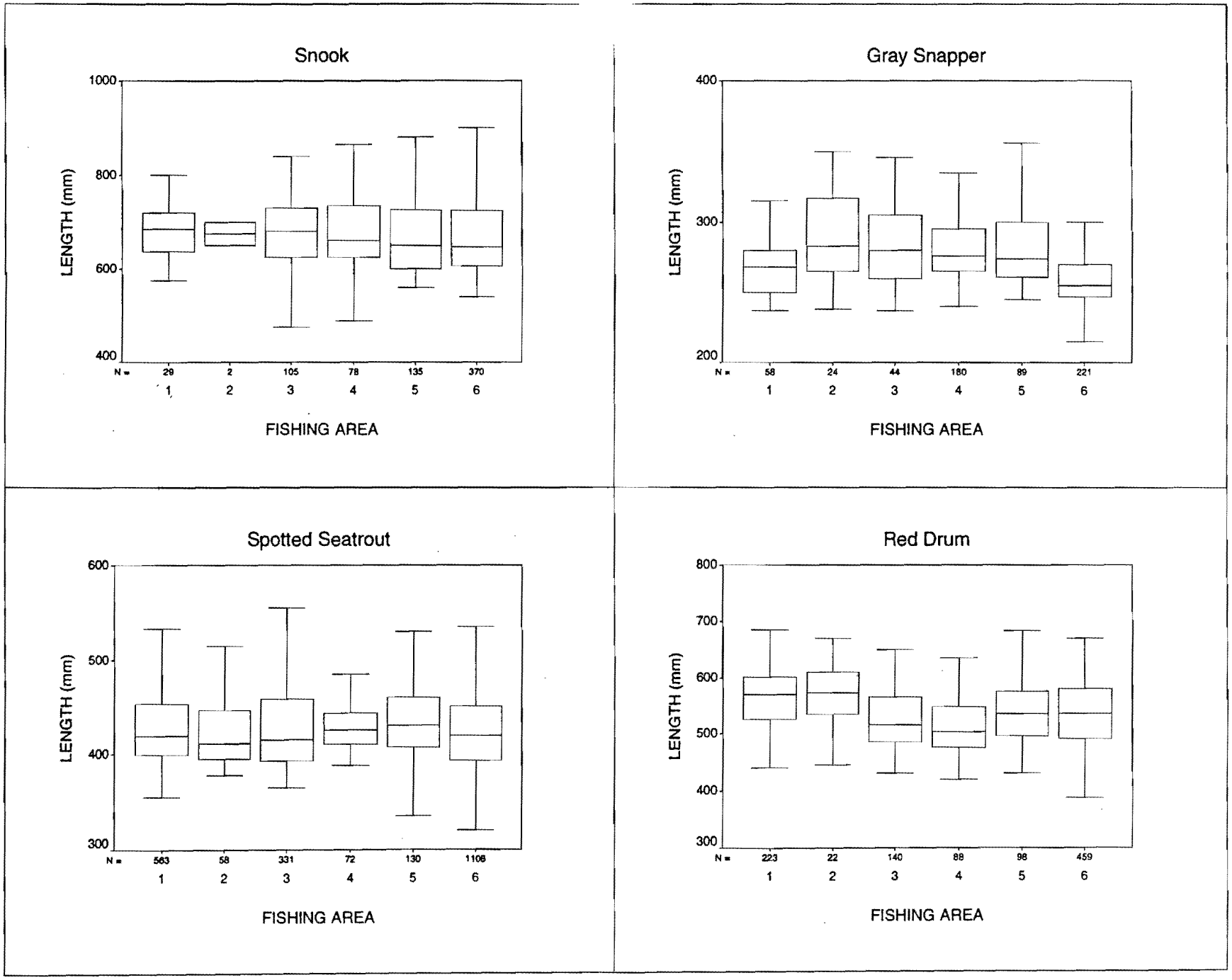


Figure 11. The mean lengths of the four major species of fish caught by recreational (non-guided) fishermen in the six ecologically distinct fishing areas in Everglades National Park during 1998. Error bars represent 95 percentiles; the horizontal line in the "box" represents the mean length; N represents the number of fish measured in each area.

