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Management Data Series Number 94
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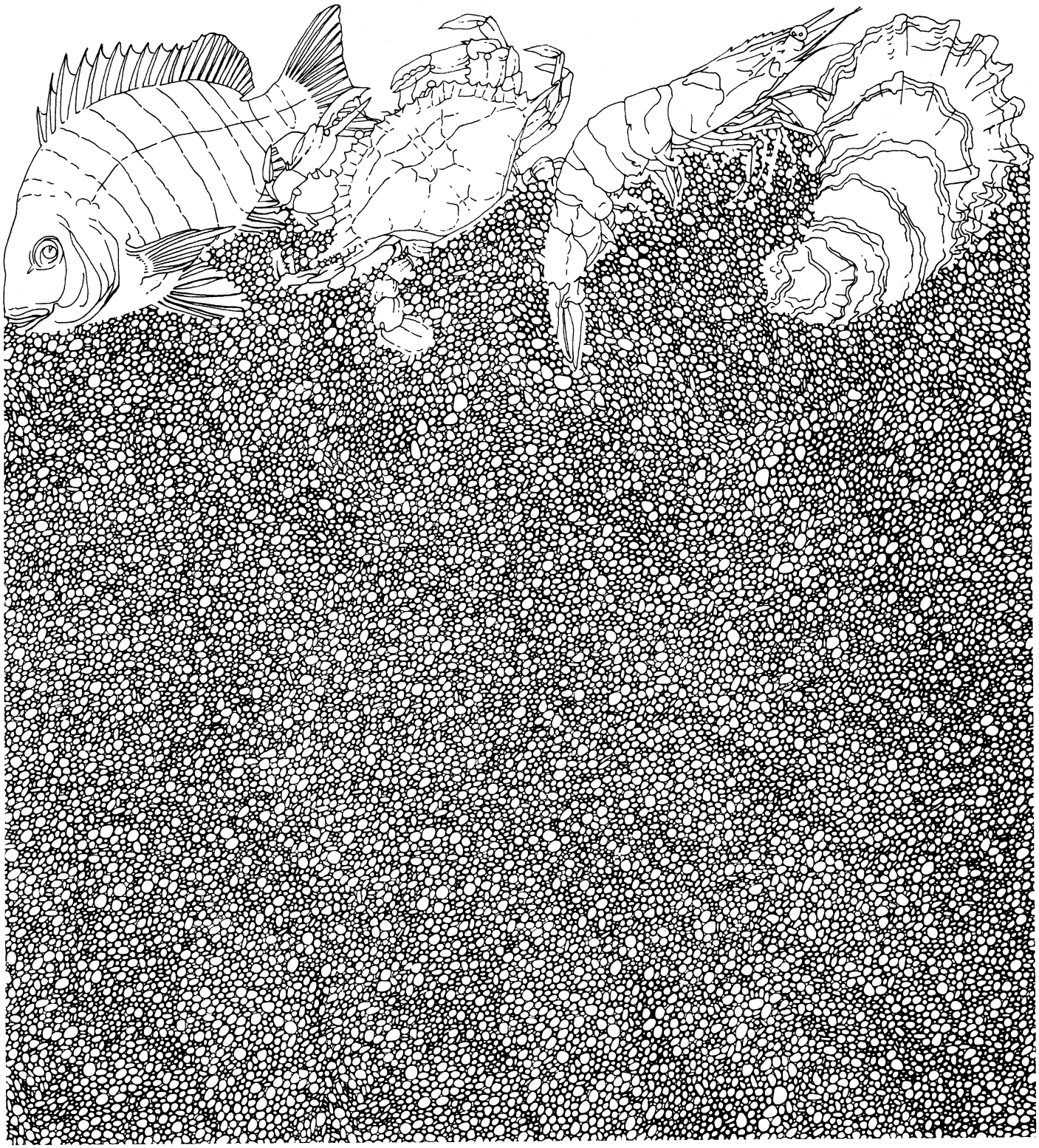

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ABSTRACT

The Texas Parks and Wildlife Department (TPWD) does not survey sport fishermen on holiday-related days (the day after Thanksgiving, the days before and after Christmas, and the day before the New Year), but assigns means for pressure and landings to those days based on their day type (weekend or weekday). Total winter sport-boat fishing activity (number of fishing interviews obtained) on weekend days, on weekdays and on four holiday-related days were compared using multiple regression analysis to see if the practice of assigning means to the holiday-related days based on their day type resulted in the most precise pressure estimates. Fishing activity during holiday-related days was as low or lower than weekday activity and was significantly lower than weekend activity. Therefore, for the purpose of estimating fishing activity for recreational landings, the day after Thanksgiving, the days before and after Christmas and the day before the New Year should be considered weekdays, regardless of actual day type. The variation in the number of angler interviews was a function of temperature, windspeed, and mean site pressure for weekend and weekday day types (measured activity at ramps from September 1974-September 1984). Fishing activity during holiday-related days was correlated with temperature and windspeed, but not correlated with mean site pressure.

INTRODUCTION

The Texas Parks and Wildlife Department (TPWD) has monitored sport-boat landings and pressure in the seven major bay systems of Texas since 1974 by intercepting anglers at boat ramps when they complete their fishing trips (Osburn and Ferguson 1985). Data are used to calculate mean daily fishing pressure and landings by day type (weekend or weekday) and season. Fishing pressure and landings are estimated by multiplying the respective mean daily statistics by the actual number of days in a day type and season. Day types are partitioned as weekday or weekend days because weekend pressure is greater than weekday pressure (Pinkas et al. 1968, Heffernan et al. 1976). Seasons are classified as a high-use season (15 May-20 November) and a low-use season (21 November-14 May) based on fishing pressure, landings, and catch rate analyses of sport-boat fishermen completing their fishing trips (McEachron et al. 1983).

Four holiday-related days (the day after Thanksgiving, the days before and after Christmas, and the day before the New Year) are designated as low-use season weekdays when they occur on weekdays for estimating total fishing pressure and harvest. These four days are classified as weekend days when they fall on weekends. However, due to the proximity of these days to a holiday, many sport-boat fishermen may utilize these days for fishing. Therefore, mean fishing pressure and landings during these holiday-related days may be more similar to weekend days than to weekdays even when they occur on weekdays.

