

# Travel Characteristics of Marine Anglers Using Oil and Gas Platforms in the Central Gulf of Mexico

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## Introduction

The nature of travel undertaken by the recreationist to and from the recreation site is an important focus of many research efforts. On land this value is usually easy to evaluate due to the constrained nature of roadways and the convenience of measuring distances between sites of origin and destination (Griffith and Jones, 1980). In contrast, marine recreational travel distances are often difficult values to assess. A con-

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*ABSTRACT—This study was designed to evaluate the travel characteristics of avid marine anglers off Louisiana in the Central Gulf of Mexico. It focuses on the complex marine travel patterns involving the extensive assemblage of oil and gas structures. In an intercept approach, marine recreational fisherman were asked to identify near and offshore travel patterns on the day of the interview. Information was also solicited regarding how respondents selected and located fishing destinations as well as what method of fishing was undertaken that day. Petroleum platforms were a principal fishing destination, and platform anglers traveled an average distance of 75.5 km (40.7 n.mi.) to and from offshore fishing locations. In fishing an average of 6.5 platforms per trip, these anglers traveled about 21.3 km (11.5 n.mi.) between the first and last platform visited. Mean total distances for platform anglers were 96 km (51.8 n.mi). Travel distances for bay, nearshore, and bluewater anglers were also obtained.*

tributing reason is the difficulty for marine recreational boaters to identify accurately the location and record the distance values of offshore destinations, especially in the absence of any physical structures or reference points (i.e., islands, charted reefs or snags, offshore facilities, buoys, line-ups, etc.). A lack of written records of the many compass headings, various rates of speed, and durations of travel within offshore trip segments may also contribute to an inaccurate assessment of the cumulative distances traveled offshore.

Understanding the offshore range of marine anglers can be useful for two purposes. First, these values may be used in determining appropriate offshore zones for the deployment of artificial reef materials (Parker et al., 1974; Schwartz, 1980; Ditton and Burk, 1985; Gordon and Ditton, 1986; Myatt and Ditton, 1986). Second, offshore travel values may be used in the effective spacing of materials within a deployment zone. This distribution may reduce the crowding and overfishing of artificial reefs sited for use by anglers.

The principal goal of this research was to gain a descriptive understanding of the marine travel patterns of avid marine anglers using the oil and gas structures off the Louisiana coast. Although this information may be of greatest utility in the siting of obsolete platforms as artificial reefs, it is suggested that research investigating how marine anglers traverse this extensive system of platforms can provide a practical (not necessarily comparable) insight into such marine recreational travel. Secondary goals included an assessment of how marine anglers se-

lect and locate offshore fishing destinations and their fishing methods.

## Study Area

In 1985, the National Research Council identified more than 3,100 oil and gas structures (platforms, pumping stations, etc.) in Federal waters off the Louisiana coast (National Research Council, 1985). Although intended to facilitate the exploration and recovery of hydrocarbons, this large assemblage of oil and gas structures also serves in a de facto capacity as artificial reefs or aggregating devices providing habitat for numerous species of fish and other marine life (Sonnier et al., 1976; Gallaway and Lewbel, 1982).

In a baseline study for the Minerals Management Service (MMS), Ditton and Auyong (1984) evaluated the recreational and commercial fishing use of selected major oil and gas platforms off the Louisiana coast. The MMS Central Gulf lease area was partitioned into three distinct study regions (Fig. 1). In a further analysis of the MMS data, Gordon (1987) investigated the utility of certain variables in forecasting the travel behavior of offshore recreational fishermen. To assess variable relationships, an on-site survey was conducted in the Delta Region, which was one of the same study areas used in the initial MMS study<sup>1</sup> (Gordon, 1987).

The Delta Region was selected for study because this region accounted for three-fourths of the recreational fishing craft observed within the three study regions (Ditton and Auyong, 1984).

<sup>1</sup> The same MMS offshore regionalization has also been utilized in other research efforts (Stanley and Wilson, 1989).