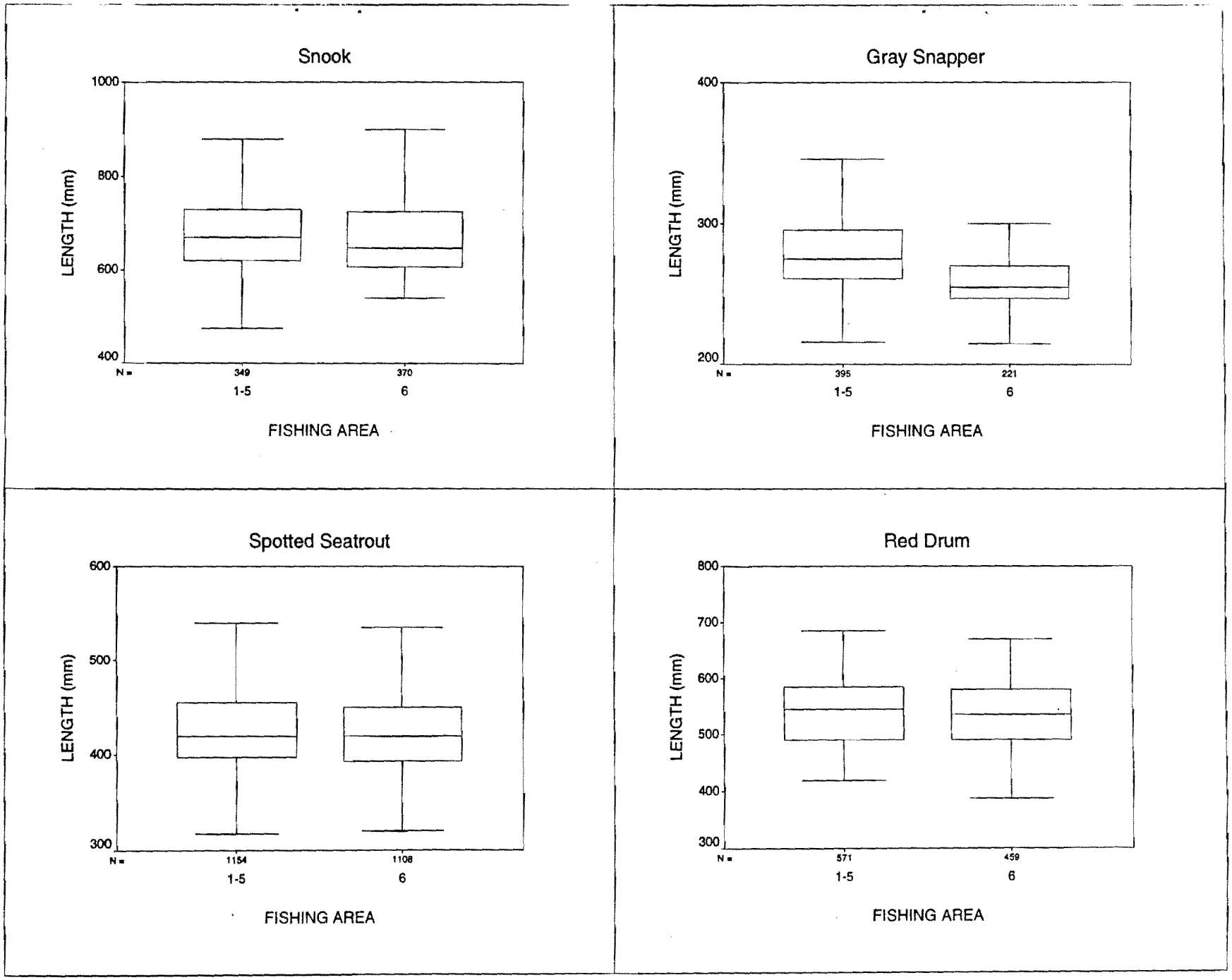


Figure 12. The mean lengths of the four major species of fish caught by recreational (non-guided) fishermen in Florida Bay (Areas 1-5) and Everglades City (Area 6) during 1998. Error bars represent 95 percentiles; the horizontal line in the "box" represents the mean length; N represents the number of fish measured in each area.

