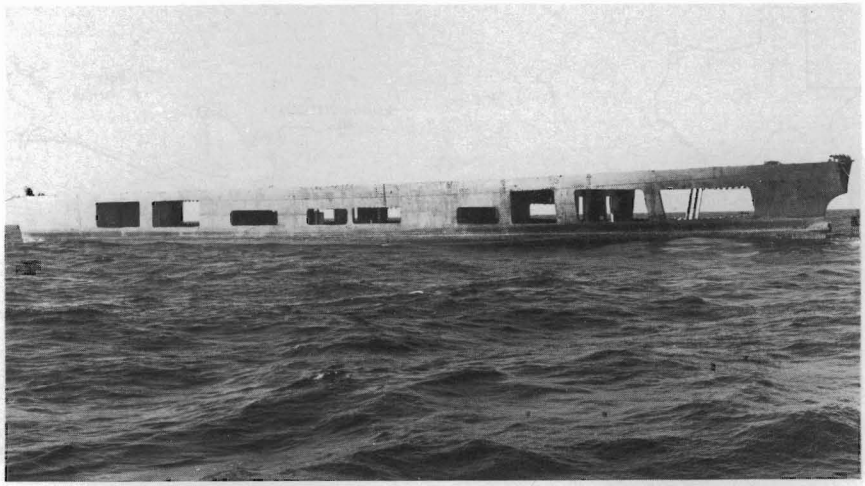
Access to and Usage of Offshore Liberty Ship Reefs in Texas

ROBERT B. DITTON, ALAN R. GRAEFE, ANTHONY J. FEDLER, and JOHN D. SCHWARTZ



Sinking a Liberty Ship off the Texas coast. Texas Coastal and Marine Council photo.

ABSTRACT—Although artificial reefs have been deployed to increase fish stocks in the United States for over a century, few studies have been done to evaluate the benefits of such reefs. This study seeks to identify the extent to which the Texas Liberty Ship reefs are used by recreational fishermen.

Two independent surveys were used to address the two principal means of gaining access to Liberty Ship reefs. One study focused on the Texas charter and party boat fleet and the other on private boat fishermen residing in the Houston-Galveston metropolitan area.

The Liberty Ship reefs were found to attract a substantial number of private boat and charter/party boat fishermen, especially when the extent of use is compared with other site-specific artificial or natural offshore attractions. Nearly all use of the Liberty Ship reefs originated from the closest access point. Use of a particular reef site appears to be related to the availability of alternative fishing grounds and the capability to travel great distances offshore.

Introduction

Artificial reefs have been used in the United States for more than a century to establish cover and habitat for fisheries. Offshore artificial reef construction began in 1935 with the sinking of four vessels and tons of other materials off Cape May, N.J. (Stone, 1974). Initial success here led many other states to become interested in deploying offshore artificial reefs. The first reef building effort in the Gulf of Mexico was initiated in 1954 by the Alabama Department of Conservation and cooperating sportsmen's groups. They used automobile bodies to develop a series of artificial snapper banks (Stone, 1974).

The scale of offshore reef efforts changed drastically with the passage of Public Law 92-402 in 1972. Subsequently, coastal states were allowed to make application to the Secretary of Commerce for surplus Liberty Ships and to use these ships for establishing artificial reefs, the ultimate purpose being to enhance the productivity of marine fisheries.

Under the sponsorship of the Texas Coastal and Marine Council, the State of Texas requested 12 surplus Liberty Ships for reef purposes. The 12 ships were received and deployed in four areas from 8 to 36 miles offshore (Fig. 1). Three reef sites each consist of three ships sunk parallel about 300-500 feet apart at a depth of 100-110 feet (Texas Coastal and Marine Council, 1976). At the fourth reef site, the first two ships were sunk at the designated location. The third ship swamped in rough weather and lies 8 miles off Freeport at a depth of 40-50 feet. This offshore artificial reef program was completed in June 1976. Since final deployment, evaluative studies have been supported by the Texas Coastal and Marine Council to assess fisheries utilization (Vetter and Roels, 1977) and biological effects (Vetter and Roels, 1978).

Evaluative research is useful to decision makers because they need to know what programs have worked and what have not (Weiss, 1972). Besides the biological assessments made by Vetter and Roels (1977, 1978), there have been no other studies that address the success and benefits actually derived from deploying the Liberty Ships as artificial reefs. This is not surprising as most of the reef literature in general deals with the technical aspects of deployment, materials, and related fish biology (Coastal Plains Center for Marine Development Services, 1973).

However, the basic question of whether or not to deploy an artificial reef is a capital investment decision. As with most public investment decisions,

The authors are with the Department of Recreation and Parks, Texas A&M University, College Station, TX 77843. This research was funded by the Texas Coastal and Marine Council, the Texas Agricultural Experiment Station, and the Texas A&M Sea Grant Program.

