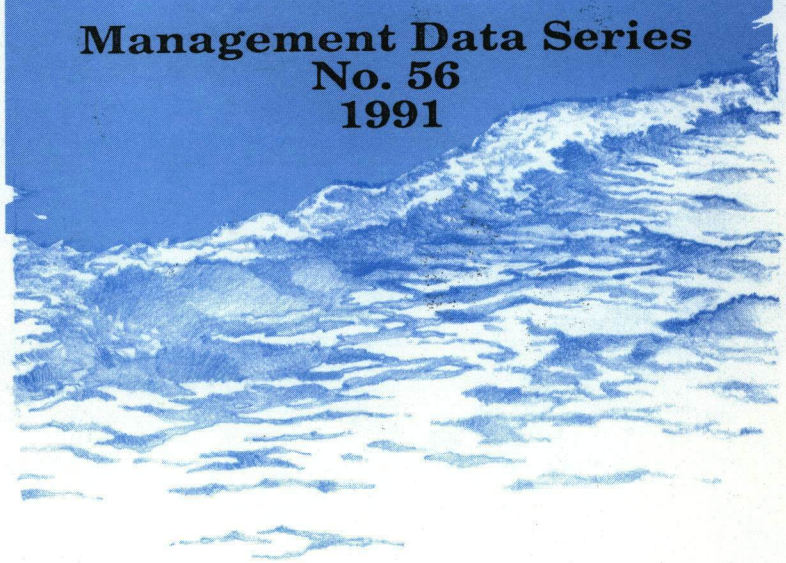
Trends In Finfish Landings, and Social and Economic Characteristics Of Sport-Boat Fishermen In Texas Marine Waters, May 1974–May 1989

by
Lee M. Green
R. Page Campbell
and
Kyle W. Spiller

Management Data Series
No. 56
1991



TEXAS
PARKS & WILDLIFE
DEPARTMENT

FISHERIES & WILDLIFE
DIVISION

4200 Smith School Road
Austin, Texas 78744

TRENDS IN FINFISH LANDINGS, AND SOCIAL AND ECONOMIC CHARACTERISTICS OF SPORT-BOAT FISHERMEN IN TEXAS MARINE WATERS, MAY 1974-MAY 1989

by

Lee M. Green,
R. Page Campbell,
and
Kyle W. Spiller

MANAGEMENT DATA SERIES
No. 56
1991

Texas Parks and Wildlife Department
Fisheries and Wildlife Division
Coastal Fisheries Branch
4200 Smith School Road
Austin, Texas 78744

ERRATA

for

Texas Parks and Wildlife Fisheries Division

MANAGEMENT DATA SERIES NO. 22

entitled

CULTURE OF RED DRUM FINGERLINGS

Page 16, PHOTOPERIOD - TEMPERATURE REGIME table

Temperature at day 140-150 should be 24 instead of 11 and hours of light/day should be 11 instead of 12.

TABLE OF CONTENTS

ACKNOWLEDGMENTS

We would like to thank each member of the Harvest and Resource Monitoring Programs who so conscientiously conducted interviews of fishermen. A special thank you is due each of the Harvest Monitoring Program team leaders -- Norma Classen, David Trimm, Mike Weixelman, Tom Wagner, Page Campbell, Lee Green, Kyle Spiller and Brett Dansby -- without whose assistance the program would not have been successfully completed. Thanks are also extended to Randy Blankinship, Brett Dansby, Rodney Girndt, Mike Hawes, Charlene Hons, Jerry Rihn, Rick Spaw, Lex Sutton and Tom Wagner for their assistance with table preparation. Al Green was responsible for designing the basic survey. Maury Osborn has been responsible for many of the modifications to the basic survey and for maintenance and enhancement of necessary computer systems. In its present format, Hal Osburn and Henry Maddux senior authored previous editions of this report. Thanks go to Lynn Benefield, C. E. Bryan, Paul Hammerschmidt, Tom Heffernan, Ed Hegen, Larry McEachron, Maury Osborn, Hal Osburn, Robin Riechers and Ted Storck for reviewing the manuscript.

This study was jointly funded by the Texas Parks and Wildlife Department; the United States Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service under PL 88-309; and the United States Department of Interior, Fish and Wildlife Service under DJ 15.605 (Project F-34-M-6).

ABSTRACT

Since May 1974, private-boat fishermen have been routinely interviewed at boat access sites. Party-boat and bay headboat fishermen have been routinely monitored since May 1983 by on-site and on-board surveys, respectively. Estimated sport-boat fishing pressure and landings in 1988-89 exceeded 6.6 million man-h and 2.5 million fish. Pressure and landings decreased 17% and 20%, respectively, from 1987-88 to 1988-89. Sport-boat fishing in bays and passes accounted for 95% of the pressure and 96% of the landings in 1988-89. The high-use season (15 May-20 November) accounted for 74% of the pressure and 76% of the landings in 1988-89.

Thirty-five percent of the 10-year (1979-89) mean annual coastwide private-boat bay and pass fishing pressure and 40% of the landings occurred in the Galveston Bay system. Spotted seatrout (Cynoscion nebulosus) comprised 38% of the 10-year mean annual coastwide private-boat bay and pass landings. Catch rates for spotted seatrout caught by private-boat fishermen in bays and passes declined to 0.08 fish/man-h in 1984-85, then increased to 0.14 in 1986-87 and remained at that level through 1988-89. A reduction in most finfish landings was detected following the coastwide fish kill in December 1983 and January 1984. Landings of some species increased in 1985-86 and again in 1986-87; however, not all species continued to show a resurgence in 1987-88 and 1988-89.

Although greater than the low of 67,600 fish in 1984-85, bay and pass party-boat landings for 1988-89 (153,700 fish) remained well below the high of 261,800 fish estimated for 1983-84. Thirty-seven percent of the 6-year (1983-89) mean annual coastwide bay and pass party-boat fishing pressure and 36% of the landings occurred in the lower Laguna Madre system compared to only 5% for both pressure and landings in the Galveston Bay system. Spotted seatrout accounted for over 72% of all landings by party-boat fishermen in bays and passes during 1983-89. Almost 40% of all spotted seatrout and red drum (Sciaenops ocellatus) landed by party-boats in bays and passes during 1983-89 were from the lower Laguna Madre system. Coastwide red drum landings for bay and pass party-boats were higher in 1988-89 than any previous year.

Bay and pass headboat pressure and landings decreased from 1987-88 to 1988-89. Eighty-five percent of the 6-year (1983-89) mean annual coastwide bay and pass headboat fishing pressure and 94% of the landings occurred during the high-use season. The Galveston Bay system accounted for 47% of the pressure and 60% of the landings during 1983-89. Sand seatrout (Cynoscion arenarius) comprised 66% of the landings by headboat fishermen; Atlantic croaker (Micropogonias undulatus) comprised 16%.

Private-boat fishing pressure in the Texas Territorial Sea (TTS) for 1988-89 was 137,600 man-h, with an estimated 25,600 fish landed. During the 1982-89 interval, the high-use season accounted for 92% of the annual coastwide pressure and 84% of the landings. Sand seatrout accounted for 41% of all fishes landed; king mackerel (Scomberomorus cavalla) and red snapper (Lutjanus campechanus) accounted for 17% and 12%, respectively.

Pressure and landings estimates for party-boat fishermen in the TTS ranged from 7,600 man-h and 1,900 fish in 1986-87 to 46,500 man-h and 20,700 fish in 1983-84. Estimated pressure and landings in 1988-89 were 9,900 man-h and 2,200 fish. During 1983-89, 96% of the annual pressure and 95% of the landings occurred in the high-use season. The Corpus Christi and lower Laguna Madre areas together accounted for 94% of the coastwide pressure and 91% of the landings. King mackerel represented 49% of the fish landed.

Private-boat fishing pressure in the United States Exclusive Economic Zone (EEZ) reached a low of 143,900 man-h in 1988-89. During 1982-89, the high-use season accounted for 92% of annual coastwide pressure and 75% of landings. Pressure was greatest off the Corpus Christi area (36%). Red snapper (45%), sand seatrout (14%) and king mackerel (13%) were the most often landed fishes.

Party-boat pressure in the EEZ decreased to 20,200 man-h in 1988-89. During 1983-89, 45% of the pressure and 42% of the landings occurred off the Corpus Christi area. The high-use season accounted for 98% of the annual coastwide pressure and 97% of the landings. King mackerel comprised 28% of the landing; red snapper comprised 15%.

A social and economic questionnaire, added to the survey in May 1987, was administered to private-boat and party-boat fishermen. Based on pre-trip interviews, spotted seatrout, red drum and flounder were the species most often sought by fishermen; however, over 30% of the fishermen sought no particular species. In pre-trip interviews fishermen rated the importance of non-catch motivations for fishing higher than catch-related ones. In post-trip interviews they rated their fulfillment of these non-catch motivations higher than catch-related ones. Equal numbers of fishermen were satisfied or unsatisfied with their fishing trips. On average, fishermen made 27 fishing trips to salt water and six trips to fresh water each year, and spent over $100/saltwater trip. In 1988-89 the majority of fishermen indicated they would not quit fishing until their annual saltwater fishing costs increased by an undetermined amount between $5,000 and $7,500.

INTRODUCTION

The Texas saltwater sport-boat fishery is an economically and biologically important segment of the total Texas coastal fishery. There were about 1.1 million saltwater sport fishermen in Texas during 1988-89 (Green et al. 1982, Texas Parks and Wildlife Department 1991). Direct expenditures by these fishermen translate into over two billion dollars of economic impact annually to the State of Texas (Texas Water Development Board 1987, United States Fish and Wildlife Service 1989). Landings data from saltwater sport-boat fishermen are required to assess the needs for and the impact of saltwater fishing regulations. Social and economic information is necessary to allow for management based on optimum sustainable yield (Carlton 1975).

The Texas Parks and Wildlife Department (TPWD) has conducted surveys of sport fishermen in Texas marine waters since 1974 (Heffernan et al. 1976; Breuer et al. 1977; Green et al. 1978; McEachron 1980a, 1980b, 1983, 1984; McEachron and Green 1981, 1982, 1983, 1984a; McEachron and Matlock 1983; McEachron et al. 1981, 1984a; Osburn and Ferguson 1985a, 1985b, 1986, 1987; Osburn et al. 1988; Maddux et al. 1989). These surveys monitored landings/unit effort and size of all species landed annually by sport-boat fishermen in the Galveston, Matagorda, San Antonio, Aransas, Corpus Christi and upper and lower Laguna Madre bay systems, and in the Gulf of Mexico off Texas. The Sabine Lake system was added in May 1987. A social and economic questionnaire was added in May 1987 (Green et al. in press). The intent of this questionnaire was to gather information necessary to determine motivations, satisfactions, and economic value and impacts associated with marine sport-boat fishing. Routine monitoring of gulf headboats was terminated in September 1984.

This report includes a summary of pressure and landings estimates for private-boat (1974-89), party-boat (1983-89) and headboat (1983-89) fishing in Texas bays and passes; private-boat (1982-89) and party-boat (1983-89) fishing in the Texas Territorial Sea (TTS); and private-boat (1982-89) and party-boat (1983-89) fishing in the United States Exclusive Economic Zone (EEZ). A summary of social and economic responses for May 1987-May 1989 is also included. A more detailed summary of the data included in this report is presented in Green et al. (1991).

MATERIALS AND METHODS

Each survey year was divided into a high-use (15 May-20 November) and a low-use (21 November-14 May) season based on analyses of fishing pressure, landings and catch rates of private-boat fishermen completing fishing trips (McEachron et al. 1983). Seasons were partitioned by day type (weekend and weekday). Six holidays (New Year's Day, Memorial Day, July 4th, Labor Day, Thanksgiving Day and Christmas Day) were classified as weekend days.

Areas fished were defined as:

1. Bays: Marine waters shoreward of the barrier islands and pass entrances;

2. Passes: Openings connecting bays with the Gulf of Mexico;

3. TTS: Gulf of Mexico from the surf line to 16.7 km offshore, excluding the 1.6-km area around a pass; and

4. EEZ: Gulf of Mexico beyond 16.7 km offshore.

Private-boat fishing was defined as fishing from a privately owned or rental boat without a guide, and includes tournament fishing if no guide was hired. Party-boat fishing was defined as fishing from a boat, operated by a guide, that carried ≤10 people for a fee. Headboat fishing was defined as fishing from a boat, operated by a guide and crew, that carried ≥11 people for a fee. Sport-boat fishing was defined as the sum of private-boat, party-boat, and bay and pass headboat fishing. Landings represent numbers of fish. All estimates are presented as a mean ± 1 SE.

Differences between estimates presented in this report and previous reports are due to updating of the data base, and thus the most recent report is the most accurate.

Private-boat Fishing

Bay fishermen were interviewed in all survey years. Beginning September 1977, all fishing parties (bay, pass and gulf) were interviewed although, gulf fishing was not separated into TTS and EEZ fishing until May 1982. Estimates for TTS and EEZ fishing were made for an area rather than a bay system because of travel through common passes and use of common gulf areas by fishermen launching their boats in separate but adjacent bay systems. Gulf areas were defined as Sabine Lake, Galveston (Galveston Bay/Freeport area), Matagorda (Matagorda Bay/San Antonio Bay), Corpus Christi (Aransas Bay/Corpus Christi Bay/upper Laguna Madre) and lower Laguna Madre.

To obtain fishing pressure estimates, TPWD personnel traveled through each bay system at a constant rate on randomly selected weekend and weekday days and counted boat trailers at identified boat ramps. Beginning May 1983, empty wet-slips and mooring spaces at marinas and boat houses were also counted. Allowances were made for unrented slips and spaces based on information obtained from marina and boat-house operators. Relative fishing pressure estimates (percent of total bay system activity per site per day) were obtained by adjusting trailer and wet-slip boat counts; counts were adjusted for non-angling activity determined from interviews at surveyed sites.

TPWD personnel were stationed at randomly selected boat-access sites on randomly selected weekdays and weekend days to collect landings data by interviewing fishing parties that had completed a trip. Interview sites were selected randomly in proportion to relative fishing pressure estimates obtained during the previous 3 years (TPWD unpublished data). Therefore, boat-access sites with high fishing activity (i.e., mean trailer and wet-slip counts adjusted by interview data) were surveyed more often than sites with low fishing activity. Based on diel activity patterns determined during the first 2 years of the survey (Heffernan et al. 1976, Breuer et al. 1977),

interviews were conducted from 1000 to 1800 hours to maximize the amount of data collected per unit of sampling effort (McEachron et al. 1983). Additional efficiency was achieved beginning 21 November 1984 by terminating weekend surveys at 1400 and beginning 21 November 1986 by terminating weekday surveys at 1600 if no fishing interviews were conducted up to those times (Weixelman and Green 1984). Beginning 21 November 1985, low-use season weekend and weekday surveys were not conducted when weather conditions reached a critical "bad" level based on nomographs relating air temperature, wind speed and precipitation to the number of interviews conducted in previous years (Spiller et al. 1988). Those surveys were counted as zero interview (zero pressure) days in the estimation procedure. Estimates have been adjusted by the percent of missed angler interviews occurring during daylight hours before 1000 and after 1800 (TPWD unpublished data).

TPWD personnel recorded species (Gallaway et al. 1972, Hoese and Moore 1977, Robins et al. 1980, Murdy 1983) and number of all fish brought to shore (landings) by fishing parties as well as number of persons in the party, geographic origin of residence, fishing location, gear and bait used, and trip length. Until May 1983, only weight (kg) of fishes was recorded. Beginning May 1983, fish were measured to the nearest mm (total length) rather than being weighed. Mean total lengths prior to May 1983 were back calculated using weight-length regressions of the mean for each species in each bay system, season and day type (Harrington et al. 1979, TPWD unpublished data). Coastwide mean weights and lengths were weighted by the estimated number of fish landed in each bay system.

Geographic origin of residence was classified as:

1. Coastal adjacent: Counties surrounding a bay system within 80 km of the surfline;

2. Coastal non-adjacent: Counties having a border within 80 km of the surfline but not adjacent to bay system where interview occurred;

3. Non-coastal: All Texas counties further than 80 km from the shoreline; and

4. Out-of-state: States other than Texas and foreign countries.

From May 1974 to May 1983, the boat owner's residence was recorded for the entire party. Beginning May 1983, residential origin was recorded for individual party members.

Before May 1980, private-boat landings were estimated as the product of mean catch (landings) rate and fishing pressure in trip man-h (Heffernan et al. 1976). Since interview sites were randomly selected in proportion to total fishing pressure, this technique depended upon a roving clerk traveling around a bay system obtaining pressure counts at all sites during the survey period. In fall of 1979, gas shortages and irregular operating hours by gas stations made it impossible to strictly comply with these procedures. Since the potential for similar problems existed in the future (1979 was the second gas shortage within a 4-year period), an alternate method of estimating

landings and pressure that depended much less on use of an automobile was developed. Data collected since 1974 were used to estimate a set of probabilities that described the patterns of fishing pressure within a day and at each inventoried boat-access site (TPWD unpublished data). A roving clerk is still required to make pressure counts at boat-access sites; however, the objective is no longer to estimate total pressure at each site but to estimate the proportion of total pressure at each site. This can be accomplished with fewer roves during a short time period (0800-1230) when there is little change in boating activity. This reduces use of an automobile by 16% to 33% from previous requirements, depending on the actual rove schedule adopted. A comparison of estimates made from selecting survey sites as strictly random samples and by selecting survey sites in proportion to the activity that occurred at each site was made by McEachron and Green (1984a).

Landings ($\hat{H}$) were estimated separately for each area (bay, pass, TTS and EEZ) using the following equations:

$$\hat{H} = \sum_{i=1}^{4} D_i \cdot \bar{h}_i$$

where

D_i - total number of days that occurred in ith stratum (season and day type); and

$\bar{h}_i$ - mean number of fish landed/day during daylight hours in ith stratum calculated as:

$$\bar{h}_i = 1/n \cdot \sum_{j=1}^{n} h_{ij} \cdot P_j/e_j$$

where

n - total number of days sampled;

h_{ij} - total number of fish observed at site j in ith stratum;

P_j - adjustment for parties missed by interviewers at site j (total number of parties seen divided by total number of parties interviewed); and

e_j - estimated proportion of total bay system fishing activity that occurred at site j calculated as:

$$e_j = FH_j / \sum_{j=1}^{k} FH_j$$

where

FH_j = total number of trailers and/or empty wet-slips observed at site j during previous 3 years; and

k = total number of sites.

Pressure ($\hat{P}$) was estimated separately for each area (bay, pass, TTS and EEZ) using the following equations:

$$\hat{P} = \sum_{i=1}^{4} D_i \cdot \bar{m}_i$$

where

D_i = total number of days that occurred in ith stratum (season and day type); and

$\bar{m}_i$ = mean number of fishing trip man-h/day during daylight hours in ith stratum calculated as:

$$\bar{m}_i = 1/n \cdot \sum_{j=1}^{n} m_{ij} \cdot p_j/e_j$$

where

n = total number of days sampled;

m_{ij} = total number of fishing trip man-h observed at site j in ith stratum;

P_j = adjustment for parties missed by interviewers at site j (total number of parties seen divided by total number of parties interviewed); and

e_j = estimated proportion of total bay system fishing activity that occurred at site j calculated as:

$$e_j = FH_j \,/ \sum_{j=1}^{k} FH_j$$

where

FH_j = total number of trailers and/or empty wet slips observed at site j during previous 3 years; and

k = total number of sites.

This technique is described by Kish (1965) and is used to make estimates from samples selected from clusters which are proportional. Variances were calculated using ratio estimation for ratios of landings/day, fishing trip

man-hours/day, estimated proportion of fishing activity/site and proportion of parties missed by interviewers (Mendenhall et al. 1971).

Estimation of the proportion (e_j) of total pass and gulf fishing activity at site j used an average of weekend and weekday activity due to a scarcity of data for individual day types. The amount of activity at each site with a history of pass or gulf fishing was computed by averaging this weekend and weekday mean pass and gulf trip man-h from all previous years since May 1979. When weekend data were not available the amount of activity was estimated as:

$$X_1 = 3X_2/2$$

where

X_1 = total number of weekend trip man-h; and

X_2 = total number of weekday trip man-h.

When weekday data were not available the amount of activity was estimated as:

$$X_2 = (X_1/2 + X_1)/2$$

where

X_1 = total number of weekend trip man-h; and

X_2 = total number of weekday trip man-h.

The amount of activity at sites which had pass or gulf activity in the year being estimated but no prior history of pass or gulf activity was set equal to sites with historical data that had similar total pressure. Relative activity percents of boat ramps with pass or gulf history were adjusted to sum to 95% of all activity. All other boat ramps without historical pass or gulf activity were assigned equal percents summing to 5% of the total activity.

When no weekday surveys were conducted (May 1976-May 1979), landings and pressure estimates for weekdays were calculated by multiplying weekend landings and pressure by an adjustment factor. Adjustment factors were calculated from the percent of total weekend and weekday landings and pressure comprised by weekend landings and pressure from May 1979 to May 1984 (Maddux et al. 1989). Ten-year means (May 1979 to May 1989) were used for figures showing percent distributions since methods were consistent and weekday landings were available among years.

Annual estimates made from this survey are comparable to previous survey estimates. However, one assumption must be made when comparing landings estimates from year to year. The mean catch rate and mean fish size for parties returning during daylight hours but before or after the interview period (1000 to 1800) must be the same as those for parties returning during the interview period.

For the purpose of making annual coastwide landings and fishing pressure comparisons, data from 1974-75 and 1975-76 have been combined and are referred to as 1974-76. Four bay systems were surveyed in 1974-75 (Galveston, San Antonio, Aransas and upper Laguna Madre) and three were surveyed in 1975-76 (Matagorda, Corpus Christi and lower Laguna Madre). Thereafter, all bay systems were surveyed each year.

Party-boat Fishing

From May 1983 to May 1989, party-boat fishermen were interviewed whenever they were encountered during the routine private sport-boat fishing survey. Inclusion of marinas and boat-houses in the boat-access site inventory provided for interception of party-boats which were previously surveyed in special studies (McEachron 1983, 1984; McEachron and Matlock 1983; McEachron et al. 1984a). Interview and estimation procedures are identical to those described for private-boat fishing.

Estimates of party-boat landings and pressure in this report may not be directly comparable to survey estimates for years prior to May 1983. Time periods, sample site selection and estimation procedures were different from previous methods. Estimates in this report were made on a high-use and low-use season basis. During June-August of 1979, 1981 and 1982, party-boat storage and launching areas were randomly selected on 8 days/month in each area, except in the Matagorda area where only 4 days/month were surveyed. Trips were estimated on an annual basis but landings were estimated for June-August only. Beginning May 1983, boat-access areas were sampled in proportion to all fishing activity rather than just bay private-boat fishing activity (Osburn and Ferguson 1985b). Before the 1984-85 survey year, historical fishing activity data used did not include party-boats. If party-boat pressure is distributed differently by site than private-boat pressure, then precision of party-boat estimates in this report will be biased. Estimates of landings and pressure in this report relied on calculation of a mean daily landings rate, adjusted by the relative proportion of activity at a site. Earlier estimates multiplied landings rates (landings/man-h) by total trips, mean trip time and mean people/trip.

Headboat Fishing

Bay and pass headboats were inventoried using the TPWD Fish Guide License list and by personally contacting marinas, bait stands and commercial guide services in each area of fishing activity.

From May 1983 to May 1989, bay and pass headboats were randomly selected on 14 weekdays and 7 weekend days during both the high-use and low-use seasons in each of the Galveston (Galveston Bay), Corpus Christi (Aransas Bay/Corpus Christi Bay) and lower Laguna Madre areas.

Headboat surveys were conducted aboard the vessel. All retained fish were counted and identified. On each trip, total lengths of up to 100 individuals of each species were measured to the nearest mm. Number of fishermen and fishing time (nearest 0.5 h) were also recorded. Total number

of daylight trips made on each survey day was determined by contacting all inventoried headboat operators by phone or in person.

Landings ($\hat{H}$) were estimated using the following equations:

$$\hat{H} = \sum_{i=1}^{4} D_i \cdot \bar{h}_i$$

where

D_i = total number of days that occurred in ith stratum (season and day type); and

$\bar{h}_i$ = mean number of fish landed/day during daylight hours in ith stratum calculated as:

$$\bar{h}_i = 1/n \cdot \sum_{j=1}^{n} h_{ij} \cdot t_i/e_{ij}$$

where

n = total number of days sampled;

h_{ij} = total number of fish landed during a trip on headboat j;

t_i = mean number of trips/day by all boats in ith stratum; and

e_{ij} = estimated proportion of total fishing activity occurring on headboat j calculated as:

$$e_{ij} = T_{ij} \cdot P_{ij} \; / \sum_{j=1}^{k} (T_{ij} \cdot P_{ij})$$

where

T_{ij} = total number of trips made by headboat j on all surveyed days in ith stratum;

P_{ij} = mean number of people/trip fishing on headboat j; and

k = total number of headboats.

Linear regression analysis revealed a positive correlation between fish landed and mean number of people/trip during the high-use but not the low-use season (Osburn and Ferguson 1985a). When no data on mean number of people/trip were available, the number was estimated by adjusting that boat's legal passenger capacity by the ratio of number of people/trip to passenger capacity of all surveyed headboats in the ith stratum. Linear regression analysis did not

reveal a positive correlation between mean number of people/trip and passenger capacity for either season ($P = 0.05$) (Osburn and Ferguson 1985a); however, correlation during the high-use season would have been significant at $P = 0.06$.

Use of e_{ij} to adjust trip catch (landings) rates is valid for proportional sampling (Kish 1965). Headboats were selected randomly for each survey day; however, when the operator of a selected headboat was contacted and found not to be making a trip on the survey day, surveyors continued contacting all headboat operators in a randomly assigned order until one making a trip was found. Thus more-active headboats were surveyed more often, resulting in de facto proportional sampling. Variances were calculated using ratio estimation (Mendenhall et al. 1971).

Procedures for calculating mean lengths and weights and classifying residential origin were similar to those described previously for private-boat fishermen.

Headboat estimates in this report are comparable to previously reported estimates although some difference in seasons does exist. Equations used in the present survey were based on mean daily catch rates. Previous reports based estimates on trip catch rates extended by number of people/trip and mean number of trips/day (McEachron 1984). Total number of trips made during a specified time period in these earlier reports was determined by a telephone census of headboat operators.

Social and Economic Questionnaire

The social and economic questionnaire used during May 1987-May 1988 included two pre-trip and six post-trip questions (Table 1). The questionnaire was modified slightly for use during May 1988-May 1989 (Table 2). Pre-trip and post-trip questions were asked of one randomly selected member from each fishing party. If a member of a fishing party had been asked the pre-trip questions, then the same person was asked the post-trip questions. Headboat fishermen were not asked these questions.

Social and economic responses were summarized by fisherman type (private-boat or party-boat) and area fished (bays and passes, TTS, or EEZ). Scaled responses not falling within procedural limits were eliminated. Trip cost responses >$50,000 and trip frequency responses >365 were also eliminated..

RESULTS

Coastwide annual sport-boat fishing pressure and landings decreased 17% and 20%, respectively, from about 8.0 million man-h and 3.1 million fish in 1987-88 to about 6.6 million man-h and 2.5 million fish in 1988-89 (Table 3). Sport-boat fishing in bays and passes accounted for 95% of the pressure and 96% of the landings in 1988-89 (Figure 1). The high-use season accounted for 74% of the pressure and 76% of the landings (Table 3).

Almost 27,000 sport-boat fishermen were interviewed during 1988-89. In bays and passes, 21,384 private-boat, 1,001 party-boat and 2,590 headboat fishermen were interviewed. In the TTS, 1,253 private-boat and 35 party-boat fishermen were interviewed. In the EEZ, 618 private-boat and 72 party-boat fishermen were interviewed.

Bays and Passes

Private-boat Fishing

Annual coastwide private-boat fishing pressure in bays and passes has generally increased since 1976-77; landings have generally decreased since 1974-76 (Figure 2). A marked decrease in pressure and landings followed a major fish kill during the freeze of winter 1983-84. Pressure declined 28% from 1983-84 to 1984-85. Landings declined from a high of 5,506,600 fish in 1974-76 to a low of 1,462,300 fish in 1984-85. After steadily increasing since 1984-85, pressure and landings decreased 15% and 27%, respectively, from 1987-88 to 1988-89. The high-use season accounted for 71% of the pressure and 77% of the landings during the last 10 years (Figure 3).

The Galveston Bay system has accounted for a greater proportion of private-boat pressure and landings in bays and passes than any of the other bay systems for the last 10 years (Figure 4). Thirty-five percent of the annual coastwide pressure and 40% of the landings occurred there. San Antonio Bay system, in contrast, accounted for only 4% of the annual coastwide pressure and landings. From 1987-88 to 1988-89, pressure decreased in all bay systems except Sabine Lake, Aransas and Corpus Christi; landings decreased in all bay systems except Sabine Lake (Figures 5-11).

Texas bays and passes yielded an assortment of fishes to private-boat fishermen during 1979-89. Spotted seatrout (Cynoscion nebulosus) comprised 38% of all fish landed from bay and passes (Figure 12). Sand seatrout (C. arenarius), Atlantic croaker (Micropogonias undulatus), southern flounder (Paralichthys lethostigma), red drum (Sciaenops ocellatus), sheepshead (Archosargus probatocephalus), black drum (Pogonias cromis) and gafftopsail catfish (Bagre marinus) accounted for an additional 55% of the landings. Species classified as "other" accounted for 7% of the fishes landed. The Galveston Bay system had the highest percentage of annual coastwide landings of Atlantic croaker, black drum, gafftopsail catfish, red drum, sand seatrout, sheepshead, southern flounder and spotted seatrout (Figures 13-14).

Annual coastwide landings of spotted seatrout in 1988-89 of 816,100 fish were 2.6 times greater than 1984-85 landings, which were the lowest during 1974-89 (Figure 15). Catch/unit effort (CPUE) has generally increased since 1984-85 to a mean of 0.14 fish/man-h in 1988-89 but remains well below 0.47 fish/man-h reported in 1976-77. Mean length and weight have increased since 1974-76. Spotted seatrout averaged 423 mm and 0.76 kg in 1988-89.

Sand seatrout landings and CPUE varied little from 1981-82 to 1989-89 (Figure 16). Landings of 299,100 fish in 1988-89 were similar to the low of 280,000 fish in 1985-86. Mean length and weight have increased since 1984-85. Sand seatrout averaged 295 mm and 0.29 kg in 1988-89.

Atlantic croaker was the third most landed fish over the last 10 years. During that time, landings and CPUE generally decreased until 1981-82 and have since remained fairly constant near 300,000 fish and 0.05 fish/man-h (Figure 17). Mean length and weight have generally increased since 1985-86. Atlantic croaker averaged 249 mm and 0.21 kg in 1988-89.

Except for 1979-80, southern flounder landings and CPUE have remained fairly constant during the last 10 years (Figure 18). Mean length and weight generally decreased until 1984-85 and generally increased thereafter. Southern flounder averaged 367 mm and 0.62 kg in 1988-89.

Landings of red drum decreased 32% from 241,700 fish in 1987-88 to 164,000 fish in 1988-89 (Figure 19). CPUE increased from 1983-84 to 1986-87. Mean length and weight have increased since 1979-80. Red drum averaged 578 mm and 2.39 kg in 1988-89.

Sheepshead landings have generally declined since 1977-78 (Figure 20). Landings reached a low in 1985-86 (48,200 fish) and were only 25% greater in 1988-89 (60,200 fish). CPUE has remained at 0.01 fish/man-h since 1985-86. Mean length and weight have generally increased since 1981-82. Sheepshead averaged 402 mm and 1.17 kg in 1988-89.

Landings of black drum declined 68% from 1982-1983 to 1984-1985 and remained low in 1988-89 (Figure 21). CPUE has remained at 0.01 fish/man-h since 1983-84. Mean length and weight were similar among years. Black drum averaged 391 mm and 1.05 kg in 1988-89.

After declining in 1979-80, gafftopsail catfish landings have remained fairly constant near 20,000 fish (Figure 22). CPUE has been low in all years. Mean length and weight generally declined from 1979-80 to 1986-87. Gafftopsail catfish averaged 483 mm and 1.18 kg in 1988-89.

Residential origin of fishermen, mean fishing party size and mean trip length have changed little from year to year. During 1974-89, the majority (59-66%) of private-boat fishing trips were made by fishermen who lived in coastal counties adjacent to the bay system fished. Annual coastwide mean fishing party size and mean trip length during 1974-89 ranged from 2.4 to 2.7 people and from 5.3 to 7.3 h.

Recreational fishing license sales and boat registrations have increased over the years suggesting increased fishing and recreational activity in Texas waters (Figure 23). The number of recreational fishing licenses sold since 1956 has increased from about 458,400 to over 1.9 million annually. In addition, saltwater fishing stamp sales have increased from about 542,600 in 1987 to about 600,960 in 1989. The number of recreational boats registered statewide has increased 25% since 1976.

Party-boat Fishing

Annual coastwide party-boat fishing pressure in bays and passes has remained between 210,000 and 255,000 man-h, except for a sharp drop in

1984-85 (Figure 24). Landings in 1988-89 of 153,700 fish, although greater than the low of 67,600 fish in 1984-85, remained below the 261,800 fish estimated for 1983-84 (Figure 24). During 1983-89, 73% of the pressure and 79% of the landings occurred in the high-use season (Figure 25).

Party-boat pressure and landings in bays and passes were greatest in the lower Laguna Madre system (Figure 26). During 1983-89, 37% of the pressure and 36% of the landings occurred in the lower Laguna Madre system compared to only 5% of coastwide pressure and landings in the Galveston Bay system. In 1988-89 pressure and landings were greater than 46,000 man-h and 25,000 fish from the Aransas Bay system southward, and less than 7,000 man-h and 11,000 fish from the San Antonio Bay system northward.

Party-boat fishermen landed more spotted seatrout and red drum from bays and passes than any other species during 1983-89 (Figure 27). Spotted seatrout accounted for 72% of all landings; red drum accounted for 14%. "Other" species accounted for 14% of the fishes landed. Almost 40% of all spotted seatrout and red drum landed by party-boats were from the lower Laguna Madre system (Figure 28).

Party-boat landings of red drum and spotted seatrout have increased since 1984-85 (Figures 29-30). Red drum landings coastwide in 1988-89 were 28,100 fish, up from 12,100 estimated for 1983-84 (Figure 29). Red drum CPUE was 0.11 fish/man-h in 1988-89, similar to estimates for 1984-85 through 1987-88. Red drum mean length and weight have generally increased with 1988-89 fish averaging 603 mm and 2.48 kg. Although landings of spotted seatrout dropped in 1984-85 to 50,000 fish, they increased through 1988-89 to 118,100 fish (Figure 30). Spotted seatrout CPUE of 0.47 fish/man-h in 1988-89 was the highest since 1983-84. Mean length and weight for spotted seatrout have generally increased since 1983-84. Spotted seatrout landed in 1988-89 averaged 435 mm and 0.85 kg.

During 1983-89, 39-47% of party-boat fishermen in bays and passes were from non-coastal counties. Annual coastwide mean fishing party size and mean trip length during 1983-89 ranged from 3.4 to 3.6 people and from 5.7 to 7.8 h.

Headboat Fishing

Annual coastwide fishing pressure and landings estimates for headboat fishermen in bays and passes were quite variable during 1983-89 (Figure 31). Pressure and landings decreased from 182,300 man-h and 132,000 fish in 1987-88 to 120,200 man-h and 104,000 fish in 1988-89. Eighty-five percent of the pressure and 94% of the landings occurred during the high-use season in 1983-89 (Figure 32).

The Galveston Bay area accounted for most of the headboat pressure (47%) and landings (60%) in bays and passes during the last 6 years (Figure 33). The lower Laguna Madre area accounted for the least amount of pressure (19%) and landings (19%).

Sand seatrout and Atlantic croaker were the fishes most commonly landed from bays and passes by headboat fishermen during 1983-89 (Figure 34). Sand seatrout and Atlantic croaker comprised 66% and 16% of the landings, respectively. "Other" species accounted for 17% of the fishes landed. Sand seatrout were commonly landed in all areas, but Atlantic croaker were landed primarily in the Galveston Bay area (Figure 35).

Atlantic croaker landings increased over 100% from 9,900 fish in 1987-88 to 20,300 fish in 1988-89 (Figure 36). CPUE also increased in 1988-89. Mean length (195 mm) and weight (0.10 kg) decreased to their lowest levels in 1988-89.

Landings of sand seatrout ranged from a high of 177,800 fish in 1985-86 to a low of 45,800 fish in 1986-87 (Figure 37). Landings and CPUE in 1988-89 were 65,700 fish and 0.55 fish/man-h. Sand seatrout landed in 1988-89 averaged 271 mm and 0.27 kg.

The majority (75%) of headboat fishing trips were made by fishermen from adjacent coastal and non-coastal counties in all years. Annual coastwide mean fishing party size and mean fishing time ranged from 21 to 29 people and from 2.4 to 2.7 h during 1983-89.

Texas Territorial Sea

Private-boat Fishing

Annual coastwide private-boat fishing pressure and landings varied from year to year in the TTS during 1982-89 (Figure 38). Annual pressure was highest in 1983-84 (344,000 man-h) and lowest in 1988-89 (137,600 man-h). Annual landings reached a low of 25,600 fish in 1988-89, as compared to a high of 107,300 fish in 1982-83. The high-use season accounted for 92% of the pressure and 84% of the landings during 1982-89 (Figure 3).

Annual private-boat pressure and landings in the TTS were greatest offshore of the Corpus Christi and Matagorda Bay areas during the last 7 years (Figure 39). The area offshore of Corpus Christi Bay accounted for 52% of the pressure and 22% of the landings. The area offshore of Matagorda Bay accounted for 21% of the pressure and 48% of the landings. Pressure decreased in all areas except offshore of the lower Laguna Madre in 1988-89.

The most commonly landed fishes in the TTS by private-boat fishermen during 1982-89 were sand seatrout, king mackerel (Scomberomorus cavalla) and red snapper (Lutjanus campechanus) (Figure 40). Sand seatrout comprised 41% of all fishes landed, followed by king mackerel (17%) and red snapper (12%). "Other" species accounted for 31% of the fishes landed. Over the 7-year survey period, king mackerel landings from the TTS were greatest off the Corpus Christi Bay area (63%); red snapper and sand seatrout were greatest off the Matagorda Bay area (58% and 63%, respectively) (Figure 41).

Estimated landings of king mackerel decreased from 1982-83 to 1986-87 and then increased in 1987-88 (Figure 42). Landings then decreased about 60% from 12,200 fish in 1987-88 to 4,800 fish in 1988-89. Generally, CPUE has followed

a similar pattern, decreasing to a low of 0.01 fish/man-h in 1986-87. Mean length and weight changed little from 1984-85 to 1988-89. King mackerel averaged 945 mm and 8.06 kg in 1988-89.

Red snapper landings and CPUE have varied little (Figure 43). An estimated 4,300 fish were landed coastwide in 1988-89. Mean length and weight increased from 264 mm and 0.27 kg in 1987-88 to 350 mm and 0.67 kg in 1988-89.

Landings and CPUE for sand seatrout remained at low levels in 1988-89 (Figure 44). Annual coastwide landings were highest in 1986-87 (58,000 fish) and lowest in 1987-88 (2,500 fish). Landings for 1988-89 were estimated to be 2,600 fish. Mean length and weight ranged from 286 mm and 0.26 kg in 1986-87 to 339 mm and 0.44 kg in 1984-85. Sand seatrout averaged 312 mm and 0.33 kg in 1988-89.

During 1982-89, most private-boat fishing trips in the TTS were made by fishermen from adjacent coastal (37-44%) and non-coastal (38-43%) counties. Annual coastwide mean fishing party size and mean trip length ranged from 2.8 to 3.0 people and from 5.9 to 6.4 h during 1982-89.

Party-boat Fishing

Trends in annual coastwide party-boat fishing pressure in the TTS closely paralleled those for landings during 1983-89 (Figure 45). Pressure and landings estimates have ranged from a high of 46,500 man-h and 20,700 fish in 1983-84 to a low of 7,600 man-h and 1,900 fish in 1986-87. Estimated pressure and landings in 1988-89 were 9,900 man-h and 2,200 fish. About 96% of the pressure and 95% of the landings occurred in the high-use season during 1983-89 (Figure 25). The area off Corpus Christi Bay had 70% of the pressure and 56% of the landings (Figure 46). The area off the lower Laguna Madre had 24% of the pressure and 35% of the landings.

King mackerel (49%) and red snapper (20%) accounted for most of the landings from the TTS by party-boat fishermen during 1983-89 (Figure 27). "Other" species accounted for 31% of the fishes landed. Eighty-eight percent of the king mackerel were landed from off the Corpus Christi area; 99% of the red snapper were landed from off the lower Laguna Madre area (Figure 47).

Landings of king mackerel during 1983-89 ranged from a high of 9,500 fish in 1983-84 to a low of 700 fish in 1986-87 (Figure 48). An estimated 1,100 king mackerel were landed in 1988-89. CPUE during 1983-89 varied from year to year. Mean fish length and weight have declined since 1986-87. King mackerel averaged 920 mm and 7.33 kg in 1988-89.

Red snapper were not landed in all years (Figure 49). An estimated 100 fish, averaging 309 mm and 0.40 kg, were landed in 1988-89.

During 1983-88, 37-76% of party-boat fishing trips in the TTS were made by fishermen from non-coastal counties. Fifty-one percent of the trips in 1988-89 were made by fishermen from adjacent coastal counties. Annual

coastwide mean fishing party size and mean trip length ranged from 3.4 to 5.0 people and from 5.5 to 7.7 h during 1983-89.

Exclusive Economic Zone

Private-boat Fishing

Annual coastwide pressure by private-boat fishermen in the EEZ reached its lowest level for the 7 years of this study in 1988-89 (143,900 man-h) (Figure 50). Pressure (267,500 man-h) was highest in 1985-86. Annual coastwide landings of 73,700 fish in 1988-89 were almost equal to those of 1987-88. During 1982-89, the high-use season accounted for 92% of the pressure and 75% of the landings (Figure 3). Although anglers fishing during the low-use season exerted only 8% of the pressure, they landed 25% of the fishes. Most of the pressure occurred offshore from the Corpus Christi (36%) and Galveston (32%) Bay areas (Figure 51). Landings were greatest offshore from the Galveston (42%) and Matagorda (28%) Bay areas.

Red snapper accounted for 45% of the annual coastwide landings by private-boat fishermen in the EEZ during 1982-89 (Figure 40). Sand seatrout and king mackerel compriesd 14% and 13% of the landings, respectively. "Other" species accounted for 28% of the fishes landed. Most king mackerel and red snapper landed were from off the Corpus Christi and Galveston Bay areas, respectively (Figure 41). Most (96%) of the sand seatrout were landed from off the Galveston and Matagorda Bay areas.

Landings of king mackerel have ranged from a high of 15,500 fish in 1982-83 to a low of 5,500 fish in 1988-89 (Figure 52). CPUE has varied from 0.06 fish/man-h in 1982-83 to less than 0.01 in 1987-88. Mean length and weight increased from 936 mm and 8.07 kg in 1987-88 to 951 mm and 8.41 kg in 1988-89.

Landings of red snapper increased from a low of 16,900 fish in 1986-87 to a high of 53,700 fish in 1988-89 (Figure 53). CPUE decreased from 1983-84 to 1987-88 but increased in 1988-89. Mean length and weight decreased slightly from 357 mm and 0.85 kg in 1987-88 to 351 mm and 0.79 kg in 1988-89.

Landings of sand seatrout declined from a high of 53,600 fish in 1982-83 to a low of 300 fish in 1988-89 (Figure 54). CPUE declined similarily. Mean lengths and weights increased from 1986-87 to 1988-89. Sand seatrout averaged 328 mm and 0.43 kg in 1988-89.

During 1982-89, the majority (76-87%) of private-boat fishing trips in the EEZ were made by fishermen from adjacent coastal or non-coastal counties. Annual coastwide mean fishing party size and mean trip length ranged from 3.1 to 3.3 people and from 7.3 to 8.8 h during 1982-89.

Party-boat Fishing

Annual coastwide pressure by EEZ party-boat fishermen of 20,200 man-h in 1988-89 was similar to the low of 18,000 man-h in 1985-86 (Figure 55). Trends

in annual coastwide pressure closely paralleled those for landings. An estimated 7,900 fish were landed in 1988-89, compared to 27,300 fish in 1987-88. The high-use season accounted for 98% of the pressure and 97% of the landings during 1983-89 (Figure 25). Most of the pressure occurred offshore from the Corpus Christi (42%) and Galveston (40%) Bay areas during 1983-89 (Figure 56). Landings were greatest offshore from the Corpus Christi Bay (45%) and lower Laguna Madre (30%) areas.

King mackerel accounted for 28% of the annual coastwide party-boat landings in the EEZ during 1983-89; red snapper accounted for 15% (Figure 27). "Other" species accounted for 57% of the fishes landed.

Landings of king mackerel decreased over 90% from 13,500 fish in 1983-84 to 800 fish in 1985-86 (Figure 57). An estimated 1,000 fish were landed in 1988-89. CPUE has varied from 0.14 fish/man-h in 1984-85 to 0.03 fish/man-h in 1987-88. Mean length and weight increased from 860 mm and 7.12 kg in 1987-88 to 962 mm and 8.51 kg in 1988-89.