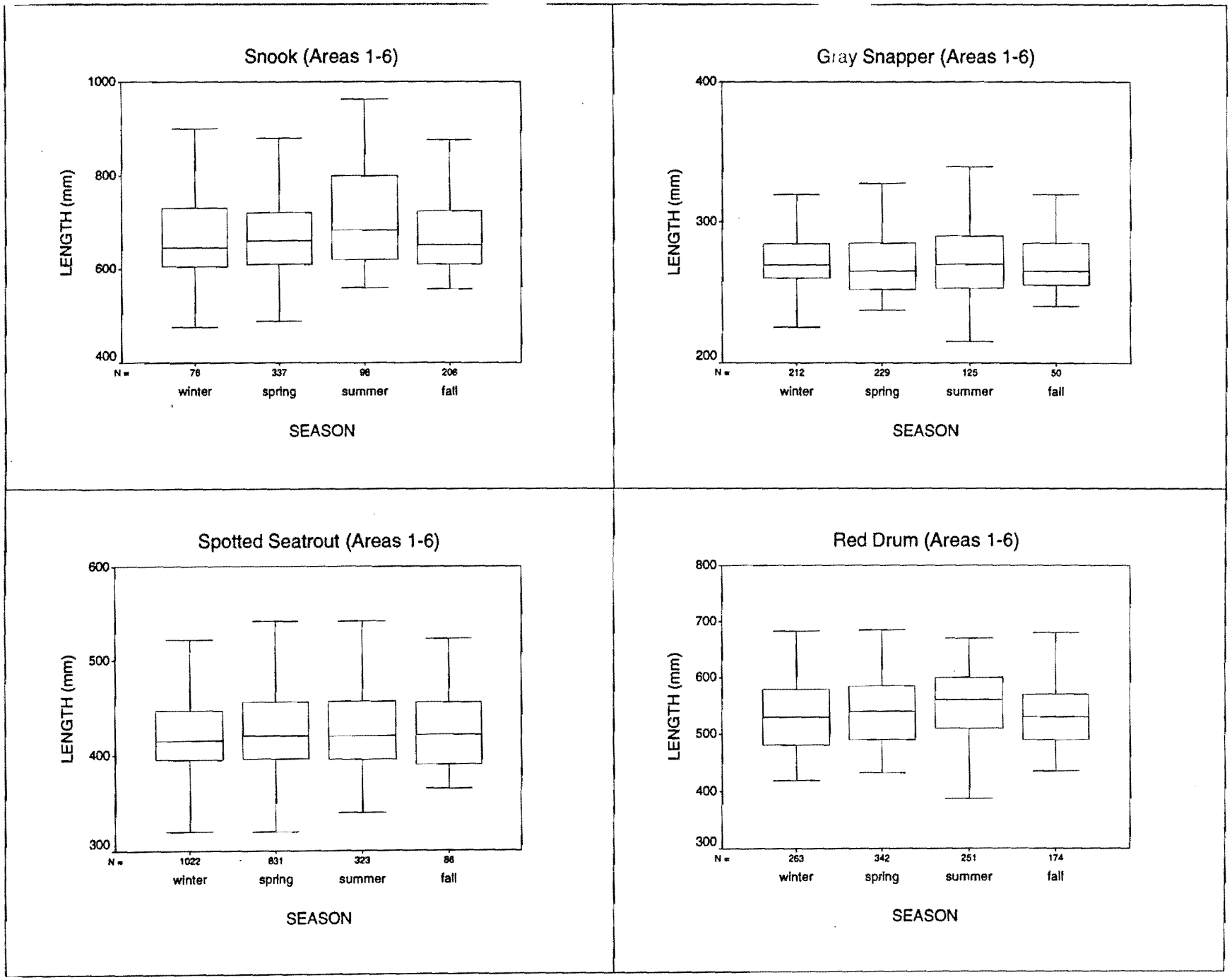


Figure 13. The mean lengths of the four major species of fish caught by recreational (non-guided) fishermen in Everglades National Park during the winter, spring, summer, and fall of 1998. Error bars represent 95 percentiles; the horizontal line in the "box" represents the mean length; N represents the number of fish measured in each season.

