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Catch Trends and Fish Utilization in Virginia's Offshore Recreational Pelagic Fishery: For the Period: September 1, 1986 - August 31, 1987 (work period extended to March 31, 1989

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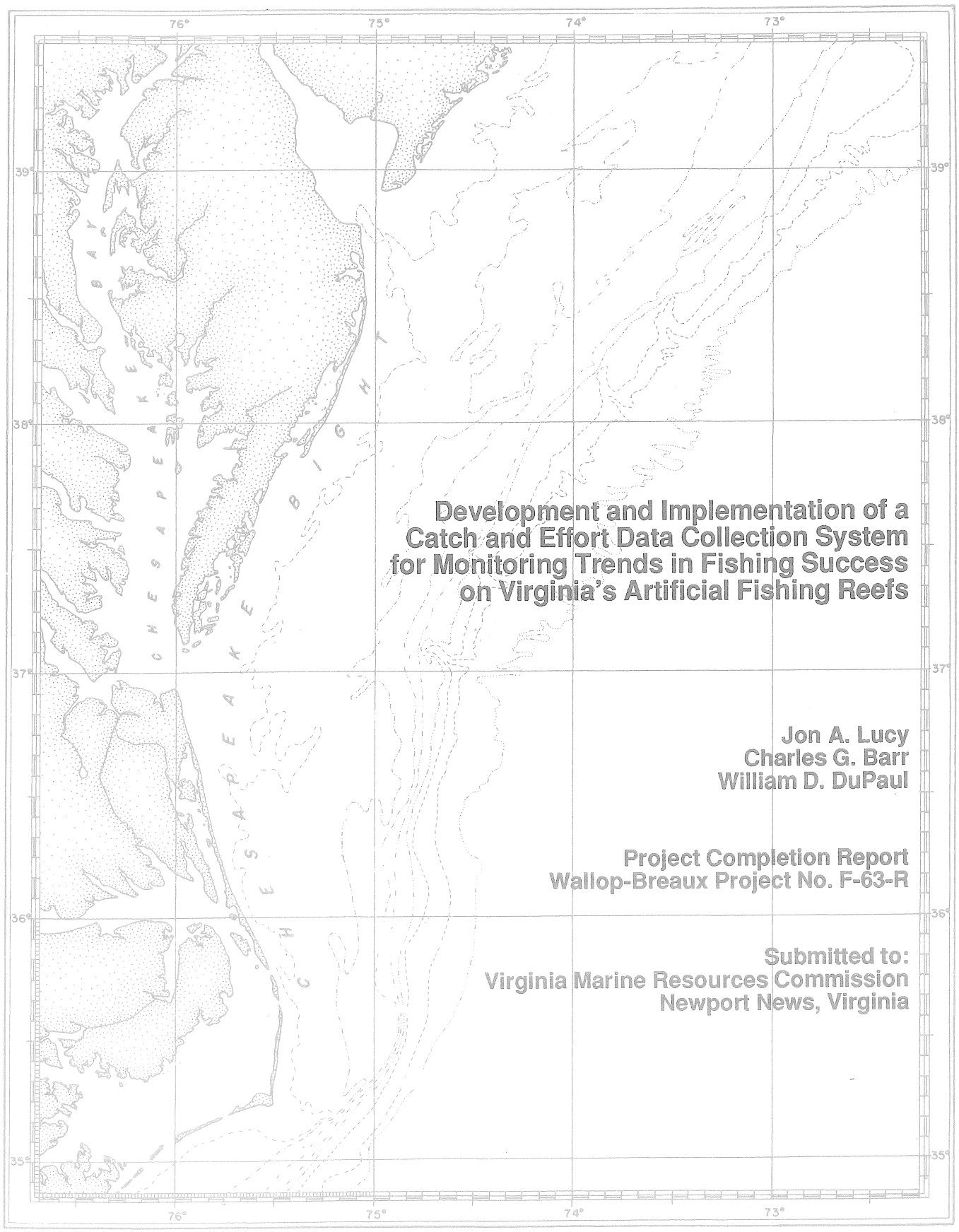

Development and Implementation of a Catch and Effort Data Collection System for Monitoring Trends in Fishing Success on Virginia's Artificial Fishing Reefs

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Project Completion Report
Wallop-Breaux Project No. F-63-R

Submitted to:
Virginia Marine Resources Commission
Newport News, Virginia

Department of Marine Advisory Services, Virginia Institute of Marine Science, School of Marine Science, College of William and Mary, Gloucester Point, Virginia

Project Completion Report
(Year One of Two-Year Project)

Wallop-Breaux Project Number F-63-R
(Sport Fish Restoration Act Fund)

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For the Period: September 1, 1986 - August 31, 1987
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Mr. Meier of the VMRC was particularly helpful in discussing various aspects of the study throughout the project and readily supplied names of fishermen to the researchers for inclusion in the study's sample population of reef fishermen. Mr. Jack Travelstead, Head of VMRC's Fisheries Division was also most helpful through his role as overall administrator of Virginia's "marine" Wallop-Breaux projects. Of particular assistance to the project was Mr. Travelstead's convening of a meeting in early June 1987 involving the principal investigator, Mr. Meier, and Dr. David Feigenbaum of Old Dominion University. Discussions of early results of the project initiated the idea for adding a question to fishermen's interviews concerning their rating the overall quality of their fishing experiences on

wreck/reef sites. This information proved to be extremely helpful to the researchers in evaluating circumstances at sites which contributed to good or bad fishing experiences. In addition to participating in the described meeting, Dr. Feigenbaum has proven helpful on other occasions throughout the study with regard to exchanging ideas on various aspects of the study.

The data analysis and preparation of report tables could not have been completed without the tireless dedication of Ms. Nancy Chartier and Mr. Edward Heist, Graduate Assistants in VIMS Department of Marine Advisory Services. Both individuals made significant contributions to the project and its final report. A similar contribution to the project was made by Ms. Maxine Butler, Secretary in VIMS Department of Marine Advisory Services. In addition to her many diverse and difficult duties, Ms. Butler found the energy and patience to rework the numerous drafts of the project report and to produce the final copy for printing. Her assistance, like that of Ms. Chartier and Mr. Heist, was critical to the successful completion of the project. The VIMS Report Center assisted with portions of the draft report. The final report was printed by Ms. Sylvia Motley of VIMS Print Shop. Ms. Cheryl Teagle, Office Services Supervisor of the Department of Marine Advisory Services, and Ms. Jane Lopez of VIMS Finance Office provided administrative assistance to the project.

Numerous Virginia fishing clubs and marina/tackle shop operators helped the researchers identify wreck and reef fishermen utilizing certain artificial reef sites. The Deltaville Fishing and Conservation Club was of major assistance to the project. In addition to providing names of its members who fished the Gwynn Island Test Reef, the Club also printed signs displayed at local businesses encouraging Gwynn Island reef fishermen to establish contact with the Club and/or VIMS researchers to become

incorporated into the sample population of fishermen for the project. Mr. James Wharton, club president, Mr. Gene Sidoli, Captain Tabb Justis, and Mr. Pat Watson were particularly helpful in spreading the word on the researchers' need to identify fishermen utilizing the Gwynn Island Reef site. Mr. Wharton also graciously invited the researchers to join him on a fishing trip to the reef, an experience which helped the researchers better interpret interview information obtained from fishermen during the study.

Other individuals, fishing clubs, organizations and businesses that went out of their way to assist the project in identifying fishermen were the following: the Virginia Saltwater Fishing Tournament in providing addresses of certified weigh stations for distributing flyers on the study (Appendix A); Mr. Dee Johnson and Mr. Bruce Easley of the Peninsula Saltwater Sport Fisherman's Association; Messrs. Roy Cahoon and George Cooper, Sr. of the Portsmouth Anglers Club; Mr. John Wetlaufer of the Virginia Anglers Club; Captain Charlie Ward of the Virginia Charter Boat Association; Mr. Carl Herring and Mr. Herb Gordon, president and secretary respectively of the Virginia Federation of Anglers, and Mr. Chuck Traub of the Virginia Wildlife Federation for reprinting articles on the project in their publications; Mr. Chuck Guthrie of Lynnhaven Marine Center in Virginia Beach; Mr. Chris Plakas of Walden Brothers Marina in Deltaville; Mr. Robert Reiner of Chesapeake Cove Marina in Deltaville; Mr. Wayne Pulley of Pulley Marine on Gwynn Island; Mr. R. S. Edwards of Edwards Marine Railway on Gwynn Island; Ms. Gay Webster of the New Point Campground in Mathews County; Mr. Warren Cobb, Ms. Nancy Cobb and the entire Cobb family, owners of Cobb's Marina on Little Creek in Norfolk; Captain Fred Feller of the Virginia Beach Fishing Center; Captains Randy Lewis and Robert Fate of the Wachapreague Marina; Captain Gordon Eastlake, chartering out of Wachapreague; Captains

Otis Asal and Donald Stiles, charter captains working out of Kings Creek Marina in Cape Charles; Mr. Tom Armstrong of Boat U.S. in Virginia Beach; and Mr. Leigh Tighe of the Tidewater Sea Urchins dive club for numerous observations on tautog and seabass movements on offshore reef sites. This listing does not include all of those individuals who helped the project by encouraging wreck fishermen to participate in the data gathering process. To such persons, as well as to those specifically mentioned, we owe a debt of gratitude for their contribution to the study.

Special mention must be made of the assistance provided the researchers by Mr. L. T. "Curley" Edwards of North, Virginia in Mathews County. Known to everyone who fishes the Gwynn Island Test Reef site, Mr. Edwards graciously invited the researchers to his home to discuss productive fishing techniques he utilizes in his almost daily trips to the reef site during the fishing season. Mr. Edwards also alerted other anglers using the Gwynn Island reef to the researchers need for information, thereby helping significantly in familiarizng fishermen with the study. Regardless of how things were going for him at the time, Mr. Edwards always shared information with the researchers about how the Gwynn Island Reef was performing for local fishermen. The research team owes Mr. Edwards a debt of gratitude for the unselfish amount of time and assistance he provided the project.

In a similar manner, most of the fishermen interviewed during the project gave freely of not only their catch information but also of their time in providing useful information about fishing situations they experienced on various wrecks and artificial reefs. While the latter information was impossible to quantify, it provided a very useful framework for researchers to use in evaluating some of the project's results. A special "thank you" is due to all fishermen who provided their names for use

in the project's sample population of wreck/reef fishermen, as well as to those who were interviewed during the course of the season. The study could not have been done without their willingness to assist the researchers in quantifying fishing activity on Virginia's wreck/reef sites.

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INTRODUCTION

Recreational fishing opportunities in Virginia for species associated with hard bottom habitats such as natural oyster reefs and/or man-made structures have been enhanced since the early 1970's through an artificial reef construction program coordinated by the Virginia Marine Resources Commission (VMRC). This program evolved under the Commission in response to private interests initiating reef development projects beginning as early as 1959. As more interest developed in establishing reef sites there became a growing need for state assistance in coordinating permits and the placement of reef materials on subaqueous bottoms under the jurisdiction of the Commonwealth and the federal government (Lucy, 1983a, Meier et al., 1985). Virginia's growing artificial reef program led the VMRC to contract with Old Dominion University (ODU) for a three year study (1983-85) of potential reef sites in Chesapeake Bay and offshore waters. The study effort provided an assessment of two test reef sites established inside Chesapeake Bay and one site offshore Wachapreague on the Eastern Shore. The test reef sites were monitored by researchers using rod and reel fishing techniques designed to compare the results of fishing effort on each reef site and adjacent "control" areas not containing reef materials. (Feigenbaum, 1984; Feigenbaum et al., 1985a; Feigenbaum et al., 1985b; Feigenbaum and Blair, 1986). As part of the study, recommendations were made for future artificial reef development in Virginia (Feigenbaum and Blair, 1986).

This project is intended to complement the previous study, establishing a data base of recreational fishermen's catch success rates on major reef sites. By systematically collecting and analyzing catch and effort data from recreational fishermen utilizing the reef sites, as well as recording

observations about how the reefs are most effectively fished, researchers seek to provide the VMRC with information that will assist in better placement and design of productive reef sites. This study will also help document current use patterns and the relative popularity of various reef sites among recreational fishermen.

OBJECTIVE

The basic objective of the study was to identify a core population of recreational fishermen owning private boats and fishing one or more Virginia artificial reef sites (Fig. 1) with some degree of regularity (making a minimum of two to three reef trips per season). This developing and expanding population of fishing boat owners was to be sampled randomly, by either telephone or fishing log books, to determine fishing effort and catch rates characterizing trips made to specific reef sites during the 1987 fishing season. Examination of the resulting data would provide a basis for determining whether all, or only a limited number of reef sites, could be successfully monitored during the study's second year. Based upon results of the first year's project, the study's methodology would be retained and/or modified during the second year to collect additional data on fishing success rates at various reef sites.

METHODS

A chart showing the locations of Virginia's three test reef sites and four major reefs was printed, including the listing of LORAN C coordinates of major materials on each site. On the reverse side of the chart were

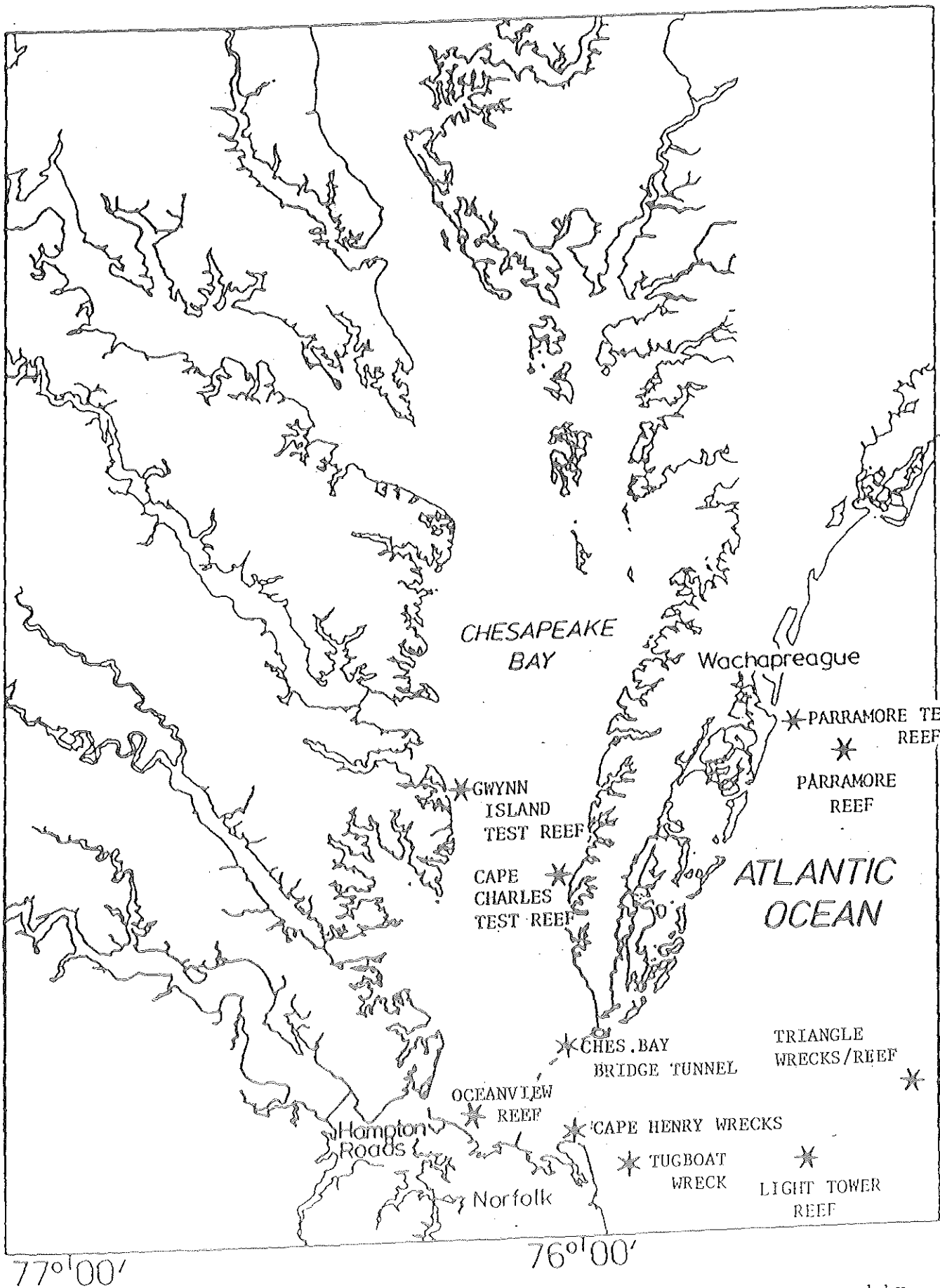

Fig. 1. Locations of artificial reefs and other major fishing sites targeted by wreck and reef fishermen during 1987 (adapted from Feigenbaum and Blair, 1986).

spaces for reef and wreck fishermen to provide VIMS researchers with their names, mailing addresses and telephone numbers, in order to assist with the reef study (Appendix A). These charts, with associated wreck fishermen identification forms on the back, were sent to major saltwater fishing clubs of coastal Virginia, requesting that they encourage wreck and reef fishing members to participate in the study. In addition, the charts, with stamped return envelopes, were sent to major marinas in the port areas serving artificial reef sites and to the majority of official weigh stations certified by the Virginia Saltwater Fishing Tournament. In addition to these efforts the researchers addressed fishing clubs, visited docking and launching facilities, promoted the study at the Virginia Sport Fishermen's Forum (Feb. 1987), prepared news releases for major metropolitan newspapers (Appendix B), and highlighted the need for fishermen's participation in the study in VIMS "Marine Resource Bulletin" (a quarterly newsletter with circulation of over 6,800) (Appendix C). Through these various techniques a population of boat-owning reef and wreck fishermen was established for sampling purposes of the project. From experience gained with studies of the offshore recreational pelagic fishery (Bochenek et al., 1988; Lucy et al; 1988), it was determined that the identified population of fishermen would best be sampled using a random telephone interview technique.