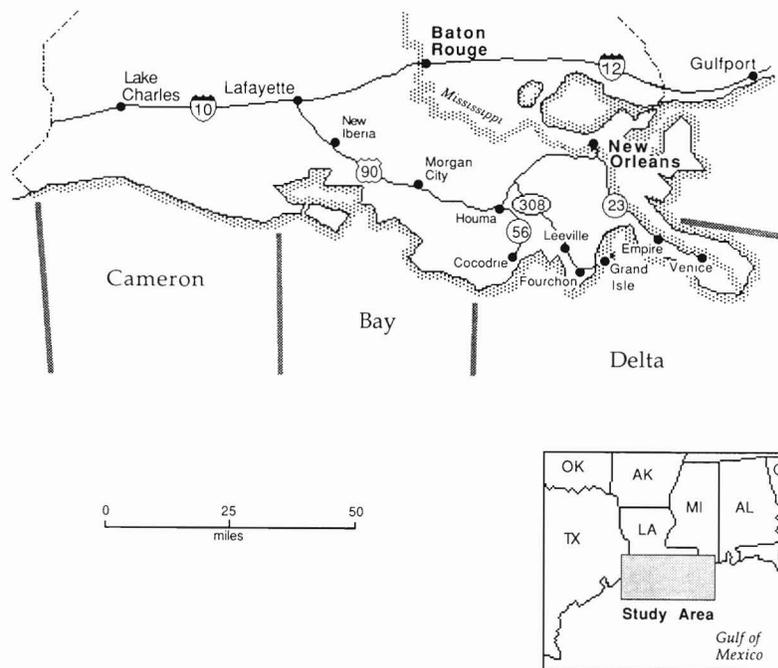


Figure 1.—Louisiana coast with area highway network, marine access system and MMS study regions.

The offshore study area is generally composed of a gently sloping continental shelf with minimal variations in bathymetry. The relatively flat bottom condition has facilitated the widespread deployment of oil and gas structures, and the depth of offshore waters where the majority of the recreational fishing occurs is usually less than 20 m. These depths would occur within 30 km (about 16.2 n.mi.) of shore.

### Methods

Based on research by Ditton and Graefe (1978) and Ditton and Fedler (1983), a study questionnaire was designed to identify land and marine travel characteristics of recreational fishermen in the Delta Region.<sup>2</sup> Al-

<sup>2</sup>As noted, only questions related to marine travel and offshore destinations are reported in this paper. The questionnaire utilized a variety of question formats. Open-ended responses were used to examine variables such as the number and location of platforms where fishing was conducted, frequency of launchsite use, as well as other launch sites used during the year, preferred waters depths, distances traveled from home to launchsite, distances traveled offshore,

though only the marine-related aspects of this study are reported in this paper, landward mobility was measured by determining travel distances on land to marine launch sites and by whether or not a boat was trailered (Gordon, 1987).

Self-reported marine travel distances for bay, nearshore, and offshore anglers were obtained. Inquiries were also made regarding the offshore location-finding capabilities of study area fishermen. Other questions addressed factors that might be important to saltwater an-

boat size, number of days spent fishing on an annual basis, seasons of fishing, and species sought after that day. A series of closed responses were read to respondents on topics regarding how fishermen find offshore destinations, what attracts anglers to particular platform destinations, and the types of onshore infrastructure required to support offshore travel. Likert-scaled questions examined the quality of fishing, the importance of onshore infrastructure and factors related to locating offshore destinations. Finally, a series of questions with a yes/no response examined topics on whether respondents fished in a tournament that day, whether platform locations were utilized, and if fishermen tied up to those structures, and whether water depth or distance from shore was a factor in selecting fishing destinations.

glers in selecting their offshore fishing destinations (i.e., the importance of water depth and distance from shore in the selection of a platform destination).