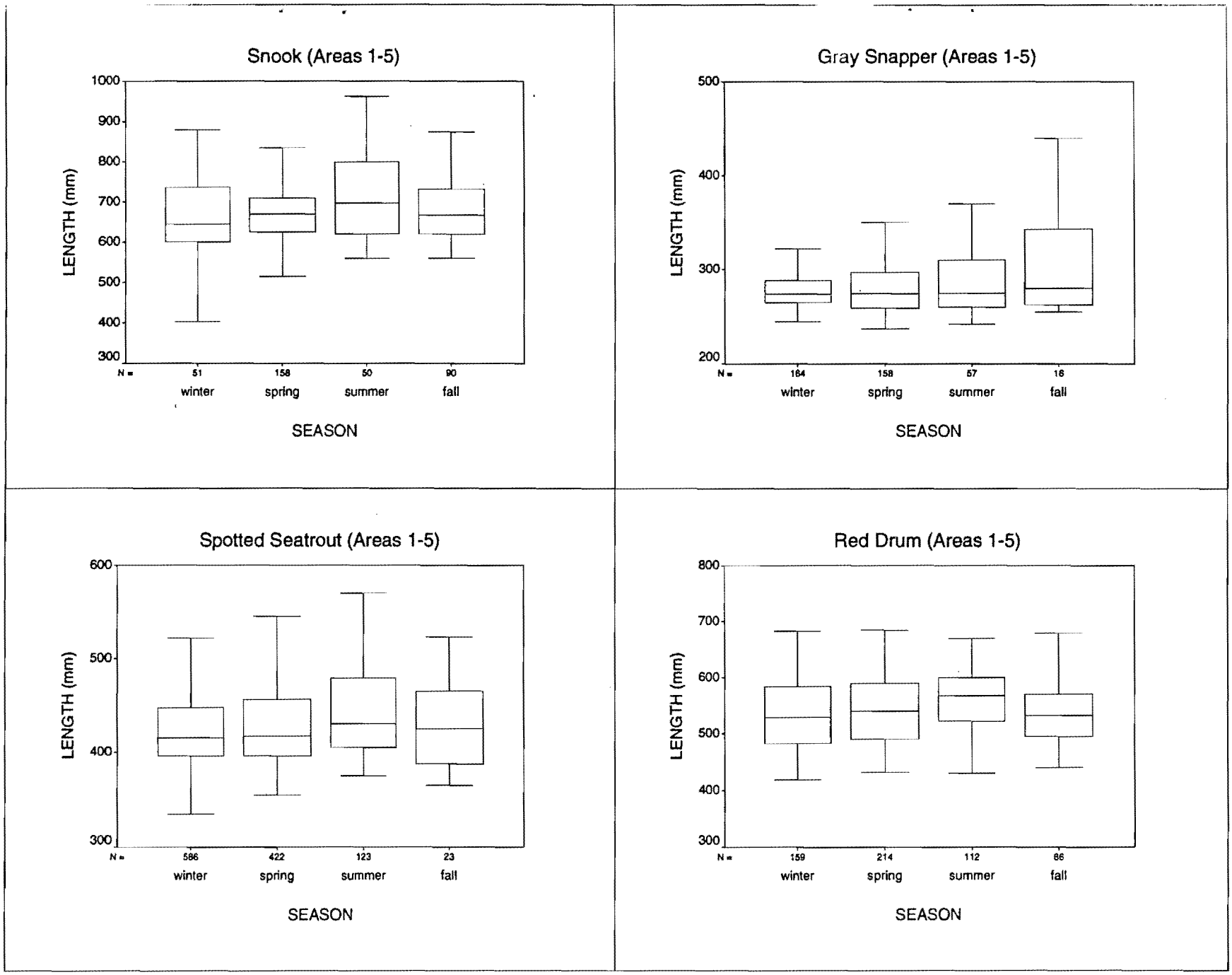


Figure 14. The mean lengths of the four major species of fish caught by recreational (non-guided) fishermen in Florida Bay (Areas 1-5) during the winter, spring, summer, and fall of 1998. Error bars represent 95 percentiles; the horizontal line in the "box" represents the mean length; N represents the number of fish measured in each season.

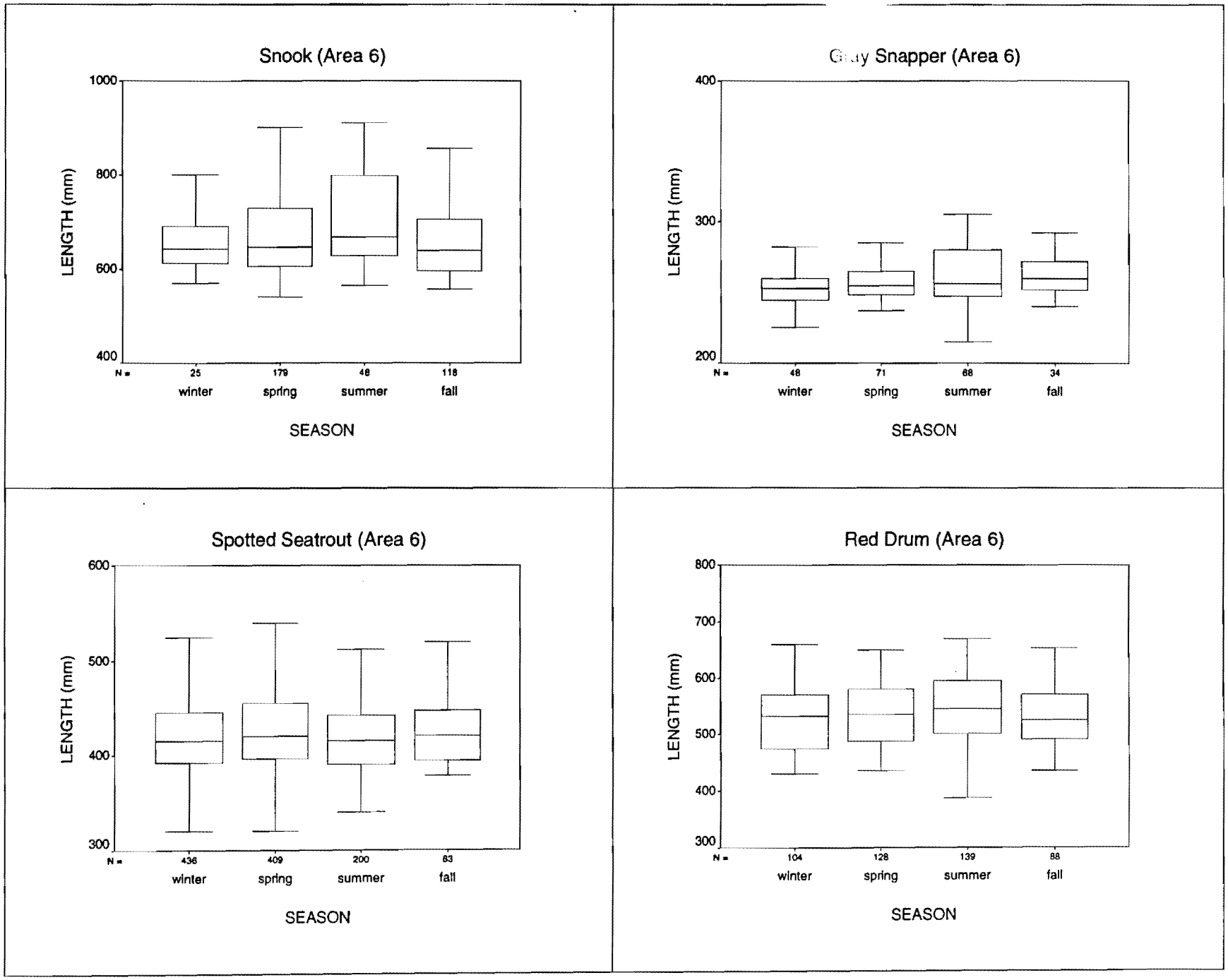


Figure 15. The mean lengths of the four major species of fish caught by recreational (non-guided) fishermen in Everglades City (Area 6) during the winter, spring, summer, and fall of 1998. Error bars represent 95 percentiles; the horizontal line in the "box" represents the mean length; N represents the number of fish measured in each season.