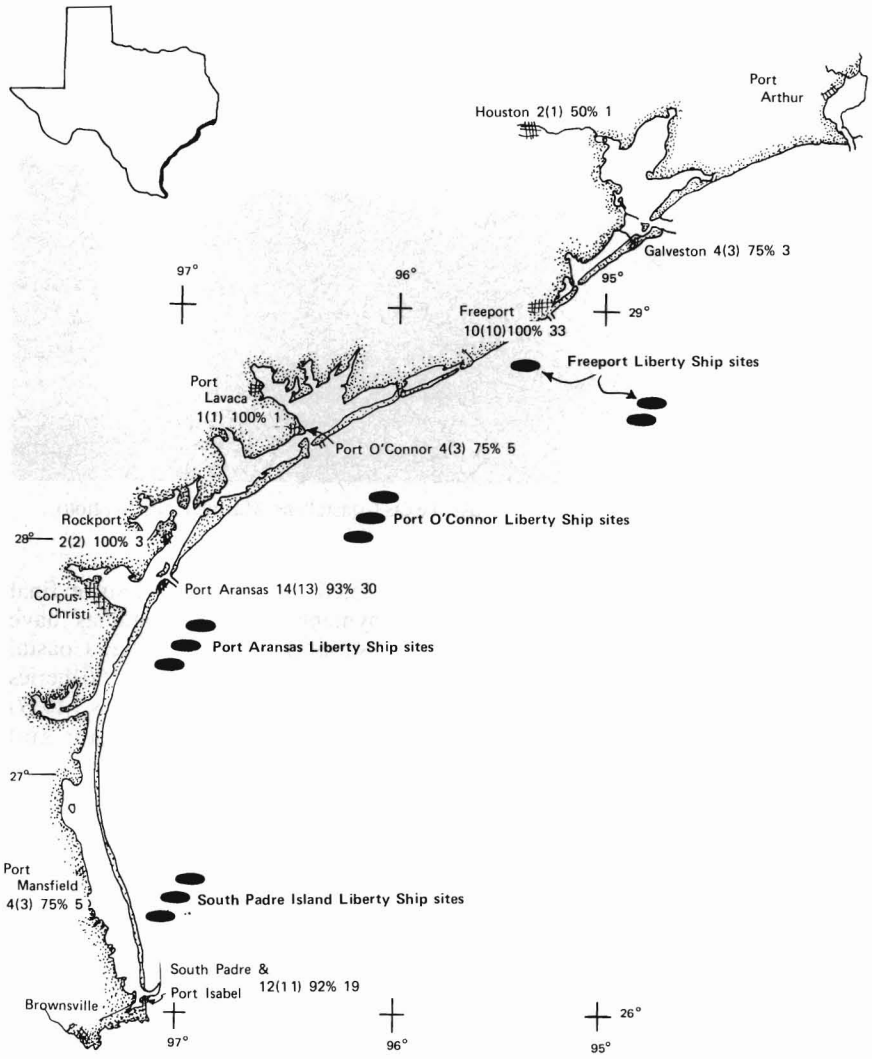


Figure 1.--Location of Texas Liberty Ship reefs and location of Texas charter/party businesses operating in 1977: population, (sample size), response rate, and number of vessels.

Daniel and Seward (1974) suggested benefit-cost analysis. Determining the costs of reefs is far less complex from a theoretical and empirical viewpoint than determining benefits. Daniel and Seward (1974) identified three benefits which can result from the creation of artificial reefs: 1) Increased productivity of the waters surrounding the reef in terms of amount of aquatic and marine life which can be supported, 2) greater fishing success for those fishermen who fish in the waters surrounding the reef, and 3) because of 1 and 2, the attraction of fishermen to the area. These are what can occur. Only a few evaluative studies have established the extent to which artificial reefs are used for fishing, by whom, the fishing success, and the economic impact (Buchanan, 1972, 1973; Liao[1]).

Although most studies have generally shown that man-made habitats improved catch rates and had a beneficial impact on the local economy, few systematically address the topics of access and spatial relationships. Parker et al. (1974) mention accessibility as a critical ingredient to a successful reef. Improved catch and economic impact depend on people being able to reach and use the reefs. If reefs are not generally accessible, these benefits are less likely to occur. As we move toward specific siting criteria that fisheries managers can use in deploying offshore reefs, we need to know considerably more about the extent to which reefs at various offshore locations are used.

This study aims to provide data toward further understanding of reef use and spatial relationships. In addition, findings serve as a baseline against which future evaluations of reef use can be viewed.

Objective

The objective of this study is to identify the extent to which the Texas Liberty Ship reefs are used for recreational fishing. This information is needed to better understand the nature of the public investment in Liberty Ship reefs in Texas.