The purpose of this study was to determine which day type category holiday-related days should be considered for calculating sport-boat fishing pressure and landings.

MATERIALS AND METHODS

Eight sport-boat fishing surveys were conducted on holiday-related days (the day after Thanksgiving, the days before and after Christmas and the day before the New Year) during 1982. These eight surveys occurred in five Texas bay systems (Galveston, Matagorda, San Antonio, Aransas and upper Laguna Madre, Fig. 1). All surveys were conducted using methods described by Heffernan et al. (1976) as modified by Green et al. (1978). Department personnel were stationed at randomly selected boat ramps from 1000 to 1800 hours. Interviewers recorded the total number of angler parties seen and fish retained by interviewed parties. Air temperature, windspeed, and precipitation were recorded at the beginning of each survey (1000 hours).

Total angler interviews conducted (Y) during each of the different surveys were compared by day type using a stepwise multiple regression analysis (SAS 1982). A regression analysis was used to increase the precision of the weekday versus holiday-related day and weekend versus holiday-related day comparisons by accounting for known weather effects on angler activity. Spiller et al. (In prep.) has demonstrated varying fishing activity associated with different temperatures, windspeeds, and the occurrence of precipitation.

The full model used for the analysis was:

$$\hat{Y} = B_o + B_1X_1 + B_2X_2 + B_3X_3 + B_4X_4 + B_5Z_1 + B_6Z_2 + B_7Z_1X_1 + B_8Z_2X_1 + B_9Z_1X_2 + B_{10}Z_2X_2 + B_{11}Z_1X_3 + B_{12}Z_2X_3 + B_{13}Z_1X_4 + B_{14}Z_2X_4,$$

where X_1 = index of mean site pressure,
X_2 = categorical variable for temperature,
X_3 = categorical variable for windspeed,
X_4 = categorical variable for rain,
Z_1 = categorical variable used to compare weekend days with holiday-related days,
Z_2 = categorical variable used to compare weekdays with holiday-related days.

The index of relative site pressure for each site ($\hat{P}_j$) was computed as relative fishing activity (mean number of fishing parties/day/site) observed at each ramp compared to the same activity observed at all other ramps (September 1974-September 1984). The relative fishing activity index was calculated using:

$$\hat{P}_j = \frac{1}{2} \sum_{i=1}^{2} \left[\left(\frac{\sum_{i=1}^{n_{ij}} I_{ijl}}{n_{ij}} \right) \left(\sum_{j=1}^{k} \frac{\sum_{i=1}^{n_{ij}} I_{ijl}}{n_{ij}} \right)^{-1} \right]$$

where,

i = day type; 1=weekend, 2=weekday,
j = the jth ramp,
k = total number of boat ramps,
l = the lth survey-day,
n_{ij} = total survey-days at jth ramp within the ith day type,
I_{ijl} = total fishing parties observed at the jth ramp within the ith day type on the lth survey day.

This was necessary to remove from the index any information about the day type on which each survey had been conducted. The categorical variable for temperature (X_2) was assigned a value of zero for temperatures < 10 C and a value of one for temperatures ≥ 10 C. The categorical variable for windspeed (X_3) was assigned a value of zero for windspeeds > 45 kmh and a value of one for windspeeds ≤ 45 kmh. The categorical variable for rain was a value of two for no rain and a value of one for rain. These values were based on a previous analysis used to evaluate the probability of seeing two or more interviews on a given day (Spiller et al., In prep.). Standard errors were calculated for the mean of each variable.

The orthogonal indicator variables (Z_1 and Z_2) were computed according to Draper and Smith (1981) to evaluate differences among day types in the following manner:

$$(Z_1, Z_2) = \frac{-n_3}{\sqrt{n_1 n_3 (n_1 + n_3)}}, 0 \qquad \text{for weekend days,}$$

$$0, \frac{-n_3}{\sqrt{n_2 n_3 (n_2 + n_3)}} \qquad \text{for weekdays,}$$

$$\frac{n_1}{\sqrt{n_1 n_3 (n_1 + n_3)}}, \frac{n_2}{\sqrt{n_2 n_3 (n_2 + n_3)}} \qquad \text{for holiday-related days,}$$

n_1 = number of weekend days,
n_2 = number of weekdays,
n_3 = number of holiday-related days.

Final variable selection for the model was accomplished using the MAXR selection option within the stepwise procedure of SAS (1982). For inclusion in the final model, all variables were required to have a significant t-value ($P \leq 0.05$). The point at which the inclusion of another variable caused the t-value for any variable to become non-significant (P 0.05) was used to stop the selection process. This model required the dependent variable (number of interviews conducted) and the independent variable (relative site pressure) to be transformed to $\log_{10} (X + 1)$ to obtain more equal variances and to adjust for non-linearity. Slopes and intercepts for significantly different regressions were adjusted for unique day type properties represented by the categorical variables using techniques described by Neter et al. (1985).

RESULTS

Fishing activity during holiday-related days was lower than weekend days or weekdays. There were six statistically significant variables (Table 1). Three of the four primary factors considered (relative site pressure, temperature, and windspeed) were significant. There were also three significant interaction terms which indicated differences among the slopes of the relative site pressure and temperature variables for the three day types. The adjusted holiday-related slope differed most and showed no relationship between relative site pressure and number of interviews conducted (Table 2). The R^2 for this regression equation was 82%. The R^2 was computed with respect to the x-axis since the intercept was not significant. Fishing activity (no. of angler interviews) for weekend days and weekdays strongly correlated with relative site pressure. The number of interviews collected on a holiday-related day and a weekend day were affected more by temperature than were weekdays. High windspeeds ($\geq$ 45 kmh) consistently decreased activity during all day types.

The adjusted slopes predicted the lowest number of interviews on holiday-related days (zero to three interviews per day based on back transformed values, Fig. 2). Weekday interviews ranged from 1 to 18 (Fig. 3) and weekend interviews ranged from 1 to 25 (Fig. 4). An examination of the residuals from the model using transformed data showed linear models were appropriate for weekdays or holiday-related days (Figures 5-6), however, the weekend residuals indicated a non-linear condition may exist (Fig. 7).