General Sampling Program for Major Wreck/Reef Sites

Two week (14 day) random telephone sampling "wave date" intervals were established for the general reef and wreck sampling program, with the first random telephone calls made on April 13-15 for the fishing (sampling) period of March 30-April 12. Each sampling period extended from Monday through the

second weekend of the two week time frame. Two weekends, the time of most private boat fishing activity, were covered in each telephone sample. For each sampling period a random selection of letters was made from the alphabet using a random numbers table. These letters were used to determine from which alphabetical group of fishermen's names interviewees would be selected. Fishermen's names were then randomly chosen from within each group of last names beginning with the randomly selected letter. Calls were made to the 25-30 randomly selected fishermen until 20 fishermen had been reached. When contacted, fishermen were asked about reef or wreck fishing trips they might have taken aboard their boat during the specified sampling period. Telephone calls were predominately made in the evenings to home telephone numbers supplied by the study participants, but calls were also made to work locations during the day, whenever such numbers were provided by fishermen. All calls were generally completed on Mondays through Wednesdays of the week immediately following the sampling period.

If contacted fishermen could adequately recall catch data on reef or wreck fishing trips made prior to the specified fishing period, these trips were recorded as "non-wave-date" recall trips and the data included with that obtained for the earlier sampling period in question. Such trips helped to supplement the small total number of artificial reef trips generally accounted for in each sampling period and provided broader coverage of numerous non-reef "wreck" and "Chesapeake Bay-Bridge Tunnel" trips made by fishermen.

By collecting data on both artificial reef and other "wreck" trips, some comparison of catch rates at both types of sites could be made. For the general survey beginning in April, fishermen's names were not reused in the telephone sampling list for at least one month. This reduced the number

of repetitive calls to the same fishermen, while also helping to insure that the majority of the population of identified fishermen would be contacted at least once during the fishing season (Bochenek et al., 1988).

Special Sampling Program for Gwynn Island Test Reef Site

The Gwynn Island Test Reef Site was of special interest to researchers because of the relatively poor catch rate performance rating it received in the Old Dominion University study (Feigenbaum et al., 1985a; Feigenbaum and Blair, 1986). The study results contrasted with reports from fishermen in the local area indicating that the site was fairly popular, producing reasonable catches of trout and spot during the summer months and some tautog in the fall (Feigenbaum et al., 1985a; Deltaville Fishing and Conservation Club, personal communication).

Telephone interviews for the first four general sampling periods, a total of 80 fishermen, produced no trips taken to the Gwynn Island Test Reef. Researchers were concerned that sufficient data would not be obtained during the season to document catch trends at this particular reef. A sampling strategy was designed to address this concern. With assistance from the Deltaville Fishing and Conservation Club and marina operators and tackle shops in the Deltaville-Gwynn Island-Mathews County area, a more concerted effort was initiated to identify a larger number of boat owners fishing the Gwynn Island Test Reef. A random telephone sampling of ten such fishermen per two-week period was begun June 1-3 for the sampling (fishing) period May 18-31, a schedule that alternated this special sampling effort with the general sampling schedule initiated for all reef sites beginning in April.

Because the population of Gwynn Island fishermen was small, especially at the beginning of the newly established special sampling program, names of such fishermen were only withheld from the random drawing of names for one sampling period before being put back into the Gwynn Island Reef population of fishermen. The designated "Gwynn Island fishermen" were also left in the total population of fishermen from which random interviews continued to be made in the general sampling effort for all reef sites. This provided the opportunity at the end of the season to compare the size of resulting data sets (number of usuable interviews) recorded for the Gwynn Island Test Reef site from the two distinctive sampling efforts. The revised sampling protocol was continued throughout the study into November (last fishing period sampled was November 2-15).

Regarding fishing trips to the Gwynn Island Test Reef, particular care was taken by researchers to include in the analysis only trips during which fishing activity was either concentrated directly on the reef materials or within approximately 325 yards (approximately 300 meters) of the reef's periphery. Bohnsack and Sutherland (1985), in their review paper on reef research, indicated that the "enhanced fishing zone" around reefs was generally accepted as being 200-300 meters wide for midwater and surface fishes and up to 100 meters wide for benthic fishes. Since both categories of fish were caught at the site, the 325 yard zone concept was utilized in determining which recorded trips, although occurring in the vicinity of the reef, should not be considered strictly "reef" trips for purposes of the study's analysis. As expected, reef fishermen sometimes had difficulty estimating how far away from the reef (two buoys) they fished. As researchers interviewed fishermen and explained the distance problem and its importance, fishermen became more attuned to the study's requirements and

more precise in describing the ways in which they fished the reef site, including estimating distances fished from the reef.

Data Collected

In both sampling programs records of fishing effort (number of fishing trips) were maintained for each sampling period and basic catch data recorded for each reef and wreck fishing trip adequately recalled (see telephone interview instrument, Appendix D). Concerning catches, fishermen were asked to list what fish(es) they were trying to catch (targeted species), all types of fish caught, the number kept and released of each species, and the estimated average weight of fish kept and released by species. In early July, a question rating the overall quality of each fishing trip experience was added to the telephone interview instrument as a result of discussions with the project coordinator, Mr. Jack Travelstead of VMRC. Since the recall periods were only 14-18 days long, the majority of fishermen contacted responded quickly and in excellent detail to the interviewer's questions. Interviewing was terminated in late November 1987 when weather consistently prevented fishermen from making reef or wreck fishing trips and the majority of such fishermen indicated they were "finished fishing for the season". Since data recorded for Gwynn Island Test Reef fishing trips was collected in the same random manner for both the general sampling program (14 trips) and special program (46 trips), the data sets were combined (60 trips) for the comprehensive monthly and seasonal analysis of the Gwynn Island site presented in the special sampling program section of the report.

RESULTS AND DISCUSSION

During the fall months of 1986 through early spring, efforts were concentrated on identifying a cross section of primarily private boat fishermen who wreck fished and included artificial reefs, to some degree, in their fishing activities. Mailings to fishing clubs, marinas and certified Virginia Saltwater Fishing Tournament weigh stations produced the bulk of the population of fishermen identified. The study population numbered approximately 125 individuals at the beginning of the telephone interview effort in early April. Throughout the year, television talk show interviews on the project, newspaper articles by outdoor writers, and growing contacts with wreck fishermen as the study progressed, continued to add fishermen to the study population. By the end of 1987 the population of identified wreck fishermen, from which individuals could be randomly sampled, had increased to approximately 250. Of this population, 66 fishermen were designated as concentrating their fishing efforts on the Gwynn Island Test Reef site.

General Sampling Program for Major Wreck/Reef Locations

The results of the general sampling effort indicated that wreck/reef fishing effort was largely directed towards a limited number of popular sites. Nine major fishing sites were targeted by the majority of fishermen in the sample population (Table 1). Of 119 fishing trips recorded from the general telephone interview sampling effort, 93 (78%) trips targeted these sites, including the Chesapeake Bay Bridge Tunnel (CBBT), largest of the "artificial reefs" existing in Virginia waters (Figure 1). The popularity of the Bridge Tunnel complex, and its accessibility from lower Chesapeake

Bay launching facilities, resulted in this site being fished more frequently than any other wreck or artificial reef site (22.7% of all trips and 22.4% of all fishing effort/rod hours recorded in the interview sampling). Fishing trips to the CBBT's third island, supporting the southern end of the most northward tunnel section, accounted for almost half of the structure's fishing activity.

Distribution of Fishing Effort and Characteristics of Fishing Trips

The most popular wreck/reef fishing sites ranking behind the CBBT were the Gwynn Island Test Reef site (11.8% of all recorded trips and 10.5% of all fishing effort/rod hours); the Triangle Wrecks area (all trips combined), including the Liberty Ships placed on the site by VMRC (10.1% of all trips and 13.5% of all fishing effort/rod hours); and the Chesapeake Light Tower Reef, one of the oldest of Virginia's artificial reefs (Lucy, 1983a; Meier et al., 1985) (9.2% of all trips and 8.0% of all fishing effort/rod hours) (Table 1). Activity directed strictly at the Triangle Wreck's Liberty Ships, accounting for one third of trips to the Triangle Wrecks area, was analyzed separately from the area's other wrecks, since the Liberty Ships technically constituted the "artificial reef" element of the overall site.

The popularity ranking of the previously mentioned sites is attributed to their access (proximity to launching facilities and ease in locating them on the water), word-of-mouth popularity, and the distribution of fishing area preferences of fishermen in the study's sample population. The special effort to identify fishermen targeting the Gwynn Island Test Reef site, for purposes of conducting a more intensive sampling of fishing activity

associated with the site, resulted in approximately 25% of the total sample population being "Gwynn Island Reef" fishermen. The popularity of the Gwynn Island Reef was, therefore, somewhat positively biased in the general sampling program.

Comparing the ranking of the targeted sites, in terms of actual number of trips versus fishing effort (rod hours fished), indicated no major change in ranking between the two effort measurements except for the Triangle Wrecks (non-Liberty Ships) area. Slightly longer average time spent fishing on these wrecks per trip (5.8 hours per trip) (Table 2) resulted in the area moving up to fourth place in terms of rod hours fished, compared to its sixth place ranking in number of trips.

The 26 remaining fishing trips not accounted for by the targeted fishing areas listed in Table 1 were spread among 14 wreck, structure (e.g. the Cell), or artificial reef sites, approximately half of which were in the Bay and half offshore. Only two trips were recorded in the overall season's sampling effort for the Cape Charles Test Reef site and no trips were recorded for the Parramore Test Reef site, located inshore of the older Parramore Artificial Reef approximately four nautical miles offshore Wachapreague Inlet (Fig. 1). This latter site lost some of its tire module units in 1984-85 (Feigenbaum and Blair, 1986) and, not being recently buoyed, has been difficult to locate for fishermen (M. Meier, VMRC, personal communication). The Cape Charles Test Reef site, having been inconsistently buoyed, has also proven difficult to locate for some fishermen. In addition, interference with and/or slight variation in LORAN C signals in the lower Bay seemed to contribute to fishermen having difficulty locating the Cape Charles Test Reef (M. Meier, VMRC, personal communication).

Basic characteristics of fishing trips targeting the most frequently fished "wreck/reef" locations indicated a slightly longer mean fishing time per trip (5.4-5.8 hours fished) for trips to the Triangle Wrecks areas, located approximately thirty nautical miles offshore (Table 2). Compared to trips targeting more inshore locations such as the Bridge Tunnel (4.4-4.8 hours fished), and even sites moderately far offshore such as the Chesapeake Light Tower Reef (3.4-3.7 hours fished), trips to the Triangle Wrecks were characterized by longer average fishing periods. Slightly higher numbers of anglers per trip (3.3-3.6 anglers) at the Triangle Wreck site, together with the greater mean fishing time per trip, resulted in the mean fishing effort (rod hours) per trip at the site being greater (17.5-20.0 rod hours) than for any other targeted fishing areas. Statistical comparisons of fishing effort were not made because of the small sample sizes involved.

The last column of the Table 2 indicates the mean number of boats estimated to have been fishing simultaneously on the reef or wreck site during a given captain's trip to the site. The initial estimates of "other boats fishing" on the site were each increased by one boat (see question on interview instrument, Appendix D), thereby also accounting for the boat whose captain provided the estimate. The values are obviously affected by captains' abilities to accurately estimate how many different boats fished a site during his/her own fishing time in the area. The estimates are also affected by differences in captains' opinions as to which boats within sight were actually fishing the wreck or reef in question. Within these limitations, however, and considering guidance provided during the interview process whereby only those boats actually in "close" proximity to the site were to be included in estimates, the observations provide a relative index of fishing activity on the major wreck/reef sites included in the study.

The Bay Bridge Tunnel led all other locations in mean boats fishing the site per fishing day. The CBBT estimates are likely low, however, since the approximately 17 mile long structure and its curving configuration prohibit accurate estimates of the total number of boats fishing the site at any given time, e.g. boats may be out of sight behind one of the four tunnel islands, out of sight at the far end of the complex, etc. Taking counting problems into account, the relative index indicated roughly similar levels of mean daily fishing activity (mean boats fishing per day) at the Triangle Wrecks (non-Liberty Ships) and the Gwynn Island Test Reef sites (5.3 boats fishing per day compared to 6.1 boats per day respectively, with similar numbers of observations). The well-known Cape Henry Wrecks at the mouth of the Chesapeake Bay received lower levels of fishing trip activity than the Gwynn Island site, while the Chesapeake Light Tower Reef received a higher rate of fishing pressure. The newest Virginia reef site, the Oceanview/Little Creek Reef in the lower Bay off Norfolk (Fig. 1), appeared to support as many boats per day as the Gwynn Island site, but the number of observations at the former site were quite limited (only three trip interviews).

The fishing activity index value obviously reflects both the popularity of a site (how accessible and consistently productive it is), as well as the number of boats the site can practically support per day. This latter factor is a result of the size of the reef, the physical distribution of its materials, and how the site can be fished, e.g. being able to anchor, drift, or troll the site according to the customary practices of fishermen using it.

Catch Trends and Quality Rating of Fishing Trips

Tautog and Seabass Catches

Virginia fishermen fishing wrecks, artificial reefs, and other structures principally target tautog (Tautog onitis), and seabass (Centropristis striata), on offshore reefs and, to a lesser extent, seek the same species, sometimes more so in the cooler months of spring and fall, at sites in the lower Bay. During 1987 fishermen customarily fishing popular offshore wrecks and reefs early in the season reported poor catches of tautog and seabass, when catches were normally expected to be good (Capt. C. Ward, and C. Bain, personal communications). A cool spring and heavy freshwater runoff from Chesapeake Bay was felt to be negatively influencing offshore wreck fishing (Capt. C. Ward and C. Bain, personal communications). Relatively cold bottom water on the continental shelf, even for inshore areas, can also result when prevailing westerly winds blow surface water offshore, causing upwelling and inshore movement of colder continental slope water (R. Gammisch, personal communication). Unusually cold and murky water was reported by recreational divers on the bottom in the vicinity of the Chesapeake Light Tower during late spring (May 30-31) (Capt. C. Ward, personal communication). During a side scan sonar survey of the Light Tower Reef site in May 1987, dense (cold) water was noted on the sonar readout (R. Gammisch, personal communication) and checking bottom temperatures with a reversing thermometer indicated the bottom water to be approximately 42-43 degrees F compared to surface water temperatures around 56 degrees F (C. Ward, personal communciation). These conditions may have contributed to somewhat lower than normal spring catch rates for tautog and seabass at some

of the popular wreck/reef sites (Table 3). Particularly for tautog, with spring catches constituting the bulk of the season's catches, catch rates were considerably reduced for 1987 (130 Virginia citations for fish weighing a minimum of nine pounds compared to 390 citations in 1986) (C. Bain, personal communication; VSFT, 1987).

Mean tautog catches ranged from 0.03 fish per rod hour at the Gwynn Island Test Reef to 1.4 fish per rod hour at the third island of the Bay Bridge Tunnel. No tautog trips were recorded in the spring and summer months for the Gwynn Island site, only for late October and November (see Table 14 and later section on special Gwynn Island sampling effort). This helped explain why the site produced such small catches for the season as a whole (Table 3). Comparable to tautog catches at the CBBT third island, catches elsewhere along the Bridge Tunnel complex averaged 1.0 fish per rod hour. The Tugboat Wreck site off Cape Henry produced tautog catch rates of 1.3 fish per rod hour while the Chesapeake Light Tower Reef provided catch rates of 0.8 fish. The Triangle Wrecks exhibited low catch rates of 0.2 per tautog per rod hour and a relatively high release rate of fish (37% on non-Liberty Ship wrecks and 26% for all trips combined). The only location with a higher release rate was the Chesapeake Light Tower (the tower structure itself), where only half as many trips (6 compared to 12) resulted in 82% of all tautog caught being released, the released fish weighing generally less than one pound.

Of tautog kept, average weights ranged from 2.0 pounds at the Gwynn Island site (no "small" fish were taken, therefore a zero release rate) to 3.9 pounds on the Triangle Wreck-Liberty Ships (no "small" fish taken as indicated by a zero release rate) (Table 3). One of the two trips recorded for the Cape Charles Test Reef was a "tautog" trip which produced a mean

catch rate for tautog of 0.9 fish per rod hour. All fish were kept, averaging 3.0 pounds each in weight.