Methods

To achieve this objective, two independent surveys of fishermen were conducted. One focused on charter and party boat operators along the entire Texas coast and their use of the Liberty Ship reef sites. The other survey focused on private boat fishermen residing in an eight county study area, encompassing the Houston/Galveston metropolitan area, and their use of the Freeport Liberty Ship reef sites. The private boat survey has a regional focus to allow a detailed description of fishing patterns relative to Liberty Ships. The Houston/Galveston region of the Texas coast provides a particularly interesting case study because usage patterns for two Liberty Ship reef sites can be compared and implications of their respective locations can be drawn. The two surveys address the only two means of accessing the Liberty Ship reefs for fishing purposes.

A 1975 Texas Parks and Wildlife Department survey of finfish harvest in Galveston Bay indicated that over 90 percent of all Bay anglers came from

[1]Liao, D. S. 1978. Economic impact of offshore sport fishing over artificial reefs and natural habitats in South Carolina. Unpubl. manuscr., 54 p. Mar. Resour. Res. Inst., Charleston, S.C.

Harris, Galveston, Chambers, and Brazoria counties, all of which border on Galveston Bay (Heffernan et al., 1975). A second group of counties, including Fort Bend, Liberty, Montgomery, and Waller, was added to the previous four counties adjacent to Galveston Bay to form the study area for the survey of boat fishermen (Fig. 2). Therefore, it is probable that nearly all private boat fishing use of Galveston Bay and adjacent offshore waters is done by residents of the study area. It is important to recognize that the focus of the private boat survey is on fishing participation by people residing within the eight county area, not on total fishing use of Galveston Bay and adjacent offshore waters. Some additional fishing use is contributed by private boat fishermen entering from outside the study area, but as indicated above, this is probably a small portion of total use.

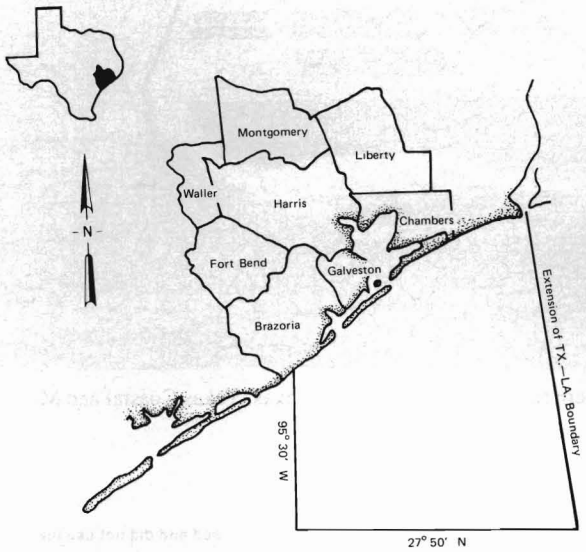


Figure 2.—Map of the eight county private boat study area.

Charter/Party Boat Operator Survey

Since we were interested in Liberty Ship reef use only, all charter/party boat operators who fished exclusively in the bays were systematically excluded. Charter and party boats were aggregated since there was often no clear distinction between them. Many operations used boats for both charter and party trips. Also, some operations ran regularly scheduled trips on a per person basis during the peak season and operated on a charter basis for the rest of the year. Some operations acted as agents for other captains. These were considered multiple boat operations and usage figures were calculated accordingly for each operation.

A total of 58 Gulf operators were identified along the Texas coast. Five operators were excluded from the population due to discontinued service or an unknown address. Each of the remaining 53 Gulf operators was sent a mail questionnaire. This was followed by a second mailing and telephone interviews with nonrespondents. Forty-seven usable responses were received for a response rate of 89 percent. Figure 3 presents the total number of Gulf operators working for each coastal port and the respective percentage of response.

