A Field Technique for Monitoring the Marine Recreational Fishery in Texas

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ABSTRACT

Since 1974 the Texas Parks and Wildlife Department has maintained a monitoring program to develop long-term trend information on species composition, size, number landed and catch per unit effort of finfish caught in Texas bays by recreational anglers. In 1987 the agency began to collect social and economic information from anglers including their motivations, extent of satisfaction with trip, species targeted, frequency of saltwater fishing, zip code, trip-related expenditures and willingness to pay.

The technique uses a stratified proportional sampling strategy. The relative probability of sampling is derived from automobile rove counts of empty boat trailers and wet slips at inventoried boat access sites on the Texas coast. The objective of each roving count is to assess the relative distribution of fishing pressure among all boat access sites. The relative distribution of fishing pressure is used to assure that sites with higher fishing pressure are surveyed more often. With this technique, landing estimates are considered to be more precise than those using strictly random sampling schemes. Data are collected through on-site interviews of fishermen completing their boat trip. Survey efforts have focused on sport boat anglers since 1980 because previous results have shown they account for two-thirds of the finfish landings.

In this paper, we will describe how the monitoring program operates with particular attention given to sampling design, field logistics, data collection and harvest estimation procedures for understanding trends in the fishery. We will also discuss the rationale for and the contribution of the social and economic questions.

An effort will be made to focus on those aspects of the monitoring technique that are transportable elsewhere in the Gulf and Caribbean region. Practical concerns of manpower and cost will also be discussed.

INTRODUCTION

Marine recreational fishing in the Gulf and Caribbean region is now recognized as being an activity of considerable importance not only economically and biologically but also socially. In 1985 over 6 million people participated in marine recreational fishing in the Gulf (U.S. Gulf coastal states)

and Caribbean (U.S. Virgin Islands and Puerto Rico) (Schmied and Burgess, 1987). Recreational anglers in the Gulf in 1985 caught nearly 143 million fish and landed 23% of these. Catch statistics for 1979 for the Caribbean indicate over 3 million fish caught with nearly 60% landed.

The economic impacts of marine recreational fishing in the Caribbean have not been well quantified, and in the Gulf, a wide range of values have been presented (Schmied and Burgess, 1987). However, even conservative estimates place direct sales related to marine recreational fishing in the Gulf at over $1 billion with millions of dollars in indirect economic impacts and thousands of employment person-years generated.

The social and personal benefits of fishing have received considerably less attention than biological and economic aspects. The best available studies, however, indicate that the social aspects of fishing are of great importance. Gulf marine anglers reported that relaxation was the single major purpose of their fishing trips (KCA, 1983). By an overwhelming majority, fishing was noted as an activity which involved family and friends.

The recreational fishery in Texas is a diverse composite of fishermen and fishing areas. Along the 360 linear miles of the Texas coast are situated a series of 8 major bay systems (Figure 1) surrounded by 2500 miles of shoreline. These bay systems and the Gulf are distinguished by a multitude of sport fishing access points. The variety of anglers utilizing these recreational fishing opportunities include private boat fishermen launching at boat ramps, marinas, or private residences; tournament boat fishermen; charter fishermen on large headboats and on small party boats; wade/bank fishermen; and pier and jetty fishermen. There are an estimated 1.6 million saltwater anglers in Texas who make over 7 million saltwater fishing trips each year. Approximately 2 million of these trips involve private fishing boats (Osburn, 1986).

This paper describes the field survey technique used to monitor the biological, economic and social aspects of the marine recreational fishery in Texas.

MANAGEMENT PROGRAMS

Texas has long recognized the importance of marine recreational fishing within the 4 million acres of marine waters under its jurisdiction. This recognition has lead to the development of monitoring programs designed to assist state fishery managers in assessing the needs for and impacts of fishery regulations. The goal of these regulations is to provide maximum economic benefits to the people of Texas while protecting the resources. To achieve this goal, Texas has taken an aggressive role in collecting both fishery-dependent and fishery-independent data.