The mean total anglers interviewed each day were 3.3 ± 1.3, 5.8 ± 0.5 and 9.3 ± 1.4 for holiday-related days, weekdays, and weekend days, respectively (Table 3). Mean total fish seen was 6.8 ± 6.4 for holiday-related days, whereas, 39.2 ± 6.4 and 29.5 ± 7.7 fish were seen for weekdays and weekend days, respectively. Environmental conditions varied little among the three day types. Holiday-related days had a mean temperature of 12.8 ± 1.5 C while weekdays and weekends had mean temperatures of 17.2 ± 0.5 and 15.6 ± 0.8 C, respectively. Mean windspeeds were 27.8 ± 6.8, 22.3 ± 10.1 and 25.0 ± 8.9 kmh for holiday-related days, weekdays, and weekend days, respectively. Rain occurred within every day type category. The relative activity from all sites visited within the three different day types was similar; mean relative site pressure indices were 0.009 ± 0.003, 0.010 ± 0.001 and 0.009 ± 0.001 for weekend, weekday, and holiday-related days, respectively.

DISCUSSION

Historically, TPWD has treated holidays as weekend days in creel surveys (Brown 1971). Saltwater fishing activity on the day after Thanksgiving, the day before and after Christmas and the day before the New Year was much lower than normal weekend activity. The low number of fishermen seen on holiday-related days makes these days more like weekdays than like weekend days. Consequently, we recommend that TPWD consider all winter holiday-related days to be weekdays, regardless of the actual day of the week on which they fall, when estimating saltwater recreational landings. We further suggest that data be collected on Thanksgiving, Christmas and the New Year; it would seem unlikely that fishing activity on these holidays would be different from that observed on days before and after. These days may have very low fishing activity as well.

Assuming winter holidays and days before and/or after should be considered more like weekdays than weekend days, the 1982 low-use weekend recreational landings were overestimated by 8%. These weekend landings were based on a 52-weekend day extension when it should have been based on a 48-day extension. There were four weekend days in 1982 that should have been considered weekdays. They were Thanksgiving, the day before Christmas, Christmas and the day before the New Year. Since the day before Christmas and the day before the New Year was a Sunday, they were counted as weekend days. The day after Thanksgiving is always a weekday and the day after Christmas and before the New Year has always been considered the day type on which they actually occurred. Fortunately, the error caused in the total landings by mistyping a day is a compensating error. Reducing or

increasing the number of days in the landings extension for weekends will cause a compensating increase or decrease in the number of days in weekdays. Therefore, low-use weekday landings should have been based on a 127-day extension instead of a 123-day extension. A total landings based on 48 weekend days and 127 weekdays would have been 474,139 fish compared to the original estimate of 476,682 fish (TPWD unpublished data). This shows that total annual landings were only overestimated by 0.5%.

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Table 1. Regression coefficients (B), standard errors (SE), t-value and probability that a greater t-value would be observed for the model used to predict fishing activity.

Variable[a]	B	SE	t	Probability $\geq \lvert t \rvert$
Relative site pressure	74.55	7.08	10.52	0.01
Temperature	0.19	0.07	2.57	0.01
Windspeed	0.18	0.07	2.44	0.02
Z_2[a] • Mean site pressure	-223.50	91.61	-2.44	0.02
Z_1 • temperature	-3.28	0.91	-3.60	0.01
Z_2 • temperature	3.85	1.00	3.87	0.01

[a]Categorical variables (Z_1, Z_2) used to test differences among the different day types on which surveys were conducted.

Table 2. Adjusted regression coefficients for each day type.

Day type	Pressure	Temperature	Windspeed
Weekend	74.55	0.34	0.18
Holiday related	-2.13	0.42	0.18
Weekday	79.31	0.11	0.18

Table 3. Selected statistics (mean ± 1 SE) from the low-use 1982-83 TPWD Creel Survey (McEachron and Green 1984) by day type (numbers in parentheses represent number of survey days of each type).

Variable	Weekend (60)		(Weekend 129)		Holiday-related (8)	
	Mean	SE	Mean	SE	Mean	SE
Total angler (no.)	9.283	1.419	5.798	0.550	3.375	1.281
Total fish (no.)	29.500	7.726	39.155	6.385	6.875	6.458
Temperature (C)	15.616	0.798	17.217	0.465	12.750	1.485
Windspeed (kmh)	24.997	1.152	22.329	0.887	27.784	2.413
Rain index	1.900	0.039	1.937	0.021	1.625	0.183
Relative site pressure index	0.009	0.001	0.010	0.001	0.009	0.004

Figure 1. Major bay systems on the Texas coast.