Trends in landings of red snapper closely paralleled those for CPUE during 1983-89 (Figure 58). Landings ranged from a low of 200 fish in 1984-85 to a high of 4,000 fish in 1988-89. After little change from 1983-84 to 1987-88, mean length and weight increased from 378 mm and 0.85 kg in 1987-88 to 528 mm and 2.39 kg in 1988-89.

During 1983-89, party-boat fishermen in the EEZ originated primarily (49-60%) from non-coastal counties. Annual coastwide mean fishing party size and mean trip length ranged from 3.9 to 5.0 people and from 7.0 to 8.7 h during 1983-89.

Social and Economic Responses

Pre-trip Responses

Fishermen responding to the pre-trip social questionnaire numbered over 4,800 in 1987-88 and over 4,300 in 1988-89.

When asked what species of fish, if any, they planned to fish for that day, 50% of the fishermen in both years indicated they sought spotted seatrout, red drum or a combination of both species (Figure 59). Flounder (Paralichthys sp.) was the third most sought species. In addition, flounder in combination with other species comprised a large proportion of the responses in the "other" species category. Over 30% of the fishermen each year sought no particular species.

When asked to rate the importance, using a 0-10 scale with 0 being "not at all" important and 10 being "extremely" important, of selected motivational dimensions for that day's fishing trip, 80% or more of the fishermen responded with a rating of 5 or greater for all ten of the dimensions queried (Figures 60-64). Based on percentages of fishermen responding with an 8, 9 or 10, "experience unpolluted natural surroundings" was most important to fishermen. Based on percentages of fishermen responding with a 0, 1 or 2,

"catch fish" and "keep the fish you catch" were equally least important to fishermen.

Post-trip Responses

Fishermen responding to the post-trip social and economic questionnaire numbered over 9,900 in 1987-88 and over 8,800 in 1988-89. About 91% of those responding were bay and pass private-boat fishermen.

When asked to rate their satisfaction, using a 0-10 scale with 0 being "not at all" satisfied and 10 being "completely" satisfied, with that day's fishing trip, 45% of the fishermen responded about equally with ratings of 0, 5 or 10; responses greater than and less than 5 were almost equal (Figure 65).

When asked to rate the extent of fulfillment, using a 0-10 scale with 0 being "not at all" and 10 being "completely", of selected motivational dimensions for that day's fishing trip, 75% or more of the fishermen responded with a rating of 5 or greater for all but two of the 10 dimensions queried (Figures 66-70). Less than 50% of the fishermen responded with a rating of 5 or greater for the extent to which they were able to "catch fish" or "keep the fish they caught".

On average in both 1987-88 and 1988-89, interviewed fishermen made about 27 fishing trips to salt water and about six fishing trips to fresh water during the preceeding 1-year period (Figure 71). About 15 of the 27 saltwater trips were made to the launching site at which the fishermen were interviewed.

Saltwater fishing trip costs averaged $116 and $107 during 1987-88 and 1988-89, respectively (Figure 72).

In 1987-88, when contingency values ranging from $50 to $20,000 were asked, the majority of interviewed fishermen indicated they would not quit saltwater fishing until their annual fishing costs increased by an undetermined amount between $5,000 and $20,000 (Figure 73). This range of possible amounts was narrowed to $5,000-$7,500 in 1988-89 when contingency values ranging from $50 to $10,000 were asked.

DISCUSSION

As participation in the saltwater fishery has increased over the past 14 years, landings have decreased. The decline in Texas private-boat landings and catch rates from 1974-76 to later survey years may have been caused by a decrease in fish availability as well as more restrictive size and bag limits on selected species. A decline in fish abundance has been documented by the TPWD fisheries-independent monitoring program (McEachron and Green 1984b, 1986; Rice et al. 1988; Dailey et al. 1988; Mambretti et al. in press). A coastwide decline in sampling gear catch rates was reported for spotted seatrout from 1976 to 1979. By 1984, gill net catch rates for spotted seatrout had declined to the lowest level recorded. Red drum gill net catch rates also declined (from 1976 to 1978 and since 1980) but increased in 1986

to one of the highest levels recorded. These two species together comprise nearly half of the private-boat fishermen landings in Texas bays and passes.

To curb the decline in finfish availability, the Texas Legislature and the Texas Parks and Wildlife Commission enacted possession and size limit regulations designed to restrict harvest of spotted seatrout and red drum (Texas Parks and Wildlife Department 1979, 1981, 1983, 1985, 1987, 1988, 1991). Stabilization of mean catch rates of red drum since 1979-80, except for 1984-85, and the increase in mean sizes for these two species since 1979-80 offers encouragement that these regulations are accomplishing their intended purpose.

The Texas coast experienced a severe fish kill due to cold temperatures during late December 1983 and early January 1984 (McEachron et al. 1984b). Preliminary estimates revealed that a minimum of 15 million marine organisms were killed. Included among these were about 567,000 spotted seatrout, 285,000 black drum, 183,000 sheepshead, 160,000 Atlantic croaker and 90,000 red drum. The negative effects of this fish kill on the sport-boat fishery in Texas bays and passes are documented in this report. Sport-boat fishing pressure declined in all bays except the lower Laguna Madre system. Recreational fishing license sales in 1984-85 were at their lowest level since 1978-79. Declines in landings and catch rates from 1983-84 to 1984-85 were particularly dramatic for spotted seatrout. These declines parallel those noted in catch rates of spotted seatrout from the TPWD fisheries-independent monitoring program (McEachron and Green 1986).

Sport-boat fishing pressure is affected by social and economic, as well as biological factors. Decreases in fishing pressure in 1976-77 and 1977-78 as compared to 1974-76 may have resulted from the combination of the decline in fishing success during those years and the increasing cost of a fishing trip. Ditton et al. (1980) reported that nearly 50% of fishing trip expenditures for bay private-boat fishermen in the Houston-Galveston area were for fuel. With a 131% increase in the price of regular gasoline from 1974 through 1980 (United States Department of Energy 1977, 1980, 1981), fishermen experienced a substantial increase in the cost of an average fishing trip. Social and economic information collected during 1987-89, and presented for the first time in this report, will help discern the motivations, satisfactions and expenditures associated with marine sport-boat fishing. Additional rigorous statistical analyses are needed to explain fully the reasons for trends presented in this report.

Only recently have landings and effort data for charter-boat fishermen been routinely collected (McEachron and Matlock 1983). Various difficulties in surveying charter-boat fishermen, such as high mobility and seasonality of boat operators (Fraser et al. 1977) and noncooperation by boat owners (McEachron 1984), have been noted. The charter industry, however, is a significant component of the total sport-boat fishery in Texas (Ditton et al. 1978). Catch rates of charterboat fishermen are appreciably greater than those reported for non-charter fishermen (McEachron 1984; Osburn and Ferguson 1985a, 1986, 1987; Trent 1977) principally due to the fish guides' greater knowledge of "good" fishing areas (Caillouet and Higman 1978). The demonstrated success of the charter fishery coupled with the increasing number

of boats in the industry emphasizes the need to continue monitoring the landings and effort of charter-boat fishermen.

This study presents pressure and landings estimates, as well as the variances associated with those estimates. Estimates, however, should be considered minimum since they do not include night-time private-boat and party-boat fishing. There are also sites where boats can dock, but TPWD has no access to conduct surveys (e.g., condominiums and private residences). Ferguson and Green (1987) estimated that from 25-30 percent of all saltwater sport-boat fishing trips originated from unsurveyed launch sites. There is also a lack of adequate data to monitor the fishing pressure and landings of shore-based fishermen in Texas (e.g., wade/bank, pier and jetty). McEachron et al. (1981) reported that these shore-based strata accounted for 33-36% of the coastwide sport-fishing landings. Resolutions of these limitations in the sport-boat monitoring program are currently being pursued, as well as methods to improve survey efficiency.

LITERATURE CITED

Breuer, J. P., R. L. Benefield, M. G. Weixelman, A. R. Martinez, and I. Nava. 1977. Survey of finfish harvest in selected Texas bays, Segment II. Project Report No. 2-231-R-2. Texas Parks and Wildlife Department, Coastal Fisheries Branch. Austin, Texas.

Caillouet, C. W. Jr., and J. B. Higman. 1978. Accuracy of sampling procedures and catch rates in sport fishing. Coastal Zone Management Bulletin Number 1. University of Miami. Sea Grant College Program. Miami, Florida.

Carlton, F. E. 1975. Optimum sustainable yield as a management concept in recreational fisheries. Pages 45-49. In: P. M. Roedel, editor. Optimum sustainable yield as a concept in fisheries management. Special Publication Number 9. American Fisheries Society. Washington, District of Columbia.

Dailey, J. A., P. C. Hammerschmidt, and L. W. McEachron. 1988. Trends in relative abundance of selected finfishes in Texas bays: November 1975-December 1987. Management Data Series Number 155. Texas Parks and Wildlife Department, Coastal Fisheries Branch. Austin, Texas.

Ditton, R. B., R. N. Jarman, and S. A. Woods. 1978. An analysis of the charter fishing industry on the Texas Gulf coast. Marine Fisheries Review. 40(8):1-7.

Ditton, R. B., A. R. Graefe, and G. Lapotka. 1980. Economic impacts of recreational boat fishing in the Houston-Galveston area of the Texas coast. Publication Number TAMU-SG-80-206. Texas A&M University, Sea Grant College Program. College Station, Texas.

Ferguson, M. O., and A. W. Green. 1987. An estimate of unsurveyed coastal recreational boat fishing activity in Texas. Marine Fisheries Review. 49(2):155-161.

Fraser, M. B., J. A. Henderson, and J. F. McManus. 1977. Survey of commercial sport-fishing boats in the coastal United States. Publication Number ORESU-T-77-009. Oregon State University, Sea Grant College Program. Corvallis, Oregon.

Gallaway, B. J., J. C. Parker, and D. Moore. 1972. Key to the estuarine and marine fishes of Texas. Publication Number TAMU-SG-72-402. Texas A&M University, Sea Grant College Program. College Station, Texas.

Green, A. W., T. L. Heffernan, and J. P. Breuer. 1978. Recreational and commercial finfish catch statistics for Texas bay systems, September 1974 to August 1977. Project Report Number 2-293-R. Texas Parks and Wildlife Department, Coastal Fisheries Branch. Austin, Texas.

Green, A. W., L. Z. Barrington, and G. C. Matlock. 1982. An estimation of the total number of Texas fishermen, 1 September 1978-31 August 1979. Proceedings 36th Annual Conference Southeastern Association Fish Wildlife Agencies. 36:241-251.

Green, L. M., R. P. Campbell, and K. W. Spiller. 1991. Trends in finfish landings, and social and economic characteristics of sport-boat fishermen in Texas marine waters, May 1974-May 1989: appendices. Management Data Series Number 56A. Texas Parks and Wildlife Department, Fisheries and Wildlife Division. Austin, Texas.

Green, L. M., H. R. Osburn, G. C. Matlock, and R. B. Ditton. In press. Development of a social and economic questionnaire for on-site interviews of marine recreational anglers in Texas. American Fisheries Society Symposium. In press.

Harrington, R. A., G. C. Matlock, and J. E. Weaver. 1979. Length-weight and dressed-whole weight conversion tables for selected saltwater fishes. Management Data Series Number 6. Texas Parks and Wildlife Department, Coastal Fisheries Branch. Austin, Texas.

Heffernan, T. L., A. W. Green, L. W. McEachron, M. G. Weixelman, P. C. Hammerschmidt, and R. A. Harrington. 1976. Survey of finfish harvest in selected Texas bays. Project Report Number 2-231-R-1. Texas Parks and Wildlife Department, Coastal Fisheries Branch. Austin, Texas.

Hoese, H. D., and R. H. Moore. 1977. Fishes of the Gulf of Mexico, Texas, Louisiana and adjacent waters. Texas A&M University Press, College Station, Texas.

Kish, L. 1965. Survey sampling. John Wiley and Sons, New York.

Maddux, H. R., H. R. Osburn, D. L. Trimm, and K. W. Spiller. 1989. Trends in finfish landings by sport-boat fishermen in Texas marine waters, May 1974-May 1989. Management Data Series Number 8. Texas Parks and Wildlife Department, Fisheries Division. Austin, Texas.

Mambretti, J. M., J. A. Dailey, and L. W. McEachron. 1990. Trends in relative abundance and size of selected finfishes and shellfishes along the Texas coast: November 1975-December 1988. Management Data Series Number 20. Texas Parks and Wildlife Department, Fisheries Division. Austin, Texas.

McEachron, L. W. 1980a. Recreational and commercial finfish catch statistics for Texas bay systems, September 1977-August 1978. Management Data Series Number 7. Texas Parks and Wildlife Department, Coastal Fisheries Branch. Austin, Texas.

McEachron, L. W. 1980b. Recreational and commercial finfish catch statistics for Texas bay systems, September 1978-August 1979. Management Data Series Number 9. Texas Parks and Wildlife Department, Coastal Fisheries Branch. Austin, Texas.

McEachron, L. W. 1983. Harvest estimates for Texas charter boats, September 1980-August 1981. Management Data Series Number 48. Texas Parks and Wildlife Department, Coastal Fisheries Branch. Austin, Texas.

McEachron, L. W. 1984. Harvest estimates for Texas marine charter boats (1978-1982). Technical Series Number 29. Texas Parks and Wildlife Department, Coastal Fisheries Branch. Austin, Texas.

McEachron, L. W., P. Campbell, and K. Meador. 1984a. Harvest by Texas headboat fishermen during September 1982-May 1983. Management Data Series Number 58. Texas Parks and Wildlife Department, Coastal Fisheries Branch. Austin, Texas.

McEachron, L. W., and A. W. Green. 1981. Recreational finfish catch statistics for Texas bay systems, September 1979-August 1980. Management Data Series Number 25. Texas Parks and Wildlife Department, Coastal Fisheries Branch. Austin, Texas.

McEachron, L. W., and A. W. Green. 1982. Weekend sport-boat fishermen finfish catch statistics for Texas bay systems, May 1974-May 1981. Management Data Series Number 35. Texas Parks and Wildlife Department, Coastal Fisheries Branch. Austin, Texas.

McEachron, L. W., and A. W. Green. 1983. Weekend sport-boat fishermen finfish catch statistics for Texas bay systems, May 1974-May 1982. Management Data Series Number 50. Texas Parks and Wildlife Department, Coastal Fisheries Branch. Austin, Texas.

McEachron, L. W., and A. W. Green. 1984a. Weekend sport-boat fishermen finfish catch statistics for Texas bay systems, May 1974-May 1983. Management Data Series Number 59. Texas Parks and Wildlife Department, Coastal Fisheries Branch. Austin, Texas.

McEachron, L. W., and A. W. Green. 1984b. Assessment of annual relative abundance and mean length of six marine fishes in Texas coastal waters. Proceedings 38th Annual Conference Southeastern Association Fish Wildlife Agencies. 38:506-519.

McEachron, L. W., and A. W. Green. 1986. Trends in relative abundance and size of selected finfish in Texas bays: November 1975-June 1985. Management Data Series Number 91. Texas Parks and Wildlife Department, Coastal Fisheries Branch. Austin, Texas.

McEachron, L. W., A. W. Green, L. Z. Barrington, M. G. Weixelman, P. Campbell-Hostettler, R. A. Spaw, K. W. Spiller, and J. P. Breuer. 1981. Survey of finfish harvest of sport fishermen in selected Texas bays, September-August 1974-76 and 1979-1980. Management Data Series Number 24. Texas Parks and Wildlife Department, Coastal Fisheries Branch. Austin, Texas.

McEachron, L. W., A. W. Green, and G. E. Saul. 1983. Increasing sampling efficiency in creel surveys. Proceedings 37th Annual Conference Southeastern Association Fish Wildlife Agencies. 37:376-384.

McEachron, L. W., and G. C. Matlock. 1983. An estimate of harvest by the Texas charter boat fishery. Marine Fisheries Review. 45(1):11-17.

McEachron, L. W., G. Saul, J. Cox, C. E. Bryan, and G. Matlock. 1984b. Fish kill. Texas Parks and Wildlife Magazine. XLII(4):10-13.

Mendenhall, W., L. Ott, and R. L. Schaeffer. 1971. Elementary survey sampling. Wadsworth Publishing Company, Incorporated. Belmont, California.

Murdy, E. O. 1983. Saltwater fishes of Texas, a dichotomous key. Publication Number TAMU-SG-83-607. Texas A&M University, Sea Grant College Program. College Station, Texas.

Osburn, H. R. and M. O. Ferguson. 1985a. Charterboat fishermen finfish catch statistics for Texas marine waters (May 1983-May 1984). Management Data Series Number 77. Texas Parks and Wildlife Department, Coastal Fisheries Branch. Austin, Texas.

Osburn, H. R. and M. O. Ferguson. 1985b. Trends in finfish catches by private sport-boat fishermen in Texas marine waters through May 1984. Management Data Series Number 78. Texas Parks and Wildlife Department, Coastal Fisheries Branch. Austin, Texas.

Osburn, H. R. and M. O. Ferguson. 1986. Trends in finfish landings by sport-boat fishermen in Texas marine waters: May 1974-May 1985. Management Data Series Number 90. Texas Parks and Wildlife Department, Coastal Fisheries Branch. Austin, Texas.

Osburn, H. R. and M. O. Ferguson. 1987. Trends in finfish landings by sport-boat fishermen in Texas marine waters: May 1974-May 1986. Management Data Series Number 119. Texas Parks and Wildlife Department, Coastal Fisheries Branch. Austin, Texas.

Osburn, H. R., M. F. Osborn, and H. R. Maddux. 1988. Trends in finfish landings by sport-boat fishermen in Texas marine waters: May 1974-May 1987. Management Data Series Number 150. Texas Parks and Wildlife Department, Coastal Fisheries Branch. Austin, Texas.

Rice, K. W., L. W. McEachron, and P. C. Hammerschmidt. 1988. Trends in relative abundance and size of selected finfishes in Texas bays: November 1975-December 1986. Management Data Series Number 139. Texas Parks and Wildlife Department, Coastal Fisheries Branch. Austin, Texas.

Robins, R. C., R. M. Bailey, C. E. Bond, J. R. Brooker, E. A. Lachner, R. N. Lea, and W. B. Scott. 1980. A list of common and scientific names of fishes from the United States and Canada. Special Publication Number 12. 4th edition. American Fisheries Society. Bethesda, Maryland.

Spiller, K. W., A. W. Green, and H. R. Osburn. 1988. Increasing efficiency of angler surveys: cancellation of sampling during inclement weather. North American Journal of Fisheries Management. 8:132-138.

Texas Parks and Wildlife Department. 1979. Saltwater finfish research and management in Texas: a report to the Governor and the 66th Legislature. Texas Parks and Wildlife Department, Coastal Fisheries Branch. Austin, Texas.

Texas Parks and Wildlife Department. 1981. Saltwater finfish research and management in Texas: a report to the Governor and the 67th Legislature. Texas Parks and Wildlife Department, Coastal Fisheries Branch. Austin, Texas.

Texas Parks and Wildlife Department. 1983. Saltwater finfish research and Management in Texas: a report to the Governor and the 68th Legislature. Texas Parks and Wildlife Department, Coastal Fisheries Branch. Austin, Texas.

Texas Parks and Wildlife Department. 1985. Saltwater finfish research and management in Texas: a report to the Governor and the 69th Legislature. Texas Parks and Wildlife Department, Coastal Fisheries Branch. Austin, Texas.

Texas Parks and Wildlife Department. 1987. Saltwater finfish research and management in Texas: a report to the Governor and the 70th Legislature. Texas Parks and Wildlife Department, Coastal Fisheries Branch. Austin, Texas.

Texas Parks and Wildlife Department. 1988. Saltwater finfish research and management in Texas: a report to the Governor and the 71st Legislature. Texas Parks and Wildlife Department, Coastal Fisheries Branch. Austin, Texas.

Texas Parks and Wildlife Department. 1991. Saltwater finfish research and management in Texas: a report to the Governor and the 72nd Legislature. Texas Parks and Wildlife Department, Coastal Fisheries Branch. Austin, Texas.

Texas Water Development Board. 1987. Regional and statewide economic impacts of sportfishing, other recreational activities, and commercial fishing associated with major bays and estuaries of the Texas gulf coast: executive summary. Texas Water Development Board. Austin, Texas.

Trent, L. 1977. Evaluation of the marine recreational fisheries in the Northwestern Gulf of Mexico from Port Aransas to Port Isabel, Texas, 1975-76. In: Environmental studies of the south Texas outer continental shelf 1975. Addendum to Volume 1. NOAA Final Report to Bureau of Land Management, Interagency Agreement Number 08550-IA5-19.

United States Department of Energy. 1977. Monthly energy review. Energy Information Administration. Washington, District of Columbia.

United States Department of Energy. 1980. Monthly energy review. Energy Information Administration. Washington, District of Columbia.

United States Department of Energy. 1981. Monthly energy review. Energy Information Administration. Washington, District of Columbia.

United States Fish and Wildlife Service. 1989. 1985 national survey of fishing, hunting and wildlife-associated recreation: Texas. United States Department of the Interior, Fish and Wildlife Service. Washington, District of Columbia.

Weixelman, M. G., and A. W. Green. 1984. Increasing creel survey efficiency: early termination of surveys on inactive days. Proceedings 38th Annual Conference Southeastern Association Fish Wildlife Agencies. 38:583-589.

Table 1. Components of the social and economic questionnaire as administered during 1987-1988.

Question type	Question wording
Species sought (pre-trip)	Are you fishing for a particular species today? What is it?
Motive importance (pre-trip)	On a 10 point scale, with 10 being extremely important and 0 being not at all important, how important is it for you to ____ on today's fishing trip? (Three phrases filled the blank including catch fish, relax and one of the following which was selected each day: do what you want to do; experience adventure and excitement; experience good weather; experience unpolluted natural surroundings; get away from crowds of people; have a quiet time to think; keep the fish you catch; and spend time with friends or family.)
Number of fishing trips (post-trip)	Since this time last year, how many fishing trips have you made to: saltwater sites in Texas; freshwater sites in Texas; and this launching site from where you currently live?
Trip satisfaction (post-trip)	On a 10 point scale, with 10 being completely satisfied and 0 being not at all satisfied, how satisfied were you with today's fishing trip?
Motive fulfillment (post-trip)	On a 10 point scale, with 10 being completely and 0 being not at all, to what extent were you able to ____ on today's fishing trip? (Three phrases filled the blank as described in the motive importance question above.)
Angler origin (post-trip)	What is the ZIP code where you currently live?
Trip cost (post-trip)	How much will you spend on this fishing trip from when you left home until you get home?
Contingency valuation (post-trip)	If the total cost of all your saltwater fishing last year was ____ dollars more, would you have quit fishing completely? (Values of 50, 100, 200, 400, 600, 800, 1,000, 1,500, 5,000 and 20,000 were rotated in the blank above, so that each succeeding interview had a different value.)

Table 2. Components of the social and economic questionnaire as administered during 1988-1989.

Question type	Question wording
Species sought (pre-trip)	Are you fishing for a particular type of fish today? What is it?
Motive importance (pre-trip)	On a 10 point scale, with 10 being extremely important and 0 being not at all important, how important is it for you to ____ on today's fishing trip? (Three phrases filled the blank including catch fish, keep the fish you catch and one of the following which was selected each day: do what you want to do; experience adventure and excitement; experience good weather; experience unpolluted natural surroundings; get away from crowds of people; have a quiet time to think; relax; and spend time with friends or family.)
Number of fishing trips (post-trip)	Since this time last year, how many fishing trips have you made to: saltwater sites in Texas; freshwater sites in Texas; and this launching site from where you currently live?
Trip satisfaction (post-trip)	On a 10 point scale, with 10 being completely satisfied and 0 being not at all satisfied, how satisfied were you with today's fishing trip?
Motive fulfillment (post-trip)	On a 10 point scale, with 10 being completely and 0 being not at all, to what extent did you ____ on today's fishing trip? (Three phrases filled the blank as described in the motive importance question above.)
Angler origin (post-trip)	What is the ZIP code where you currently live?
Trip cost (post-trip)	How much money will you spend on this fishing trip from when you left home until you get home?
Contingency valuation (post-trip)	Based on your current income, if the total cost of all your saltwater fishing last year was ____ dollars more, would you have quit fishing completely? (Values of 50, 200, 500, 1,000, 2,000, 3,000, 4,000, 5,000, 7,500 and 10,000 were rotated in the blank above, so that each succeeding interview had a different value.)

Table 3. Annual and seasonal sport-boat fishing pressure (man-h x 1,000) and finfish landings (No. x 1,000) by year, area fished and strata (1983-1989).

Year / Area / Stratum	High-use		Low-use		Annual[a]	
	Pressure	Landings	Pressure	Landings	Pressure	Landings
1983-1984						
Bay and Pass						
Private boat	4,465.7	2,089.4	1,180.3	387.9	5,646.0	2,477.3
Party boat	206.8	240.7	44.3	22.2	249.9	261.8
Headboat	162.1	129.1	28.6	7.6	190.7	136.6
Total	4,834.6	2,459.2	1,253.2	417.7	6,086.6	2,875.7
Territorial Sea						
Private boat	311.5	29.0	32.5	7.7	344.0	32.7
Party boat	46.5	20.7	0.0	0.0	46.5	20.7
Total	358.0	49.7	32.5	7.7	390.5	53.4
Exclusive Economic Zone						
Private boat	197.2	76.7	23.5	8.4	220.7	81.3
Party boat	117.1	33.5	0.0	0.0	117.1	33.5
Total	314.3	110.2	23.5	8.4	337.8	114.8
Grand Total[a]	5,506.9	2,619.1	1,309.2	433.8	6,814.9	3,043.9
1984-1985						
Bay and Pass						
Private boat	2,705.0	1,059.5	1,378.1	402.8	4,083.1	1,462.3
Party boat	89.7	41.8	37.5	25.6	127.6	67.6
Headboat	108.1	65.6	31.2	9.6	139.3	75.3
Total	2,902.8	1,166.9	1,446.8	438.0	4,350.0	1,605.2
Territorial Sea						
Private boat	127.0	22.7	21.6	20.8	148.6	42.8
Party boat	11.4	1.5	4.5	1.3	15.9	2.9
Total	138.4	24.2	26.1	22.1	164.5	45.7
Exclusive Economic Zone						
Private boat	159.9	42.4	9.5	11.4	169.1	51.2
Party boat	26.5	5.8	3.5	0.8	30.0	6.6
Total	186.0	48.2	13.0	12.2	199.1	57.8
Grand Total[a]	3,227.2	1,239.3	1,485.9	472.3	4,713.6	1,708.7

Table 3. (Cont'd.)

Year Area Stratum	High-use Pressure	 Landings	Low-use Pressure	 Landings	Annual[a] Pressure	 Landings
1985-1986						
Bay and Pass						
Private boat	3,269.9	1,212.6	2,208.1	514.8	5,477.9	1,727.4
Party boat	129.2	69.1	95.7	34.9	224.8	104.0
Headboat	179.5	218.8	30.0	13.3	209.6	232.0
Total	3,578.6	1,500.5	2,333.8	563.0	5,912.3	2,063.4
Territorial Sea						
Private boat	161.5	29.2	15.3	10.6	176.9	39.8
Party boat	18.6	5.7	0.0	0.0	18.6	5.6
Total	180.1	34.9	15.3	10.6	195.5	45.4
Exclusive Economic Zone						
Private boat	253.1	50.9	14.4	21.1	267.5	72.1
Party boat	18.0	8.8	0.0	0.0	18.0	8.8
Total	271.1	59.7	14.4	21.1	285.5	80.9
Grand Total[a]	4,029.8	1,595.1	2,363.5	594.7	6,393.3	2,189.7
1986-1987						
Bay and Pass						
Private boat	4,020.0	1,720.4	2,350.8	718.7	6,370.8	2,439.2
Party boat	151.3	97.5	62.4	42.8	213.7	140.3
Headboat	90.7	90.7	18.2	5.7	108.9	96.5
Total	4,262.0	1,908.6	2,431.4	767.2	6,693.4	2,676.0
Territorial Sea						
Private boat	259.1	72.7	21.9	9.2	280.9	81.9
Party boat	7.2	1.4	0.4	0.6	7.6	1.9
Total	266.3	74.1	22.3	9.8	288.5	83.8
Exclusive Economic Zone						
Private boat	171.1	36.1	17.7	16.6	188.7	52.6
Party boat	41.2	12.5	3.2	0.8	44.4	13.3
Total	212.3	48.6	20.9	17.4	233.1	65.9
Grand Total[a]	4,740.6	2,031.3	2,474.6	794.4	7,215.0	2,825.7

Table 3. (Cont'd.).

Year Area Stratum	High-use Pressure	 Landings	Low-use Pressure	 Landings	Annual[a] Pressure	 Landings
1987-1988						
Bay and Pass						
Private boat	5,061.2	2,144.3	1,847.9	582.7	6,909.1	2,727.0
Party boat	172.4	108.3	39.6	12.5	212.0	120.8
Headboat	164.5	126.9	17.8	5.1	182.3	132.0
Total	5,398.1	2,379.5	1,905.3	600.3	7,303.4	2,979.8
Territorial Sea						
Private boat	268.7	42.4	17.3	4.3	285.9	46.7
Party boat	20.1	6.4	0.0	0.0	20.1	6.5
Total	288.8	48.8	17.3	4.3	306.0	53.2
Exclusive Economic Zone						
Private boat	182.2	48.9	21.3	24.6	203.5	73.5
Party boat	138.6	25.8	2.3	1.5	140.8	27.3
Total	320.8	74.7	23.6	26.1	344.3	100.8
Grand Total[a]	6,007.7	2,503.0	1,946.2	630.7	7,953.7	3,133.8
1988-1989						
Bay and Pass						
Private boat	4,297.8	1,591.9	1,588.0	549.9	5,885.8	2,141.8
Party boat	188.6	115.9	63.5	37.8	252.1	153.7
Headboat	105.9	99.9	14.3	4.0	120.2	104.0
Total	4,592.3	1,807.7	1,665.8	591.7	6,258.1	2,399.5
Territorial Sea						
Private boat	122.4	22.5	15.2	3.1	137.6	25.6
Party boat	9.9	2.2	0.0	0.0	9.9	2.2
Total	132.3	24.7	15.2	3.1	147.5	27.8
Exclusive Economic Zone						
Private boat	134.0	68.7	9.9	4.9	143.9	73.7
Party boat	20.2	7.9	0.0	0.0	20.2	7.9
Total	154.2	76.6	9.9	4.9	164.1	81.6
Grand Total[a]	4,878.8	1,909.0	1,690.9	599.7	6,569.7	2,508.9

[a]Due to rounding of numbers, these totals may not exactly equal individual totals.

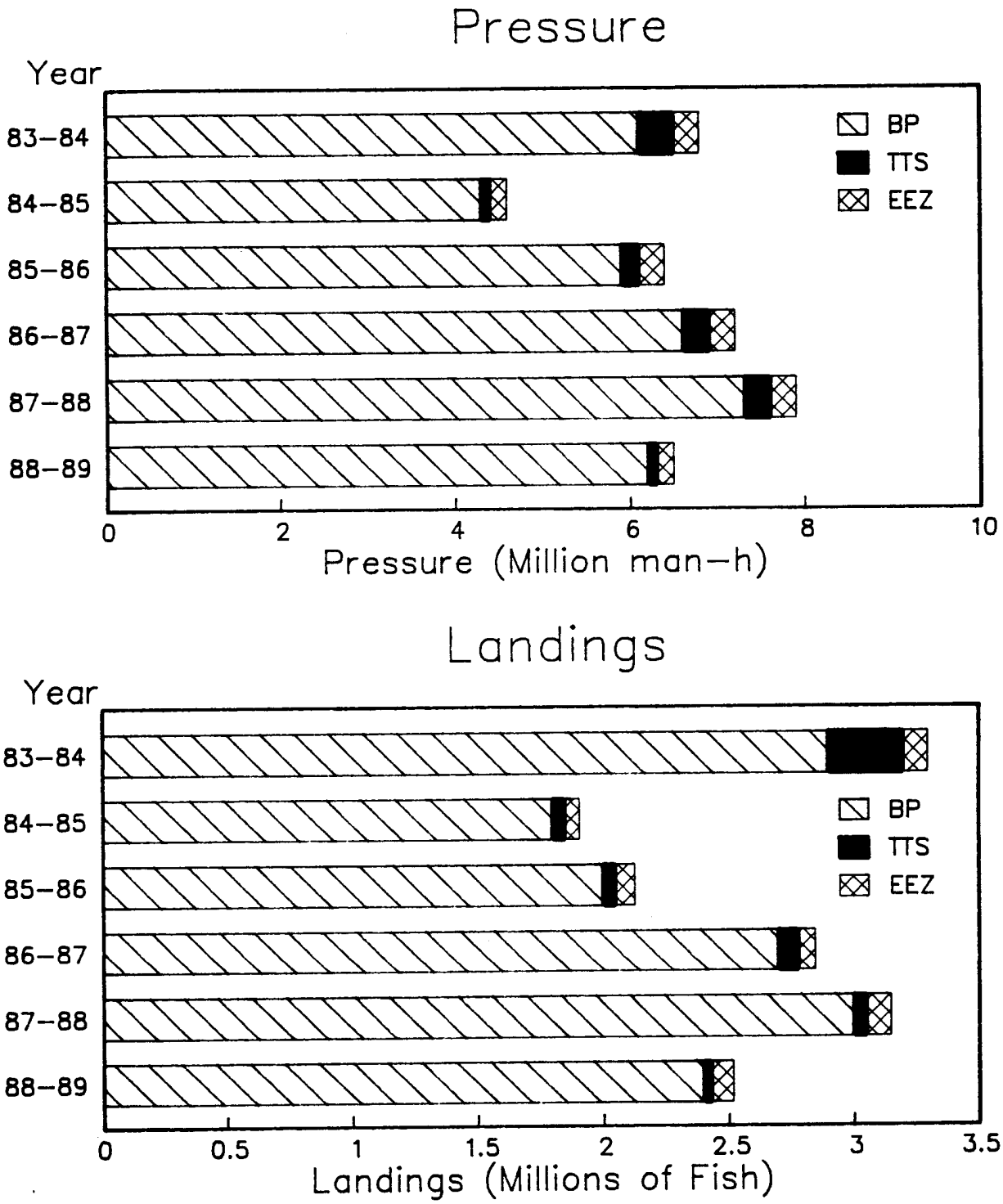


Figure 1. Annual coastwide sport-boat fishing pressure and landings in bays and passes (BP), the Texas Territorial Sea (TTS) and the Exclusive Economic Zone (EEZ), May 1983-May 1989.

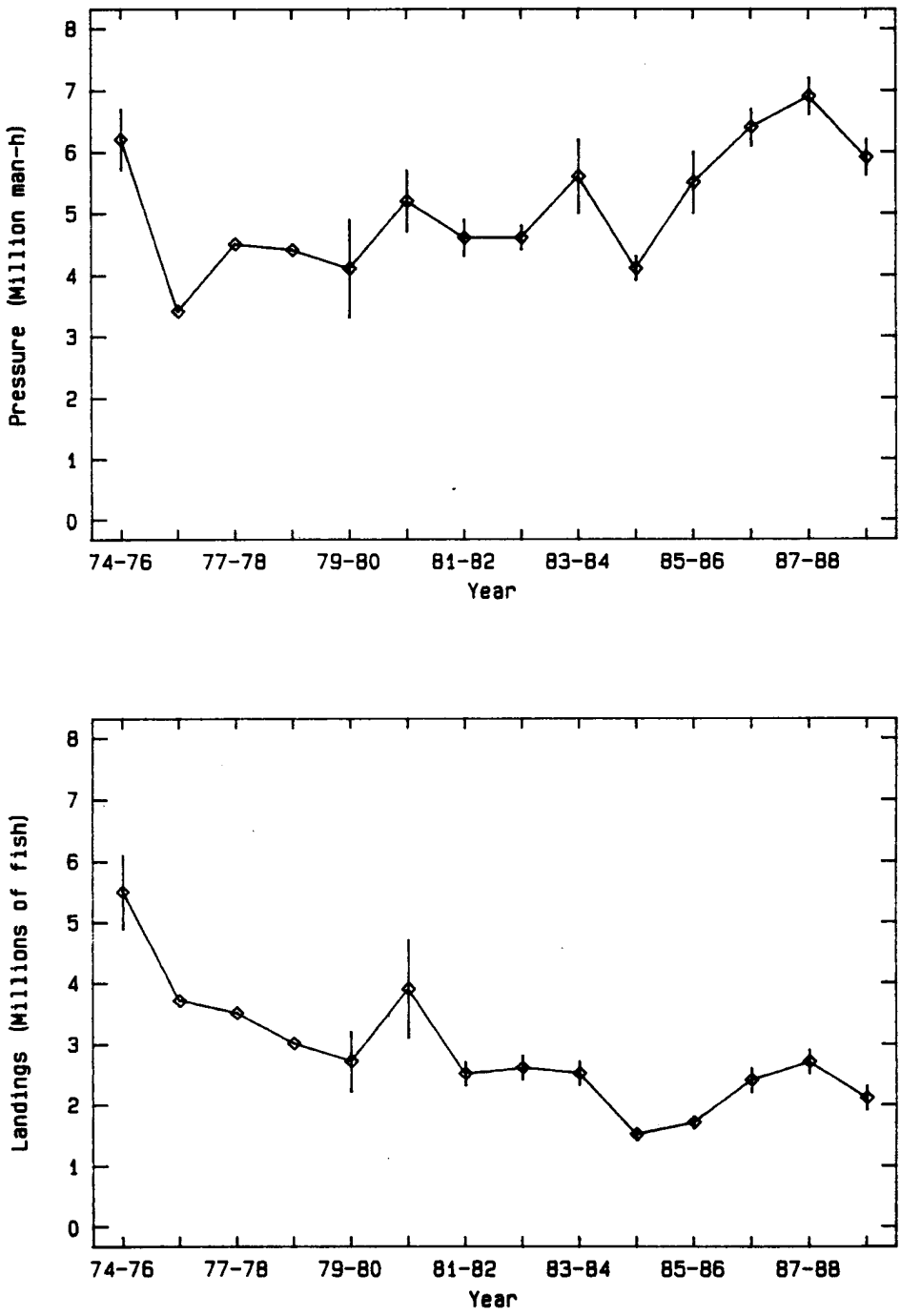


Figure 2. Annual coastwide private-boat fishing pressure (± 1 SE) and landings (± 1 SE) in Texas bays and passes, May 1974-May 1989.

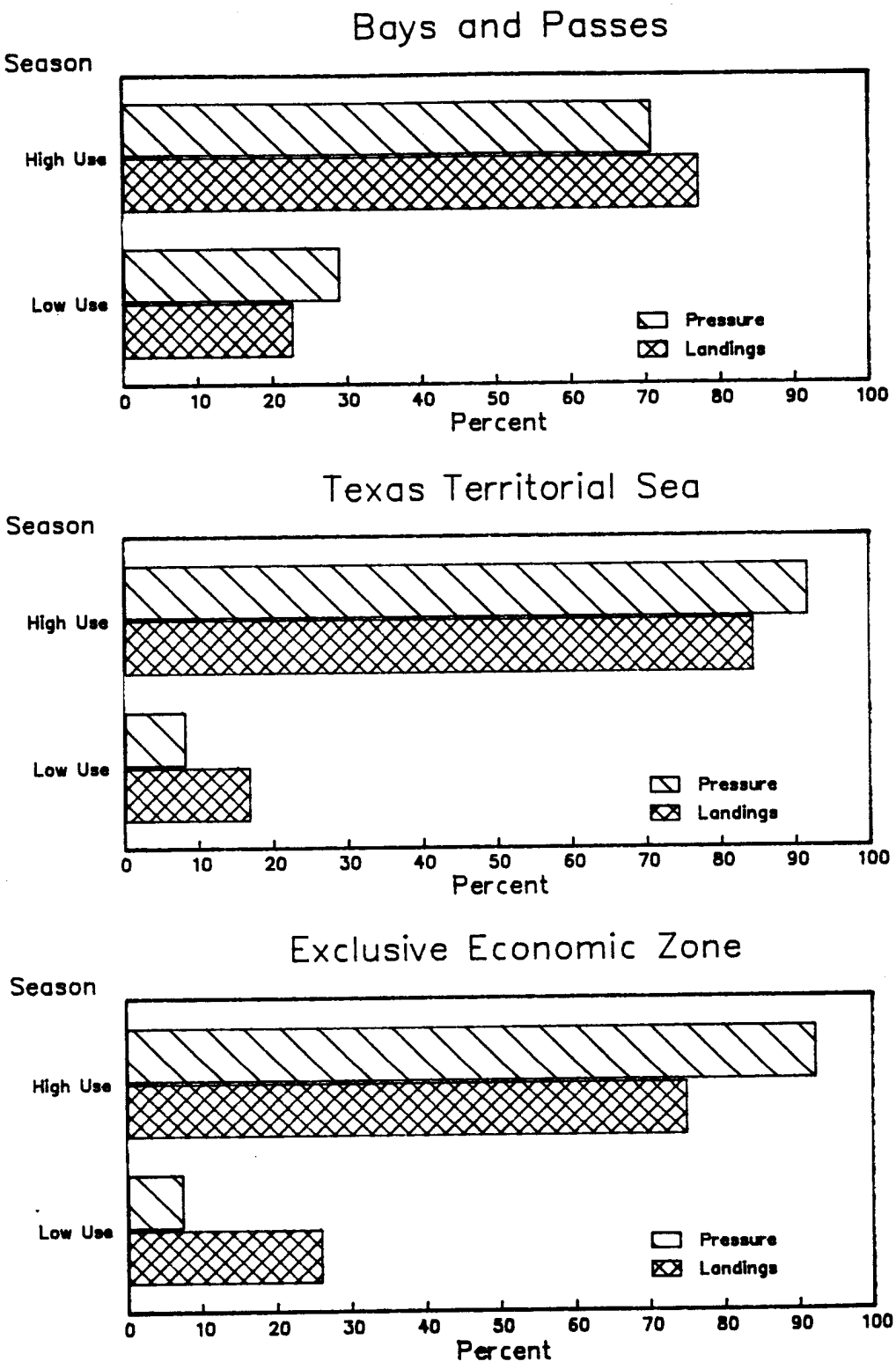


Figure 3. Distribution of annual coastwide private-boat fishing pressure and landings between seasons in bays and passes, May 1979-May 1989 (10-year mean), and in the Texas Territorial Sea and the Exclusive Economic Zone, May 1982-May 1989 (7-year mean).

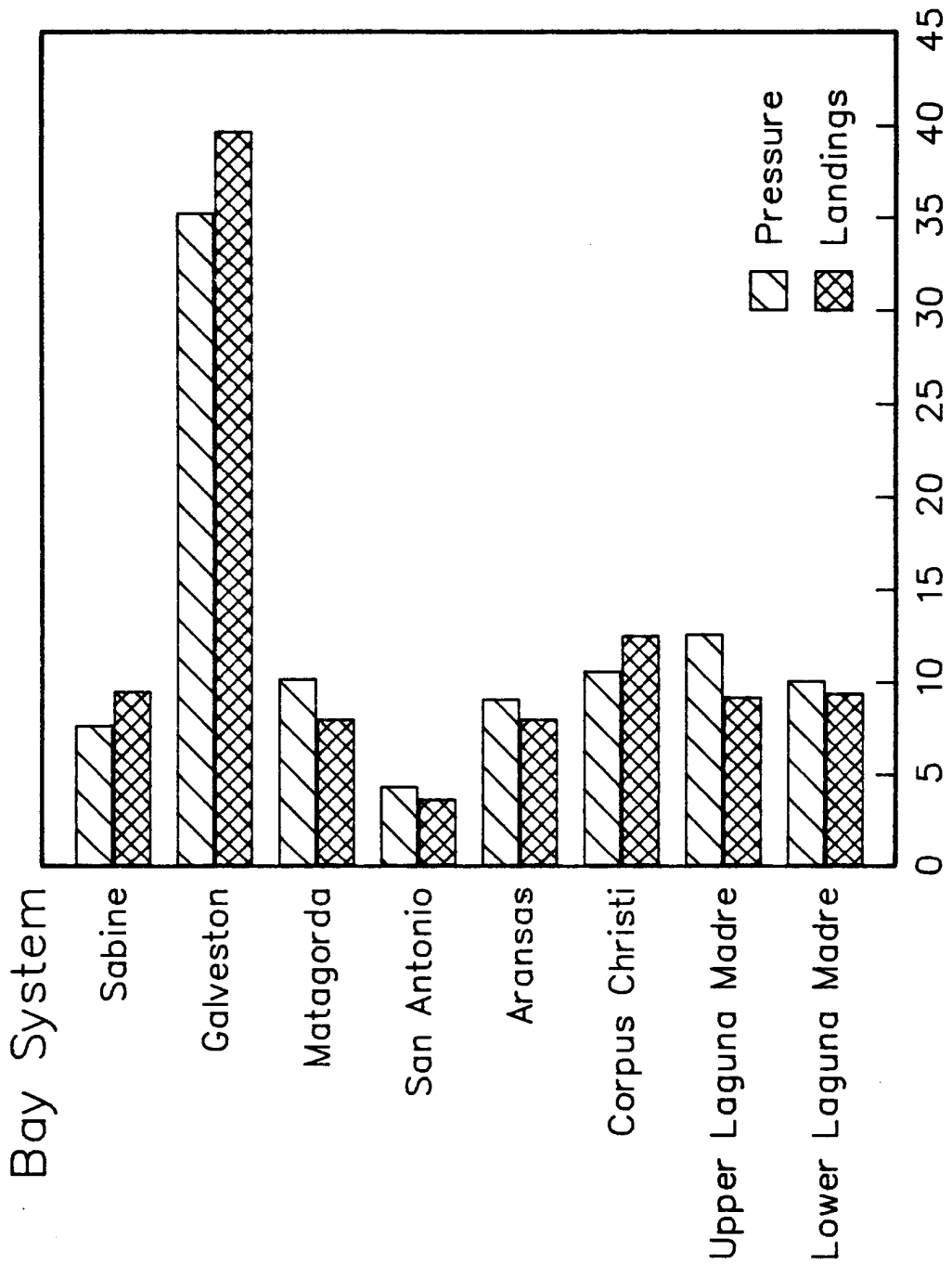


Figure 4. Distribution of annual coastwide bay and pass private-boat fishing pressure and landings among bay systems, May 1979-May 1989 (based on 2-year mean in Sabine Lake system and 10-year means in all other bay systems).