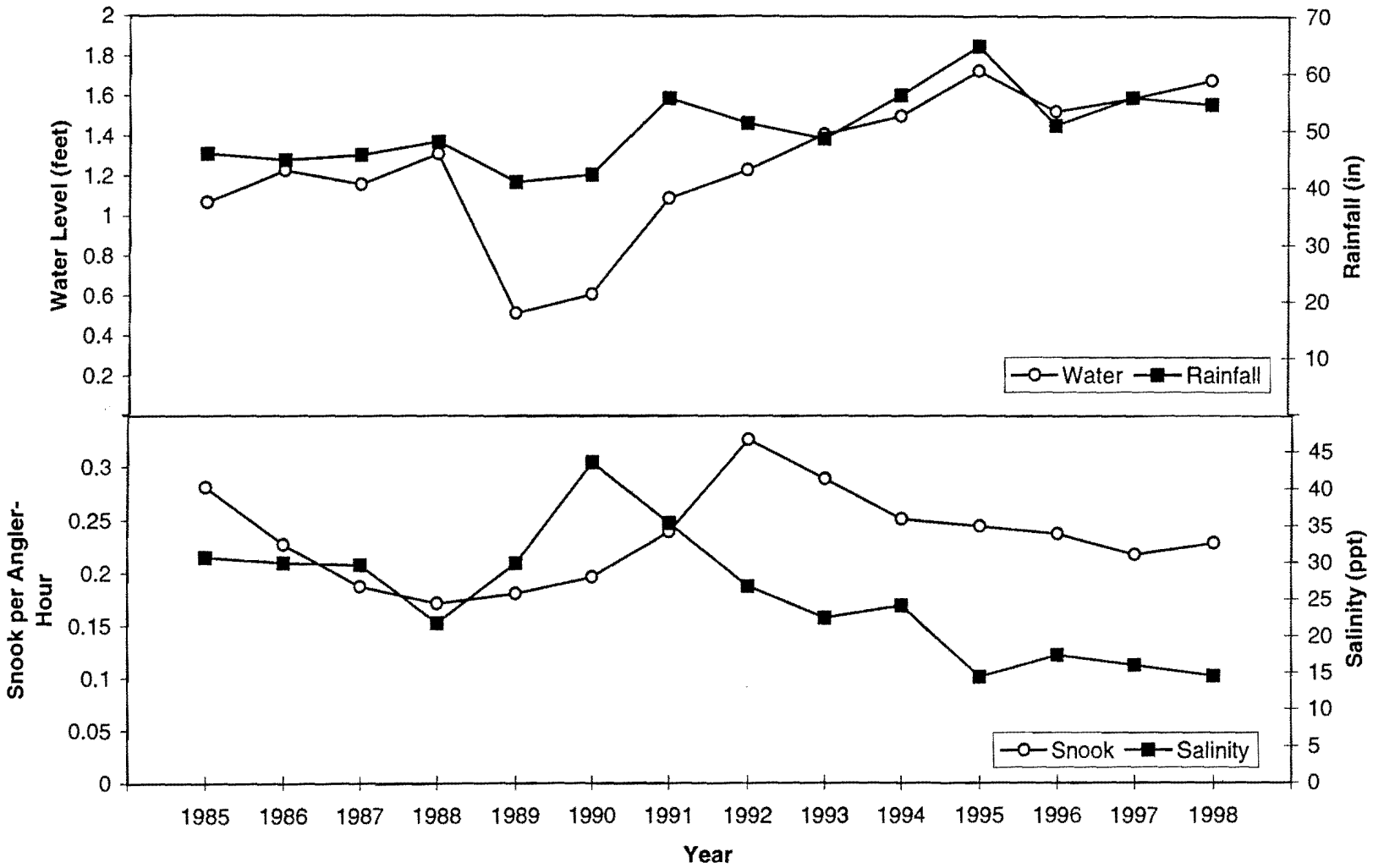


Figure 16. Average rainfall recorded at 5 stations in or near ENP, average water level at P-37 in Taylor Slough, average salinity at 3 stations in northern Florida Bay, and non-guide catch rates of Snook in Florida Bay (Areas 1-5) from 1985 to 1998.