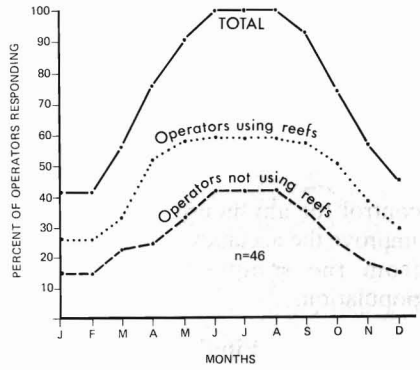


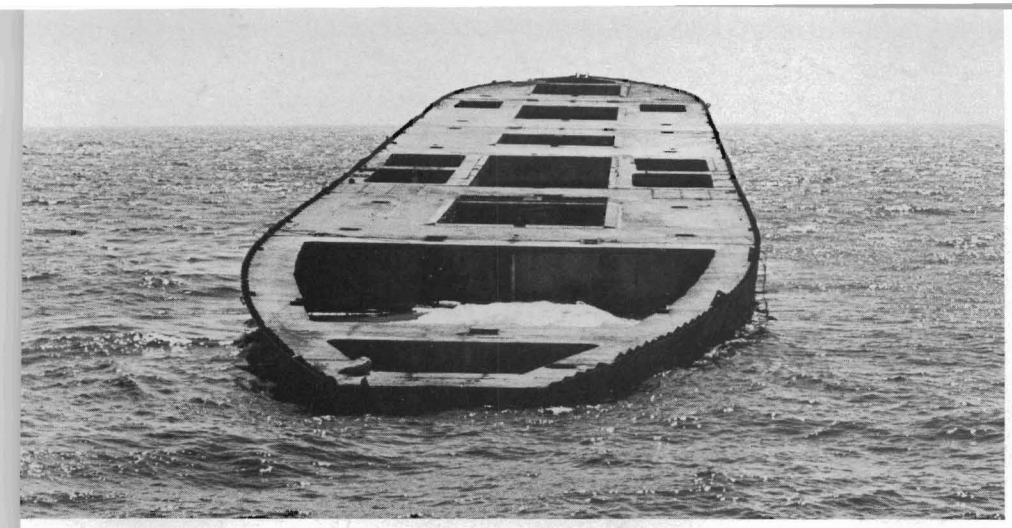
Figure 3.—Seasonality of charter/party operators.

Houston/Galveston Boat Fishermen Survey

We recognized that not all boat owners fish and of those that do, not all fish Liberty Ship reefs. Some boaters fish in freshwater only while others fish freshwater and saltwater. Some saltwater fishermen fish in bays only or offshore only with others fishing in both locations. Therefore, it was necessary to select a sample of sufficient size to be statistically meaningful with regard to subsample findings, for example those who fished Liberty Ship reefs.

There were 113,397 registered pleasure boats in the eight county study area as of October 1977, according to the Texas Parks and Wildlife Department's computerized boat registration file. Boats were classified into categories of less than 26 feet in length and 26 feet in length or longer. A sample of 1,500 (1.34 percent) was drawn from all boats less than 26 feet in length. The number of boats needed from each of the eight counties to provide the sample size was calculated based on a constant sampling proportion. The Texas Parks and Wildlife Department computer then selected from the registration file the specified number of entries from each county using systematic sampling with a random start. The entire population of 1,953 boats 26 feet or longer was included since it was expected that these boats would have a greater propensity to travel offshore to fish and thus utilize the Liberty Ship reefs.

A pretested survey questionnaire was sent to the sample of 3,453 boat owners in March 1978. The total usable response rate for the survey was 50.3 percent. Telephone interviews were conducted with a sample of approximately 200 nonrespondents to



Liberty Ship settles stern first into Gulf waters off Texas. Texas Coastal and Marine Council photo.

Table 1.—Description of charter/party boat operations that used and did not use the Liberty Ship reefs.

Item	Number of operations	Number of vessels in operation	Average number of vessels per operation	Number of trips made to Gulf	Average number of trips per operation	Average distance traveled into Gulf
Reef users	27	72	2.7	4,895	[1]188.3	30.7
Non-reef users	20	28	1.4	1,351	[2]79.5	24.7
Total	47	100		6,246		

[1]Average based on 26 operations which indicated the number of trips they made.
[2]Average based on 17 operations which indicated the number of trips they made.

control for any nonresponse bias and improve the accuracy of extrapolations from the sample findings to the population.

Findings

Charter/Party Boat Operator Survey

Of the 47 operations that responded, 27 (57 percent) indicated they used the Liberty Ship reefs since they were deployed in 1976 (Table 1). These 27 reef-using operations accounted for 72 vessels whereas non-reef-using operations had only 28 vessels. Therefore, the average number of boats was 2.7 and 1.4 for reef-using and non-reef-using operations, respectively. The reef-using operations reported a yearly average of 188 trips into the Gulf, or 72.3 trips per vessel. The non-reef-using operations reported an average of 80 trips into the Gulf, or 57.1 trips per vessel. These findings indicate that in terms of number of vessels and trips, the reefs are used mainly by the larger, multiple boat operations. However, of the 4,895 trips made into the Gulf by the reef-using operations, 600 trips, or 12 percent, were made to the Liberty Ship reefs.

Reef users traveled further seaward than non-reef users. Average one-way distances traveled were 30.7 miles and 24.7 miles for reef users and non-reef users, respectively. For all port areas except Houston and Galveston, however, the average one-way distance traveled seaward by both reef users and nonusers was in excess of the distance to the adjacent reef location. This would indicate that most of the charter/party boats are going beyond the Liberty Ships to other fishing locations.