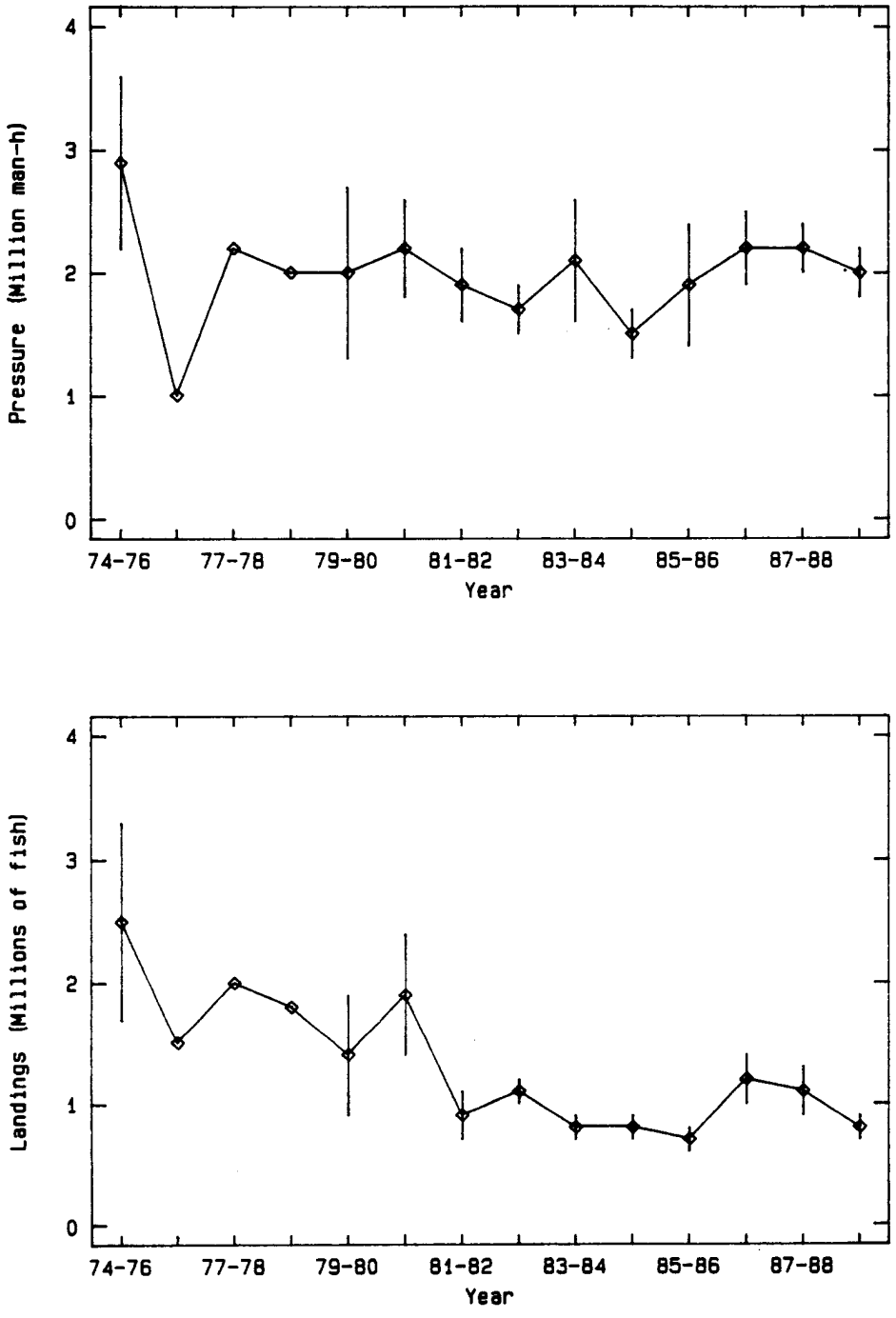


Figure 5. Annual bay and pass private-boat fishing pressure (± 1 SE) and landings (± 1 SE) for Galveston Bay system, May 1974-May 1989.

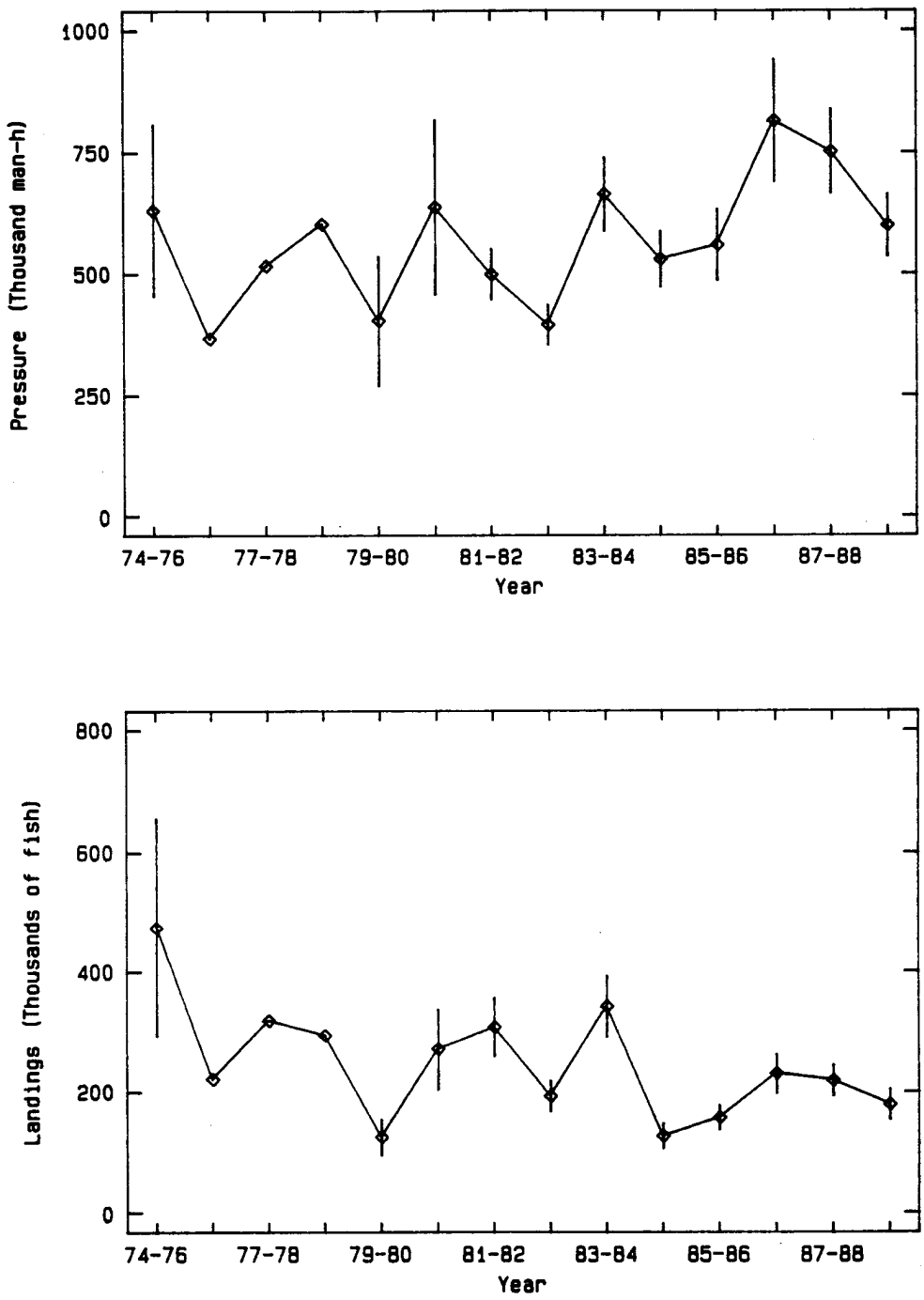


Figure 6. Annual bay and pass private-boat fishing pressure (± 1 SE) and landings (± 1 SE) for Matagorda Bay system, May 1974-May 1989.

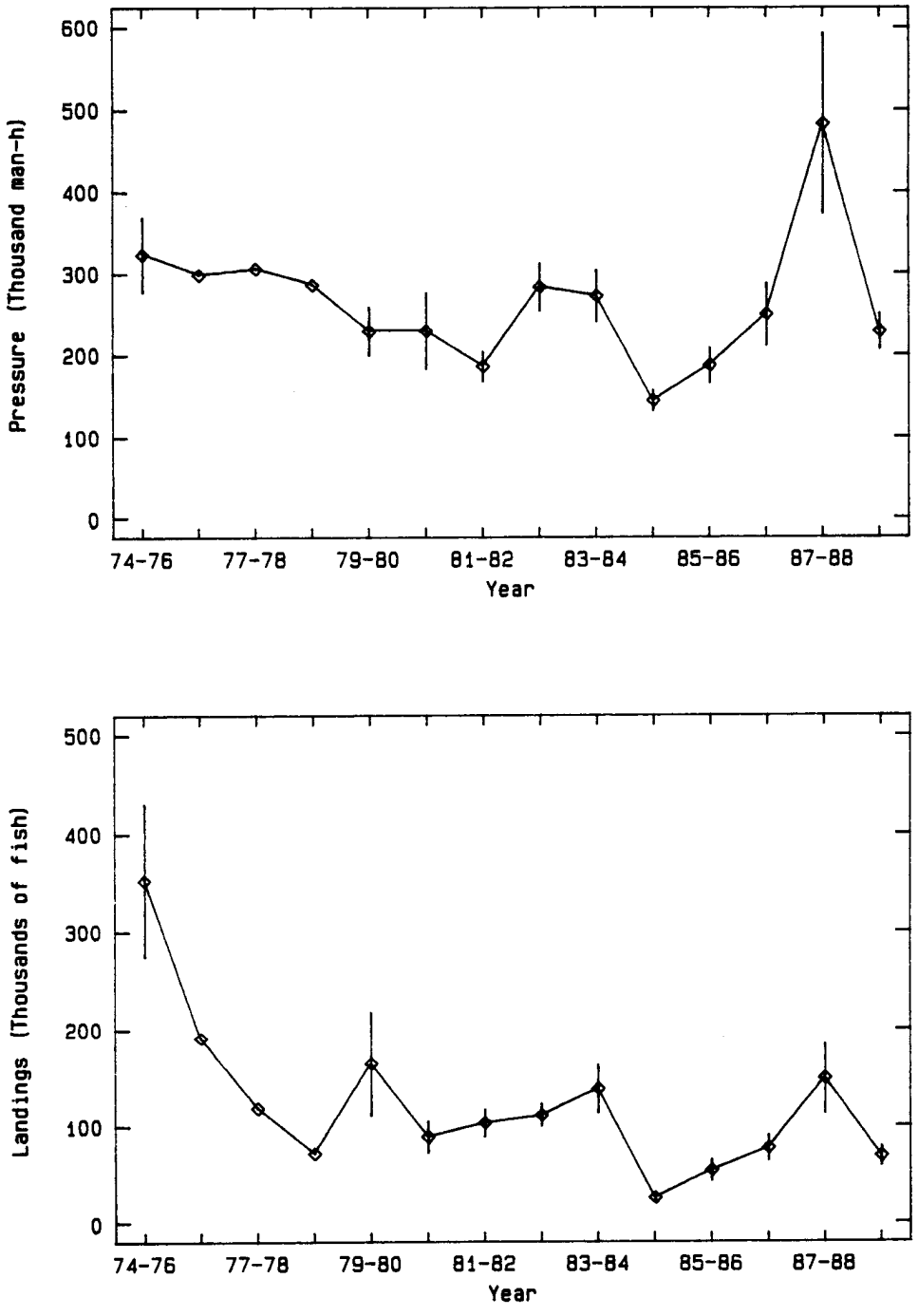


Figure 7. Annual bay and pass private-boat fishing pressure (± 1 SE) and landings (± 1 SE) for San Antonio Bay system, May 1974-May 1989.

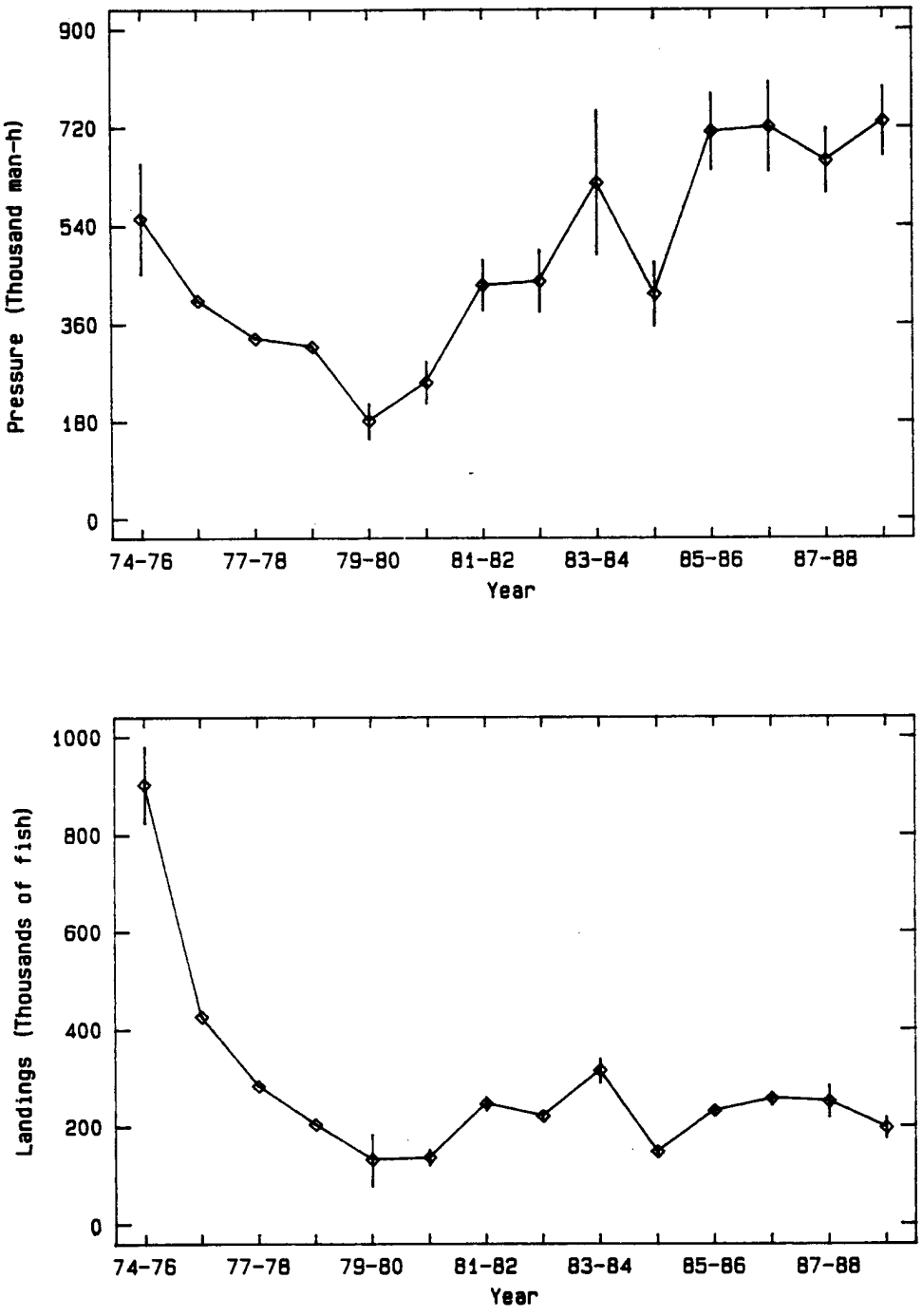


Figure 8. Annual bay and pass private-boat fishing pressure (± 1 SE) and landings (± 1 SE) for Aransas Bay system, May 1974-May 1989.

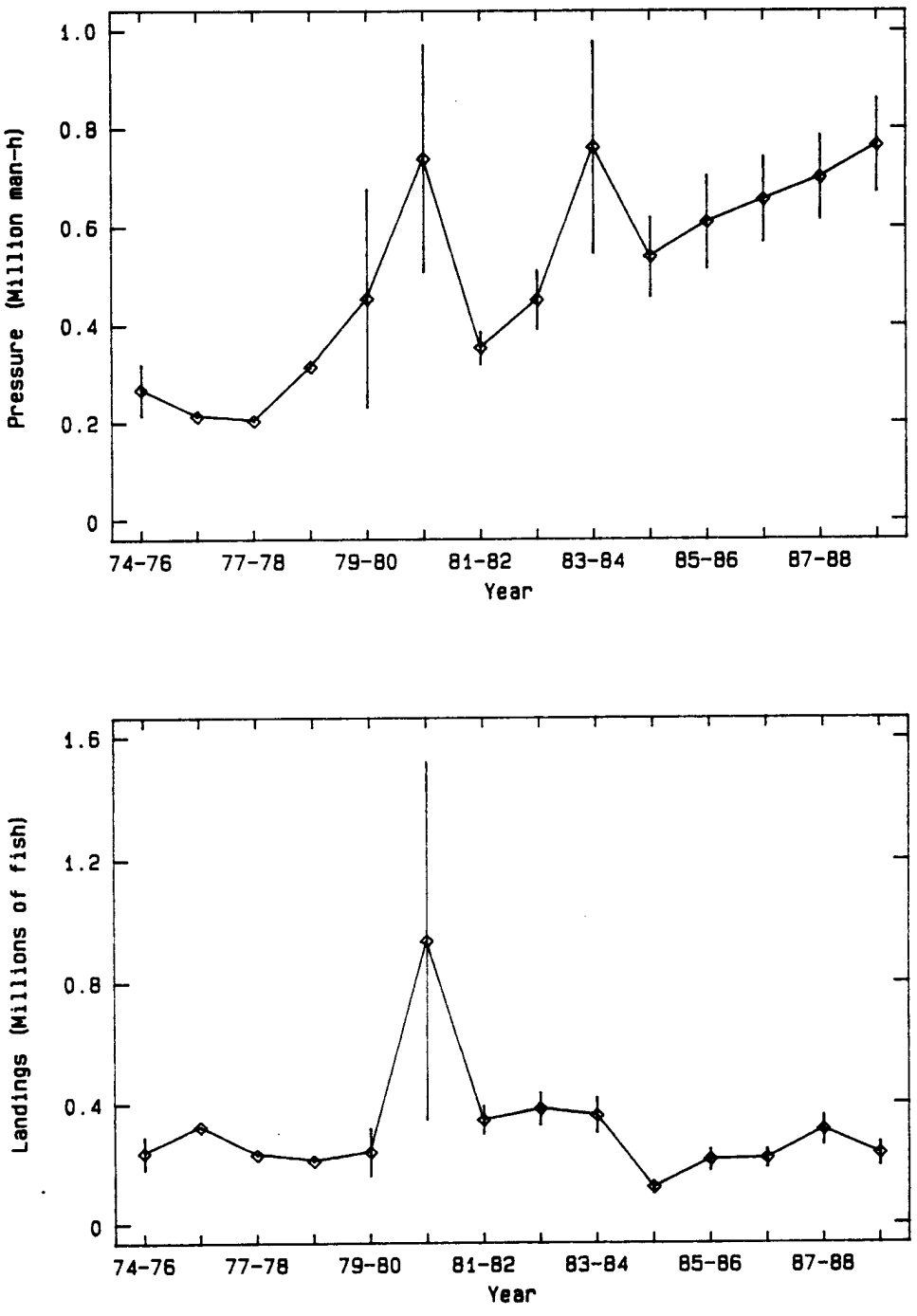


Figure 9. Annual bay and pass private-boat fishing pressure (± 1 SE) and landings (± 1 SE) for Corpus Christi Bay system, May 1974-May 1989.

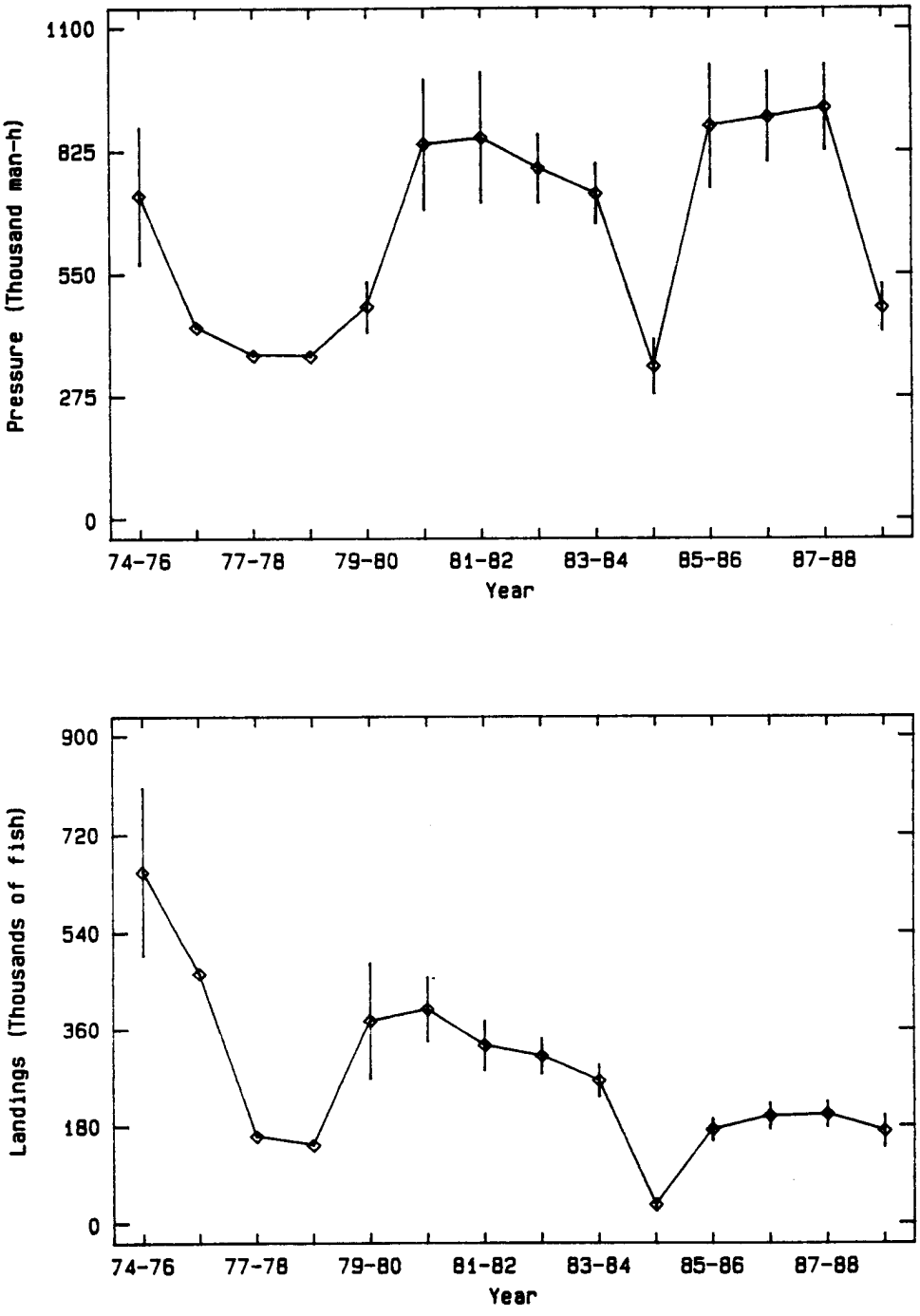


Figure 10. Annual bay and pass private-boat fishing pressure (± 1 SE) and landings (± 1 SE) for the upper Laguna Madre system, May 1974-May 1989.

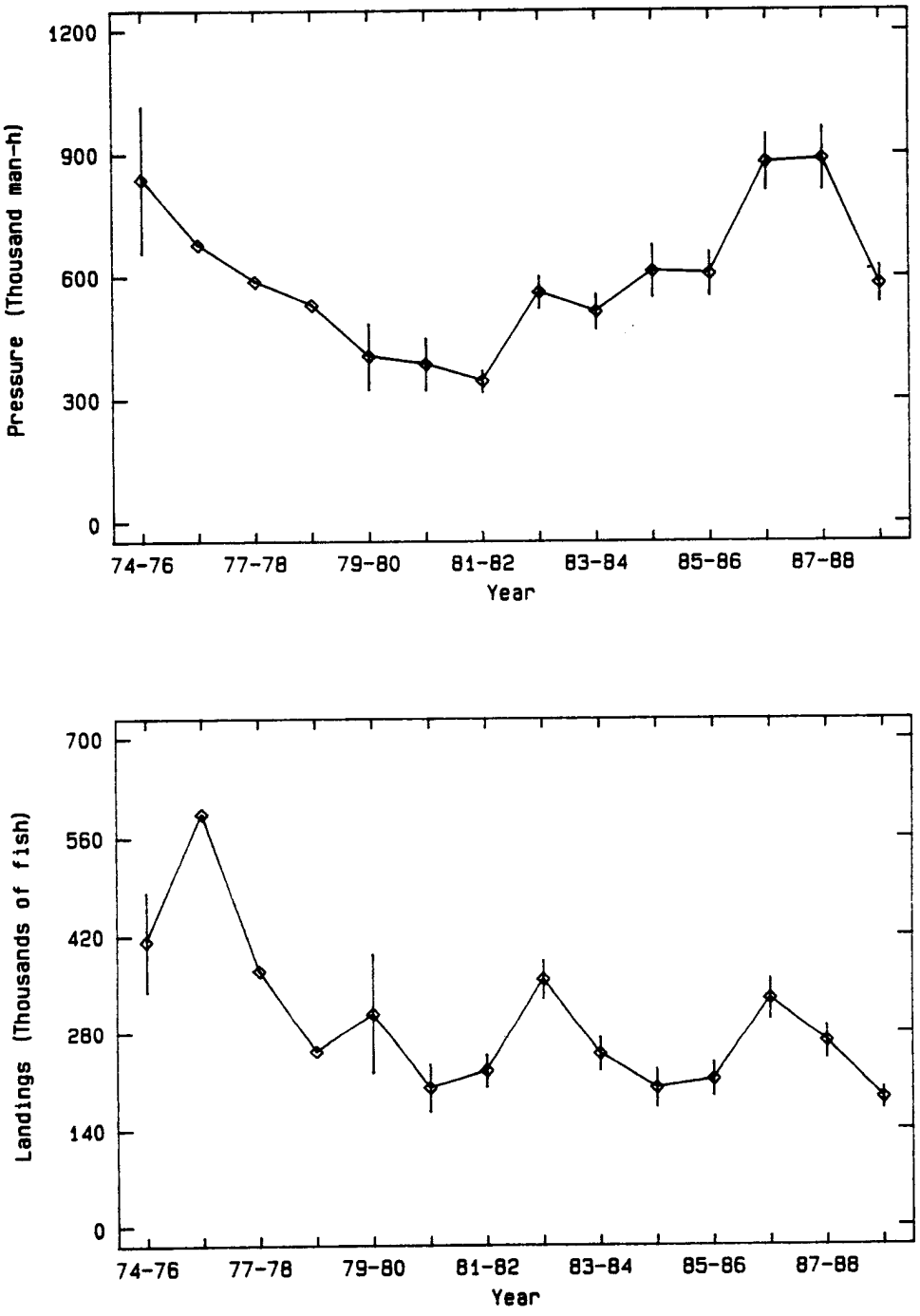


Figure 11. Annual bay and pass private-boat fishing pressure (± 1 SE) and landings (± 1 SE) for the lower Laguna Madre system, May 1974-May 1989.

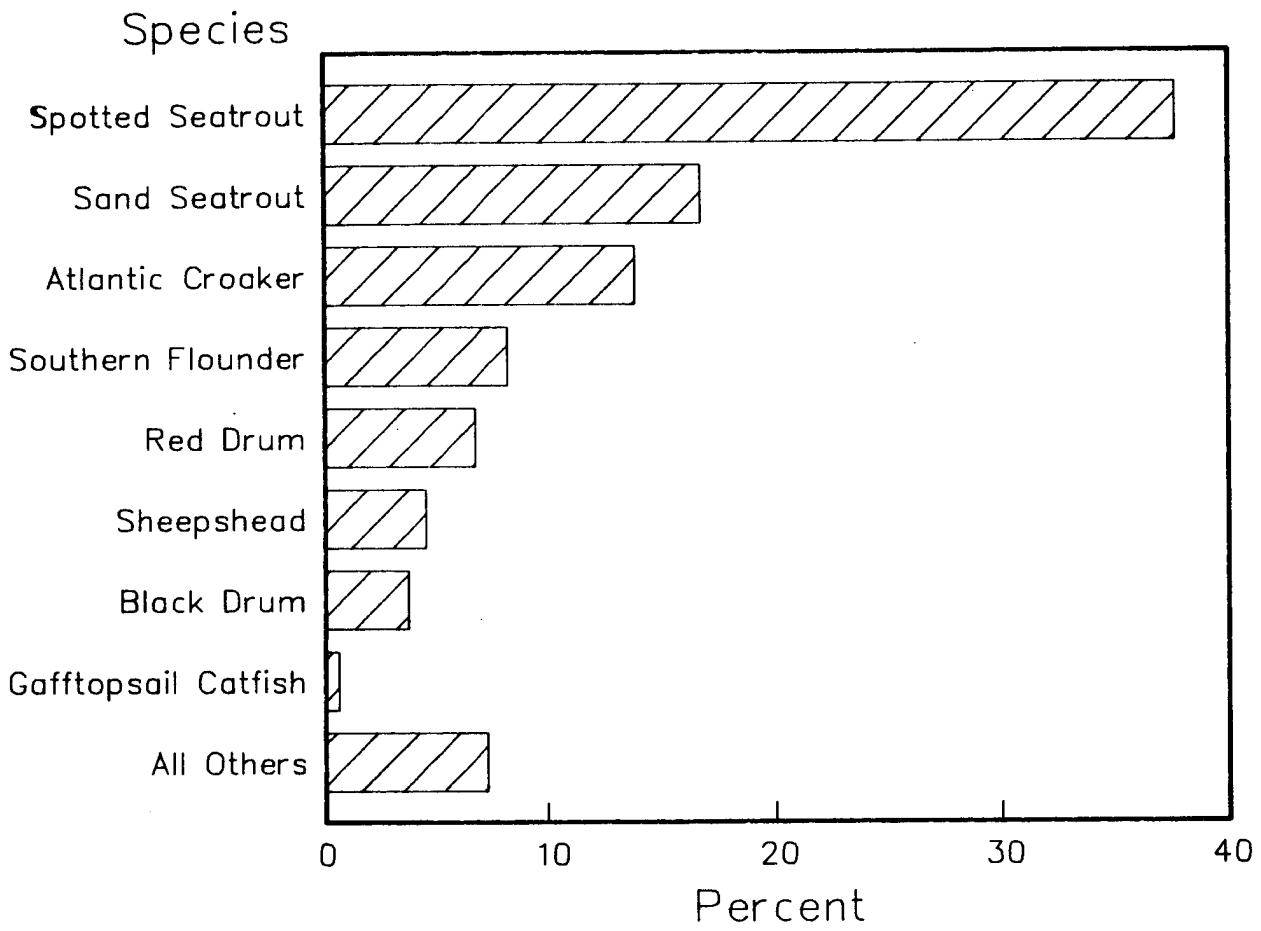


Figure 12. Species composition of annual coastwide bay and pass private-boat finfish landings, May 1979-May 1989 (10-year mean).

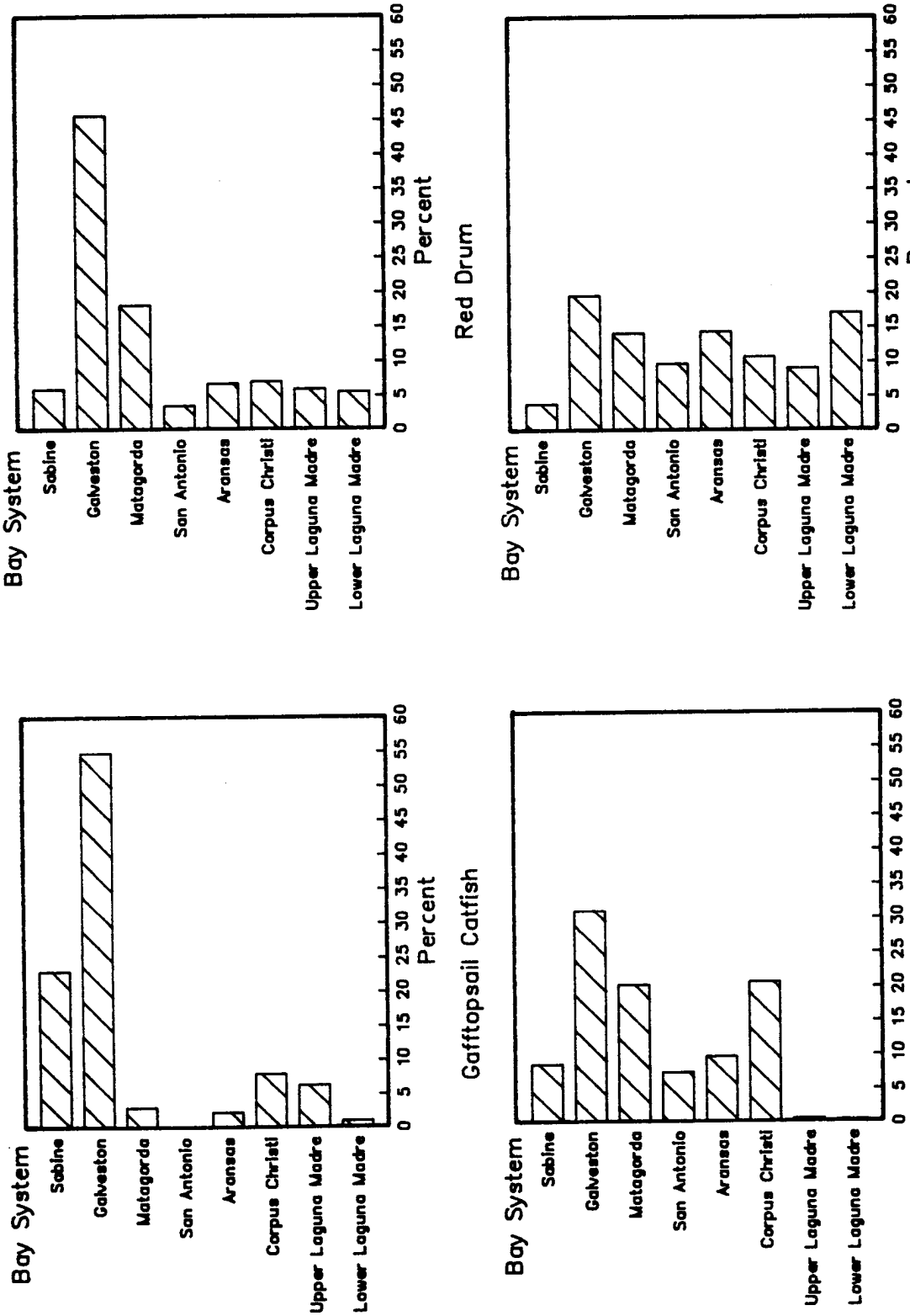


Figure 13. Distribution of annual coastwide bay and pass private-boat landings of selected finfishes among bay systems, May 1979-May 1989 (based on 2-year mean in Sabine Lake system and 10-year means in all other bay systems).

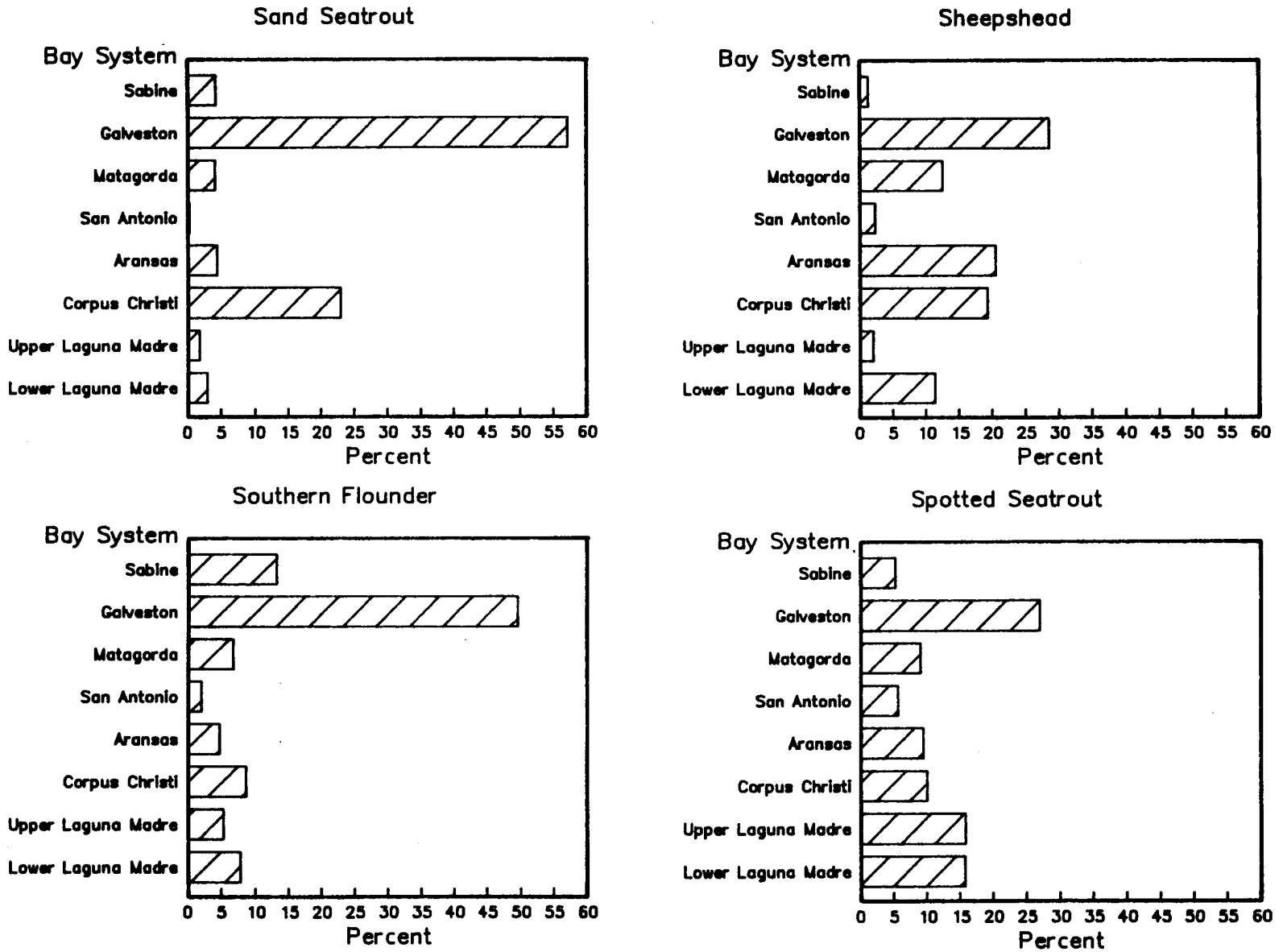


Figure 14. Distribution of annual coastwide bay and pass private-boat landings of selected finfishes among bay systems, May 1979-May 1989 (based on 2-year mean in Sabine Lake system and 10-year means in all other bay systems).

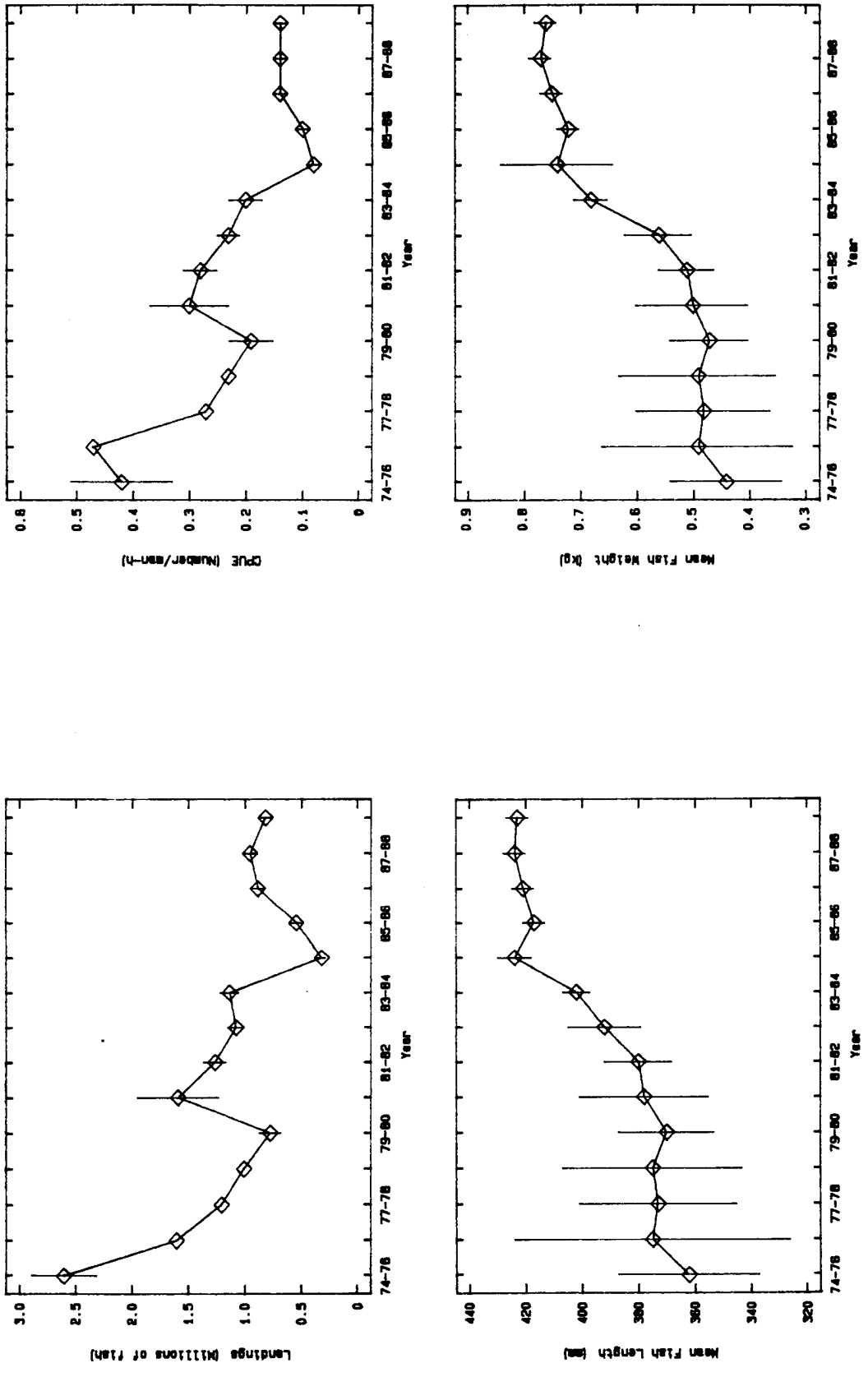


Figure 15. Annual coastwide statistics (± 1 SE) for spotted seatrout landed from bays and passes by private-boat fishermen, May 1974-May 1989.