Long-term abundance and stability of any fishery stock is best monitored using fishery-independent sampling techniques with standardized equipment and

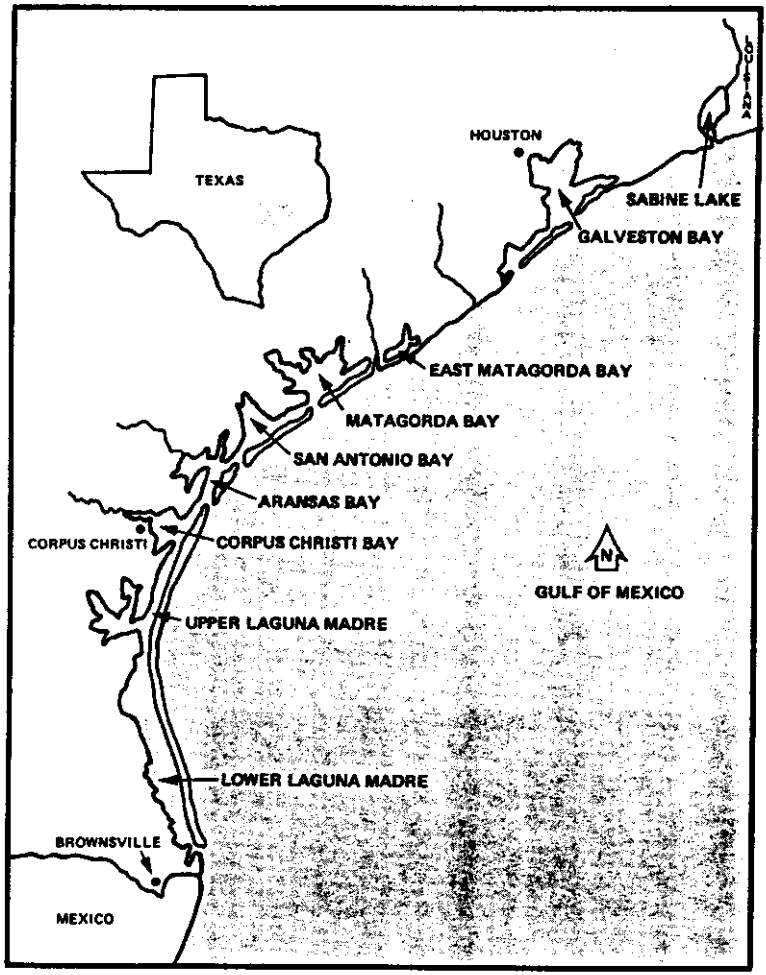

Figure 1. Bay systems on the Texas coast.

procedures to minimize bias. In Texas, annual sampling programs are conducted coastwide using gill nets, bag seines, trawls and oyster dredges. These data can indicate the need to regulate the fishing mortality of an exploited stock. However, to formulate the specific regulation needed and to assess over time whether that regulation produced the intended result requires fishery-dependent data collected on all major user groups.

With increasing demands on limited fishery resources, fishery managers are confronted with conflicts over utilization of these resources among and within the user groups. Faced with the need to make such allocation decisions, and with optimum yield from the resource as a goal (Radovich, 1975), it becomes critical for the managers to know the historical and current trends in fishing pressure and landings as well as the social and economic characteristics of each user group.

FISHERY MONITORING TECHNIQUES

A variety of techniques are available to document facts about marine recreational anglers, including license sales, telephone surveys, mail surveys, aerial boat counts and on-site creel interviews. All of these techniques have been employed by Texas, but by far the most comprehensive data collection program on marine recreational fishing involves on-site interviews of fishermen as they complete their fishing trip. On-site interviews have the advantage of allowing the collection of trip-specific biological, economic and social data while minimizing time-induced recall bias from fishermen. Observed rather than self-reported data can be gathered on landed organisms, thus permitting accurate species and sex identification, length and weight measurements, tag recoveries, and the collection of other desirable life-history related parameters. In addition, interview questions can be rapidly modified, if need be, to provide real-time feedback on management-related issues.