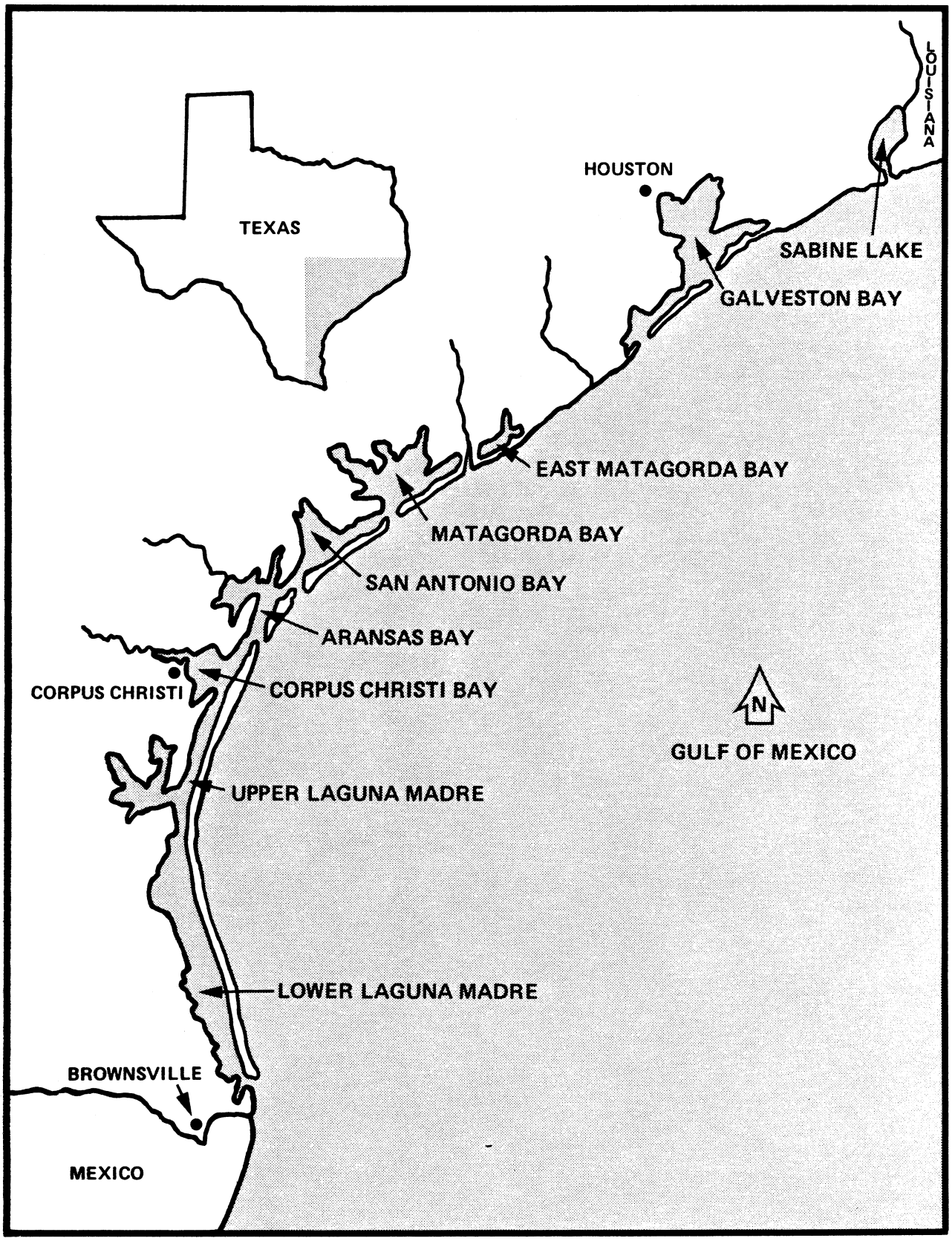
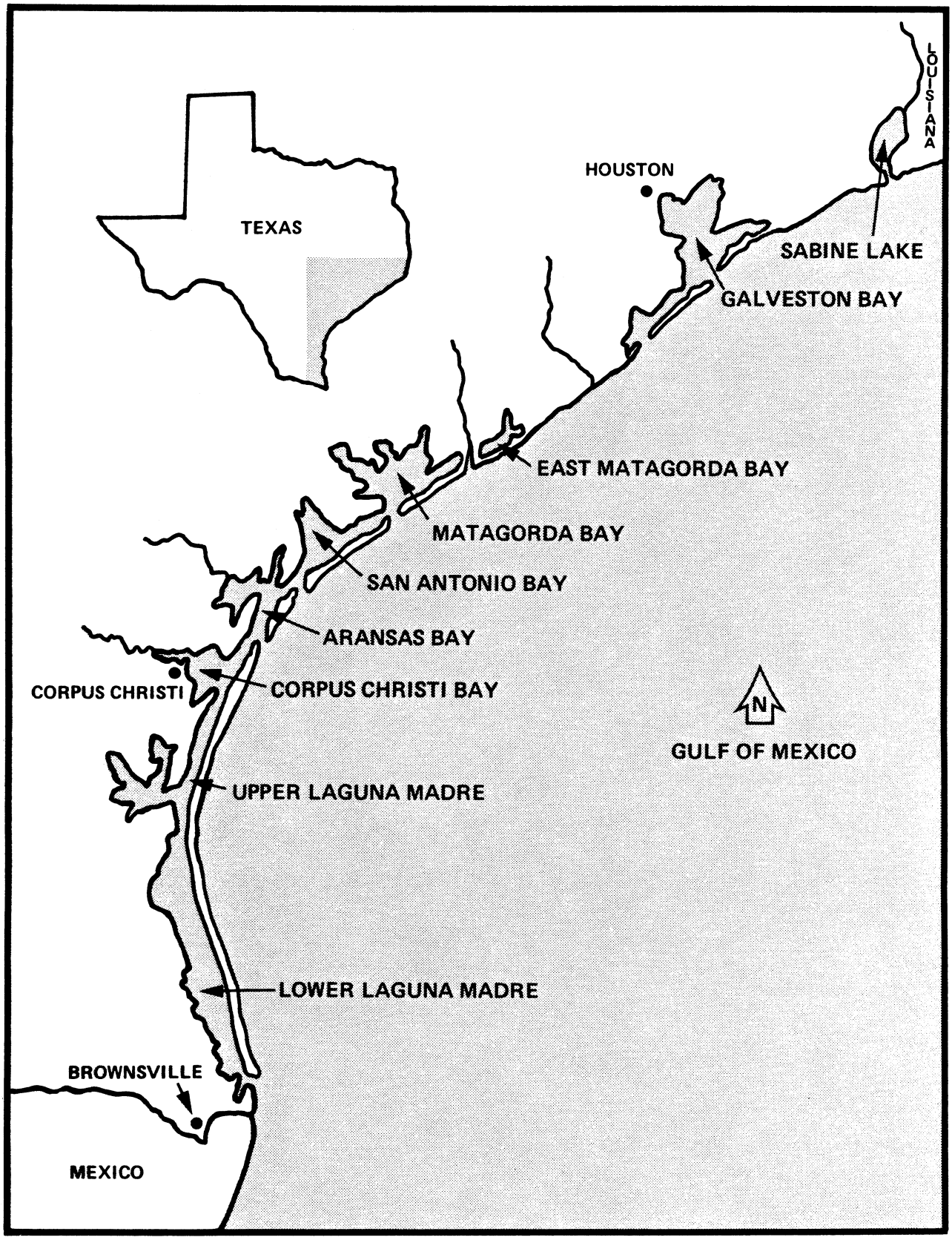

LOUISIANA
HOUSTON
TEXAS
SABINE LAKE
GALVESTON BAY
EAST MATAGORDA BAY
MATAGORDA BAY
SAN ANTONIO BAY
ARANSAS BAY
CORPUS CHRISTI
CORPUS CHRISTI BAY
N
GULF OF MEXICO
UPPER LAGUNA MADRE
LOWER LAGUNA MADRE
BROWNSVILLE
MEXICO

Figure 2. Comparison of predicted (*) and observed (o) values for holiday-related days from the predictive fishing activity equation developed for weekend days, holiday-related days, and weekend days.