A survey strategy was developed to determine which launch site locations would be most suited to maximize the number of completed surveys. In all, 200 interviews were conducted on-site during a 2-week period in late July and early August 1985.<sup>3</sup> This timeframe included two weekend periods of fishing activity. More marine recreational fishermen usually fish on weekends than during week days, generally allowing more fishermen to be intercepted in a reasonable period of time (Ditton and Auyong, 1984).

Upon their return to shore, recreational anglers were asked to recount the nature of their offshore fishing trip and to indicate on a helicopter flight map which platforms or lease blocks they had fished at (Houston Helicopters, Inc., 1985). Although some fishermen had difficulty recalling the platform or block numbers of all the fishing destinations visited that day, nearly all respondents knew the identification number of the lease blocks in which they had fished. With this information, travel distance values could be calculated with a computerized digitizer for each survey response.

Recreational fishermen were interviewed on their return to shore as opposed to their initial departure to offshore fishing destinations for several reasons. First, many of the anglers interviewed had preselected the offshore destinations that they would fish that day. In just as many situations, these individuals would alter their trip pattern and choose alternative destinations while in transit offshore. This change in trip pattern usually resulted from poor fishing at initial platform or

<sup>3</sup>With the possibility of temporal limitations for the 1985 data, the author returned to the study area during the month of August 1990 to determine if limitations existed. During a 3-day period of time, the author interviewed both tournament and nontournament anglers regarding their offshore travel behavior and destination preferences. With essentially the identical launch sites, offshore destinations and boating capabilities (equipment), it was concluded that travel trends and behavior had yet not changed appreciably since the original survey.

offshore destinations. Also, fishermen were generally more relaxed upon their return to shore and were willing to respond while securing their craft. Fishermen were also able to accurately locate platform or offshore destinations and identify trip segments of the just completed fishing trip.

Three trained interviewers remained at launch sites during the entire day to intercept all returning recreational fishermen. During the pretest, two temporal patterns emerged. One group of fishermen would depart from shore early in the morning and return in the late morning, while the other group would leave in late morning and return in the late afternoon or early evening. As fishermen returned to the launch site from their offshore fishing trip, a representative of each boat (group) was intercepted and interviewed. The operator of the craft was usually the individual who was interviewed. This person was preferred because it was he/she who had navigated the offshore waters and who had the most knowledge of the marine travel pattern used that day. All individual anglers that were approached for questioning, with the exception of only one boat owner who was rushed for time to return home, responded to the survey.

The locations of reported platform or block destinations were digitized to calculate distance values as follows: 1) Launch site to the first platform encountered, 2) platform to platform, 3) last platform to launch site, and 4) the travel distance for the entire trip (including bay and nearshore travel).

Interviews for this research were administered at five marine launch sites in the study area. Because questionnaires were completed at two launch sites where fishing tournaments were being conducted, some of the fishermen interviewed had actually completed their fishing trips from other launch locations and had driven to the tournament weigh stations. In all, sixteen public and commercial launch sites were represented in this study. The launch sites utilized by respondents were similar to those identified by Dugas et al. (1979) and Stanley and Wilson (1989).

Nearly half of the fishermen interviewed (46%) were participating in fishing tournaments conducted during the data collection. Although tournament locations provided an opportunity to gain access to a greater number of fisherman than otherwise would have been interviewed, it was necessary to evaluate any difference in marine travel behavior between tournament and sport fishermen (Dawson and Wilkins, 1980; Loomis and Ditton, 1987). These differences are reported later in this paper.

The SPSSx statistical software package was utilized in all data analyses. Analyses included response frequencies, means and respective standard error values, as well as t-tests for differences in means. All statistical tests were conducted at the 0.05 level.