In addition to the extent of Liberty Ship usage, seasonality of fishing use was investigated. The seasonality of Gulf fishing by reef-users is compared with that of non-reef-users in Figure 3. As shown, 74 percent or more of the operators are engaged in Gulf fishing between April and October. Forty-eight percent of the reef-using operations reported that the Liberty Ship reefs increase the length of their fishing seasons. Many of these operators reported using the reefs in the spring or fall when other forms of fishing were not available. Liberty Ship reef users tended to have periods of inoperation due to a lack of customers whereas nonusers claimed more often that the inoperation was due to a lack of sport fish. This makes sense since the Liberty Ship reefs would increase the number of sport fish but not the number of customers. Therefore the season for reef users is determined to a greater extent by customer demand than the availability of sport fish. The lack of sport fish will affect smaller non-reef-using operations that specialize in fishing for one kind of species, particularly when that species has a specific natural season.

A regional difference is shown in Figure 4 where findings from the South Padre/Port Isabel area are compared with the rest of the coast. Reef-using operations outnumber non-reef-using operations on the rest of the Texas coast while the opposite is true in the South Padre/Port Isabel area. Only 43 of the approximately 600 trips to the Liberty Ship reefs were generated from the latter port areas and 30 of these ships were from a single operator. Most South Padre/Port Isabel operators indicated that the Liberty Ship reefs are too far from shore and that an array of fish are available within a shorter distance from the harbor. Also, South Padre/Port Isabel's southernmost location allows for a longer season and the outer continental shelf is closer to shore giving greater water depths at shorter distances.

Thus, for several reasons South Padre/Port Isabel operators use alternative fishing grounds. Other Texas operators have to travel farther to find alternative fishing areas and tend to make greater use of the new reef resources. Of the approximately 600 trips taken to the Liberty Ships, 557 were to the three northernmost reef areas.

Charter/party boat use of the Freeport Liberty Ship sites originated almost exclusively from Freeport.

Only 2 percent of the trips from Galveston were to the Liberty Ship reefs. The reason reported most often as to why there was so little use from Galveston was that the reefs are too far from the harbor (52 miles).

Eight out of the 10 operators from Freeport used the Liberty Ship reefs. All 10 operators made a total of 2,159 trips into the Gulf. Of these trips, 8 operators made 246 of them to the Liberty Ship reefs. This accounts for 11 percent of the total charter and party boat fishing activity from Freeport.

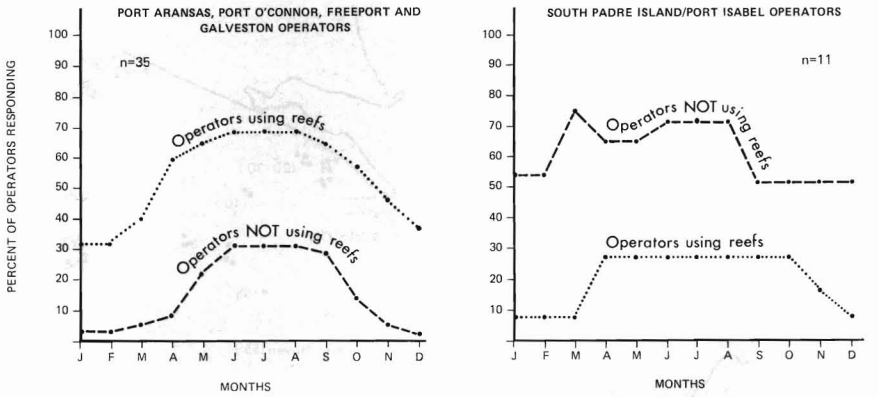


Figure 4.—Seasonality of charter/party use and non-use of the Liberty Ship reefs.

Houston/Galveston Boat Fishermen Survey

The offshore area adjacent to the Galveston Bay system includes a wide variety of artificial fishing attractions in addition to the natural reefs and banks that occur in the area (Fig. 5). Survey results indicated that 5,542 boats were used for fishing this offshore area during 1977. These boats accounted for 66,924 offshore fishing trips during the study year.

Table 2 provides the distribution of this offshore fishing activity across alternative fishing attractions. It is readily apparent from the table that the two Liberty Ship sites in this area accounted for only a small portion (5 percent) of the total number of offshore fishing trips. Fishing around oil platforms was the dominant type of offshore fishing, accounting for 50 percent of all offshore trips. Trolling, which cannot be attributed to any particular type of attraction, accounted for another 31 percent of offshore trips. Three other specific artificial attractions, the Fish Haven, V. A. Fogg, and S. E. Lump, collectively accounted for about as much fishing (6 percent) as the Liberty Ship reefs. Finally, natural reefs and banks attracted about 8.3 percent of the fishing trips during the study year.

When interpreting these findings it is important to remember that, although the Liberty Ships accounted for a small portion of offshore fishing, they represent only two specific offshore fishing sites intermixed among many alternative attractions (Fig. 5). The dominance of oil platform fishing in this area is probably a function of the large number (approximately 138) of oil platforms found at varying distances from shore and major population centers. When fishing participation at Liberty Ships is compared with that at other site-specific attractions or at natural reefs as a whole, the Liberty Ships appear to constitute a significant and competitive attraction to offshore fishermen.