Seabass catch rates also appeared somewhat low at the targeted fishing areas, ranging from 0.1 fish per rod hour at the Gwynn Island site to 2.4 fish per rod hour at the Triangle Wreck-Liberty Ships. As with tautog, no seabass catches were recorded at the Oceanview Reef, but trips to the site recorded in the sampling effort occurred just before and after the site was enhanced with 40 large concrete igloos (approximately 7 feet tall with an outside diameter of 9 feet at base). Some tautog were caught on the site by a few anglers in the fall (M. Meier, VMRC, personal communication). In contrast to seabass catches on other sites, the Parramore Reef produced catches of 10.0 fish per rod hour. Unfortunately, only four trips were recorded in the sampling effort, making it impossible to know whether this catch rate was typical for the site over the entire season. Seabass catch rates were two to ten times as great as those for tautog at the Gwynn Island Test Reef, the Chesapeake Light Tower Reef, Cape Henry Wrecks, Chesapeake Light Tower (structure only), and both portions of the Triangle Wrecks (Liberty Ships and non-Liberty Ships) (Table 3). At most fishing sites, more small seabass were caught and released in comparison to tautog catches.

Most seabass kept by fishermen weighed 1-2 pounds each. Combined catch rates of tautog and seabass ranged from 0.1 fish per rod hour at Gwynn Island to 3.4 fish per rod hour at the Triangle Wrecks (Liberty Ships). The Oceanview and Parramore Reef sites were the exception to these catch rates, exhibiting respective catches of zero and 10.1 tautog-seabass per rod hour. For combined catches of these species, release rates ranged from 11-33% at most fishing sites, with Gwynn Island exhibiting a 67% release rate due to

only small seabass (0.4 pounds each) being caught and all being released (Table 3).

For those fishing areas where tautog and seabass were among the principal targeted species for the entire fishing season (CBBT-third island, Cape Henry Wrecks, Tugboat Wreck, Chesapeake Light Tower Reef, Triangle Wrecks (all trips combined), and the Parramore Reef) the mean quality rating of the fishing experience for the trips recorded ranged from 2.0 to 3.7. Since tautog and seabass were the most often sought species at these sites, the quality rating largely reflects fishermen's satisfaction with catches of these species. A rating of one (1) indicates that the overall fishing experience for the day was rated "poor", two (2) indicates "fair", three (3) "good", four (4) "very good", and five (5) "excellent" (Table 3, footnote c). The Chesapeake Light Tower Reef exhibited the lowest mean fishing trip quality rating of 1.0, while the Triangle Wreck-Liberty Ships (only four trips) received an excellent rating of 5.0. In both cases, however, only one or two captains interviewed provided quality rating responses.

Spot, Croaker and Gray Trout Catches

As expected, spot (Leistomus xanthurus), croaker (Micropogonias undulatus), and gray trout (Cynosion regalis) were primarily caught only at wreck/reef fishing areas in the mouth of the Bay and further up the estuary (Table 4). Catch rates for spot and croaker ranged from 0.0 to 5.4 fish per rod hour, with trout exhibiting catches of 0.0 to 0.9 fish per rod hour. The lowest catch rates for spot were at the CBBT (third island), where only tautog, seabass and flounder were targeted, and the Oceanview Reef, where none were caught. The Gwynn Island Test Reef produced the highest mean

catch rates for spot (2.9 fish per rod hour). While only one croaker was included in CBBT (third island) catches, 125 fish were caught in two trips on the Oceanview Reef (Table 6), producing the highest catch rate for croaker among all areas from which trips were recorded (Table 4). Significant numbers of gray trout were recorded only in catches for trips made to non-third island areas of the CBBT and the Gwynn Island Test Reef. Only one or two trout occurred in catches recorded at the Cape Henry Wrecks and CBBT (third island) (Table 6). Virginia Saltwater Fishing Tournament citation records for gray trout (12 pound minimum) demonstrated a 75% drop in trout citations for 1987 (55) compared to 1986 (168) (VSFT, 1987).

Lower catch rates of each of the sciaenid species at the CBBT (third island), compared to trips to other areas of the complex, were also reflected in the mean catch rates for all three species combined. Combined spot, croaker, and trout catches at the CBBT (third island) were 0.01 fish per rod hour, while combined catch rates for other areas of the Bridge Tunnel were 3.4 fish per rod hour (Table 3). These catch rates were primarily indicative of fishermen's species preferences and fishing techniques, these being different when fishing the various segments of the CBBT complex. Over 80% of the fishing trips recorded for the CBBT (third island) targeted tautog, with flounder the only additional target species mentioned. Target species specified for trips to other sections of the CBBT complex were much more varied, including trips for trout, trout-spot-croaker and tautog, flounder-spot-croaker, seabass-tautog, and tautog only. Croaker, spot or trout were targeted in over 50% of the recorded trips, tautog along with other species in 30% of the trips, and "tautog only" in 30% of the trips.

In comparing species preference patterns between the Gwynn Island Test Reef, Bridge Tunnel (previously described), and the Cape Henry Wrecks, fishermen targeted seabass or tautog in over 60% of the trips and king mackerel in 33% of the trips to the latter site. In contrast Gwynn Island reef fishermen targeted tautog in the spring (May) and fall (late October into November), then shifted their efforts almost totally to spot, croaker and/or trout from June through early October (Table 12). Flounder were also sought by fishermen at the site during October, but no catches were recorded in trip interviews.

Catch rates for trout at Gwynn Island appeared to be slightly less than those experienced at the CBBT (non-third island) areas, but variation in catches at the bridge tunnel was quite large (Table 4). Unlike spot, with kept fish weighing more on the average at the CBBT (1.0 lb.) than at Gwynn Island (0.8 lb.), "keeper" trout were almost equal in average weight at both sites (2.0-2.2 lbs.). Similarity in weights of trout caught at the two sites was also indicated by similar release rates for the species at each location (49% at the CBBT third island and 41% at Gwynn Island). Higher spot catch rates at Gwynn Island countered relatively higher croaker catch rates at the CBBT (non-third island trips), the result being that combined spot-croaker-trout catch rates for the two areas were similar (3.4 fish per rod hour for CBBT non-third island trips and 3.6 fish per rod hour for Gwynn Island) (Table 4).

Bluefish, Flounder and Combined Catches of Desirable Species

In light of their low catch rates, bluefish (Pomatomous saltatrix) and flounder (Paralichthys dentatus) were almost incidental catches at those

sites where catches occurred, although flounder were mentioned occasionally as targeted species for trips to the CBBT, Gwynn Island Test Reef and the Oceanview Reef. Flounder were only recorded in catches for trips to the CBBT, the mean catch rates for the season being low (0.1 fish per rod hour) (Table 5). Bluefish were never targeted by wreck fishermen in any of the trip interviews. A few bluefish were caught at the CBBT, the Chesapeake Light Tower Reef, the Cape Henry Wrecks, the Triangle Wrecks, and the Chesapeake Light Tower, with mean seasonal catch rates being 0.006 to 0.3 fish per rod hour. The fish were generally sought by fishermen targeting seabass, trout, or flounder at the CBBT; seabass or tautog at the Light Tower Reef; king mackerel at the Cape Henry Wrecks; and amberjack at the Triangle Wrecks, as well as at the Chesapeake Light Tower. Virginia citations for bluefish (16 pound minimum weight) declined almost 75% from those registered the previous year while flounder citations (six pound minimum weight) remained approximately the same for the two years (VSFT, 1986 and 1987).

An examination of mean seasonal catch rates for all desirable (customarily edible) species and fishing experience catch ratings indicated that only about half of the wreck/reef sites produced catches considered "good" during 1987 (Table 5). Species generally not considered desirable (and generally released) were small "sand sharks" (spp. unknown) and "spiny" dogfish, most likely Squalus acanthias. The majority of the major fishing areas targeted by wreck/reef fishermen produced overall catch rates of 1.2-5.7 desirable fish per rod hour. The one exception was the Parramore Reef (10.3 fish per rod hour), for which only four trips were recorded. The Gwynn Island Test Reef produced mean catch rates for desirable species of 3.7 fish per rod hour, a rate only exceeded by the CBBT non-third island

areas (5.7 fish per rod hour), the Oceanview (5.4 fish per rod hour, based upon croaker caught during two trips), and the previously mentioned Parramore Reef (Table 5).

Quality Rating of Fishing Experiences at Various Sites

Mean overall fishing experience quality ratings were relatively low for six of eleven sites, falling below 3.0 ("good"). Fishing trips to the Chesapeake Light Tower, distinguished from the Light Tower Reef, received the lowest quality rating of 1.0 ("poor") of all areas, however, only one interview of six produced a quality rating response (Table 5). Chesapeake Light Tower Reef trips were the next lowest ranked. With just over half of the captains interviewed providing mean quality rating data, fishing experiences were ranked 2.0 ("fair"). The small sample of trips to the Oceanview Reef produced a quality rating of 2.3 (just better than "fair"), but two of these trips actually occurred just before the new igloos had been put in place. This rating is not therefore applicable to the "enhanced" site. The Gwynn Island Test Reef, the Cape Henry Wrecks and the CBBT (non-third island areas) were all ranked about equally (2.7-2.9) in mean quality of their fishing experiences. This ranking would indicate that, on the average, fishermen considered fishing experiences at the sites to rank better than "fair", almost to the point of being "good". The Triangle Wrecks (non-Liberty Ships), Tugboat Wreck, and Parramore Reef were all ranked as producing "good" fishing experiences overall (3.0). It must be noted, however, that only 58% of the captains interviewed for trips to the Triangle Wrecks area provided quality rating responses and that only one or two captains provided this data for the Tugboat Wreck (Table 3). With just

over a 50% response rate to the quality rating question, captains fishing the CBBT third island ranked it above all other sites with a mean quality rating of 3.7 (between "good" and "very good").

The excellent rating (5.0) indicated for the Triangle Wrecks-Liberty Ships Reef was not truly representative of the site since quality rating data was provided for only one trip to the site. During this one trip the captain caught 100 seabass averaging 1.5 pounds each and 12 tautog averaging 4.0 pounds, a catch rate of 2.0 fish per rod hour (fishing 8.0 hours with five anglers). At different times, however, two other captains also experienced catches at the site of 3.3-3.8 seabass per rod hour. Unfortunately they did not provide quality rating data for their trips. When seabass and tautog were biting, fishing seemed to be consistently "good" at the site. The only other trip recorded for the site, and for which usable catch data was provided, produced catches of "spiny dogfish" sharks (1.9 fish per rod hour or 20 dogfish caught by three anglers over a period of 3.5 hours). A more comprehensive sampling of trips to the area would have been necessary to properly evaluate catch rates and quality of fishing experiences at the Liberty Ships Reef in the Triangle Wrecks area. The quality rating for all trips combined at the Triangle Wrecks was 3.2, a little better than "good" for the entire area. Numerous ship wrecks dating back to World War II exist at the site, in addition to the four Liberty Ships placed there in the mid 1970's by VMRC (Lucy, 1983a,b; Meier et al., 1985).

A considerable range in seasonal catch rates produced the same general quality rating at different wreck and reef sites. The disparity in catch rates versus quality ratings documented, to some degree, the phenomenon of fishermen having different expectations (and correspondingly different

quality ratings of fishing experiences) when fishing for various types of fish at different fishing sites (Fedler, 1984). For example, while a mean catch rate of 1.0 tautog/seabass per rod hour corresponded to a quality rating of 1.0 ("poor") at the Chesapeake Light Tower (as distinguished from the Tower Reef to the southwest of the structure), only slightly greater catch rates of 1.5 to 1.6 fish per rod hour received overall quality ratings of 3.0 ("good") for the same species group at the Triangle Wrecks (non-Liberty Ships) and Tugboat Wreck (Table 3). Seabass and tautog were the principal fish targeted at all three sites. In addition, two of the Light Tower trips targeted amberjack, with the mean catch rate for this species being only 0.1 fish per rod hour (Table 5). Tautog catches at the Light Tower also constituted a smaller portion of the total catch (6.3%) than at the other two locations (14.9% - Triangle Wrecks; 91.3% - Tugboat Wreck) (Table 6). The Light Tower trips also produced a greater release rate of tautog (82%) than occurred at the other areas (19-61%), another indication that a greater portion of the tautog caught at the site were smaller fish. Average weights of "kept" tautog were essentially the same at the Light Tower (3.1 pounds) and the Tugboat Wreck (3.0 pounds), while tautog kept from trips to the Triangle Wrecks averaged 6.1 pounds each. Examining these various factors indicated that catch rates, while certainly contributing to the quality of fishermen's fishing experience, can be overshadowed by catch composition in terms of species mix and the proportion of "keeping size" fish.

Comparing catch rates and quality ratings between the Chesapeake Light Tower Reef and the CBBT (third island) indicated the impact traveling time/distance to the fishing site may have had on the perceived quality of the fishing experience. Both sites accounted for essentially equal numbers

of trips (11-12 trips) in the sampling effort and both produced seasonal mean catch rates for "desirable" species of 2.3-2.4 fish per rod hour. The Light Tower Reef, however, only received a mean fishing experience quality rating of 2.0 ("fair"), while the CBBT (third island) received nearly the highest mean quality rating (3.7) for all wreck/reef sites. Species preferences were similar for fishermen at both sites, primarily seabass and tautog, although a few Tower Reef trips also targeted amberjack and king mackerel. The CBBT (third island) produced somewhat better mean catch rates of tautog (1.4 fish per rod hour) compared to the Tower Reef (0.8 fish per rod hour), with the trend reversed for seabass catches (0.7 fish and 1.5 fish per rod hour respectively) (Table 3). The net result of the reversed trends was that mean catch rates for tautog and seabass combined were approximately equal for both sites (2.1-2.3 fish per rod hour) (Table 3). While the CBBT (third island) exhibited slightly better catch rates for tautog, with the "keeper" fish being slightly larger (3.6 pounds versus 3.1 pounds on the average), the Tower Reef produced better seabass catch rates and slightly larger fish on the average (1.0 pounds versus 0.8 pounds) (Table 3). Other than the fact that tautog are possibly considered a more highly favored catch for wreck fishermen, the only major difference in the two sites is that the Tower Reef is approximately 13 nautical miles offshore of Virginia Beach, while runs to the CBBT (third island) are frequently no more than 6-8 nautical miles for many boats targeting the site. Therefore, the travel distance/time factor may also affect fishermen's expectations and eventual quality rating for trips to a given site, i.e. more effort and money invested per trip for longer trips should produce more and/or "better" fish per trip.

Effectiveness of General Sampling Program

In evaluating the overall effectiveness of the general sampling effort, it must be concluded that biweekly random interviews of only twenty boat owners/captains targeting wrecks and reefs did not produce enough "captured" trips for researchers to fully evaluate the major targeted sites' fishing potential. The sampling effort captured 11-15 trips during the season to each of the four most popular fishing locations frequented by fishermen in the sample population: the CBBT (1st & 4th islands and unspecified areas of the complex); the Gwynn Island Test Reef; the CBBT (third island); and the Chesapeake Light Tower Reef (Table 1). For each of these locations, fishing trips were captured by the sampling effort during five to six of the eight months (April-November) sampled in the fishing season. While not providing enough trips for adequate catch comparisons between months, the fairly even distribution of the sampled trips over the fishing season resulted in a "minimal" representative seasonal sampling for these targeted fishing areas. The remaining wreck and reef areas targeted by fishermen in the study population, while obviously of importance to the fishery, were not represented by enough fishing trips in the sampling program to provide researchers with much confidence in making seasonal comparisons among the sites. For these sites (Table 1), the general sampling program only captured fishing trips representing three to four months of the eight month sampling season.

Since species availability and fishermen's preferences change somewhat as the fishing season progresses, an adequate sampling program needs to capture at least some trips (preferably two or three trips) during each month that an area is significantly fished. Enough catch data may then be

available to make at least seasonal comparisons among sites. A preferred situation would be to design a sampling program that would capture enough fishing trips to major targeted wreck/reef sites during each month of the fishing season to allow monthly comparisons of catches and catch rates with the monthly data then combined to provide a comprehensive seasonal assessment of each site. Monthly and overall seasonal catches could then be compared for different sites. A sampling program seeking to obtain such a representative distribution of fishing trips was implemented on an experimental basis for the Gwynn Island Test Reef site, beginning in early June.

Special Sampling Program for the Gwynn Island Test Reef

As previously mentioned, the general sampling program, focusing on the total population of identified wreck/reef fishermen, recorded no trips to the Gwynn Island site out of 80 fishermen contacted during April and May. To evaluate the site, the researchers had to insure that fishing trip interviews were obtained. To accomplish this, a special sampling program was directed solely at fishermen who indicated they, at least occasionally, fished the site (see Methods section). Special efforts were also made to expand the sample population of fishermen using the site.

Distribution of Fishing Effort and Characteristics of Fishing Trips

Initiating the special sampling effort during the first week of June resulted in capturing four fishing trips to the Gwynn Island Reef for the month of May, with two of the trips made by one fisherman. This set the

pattern for the remainder of the season. Each biweekly sampling of ten fishermen generally produced two or three individuals who had recently fished the site. By the end of the study period in November, 66 individual boat-owning fishermen were identified who targeted the Gwynn Island Reef, including two head (party) boat captains.

Of the total captain/boat-owner sample population, 40 captains (60.6%) were recorded making trips to the reef during the season. Five captains (7.6%) were documented having made two reef fishing trips in a particular month, while one fishermen made five trips to the reef in October and another made two trips in two different months (July and October).