LOUISIANA
HOUSTON
TEXAS
SABINE LAKE
GALVESTON BAY
EAST MATAGORDA BAY
MATAGORDA BAY
SAN ANTONIO BAY
ARANSAS BAY
CORPUS CHRISTI
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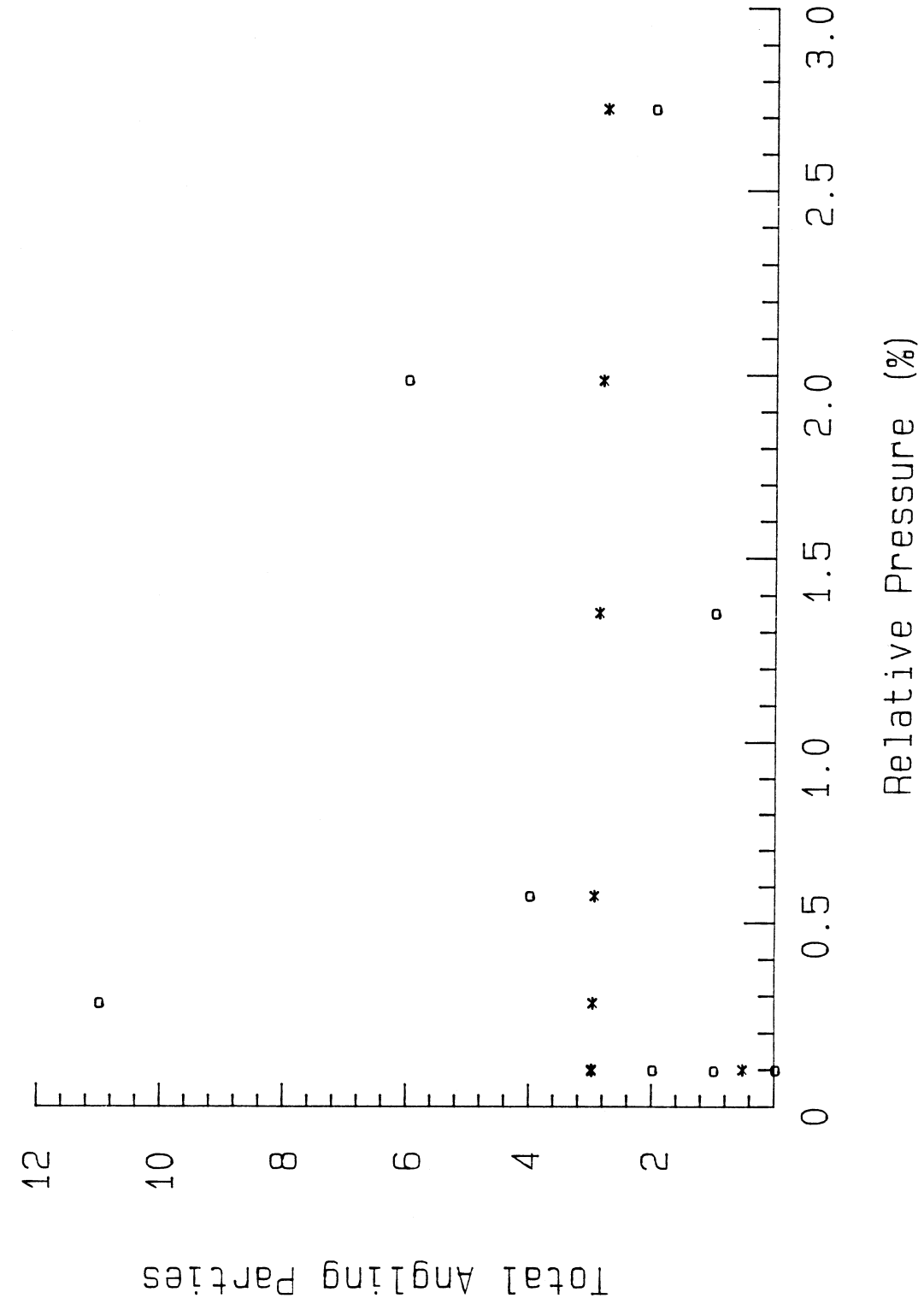

Total Angling Parties
12
10
8
6
4
2
0
0.5
1.0
1.5
2.0
2.5
3.0
Relative Pressure (%)

Figure 3. Comparison of predicted (*) and observed (o) values for weekdays from the predictive fishing activity equation developed for weekend days, holiday-related days, and weekend days.