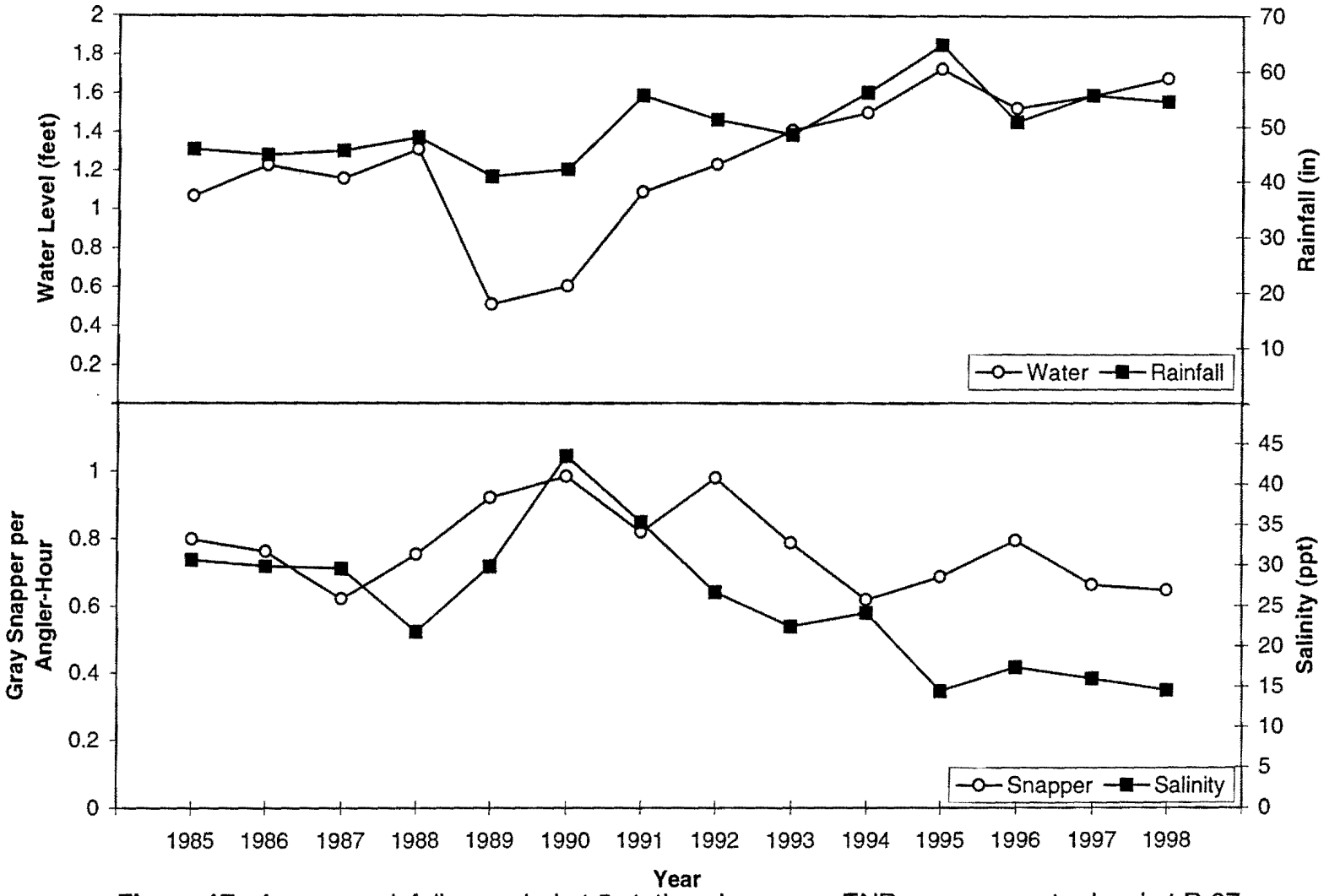


Figure 17. Average rainfall recorded at 5 stations in or near ENP, average water level at P-37 in Taylor Slough, average salinity at 3 stations in northern Florida Bay, and non-guide catch rates of Snapper in Florida Bay (Areas 1-5) from 1985 to 1998.