#### Validity of the Intercept Approach

The questionnaire used in this study was administered on-site in an intercept format. An on-site approach was chosen over an area-wide (mail or telephone) technique for two reasons. First, an area-wide approach would require a sample to be drawn from a state-wide population (Ditton and Graefe, 1978; Liao and Cupka, 1979; Zapata and Ditton, 1979; Ditton and Fedler, 1983; Bockstael et al., 1986). Identification of the marine fishing population from the noncomputerized Louisiana state boat registration system, and the selection of a sample from this population was beyond the financial resources of this research. Other marine recreational studies examining Louisiana offshore fishing have encountered similar constraints (Roberts et al., 1985; Stanley and Wilson, 1989).

Although travel behavior data are limited by temporal and areal constraints, the on-site approach to data collection was justified by the breadth of the data obtained. The representativeness of the on-site study data was evaluated by successfully comparing fishermen characteristics (marine travel behavior, methods of fishing used, etc.) with data acquired in other research efforts (Ditton and Graefe, 1978; Dugas

et al., 1979; Ditton and Fedler, 1983; Market Facts, Inc., 1983; Ditton and Auyong, 1984; Witzig, 1986).

Secondly, although an area-wide method might provide a more representative cross-section of the marine fishing population, the intercept approach was more likely to include more "avid" fishermen, as opposed to "casual" or less avid fishermen (Ditton and Fedler, 1983; Gordon, 1987; Milon, 1989). Because of the exploratory nature of the on-site research, it was desirable to gain insight into the activities of avid fishermen. It is these individuals who generally place greater fishing pressure on the marine resource system.

## Results

### Criteria Used in Selecting and Locating Offshore Fishing Destinations

The anglers interviewed in this study relied upon diverse considerations in choosing their fishing destination(s). Nearly 60% indicated that their choice of an offshore destination was based upon their past fishing experience at that location (Table 1). One-fourth of the respondents noted that the variety of fish species at a known platform, or the species they desired, was an important factor in selecting an offshore destination. Other considerations included the recommendations of friends who had previously fished at a chosen platform, as well as physical characteristics such as the varying clarity of water at the platform site and the proximity to shore. Preferred water depths for fishing were usually less than 60 m (Table 2).

Table 1—Reasons<sup>1</sup> why anglers choose specific offshore oil platforms for fishing.

Consideration	Frequency	Percent
Past success	117	58.5
Variety of species	50	25.0
Friend's recommendations	40	20.0
Clarity of water	27	13.5
Depth of water	12	6.0
Trying new platforms	12	6.0
Closeness to shore	12	6.0
Size of platform	1	0.5
Other	7	3.5

<sup>1</sup>Respondents could report more than one consideration; therefore, the number of responses exceeded the number of respondents.

**Table 2—Water depths preferred for fishing in the study area.**

Depth (m)	Frequency	Percent
0–15	78	39.0
16–30	43	21.5
31–60	28	14.0
61–90	7	3.5
91–120	2	1.0
121–150	1	0.5
>150	6	3.0
No one depth	30	15.0
Unknown	5	2.5
	n=200	100.0

### Locating Offshore Oil and Gas Platforms

Fishermen used various methods to locate the offshore platform(s) visited on the day they were interviewed (Table 3). Slightly over half of the respondents indicated that they used a compass in navigating offshore waters. Nearly 20% stated that visual sightings of known reference points were used to reach offshore objectives. Two-thirds of the respondents (66%) indicated that they used the shape of configuration of a platform (or complex) to locate their position while on the water. As noted by some of the respondents, this particular practice may confuse the person navigating if there has been a period of time between offshore visits.

**Table 3—How anglers located offshore oil platforms in the study area.**

Method	Frequency	Percent
Compass headings	101	50.5
Sight	35	17.5
LORAN	20	10.0
Depthfinder	12	6.0
Unknown	32	16.0
	n=200	100.0

### Fishing Destinations

Four location groups emerged as the principal fishing destinations: 1) Petroleum platforms, 2) nearshore locations (jetties and beaches), 3) bay locations, and 4) bluewater locations. Platform locations were the destination for about three-fifths (61%) of the respondents who fished near or at them. Nearly as many anglers (59%) stated that they had actually tied to a platform to fish. One-fifth (21%) of the responding anglers specified that they had fished nearshore (usually near jet-

ties), while 11% fished bay locations. Bluewater anglers (11%) were the smallest response group.