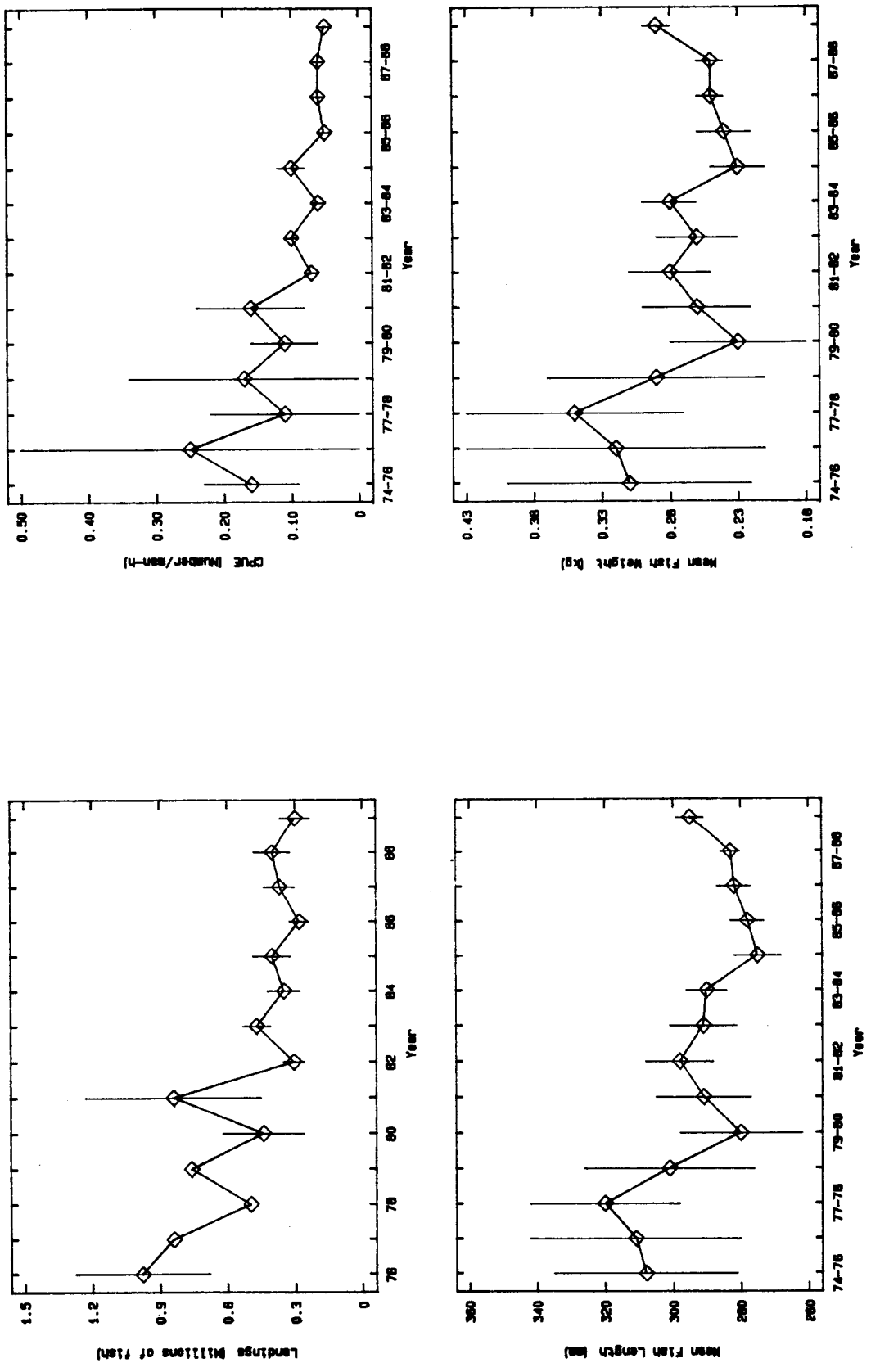


Figure 16. Annual coastwide statistics (± 1 SE) for sand seatrout landed from bays and passes by private-boat fishermen, May 1974-May 1989.

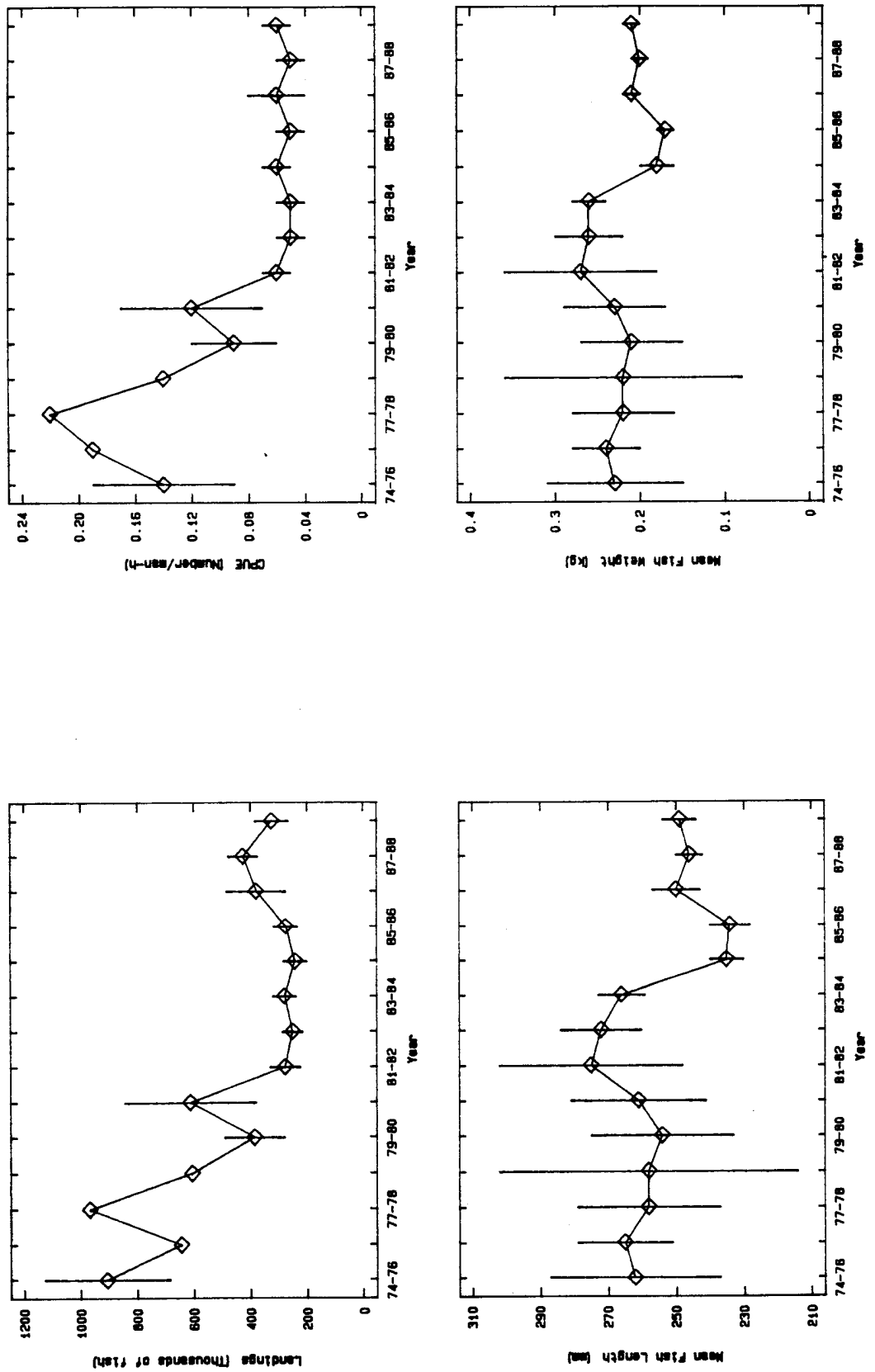


Figure 17. Annual coastwide statistics (± 1 SE) for Atlantic croaker landed from bays and passes by private-boat fishermen, May 1974-May 1989.

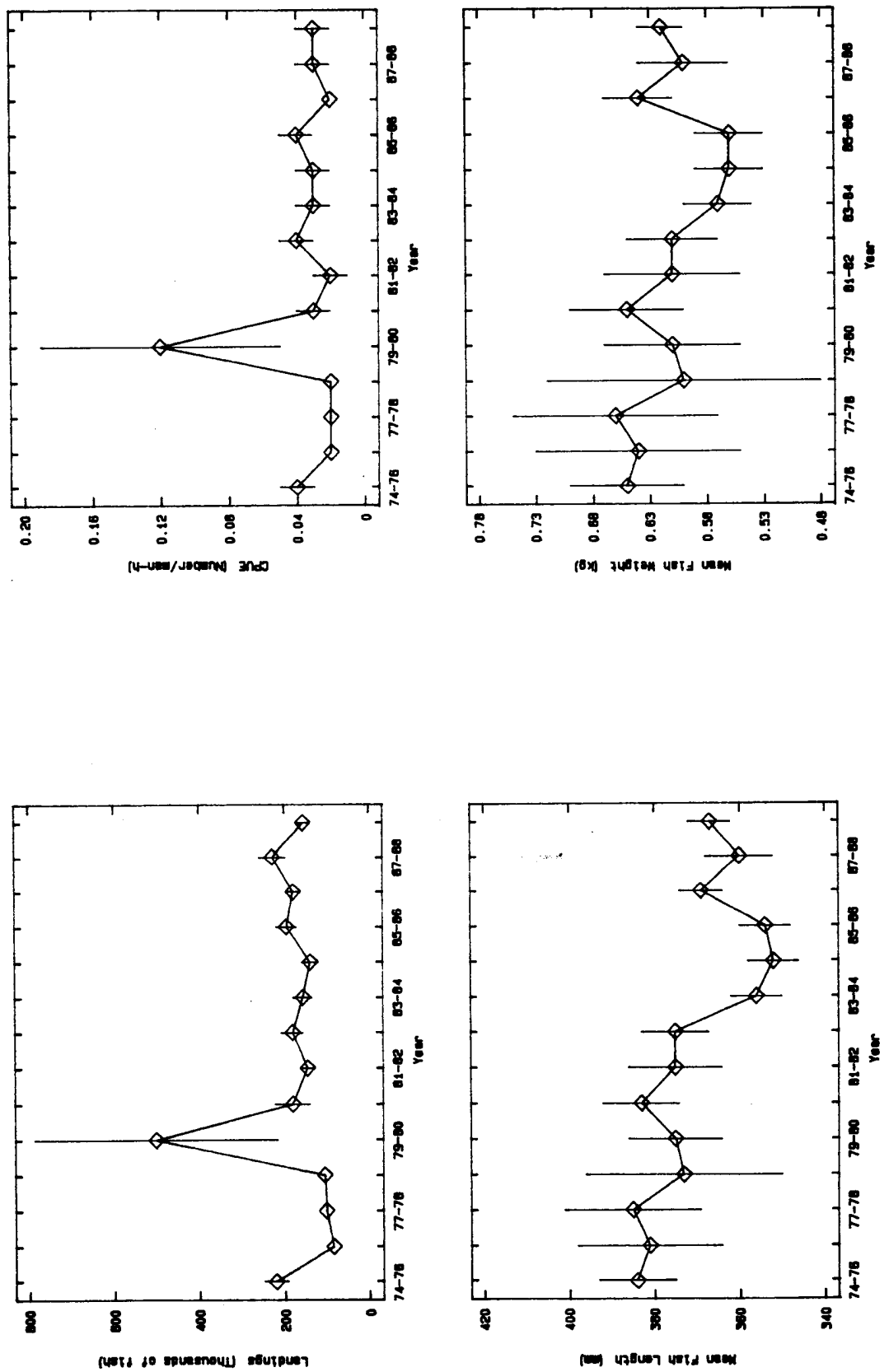


Figure 18. Annual coastwide statistics (± 1 SE) for southern flounder landed from bays and passes by private-boat fishermen, May 1974-May 1989.

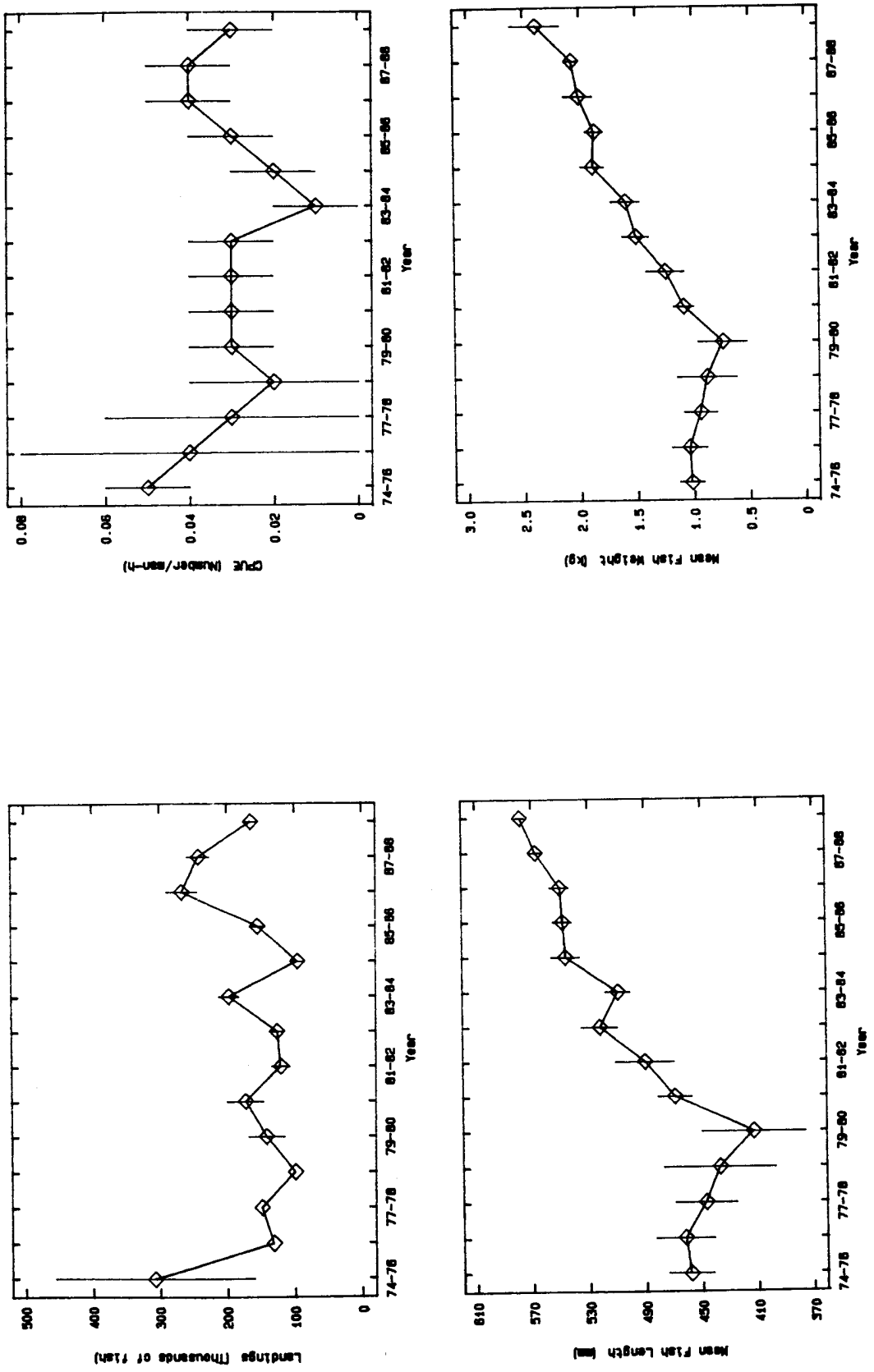


Figure 19. Annual coastwide statistics (± 1 SE) for red drum landed from bays and passes by private-boat fishermen, May 1974-May 1989.

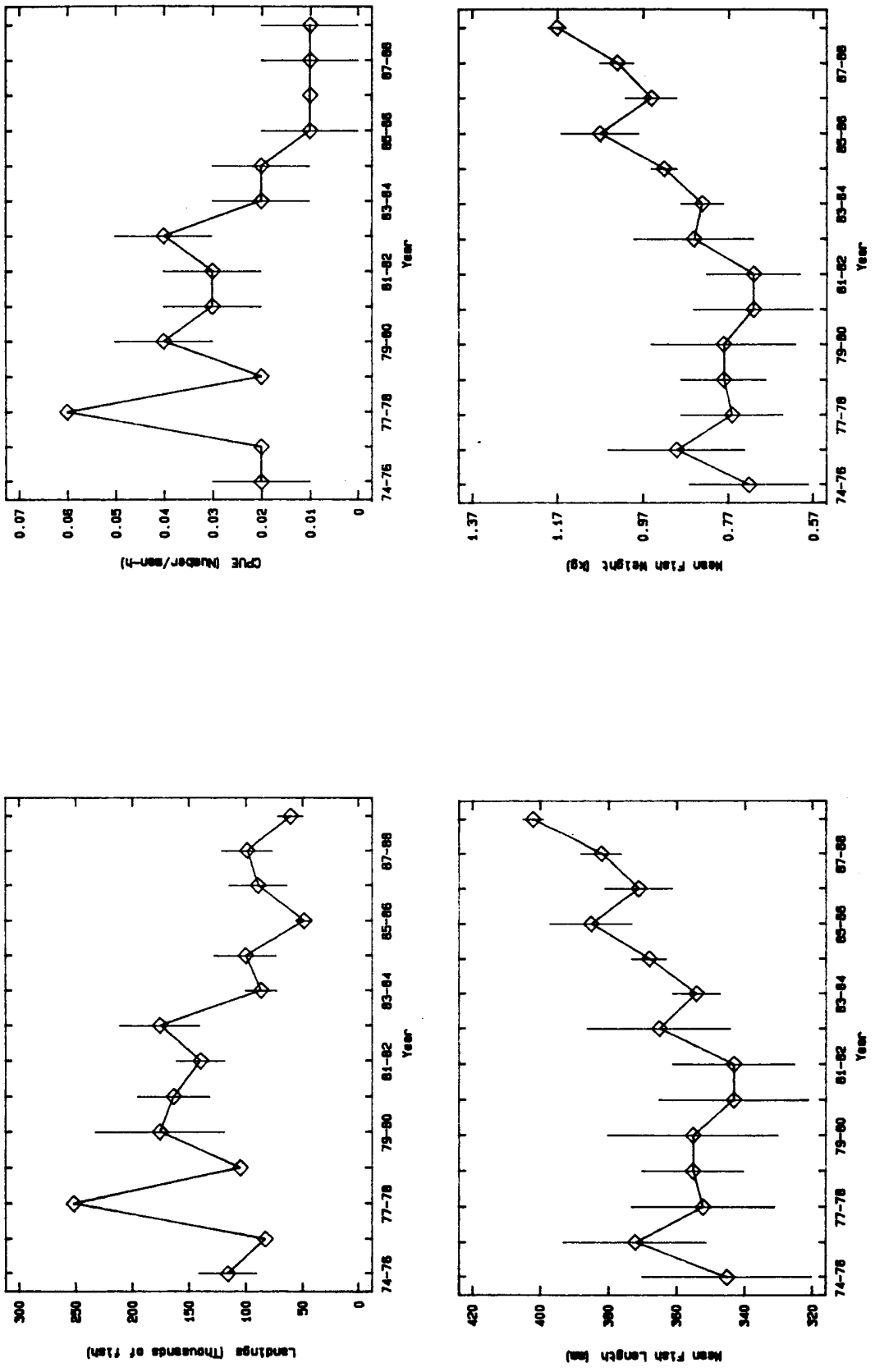


Figure 20. Annual coastwide statistics (± 1 SE) for sheepshead landed from bays and passes by private-boat fishermen, May 1974-May 1989.

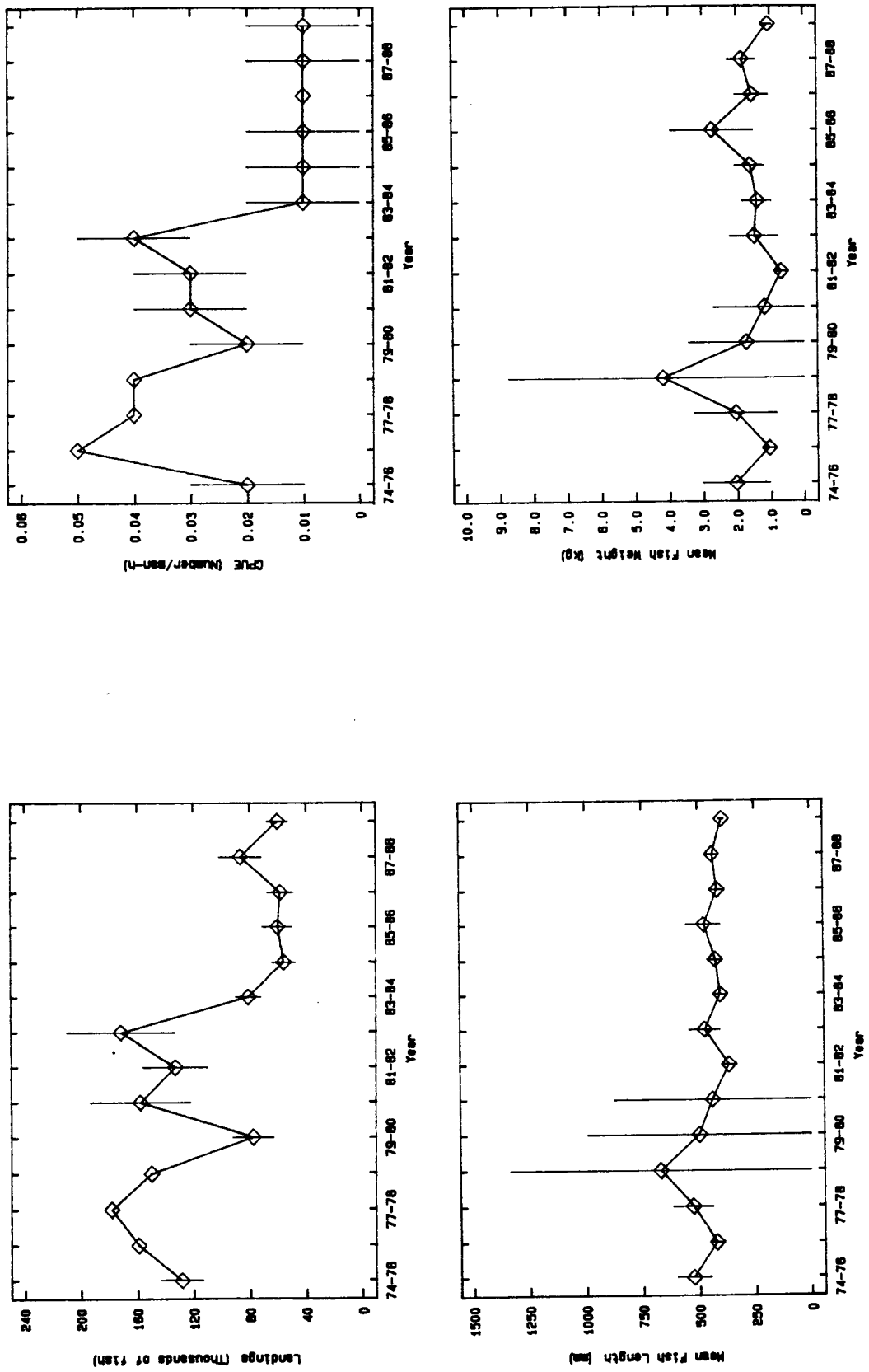


Figure 21. Annual coastwide statistics (± 1 SE) for black drum landed from bays and passes by private-boat fishermen, May 1974-May 1989.

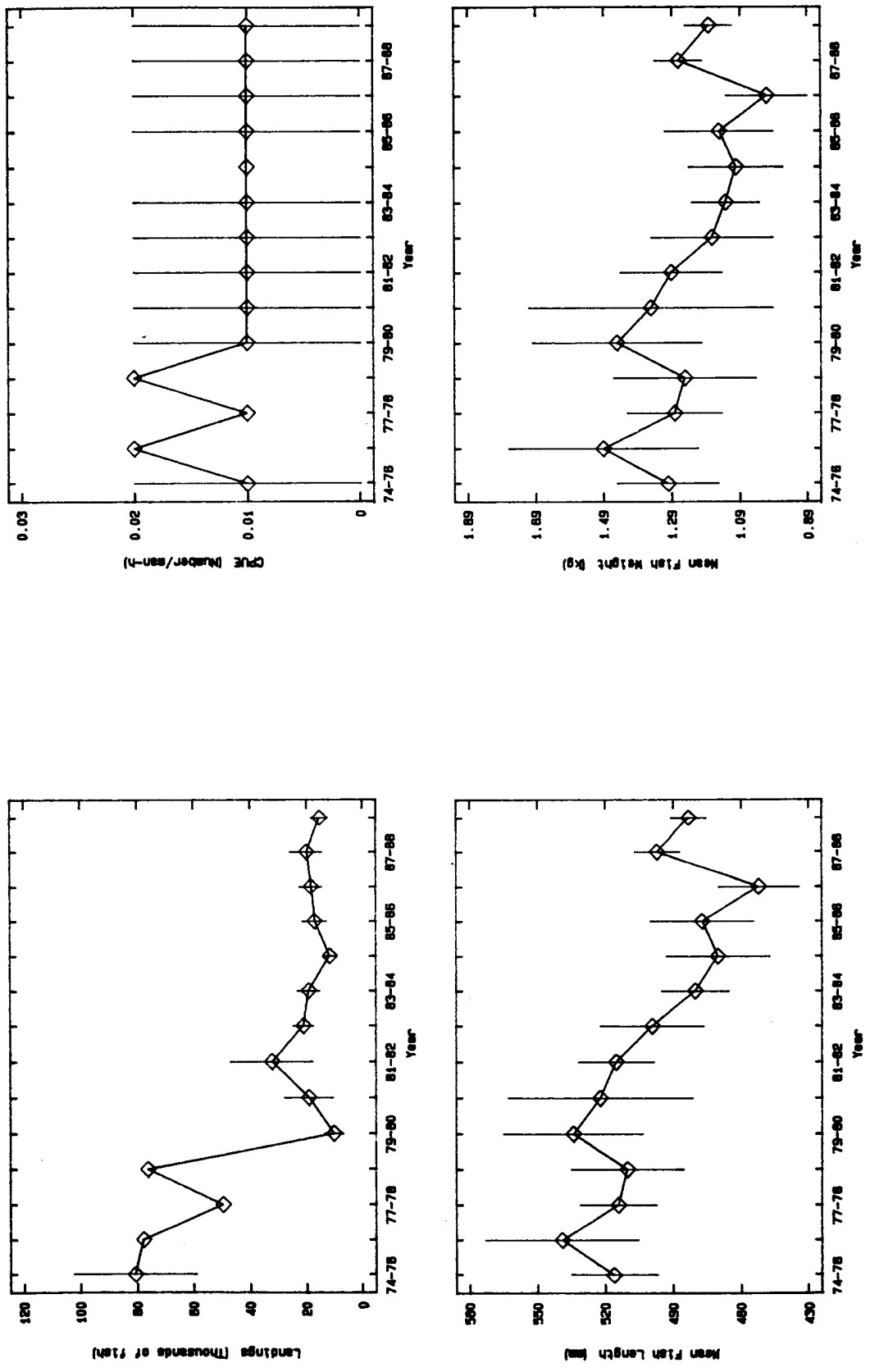


Figure 22. Annual coastwide statistics (± 1 SE) for gafftopsail catfish landed from bays and passes by private-boat fishermen, May 1974-May 1989.

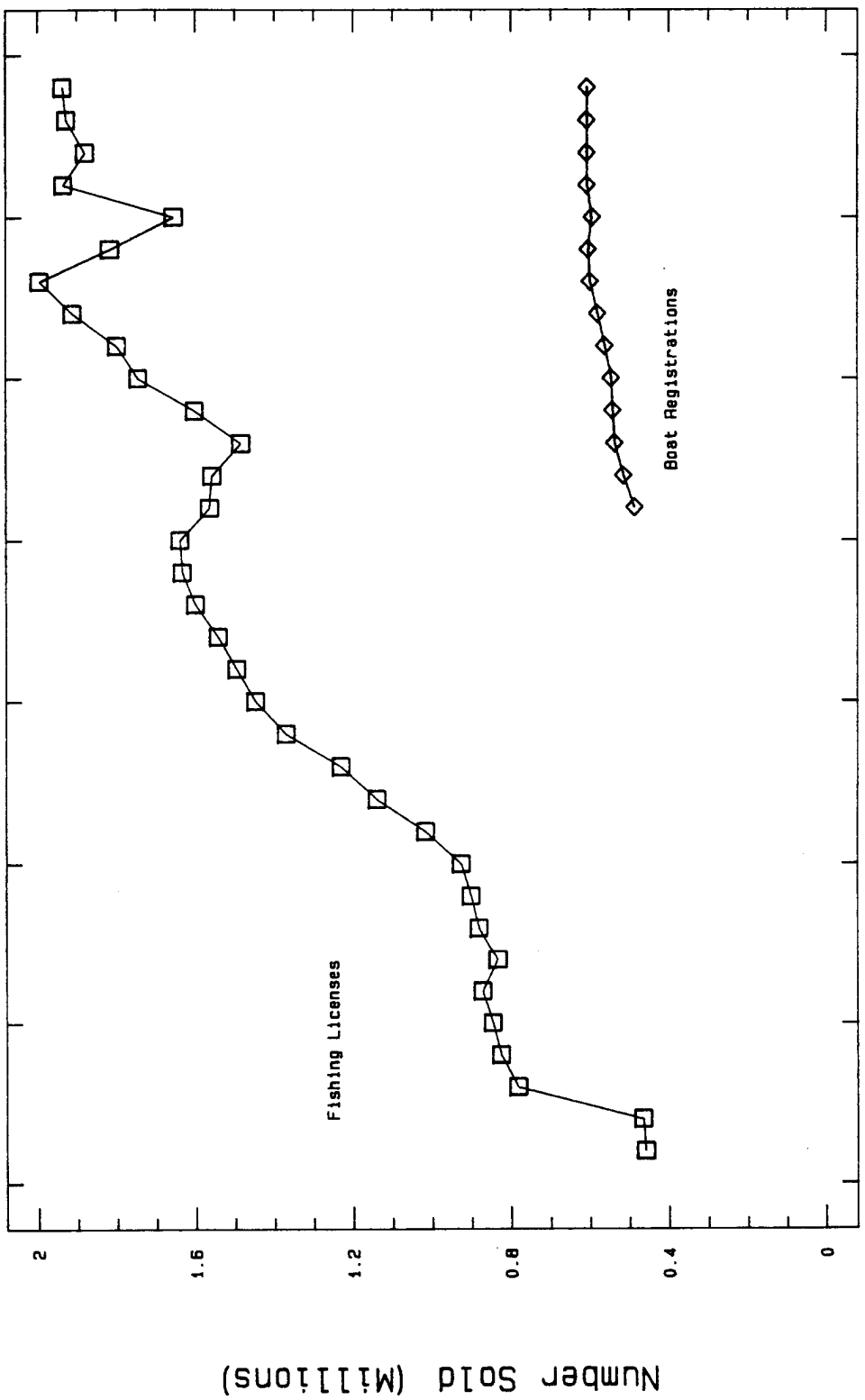


Figure 23. Number of recreational fishing licenses (1955-1989) and boat registrations (1975-1989) sold in Texas by fiscal year (1 September-31 August).

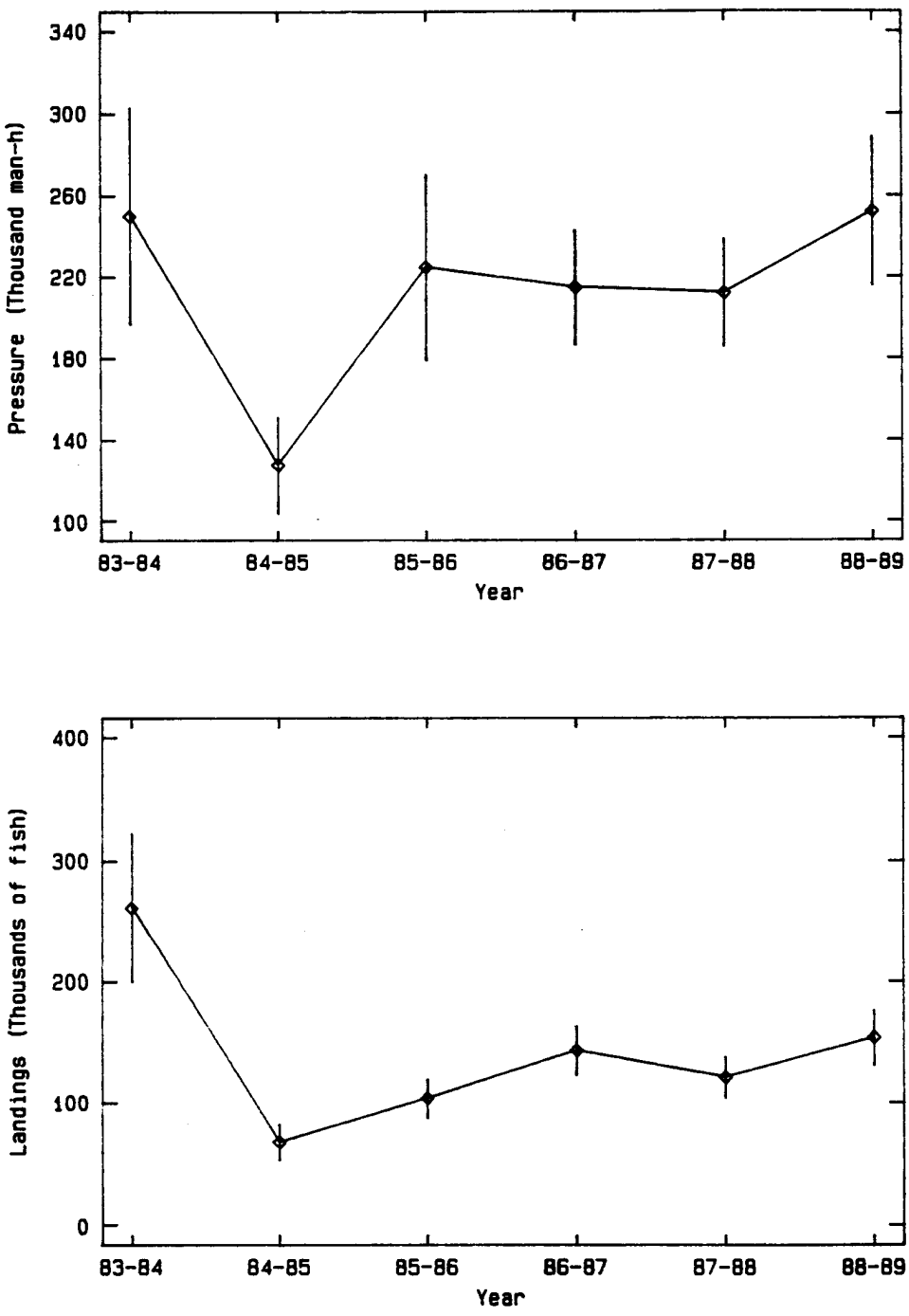


Figure 24. Annual coastwide party-boat fishing pressure (± 1 SE) and landings (± 1 SE) in Texas bays and passes, May 1983-May 1989.

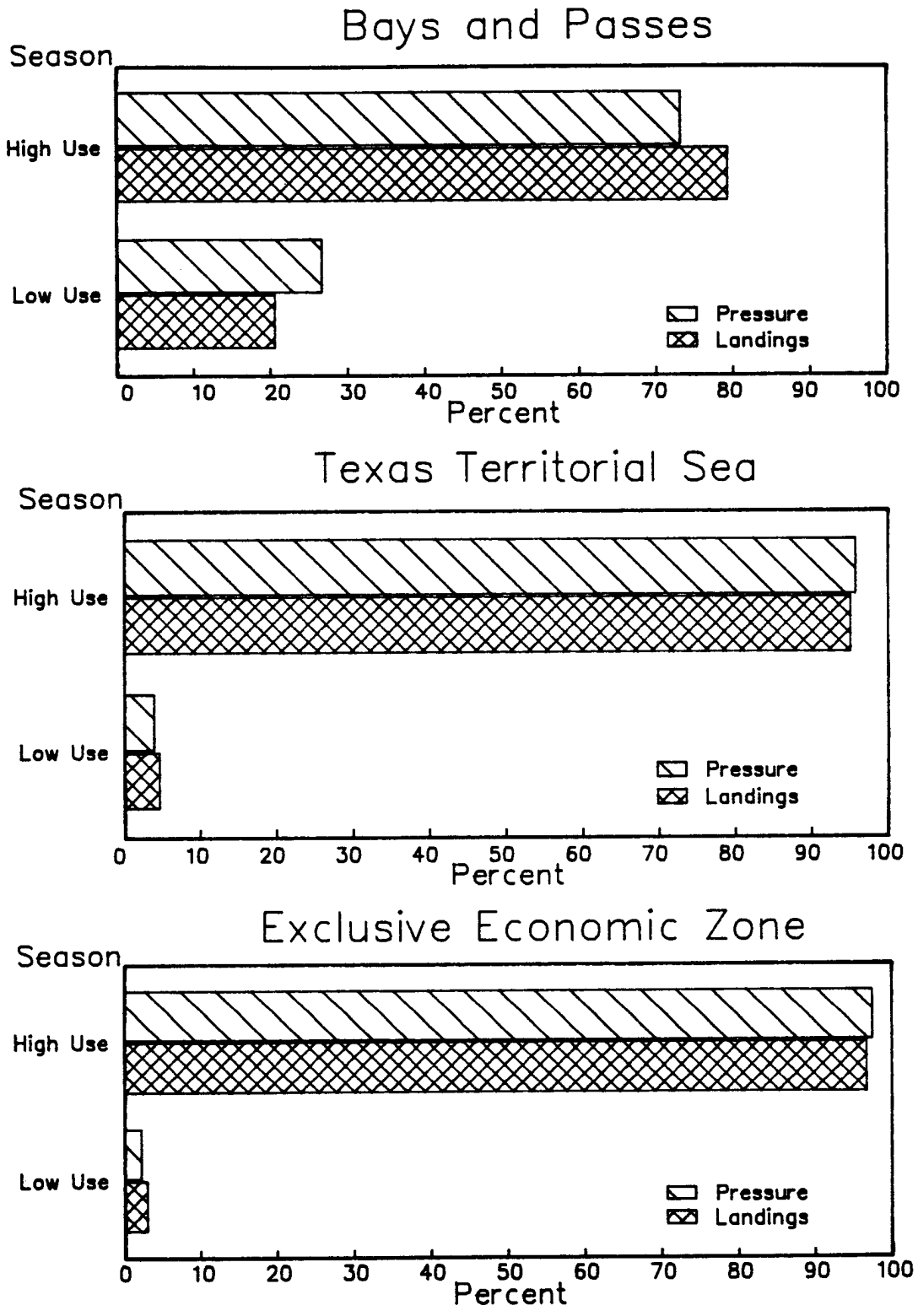


Figure 25. Distribution of annual coastwide party-boat fishing pressure and landings between seasons in bays and passes, the Texas Territorial Sea and the Exclusive Economic Zone, May 1983-May 1989 (6-year mean).

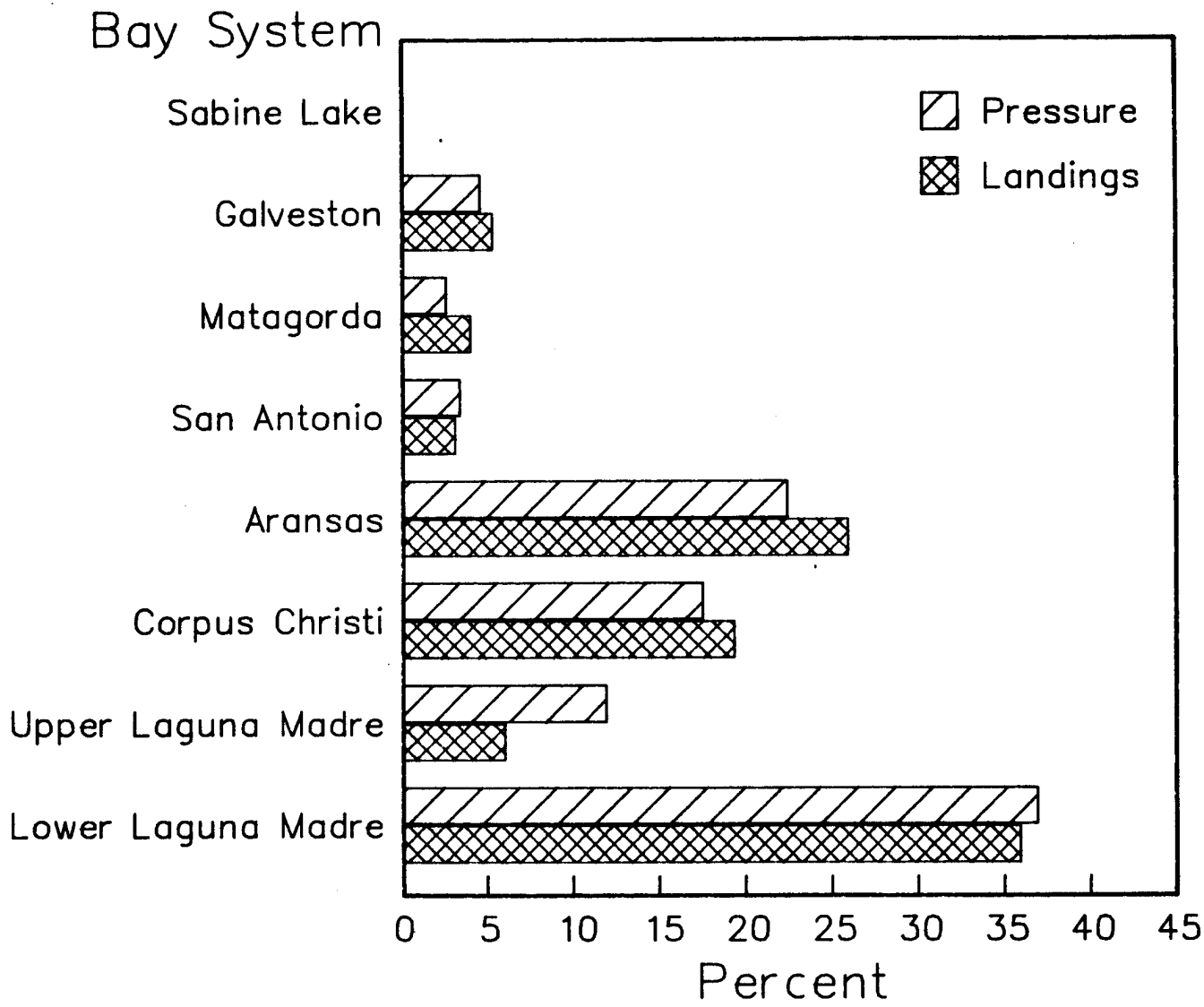


Figure 26. Distribution of annual coastwide bay and pass party-boat fishing pressure and landings among bay systems, May 1983-May 1989 (based on 2-year mean in Sabine Lake system and 6-year means in all other bay systems).

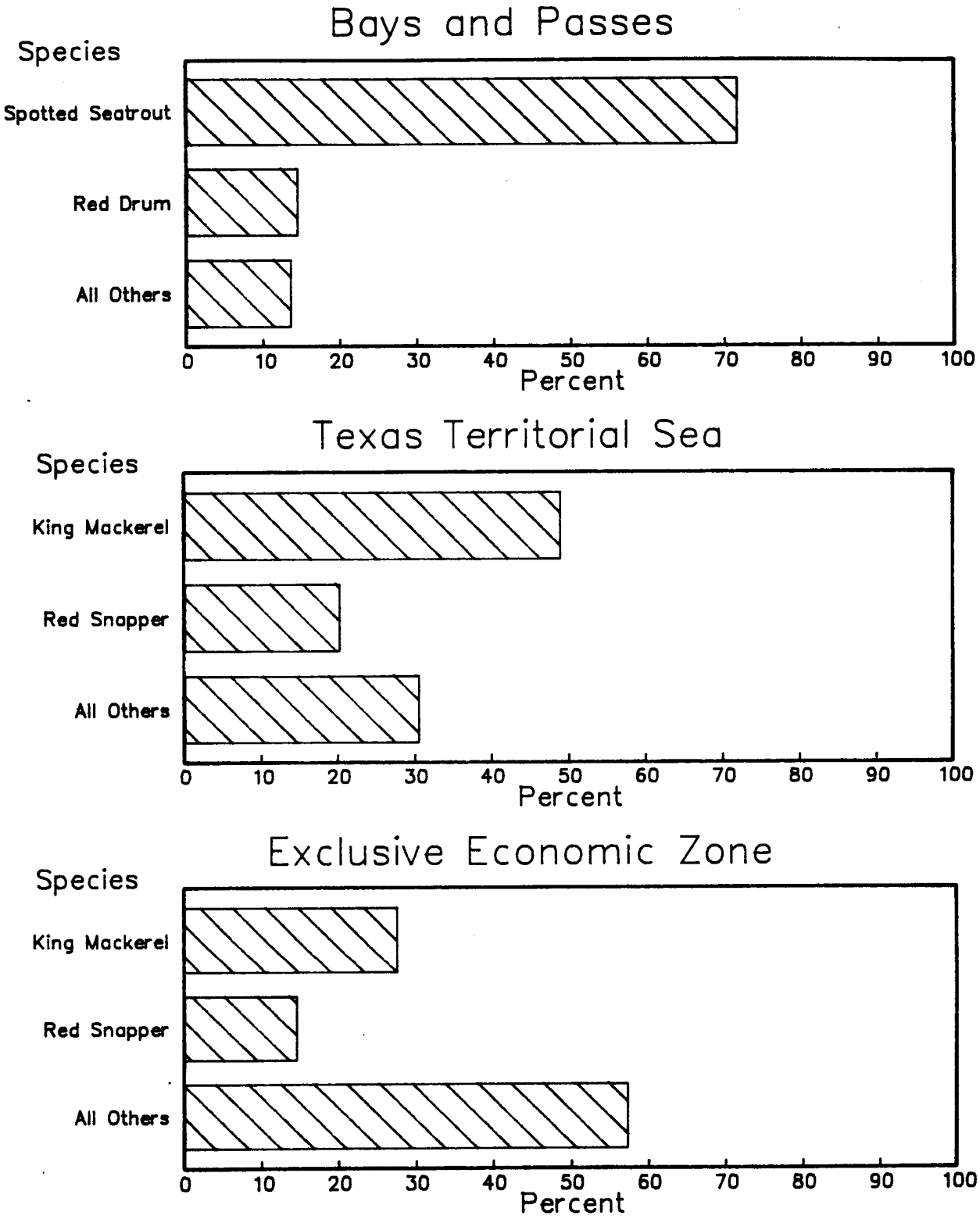


Figure 27. Species composition of annual coastwide party-boat finfish landings in bays and passes, the Texas Territorial Sea and the Exclusive Economic Zone, May 1983-May 1989 (6-year mean).