CREEL SURVEY PROGRAM

The Texas Parks and Wildlife Department has monitored marine recreational fishing annually with an on-site interview creel survey program since 1974 (Hefferman and Green, 1977; Osburn, 1986; Osburn and Ferguson, 1987). The original 1974 creel surveys included on-site interviews of shorebased (wade/bank and lighted pier) as well as sport boat anglers. These data, a repeat of the same study in 1979-1980 (McEachron *et al.*, 1981) and a survey of Gulf piers and jetties (McEachron, 1980) demonstrated that sport boat anglers accounted for two-thirds of the overall finfish landings in Texas. To reduce sampling costs while maintaining a high level of harvest estimate precision, our creel survey efforts were stratified to monitor sport boat anglers annually while repeating the survey of shorebased anglers once every 10 years. Even though our creel surveys now target sport boat anglers, we are able to estimate the total

annual recreational finfish landings from multiple regression equations which use variables collected from sport boat anglers (Osburn and Ferguson, 1985).

Currently, 1.014 creel surveys are conducted each year at sport boat access sites throughout the 8 major bay systems on the texas coast (Figure 1). In addition, 16 roving count surveys of all boat access sites in each bay system are conducted annually. The objective of each roving count is to assess the relative distribution of daily fishing pressure among all the boat access sites. Roves are conducted by automobile in a 3 to 4-hour period to instantaneously count the number of empty boat trailers or empty but rented wet slips at each site throughout a bay system. Boat access sites include boat ramps, marinas with wet slips and other public launching areas. Boats launching from private residences are not captured in our survey; however, based on mail survey data (Ferguson and Green, 1987), at least 78% of all saltwater sport boat fishing trips originate from boat access sites currently surveyed by the TPWD creel program. There are currently over 300 boat access sites coastwide which are continuously inventoried and surveyed each year by a staff of 18 biologists and technicians.

Biologist and technicians make maximum use of their time while conducting interviews by recording as much data as possible about every boating party. Harvest information recorded on standardized data sheets for each party interviewed includes the boat registration number, time of the interview, total length of the boat trip, the number of persons in the party and their county or state of residence, the specific activity in which the party was engaged (*e.g.*, fishing, sailing, etc.), the location within each bay system where the majority of the activity took place, the location of their empty boat trailer if one exists, the gear and bait types used, whether they bought or caught shrimp for bait, whether they found a tag in any fish caught, the number of each species landed, and lengths of up to 6 individuals for each species landed. Individual fish weights are not collected; weight-length regression equations from previous survey data are used to convert lengths to weights when necessary. Measuring a maximum of 6 fish per species in each party's landings will provide measurements for at least 75% of all fish encountered in surveys (TPWD, unpublished data). Questions designed to measure the expectations, motivations, satisfactions and expenditures of recreational fishermen are also asked and will be detailed later. The creel data sheets with the coded interview data are edited and then submitted for computer entry.

An average of 10,000 interviews of sport boat parties occurs during over 1,000 creel surveys conducted coastwide each year. From these interviews a mean daily landings and mean daily fishing pressure are calculated (Appendix A). These means are expanded by the number of fishable days in the season to yield the total estimated sport boat fishing landings, pressure and catch (retention) per unit effort. These estimates are provided individually and combined by species, day type, season, bay system and areas fished. Areas

fished include the bays, the passes, the Texas Territorial Sea and the Exclusive Economic Zone.

SAMPLING STRATEGIES

The number of days surveyed each year is based on a sample size estimation using survey results from previous years (TPWD, unpublished data). Variances from prior landings estimates were used to calculate a sample size which would provide annual sport boat landings estimates for each by a system with coefficients of variation of about ± 10 percent. Such a high degree of precision allows fishery managers to determine differences in trends among areas and years.

The key to yielding the most precise estimates with the least amount of survey effort lies in the use of a stratified proportional sampling strategy. The resulting landings estimates are more precise than those from simple random sampling schemes. Angling activity at a site is used to select survey sites prior to each sampling season, thus assuring that sites with higher fishing pressure are surveyed more often. Survey sites are selected at random but are weighted according to mean adjusted roving counts for each site obtained over the previous 3 years. Since personnel conducting roves cannot know the activity of the boaters whose empty trailers or wet slips they are counting, the mean roving count for each site is adjusted by the proportion of sport boat fishing parties interviewed at the site during previous on-site surveys.