As another measure of the attractiveness of offshore petroleum platforms as fishing destinations, nearly three-fourths (74%) of the fishermen interviewed tie to platforms at some time during the year. Only 11% noted that although they have the opportunity, they choose not to tie to platforms.

### Fishing Methods

Marine anglers in the study area were categorized into five groups: 1) Nearshore and bay fishermen, 2) offshore platform fishermen, 3) offshore (platform vicinity) trollers/anchors, 4) platform sportfishing divers, and 5) bluewater fishermen. The first group consisted of those fishermen who have small craft (4.3–5.2 m) and, due to safety considerations, opt to do their fishing either in “inside” waters (bays, inlets, bayous, etc.) or at jetty locations and nearshore platforms. Many of these fishermen either anchor to fish or troll the shallow waters.

The second group included those fishermen who traveled offshore to fish at or near oil and gas platforms. Fishermen who tied to the structures were seeking those fish inhabiting the support-structure of the platform (benthics or demersals). Those fishermen trolling or anchoring near the structures (third group) were generally seeking the pelagic species that prey upon the “reef” fish that inhabit the platform (Klima and Wickham, 1971; Dugas et al., 1979; Gallaway and Lewbel, 1982; Seaman et al., 1989). The fourth group, sportfishing divers, also sought their catch at or near platforms (Roberts and Thompson, 1983).

The final group, bluewater fishermen, sought clear and deep waters to pursue billfish, tarpon, tuna, or shark. Dugas et al. (1979) noted that “. . . the location of bluewater varies from 35 to 70 miles (offshore), depending upon seasonal meteorological and/or hydrological regimes.” Dugas et al. (1979) also observed that although bluewater distances vary from shore and that most trolling is done in open water, most of these fishermen “will make a concerted

effort to troll adjacent to oil platforms whenever the opportunity presents itself.” A frequency distribution of fishing methods used in the study area by respondents is presented in Table 4.

**Table 4—Angling methods used in the study area.**

Method	Frequency	Percent
Tie to platforms	109	54.5
Troll near platforms	60	30.0
Anchor near platforms	3	1.5
Bluewater (tarpon, etc.)	15	7.5
Dive and tie at platforms	10	5.0
Unknown	3	1.5
	n=200	100.0

### Marine Travel Characteristics

Saltwater anglers who did not fish at or near platforms (n=54, SE=1.01), but fished nearshore or in the coastal bay systems, reported a mean total trip length of 16.8 km (9.0 n.mi.). Anglers fishing at platform locations reported a mean travel distance of 34.2 km (18.5 n.mi.) from launch site to the first platform used (n=109, SE=0.97), an additional mean distance of 21.3 km (11.5 n.mi.) when traveling from platform to platform (SE=1.34), and a mean travel distance of 41.3 km (22.3 n.mi.) from the last platform encountered back to the launch site (SE=1.21). A mean total trip length of 96.8 km (52.2 n.mi.) was calculated for platform fishermen (n=109, SE=2.78).<sup>4</sup>

The mean trip length for offshore trollers and bluewater fishermen (n=17, SE=8.49) was 104.5 km (56.4 n.mi.). When asked if distance offshore was a factor in selecting platform or offshore destinations, almost three-fourths (71%) of all respondents noted that distance was a consideration. Respondents indicated that the furthest distance offshore they would be willing to travel was about 50 km (27.0 n.mi., n=196, SE=1.81). Table 5 presents a range of these offshore distance values.

<sup>4</sup>In the present analysis, travel distances are assessed according to the type of angler, as well as by temporal and behavioral factors (i.e., tournament vs. nontournament fishermen). The present distance analysis varies from Gordon's (1987) work in that the earlier work did not isolate travel contributions by divers and inshore and offshore trollers.