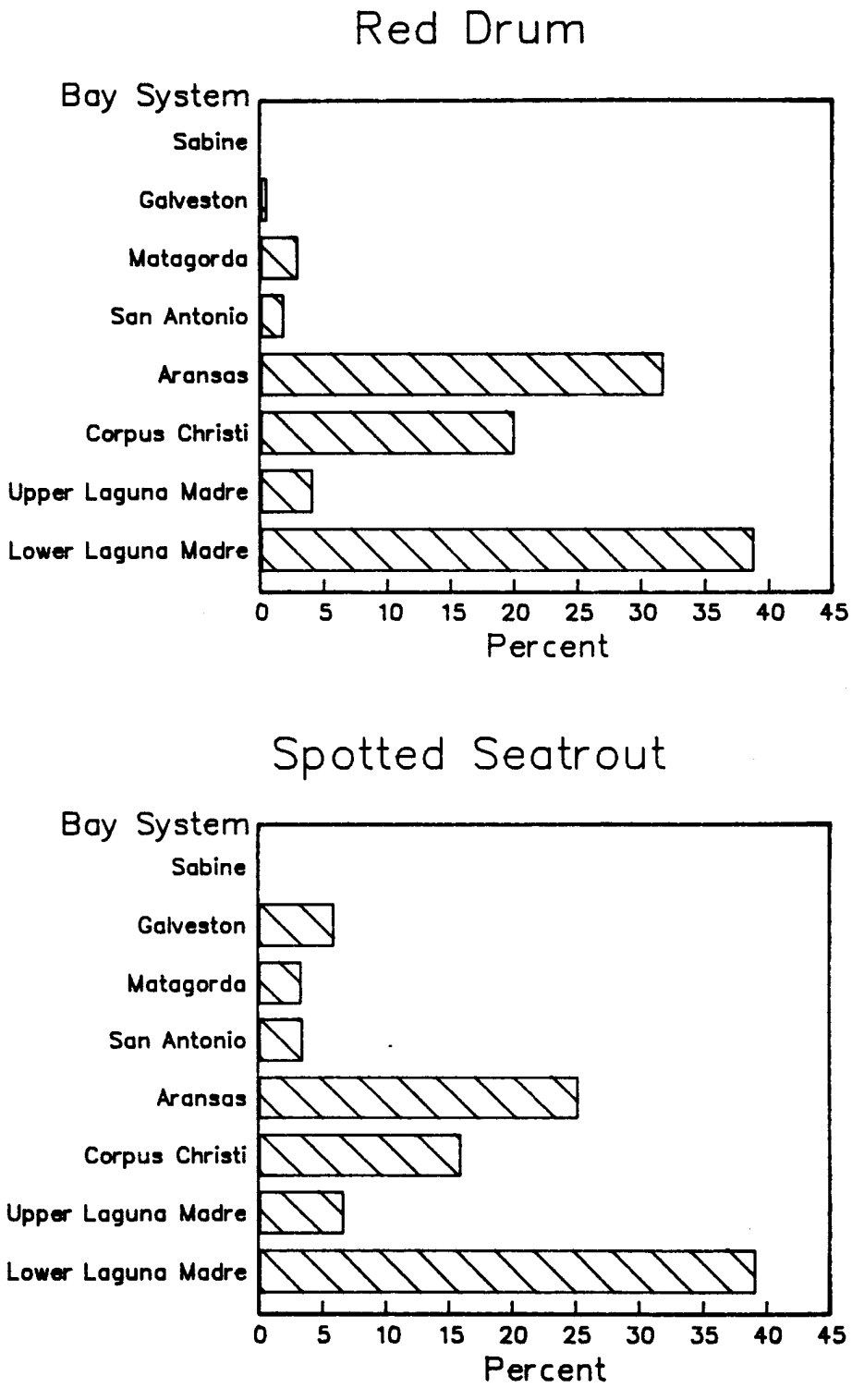


Figure 28. Distribution of annual coastwide bay and pass party-boat landings of selected species among bay systems, May 1983-May 1989 (based on 2-year mean in Sabine Lake and 6-year means in all other bay systems).

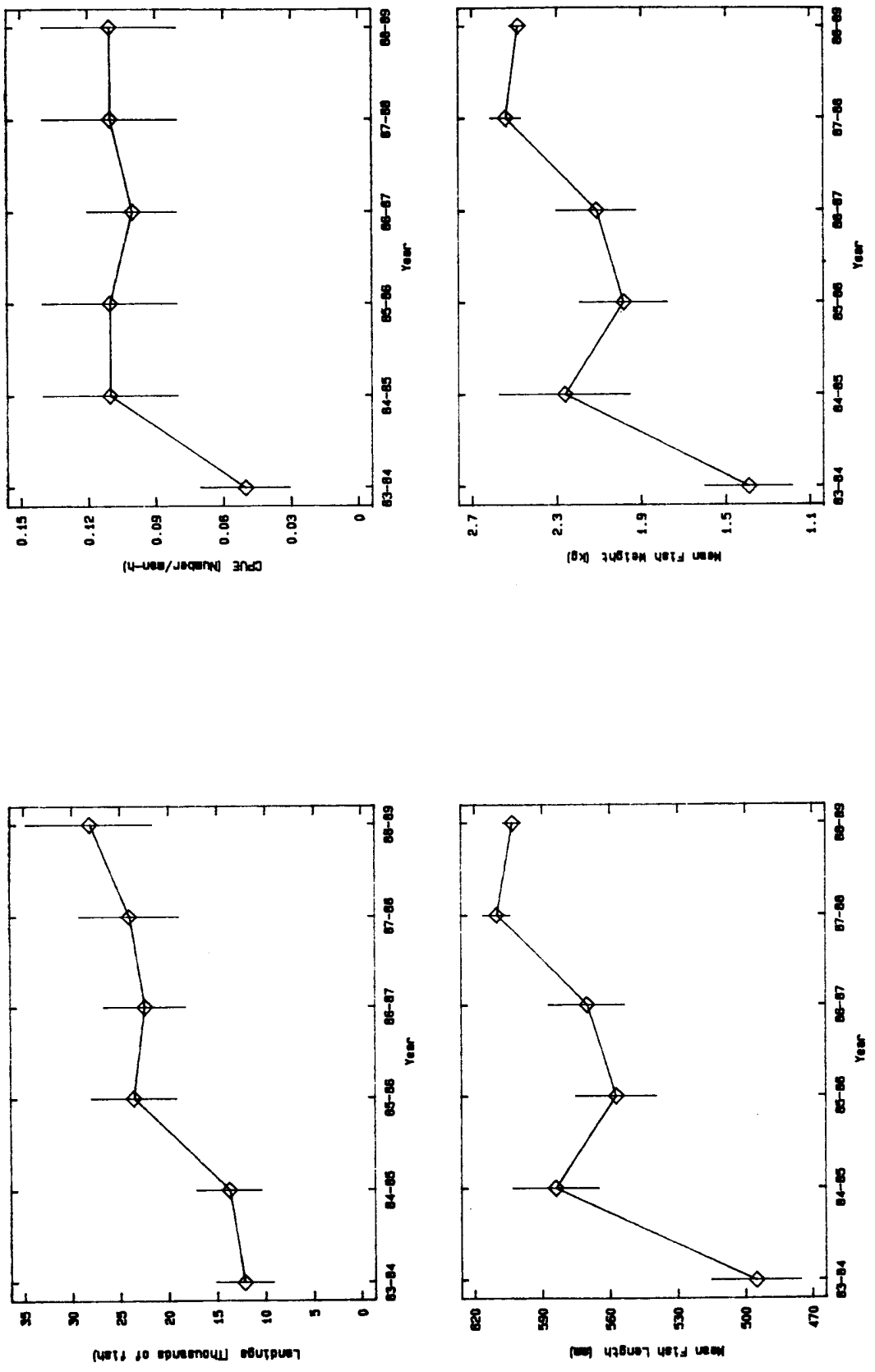


Figure 29. Annual coastwide statistics (± 1 SE) for red drum landed from bays and passes by party-boat fishermen, May 1983-May 1989.

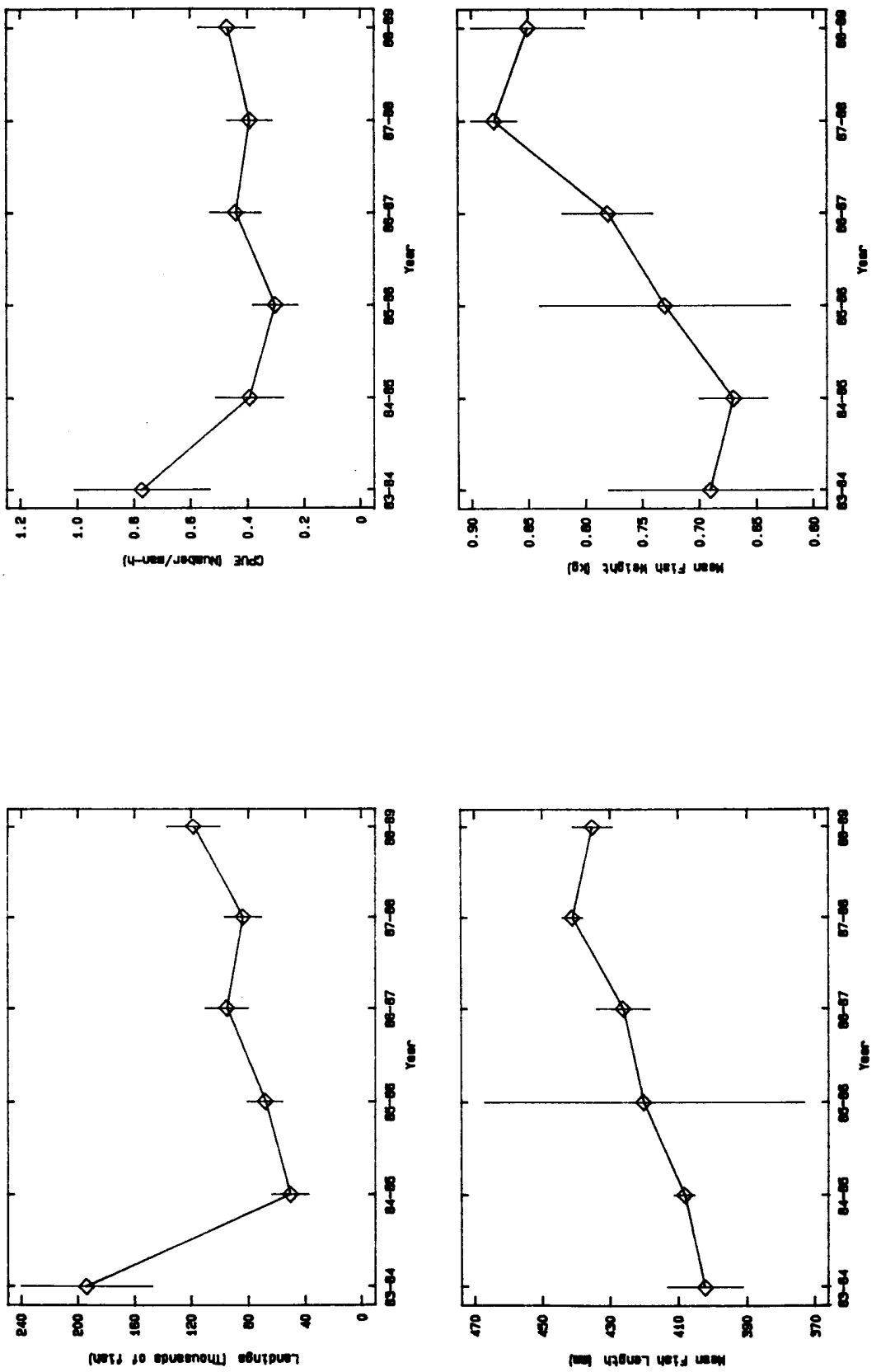


Figure 30. Annual coastwide statistics (± 1 SE) for spotted seatrout landed from bays and passes by party-boat fishermen, May 1983-May 1989.

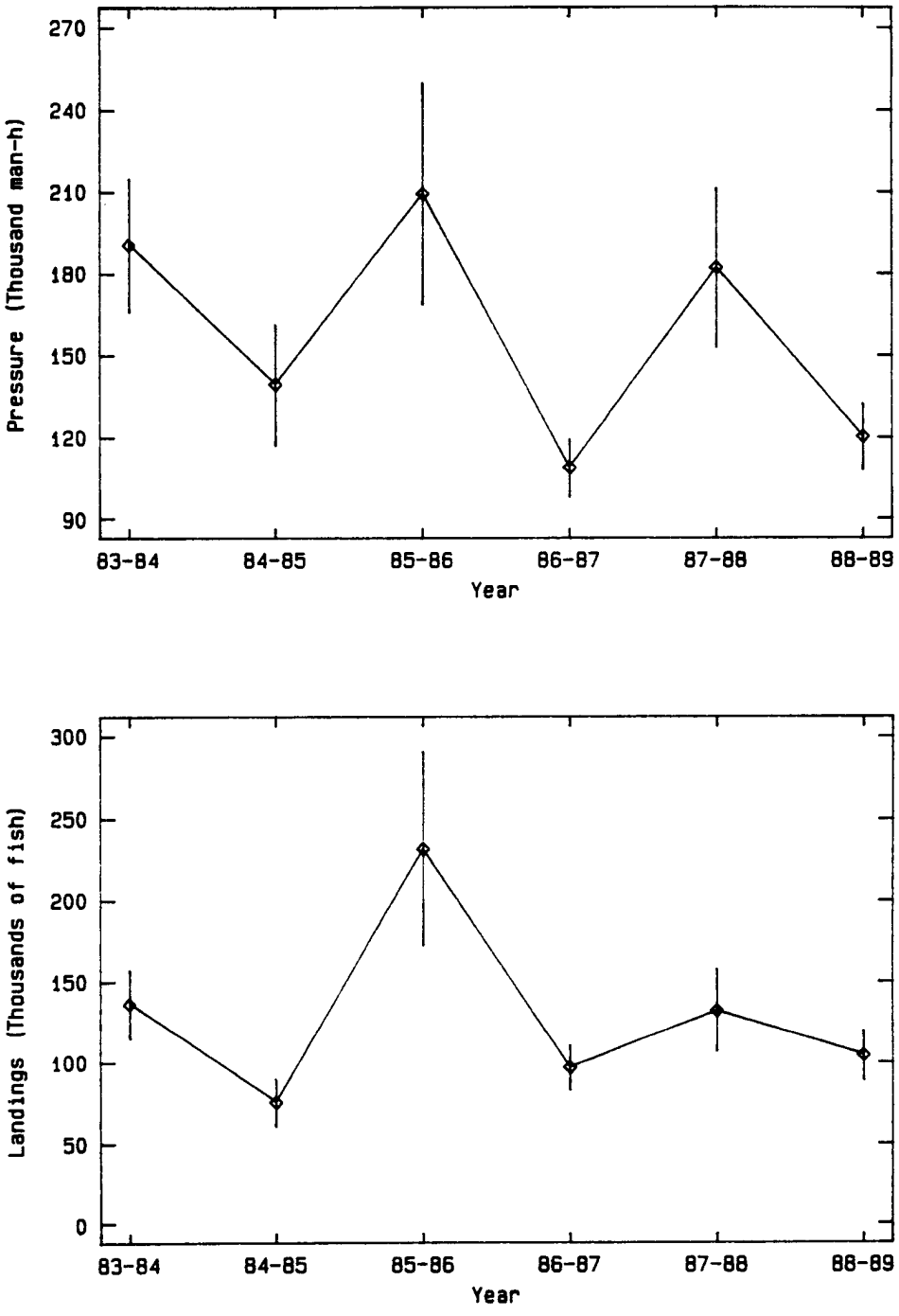


Figure 31. Annual coastwide headboat fishing pressure (± 1 SE) and landings (± 1 SE) in Texas bays and passes, May 1983-May 1989.

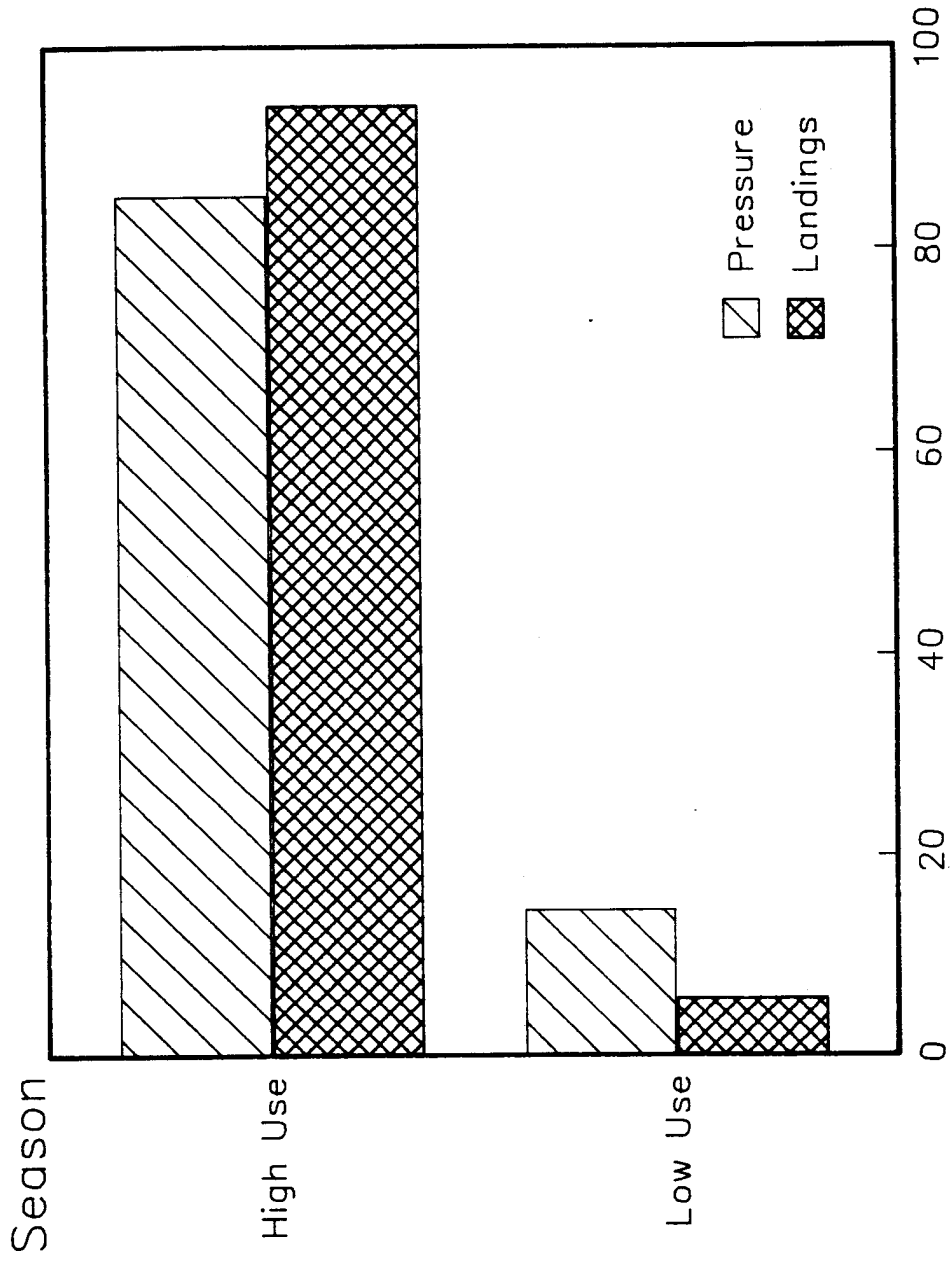


Figure 32. Distribution of annual coastwide bay and pass headboat fishing pressure and landings between seasons, May 1983-May 1989 (6-year mean).

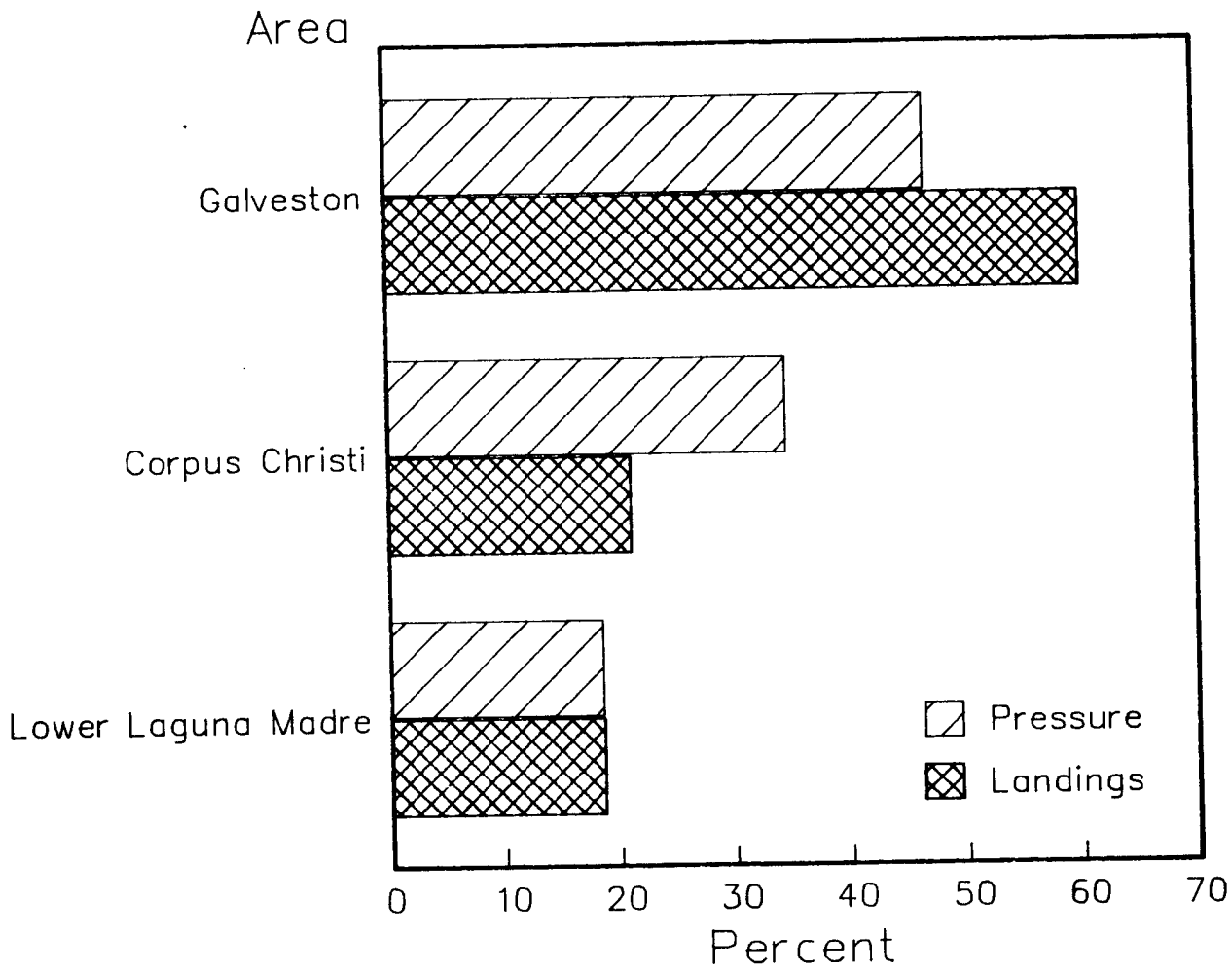


Figure 33. Distribution of annual coastwide bay and pass headboat fishing pressure and landings among areas, May 1983-May 1989 (6-year mean).

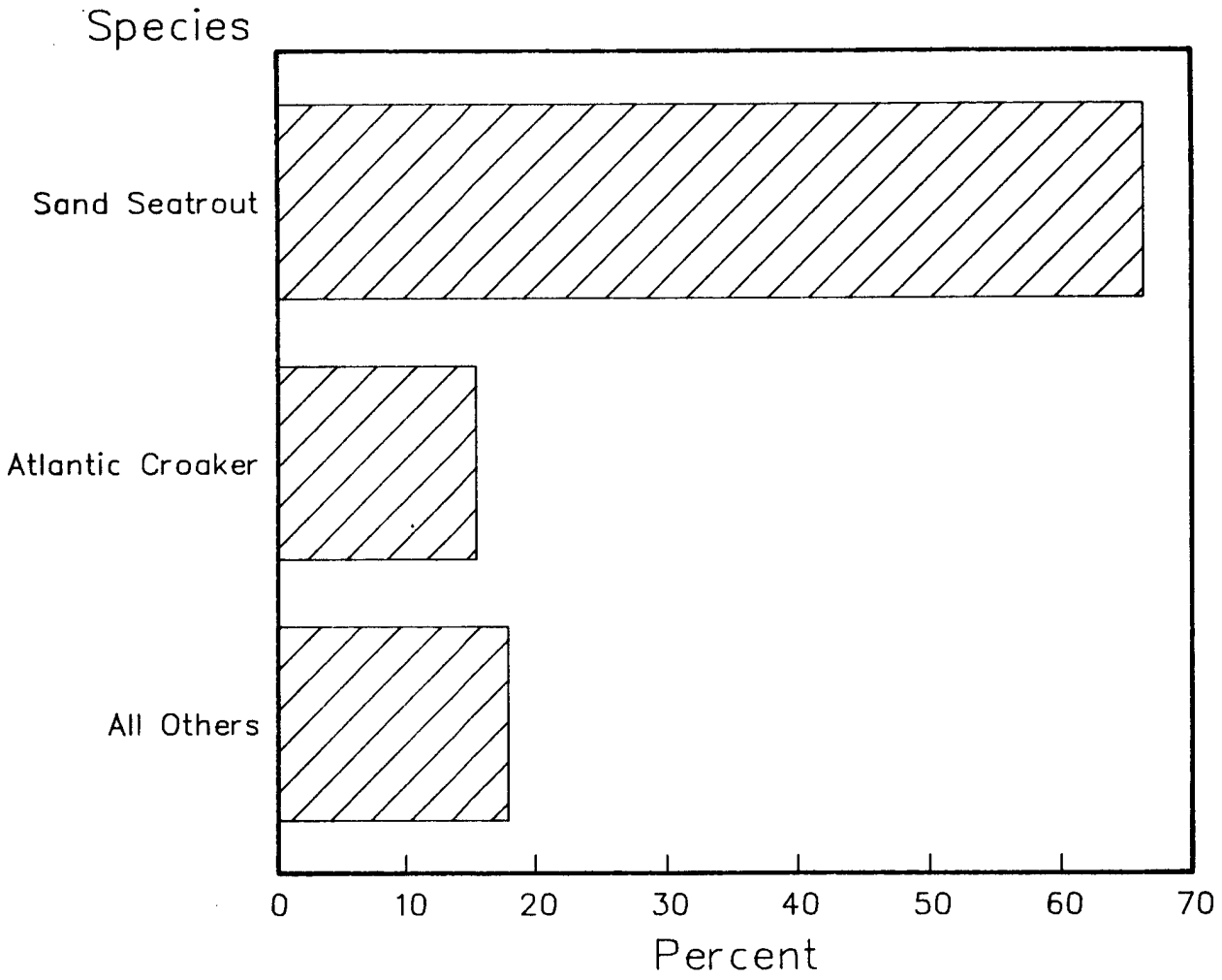


Figure 34. Species composition of annual coastwide bay and pass headboat finfish landings, May 1983-May 1989 (6-year mean).

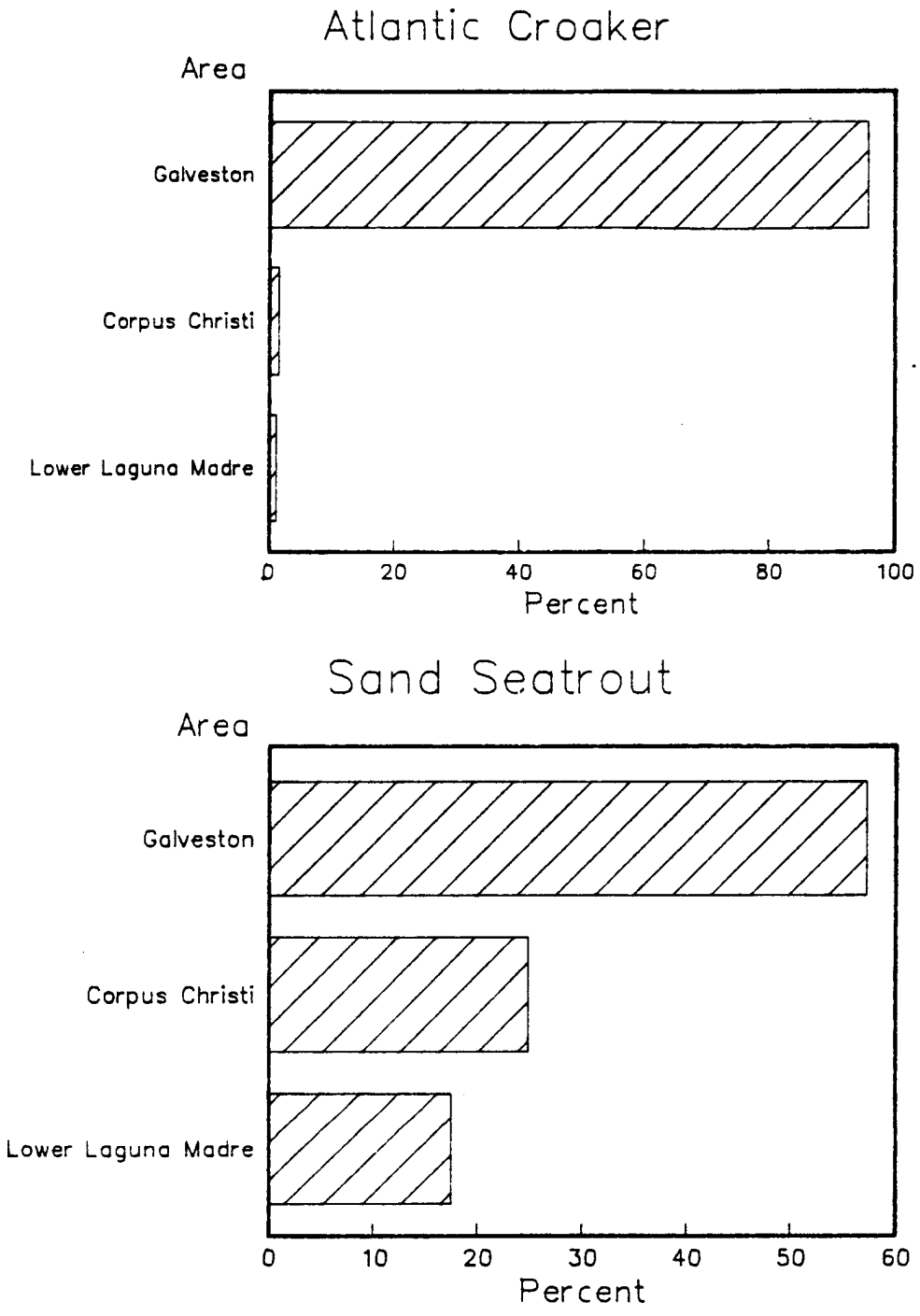


Figure 35. Distribution of annual coastwide bay and pass headboat landings of selected species among areas, May 1983-May 1989 (6-year mean).

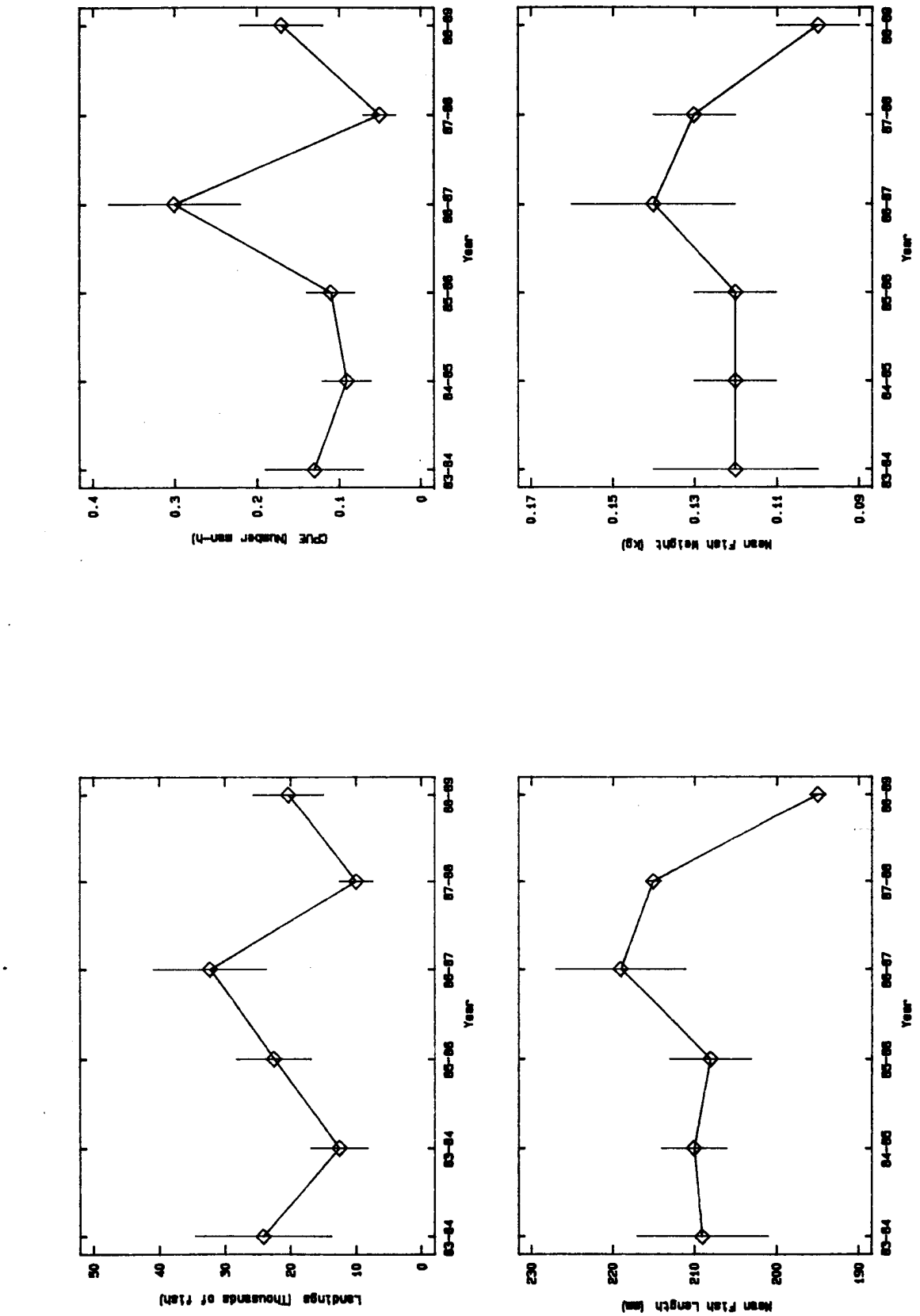


Figure 36. Annual coastwide statistics (± 1 SE) for Atlantic croaker landed from bays and passes by headboat fishermen, May 1983-May 1989.

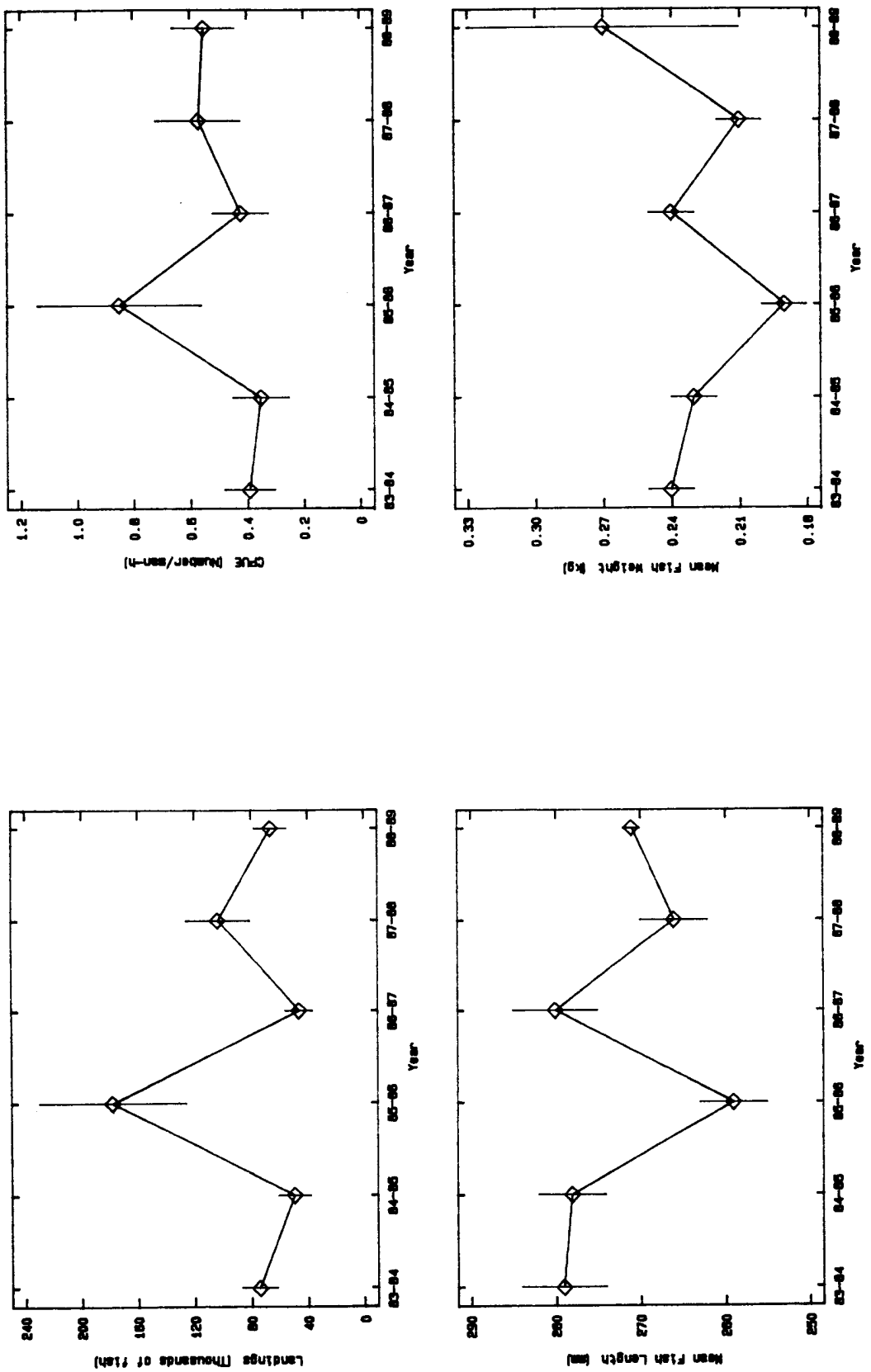


Figure 37. Annual coastwide statistics (± 1 SE) for sand seatrout landed from bays and passes by headboat fishermen, May 1983-May 1989.

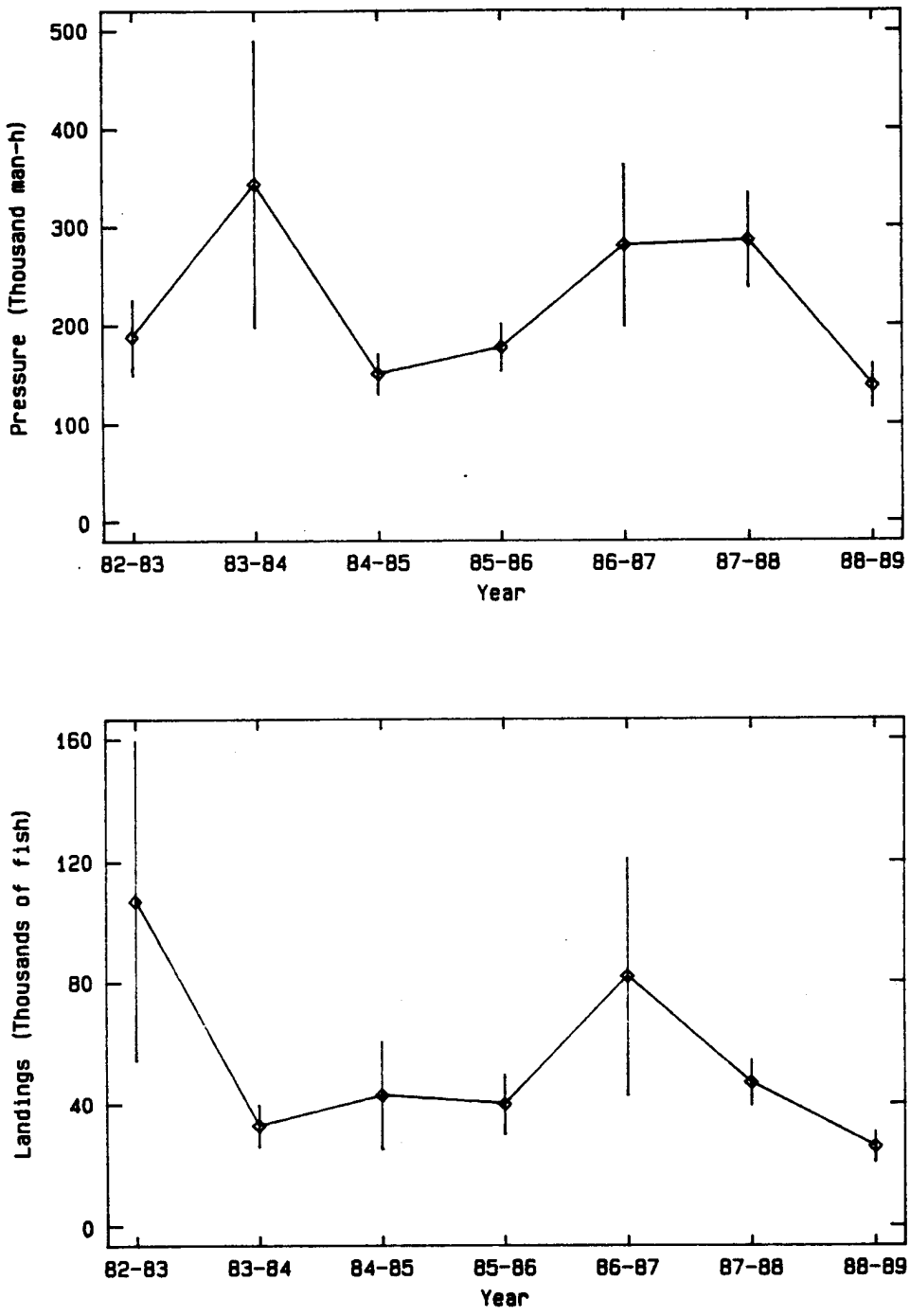


Figure 38. Annual coastwide private-boat fishing pressure (± 1 SE) and landings (± 1 SE) in the Texas Territorial Sea, May 1982-May 1989.

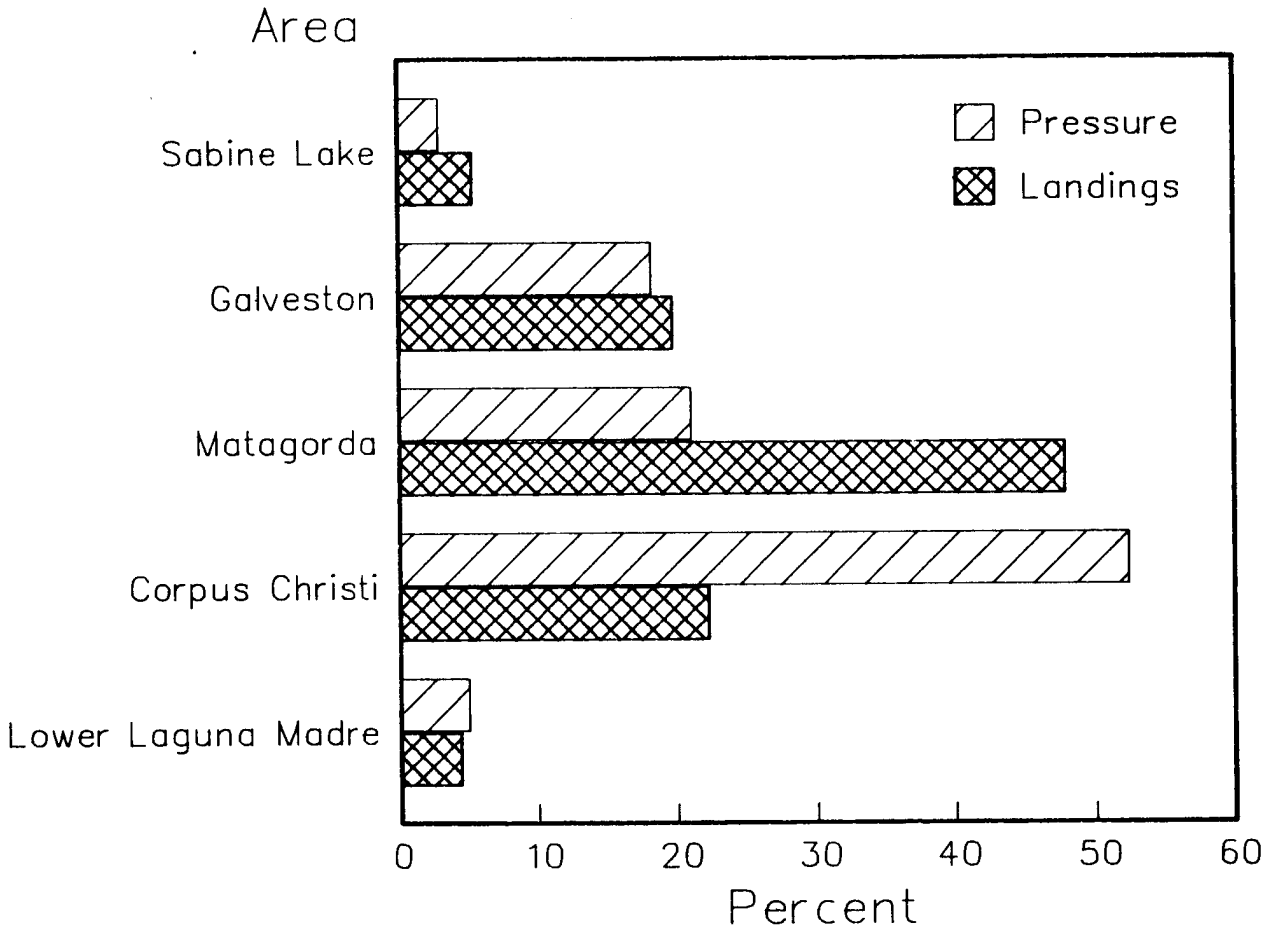


Figure 39. Distribution of annual coastwide Texas Territorial Sea private-boat fishing pressure and landings among areas, May 1982-May 1989 (based on 2-year mean in Sabine Lake area and 7-year means in all other areas).