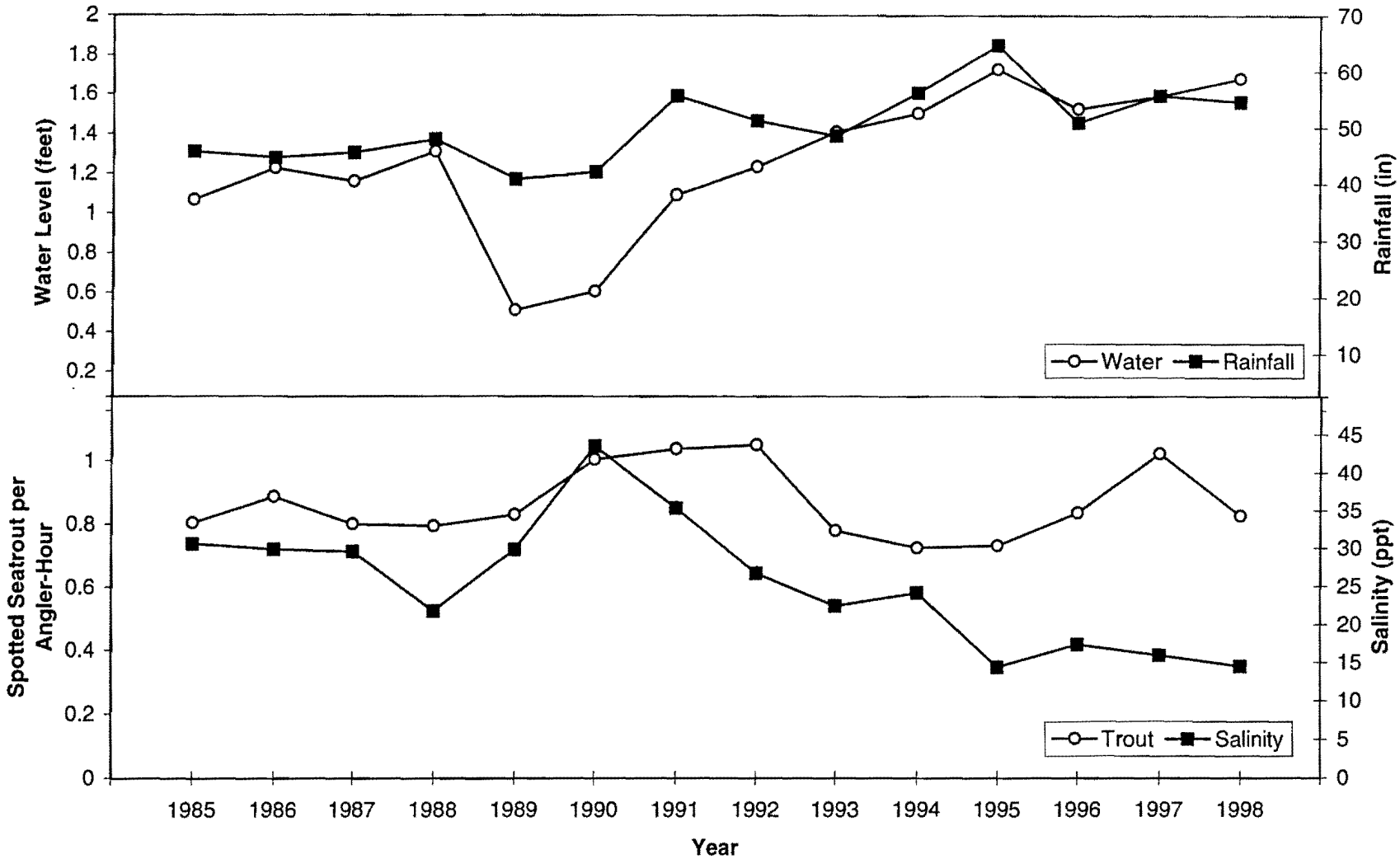


Figure 18. Average rainfall recorded at 5 stations in or near ENP, average water level at P-37 in Taylor Slough, average salinity at 3 stations in northern Florida Bay, and non-guide catch rates of Trout in Florida Bay (Areas 1-5) from 1985 to 1998.