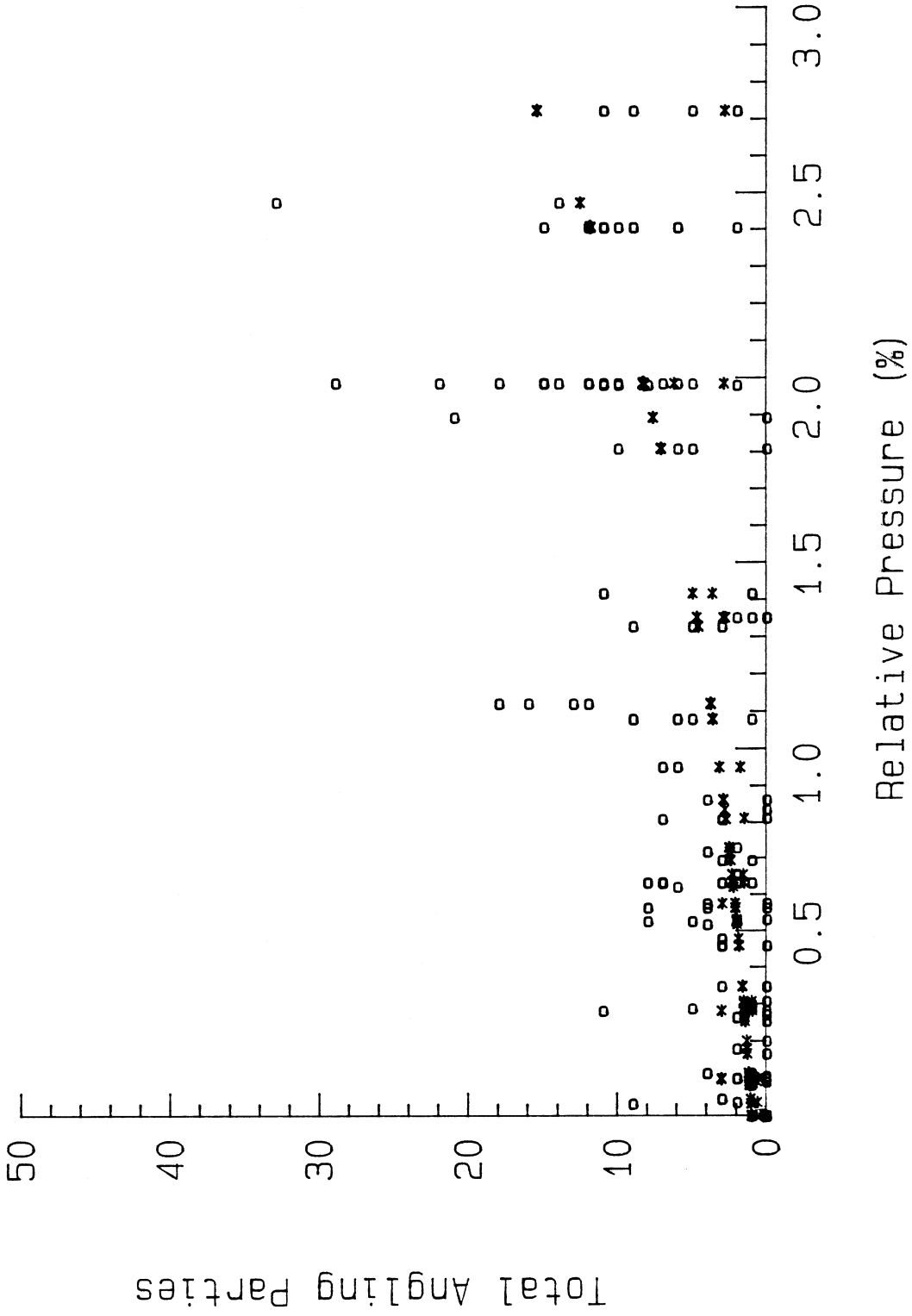

Total Angling Parties
0
10
20
30
40
50
0.5
1.0
1.5
2.0
2.5
3.0
Relative Pressure (%)

Figure 4. Comparison of predicted (*) and observed (o) values for weekend days from the predictive fishing activity equation developed for weekend days, holiday-related days, and weekdays.

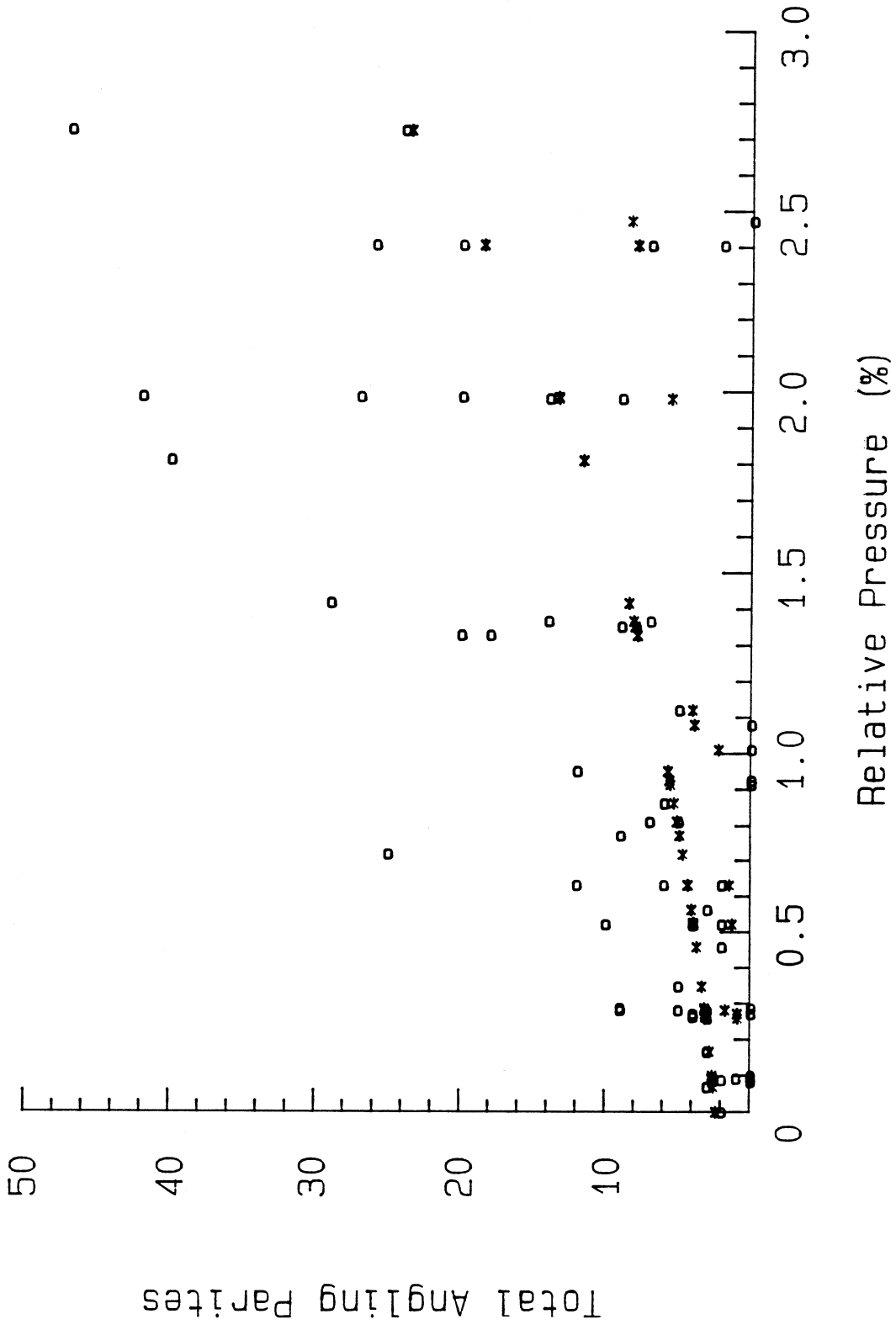

Total Angling Parites
50
40
30
20
10
0
0.5
1.0
1.5
2.0
2.5
3.0
Relative Pressure (%)

Figure 5. Comparison of residuals obtained for weekdays from the fishing activity predictive equation developed for weekend days, holiday-related days, and weekdays.