It must be remembered that fishermen, when randomly contacted on the telephone, were only asked if they had fished the site during the prior two week period to keep recall time (and reporting accuracy) at an optimum. If they could recall all necessary details from a slightly earlier trip to the reef, that trip data was also recorded. This meant that each identified Gwynn Island Reef fishermen did not have his/her entire seasonal use of the reef site documented, but that only two, or possibly three to four week "snapshots" were obtained periodically of each individual's reef fishing activity. The frequency of sampling, however, was such that, especially with the small sample population at the beginning of the program, identified fishermen were contacted approximately once every four to six weeks.

Another way of looking at boat owners'/captains' frequency of use patterns of the Gwynn Island Reef site is to look at the seasonal picture. For the period from mid May through mid November, ten captains made at least two trips to the reef, three captains made three trips, one captain four trips, and one five trips. For the sampling period 40 captains were recorded making a total of 60 fishing trips to the reef, a seasonal rate of

1.5 reef trips per captain. Later in this section a conservative estimate is provided of the total number of fishing trips made to the reef site during the sampling period (Table 17).

In most instances, enough fishing trips to the Gwynn Island Test Reef were captured during each month to allow reasonable monthly comparisons of fishing effort (Table 7) and characteristics of the fishing trips (Table 8). To obtain the monthly breakdown of the data, biweekly sampling periods were grouped into monthly periods. A biweekly sampling period having the majority of its days falling in a given month was assigned to that month, e.g. data for the sampling period of June 29-July 12 was designated as "July" data.

Fishing effort, based upon number of trips recorded in the sampling program, was well dispersed across the months of June through September, with each month accounting for 11.7-18.3% of the overall seasonal effort (Table 7). May effort was not as representative of all fishing activity that may have occurred during the month, since only the last two weeks of the month were sampled. Comparing effort in terms of rod hours per month for the same period (June through September) indicated only slight monthly changes in the distribution of effort (12.4-22.1%). These differences were primarily the result of slight shifts in mean trip length (hours fished) and mean number of anglers fishing/rods-fished-per-trip in various months (Table 8).

The most dramatic shift in the two fishing effort distributions occurred between the months of July and August. While both months recorded equal trip effort, rod hours fished in August (157 rod hours) were almost twice that in July (88 rod hours) (Table 7). The difference was due to changes in fishing practices between the months. Trips in August averaged

slightly over one hour longer (3.6 hours actual fishing time) than those in July (2.5 hours). The average number of fishermen per trip (and resulting mean rod hours) was greater in August than July (Table 8). This combination of factors produced the dramatic increase in "rod hour" effort witnessed in August.

Observations of numbers of "other" boats fishing the reef were also recorded for each trip interview, when the captain could recall this data. Captains were instructed to only consider in their count those boats they felt sure were fishing in the "enhanced fishing zone" of the reef, or within approximately 325 yards of the reef, as marked by the two buoys on the site throughout most of the season. Captains' boat count observations which researchers felt violated this condition were discarded from calculations of mean number of boats per fishing day, presented in Table 8. As was the case for the general sampling program, daily estimates of boats fishing the site were adjusted to include the boat recording the observations. The estimated boat counts indicated a fairly steady increase in boats fishing per day of observation through September, with a slight decline in October followed by a return to June-July levels in November (Table 8).

Fishing effort, as measured in mean rod hours per trip and mean boats fishing per day of observation, remained high in September and October, a period when offshore fishing trips traditionally decline. Reefs in the middle and lower Bay have a tendency to attract more fishing activity in the early fall when fishermen can expect good spot and trout catches to continue into October (Tables 10 and 12), while also beginning again to catch more tautog and seabass (Tables 12 and 13). With the weather becoming more unstable in the fall, fishermen are likely more comfortable fishing Bay sites because they can generally remain closer to port than when fishing

offshore. This situation helped maintain high numbers of boats fishing per day on the Gwynn Island site in October (Table 8) and resulted in October fishing effort (in terms of number of trips) accounting for 28.3% (32.8% in terms of rod hours) of the entire season's activity (Table 7), the most for any month.

Catch Trends and Quality Rating of Fishing Trips

Tautog and Seabass Catches

Since species availability and fishermen's preferences change over the fishing season, Gwynn Island Reef catches are examined in sequence of when species were targeted. Tautog and seabass are generally the first species targeted on wrecks and reefs in the spring. If spring weather warms rapidly, fishermen may also target spot and croaker, especially in the latter half of May. This pattern was exhibited by the few fishermen contacted who fished in May, with tautog and spot/croaker being targeted at the reef (Table 13). No tautog or seabass were recorded in spring catches, however, and it was not until October that these species were again targeted (Table 13) and caught (Table 9). Catches of these species were surprisingly low in October, with only 0.03 tautog and 0.3 seabass taken per rod hour (Table 9). These low catch rates were reflected in the small percentage of the total month's catch consisting of "keeping size" tautog (2.7 pounds average) and seabass (0.9 pounds average) (Table 9). Only 0.8% of October's "kept" fish were tautog and 2.4% seabass, with the bulk of the month's catches being spot (83%) (Table 12). November produced a complete reversal in catch patterns with tautog and seabass accounting for 43.5% and 52.2% of

the total monthly catch respectively (Table 12). Tautog catch rates increased to 0.6 fish per rod hour while seabass catches were 1.2 fish per rod hour (Table 9). A good portion of seabass caught were small fish under one pound in weight and 45% of the caught fish were released. Overall mean rates for the combined species catches went from 0.4 per rod hour in October to 1.8 per rod hour in November. Since tautog and seabass accounted for all but 4.3% of the November catch, these being flounder, the mean quality rating for November of 2.0 ("fair") essentially represented the satisfaction level of fishermen regarding catches of these two species.

The Gwynn Island Reef's November tautog catch rates, 0.6 fish per rod hour (Table 9), were as good or better than the overall season's tautog catch rates at most offshore wrecks and reefs (Light Tower Reef, Cape Henry Wrecks, Triangle Wrecks, Chesapeake Light Tower, and the Parramore Reef) (Table 3). The only sites producing better mean seasonal catches were the CBBT and the Tugboat Wreck. The major difference in sample sizes between the various sites, however, makes the comparison a bit tenuous, as does comparing one month's catch rate at a site with that of overall seasonal rates at other sites. It is appropriate to conclude, however, that in November, the only time for which tautog were significantly targeted at Gwynn Island, the site "held its own" with other major wreck/reef sites. During November the Gwynn Island Reef also produced average weights of tautog (3.0 pounds) (Table 9) equal to or better than average seasonal weights of the species in catches recorded at most other major wreck/reef sites. The only exceptions were the CBBT and Triangle Wrecks.

Seabass catches at the Gwynn Island site were not generally as good as at other wreck/reef sites, since mid-Bay salinities result in primarily young fish occupying the reef site (Feigenbaum and Blair, 1986). Catch

rates for seabass at the Gwynn Island Test Reef, generally 0.2-0.3 fish per rod hour except in November when rates improved to 1.2 fish, were lower than rates at the major sites covered in the general sampling program. The only exception to this pattern was the Tugboat Wreck (off Cape Henry). Gwynn Island November mean seabass catch rates (1.2 fish rod hour) nearly equaled or exceeded overall seasonal catch rates for the species at the CBBT (third island), Triangle Wrecks (non-Liberty Ships), Tugboat Wreck, Chesapeake Light Tower,and the Oceanview Reef (only three trips recorded, none of which targeted seabass or tautog) (Table 3). As with tautog catch rates, the November period at the Gwynn Island site produced seabass catch rates which were approximately the same as the overall seasonal rates documented for other popular locations (Tables 3 and 9). Weights of "kept" fish (0.9 pounds on the average) taken on the reef (Table 9), however, were generally less than those of "kept" seabass caught at most other major wreck/reef sites covered in the general sampling program (the exceptions being the CBBT-third island and the Chesapeake Light Tower) (Table 3). Another indication of the overall small size of seabass taken at the Gwynn Island Test Reef was that the site's seabass release rates (71%) for the season were higher than for any other major wreck/reef site sampled.

Spot, Croaker and Gray Trout Catches

Catches of the sciaenid group of fish, especially spot, were the mainstay of the Gwynn Island Test Reef fishery. For the months May through September spot, croaker and gray trout accounted for essentially 100% of the fish kept by anglers (Table 12). Small catches of tautog and seabass in the latter part of October only reduced the sciaenid total "kept" fish catch

proportion by 3.5%. By November the sciaenid species appear to have migrated down the Bay toward their offshore over-wintering grounds and were not recorded in reef trips. Good numbers of gray trout and speckled trout (Cynoscion nebulosus) were still in the vicinity of the reef on November 6, 1987, since a mixed gillnet catch of both species, estimated at about 300 pounds, was reported (T. Stainback, personal communication). The trout were not being targeted by reef fishermen, however (Table 13).

As mentioned previously in discussion of the Gwynn Island site's catches under the general sampling program, spot catch rates at the reef exceeded catch rates for the species at all other wreck/reef sites where the fish was targeted (CBBT third island and non-third island areas, the Cape Henry Wrecks, and the Oceanview Reef) (Tables 4 and 10). The best catch rates at the Gwynn Island site were in July and September, when 91-100% of the captains interviewed indicated they were using bloodworms for bait, the preferred choice for spot (Tables 10 and 14). Why catch rates for spot were lower and more varied in August (2.3 fish per rod hour) is not known (Table 10), except that more fishermen (36%) of those interviewed also used squid bait in conjunction with bloodworms in August than for either July or September (Table 14). This somewhat different bait mix might have negatively influenced spot catches, but there is no real evidence supporting this. Another contributing factor to lower mean August spot catch rates might have been the prevalence of windy weather reported by interviewed fishermen. Compared to July and September, a greater proportion of interviewed boat captains drift-fished in August as opposed to anchoring (Table 15). Considering the windy conditions previously mentioned for August, drift rates might have been too great for optimum spot catches, especially in conjunction with more turbid water conditions that one might

expect to be associated with windy periods. Unusual water turbidity conditions, however, were not mentioned by fishermen interviewed in August. Finally, high water temperatures typical of August might have depressed catches, a common pattern in Bay bottom fishing activity.

Croaker and trout catch rates at the Gwynn Island site were approximately equal for most months, except in May when croaker catch rates (1.7 fish) were almost three times greater than those for trout (0.6 fish per rod hour) (Table 10). The CBBT (non-third island areas) and Oceanview Reef produced higher seasonal mean catch rates for croaker (2.0 and 5.4 fish per rod hour respectively) (Table 4) than the Gwynn Island site, even in the Gwynn Island Reef's best month (Table 10). Weights of "kept" croaker catches (2.0-2.6 pounds on the average) for other sites where the species was targeted and/or available (Table 4) generally exceeded those for "kept" fish at the Gwynn Island Reef (0.8-1.5 pounds on the average) (Table 10). The same relationship also existed among the sites "kept" trout catches, with Gwynn Island fish averaging 1.0-2.5 pounds each compared to 2.0-4.0 pounds for trout at the other sites (no trout were recorded caught at the Oceanview Reef) (Tables 4 and 10). For the entire fishing season "kept" croaker constituted only 5.3% (by number) of total seasonal catches at the Gwynn Island site and trout accounted for 13.1% of the catch (Table 12). In comparison, croaker accounted for higher proportions of total catch (by number) at the CBBT (all trips combined) (31.7%), the Cape Henry Wrecks (15.8%), and the Oceanview Reef (19.9%) (Tables 6 and 12). Concerning trout contributions to total catches at different sites, the Gwynn Island Test Reef produced a slightly greater proportion of trout (13.1%) than the CBBT (non-third island areas), the only other site where trout significantly contributed to total seasonal catches (Tables 6 and 12).

Combined catches of spot-croaker-trout exhibited a higher mean catch rate (4.0 fish per rod hour) for the season overall at the Gwynn Island site than at other locations where the fish were targeted (CBBT third and non-third island areas and the Cape Henry Wrecks) (Table 4). The only fishing area with a higher overall "combined sciaenid" species mean catch rate was the Oceanview Reef, based only upon croaker caught during two fishing trips recorded for the site immediately prior to the concrete igloos being placed there (Tables 4 and 10). In September Gwynn Island mean catch rates for the combined species were 6.2 fish per rod hour (primarily attributed to the highest spot catch rates for the season), exceeding even the Oceanview Reef catch rate previously mentioned (Tables 4 and 10).

Bluefish, Flounder and Combined Catches of Desirable Species

As discussed previously for the Gwynn Island site in the general sampling program section, the special sampling effort confirmed that bluefish were never targeted by fishermen at the reef (Table 14). Flounder were only mentioned in October as a targeted species by 12% of the captains interviewed and trout/flounder mentioned by only 6% of the captains (Table 14). To a large extent the non-targeting of both species by captains was responsible for the very low catch rates of each fish (Table 11). Of the few fish caught, 80-100% were released from August through October, with only November's one 3.0 pound flounder being kept (Table 11). November's single flounder catch only accounted for 4.3% of the month's total catch (Table 12). For the season only three flounder were kept at the Gwynn Island site. Flounder also contributed only 3.6% to the total catches-

recorded for the CBBT (third island), the largest contribution by number to any site's total catch (Table 6).

Comparing Gwynn Island Reef seasonal catch rates (Table 11) for all "desirable" species (those fish normally kept for eating) with rates for other major wreck/reef sites (Table 5), indicated that the Gwynn Island site was as "productive" as most targeted wreck-fishing sites. The Gwynn Island Test Reef's catch rate for desirable species averaged 4.2 fish per rod hour, compared to seasonal mean catch rates of 1.2-3.7 fish period hour for most major wreck/reef sites covered in the general sampling program. Exceptions to this pattern were the CBBT non-third island areas (5.7 fish per rod hour), the Parramore Reef off Wachapreague (10.3 fish per rod hour), and the Oceanview Reef (5.4 fish per rod hour, attributed only to croaker catches on two trips) (Table 5). The obvious major differences between the Gwynn Island Reef and the other sites were that the principal group of species targeted and caught by fishermen using the reef were spot, croaker and trout for all months except November, when emphasis shifted to tautog and seabass (Tables 9-13). In addition, the average size of "kept" fish at the Gwynn Island Test Reef was somewhat less than "kept" catches of the same species at other lower Bay and offshore sites, except for spot (Tables 3-5 and 9-11).

The mean seasonal catch rate of 4.2 desirable fish per rod hour for fishermen targeting the Gwynn Island Test Reef, as determined in this study, was slightly lower than the 1984 mean catch rate of 5-6 fish per rod hour observed during "monitoring" fishing trips conducted by ODU researchers (Feigenbaum and Blair, 1986). This study's mean catch rate, however, approximately equaled the catch rate of 4-5 fish per rod hour measured on the site by ODU researchers in 1985. During 1985 maximum catch rates of

approximately 7 fish per rod hour were achieved during monitoring fishing trips in August, with slightly lower rates of 4-6 fish per rod hour observed in September and October (Feigenbaum and Blair, 1986). In this study, September produced the highest catch rates (6.2 fish per rod hour) while July and October produced mean catch rates of 5.1-5.2 fish per rod hour (Table 11).

Although fishermen interviewed in this study were asked to name all fish caught, including "trash" fish, none mentioned catches of oyster toadfish (Opsanus tau) among their catches. The ODU study's monitoring fishing trips during 1984-1985 resulted in toadfish constituting 11.6% (by number) of total catches taken directly on the reef site (Feigenbaum and Blair, 1986). It is possible that Gwynn Island fishermen interviewed during this study caught small numbers of toadfish, but considered them too insignificant to mention. "Sand sharks" and searobin catches, however, were mentioned by fishermen during interviews. On the other hand the majority of fishermen (60%) sampled in this study indicated they either fished "off the edge of the reef" (45% of trip interviews) or "drifted past the reef" (15% of trip interviews) (Table 15). This fishing strategy obviously did not produce significant toadfish catches or they would have been noted by fishermen interviewed. The ODU study's monitoring fishing trips made on "control" areas away from the reef structure produced only one toadfish during 1984-1985. It appears both studies have documented that using a strategy of fishing some distance away from the reef (in its enhanced fishing zone in this study), as opposed to fishing directly over the reef materials, produces a minimum of toadfish catches during the warmer portion of the season when spot, croaker and trout are targeted at the site.

Quality Rating of Fishing Experiences at the Gwynn Island Site

Examination of the quality ratings of fishing experiences at the Gwynn Island Test Reef indicated that slightly different species and smaller "keeping size" fish did not significantly reduce the quality of trips to the site for fishermen. Receiving a mean overall seasonal fishing experience rating from captains of 2.6 ("better than fair") (Table 11), the Gwynn Island Test Reef was ranked higher than the Chesapeake Light Tower (1.0 quality rating, but only one rating response was obtained), the Chesapeake Light Tower Reef (2.0), and the Oceanview Reef (2.3, but trips do not indicate fishing experiences on "enhanced" site, as previously discussed) (Table 5). The Gwynn Island Reef ranked nearly as high in its mean fishing experience rating as the Cape Henry Wrecks (2.8 rating) and the CBBT non-third island areas (2.9 rating) (Table 5). September produced the highest ranked fishing experiences, probably because mean catch rates of spot-croaker-trout (combined) were the best (6.2 fish per rod hour) during that month (Table 10). Spot and croaker were the primary contributors to this high catch rate. Although croaker catches only contributed 5.2% of September's total catch by number, the few fish caught averaged 1.2 pounds each (Tables 10 and 12).