Mean roving counts are not only used to stratify surveys among boat access sites but also between survey seasons. An analysis of the mean distribution of roving counts throughout the year resulted in a two-season sampling stratification (high-use season - May 15 to November 20; low-use season - November 21 to May 14) (McEachron, 1979). Nearly three times as many creel surveys are now done during the high-use season than during the low-use season with a resulting improvement in estimate precision.

The interview period for all creel surveys is 10 am to 6 pm. This continuous 8-hour daylight interview period was found, based on coastwide diurnal surveys, to be the most efficient and economical use of survey personnel. The 10 am to 6 pm period yielded the highest percent of boating parties completing their trip with a 90% or greater value in each season and bay system coastwide (Heffernan and Green, 1977).

SURVEY EFFICIENCY

The relatively high manpower requirements of the marine recreational fishery monitoring program in Texas have dictated the need for investigating cost reduction measures. Over 3,000 man-days at a program cost of $225,000 were needed to provide the recreational harvest estimates in 1987-88.

The interview period has recently been modified to reduce the unproductive

time spent by survey personnel at boat access sites which receive little or no sport boat fishing activity on an assigned survey day. Based on analyses of previous survey data (Weixelman and Green, 1984; Osburn and Weixelman, in manuscript) creel surveys are now terminated at 2 pm on weekends and 4 pm on weekdays when no angler interviews are conducted prior to those times. On average, less than 3 percent of the total interviews and retained fish are missed coastwide using this procedure. About 20% of the annual surveys can be terminated early thus allowing survey personnel to perform more constructive duties without significantly reducing the precision of the landings estimates.

Additional increases in program efficiency have also been realized by allowing the cancellation of "bad weather" survey days during the low-use season. Measurements of air temperature, wind speed, and the occurrence of rain, which have been recorded for each creel survey day since 1974, were subjected to multiple regression analysis, thus allowing the development of nomographs which are now used by survey personnel to assess the potential for survey cancellation (Spiller *et al.*, 1988). The regression equation predicts, based on weather parameters measured 1 hour before the creel survey is scheduled to begin, when a survey day will yield on average no more than 2 angling interviews and thus qualified for cancellation. The percentages of total angling interviews and retained fish missed coastwide from this procedure are less than 4 and 3%, respectively. Nearly 17% of all low-use season survey days can be cancelled because of inclement weather; survey personnel can then be assigned other duties on those days without a significant loss in precision of landings estimates.

SOCIAL AND ECONOMIC CONSIDERATIONS

Starting in May 1987, social and economic questions were appended to the set of creel survey questions used. Each question was pretested during the preceding 2 years to determine the most appropriate measurement scales and formats. Questions added to the creel survey had to be managerially useful but brief due to time constraints involved in interviewing anglers at boat access sites.

Specifically, anglers were asked about the importance and performance of 10 motivational items for fishing (*e.g.*, relaxation, experiencing adventure, catching fish), how they graded their overall trip on a scale of 0-10, species preferences, zip code, number of saltwater trips made to the surveyed site and to all sites in the previous year, extent of fishing trip expenditures and how much they valued saltwater fishing using a hypothetical contingency valuation format.

Some questions were asked of anglers before their trip and others were asked at the conclusion of their trip. For example, species preference was asked during the pre-trip interview; otherwise post-trip preference by the angler could shift to mirror his actual catch. Slightly modified versions of motivational items

were asked before and after the trip to understand how important each item was as a reason for fishing and to what extent they were realized on the trip, respectively. The goal of this approach was to compare importance/performance responses for each angler; during the high-use season in 1987 over 20% of the 1,900 pre-trip interviews were also matched up with post-trip interviews.