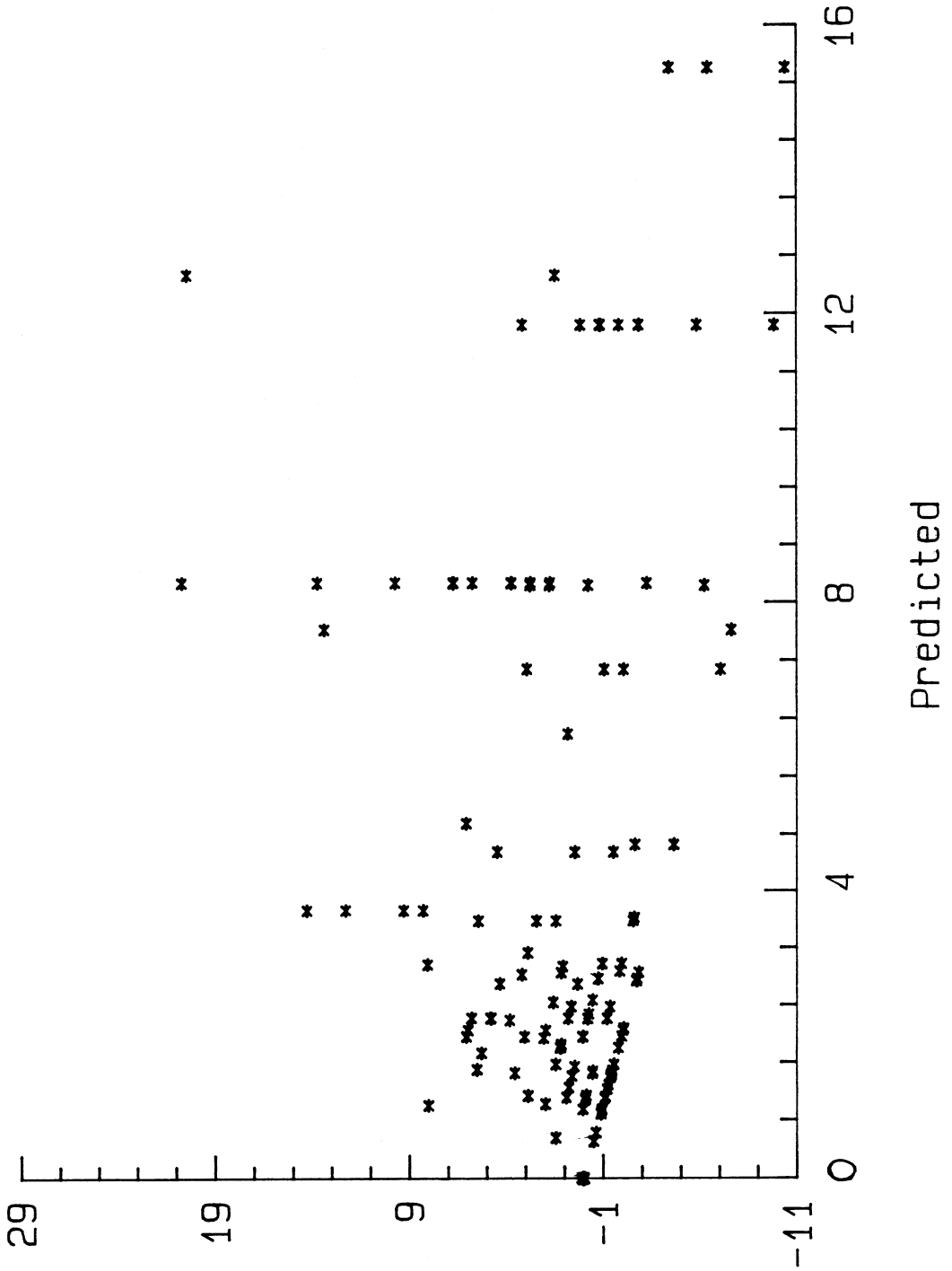

Residuals
29
19
9
-1
-11
0
4
8
12
16
Predicted

Figure 6. Comparison of residuals obtained for holiday-related days from the fishing activity predictive equation developed for weekend days, holiday-related days, and weekdays.