The test reef's September mean quality rating of 3.3 (Table 11) exceeded the overall seasonal rating for all but two other major wreck/reef sites (the CBBT-third island with 3.7 and the Triangle Wrecks-Liberty Ships with a 5.0 rating, the latter based upon only one captain's response). Fishing expectations were different at the Gwynn Island Reef and its "better than fair" quality rating for fishing experiences was largely based upon

spot-croaker-trout catches for all of the fishing season except the month of November, when tautog and seabass were targeted.

Another method for examining the pattern of fishing experience quality ratings recorded for fishing trips to the Gwynn Island site is presented in Table 16. The majority (33%) of "fair" ratings occurred in June (when quality rating questions were initiated) and November (only three trips recorded), while the majority (57-64%) of "good" fishing experiences (trips) were recorded in July and September, two months exhibiting the best overall mean catch rates for desirable species (5.2 and 6.2 fish per rod hour respectively) (Table 11). Lower overall mean catch rates in August (2.9 fish per rod hour) were associated with only 18% of trips during that month being rated as "good" (Table 16) and 27% rated as "poor". August also produced several "very good" fishing trips as well as one "excellent" trip (2 anglers fishing 2 rods for 2.5 hours caught 148 spot weighing 0.5-0.75 pounds each--a daily catch rate of 29.6 fish per rod hour). October trips produced more variation in quality of fishing experiences at the reef than August. Although overall mean catch rates were 5.1 fish per rod hour, this catch rate was down 1.1 fish per rod hour compared to September (Table 11). The drop in mean catch rate was principally attributed to apparent declines in catch rates of spot and croaker (Table 10). Catches of trout and seabass began to improve somewhat in October, but were still at such low levels that they did not compensate for the declines in catch rates of the previously mentioned species (Tables 9 and 10). The result was that a relatively higher proportion of "poor" catches (41% of all catches) were recorded in October than for any other month of the season.

Examining the circumstances of the "poor" rated trips during October provided some insight into why fishing might have been off for at least

some, but not all, of the captains interviewed. Windy conditions prevailed during the week of October 12-16, being mentioned by one fisherman as possibly contributing to poor fishing during the weekend of October 17-19. The windy conditions may have also helped cool down water temperatures in the middle Bay, causing spot and croaker to begin moving toward offshore waters. A few spot, however, were still taken on the reef on October 31 and November 1 by one fisherman, but catch rates were low (0.4-0.9 spot per rod hours) in comparison to previous months. Another factor that may have contributed to the high percentage of poor catches was that the fishing strategy on two trips during early October (Oct. 10-11) involved drifting directly over the reef structure. These trips, made by the same fisherman targeting spot and trout on both days, produced only small spot (6-8 ounces each), all of which were released. Three of the "poor" October trips produced no fish for 1-4 hours of fishing effort. Two of these trips, made by different boats, occurred on the same day (Oct. 17) immediately after the previously mentioned week of high winds. Other than the possible negative influence of the windy conditions prior to the fishing trips, there were no apparent reasons for the zero catches. The overall quality rating pattern for the Gwynn Island test reef appears to vary during the season much like that for bottom fishing in general in the middle Bay region, e.g. after picking up to good levels in June and July, fishing slacks off somewhat during the hot days of August, then picks up again in September before becoming more variable in October as it tapers off.

Effectiveness of Special Sampling Program in Reference to General Program

The special sampling effort directed towards fishermen targeting the Gwynn Island Test Reef produced sufficient sampling of fishing trips to allow monthly comparisons of catches and catch rates for most of the fishing season. As previously discussed, only the latter half of May was accounted for in the sampling effort, and it is inappropriate to consider the results of the four trips recorded as representing the entire month's fishing activity, unless no fishing trips were actually made to the site in the first two weeks of the month (this is not likely to have been the case). Only three fishing trips to the reef were recorded in November, but the majority of those fishermen randomly contacted after November 15th indicated that either they were finished fishing for the season or bad weather was closing the season down for them. In either case it was apparent that additional trips to the reef would be unlikely for most fishermen. The three trips recorded, therefore, were considered to represent the November fishing activity. As with May, however, a few more recorded trips in November would have made the researchers more confident that the sampled trips were repesentative of fishing on the site in that month.

Except for these concerns, the random sampling effort directed biweekly at ten Gwynn Island reef fishermen largely provided satisfactory coverage of the reef site's fishing activity. The data from the special sampling program, however, was enhanced by that from the 14 trips recorded in the general program to maximize the amount of information available in evaluating the site. As determined in Tables 8 and 17, most fishing activity occurred on weekends. During the principal months of the season fishing trips were recorded during every weekend in the period but for one

in June, one in August (four of five weekends were represented by recorded trips), and one in September.

In comparison to the 14 Gwynn Island Reef fishing trips recorded in the General Sampling Program, the Special Program provided much more detailed coverage of the reef site's fishing activity (46 trips total). Monthly fishing comparisons would have been inappropriate using the data collected in the general sampling effort. Under that sampling regime only three to four trips per month were recorded for the months of June, July, August and October. Only one trip was recorded for November and no trips were recorded for either May or September, the latter month producing the highest spot and spot-croaker-trout (combined) catch rates of the entire fishing season (Table 10). Because fishing activity, fishing success rates, and targeted species preferences change for fishermen using a given reef site over the fishing season (as illustrated by the Gwynn Island Reef experience), a comprehensive analysis of a reef's performance requires representative monthly sampling of fishing activity. Only very general seasonal comparisons can be made among sites if such a sampling effort is not made and then, only if all major fishing periods (months) are represented by sampled fishing trips.

The special sampling effort directed at the Gwynn Island site also produced additional information which was beyond the capability of the general sampling program. By providing comprehensive coverage of fishing activity, in particular for the majority of weekends in the fishing season, the special sampling of Gwynn Island Reef fishing trips permitted a calculation of estimated fishing trips supported by the site over the season (Table 17). By projecting daily observations of boats fishing the site for weekends and weekday periods during which observations were recorded from

fishermen, it was conservatively estimated that 447 fishing trips were made to the test reef during the 1987 season. As previously mentioned, three weekends during the fishing period from mid-May through mid-November did not have fishing trips recorded for them. These nine weekend days were excluded from the projection, as were all but 16 weekdays of the sampling period (see footnotes, Table 17). Considering that 60 fishing trips were captured (sampled) in the combined general and special sampling programs, approximately 13% of the total fishing effort directed at the site was sampled.

While beyond the scope of this study, knowing the estimated total fishing trips made to the site would permit projections of total estimated catches for the entire season, information useful in managing productivity of artificial reef sites. Combining total catch estimates with data on monthly and seasonal catch trends for targeted species and all desirable species combined would provide reef managers with indicators useful in monitoring the harvest of fish on particular sites. With such tools reef managers would be in a much better position to determine how much fishing pressure individual sites could reasonably support. This knowledge could be used to redistribute fishing pressure among available reef sites, if necessary. It could also enable managers to better determine the benefits of expanding and/or modifying the design of a reef to produce greater overall catch rates (more fish of all sizes), greater catch rates of "keeping" size fish, a greater possibility of catching trophy fish, etc. Managing fishing pressure on existing reef sites could also produce some of these same results, as recommended by Feigenbaum and Blair (1986).

CONCLUSION

The comparison of two distinctive sampling programs has shown the benefit of both systems, indicating that a comprehensive analysis of a particular reef site requires a more rigorous sampling effort than would be provided by the general sampling program initiated in this study. A broad sampling effort of identified wreck/reef fishermen can produce useful comparative data for the most popular fishing sites. Any omission of major fishing periods in the sample data, however, increases the possibility that overall seasonal catch trends and fishing trip characteristics might be poorly documented or worse, inaccurately represented.

To provide adequate coverage of fishing activity at only the most popular wreck/reef fishing sites identified in this study would likely require both an expansion of the wreck/reef, boat-owning fishing population as well as an approximate doubling of sampling effort, i.e. randomly contacting forty (40) such fishermen biweekly during the season. If the distribution of fishermen's preferences in the sample population remained largely the same as for this study, a doubling of sampling effort would likely provide adequate seasonal data for the following targeted sites: the Chesapeake Bay Bridge Tunnel complex, Gwynn Island Test Reef, Chesapeake Light Tower Reef, and the Triangle Wrecks area (all wrecks combined). Any major shift in fishing site preferences of identified fishermen in the sample population would result in a general sampling program, like that implemented in this study, capturing proportionately more fishing trips for those areas towards which the population of fishermen's preferences had shifted. This means that if one of the sites previously mentioned declined in popularity for some reason, the proposed increased sampling effort might

not produce enough data to adequately document the site's overall seasonal fishing activity.

The general sampling program of this study documented the current popularity of certain wreck/reef fishing sites. It would benefit overall management of Virginia's artificial reef program to periodically (biannually perhaps) repeat such a program, but with more fishermen interviewed per sampling period, as previously mentioned. Two major objectives could then be accomplished. First, the constantly changing sample population of identified wreck/reef fishermen could be updated, a factor found to be essential in gathering representative data on Virginia's pelagic recreational fishery (Bochenek, et al., 1988). Secondly, the relative popularity of various sites frequented by wreck/reef fishermen could be documented and overall seasonal fishing trends compared for the most popular sites. This second objective, given a larger sampling effort than in this study, would provide useful "baseline data" reference sites against which particular artificial reefs' fishing productivity could be compared.

The special sampling program directed at the Gwynn Island Test Reef indicated what can be accomplished by targeting a special segment of the wreck/reef fishing population utilizing a particular reef site. The sampling effort, affected by the size of the identified sample population of fishermen, appeared to be adequate to provide representative data of most month's fishing activity. A slightly greater sampling effort than actually used in the special program would be required to achieve the same fishing frequency of recorded trips per month shown in Tables 7-11, since these tables reflect the combination of trip data from both the general and special sampling programs. Greater monthly fishing trip sample sizes would provide the opportunity for meaningful statistical comparisons in catch

trends and fishing trip characteristics among months. Better representation of beginning and ending periods of the fishing season for a particular site might also be obtained if sampling effort could be increased. Such benefits, however, must be weighed against the manpower necessary to significantly increase sampling effort.

Comparing the overall performance of the Gwynn Island Test Reef to that of other major wreck/reef sites covered in the study indicated that the reef produced mean seasonal catch rates of desirable species comparable to those at most other sites. Only fishing trips to the Chesapeake Bay Bridge Tunnel (non-third island areas), the Parramore Reef off Wachapreague, and the Oceanview Reef produced greater overall catch rates of desirable species. During the month of September mean monthly catch rates of spot, croaker and trout (combined catches) at the Gwynn Island Test Reef exceeded mean seasonal catch rates for any targeted species, or combination of desirable species, at all other major wreck/reef sites except the Parramore Reef. In their overall rating of the quality of fishing experiences at the Gwynn Island site, fishermen rated the site better than a few other major sites targeted by wreck/reef fishermen, most notably the Chesapeake Light Tower Reef. The site also was ranked nearly as high in its seasonal mean quality rating of fishing experiences as the Cape Henry Wrecks at the mouth of the Bay and the Chesapeake Bay Bridge Tunnel (non-third island areas). The principal difference between the Gwynn Island Test Reef and other wreck/reef sites was that fishermen utilizing the site primarily targeted spot, croaker, and trout during the majority of the fishing season, shifting their preferences to tautog and seabass in late October and November. In addition, the average weight of "keeper" size fish at the Gwynn Island site

was somewhat less than that for the same species taken at other wreck/reef sites, except in the case of spot.

Based upon the results of the special sampling program, and the fact that a limited general sampling program for major wreck/reef sites targeted by Virginia fishermen has been completed in the first year of this study, the researchers propose the following course of action for the second year of the project:

(1) Sampling efforts continue to focus on fishing activity targeting the Gwynn Island Test Reef, since this reef is the most up-Bay site of the VMRC Reef Program and thereby provides the best opportunity to evaluate future reefs, or expansion of the Gwynn Island site itself, in the mid-Bay area.

(2) A special sampling effort be directed at the most recently established reef in the lower Bay, the Oceanview (Little Creek) Reef, since this reef is expected to provide substantial fishing activity for the large number of fishermen concentrated in the Little Creek, Lynnhaven, and Willoughby Bay areas (all sites of numerous large marinas and boat ramps). The Oceanview Reef provides a unique opportunity to evaluate the impact of potentially heavy fishing pressure on a newly established reef site.

(3) If time and manpower permits, a third reef, either the Cape Charles Test Reef or one of the oceanic reefs might be targeted for special sampling of fishermen utilizing the site. Comparisons in catch trends and fishing techniques could then be made with the two previously mentioned sites.

The first priority of the second year's work would be to expand the identified population of fishermen targeting the Gwynn Island and Oceanview Reef sites. Only if these efforts were making satisfactory progress and the sampling program of biweekly random telephone calls was producing adequate numbers of captured fishing trips for the Gwynn Island and Oceanview Reefs, could work on a third site be considered.

Table 1. Distribution of recorded fishing effort at sites targeted by wreck and artificial reef fishermen during 1987.

Fishing Area	Fishing Trips			Rod Hours[a]		
	No.	Ov. Freq.[b]	Rel. Freq[c]	No.	Ov. Freq[b]	Rel. Freq[c]
Ches. Bay Bridge Tunnel[d] (1st+4th islands;unspec.)	15	12.6%	16.1%	233	13.2%	18.1%
Gwynn Island Test Reef	14	11.8	15.1	186	10.5	14.4
Ches. Bay Bridge Tunnel (3rd island only)	12	10.1	12.9	164	9.2	12.7
Ches. Light Tower Reef	11	9.2	11.8	141	8.0	10.9
Cape Henry Wrecks	9	7.6	9.7	95	5.4	7.4
Triangle Wrecks (non-Liberty Ships)	8	6.7	8.6	160	9.0	12.4
Tugboat Wreck (off Cape Henry)	7	5.9	7.5	119	6.7	9.2
Ches. Light Tower (tower structure only)	6	5.0	6.5	67	3.8	5.2
Triangle Reef-Liberty Ships (Webster, Haviland)	4[e]	3.3	4.3	78	4.4	6.0
Parramore Reef/R-10 Buoy[f]	4	3.3	4.3	24	1.4	1.9
Oceanview Reef[g]	3	2.5	3.2	23	1.3	1.8
Ches.Bay Bridge Tunnel (all trips combined)	27	22.7	29.0	397	22.4	30.8
Triangle Wrecks (all trips combined)	12	10.1	12.9	238	13.5	18.4

[a] Rod hours equal number of rods fished times number of hours actually fished

[b] Overall frequency indicates frequency of use of fishing area compared to all other fishing areas (wrecks, artificial reefs, and other structures) recorded in season's sampling effort; based upon 119 trips and 1769 total rod hours

[c] Relative frequency indicates frequency of use of area relative to other major fishing areas listed in this table; based upon 93 trips and 1290 rod hours

[d] Trips targeting first and fourth islands of the CBBT plus the "high rise" area and other unspecified areas along the bridge and/or tunnel portions of the complex

[e] An additional 2 trips were recorded for "Triangle Reef-Liberty Ships" area (Garrison and Clark wrecks), but fishing effort and catch data were not specified in a usable format

[f] Two of four trips included in sample were not randomly sampled but obtained from angler when contacted for other information

[g] Site dramatically enhanced July 8, 1987; two of three trips were made approximately one week before new structure (40 concrete igloos) added to site; one trip made ten days after new material added; remnants of old menhaden vessels on site prior to July 8

Table 2. Basic characteristics of fishing trips recorded from random interviews of fishermen targeting the indicated wrecks, artificial reefs, and the Chesapeake Bay Bridge Tunnel.

Fishing Area	Total Trips	Total Rod Hrs.	Mean[a] Angl/Trip	Mean Hrs. Fished	Mean # Rods	Mean Rod Hrs.	Mean No.[b] Boats Fishing
Ches.Bay Bridge Tun. (1st+4th isl;unspec.)	15	233	2.8	4.8	3.1	15.5	13.5
Gwynn Isl. Test Reef	14	186	3.8	3.6	4.3	13.3	6.1
Ches.Bay Bridge Tun. (3rd island only)	12	164	2.9	4.4	3.0	13.6	18.9
Ches.Light Tower Reef	11	141	3.3	3.7	3.5	12.8	8.9
Cape Henry Wrecks	9	95	2.8	3.4	3.3	10.6	4.0[c]
Triangle Wrecks (non-Liberty Ships)	8	160	3.6	5.8	3.6	20.0	5.3
Tugboat Wreck (off Cape Henry)	7	119	3.3	4.1	4.3	17.0	2.7
Ches. Light Tower (tower structure only)	6	67	3.2	3.2	3.5	11.2	4.6
Tri. Reef-Lib.Ships (Webster, Haviland)	4	78	3.3	5.4	3.3	17.5	2.3
Parr. Reef/R-10 Buoy	4	24	3.8	1.6	3.8	6.0	3.0
Oceanview Reef	3	23	2.0	2.6	2.7	7.7	5.0[d]
Ches.Bay Bridge Tun. (all trips combined)	27	404	2.9	4.6	3.1	15.0	16.6
Triangle Wrecks (all trips combined)	12	238	3.5	5.6	3.5	19.8	4.8

[a] Mean number of anglers per trip

[b] Mean number of boats per day observed fishing the site, including the boat of the captain interviewed; based upon boat captains' estimates derived from telephone interviews

[c] Only based upon two observations (fishing trips); not recorded for seven other trip interviews

[d] Based upon only one trip interview; not recorded for two other trip interviews

Table 3. Catch and release rates for tautog, seabass, and combined catches of both species for major fishing areas frequented by wreck and artificial reef fishermen during 1987 (average weight of "kept" fish and overall mean trip quality ratings also presented).