Further insight into the use of Liberty Ships can be gained by considering two additional variables: boat size and port of origin. Relative to boat size, Table 3 presents the distribution of Liberty Ship fishing participation for boats less than 26 feet in length versus those 26 feet or longer. As would be expected, given the relative abundance of smaller boats in the study area, most of the trips to the Liberty Ships were made by boats less than 26 feet in length.

The usual notions of decay in "consumption," or participation, with increasing distance from population centers would suggest that the nearshore ship should be used more than the offshore ship (Clawson and Knetsch, 1966). This is because the costs (in both time and money) of participation are lower for the nearshore reef and hence consumption should be greater at the nearshore location. In general this pattern was observed, but there was a marked contrast in use by boat size between the nearshore ship and the offshore ship.

Table 2.—Extent of fishing participation during 1977 at various offshore fishing attractions.

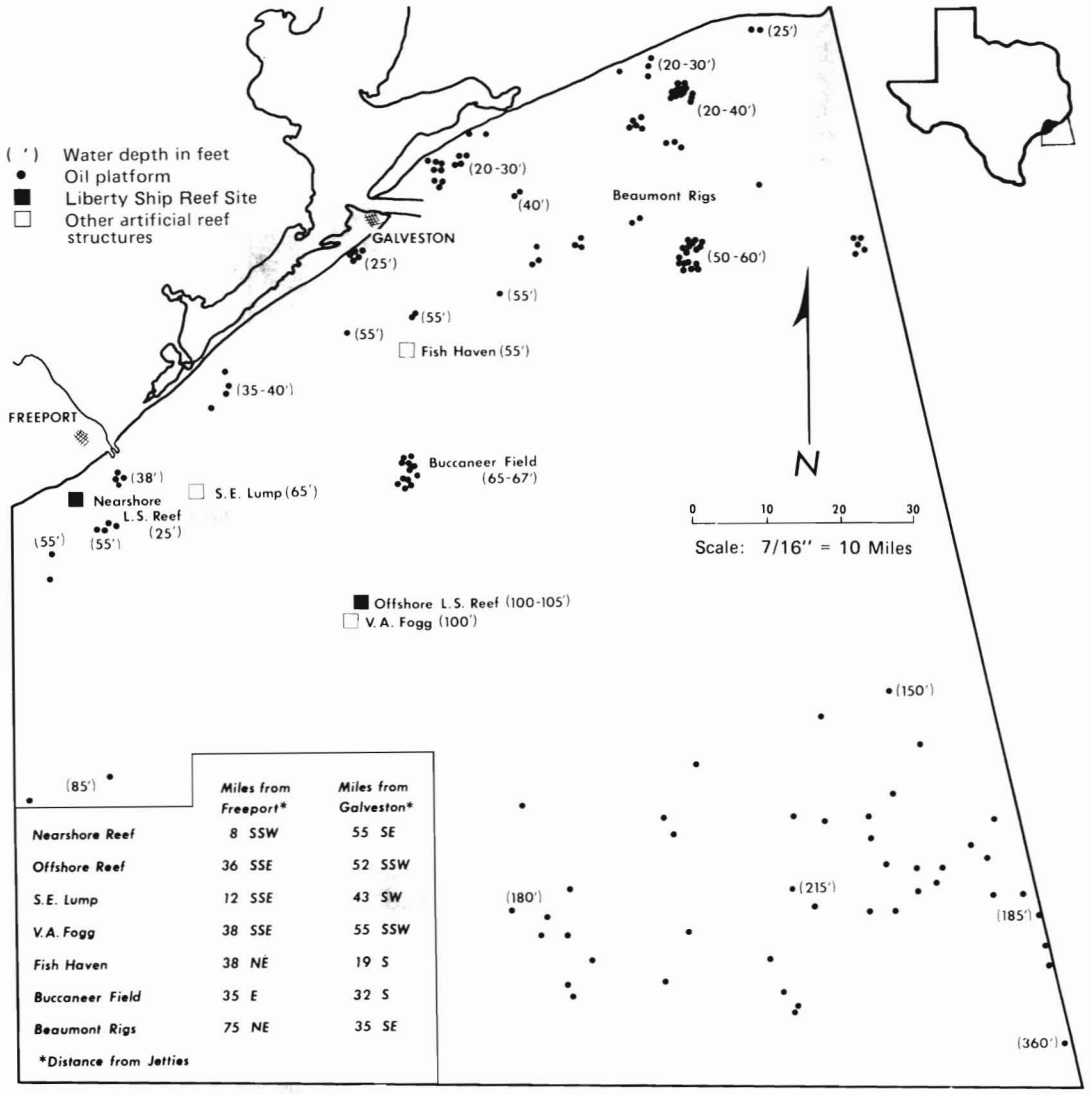
Attraction	No. of trips in 1977 (n=358)	Percent of total trips	No. of person-trips
Nearshore Liberty Ship	1,895	2.8	8,149
Offshore Liberty Ship	1,493	2.2	6,719
Oil platforms	33,434	50.0	133,870
Other artificial attractions[1]	3,959	6.0	15,564
Natural reefs	5,588	8.3	20,676
Trolling (not place specific)	20,555	30.7	84,276
Total	66,924	100.0	269,254

[1]Includes Fish Haven, V.A. Fogg, and S.E. Lump.