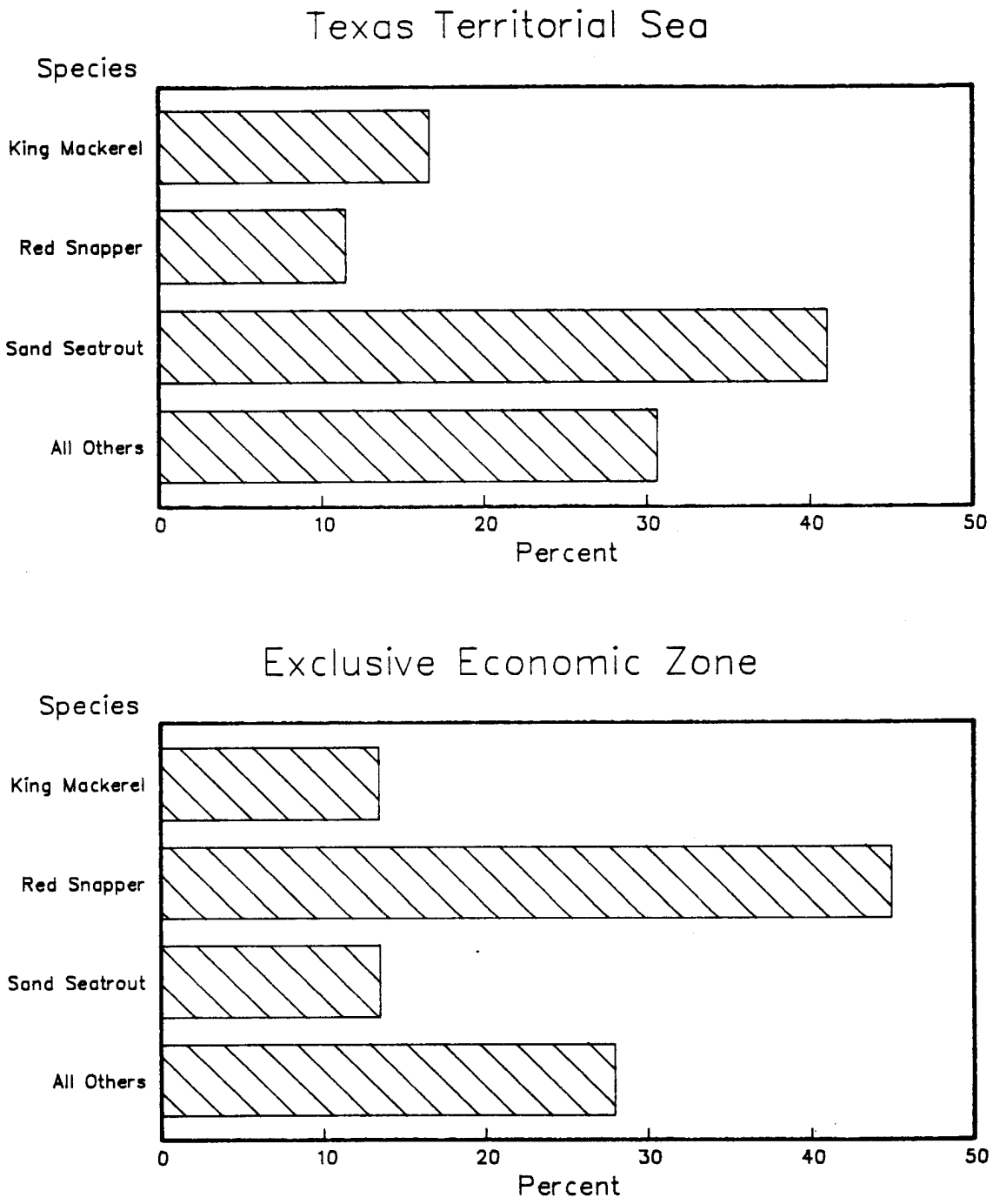


Figure 40. Species composition of annual coastwide Texas Territorial Sea and Exclusive Economic Zone private-boat finfish landings, May 1982-May 1989 (7-year mean).

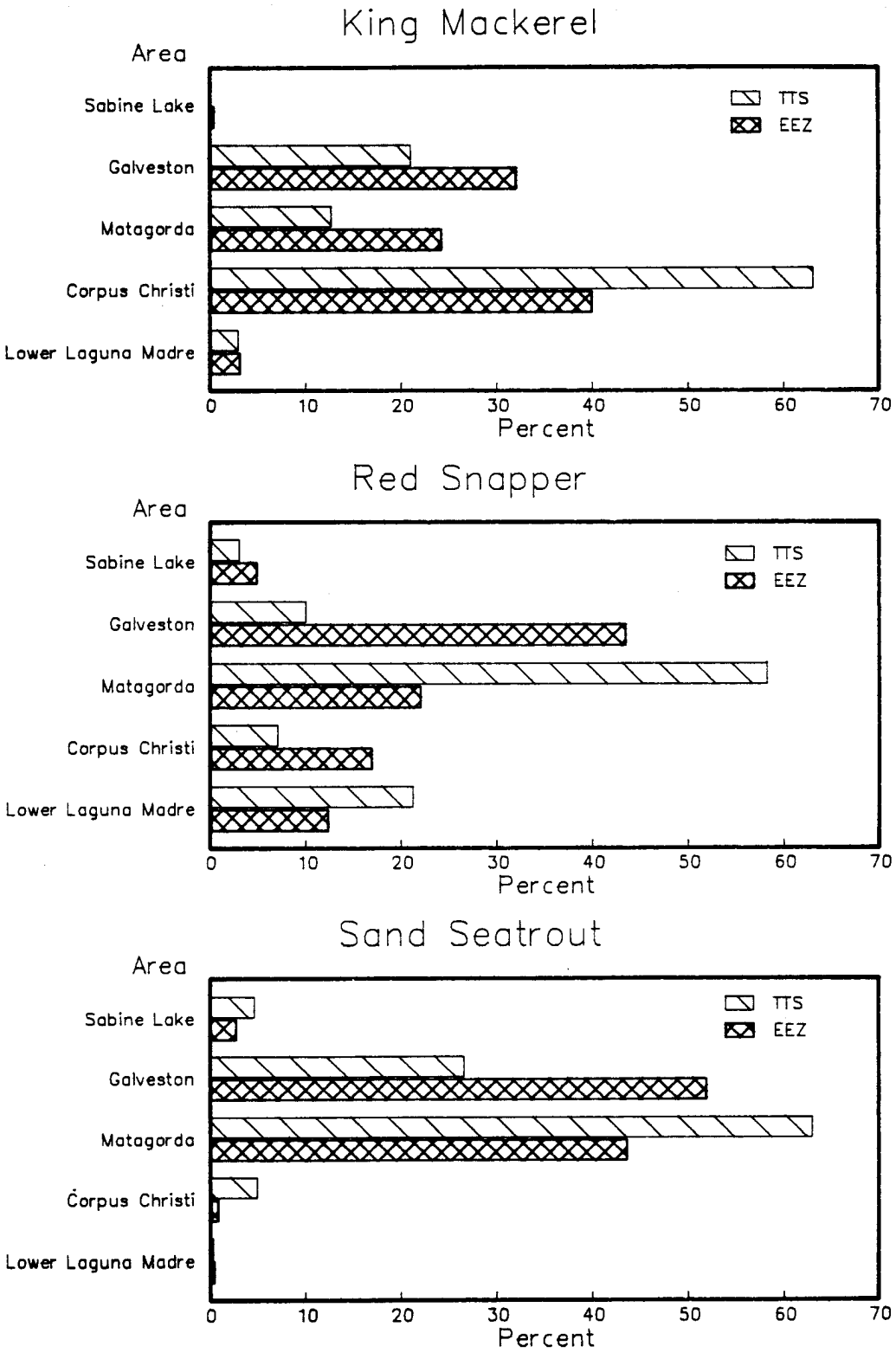


Figure 41. Distribution of annual coastwide Texas Territorial Sea and Exclusive Economic Zone private-boat landings of selected finfishes among areas, May 1982-May 1989 (based on 2-year mean in Sabine Lake area and 7-year means in all other areas).

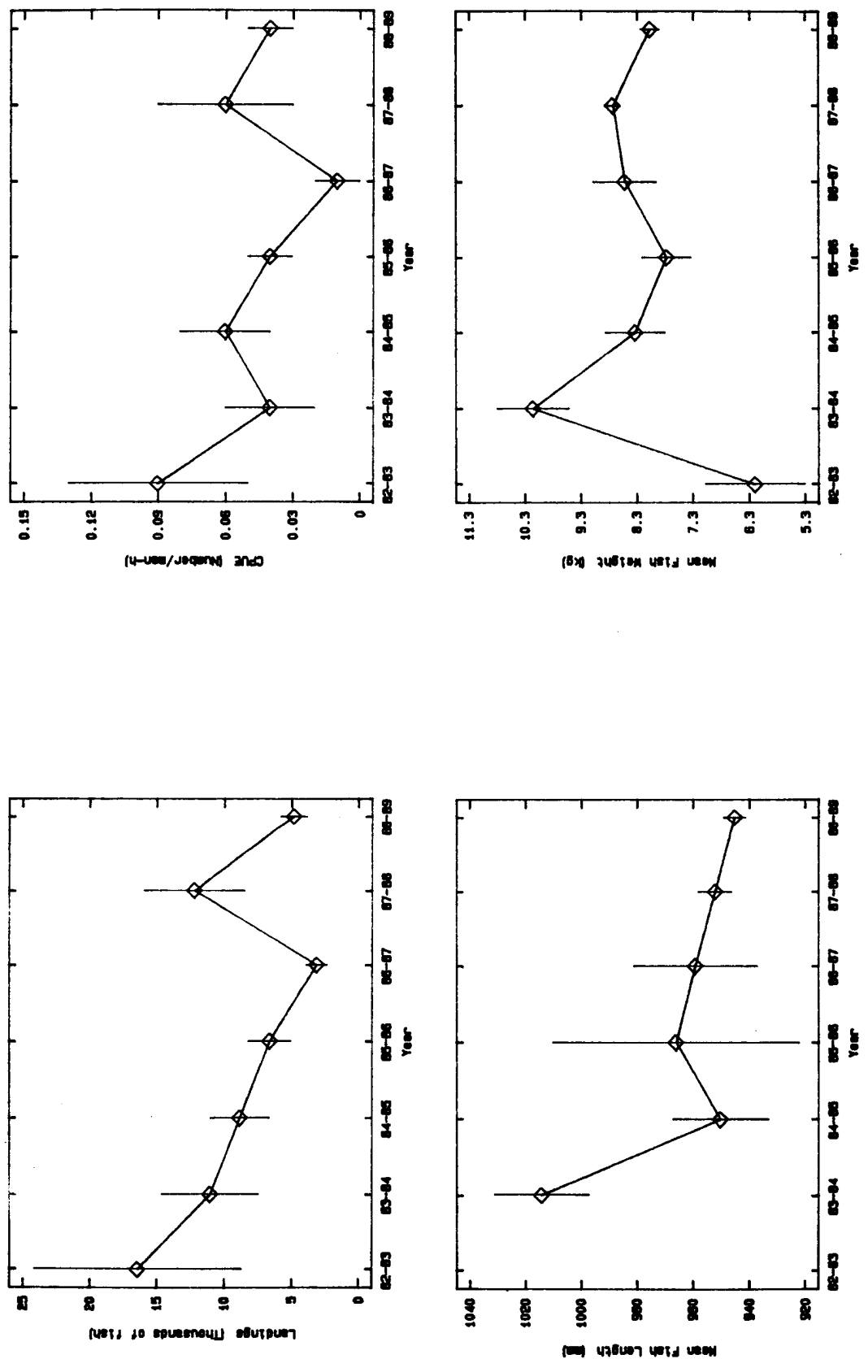


Figure 42. Annual coastwide statistics (± 1 SE) for king mackerel landed from Texas Territorial Sea by private-boat fishermen, May 1982-May 1989.

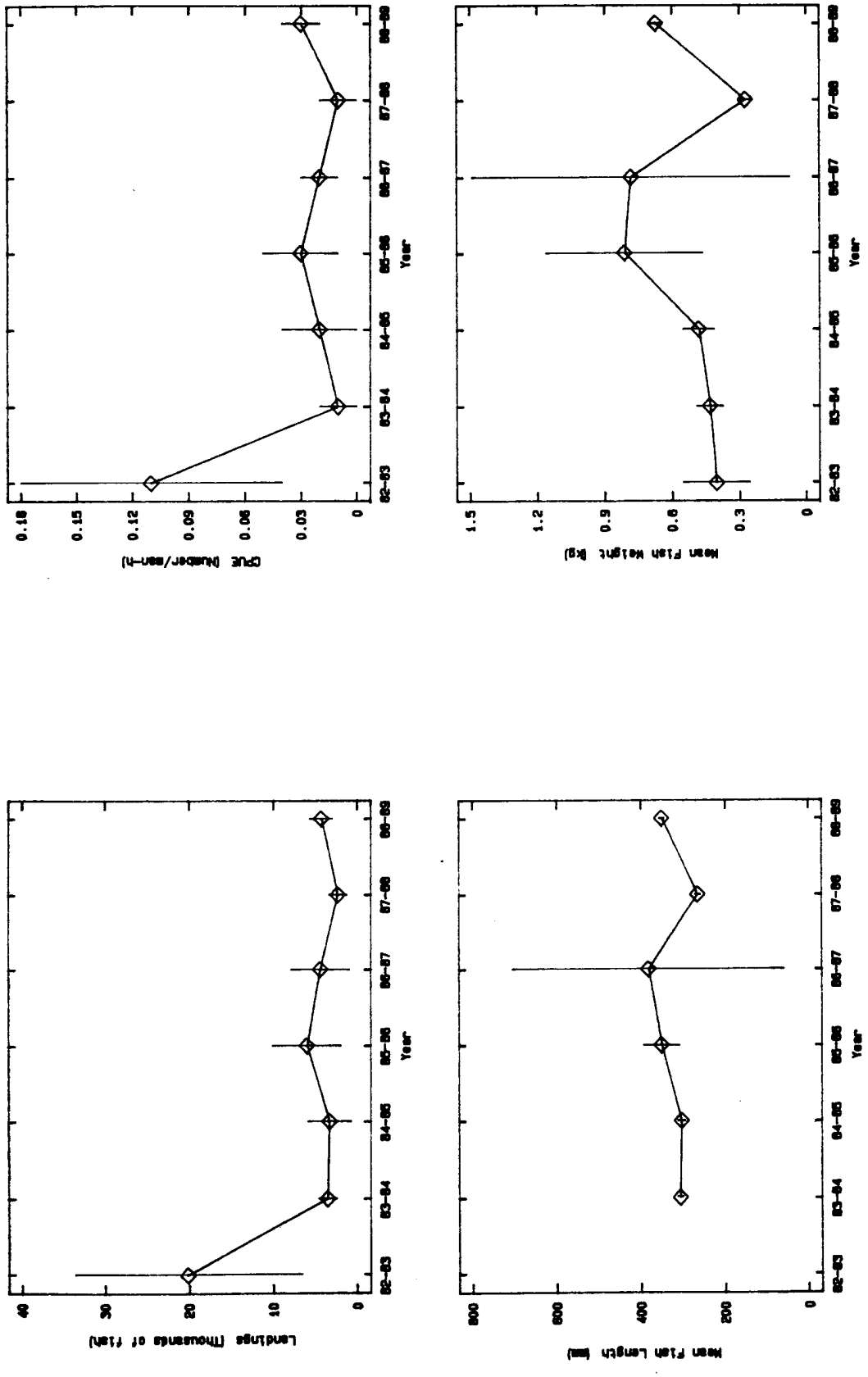


Figure 43. Annual coastwide statistics (± 1 SE) for red snapper landed from Texas Territorial Sea by private-boat fishermen, May 1982-May 1989.

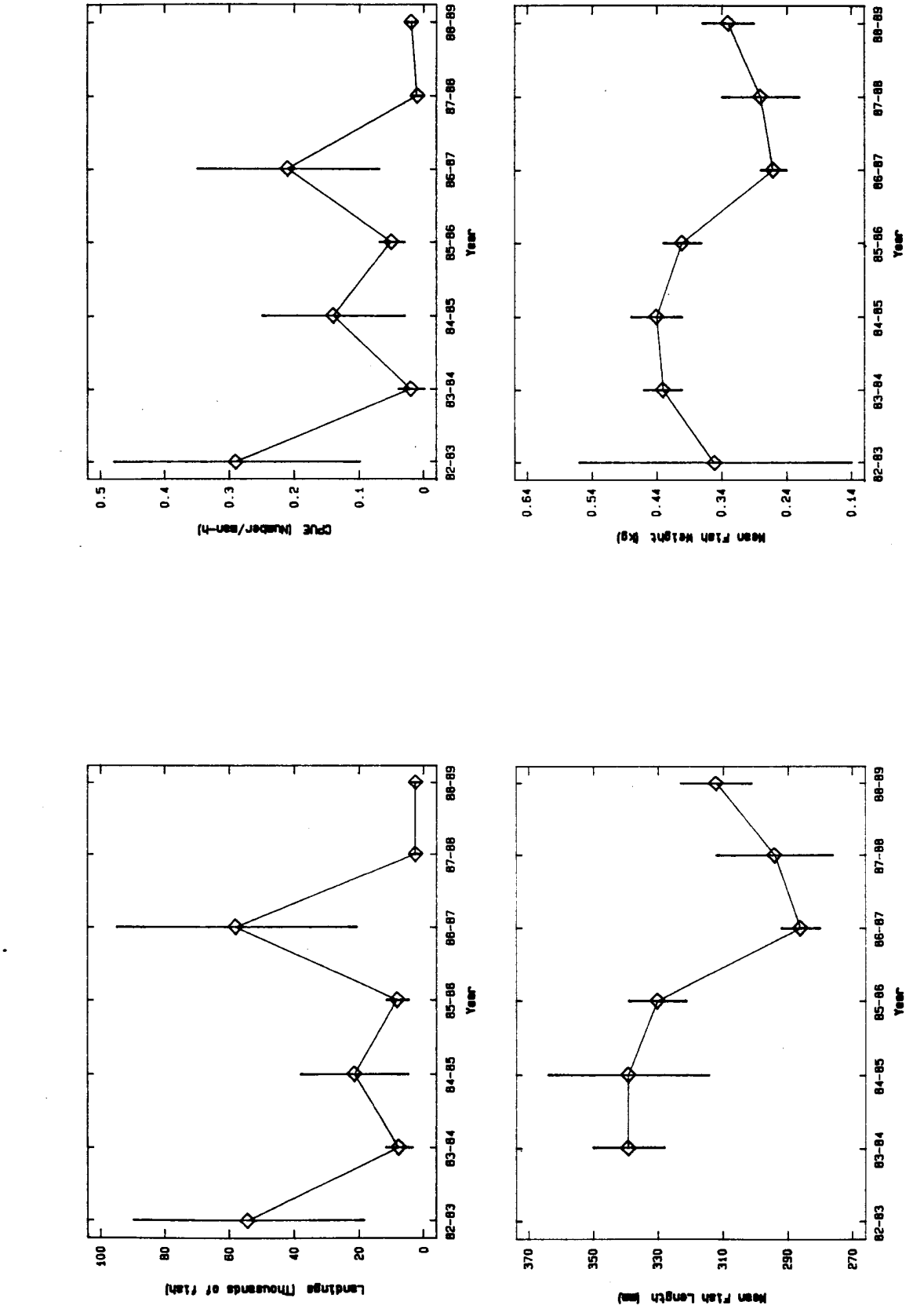


Figure 44. Annual coastwide statistics (± 1 SE) for sand seatrout landed from Texas Territorial Sea by private-boat fishermen, May 1982-May 1989.

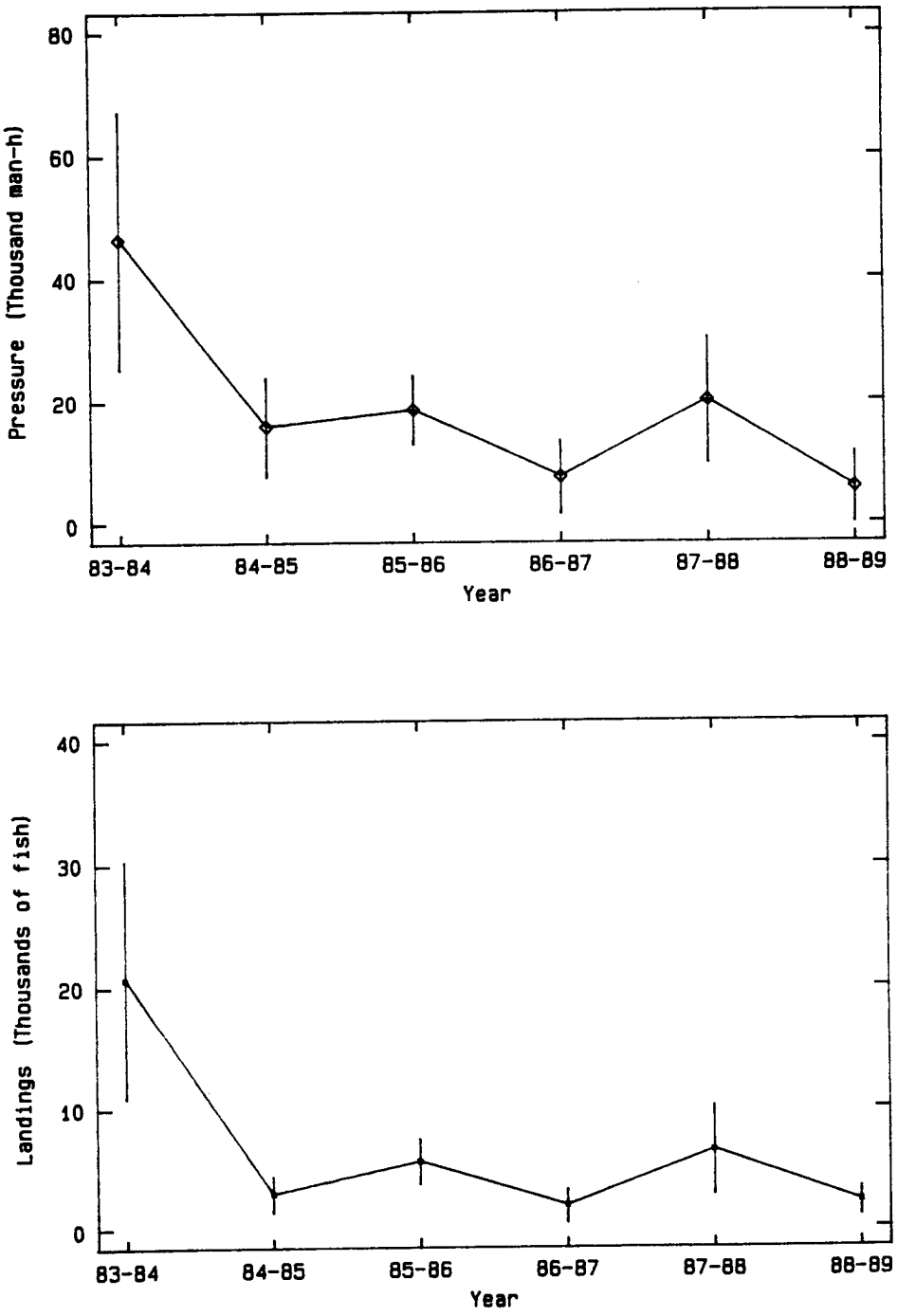


Figure 45. Annual coastwide party-boat fishing pressure (± 1 SE) and landings (± 1 SE) in the Texas Territorial Sea, May 1983-May 1989.

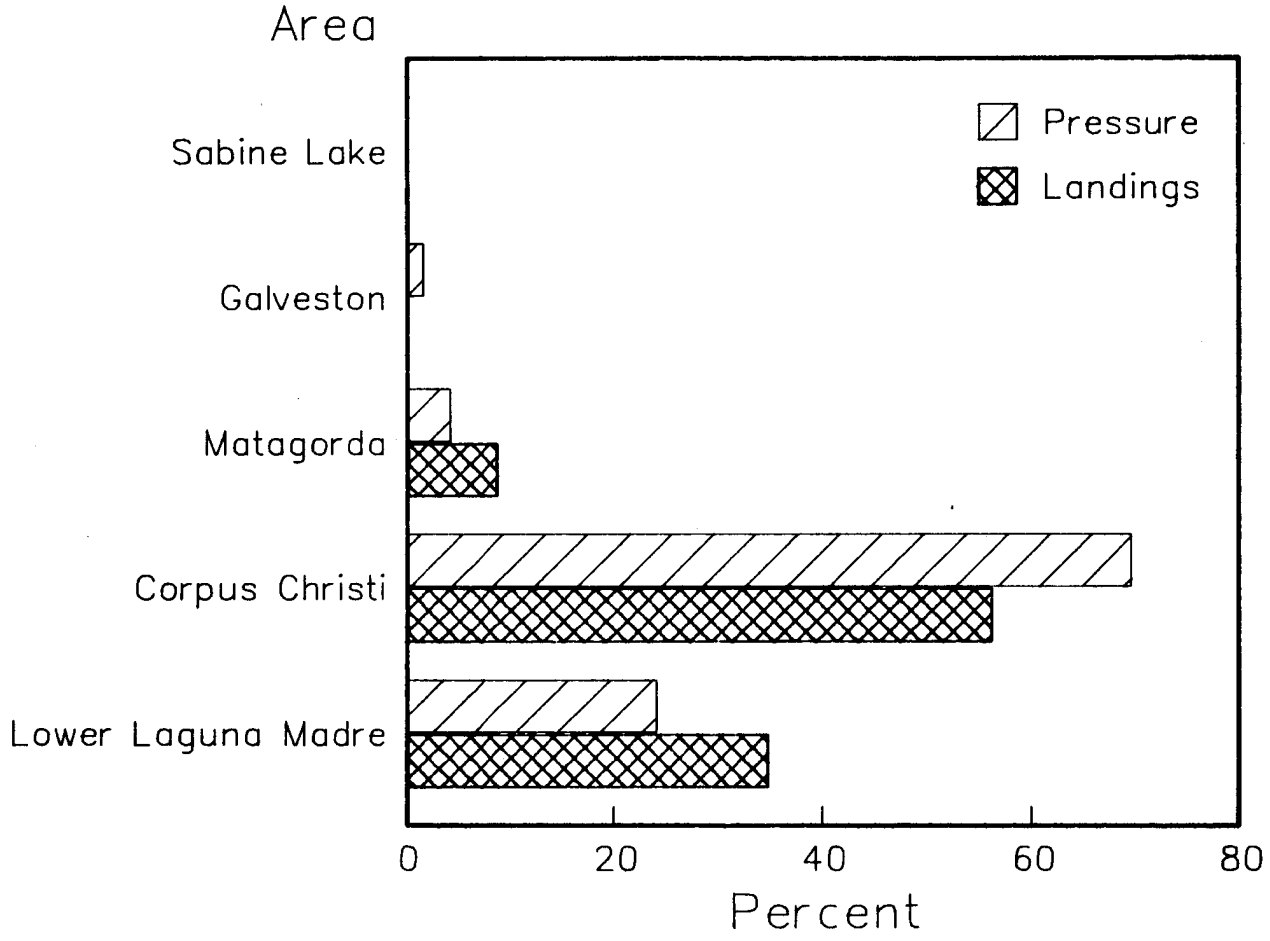


Figure 46. Distribution of annual coastwide Texas Territorial Sea party-boat fishing pressure and landings among areas, May 1983-May 1989 (based on 2-year mean in Sabine Lake area and 6-year means in all other areas).

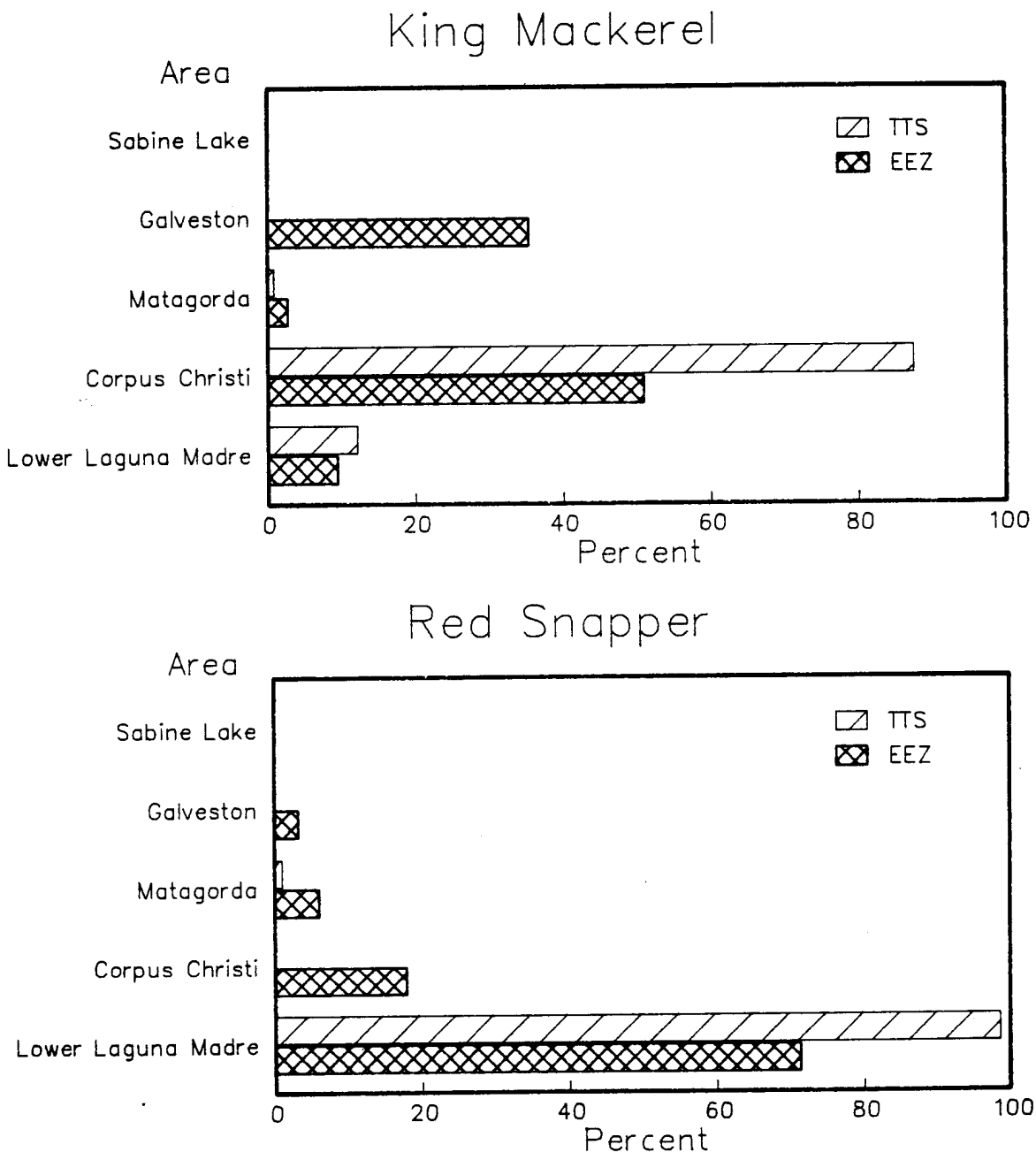


Figure 47. Distribution of annual coastwide Texas Territorial Sea and Exclusive Economic Zone party-boat landings of selected species among areas, May 1983-May 1989 (based on 2-year mean in Sabine Lake area and 6-year means in all other areas).

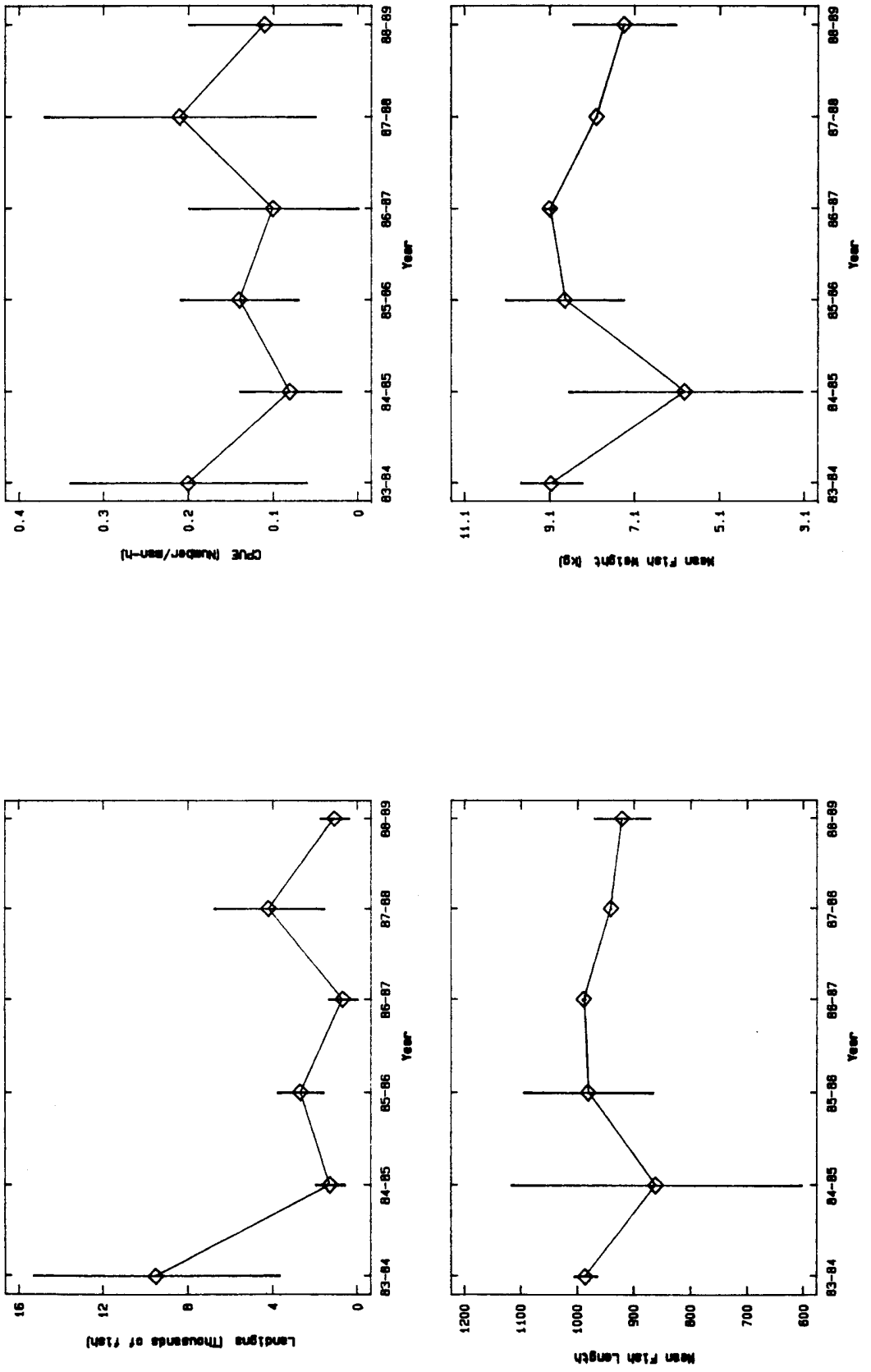


Figure 48. Annual coastwide statistics (± 1 SE) for king mackerel landed from Texas Territorial Sea by party-boat fishermen, May 1983-May 1989.

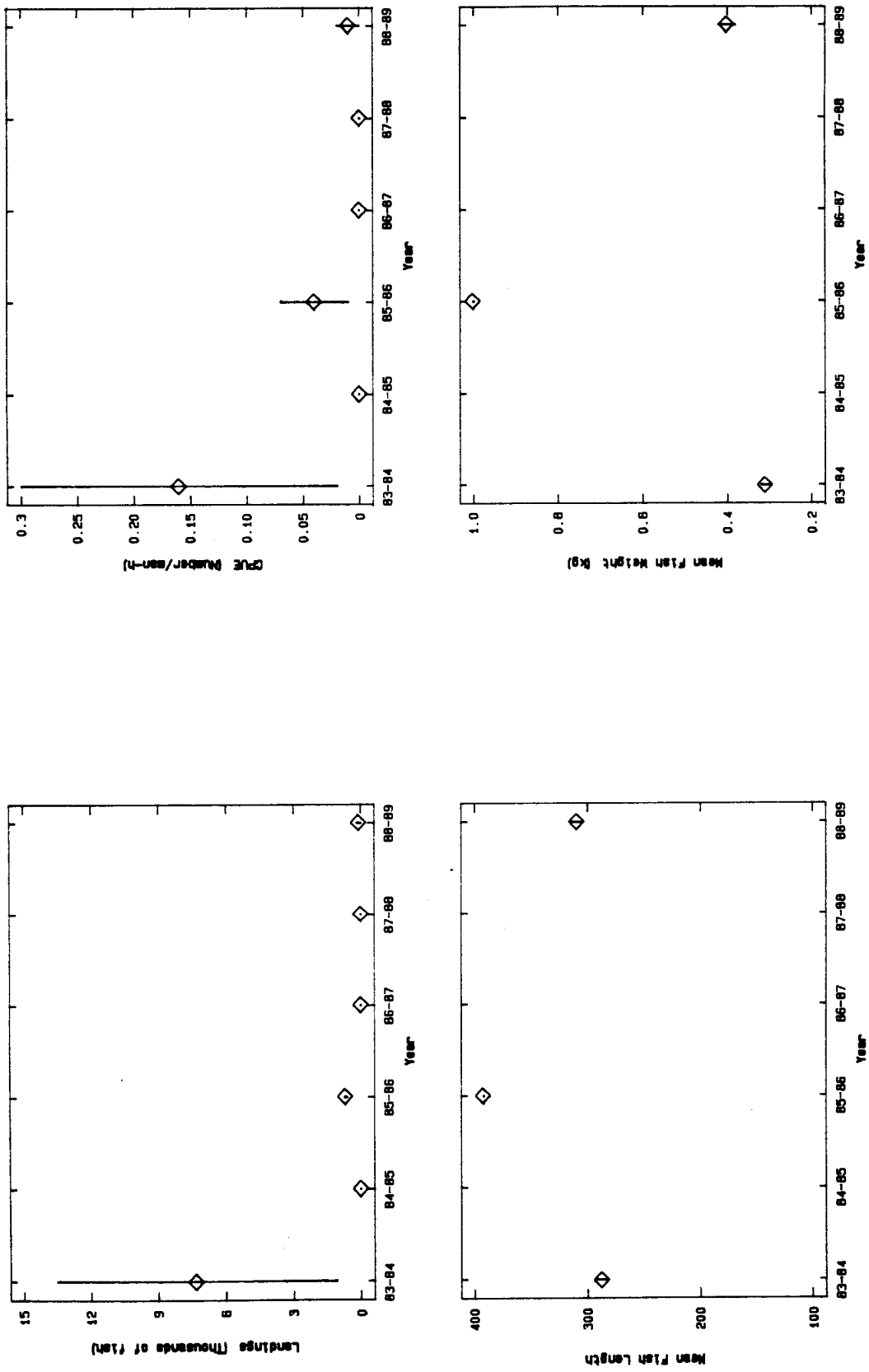


Figure 49. Annual coastwide statistics (± 1 SE) for red snapper landed from Texas Territorial Sea by party-boat fishermen, May 1983-May 1989.

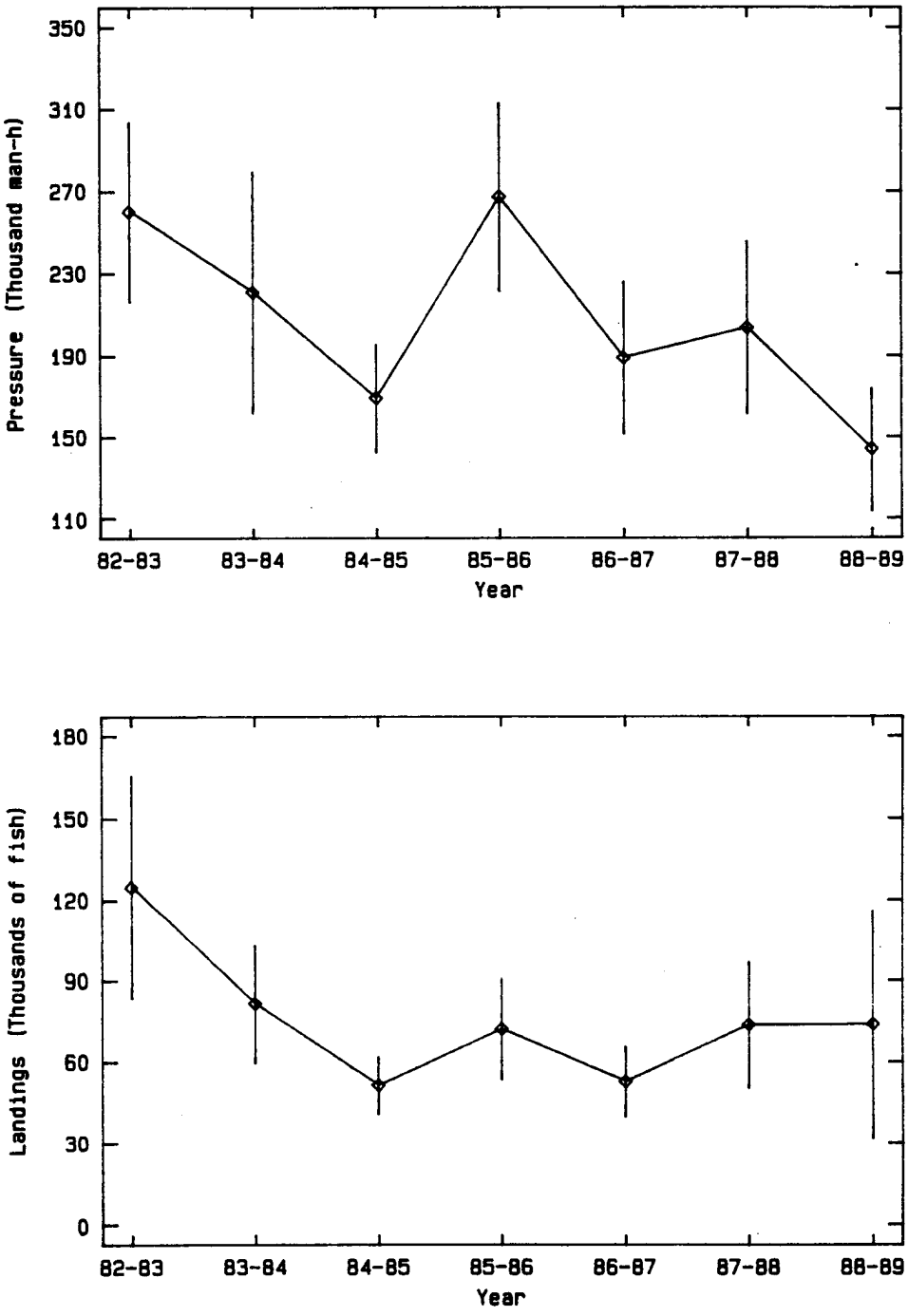


Figure 50. Annual coastwide private-boat fishing pressure (± 1 SE) and landings (± 1 SE) in the Exclusive Economic Zone, May 1982-May 1989.