Fishing Area	No. Trips	Tautog Mean[a]	Tautog %Rel.	Tautog Av.Wt.[b]	Seabass Mean	Seabass %Rel.	Seabass Av.Wt.	Tautog - Seabass Mean	Tautog - Seabass %Rel.	Tautog - Seabass QUAL.[c]
Ches.Bay Bridge Tun. (1st+4th isl;unspec.)	15	1.0(1.9)	0%	53oz/3.31b	0.8(2.4)	48%	18oz/1.11b	2.0(2.8)	21%	3.2
Gwynn Isl. Test Reef	14	0.03(0.04)	0	32/2.0	0.1(0.3)	100	7/0.4[d]	0.1(0.1)	67	2.7[e]
Ches.Bay Bridge Tun. (3rd island only)	12	1.4(3.2)	2	58/3.6	0.7(2.8)	54	12/0.8	2.1(3.1)	18	3.7[e]
Ches.Light Tower Reef	11	0.8(1.8)	3	49/3.1	1.5(2.0)	15	16/1.0	2.3(2.3)	11	2.0[f]
Cape Henry Wrecks	9	0.1(0.1)	0	40/2.5	1.3(3.5)	34	18/1.1	1.4(1.2)	33	2.8
Triangle Wrecks (non-Liberty Ships)	8	0.3(0.3)	61	98/6.1	1.2(1.4)	23	34/2.1	1.5(1.3)	30	3.0[e]
Tugboat Wreck (off Cape Henry)	7	1.3(1.4)	19	48/3.0	0.2(0.3)	52	24/1.5	1.6(0.7)	14	3.0[f]
Ches. Light Tower (tower structure only)	6	0.3(0.5)	82	49/3.1	0.6(2.8)	0	15/0.9	1.0(0.9)	28	1.0[f]
Tri. Reef-Lib. Ships (Webster, Haviland)	4	0.2(0.2)	0	64/4.0	2.4(1.7)	0	34/2.1	3.4(2.9)	0	5.0[f]
Parr. Reef/R-10 Buoy	4	0.1(0.2)	0	48/3.0	10.0(3.9)	17	24/1.5	10.1(11.5)	17	3.0
Oceanview Reef	3	0.0(---)	---	----	0.0(---)	---	----	0.0(---)	---	2.3
Ches.Bay Bridge Tun. (all trips combined)	27	1.2(2.8)	3	56/3.5	0.8(2.4)	48	18/1.1	2.0(2.8)	21	3.2[g]
Triangle Wrecks (all trips combined)	12	0.2(0.3)	43	81/5.1	1.6(1.6)	12	34/2.1	1.9(1.7)	16	3.7[h]

[a] Mean catch per rod hour for all fish caught (kept and released fish combined); standard deviation in parentheses
[b] Mean weight of fish kept (does not include weight of fish released)
[c] Mean quality rating of overall fishing experience for all fishing trips, not only for catches of species listed in this table (1-poor; 2-fair; 3-good; 4-very good; 5-excellent); at least 75% of boat captains interviewed provided quality rating response, unless otherwise indicated; no average weight of combined catches presented because of wide variation in weights among species
[d] Mean weight of fish released, since all fish were released
[e] Only 58% of captains interviewed provided quality rating data
[f] Only 17% - 27% of captains interviewed provided quality rating data
[g] 70% of captains interviewed provided quality data
[h] Only 22% of captains interviewed provided quality rating data

Table 4. Catch and release rates for spot, croaker, gray trout, and combined catches of the three species for major fishing areas frequented by wreck and artificial reef fishermen during 1987; areas listed are those at which these species were targeted/likely to be caught; areas not included from Table 3 produced no catches of these species (average weights of "kept' fish and overall mean trip quality ratings also presented).

Fishing Area	No. Trips	Spot			Croaker			Gray Trout			Spot-Croaker-Trout		
		Mean[a]	%Rel.	Av.Wt.[b]	Mean	%Rel.	Av.Wt.	Mean	%Rel.	Av.Wt.	Mean	%Rel.	QUAL[c]
Ches.Bay Bridge Tun. (1st+4th isl;unspec)	15	0.5(1.5)	42%	16oz/1.01b	2.0(6.6)	11%	41oz/2.61b	0.9(4.1)	49%	36oz/2.21b	3.4(8.2)	26%	2.9
Gywnn Isl. Test Reef	14	2.9(10.2)	9	12/0.8	0.2(0.7)	7	12/0.8	0.5(0.6)	41	32/2.0	3.6(10.2)	11	2.7
Ches.Bay Bridge Tun.[d] (3rd island only)	12	0.0(---)	---	----	0.01(0.02)[e]	0	40/2.5[e]	0.01(0.02)[e]	0	64/4.0[e]	0.01(0.03)	0	3.7[f]
Cape Henry Wrecks	9	0.4(0.9)	0	12/0.8	0.3(0.6)	0	34/2.1	0.02(0.04)	0	40/2.5	0.8(1.4)	0	2.8
Oceanview Reef[g]	3	0.0(---)	---	----	5.4(3.9)	0	24/2.0	0.0(---)	---	----	5.4(3.9)	0	2.3[h]
Ches.Bay Bridge Tun. (all trips combined)	27	0.3(1.1)	42	13/0.8	1.2(5.0)	11	28/1.8	0.5(3.1)	48	38/2.4	2.0(6.4)	26	3.2

[a] Same as in Table 3
[b] Same as in Table 3
[c] Same as in Table 3
[d] Spot, croaker, and trout not specifically targeted at CBBT third island; principal targeted species were tautog and seabass with bluefish and flounder sought to a lesser degree
[e] Represents only one specimen
[f] Only 58% of captains interviewed provided quality rating data
[g] Reef site dramatically enhanced July 8, 1987 with addition of 40 concrete igloo units
[h] Based upon 100% response rate of captains interviewed

Table 5. Catch and release rates for bluefish, flounder, and all desirable species combined for major fishing areas frequented by wreck and artificial reef fishermen during 1987 (average weights of "kept" fish and overall mean trip quality ratings also presented).

Fishing Area	No. Trips	Bluefish Mean[a]	Bluefish %Rel.	Bluefish Av.Wt.[b]	Flounder Mean	Flounder %Rel.	Flounder Av.Wt.	All Desirable Species Mean	All Desirable Species %Rel.	All Desirable Species QUAL[c]
Ches.Bay Bridge Tun. (1st+4th isl;unspec)	15	0.1(0.4)	47%	100oz/6.21b	0.1(0.2)	1%	36oz/2.21b	5.7[d]	27%	2.9
Gwynn Isl. Test Reef	14	0.0(---)	---	-----	0.0(---)	---	-----	3.7[e]	11	2.7
Ches.Bay Bridge Tun. (3rd island only)	12	0.2(0.5)	0	32/2.0	0.1(0.1)	0	48/4.0	2.4[f]	16	3.7
Ches.Light Tower Reef	11	0.01(0.08)	0	40/2.5[g]	0.0(---)	---	-----	2.3[h]	13	2.0
Cape Henry Wrecks	9	0.3(0.2)	0	32/2.0	0.0(---)	---	-----	2.1[i]	22	2.8
Triangle Wrecks (non-Liberty Ships)	8	0.006(0.04)	100	-----	0.0(---)	---	-----	1.5[j]	30	3.0
Tugboat Wreck (off Cape Henry)	7	0.0(---)	---	-----	0.0(---)	---	-----	1.6	14	3.0
Ches. Light Tower (tower structure only)	6	0.2(0.4)	0	237/14.8	0.1(0.1)[k]	0[k]	640/40[k]	1.2[l]	22	1.0[m]
Tri.Wreck-Lib.Ships (Webster, Haviland)	4	0.0(---)	---	-----	0.0(---)	---	-----	2.7[n]	0	5.0[o]
Parr.Reef/R-10 Buoy	4	0.0(---)	---	-----	0.0(---)	---	-----	10.3[p]	17	3.0
Oceanview Reef	3	0.0(---)	---	-----	0.0(---)	---	-----	5.4	0	2.3
Ches.Bay Bridge Tun. (all trips combined)	27	0.2(0.5)	23	77/4.8	0.1(0.2)	1	36/2.2	4.0[df]	2	3.2
Triangle Wrecks (all trips combined)	12	0.004(0.03)	100	-----	0.0(---)	---	-----	1.9[jn]	19	3.7

[a] Same as in Table 3
[b] Same as in Table 3
[c] Same as in Table 3
[d] Standard deviation not presented for "all desirable species" because of the wide variation in catches among all species; mean catch rate includes 1 Spanish mackerel (Scomberomorus maculatus) and 1 gray triggerfish (Balistes capriscus)
[e] Does not include 11 small "sand sharks" (sp. unknown), all released
[f] Mean catch rate includes 1 black drum (Pongonias cromis)
[g] Represents weight of only one fish
[h] Mean catch rate includes 5 Spanish mackerel (Scomberomorus maculatus); does not include 3 "sand sharks" (sp. unknown) and 1 pinfish (Lagondon rhomboides)
[i] Mean catch rate includes 8 king mackerel (S. cavalla) and 6 false albacore (Euthynnus alletteratus)
[j] Does not include 9 "spiny" dogfish (most likely Squalus acanthias), 4 amberjack (Seriola dumerili), and 1 bluefish (Pomatomus saltatrix), all released
[k] Data represents amberjack catches, not flounder catches
[l] Does not include 1 "spiny" dogfish (most likely S. acanthias), released
[m] Quality rating only represents one trip interview; no fish were caught
[n] Does not include 20 "spiny" dogfish (most likely S. acanthias), all released
[o] Quality rating based upon one trip only; data not recorded for other trips
[p] Mean catch rate includes 6 "ling," which were most likely red hake (Urophysis chuss)

Table 6. Distribution of "kept-fish" catches by fishing area for trips recorded from the general sampling effort during 1987.

Fishing Area	Total Fish Kept[a]	Relative and Absolute Frequency of Kept Fish							
		Tautog	Sea Bass	Spot	Croaker	Gray Trout	Bluefish	Flounder	Other
Ches. Bay Bridge Tunnel (1st+4th isl; unspec.)	975	24.2% (236)	12.2% (119)	7.0% (68)	42.4%(413)	11.1% (108)	1.7% (17)	1.2% (12)	0.2% (2)[b]
Gywnn Island Test Reef	598	0.8 (5)	--- (---)[c]	81.4 (487)	4.7 (28)	13.0 (78)	--- (---)	--- (---)	--- (---)
Ches. Bay Bridge Tunnel (3rd island only)	332	69.9 (232)	15.4 (51)	--- (---)	0.3 (1)	0.3 (1)	10.2 (34)	3.6 (12)	0.3 (1)[d]
Ches. Light Tower Reef	289	37.4 (108)	60.6 (175)	--- (---)	--- (---)	--- (---)	0.3 (1)	--- (---)	1.7 (5)[e]
Cape Henry Wrecks	202	3.0 (6)	41.6 (84)	19.8 (40)	15.8 (32)	0.9 (2)	11.9 (24)	--- (---)	6.9 (14)[f]
Triangle Wrecks (non-Liberty Ships)	175	14.9 (26)	85.1 (149)	--- (---)	--- (---)	--- (---)	--- (---)	--- (---)	--- (---)
Tugboat Wreck (off Cape Henry)	161	91.3 (147)	8.7 (14)	--- (---)	--- (---)	--- (---)	--- (---)	--- (---)	--- (---)
Ches. Light Tower (tower structure only)	63	6.3 (4)	68.3 (43)	--- (---)	--- (---)	--- (---)	19.0 (12)	--- (---)	6.3 (4)[g]
Tri. Reef-Liberty Ships (Webster, Haviland)	207	8.2 (17)	91.8 (190)	--- (---)	--- (---)	--- (---)	--- (---)	--- (---)	--- (---)
Parramore Reef/R-10 Buoy	208	1.0 (2)	96.2 (200)	--- (---)	--- (---)	--- (---)	--- (---)	--- (---)	2.9 (6)[h]
Oceanview Reef	125	--- (---)	--- (---)	--- (---)	100 (125)	--- (---)	--- (---)	--- (---)	--- (---)
Ches. Bay Bridge Tunnel (all trips combined)	1307	35.8 (468)	13.0 (170)	5.2 (68)	31.7 (414)	8.3 (109)	3.9 (51)	1.8 (24)	0.2 (3)
Triangle Wrecks (all trips combined)	382	11.3 (43)	88.7 (339)	--- (---)	--- (---)	--- (---)	--- (---)	--- (---)	--- (---)

Table 6 cont'd

[a] Fishing trips (fishing effort) not equal among sites
[b] 1 Spanish mackerel (Scomberomorus maculatus) and 1 gray triggerfish (Balistes capriscus)
[c] No fish caught, or if caught, were released; relative frequency (%) followed by absolute frequency ( )
[d] Black drum (Pongonias cromis)
[e] 5 Spanish mackerel (S. maculatus)
[f] 8 king mackerel (Scomberomorus cavalla) and 6 false albacore (Euthynnus alletteratus)
[g] Amberjack, Seriola dumerili
[h] "Ling," most likely red hake (Urophycis chuss)

Table 7. Distribution of recorded fishing effort at Gwynn Island Test Reef site during 1987.

	Fishing Effort			
Month	No. Trips	Relative Frequency	No. Rod Hours	Relative Frequency
May	4	6.7%	16	2.3%
June	7	11.7	106	14.9
July	11	18.3	88	12.4
August	11	18.3	157	22.1
September	7	11.7	93	13.1
October	17	28.3	233	32.8
November	3	5.0	18	2.5
Season	60	100.0	711	100.1[a]

[a] Does not equal 100% due to rounding

Table 8. Basic characteristics of fishing trips recorded from random telephone interviews of fishermen targeting the Gwynn Island Test Reef site during 1987.

Month	Total Trips	Total Rod Hrs.	Mean[a] Angl/Trip	Mean Hrs. Fished	Mean # Rods	Mean Rod Hrs.	Mean No.[b] Boats Fishing
May	4	16	2.5	1.8	2.5	4.0	2.3[c]
June	7	106	3.6	3.7	3.7	15.1	4.5[d]
July	11	88	2.8	2.5	2.9	8.0	4.0[e]
August	11	157	3.6	3.6	3.7	14.3	6.4[f]
September	7	93	3.4	3.4	3.7	13.3	8.7[g]
October	17	233	3.3	3.6	3.4	13.7	7.8[h]
November	3	18	2.3	2.7	2.3	6.0	4.7[i]
Season	60	711	3.2	3.2	3.3	11.8	5.8[j]

[a] Mean number of anglers per trip

[b] Mean number of boats observed fishing the site including the boat of the captain interviewed; in a few instances when 2-3 observations were obtained for the same day, the observations were averaged providing a single mean daily boat count estimate

[c] Observations based upon 3 weekend days (Sat. or Sun.) over 2 weekends

[d] Observations based upon 6 weekend days (Sat. or Sun.) over 3 weekends

[e] Observations based upon 7 weekend days (Fri., Sat., or Sun.) over 4 weekends

[f] Observations based upon 5 weekend days (Fri., Sat., or Sun.) over 4 of 5 weekends in month

[g] Observations based upon 4 weekend days (Sat. or Sun.) over 3 weekends and 1 weekday (8.0 boats per weekday; 9.0 boats per weekend day on average)

[h] Observations based upon 10 weekend days (Fri., Sat., or Sun.) over 4 weekends and 2 weekdays (2.0 boats per weekday on average; 9.0 boats per weekend day on average)

[i] Observations based upon 2 weekend days (Sat. and Sun.) over 1 weekend and 1 weekday (1.0 boat per weekday; 6.5 boats per weekend day on average)

[j] Observations based upon 37 weekend days (Fri., Sat., or Sun.) over 21 weekends and 5 weekdays (3.0 boats per weekday on average; 5.0 boats per weekend day on average)

Table 9. Catch and release rates for tautog, seabass, and combined catches of both species for all months in which trips were recorded at the Gwynn Island Test Reef site during 1987 (average weights of "kept" fish and overall mean trip quality rating also presented).