**Table 5—Maximum distance an angler would travel offshore in this study.**

Distance (km)	Frequency	Percent
0 -16	57	28.5
16.1- 32	30	15.0
32.1- 48	27	13.5
48.1- 64	25	12.5
64.1- 80	23	11.5
80.1- 96	10	5.0
96.1- 112	5	2.5
112.1-128	3	1.5
>128	11	5.5
Unknown	9	4.5
	n=200	100.0

Platform fishermen fished about 6.5 platforms (SE=0.56) on the day they were interviewed (Table 6). When dividing the mean distance traveled between platforms (21.3 km) by the approximate number of platform visits, study anglers traveled 3.3 km (1.8 n.mi.) between each platform visited.

**Table 6—Number of oil and gas platforms visited per fishing trip.<sup>1</sup>**

Number of platforms fished	Frequency	Percent
1-2	29	24.4
3-4	23	19.3
5-6	24	20.2
7-8	16	13.4
9-10	10	8.4
11-14	3	2.5
15-18	7	5.9
19-21	4	3.4
>21	3	2.5
	n=119	100.0

<sup>1</sup> It should be noted that the higher values for platform fishing were the result of fishing the entire day (minimal travel time) or fishing over a 2-day trip.

As noted earlier, nearly half of the fishermen interviewed (46%) were participating in fishing tournaments. Responses were tested for bias on travel-related behavior, and it was concluded that there was a significant difference in behavior between the two groups. Results of a t-test for differences in means (n=114: this value represents the number of individuals interviewed on days when tournaments were taking place), suggested that the mean value of total marine trip distance for nontournament fishermen (79 km or 42.6 n.mi., n=60) was significantly different at the 0.05 significance level, than the mean travel value for tournament fishermen (114 km or 61.5 n.mi., n=54) (t=4.01>1.98, F=16.1).

An analysis of offshore and nearshore craft used by respondents in the Delta Region revealed that the "av-

erage" craft size was 6.9 m (22.7 feet, SE=0.52). Nearly 80% of the respondents operated marine craft less than 8 m long (Table 7). The fishing craft operated by respondents generally carried between three and four persons. The 200 respondents interviewed represented a total of 708 marine recreational fishermen. This was an average of 3.7 fishermen per craft (SE=0.12, n=161, missing data=39).

**Table 7—Classification of boat sizes<sup>1</sup> in the study area.**

Boat size (m)	Frequency	Percent
<4.3 m	1	0.5
4.3-5.5	57	28.5
5.6-7.6	99	49.5
7.7-8.8	16	8.0
8.9-10.4	10	5.0
10.5-11.9	3	1.5
12.0-13.4	6	3.0
>13.4	6	3.0
Unknown	2	1.0
	n=200	100.0

<sup>1</sup> Based on boat size classes used by Ditton and Graefe (1978).

## Discussion

A limited literature has developed in recent years focusing on the offshore range of travel of marine recreationists. These studies have generally concentrated on two travel components, which include: 1) Landward travel to and from a launch site or marina (Noden and Brown, 1975; Bender and Winsor, 1979) and 2) offshore travel characteristics (Buchanan, 1973; Ditton and Graefe, 1978; Liao and Cupka, 1979; Ditton et al., 1980; Ditton and Fedler, 1983; Ditton and Auyong, 1984; Bockstael et al., 1986; Gordon, 1987; Milon, 1989; Stanley and Wilson, 1989).

Offshore trip characteristics are infrequently examined within the marine recreational literature. These activities are either recorded in terms of total trip distances or one-way distance values (shore to destination). Marine recreational travel between various offshore destinations is usually not assessed. Although complex trip patterns are likely to exist, mail survey techniques or other sampling procedures make it difficult for respondent to identify the sequence of past offshore trip patterns.