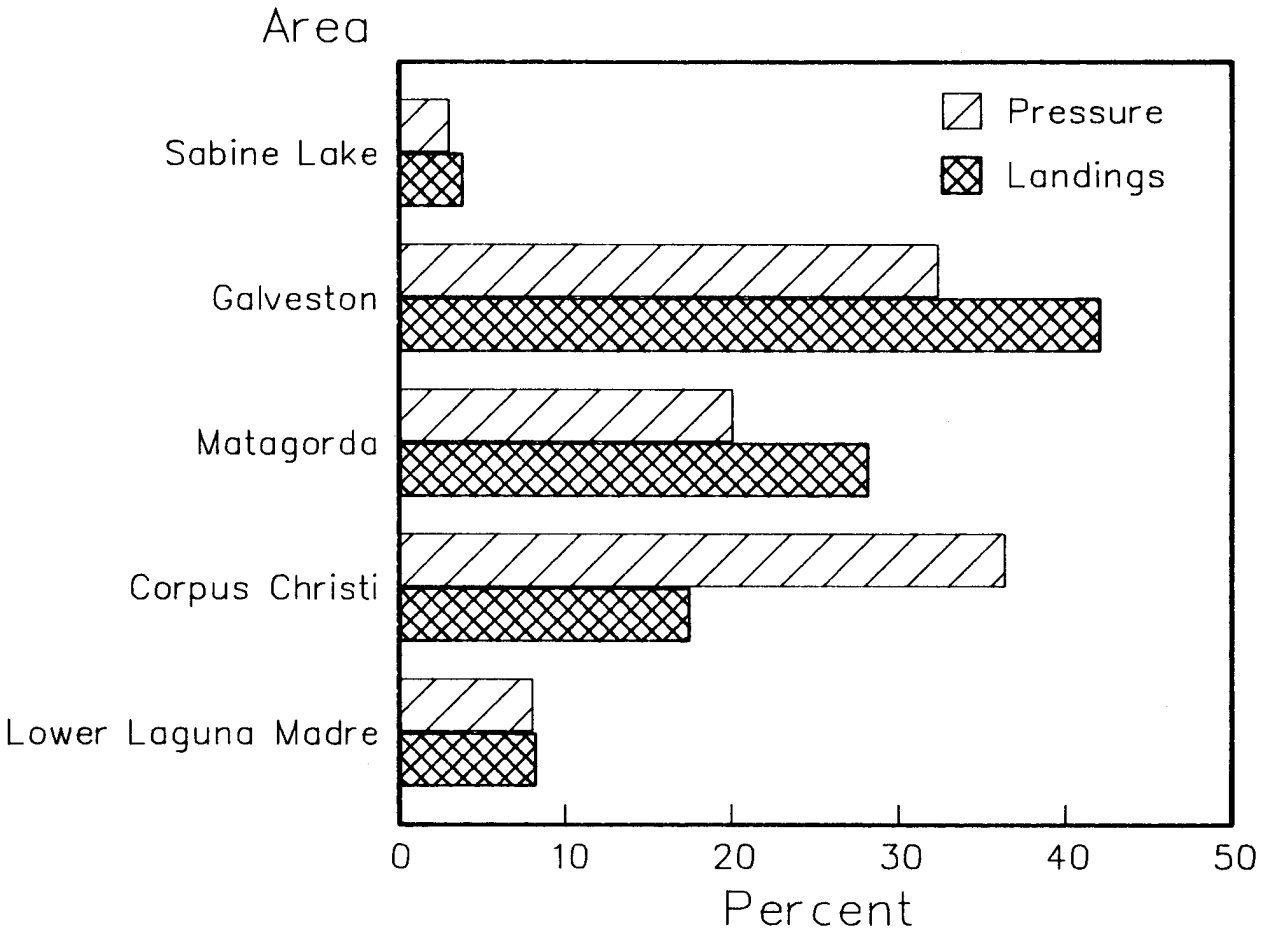


Figure 51. Distribution of annual coastwide Exclusive Economic Zone private-boat fishing pressure and landings among areas, May 1982-May 1989 (based on 2-year mean in Sabine Lake area and 7-year means in all other areas).

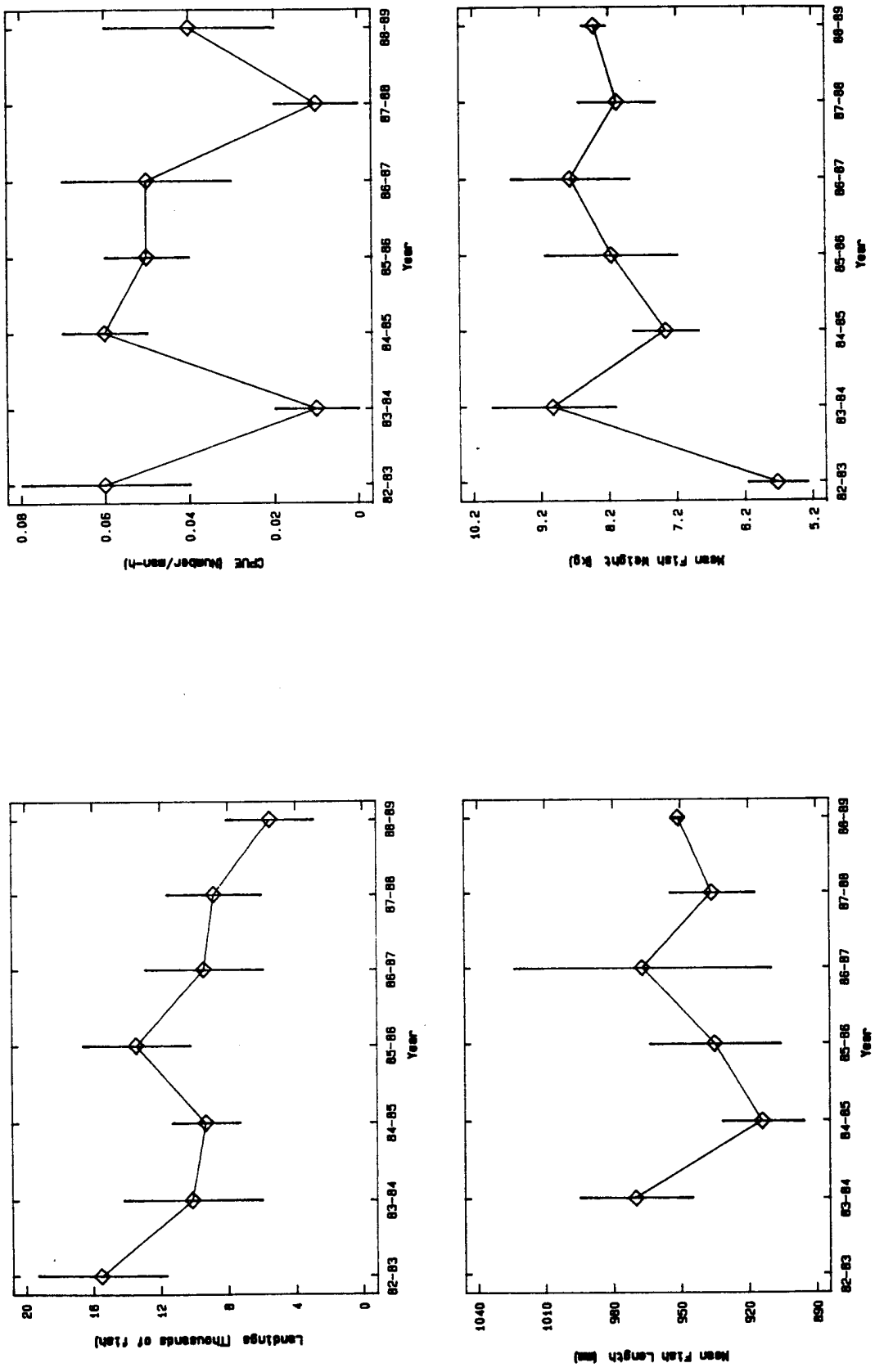


Figure 52. Annual coastwide statistics (± 1 SE) for king mackerel landed from Exclusive Economic Zone by private-boat fishermen, May 1982-May 1989.

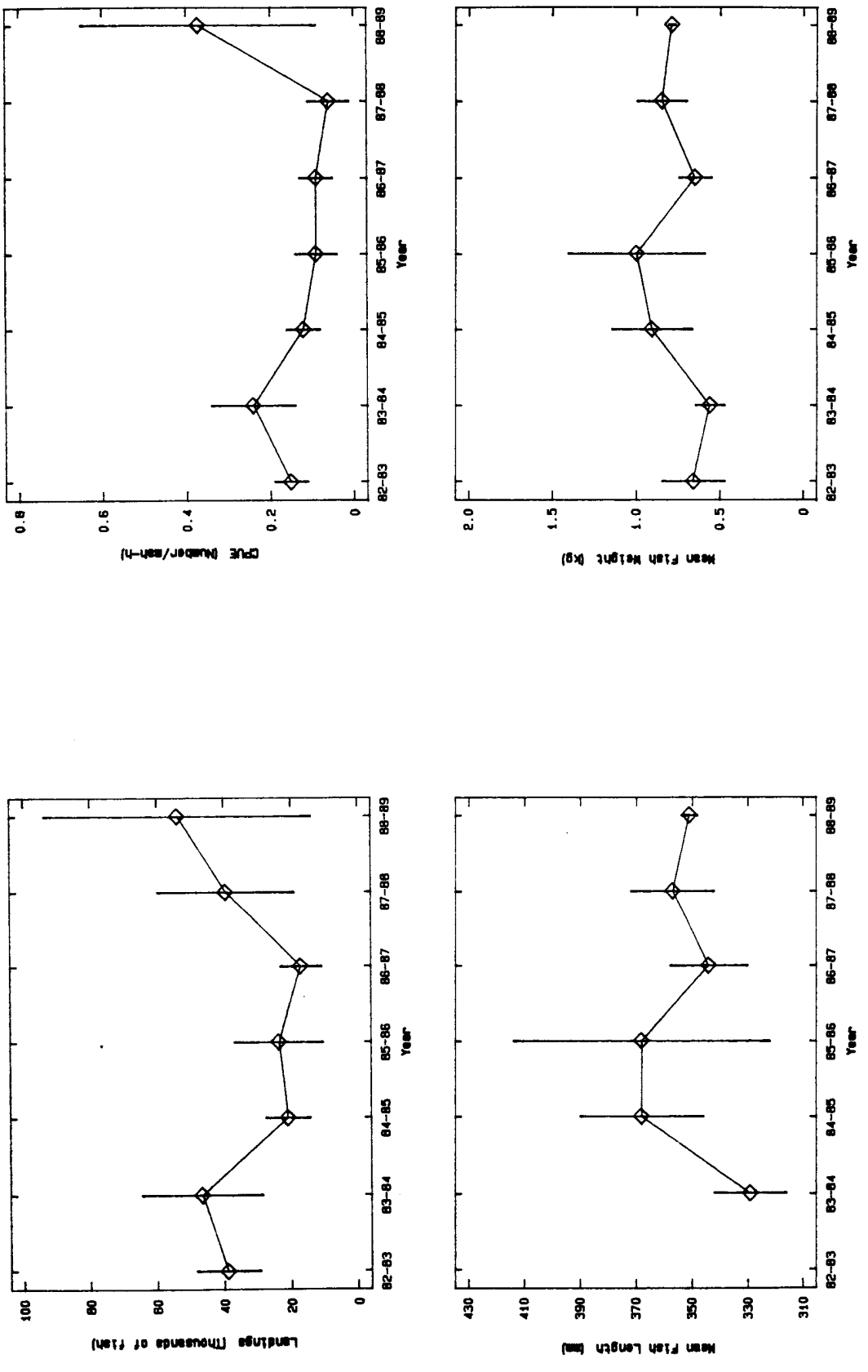


Figure 53. Annual coastwide statistics (± 1 SE) for red snapper landed from Exclusive Economic Zone by private-boat fishermen, May 1982-May 1989.

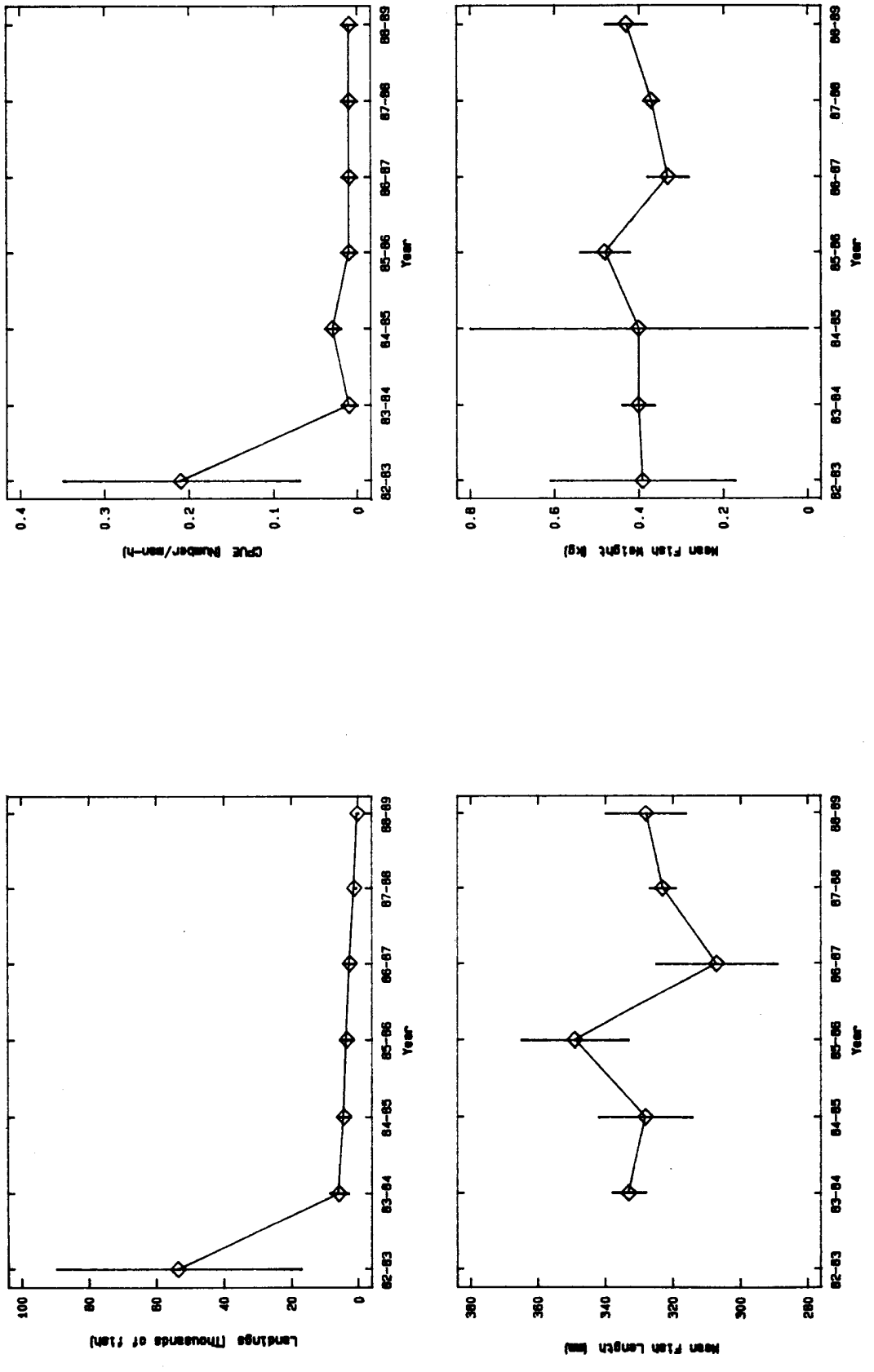


Figure 54. Annual coastwide statistics (± 1 SE) for sand seatrout landed from Exclusive Economic Zone by private-boat fishermen, May 1982-May 1989.

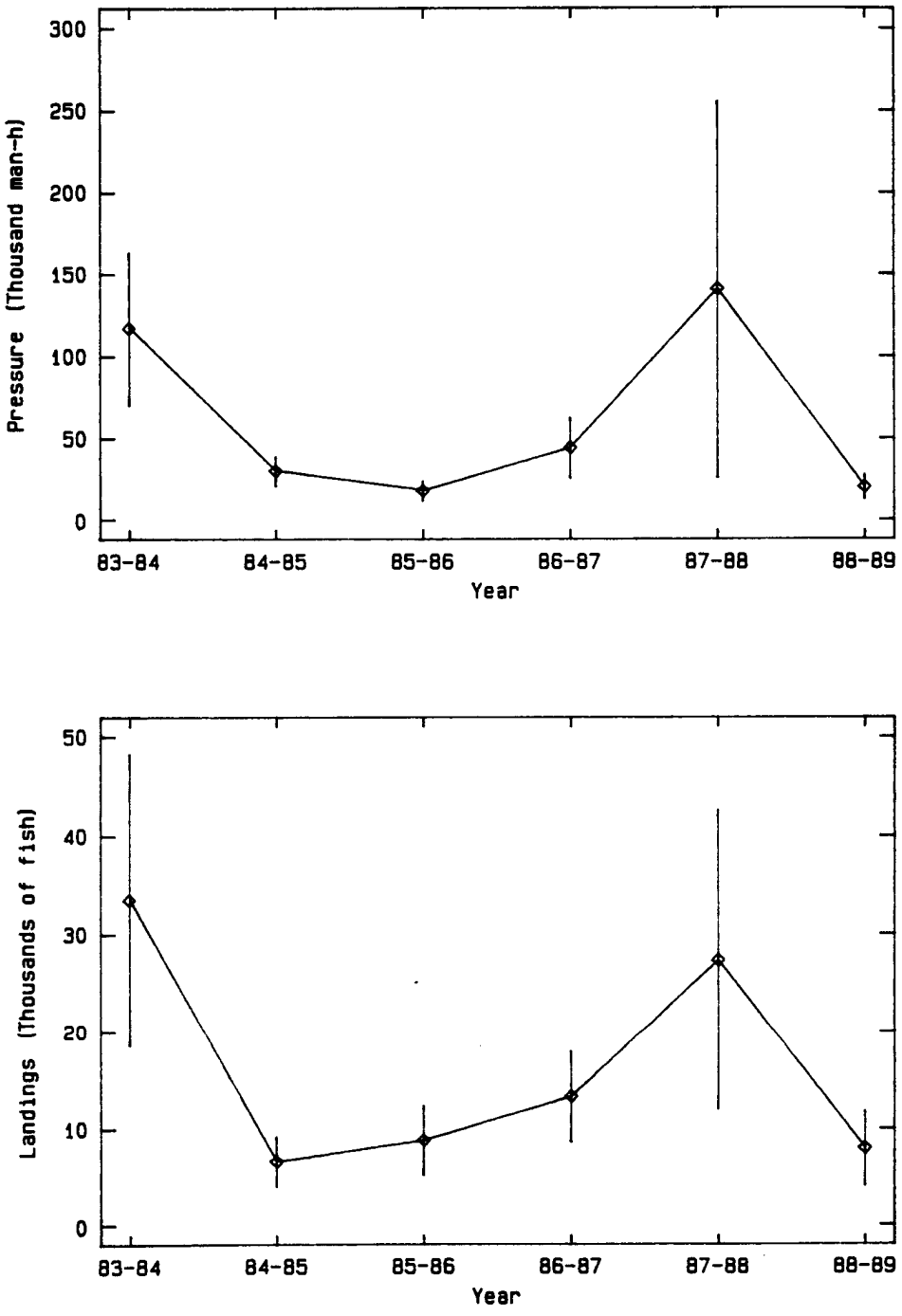


Figure 55. Annual coastwide party-boat fishing pressure (± 1 SE) and landings (± 1 SE) in the Exclusive Economic Zone, May 1983-May 1989.

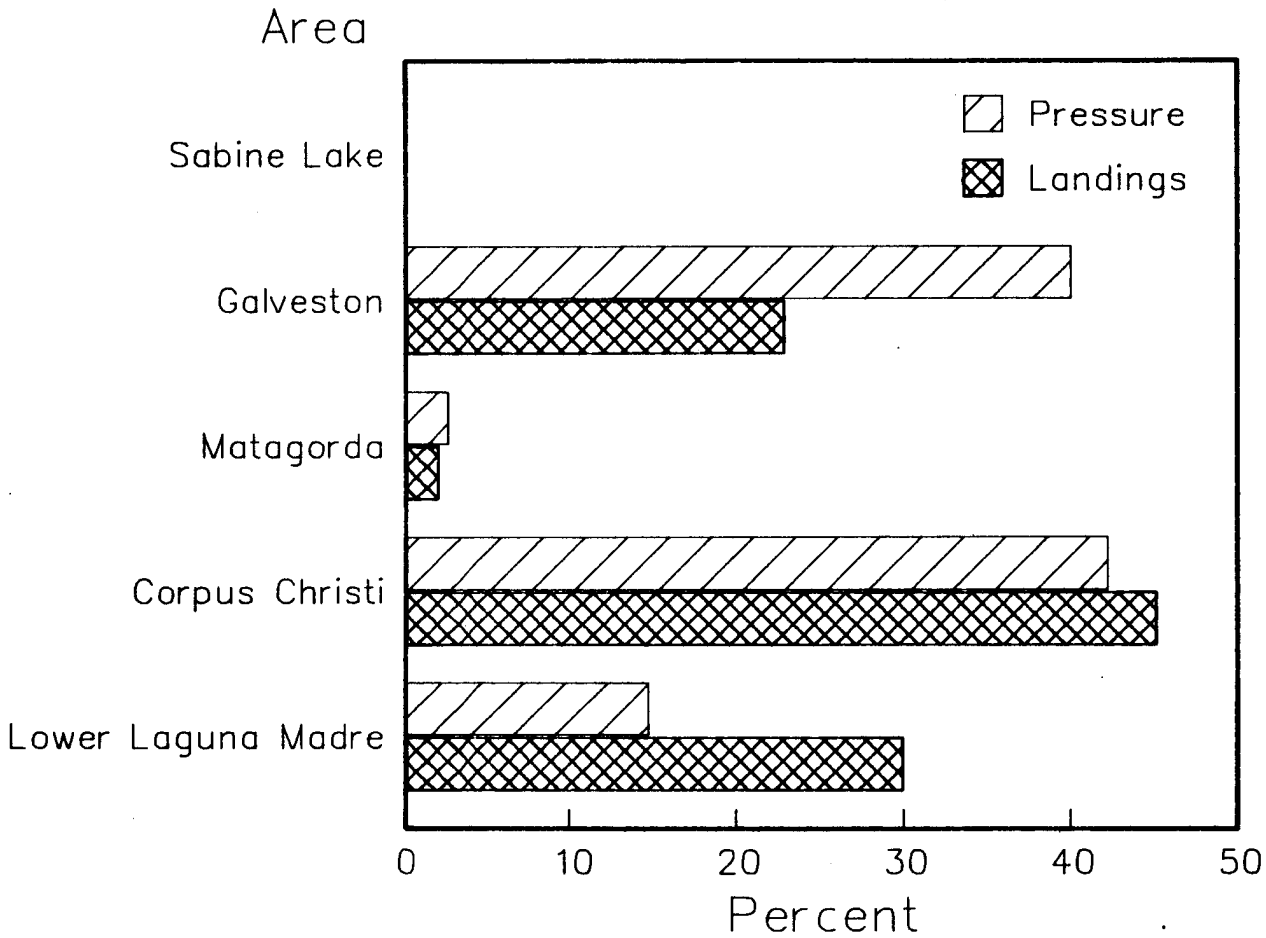


Figure 56. Distribution of annual coastwide Exclusive Economic Zone party-boat fishing pressure and landings among areas, May 1983-May 1989 (based on 2-year mean in Sabine Lake area and 6-year means in all other areas).

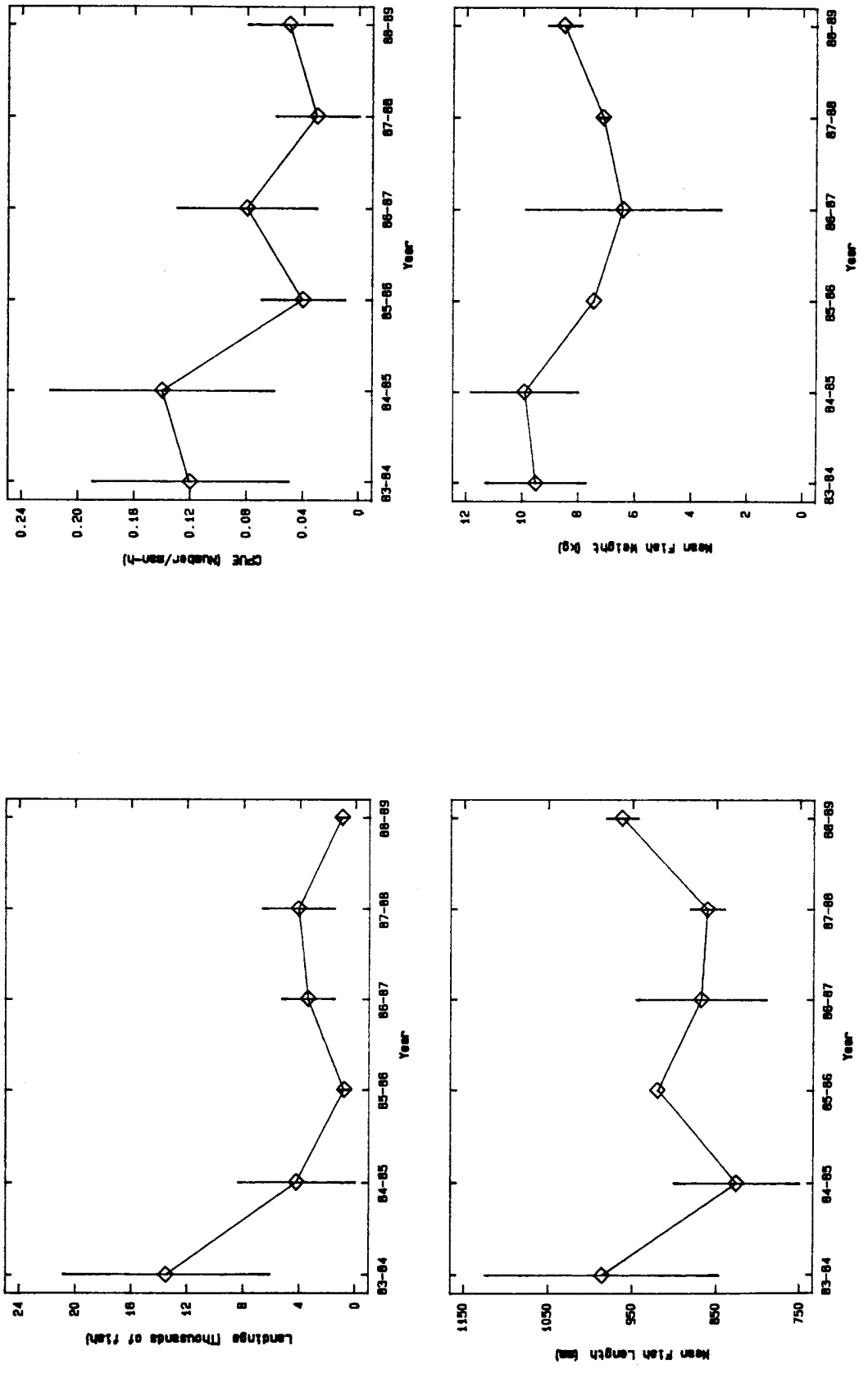


Figure 57. Annual coastwide statistics (± 1 SE) for king mackerel landed from Exclusive Economic Zone by party-boat fishermen, May 1983-May 1989.

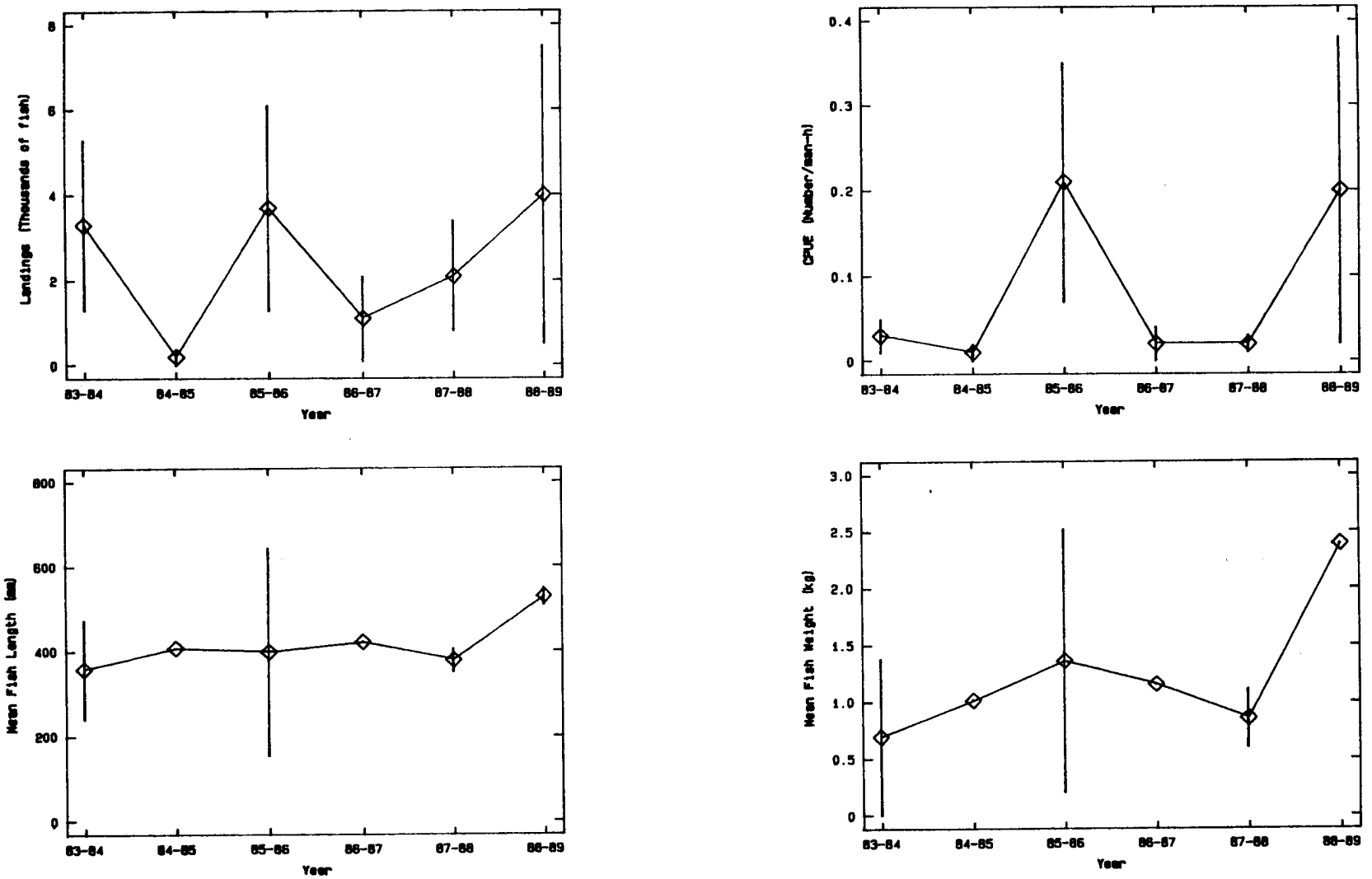


Figure 58. Annual coastwide statistics (± 1 SE) for red snapper landed from Exclusive Economic Zone by party-boat fishermen, May 1983-May 1989.

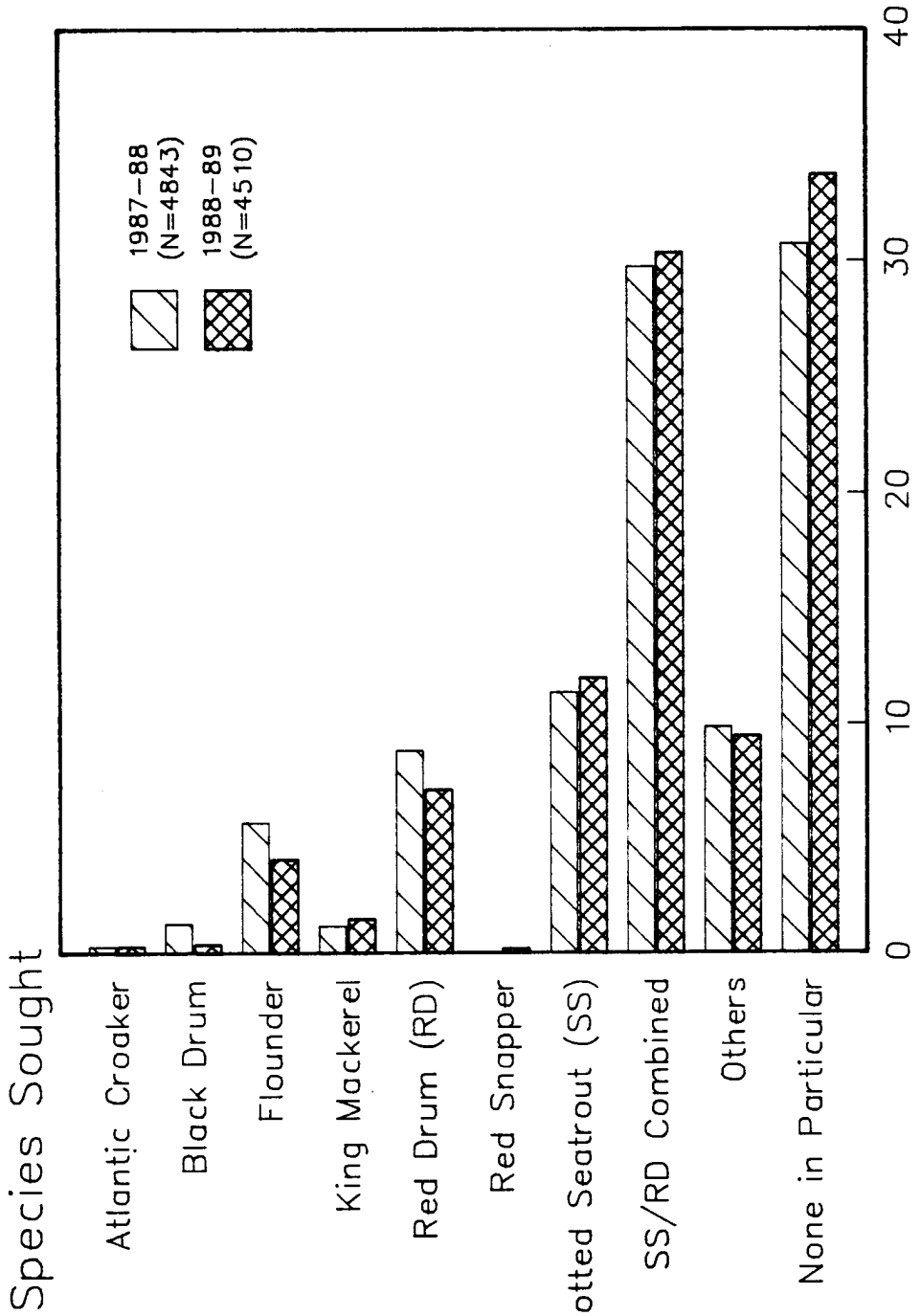


Figure 59. Species sought by sport-boat fishermen along the Texas coast as indicated by pre-trip interviews, May 1987-May 1989.

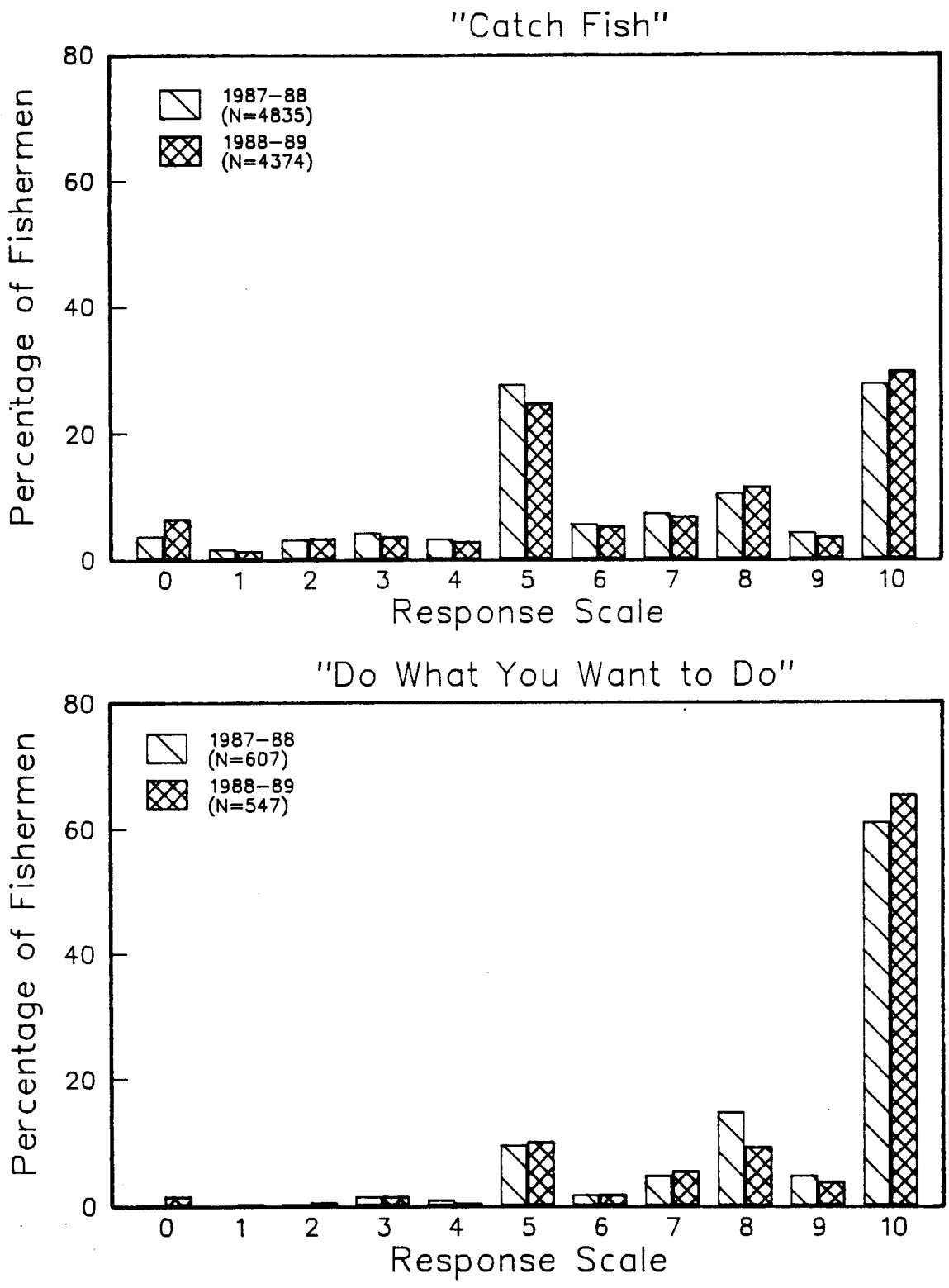


Figure 60. Importance to sport-boat fishermen to "catch fish" and "do what you want to do" during fishing trips along the Texas coast as indicated by pre-trip interviews, May 1987-May 1989 (0 = "not at all"; 10 = "extremely").

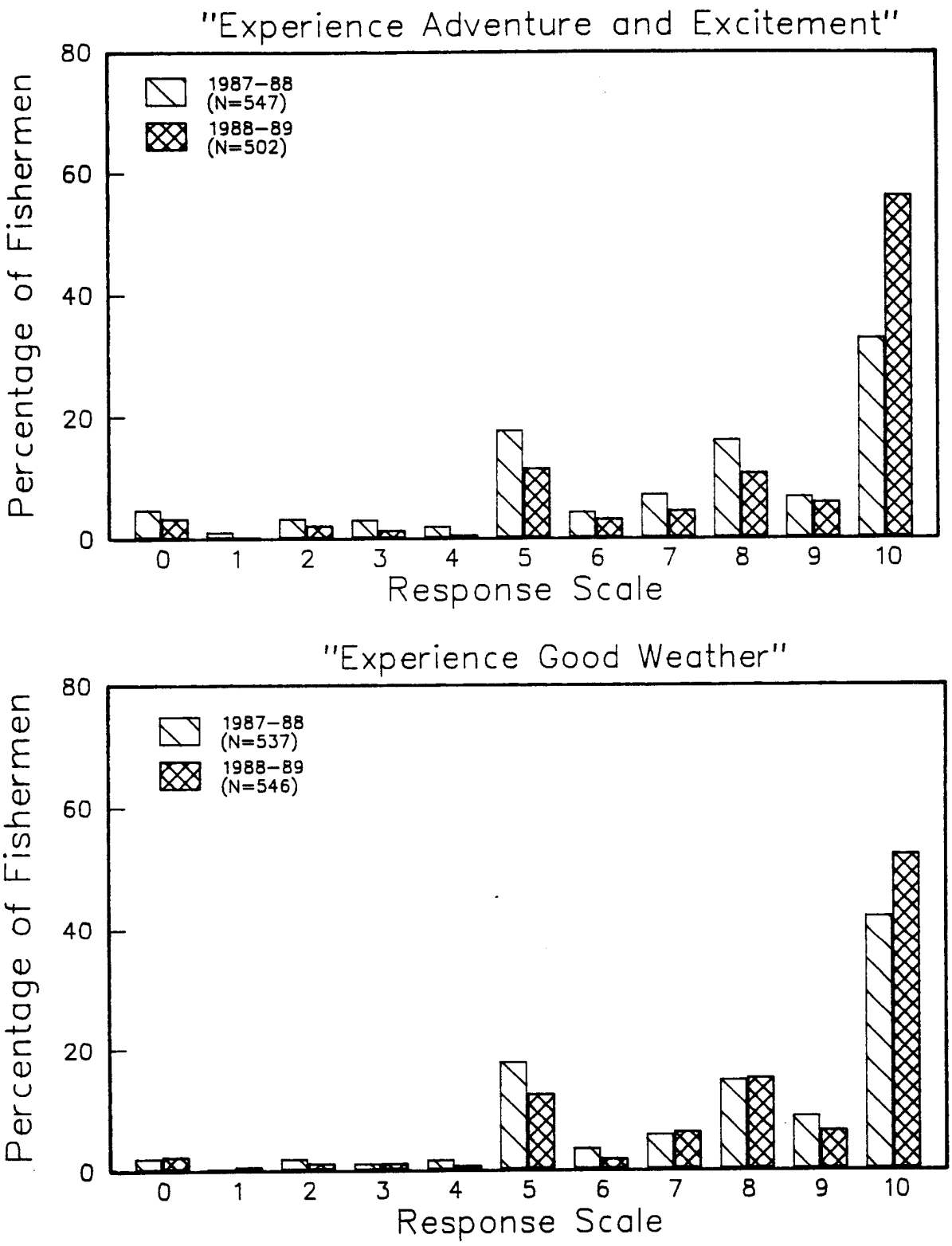


Figure 61. Importance to sport-boat fishermen to "experience adventure and excitement" and "experience good weather" during fishing trips along the Texas coast as indicated by pre-trip interviews, May 1987-May 1989 (0 = "not at all"; 10 = "extremely").

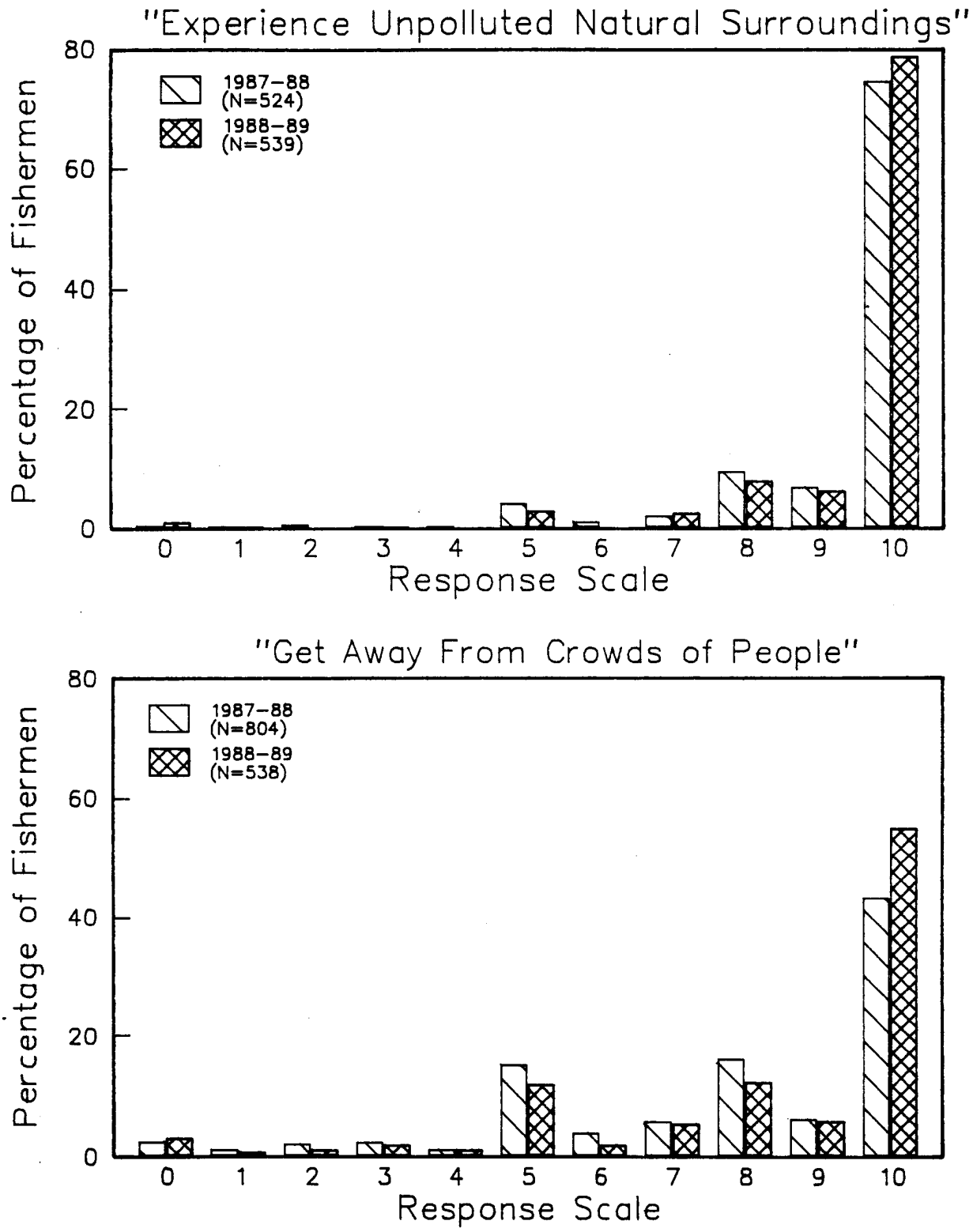


Figure 62. Importance to sport-boat fishermen to "experience unpolluted natural surroundings" and "get away from crowds of people" during fishing trips along the Texas coast as indicated by pre-trip interviews, May 1987-May 1989 (0 = "not at all"; 10 = "extremely").