Table 3.—Extent of Liberty Ship fishing during 1977 by boat length category.

Attraction	No. of trips-boats less than 26 feet (n=51)	No. of trips-boats 26 feet or longer (n=307)	Total
Nearshore Liberty Ship	1,663	232	1,895
Offshore Liberty Ship	1,078	415	1,493
Total	2,741	647	

The nearshore ship received considerably more fishing use by boats under 26 feet as would be expected, but the offshore ship was used to a greater extent by the larger boats. In fact, the larger boats accounted for almost one-third (28 percent) of the fishing trips to the offshore reef while they accounted for only 12 percent of the fishing trips to the nearshore reef. Thus, boats 26 feet or longer showed a reversal of the expected distance decay



	Miles from Freeport*	Miles from Galveston*
Nearshore Reef	8 SSW	55 SE
Offshore Reef	36 SSE	52 SSW
S.E. Lump	12 SSE	43 SW
V.A. Fogg	38 SSE	55 SSW
Fish Haven	38 NE	19 S
Buccaneer Field	35 E	32 S
Beaumont Rigs	75 NE	35 SE

*Distance from Jetties

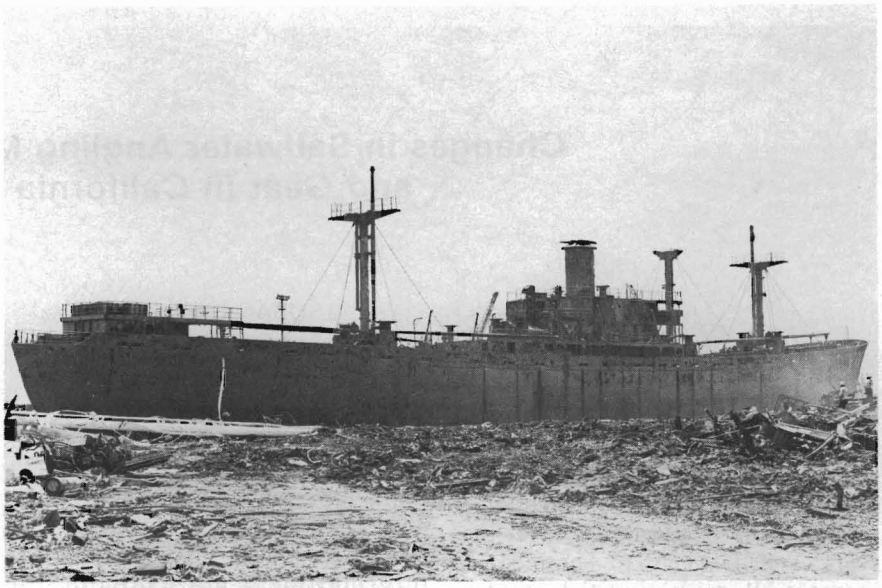
Figure 5.—Map of the offshore area adjacent to the Galveston Bay system.

relationship: almost twice as many trips by such boats were made to the more distant reef. This finding suggests that variables other than distance are considered by offshore fishermen in selecting fishing locations. Considerations of water depth as it relates to species of fish sought, for example, probably draw many fishermen beyond the nearshore Liberty Ship. Thus, the nearshore ship may be a popular attraction for those boats which are limited by their size and equipment to staying within a few miles of shore, but the offshore ship site and its related fisheries are more attractive to those which have the capability of traveling 30 miles or farther offshore.

Considering the port of origin of Liberty Ship fishermen provides further insight into patterns of participation. Most fishermen in the region generally launch their boats at Freeport or Galveston, although some boats are kept in marinas or launched at other locations along the coastline. However, nearly all of the fishing at the Liberty Ships originates from Freeport, the closest access point. Table 4 presents the percentage of offshore fishermen utilizing each major access point who used the Liberty Ships during the study year. Despite the relatively large number of fishermen who launch at Galveston, almost none of them traveled the 50 or more miles to reach either Liberty Ship site. On the other hand, a noticeable proportion of Freeport fishermen did utilize each reef. When one considers the 5 percent of offshore trips that Liberty Ships account for in terms of the relatively large size of the regional population and the fact that nearly all of these trips are channeled through Freeport, it is apparent that the impacts of the Liberty Ships on this single local community could be considerable.

Table 4.—Relative distribution of participation in Liberty Ship fishing by major access point.