In a distance study of offshore boat fishermen in the Houston/Galveston region of the Texas coast, Ditton and Graefe (1978) observed that offshore fishermen reported travel distances of 29.5 km (15.9 n.mi.) and 40.9 km (22.1 n.mi.) offshore in their average and longest trips. In a state-wide study of marine recreational boat fishermen, Ditton and Fedler (1983) reported that offshore fishermen reported travel distances of 22.5 km (12.1 n.mi.) and 34.3 km (18.5 n.mi.) in their average and longest trips, respectively.

In commenting on these studies, Ditton and Auyong (1984) attributed these trip differences to be the result of varying widths and depths of the outer continental shelf. Ditton and Auyong (1984) observed that "Louisiana fishermen are probably attracted farther offshore than Texas fishermen by the extensive array of petroleum platforms." The present study provides support for the assertion that Louisiana fishermen travel further offshore to fish than their Texas counterparts. Although present findings revealed that marine anglers traveled a mean distance of 34.2 km (18.5 n.mi.) offshore, it is again important to note that these distances represent only one segment of the offshore trip. There are no prior studies conducted in the region which report on total trip characteristics.

Offshore travel behavior can be influenced by the type of fishing activity being conducted. When examining variations in the behavior of marine anglers, tournament fishermen exhibited 40% greater mobility than other sport anglers, thereby exerting fishing pressure at distances from shore. Whatever the motive for fishing, there is one factor which has not been effectively addressed within the literature. Travel within the de facto artificial reef setting of offshore oil and gas structures is likely to be greater than travel within an equally dispersed, yet totally submerged system of artificial reef destinations. This behavior might be prompted by the realization that if trouble occurs offshore, emergency assistance can usually be secured from platform personnel. In such a situation, it is likely that the array of off-

shore platforms in the central Gulf of Mexico serves as an "attractive nuisance," luring fishermen further offshore.

The majority of studies within the Louisiana/Texas offshore region, including the present research, reported average offshore travel distances to be within 48 km (25.9 n.mi.) of shore. The only exception is a study by Stanley and Wilson (1989) which observed extensive marine recreational travel behavior in the waters offshore Louisiana. Stanley and Wilson (1989) observed average one-way travel distances of "at least 62 km (33.5 n.mi.) for marine recreational fishermen within the Delta study region. Their minimum total travel distance value of 124 km (66.9 n.mi.) did not account for additional platform to platform travel segments, which consisted of more than 20% of the total offshore trip in the present study.

The equipment capabilities of the Stanley and Wilson respondents are more indicative of charter boat operations or the larger range of private recreational craft than the typically smaller craft encountered in the present research.<sup>5</sup> Although Stanley and Wilson (1989) acknowledged that their respondents were not representative "of all recreational anglers and divers off the Louisiana coast," their travel values appear to be overstated. In the present research, the furthest offshore distances considered by respondents (49.2 km or 26.6 n.mi.) were found largely to be consistent with research by Ditton and Graefe (1978), Ditton and Fedler (1983), Ditton and Auyong (1984), and Bockstael et al. (1986).

Similar to observations by Ditton and Auyong (1984), petroleum platforms served as principal offshore destinations for the present study. The offshore respondent traveled approxi-

<sup>5</sup>Within the Delta Region, Stanley and Wilson (1989) observed a mean engine power rating of 289 horsepower for recreational craft. This value was much higher than the power ratings observed by Ditton et al. (1980). Although horsepower characteristics were not a formal variable within the present research, the Stanley and Wilson values appear to be higher than engine ratings observed during the present field survey. Such characteristics suggest that Stanley and Wilson may have observed behavior beyond the norm for the Delta region.

mately 100 km (54.0 n.mi.) on water in pursuit of his recreation. The ease with which this was accomplished (i.e., speed and range of the craft) provided the opportunity for the fisherman to choose from multiple offshore destinations. Familiarity with the offshore system allowed platform or destination choice to be based upon past success at particular fishing locations, as well as the choice of desired species and information passed on by friends. In a study of an artificial reef system in Florida, Milon (1989) observed that the importance of anticipated catches and previous success were important in choosing artificial reef destinations.