Month	No. Trips	No. Rod Hrs.	Tautog Mean[a]	Tautog %Rel.	Tautog Av.Wt.[b]	Seabass Mean	Seabass %Rel.	Seabass Av.Wt.	Tautog - Seabass Mean	Tautog - Seabass %Rel.	Tautog - Seabass QUAL[c]
May	4	16	0.0(---)	---	(oz/lb)	0.0(---)	---	(oz/lb)	0.0(---)	---	N/A[d]
June	7	106	0.0(---)	---	----	0.0(---)	---	----	0.0(---)	---	2.0[e]
July	11	88	0.0(---)	---	----	0.1(0.4)	100%	----	0.1(0.4)	100%	2.6[f]
August	11	157	0.0(---)	---	----	0.0(---)	---	----	0.0(---)	---	2.5
September	7	93	0.0(---)	---	----	0.2(0.6)	100	----	0.2(0.06)	100	3.3
October	17	233	0.03(0.04)[f]	0%	43/2.7	0.3(2.6)	74	15/0.9	0.4(2.5)	68	2.4
November	3	18	0.6(1.1)	0	48/3.0	1.2(3.3)	45	12/0.8	1.8(4.4)	31	2.0[g]
Season	60	711	0.03(0.3)	0	46/2.9	0.2(1.6)	71	14/0.9	0.2(1.7)	62	2.6[h]

[a] Mean catch per rod hour for all fish caught (kept and released fish); with standard deviation in parentheses

[b] Mean weight of fish kept (does not include weight of fish released)

[c] Mean quality rating of overall fishing trip experience for all fishing trips, not only for catches of species listed in this table (1-poor; 2-fair; 3-good; 4-very good; 5-excellent); at least 86% of captains interviewed provided quality rating response, unless otherwise indicated

[d] N/A - No data available; quality rating question was not included in interviews until latter half of June

[e] Only 28% of interviewed captains provided quality rating data (2 captains)

[f] 86-100% of captains interviewed provided quality rating data unless otherwise specified

[g] Fishermen primarily began targeting tautog and seabass in the latter portion of October and in November, thereby changing their fishing strategy from generally fishing periphery of reef area for spot-croaker-trout to fishing directly over reef material; only 33% of captains provided quality rating data (1 captain)

[h] 75% of captains interviewed provided quality rating data for their trips' overall fishing experience

Table 10. Catch and release rates for spot, croaker, gray trout, and combined catches of the three species for all months in which fishing trips were recorded for the Gwynn Island Test Reef site during 1987 (average weights of "kept" fish and overall mean trip quality rating also presented).

Month	No. Trips	No. Rod Hrs.	Spot			Croaker			Gray Trout			Spot-Croaker-Trout		
			Mean[a]	%Rel.	Av.Wt.[b]	Mean	%Rel.	Av.Wt.	Mean	%Rel.	Av.Wt.	Mean	%Rel.	QUAL[c]
May	4	16	1.0(0.9)	38%	12oz/0.81b	1.7(3.1)	0%	18oz/1.11b	0.6(0.7)	11%	40oz/2.51b	3.2(2.6)	13%	N/A[d]
June	7	106	1.2(1.1)	0	8/0.5	0.4(0.5)	0	24/1.5	0.7(0.8)	0	17/1.1	2.2(1.3)	0	2.0[e]
July	11	88	4.2(8.0)	8	10/0.6	0.4(0.1)	0	12/0.8	0.5(0.8)	0	19/1.2	5.1(8.0)	6	2.6[f]
August	11	157	2.3(11.2)	0	11/0.7	0.1(0.1)	100	----	0.5(0.5)	3	16/1.0	2.8(11.1)	2	2.5
September	7	93	5.2(4.5)	18	13/0.8	0.6(0.5)	58	20/1.2	0.4(0.7)	44	27/1.7	6.2(4.4)	23	3.3
October	17	233	4.0(8.3)	21	15/0.9	0.03(0.1)	0	20/1.2	0.6(1.1)	25	32/2.0	4.6(9.2)	22	2.4
November	3	18	0.0(---)[g]	---	----	0.0(---)[g]	---	----	0.0(---)[g]	---	----	0.0(---)[g]	---	2.0[g]
Season	60	711	3.2(7.5)	14	12/0.8	0.2(1.0)	23	19/1.2	0.5(0.8)	15	25/1.6	4.0(7.8)	15	2.6[h]

[a] Same as Table 9
[b] Same as Table 9
[c] Same as Table 9
[d] Same as Table 9
[e] Same as Table 9
[f] Same as Table 9
[g] Same as Table 9
[h] Same as Table 9

Table 11. Catch and release rates for bluefish, flounder, and all desirable species combined for all months in which fishing trips were recorded for the Gwynn Island Test Reef site during 1987 (average weights of "kept" fish and overall mean trip quality ratings also presented).

Month	No. Trips	No. Rod Hrs.	Bluefish Mean[a]	Bluefish %Rel.	Bluefish Av.Wt.[b]	Flounder Mean	Flounder %Rel.	Flounder Av.Wt.	All Desirable Species Mean	All Desirable Species %Rel.	All Desirable Species QUAL[c]
May	4	16	0.0(---)	---	oz/lb	0.0(---)	---	oz/lb	3.2[d]	16%	N/A[e]
June	7	106	0.0(---)	---	----	0.0(---)	---	----	2.2	0	2.0[f]
July	11	88	0.0(---)	---	----	0.0(---)	---	----	5.2	8	2.6
August	11	157	0.02(0.04)	100%	----	0.01(0.01)	0	16/1.0	2.9	3	2.5
September	7	93	0.0(---)	---	----	0.02(0.06)	100	----	6.2	24	3.3
October	17	233	0.0(---)	---	----	0.02(2.6)	80	48/3.0	5.1	26	2.4
November	3	18	0.0(---)	---	----	0.06(0.1)	0	48/3.0	1.8	30	2.0[f]
Season	60	711	0.004(0.02)[g]	100	----	0.01(0.05)[g]	67	37/2.3	4.2[h]	17[h]	2.6[i]

[a] Same as in Table 9
[b] Same as in Table 9
[c] Same as in Table 9
[d] Standard deviation not presented for "all desirable species" because of the wide variation in catches when combining all species
[e] Same as footnote d in Table 9
[f] Same as footnote e in Table 9
[g] Neither of these species were targeted by fishermen except for 1 October trip when trout/flounder were targeted (see Table 14)
[h] Monthly and seasonal mean catch and release rates for "all desirable species" do not include 13 puffers (Sphoeroides maculatus) and 12 searobins (most likely Prionotus carolinus), caught in August; and 11 "sand sharks" (sp. unknown), caught in July; all were released
[i] Same as footnote g in Table 9

Table 12. Distribution of "kept-fish" catches by month and season at the Gwynn Island Test Reef site during 1987.

Month	Total Fish Kept[a]	Relative and Absolute Frequency of Kept Fish							
		Tautog	Sea Bass	Spot	Croaker	Gray Trout	Bluefish	Flounder	Other
May	45	--% (---)[b]	--% (---)	22.2% (10)	60.0% (27)	17.8% (8)	--% (---)	--% (---)	--% (---)
June	235	--- (---)	--- (---)	51.9 (122)	17.9 (42)	30.2 (71)	--- (---)	--- (---)	--- (---)
July	419	--- (---)	--- (---)	82.1 (344)	8.1 (34)	9.8 (41)	--- (---)	--- (---)	--- (---)
August	437	--- (---)	--- (---)	84.0 (367)	--- (---)	15.8 (69)	--- (---)	0.2 (1)	--- (---)
September	440	--- (---)	--- (---)	89.8 (395)	5.2 (23)	5.0 (22)	--- (---)	--- (---)	--- (---)
October	873	0.8 (7)	2.4 (21)	83.0 (725)	0.7 (6)	12.9 (113)	--- (---)	0.1 (1)	0.2 (2)[c]
November	23	43.5 (10)	52.2 (12)	--- (---)	--- (---)	--- (---)	--- (---)	4.3 (1)	--- (---)
Season	2472	0.7 (17)	1.3 (33)	79.4 (1963)	5.3 (132)	13.1 (324)	--- (---)	0.1 (3)	0.1 (2)

[a] Fishing trips (fishing effort) not equal among months
[b] No fish caught or, if caught, were released; relative frequency (%) followed by absolute frequency ( )
[c] Likely the striped (jumping) mullet, Mugil cephalus

Table 13. Targeted species and species groups specified by boat captains fishing Gwynn Island Test Reef site during 1987.

	Month							
Target Species	May	June	July	August	Sept.	Oct.	Nov.	Season
Bottom Fish	--%	14%	27%	9%	--%	--%	--%	8%
Croaker	---	14	---	---	---	---	---	2
Spot	---	---	9	9	14	---	---	5
Trout	---	14	9	18	---	18	---	10
Seabass	---	---	---	---	---	---	---	---
Tautog	25	---	---	---	---	---	100	7
Flounder	---	---	---	---	---	12	---	3
Spot/Trout	---	14	18	27	14	35	---	22
Spot/Croaker	25	14	27	9	14	6	---	13
Spot/Croaker/Trout	---	14	9	18	57	---	---	13
Seabass/Trout	---	---	---	---	---	6	---	2
Seabass/Tautog	---	---	---	---	---	6	---	2
Trout/Flounder	---	---	---	---	---	6	---	2
Unspecified[b]	50	14	---	9	---	12	---	10
Total Trips	4	7	11	11	7	17	3	60

[a] Monthly and overall season frequencies may not total 100% due to rounding

[b] Unspecified category means that boat captain did not specify any species or species group as being targeted by trip in question, e.g. "seeking anything that would bite;" in a few instances, researchers inadvertently did not record target species data

Table 14. Relative frequency of use of various baits by fishermen at the Gwynn Island Test Reef site during 1987.

Month	Bait Used[a] Bloodworm	Crab	Squid	Cut Bait	Clam	Minnows
May	75%	75%	--%[b]	--%	--%	--%
June	71	43	57	14	---	---
July	91	55	27	18	---	---
August	91	45	36	27	18	18
September	100	29	14	29	---	14
October	82	29	53	35	6	---
November	---	67	33	---	67	---
Season	84	45	38	24	9	5

[a] Anglers frequently used at least two bait types per fishing trip; since it was not known how long each bait type was used, a single trip in which multiple bait types were used was counted as a whole trip for each bait type (baits given full trip weighting); e.g. for a trip on which bloodworms and crab baits were used, the assigned bait use value would be one trip for bloodworms plus one trip for crab bait; bait use frequencies, therefore, total over 100% for a given month and for the season overall

[b] Bait type not mentioned as being used by fishermen on any trip during month indicated

Table 15. Monthly and seasonal fishing strategies practiced by boats making trips to the Gwynn Island Test Reef site during 1987 (positioning mode of boat relative to reef structure; anchored, drifting, trolling mode of fishing).

	Boat Positioning Mode (no. of trips)						Anchored-Drifting-Trolling Mode				
								Frequency[b]			
Month	Fishing off Edge of Reef	Drifting Past Reef	Anchored/Drifted Over Structure	Start Drift at Reef	Unspecified[a]	Total Trips	Anch.	Drift	Troll	A/D	A/D/T
May	2A[c]	---	-----	----	1A; 1A/D[d]	4	75%	---%	---%	25%	---%
June	1A	1D	1A	1D	1A; 1A/D; 1A/D/T[e]	7	43	29	---	14	14
July	5A	2D	1A	---	1A; 2D	11	64	36	---	---	---
August	2D; 1A; 2A/D	1D	1A; 1A/D	2D	1D	11	18	55	---	27	---
September	2D; 2A; 1A/D	---	1A/D	---	1A	7	43	14	---	29	---
October	9A	3D	2D	---	3A	17	71	29	---	---	---
November	---	---	2A	---	1A	3	100	---	---	---	---
Seasonal Position Mode (Freq)	45%[f]	12%	15%	5%	23%	60	55%[g]	32%	---	12%	2%[h]
Seasonal Anchor-Drift-Troll Mode Within Position Strategy (Freq)	74%A; 15%D; 11%A/D	100%D	56%A; 22%D; 22%A/D	100%D	57%A; 21%D; 14%A/D; 7%A/D/T						

[a] Captain or researcher did not clarify fishing strategy for positioning boat on reef site
[b] Frequency distribution based upon total number of trips recorded in interviews for each month
[c] Two (2) boats, both anchored while fishing off edge of reef site
[d] One (1) boat anchored part of time and drifted part of time while fishing reef site, but positioning of boat relative to reef not specified
[e] One (1) boat anchored, drifted, and trolled on reef site, but did not specify positioning mode
[f] Proportion of boats practicing indicated boat-positioning mode compared to total number of recorded trips (60 trips) for entire season
[g] Proportion of boats practicing anchored, drifting, trolling, etc., mode of fishing compared to total number of recorded trips (60 trips) for entire season
[h] Frequencies do not total 100% due to rounding

Table 16. Distribution of fishing trip quality rating responses by month and season for trips to Gwynn Island Test Reef site during 1987.

		Overall Quality of Fishing Trip (Freq.)[a]					
Month	No. Trips	Poor	Fair	Good	Very Good	Excellent	Unspecified
May	4	--%[b]	--%	--%	--%	--%	--%
June	7	---[b]	29	---	---	---	71
July	11	18	9	64	9	0	0
August	11	27	9	18	18	9	18[c]
September	7	0	0	57	29	0	14
October	17	41	12	6	18	12	11
November	3	0	33	0	0	0	67
Season	60	21%	12%	25%	14%	5%	21%

[a] Four (4) May trips not included in monthly and seasonal frequency distributions since quality rating question not asked boat captains in May; frequency distributions based upon 56 trip interviews

[b] Fishing experience quality rating data question not included in sampling interviews until sampling period covering June 15-28

[c] Relative frequencies across month and season may not equal 100% due to rounding

Table 17. Conservative estimate of number of fishing trips made to the Gwynn Island Test Reef by month and season during 1987 (does not indicate the number of different boats using the site since the same boat might make more than one trip to the reef during a weekend and/or month).

	No. Actual Obs.[a]		Mean No.	Total No.	Mean No.	Total No.	Est. Total
	WE Days	W Days	Boats/WE Day	Weekend Days	Boats/W Day	Weekdays	No. Boats
May	3/2[b]	---	2.3[c]	6[d]	-----	---	14[e]
June	6/3	---	4.5	9[d]	-----	---	40[d]
July	7/4	---	4.0	13	-----	---	52
August	5/4	---	6.4	11[d]	-----	---	70[d]
September	4/3	1	9.0	9[d]	8.0[f]	4[g]	113[dg]
October	10/4	2	9.0	14	2.0[h]	4[h]	134[h]
November	2/1	1	6.5	3[i]	1.0	4[i]	24[i]
Season	37/21	4	6.0	68[di]	4.0[fh]	12[ghi]	447[j]

[a] Weekend days (WE) considered to be Friday, Saturday, or Sunday; weekdays (W) considered to be Monday through Thursday

[b] 3/2 - Three (3) weekend day observations over two (2) separate weekends and no weekday observations available

[c] Based upon observations obtained from interviews as specified in Table 8, including footnotes

[d] Only included weekend days in actual periods of weekends during which observations made

[e] Derived from multiplying value in second column (2.3 boats/WE Day) x value in third column (6 weekend days in observation period); rounded to nearest even number

[f] Only 1 weekday observation recorded

[g] Since only 1 weekday observation available, included only 4 weekdays of that week in boat count projection (8.0 boats/W Day x 4 W Days)

[h] Two (2) weekday observations recorded on separate days during same week; only 4 weekdays of that week included in boat count projection (2.0 x 4 W Days)

[i] Only counting weekend days and weekdays for week during which interviews made, since bad weather all but stopped fishing beyond Nov. 2, 1987

[j] Conservative estimate; includes few weekday trips and not all weekends in May, June, or September

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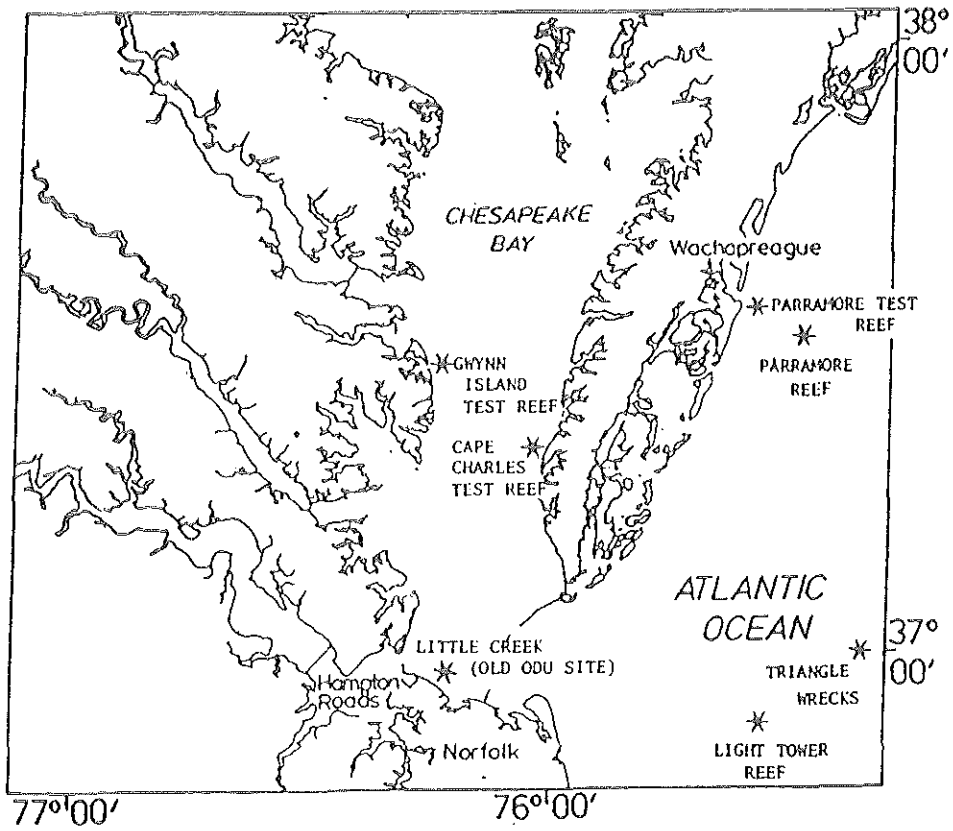
ARTIFICIAL REEF FISHING STUDY
Virginia Institute of Marine Science, Gloucester Point, VA 23062
(Funded by Sport Fish Restoration (Wallop-Breaux) Funds
Through the Virginia Marine Resources Commission)



ARTIFICIAL REEF AND WRECK STUDY SITES
(Sites to be Re-Buoyed By Late Spring 1987)

LOCATION	LORAN BEARINGS	REEF MATERIAL
PARRAMORE TEST REEF	41784.1/27125.4	Concrete Pipes
3.8 N.M. from Parramore	41741.0/27126.0	Concrete Igloos
Coast Guard Tower on	41747.5/27125.2	Concrete Pipes
Course 115 degrees T	41744.0/27125.2	Tire Modules
	41738.0/27126.3	Tire Modules
PARRAMORE REEF	41746.3/27095.5	Vessel: Walter Hines Page
(Buoy "R-10")	41744.0/27095.0	Vessel: Mona Island
8.7 N.M. from Parramore		
Coast Guard Tower on		
Course 102 degrees T		
TRIANGLE WRECKS	41391.4/27020.2	Vessel: Webster
(GA Buoy)	41390.7/27020.5	Vessel: George P. Garrison
18 N.M. from Chesapeake Light	41389.6/27020.0	Vessel: James Haviland
Station on Course 071 degrees T	41386.2/27018.9	Vessel: Edgar Clark
LIGHT TOWER REEF	41286.2/27103.0	60′ X 80′ Drydock
S.W. of Chesapeake Light Station		
GWYNN ISLAND TEST REEF	41637.2/27299.4	Tire Modules/Concrete Igloos
1.35 N.M. NE of "Hole-in-the-Wall"		
CAPE CHARLES TEST REEF	41541.2/27231.0	Concrete Igloos
N/NW of Entrance to Cherrystone	41539.0/27231.2	Tire Modules
Inlet immediately east of Buoy "C 12"	41539.4/27230.8	Concrete Pipes
LITTLE CREEK (after Aug. 1, 1987)	41259.8/27225.3	Concrete Igloos
900 yds. off Ocean View Beach	41259.7/27225.0	Concrete Igloos
W. of Little Creek Entrance		

Appendix A. Chart showing locations of artificial reef study sites.