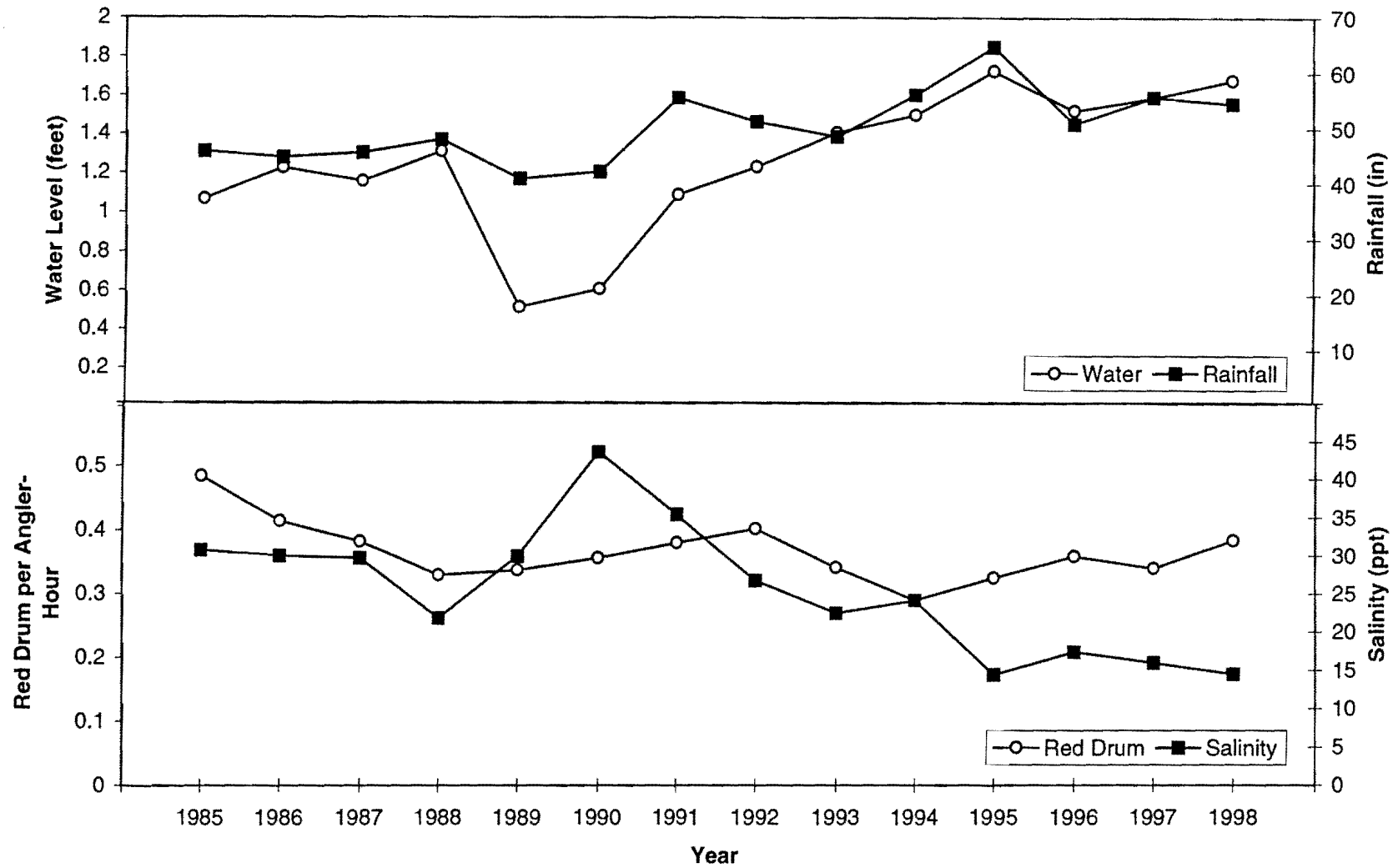


Figure 19. Average rainfall recorded at 5 stations in or near ENP, average water level at P-37 in Taylor Slough, average salinity at 3 stations in northern Florida Bay, and non-guide catch rates of Red Drum in Florida Bay (Areas 1-5) from 1985 to 1998.

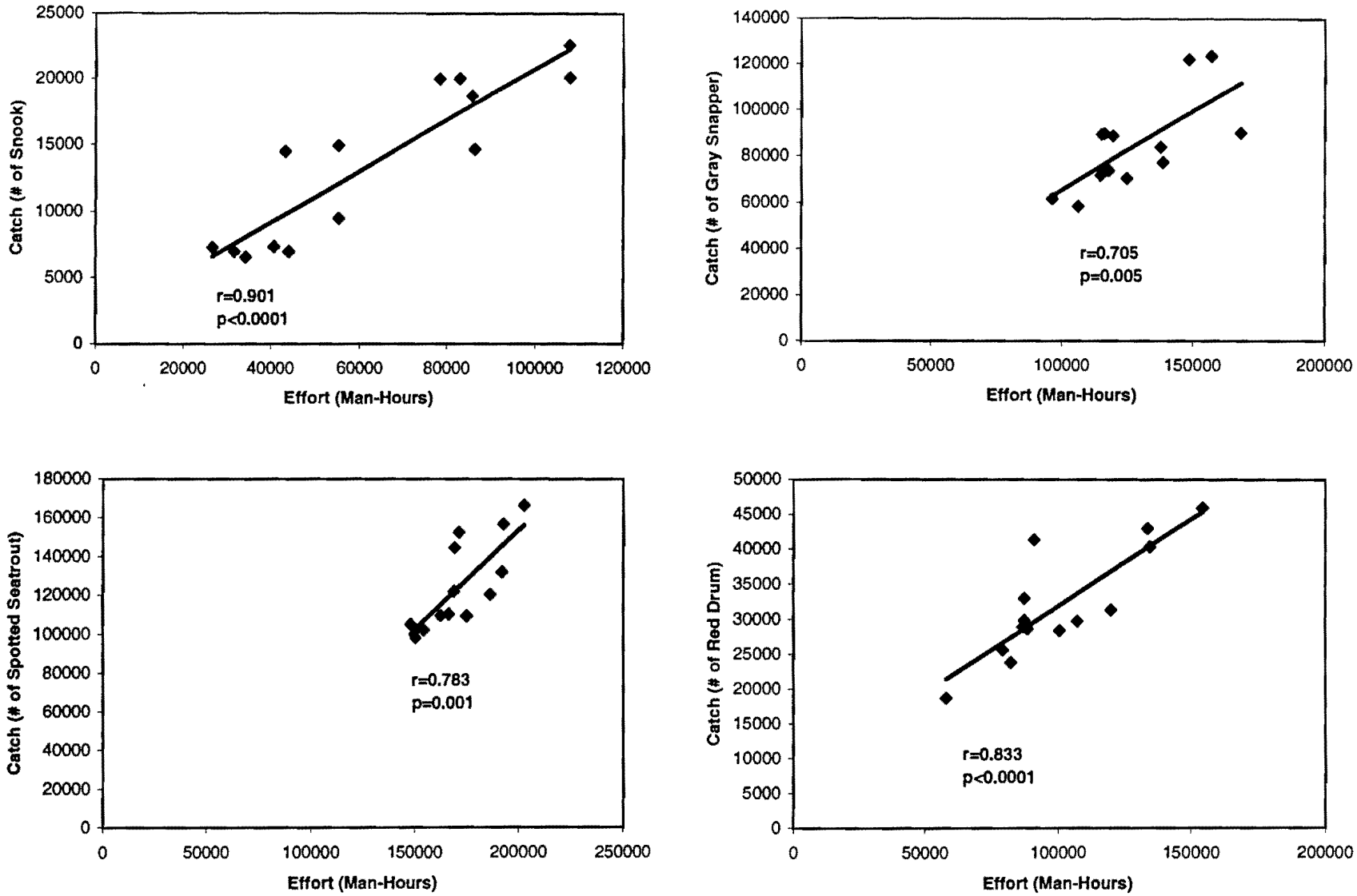


Figure 20. Correlation of total estimated catch and total estimated effort for snook, gray snapper, spotted seatrout, and red drum in Florida Bay (Areas 1-5), 1985-1998.