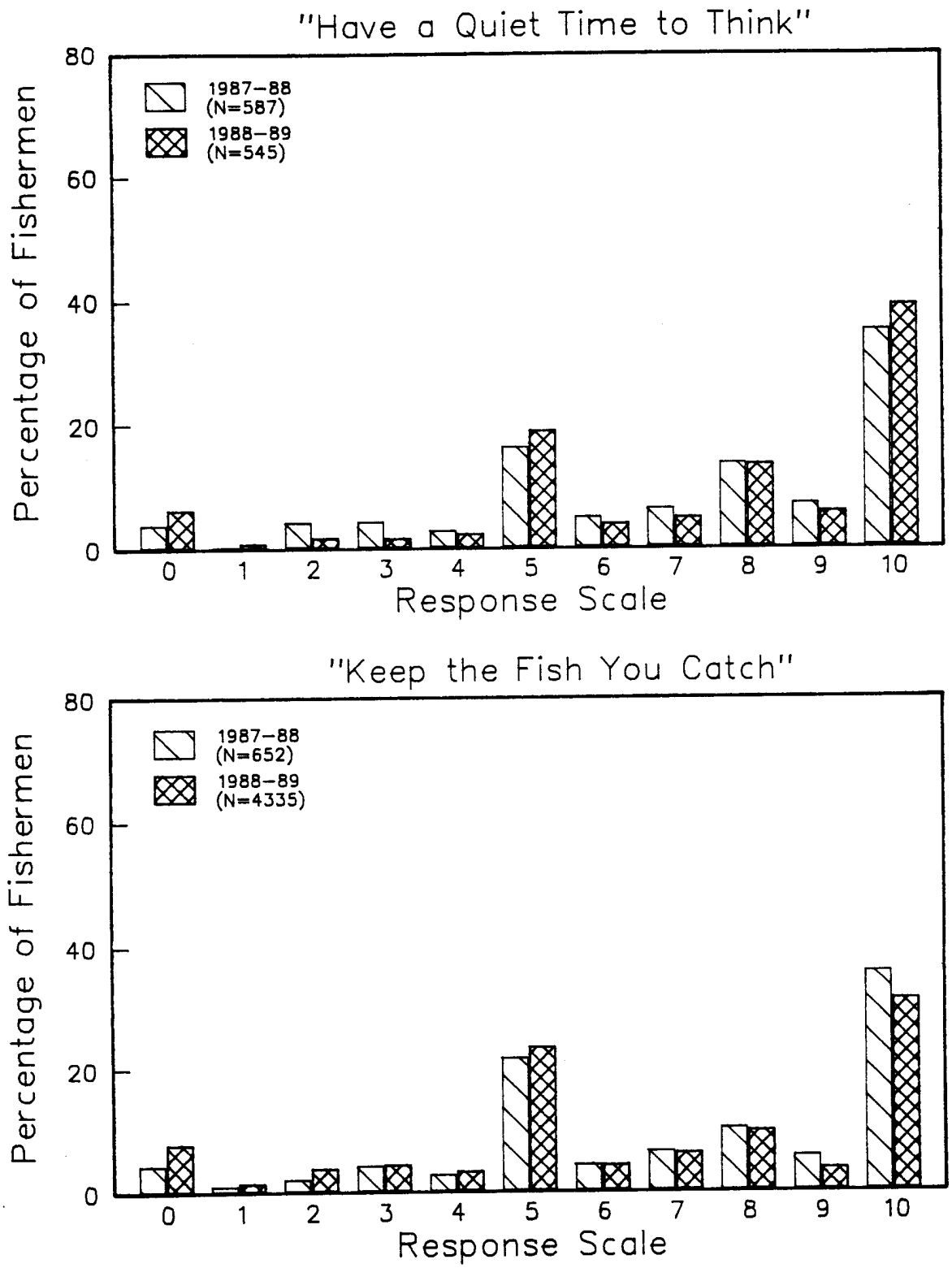


Figure 63. Importance to sport-boat fishermen to "have a quiet time to think" and "keep the fish you catch" during fishing trips along the Texas coast as indicated by pre-trip interviews, May 1987-May 1989 (0 = "not at all"; 10 = "extremely").

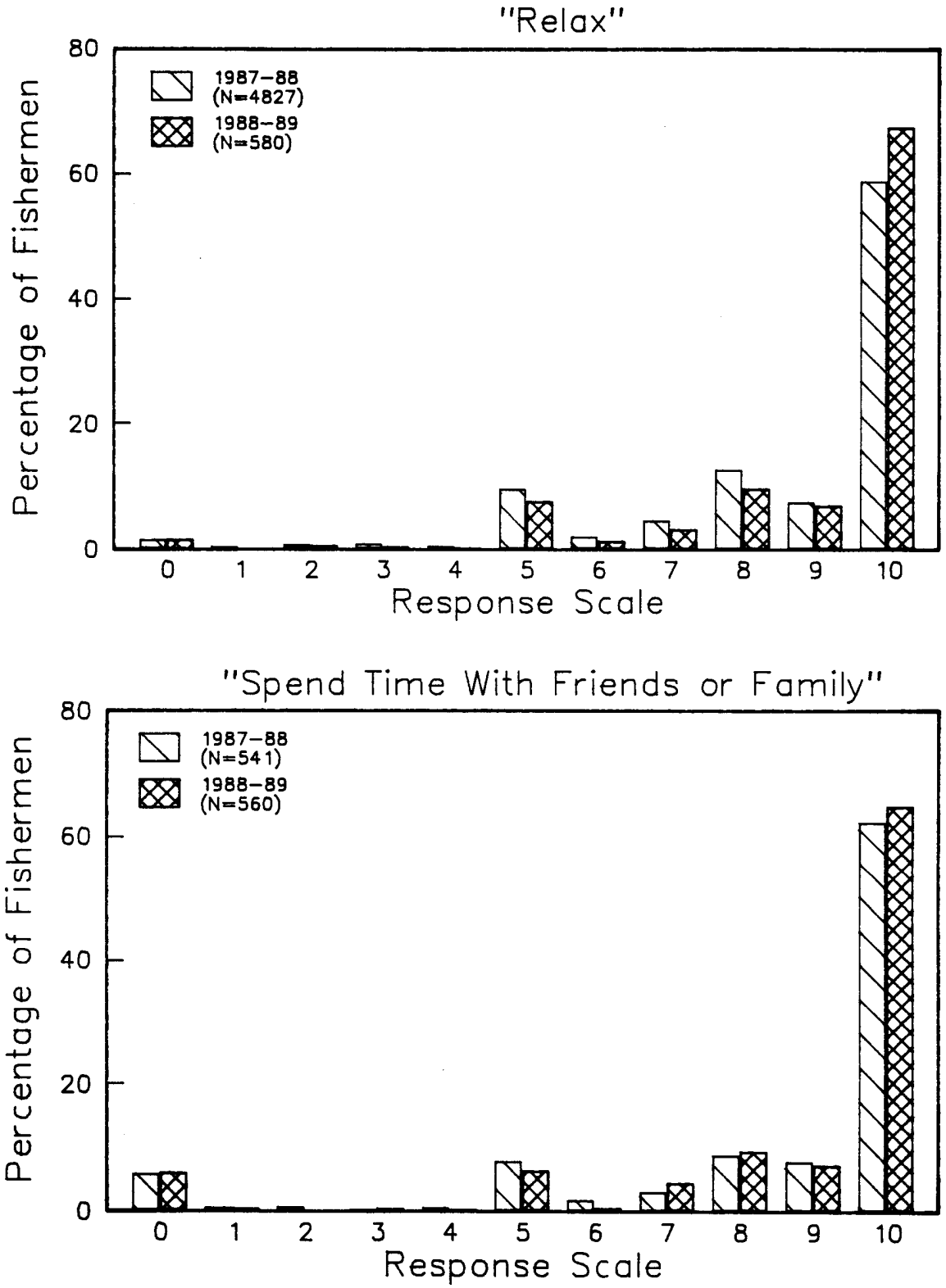


Figure 64. Importance to sport-boat fishermen to "relax" and "spend time with friends or family" during fishing trips along the Texas coast as indicated by pre-trip interviews, May 1987-May 1989 (0 = "not at all"; 10 = "extremely").

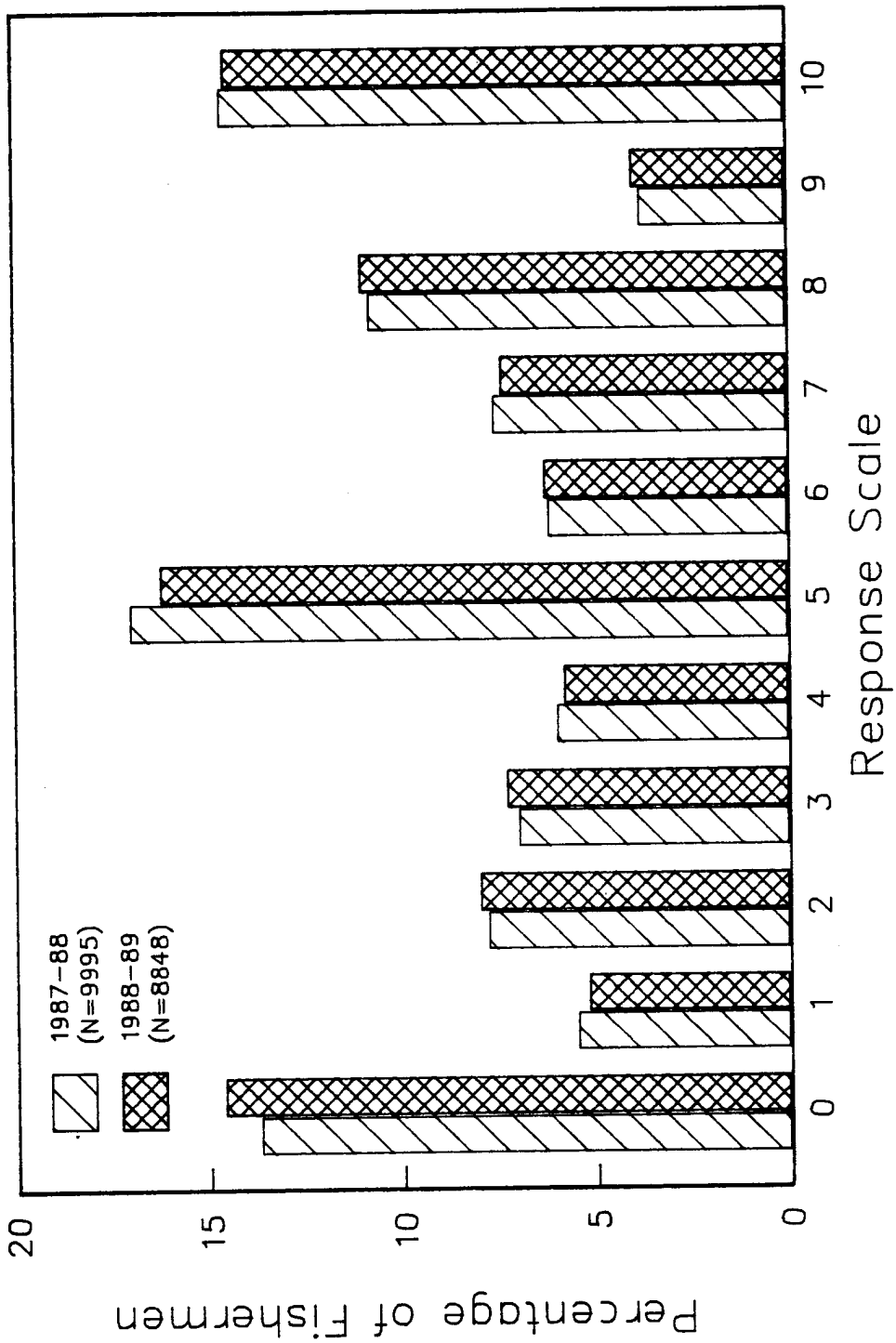


Figure 65. Trip satisfaction of sport-boat fishermen along the Texas coast as indicated by post-trip interviews, May 1987-May 1989 (0 = "not at all"; 10 = "completely").

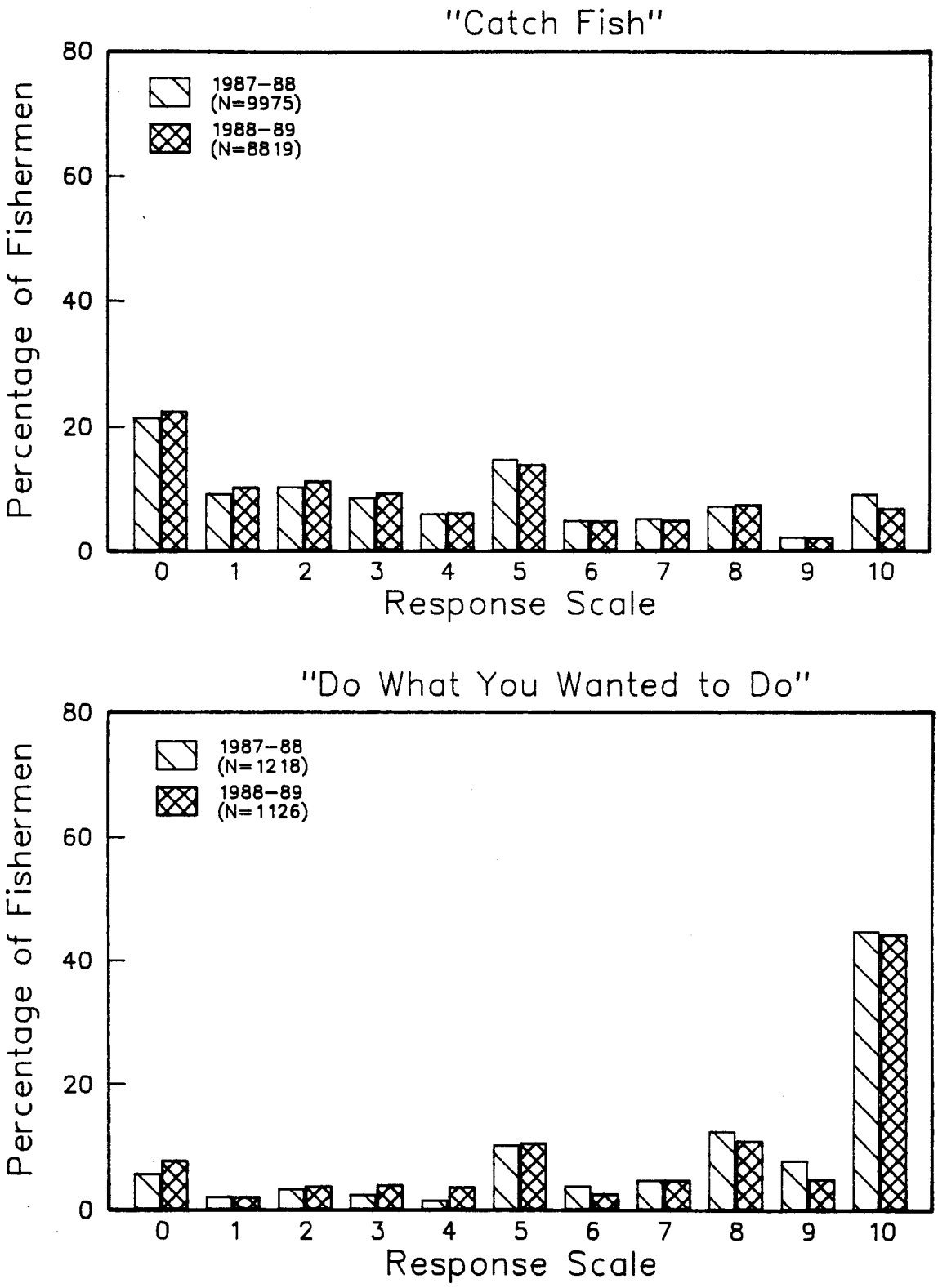


Figure 66. Extent to which sport-boat fishermen were able to "catch fish" and "do what you wanted to do" during fishing trips along the Texas coast as indicated by post-trip interviews, May 1987-May 1989 (0 = "not at all"; 10 = "completely").

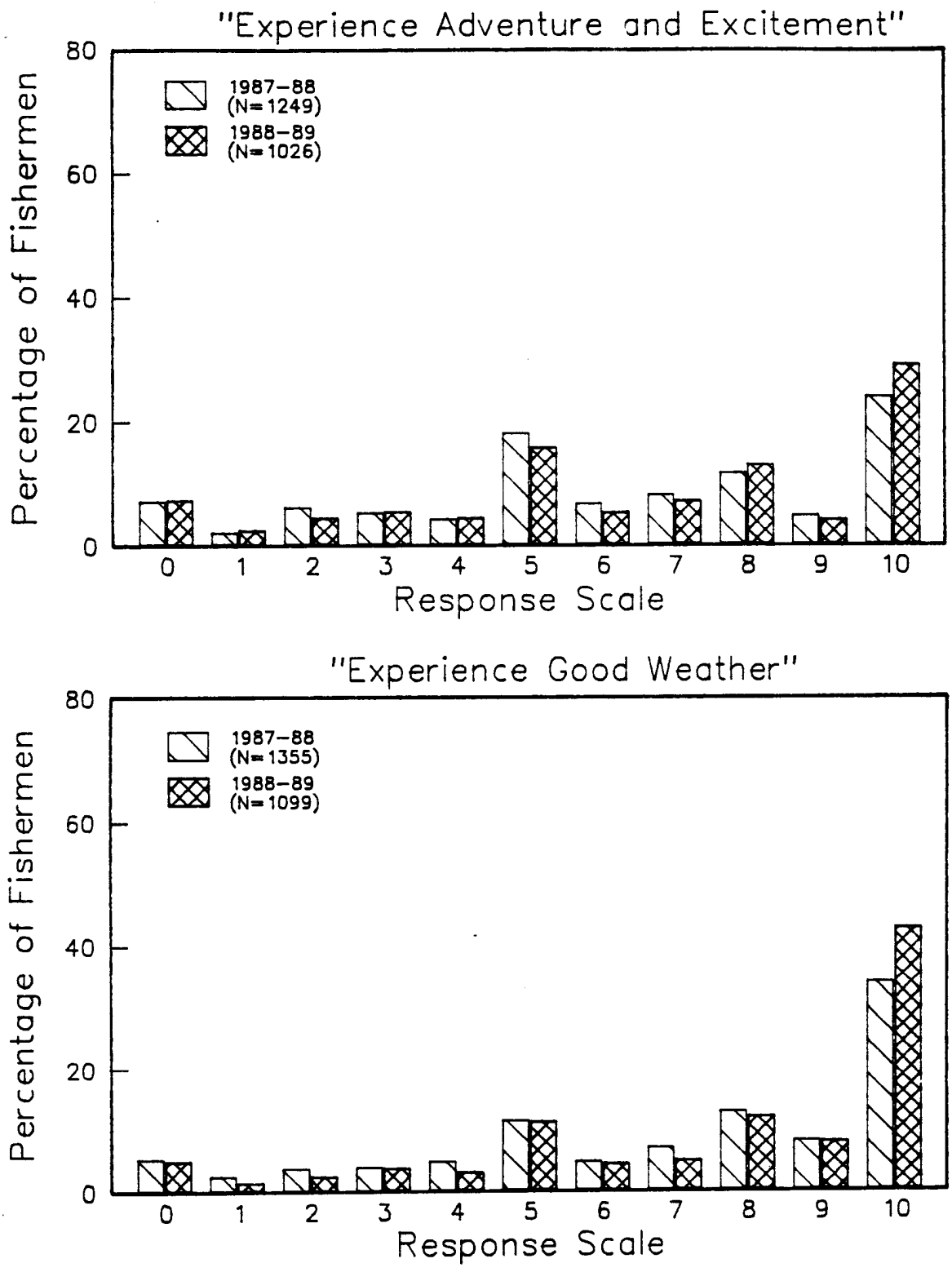


Figure 67. Extent to which sport-boat fishermen were able to "experience adventure and excitement" and "experience good weather" during fishing trips along the Texas coast as indicated by post-trip interviews, May 1987-May 1989 (0 = "not at all"; 10 = "completely").

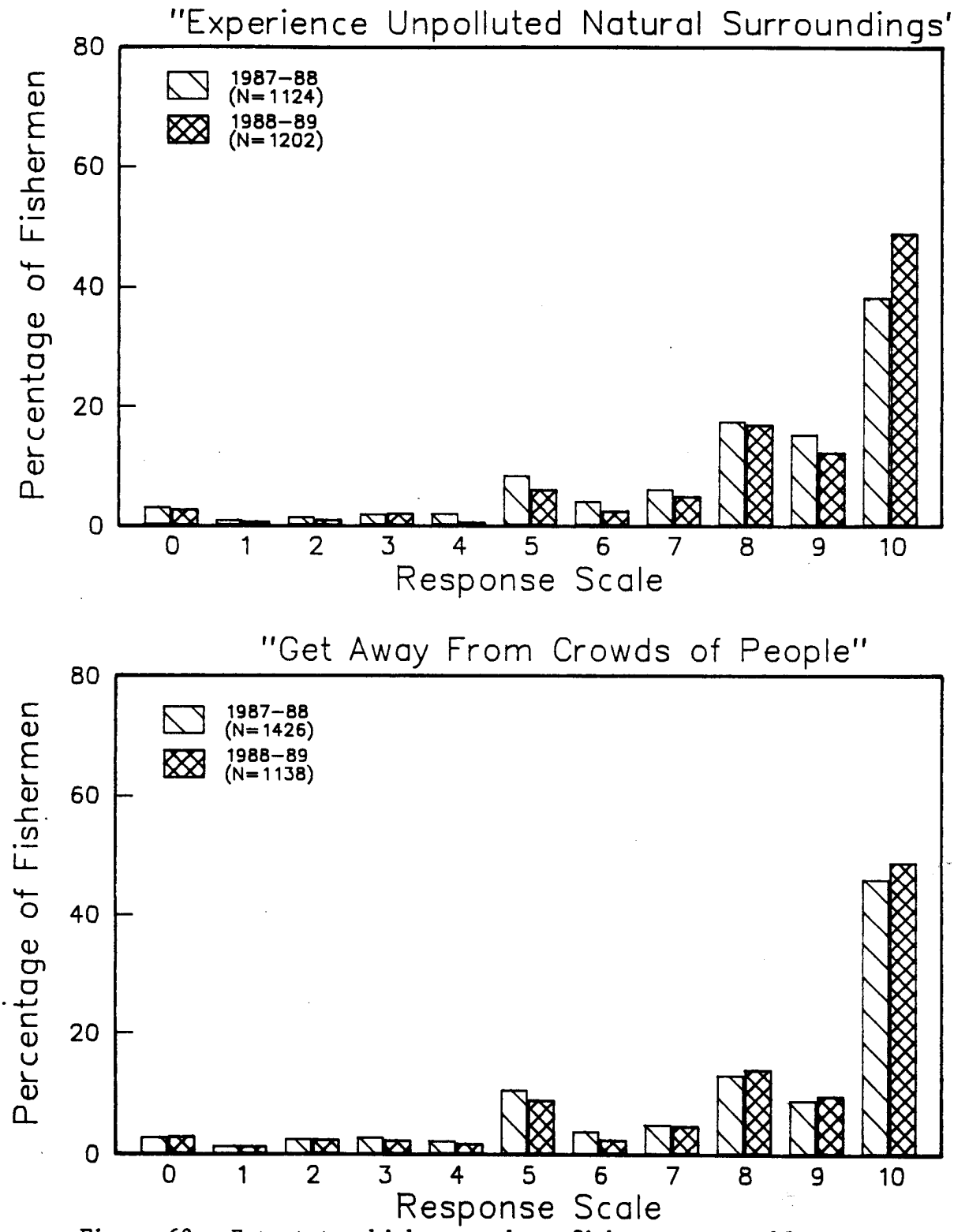


Figure 68. Extent to which sport-boat fishermen were able to "experience unpolluted natural surroundings" and "get away from crowds of people" during fishing trips along the Texas coast as indicated by post-trip interviews, May 1987-May 1989 (0 = "not at all"; 10 = "completely").

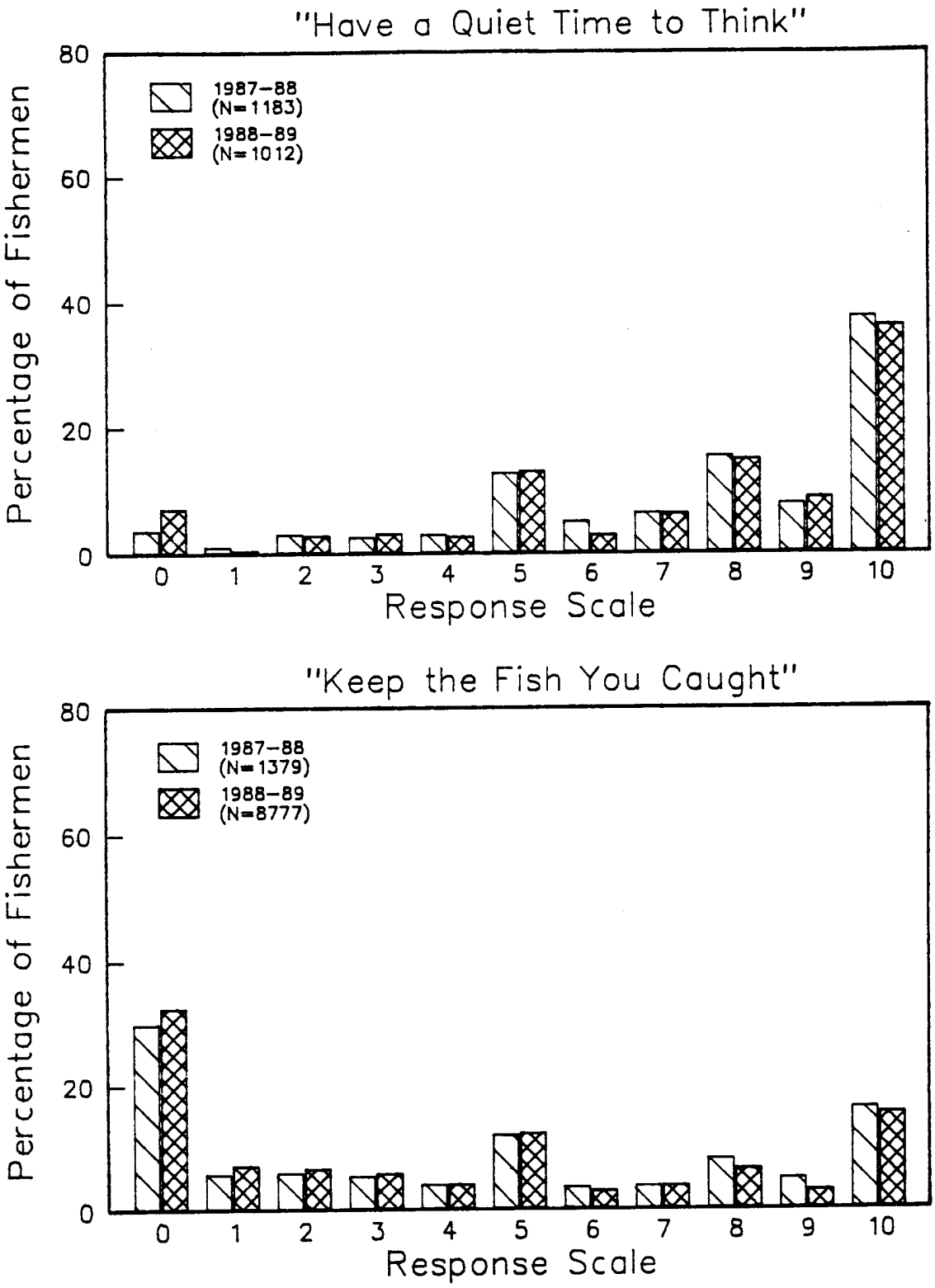


Figure 69. Extent to which sport-boat fishermen were able to "have a quiet time to think" and "keep the fish you caught" during fishing trips along the Texas coast as indicated by post-trip interviews, May 1987-May 1989 (0 = "not at all"; 10 = "completely").

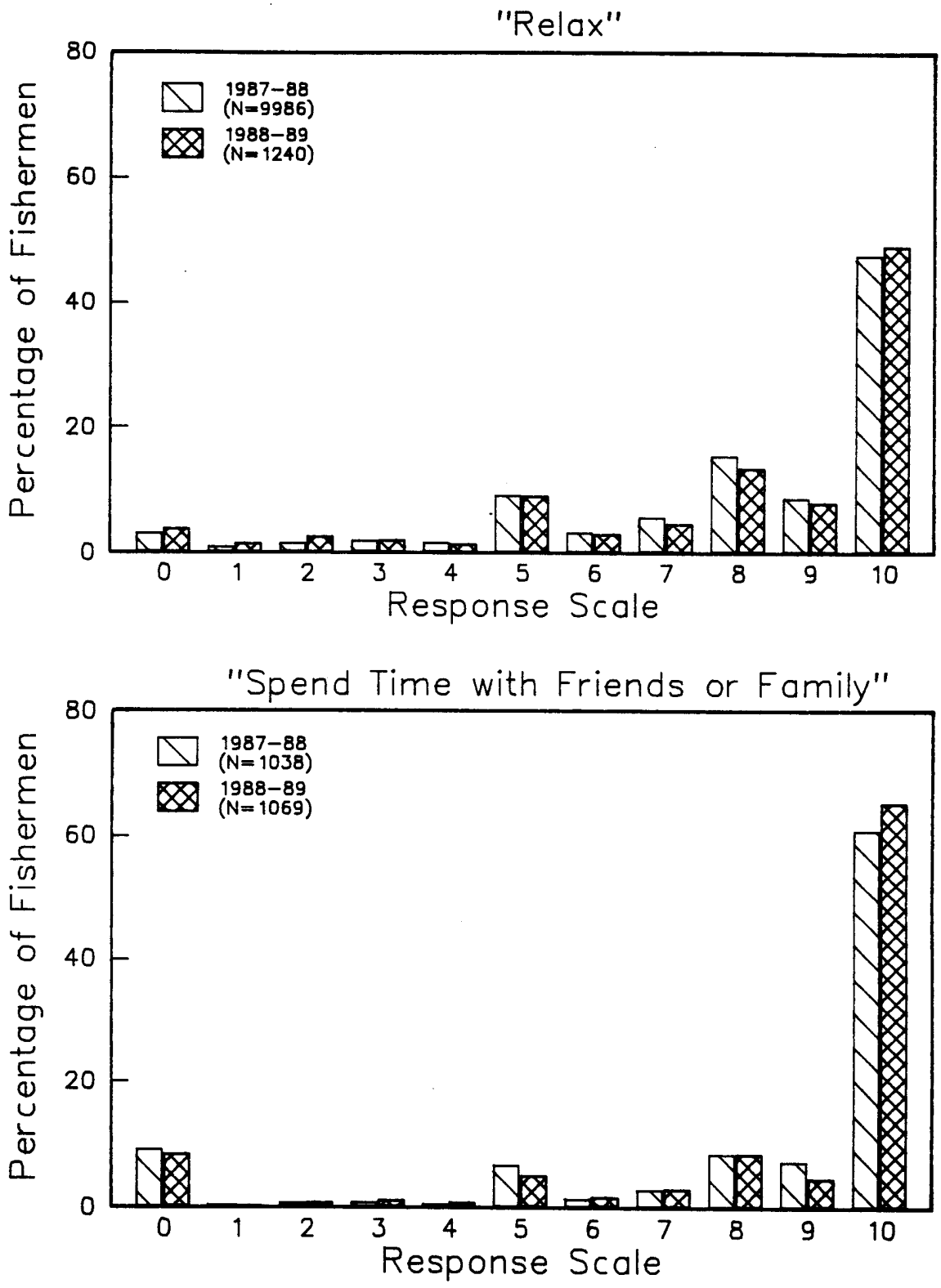


Figure 70. Extent to which sport-boat fishermen were able to "relax" and "spend time with friends or family" during fishing trips along the Texas coast as indicated by post-trip interviews, May 1987-May 1989 (0 = "not at all"; 10 = "completely").

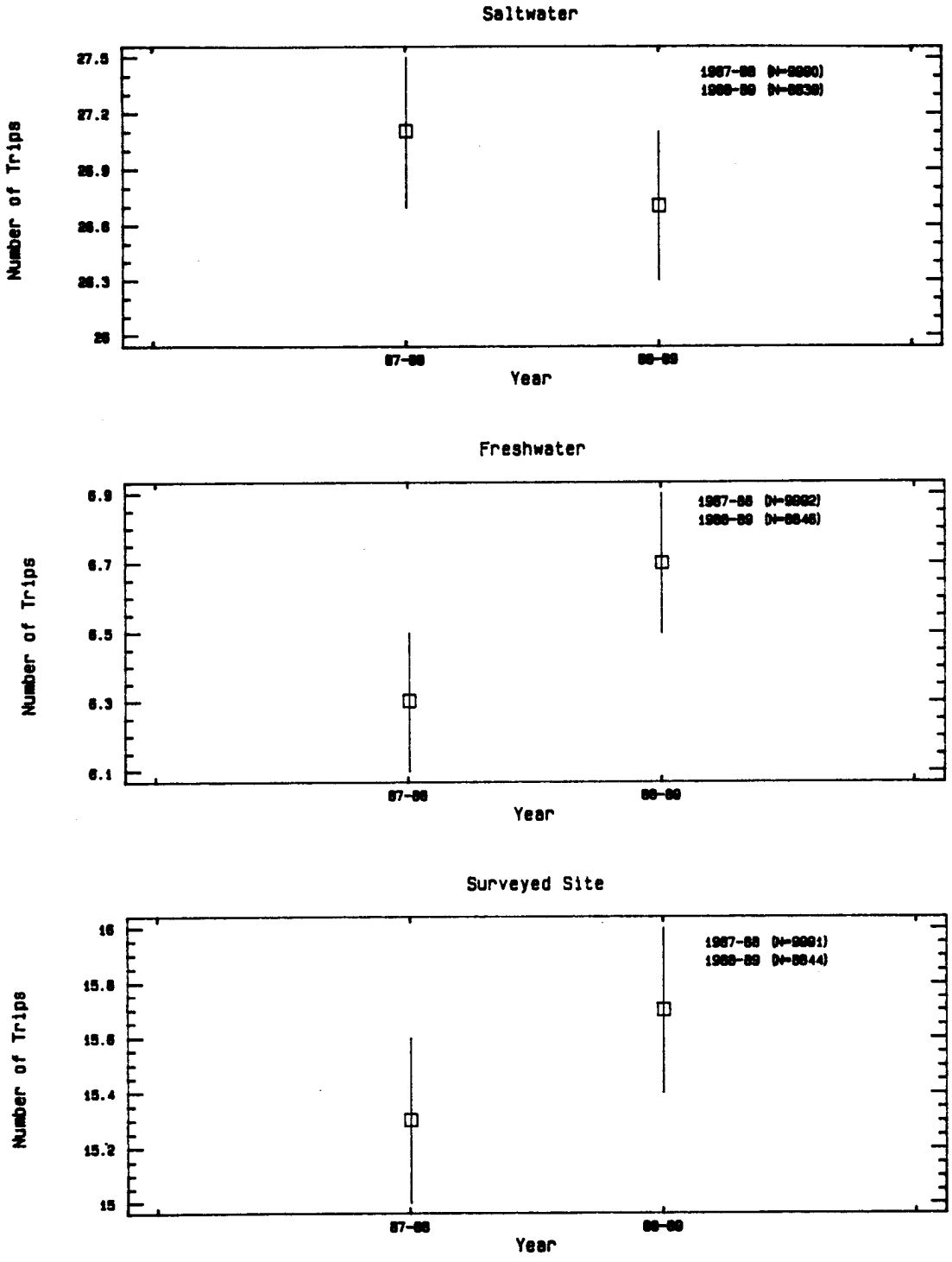


Figure 71. Number of fishing trips (± 1 SE) made to saltwater, freshwater and surveyed site in Texas by sport-boat fishermen during previous one-year period as indicated by post-trip interviews, May 1987-May 1989.

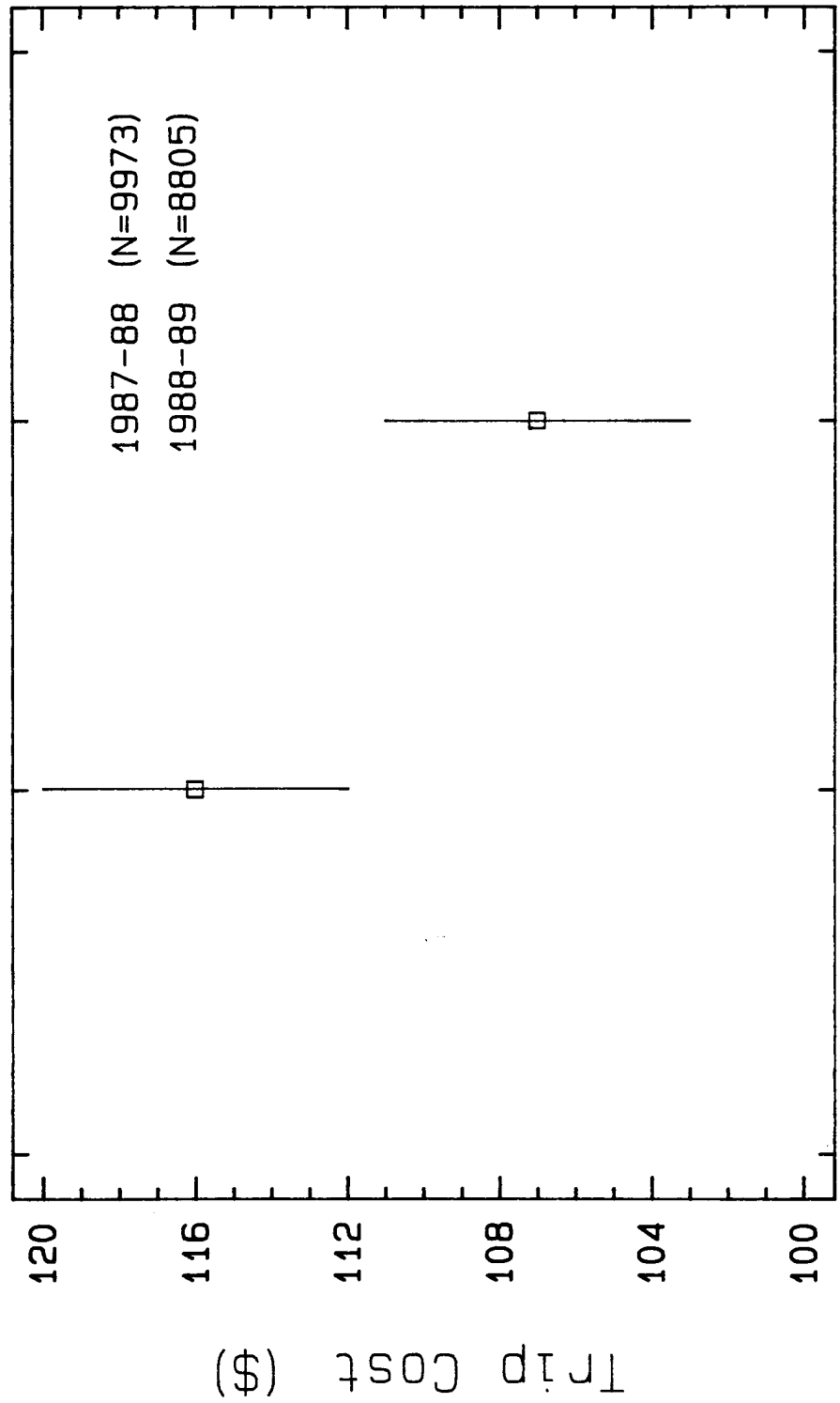


Figure 72. Trip costs of sport-boat fishermen along the Texas coast as indicated by post-trip interviews, May 1987-May 1989.

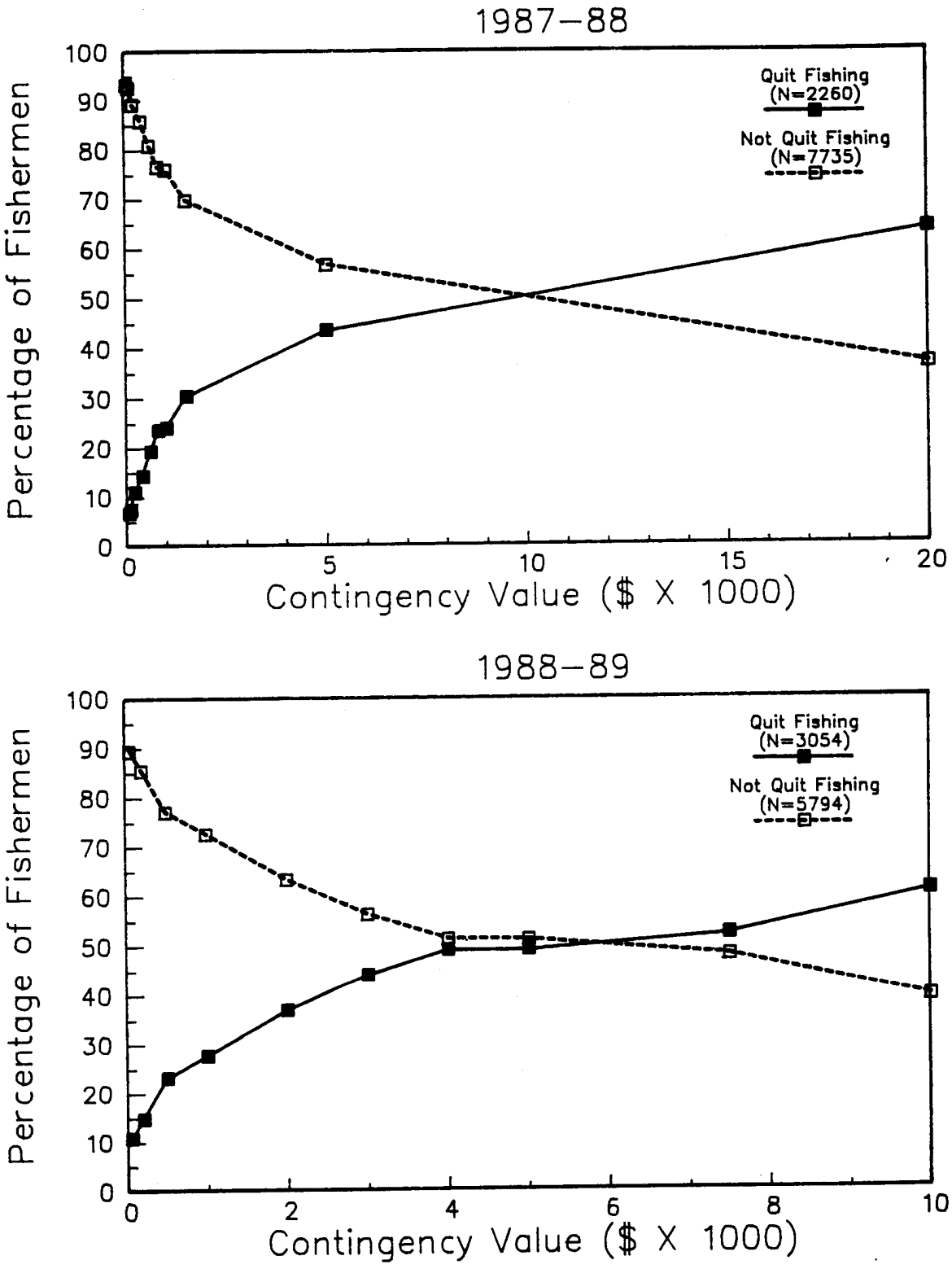


Figure 73. Contingency valuation of sport-boat fishermen along the Texas coast as indicated by post-trip interviews during May 1987-May 1988 and May 1988-May 1989.

PWD–RP–3400–356–4/91