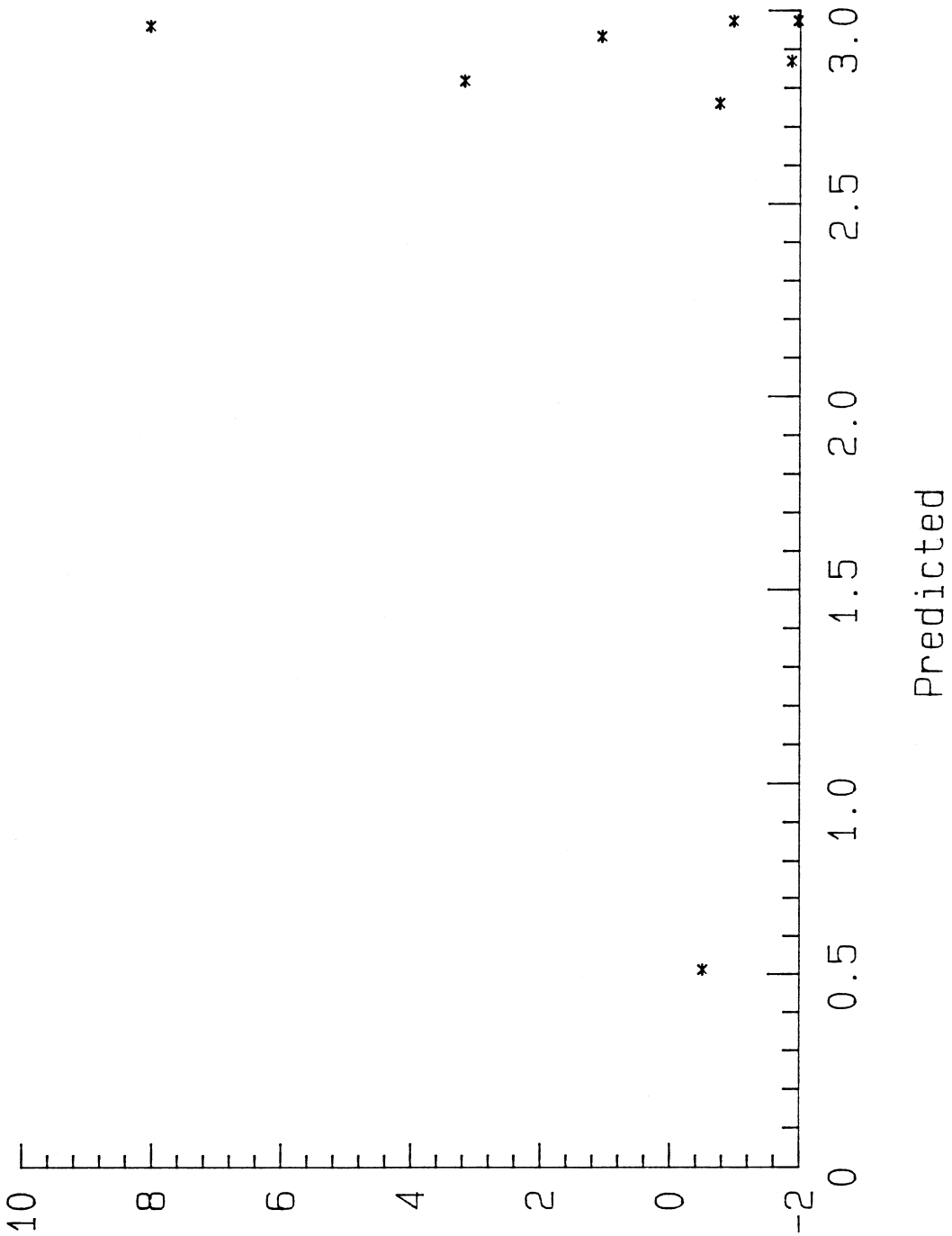
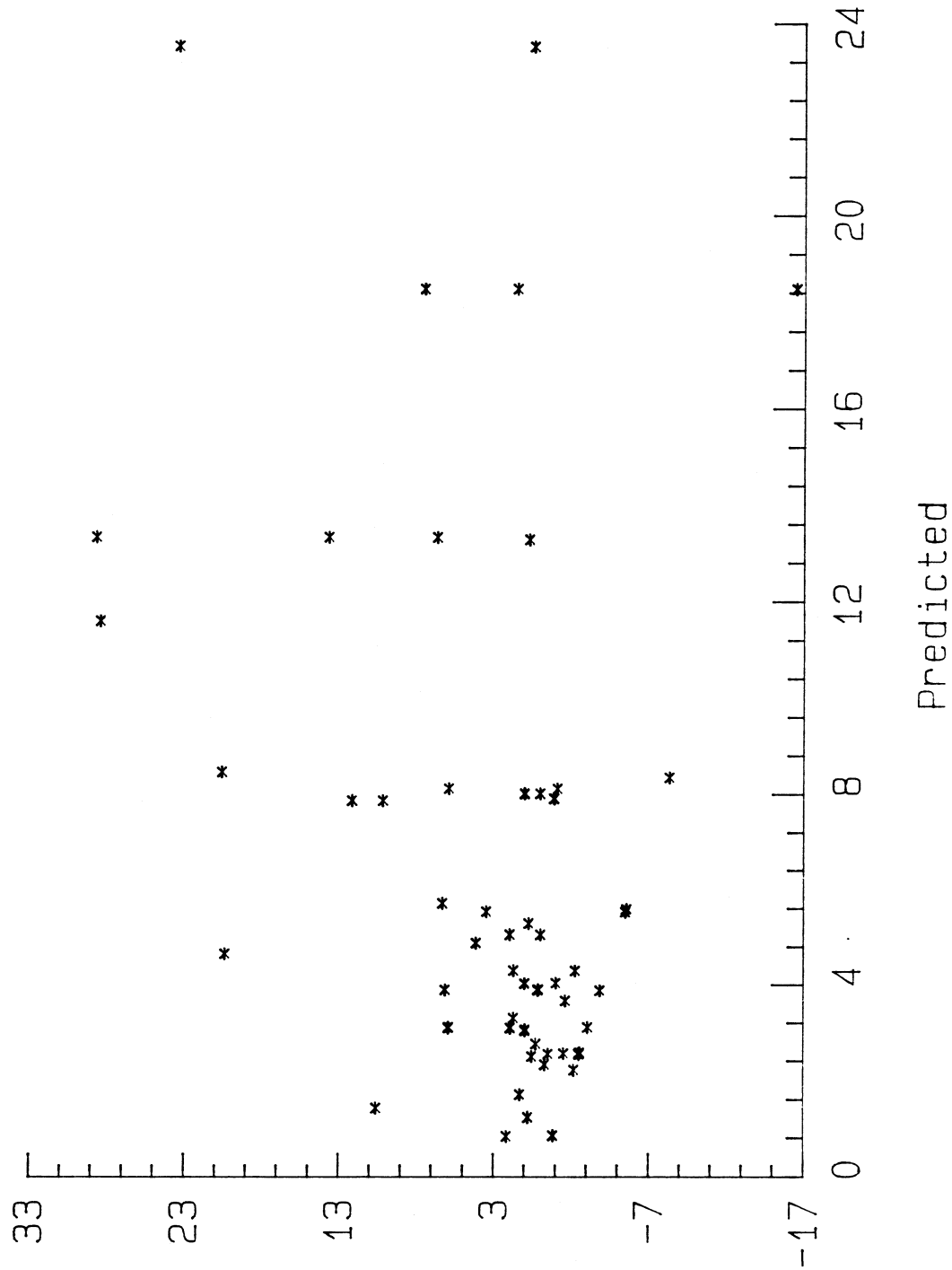

Residual
10
8
6
4
2
0
-2
0
0.5
1.0
1.5
2.0
2.5
3.0
Predicted

Figure 7. Comparison of residuals obtained for weekend days from the fishing activity predictive equation developed for weekend days, holiday-related days, and weekdays.


Residuals
33
23
13
3
-7
-17
0
4
8
12
16
20
24
Predicted