Also in the present research, offshore anglers demonstrated an effective use of several platform destinations per trip. Offshore trips seldom involved traveling to a single destination. It appeared that if a particular platform destination was providing poor fishing results, then another nearby platform would be visited. Mileage results revealed that these visits were generally completed within 20 km (10.8 n.mi.) of the first and last encounter with a platform destination. Nearly three-fourths of each platform fishing trip's total distance was spent traveling to and from offshore destinations.

Results suggest that most platform fishermen travel to those structures easily located within their visible horizon. The proximity of structures (clusters) located near each other may encourage this apparent travel behavior for two reasons. First, there is the ease of visual navigation between structures, and second, there is the realization of having additional opportunities nearby. Additional opportunities may be important if the fishermen is having limited success at a particular platform.

### Implications

The offshore travel of marine anglers in the Gulf of Mexico study area is composed of travel components to and from offshore destinations, as well as travel amongst offshore destinations. Understanding the importance of these multiple travel components is useful for the effective planning of artificial

reef opportunities intended for marine recreationists. The majority of studies to date reflect only a basic understanding of one-way distance values from shore to an offshore destination.

The use of statistical means representing average offshore travel values has been used to establish distance zones or arcs for the deployment of reef materials. Identified on the basis of effective travel distances, outer ranges of travel within a concentric arc have been identified at 32 km (17.3 n.mi.) (Myatt and Ditton, 1986), 40 km (21.6 n.mi.) (Wilson et al., 1987) and 48 km (25.9 n.mi.) offshore (Schwartz, 1980). Stanley and Wilson (1989) have established a range of maximum travel distances of 62–83 km for the Louisiana Artificial Reef Initiative, although platforms have been deployed as artificial reefs as far offshore as 193 km (104.2 n.mi.)

The preponderance of literature within the Central Gulf of Mexico region suggests that maximum arc distances for recreational fishermen should be established at 48 km (25.9 n.mi.) offshore. Deployment of reef materials within this system should take into consideration the clustering of materials at reef sites based upon effective distances between offshore reef destinations.<sup>6</sup> The spacing of materials within the cluster, as well as the distances between competitive reef opportunities would serve to distribute fishing pressure by distinguishing reef users according to safety, skills, experience, equipment capabilities, and fishing expectations. Crowding and declining fishing use may result if a proper assessment of the density of deployed reef materials is not conducted.

Beyond this outer arc, materials can be deployed for deep water habitat or charter and commercial uses (Wilson et al., 1987). The highly specialized marine recreational fisherman profiled by Stanley and Wilson (1989) possessed equipment beyond the norm.

<sup>6</sup>Although the platform-to-platform travel distances in the present study represented over 20% of the total offshore trip, it is suggested that similar patterns of destination-to-destination travel are likely to exist in other marine reef settings.

These individuals who have an offshore craft provisioned with sophisticated navigational and safety equipment are capable of using reef structures located further offshore. It is only these individuals who are properly equipped to take advantage of deployments as far offshore as the 193 km (104.2 n.mi.) siting by the Louisiana Artificial Reef Initiative. More distant offshore locations may also be of benefit to the tournament fishing community, who in this study represented a greater range of offshore travel than nontournament anglers.

With a finite supply of materials available for artificial reef development, it is important that state artificial reef programs examine all components of offshore travel undertaken by marine recreational anglers within their jurisdiction. It is only with such detailed information that artificial reef planners can insure that materials (targeted for recreational use) are optimally sited for maximum recreational benefit. In concluding, although this paper has addressed marine recreational travel amongst the offshore oil and gas structures located adjacent to Louisiana, it is most probable that complex travel patterns exist in more traditional reef settings. The need exists to implement research which identifies travel behavior in other marine settings. For example, a better understanding of travel behavior in the marine environment off the Florida or southeast Atlantic (U.S.) coastline may assist in a more effective deployment of reef materials intended for recreational benefit.

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