Attraction	Boats less than 26 feet: Percent of Freeport offshore fishermen (n=19)	Boats less than 26 feet: Percent of Galveston offshore fishermen (n=23)	Boats 26 feet or longer: Percent of Freeport offshore fishermen (n=104)	Boats 26 feet or longer: Percent of Galveston offshore fishermen (n=108)
Nearshore Liberty Ship	26	0	21	1
Offshore Liberty Ship	11	4	30	3



A Liberty Ship is prepared for use as an artificial reef. Texas Coastal and Marine Council photo.

Conclusions

To what extent are the Texas Liberty Ships used for recreational fishing? This study indicates that the ships attract both private boat and charter/party boat fishermen. The ships probably have the greatest impact on the charter/party boat fishery for they contribute to the livelihood of the operators and create recreational opportunities for the customers. While they account for 10 percent of all offshore trips by charter/party boats, the Liberty Ships extend the season for some operators by providing concentrations of fishes at locations and at times when they would otherwise be lacking. Relative to private boat fishing, the Liberty Ships account for a portion of offshore fishing which is comparable with the extent of fishing at other site-specific artificial or natural offshore attractions.

Nearly all use of the northernmost reefs (charter/party and private) was found to originate from the closest access point, Freeport. The attraction of the reefs did not appear to extend to nearby access points or population centers, as illustrated by the relative lack of Galveston fishermen who used the reefs. Further, the effect of location of the reef, or distance, appears to be related to both the availability of alternative fishing grounds and the capability to travel great distances offshore. Regional differences in charter/party boat use patterns suggested that competing opportunities was an import factor influencing whether or not the ships were used. Private boats similarly showed a sensitivity to the supply of alternative attractions but also were limited in the distances they could travel offshore by their size and equipment. The nearshore reef (8 miles from Freeport but only 4 miles from land) was more popular among small boats which are generally incapable of traveling farther offshore. The offshore reef (36 miles from Freeport), on the other hand, was more popular among larger boats with greater travel capability, suggesting that perhaps the offshore ship provides a better "quality" reef for the relatively few whose boats are able to reach it.

This study has focused on recreational fishing use of Liberty Ships as one category of benefits that have resulted from this public investment program. This is not to imply that there are no other benefits of the program nor that there are no costs. To fully comprehend the merits of the decision to deploy ships as reefs in Texas and elsewhere, further research should focus on analyses of all costs and benefits associated with each program.

Literature

Buchanan, C. C. 1972. A comparison of sport fishing statistics from man-made and natural habitats in the New York Bight. Coastal Plains Cent. Mar. Dev. Serv., Semin. Ser. 1:27-37.

_____. 1973. Effects of an artificial habitat on the marine sport fishery and economy of Murrells Inlet, South Carolina. Mar. Fish. Rev. 35(9):15-22

Clawson, M., and J. L. Knetsch. 1966. Economics of outdoor recreation. The Johns Hopkins Press, Baltimore, 328 p.

Daniel, D. L., and J. E. Seward. 1974. Natural and artificial reefs in Mississippi coastal waters: Sport fishing pressure and economic considerations. Bur. Bus. Res., Univ. South. Miss., Hattiesburg, 27 p.

Heffernan, T. L., A. W. Green, L. W. McEachron, M. G. Weixelman, P. C. Hammerschmidt, and R. A. Harrington. 1975. Survey of finfish harvest in selected Texas bays. Tex. Parks Wildl. Dep. Proj. No. 2-231-R-1, Austin, Tex., 115 p.

Parker, R. O., Jr., R. B. Stone, C. C. Buchanan, and F. W. Steimle, Jr. 1974. How to build marine artificial reefs. U.S. Dep. Commer., NOAA, Natl. Mar. Fish. Serv., Fish. Facts 10, 47 p.

Steimle, F., and R. B. Stone. 1973. Bibliography on artificial reefs. Coastal Plains Cent. Mar. Dev. Serv. Publ. 73-2, 129 p.

Stone, R. B. 1974. A brief history of artificial reef activities in the United States. *In* Proceedings: Artificial reef conference, p. 24-27. Tex. A&M Univ. Cent. Mar. Res., Houston.

Texas Coastal and Marine Council. 1976. Liberty Ship reef program. Public Brochure.

Vetter, R. D., and O. A. Roels. 1977. An assessment of the sportfishery on artificial Liberty Ship reefs off Port Aransas, Texas. Rep. to Tex. Coast. Mar. Counc., Univ. Tex. Mar. Sci. Inst., Port Aransas Mar. Lab., 11 p.

_____, and _____. 1978. The icthyofaunal composition and trophic interactions of the artificial Liberty Ship reefs off Port Aransas, Texas. Rep. to Tex. Coast. Mar Counc., Univ. Tex. Mar. Sci. Inst., Port Aransas Mar. Lab., 13 p.

Weiss, C. H. 1972. Evaluation research; methods for assessing program effectiveness. Prentice-Hall, Englewood Cliffs, N.J., 160 p.