Over 5,500 post-trip angler interviews were completed from May 15 to November 20, 1987. Planned analyses of this initial socioeconomic data set includes importance/performance items, degree of correlation between matched pre- and post-trip responses and the contribution of each importance/ performance item toward explaining the variation in the overall trip grade. A knowledge of the items which influence the level of satisfaction of anglers is critical to fisheries managers as they strive to provide maximum social and economic benefits to the state. Dissatisfied anglers may reduce their fishing activity, fish elsewhere or exert strong political pressure to change management efforts.

Responses to these socioeconomic questions can be monitored over time by geographic area to provide managers with useful trend information on angler characteristics and how these characteristics change in response to management decisions. For example, species preference data can indicate the success of having promoted underutilized species. Data on the number of fishing trips can indicate the activity levels of the angling population; it can also be used to expand the trip-specific expenditure data for estimating economic value of the fishery. Zip codes can provide a wealth of information about anglers relating both to their social characteristics and their economic potential. Economic potential in the fishery can be further refined through the contingent valuation or willingness to pay data which can ultimately measure the untapped consumer surplus associated with the fishing experience.

The addition of social and economic questions to the creel survey was, however, accompanied by some additional interviewing problems. First, creel survey personnel were unfamiliar with social and economic data collection and, in particular, the need to recite questions verbatim. In addition, field personnel had to be trained in different interviewing techniques to better response to anglers who were unfamiliar with the questions (and their managerial importance) and who were often unwilling to respond to the "new" questions. No doubt it will take some time for anglers to appreciate the importance of the expanded set of creel survey questions. Finally, there is concern over the length of the total interview during busy survey periods which can cause a higher than normal proportion of anglers completing trips at the boat access site to be missed entirely. The implications of these missed interviews as well as the interview refusals need to be addressed as social and economic data collection continues simultaneously with the harvest-related data collection.

The inclusion of social and economic questions is much more than a

symbolic effort on the part of the Texas Parks and Wildlife Department. It is reflective of a changing view of fisheries management, namely, that conservation agencies are managing people in order to manage fishery resources, with an additional new management goal of angler satisfaction. As rules and regulations are implemented to protect and allocate scarce fishery resources, managers are politically wise to understand their constituencies so the most palatable and equitable solutions can be chosen. Creel survey data taken with other data collected from anglers provide an additional basis for managerial decisionmaking.

SUMMARY AND CONCLUSIONS

Marine recreational fishing has developed into a dynamic force throughout the Gulf and Caribbean with far-reaching influences on not only the biological resources but also the social and economic well-being of the region. As such it deserves to be managed to yield its optimum benefits for the peoples of the region. Effective management, however, requires an ongoing source of data that describes the impacts on all aspects of the fishery. Texas' on-site creel survey program provides a model for other areas to use in establishing their own saltwater angler survey programs. Within whatever budget constraints are necessary, any creel survey program should begin with an inventory of the angling universe and from there the process of stratification can begin. The goal of stratification should be to increase precision while reducing costs. Indeed, monitoring a fishery does not require that every angler group be surveyed all the time, but it does require that, whatever angler groups are surveyed, the data are collected in a consistent and statistically valid manner which allows for direct comparisons to previous years. Changes to a long-term creel monitoring program should only be made after assuring that comparability is not compromised. Future generations of fishery scientists and anglers alike will benefit from our current commitment to manage marine recreational fisheries with the best data collection programs possible.

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APPENDIX A. EQUATIONS USED TO ESTIMATE MARINE SPORT BOAT LANDINGS AND PRESSURE (FROM OSBURN AND FERGUSON 1987).

The following equations were used to estimate landings (H^)(or pressure):

$$H^{\wedge} = \sum_{i=1}^{4} D_i \, h_i$$

where,

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

h_i = the mean number of fish landed (or fishing trip man-hours for pressure estimate) per day during daylight hours in the ith stratum calculated as

$$h_i = 1/n \sum h_{ij} \; P_j / e_j$$

where,

n = the total number of days sampled

h_{ij} = the total number of fish (or fishing trip man hours for pressure estimate) observed at site j in the ith stratum,

P_j = the proportion of parties missed by interviewers at site j (total number of parties seen divided by the total number of parties interviewed),

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

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

where,

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

k = the total number of sites