ATTENTION
WRECK & ARTIFICIAL REEF FISHERMEN

WE NEED YOUR HELP! The Virginia Institute of Marine Science (VIMS) is beginning a two-year study to develop catch and effort information for determining trends in recreational fishing on Virginia's artificial fishing reefs. Offshore and Chesapeake Bay sites will be studied. (See chart, reverse side).

The study will help document fishing success rates of experienced fishermen on the reef sites. Study results will be useful to the Virginia Marine Resources Commission (VMRC) in maintaining and expanding its reef program. Primary funding for the study is provided by Sport Fish Restoration (Wallop-Breaux) Funds administered by VMRC.

PARTICIPATION BY PRIVATE BOAT FISHERMEN IS NEEDED! If you occasionally fish reef sites, please fill in a line below so we can contact you several times during the fishing season about your catches. We promise to be brief and appreciate your help!

NAME	ADDRESS	PHONE NO.	BOAT NAME

Appendix A (cont.) Form for soliciting names and addresses of boating owning wreck and reef fishermen.

VIMS needs help to see if anglers catch fish at reefs

Jay Mundy

Fishing

GLOUCESTER POINT — Researchers at the Virginia Institute of Marine Science need our help. They need to know if we're catching fish on the artificial reefs that's been planted around the lower Chesapeake Bay.

For the past dozen years, the Marine Resource Commission has spent roughly $350,000 building artificial reefs in the Atlantic at such locations as the Chesapeake Light Tower, some 15 miles east of the Chesapeake Bay Bridge, and the Triangle Wrecks, another 15 miles beyond the Light Tower.

Today these reefs are not only providing excellent recreational fishing for such species as black sea bass and tautog, but also provide a sizable commercial catch for watermen.

Since 1983, VMRC has planted four reefs in the bay itself, with a fifth scheduled to be completed on the old ODU site off east Ocean View by August of this year. Two more are located in the Atlantic just off Parramore on the Eastern Shore.

Jon Lucy, coordinator for the VIMS project, said the reefs inside the bay are perfect for such species as croaker, spot and flounder, but there is little proof that fish have taken up residence.

"Part of the problem may be the sites are really test sites and rather small in size, and anglers simply can't locate them," he said.

For example, the Gwynn Island site, located at the southern tip of the mouth of the Rappahannock River a little more than a mile northeast of the "Hole-in-the-Wall, " the passage between the island and the mainland, is only about 50 yards by 75 yards.

"We know this site marks well on a fish finder," Lucy said. "We know also that some spot, croaker and even flounder have been caught there, because we've already spoken with some fishermen who had good results fishing there.

"What we need to know now," he added, "is if the fish have started to hang around the reef all season, like they do on the offshore reefs, or if they're just moving in and out, say with the tide, or when they're chasing baitfish."

The Gwynn Island site, as with all the sites, were constructed of the best material known at this time, according to Mike Meier, reef director for VMRC.

The Gwynn Island site was constructed from concrete igloos and old tires, and fashioned after designs perfected by the Japanese, world leaders in artificial reef construction.

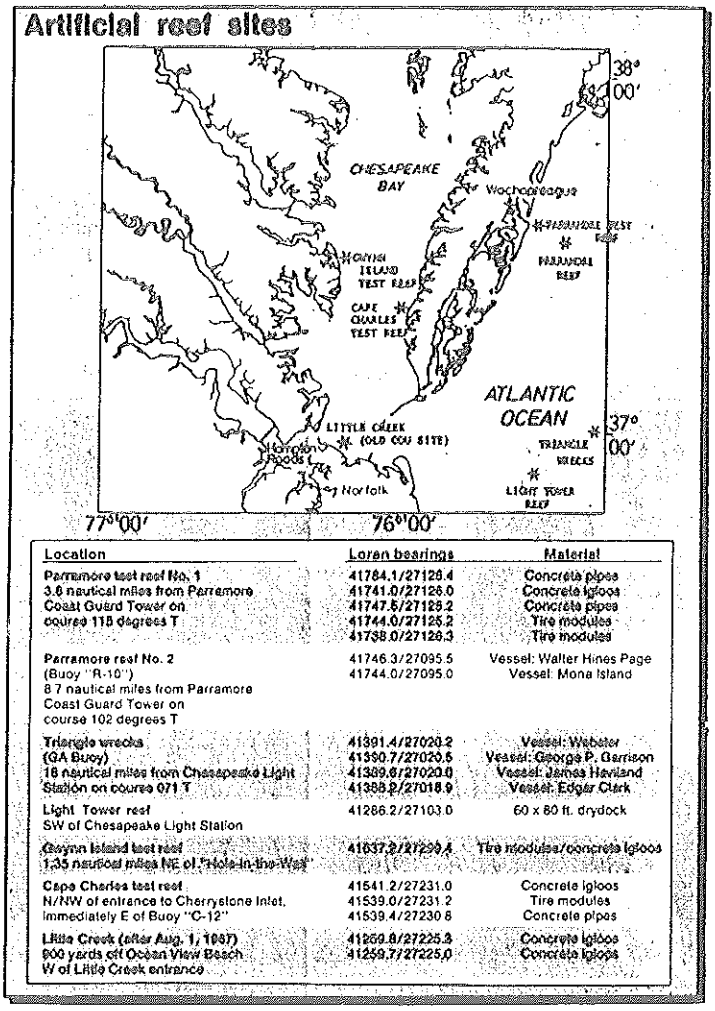
They're laid out in a ragged line, much like the ballast rocks that make up the foundation for Bluefish Rock, a popular fishing spot located just off Grandview Beach in Hampton. The water depth around the Gwynn Island site is about 20 feet.

The reef is normally marked with three small, white spar buoys bearing the words "Gwynn's Island Reef." At the moment there are only two of the buoys in place, the third having blown away with the last northeaster.

"In fact," Meier said, "our biggest problem right now is keeping the buoys on the site. Anytime you notice one is missing or damaged, please call me."

Meier said the buoys will be replaced this spring.

Lucy said it's interesting to note that more croaker are caught off the concrete igloos than the tires.



Location	Loran bearings	Material
Parramore test reef No. 1 3.6 nautical miles from Parramore Coast Guard Tower on course 118 degrees T	41784.1/27126.4 41741.0/27126.0 41747.5/27128.2 41744.0/27125.2 41738.0/27126.3	Concrete pipes Concrete igloos Concrete pipes Tire modules Tire modules
Parramore reef No. 2 (Buoy "R-10") 8.7 nautical miles from Parramore Coast Guard Tower on course 102 degrees T	41746.3/27095.5 41744.0/27095.0	Vessel: Walter Hines Page Vessel: Mona Island
Triangle wrecks (GA Buoy) 18 nautical miles from Chesapeake Light Station on course 071 T	41391.4/27020.2 41390.7/27020.5 41389.6/27020.0 41388.2/27018.9	Vessel: Webster Vessel: George P. Garrison Vessel: James Haviland Vessel: Edgar Clark
Light Tower reef SW of Chesapeake Light Station	41286.2/27103.0	60 x 80 ft. drydock
Gwynn Island test reef 1.35 nautical miles NE of "Hole-in-the-Wall"	41637.2/27239.4	Tire modules/concrete igloos
Cape Charles test reef N/NW of entrance to Cherrystone Inlet, immediately E of Buoy "C-12"	41541.2/27231.0 41539.0/27231.2 41539.4/27230.8	Concrete igloos Tire modules Concrete pipes
Little Creek (after Aug. 1, 1987) 900 yards off Ocean View Beach W of Little Creek entrance	41260.6/27225.3 41259.7/27225.0	Concrete igloos Concrete igloos

"I don't know why at this time," he said. "Maybe you fishermen have an idea."

Speculation is because the igloos, which measure nine feet by seven feet, stand higher off the bottom than the tire modules.

"Anything standing off the bottom will grow barnacles and such much quicker, which attract bottom-feeder likes croaker," Lucy said.

The other site in the lower bay is located north/northwest of the entrance to Cherrystone Inlet on the Chesapeake side of the Eastern Shore, immediately east of Buoy C-12.

The buoys there have all blown away said Meier.

The reef lies in 25 to 35 feet of water and is laid out in more of a square than the Gwynn Island reef.

"There's a little different situation here than on the western side of the bay," Meier noted. "The Cape Charles site has produced a few more fish than Gwynn's Island, especially small sea bass, called Black Wills."

Neither marine expert could say if the reefs were attracting large species such as bluefish, red and black drum, or cobia.

To reach Lucy or Charles Barr, a graduate student helping on the project, call VIMS at Gloucester Point (804) 642-7166 during work hours, or after hours leave a message on the institute's answering machine, at 642-7000.

Meier can be reached at VMRC's headquarters in Newport News by calling 247-2263.

Appendix B. Newspaper and periodical articles on Wallop-Breaux reef study

WILLIAM AND MARY NEWS

Wednesday, May 13, 1987

VIMS seeks information on fishing reefs

The Institute's Sea Grant Marine Advisory Services Program is conducting a reef fishing study to provide the Virginia Marine Resources Commission with an analysis of catch and fishing effort data. The study will assist in evaluating the maintenance and expansion of exisiting as well as new reef sites. Jon Lucy, professor of marine science, is coordinator for the study and is being assisted by Charles Barr, a graduate student on the project. The work is primiarily funded from Sport Fish Restoration (Wallop-Breaux) Funds administered by VMRC.

The Virginia Institute of Marine Science has begun collecting catch information from recreational fishermen using Virginia's artificial fishing reefs.

VIMS

Continued from p. 2.

Lucy is requesting that fishermen who fish the reef sites contact him at VIMS. Fishermen who call will be randomly contacted at various times during the fishing season. All information on catches will be kept confidential and only summarized in the study report.

Lucy and Barr recently mailed flyers to marinas and Virginia Saltwater Fishing Tournament weight stations in another attempt to reach fishermen.

Fishermen may also contact Lucy at the following address: Reef Fishing Study, Virginia Institute of Marine Science, Gloucester Point, 23062. He can be reached by phone during working hours at 642-7166. After hours, callers may leave a message with the Institute's answering service at 642-7000.

Appendix B. (cont.)

Richmond Times-Dispatch, Tuesday, May 5, 1987 C-3

Harlow's determination lands 22-pound turkey

News from all over:

• Here's one of those interesting things that can happen to you if you'll get out in the woods during spring turkey season instead of lying in bed dreaming about Jane Pauley.

David Harlow of Richmond was in the woods near a Goochland County lake a few mornings ago at 5:30 a.m.

"At that time of day (day?), hoot owls are still calling and you can bump into trees without even suspecting they're there.

"Just after dawn, David heard a gobbler tune up across the lake. He called and called. The gobbler would answer but wouldn't walk around the lake.

David decided to go to the gobbler, so he sneaked around the lake, then called again.

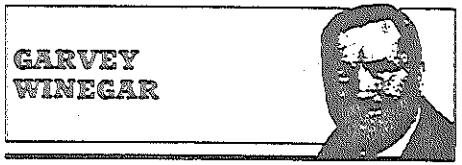
A hen came to the call and walked right past him and into the brush. Then she started clucking for David, so to speak. "I decided to shut up and see how well she could do," he said.

The gobbler came to her, but got between the real hen and David. David began to think he'd better start sounding good again. It was now or never.

This time, hen and gobbler came to David's call. "She was leading him," said David.

They were still out of range when something went wrong. They saw David bat an eye or maybe just got suspicious. Both flew.

David waited half an hour, then walked to where the birds had flushed. He hit the caller once; the gobbler



answered.

It took 30 minutes to work him back but finally, after that three-hour game of musical chairs, the gobbler returned to David.

He was a beaut — 22 pounds with an 11-inch beard.

If at first you don't succeed. . . .

• Woo Daves keeps racking up points in national bass fishing competition.

This past weekend, the Chester resident caught 37½ pounds of fighting largemouth bass during the $137,000 Bassmaster Invitational tournament at Guntersville, Ala.

That was good enough to take 15th place in a field of 40 of the country's top bass fishermen. Daves' seven bass were worth $1,500 prize money.

With only one more tournament to go before the Bass Classic in Louisville, Ky., in August, Daves' outstanding year of competitive bass fishing has assured him a place in what is often called the World Series of angling.

Also, he was in fourth place for bass angler of the year award going into the Alabama contest.

The Alabama tournament was won by Texan Ricky Clunn. First place was worth $32,000.

• The fishing game, or something closely related, has recognized another Virginian.

Martin Clavert of Virginia Beach beat a field of seven finalists with a cast of 692 feet (that's more than two football fields laid end to end) to win the Du Pont Stren Longcasting Virginia/Carolinas regional tournament.

Don Kohlman of Newport News made a cast of 650 feet to finish second.

The winners went home with a truckload of fishing gear and outdoor merchanise. In addition, Calvert won $500 in cash. He now advances to the June final in Montana.

• As part of a national campaign called "Take Pride in America," refuge personnel at the Great Dismal Swamp National Wildlife Refuge near Suffolk are making an effort to better acquaint visitors with the lore, history and wildlife of the swamp.

On Saturdays and Sundays in May, staff members will be stationed at Dismal Town parking lot on Washington Ditch to provide information and answer questions. Hours are from 11 a.m. to 7 p.m.

Information will available on public use programs, group tours and slide presentations. Access to Lake Drummond will be permitted if weather allows.

• If you fish saltwater, specifically the ship wrecks and artificial reefs in Virginia waters, The Virginia Institute of Marine Science (VIMS) at Gloucester Point needs your help.

VIMS is conducting a reef study. The purpose is to analyze how much the reefs are being used by anglers, as well as attempt to measure the success of the reef program in helping fish populations.

"We need to identify a cross-section of charter and private boat fishermen who fish wrecks and artificial reefs for the study to be successful," said Jon Lucy, VIMS coordinator for the study.

Over the past several years, a variety of artificial reefs have been formed off the Virginia coast and in the Chesapeake Bay by sinking barges of tires and even old Liberty ships.

Lucy asks fishermen who fish the reefs to contact him. He in turn will randomly call anglers at various times during the fishing season for brief information about wreck or artifical reef trips. All information will be kept confidential.

Contact Jon Lucy, Reef Fishing Study, Virginia Institute of Marine Science, Gloucester Point 23062. Lucy can be reached during the work week at 804-642-7166, or after work or on weekends at the VIMS answering service at 804-642-7000.

A chart of reef sites and their Loran coordinates is available free from VIMS.

The reef study is being funded primarily through Sport Fish Restoration (Wallop-Breaux) funds raised through an excise tax on fishing equipment.

REEF FISHING STUDY NEEDS FISHERMEN

The Virginia Institute of Marine Science of the College of William and Mary recently began collecting catch information from recreational fishermen fishing the Commonwealth's artificial fishing reefs. The Institute's Sea Grant Marine Advisory Services Program is conducting a Reef Fishing Study to help provide the Virginia Marine Resources Commission (VMRC) with an analysis of catch and fishing effort data from experienced fishermen utilizing the state's reef sites. The study will assist VMRC's Artificial Reef Program in evaluating the maintenance and expansion of existing as well as new reef sites.

"We need to identify a significant cross section of charter and private boat fishermen who fish wrecks and artificial reefs for the study to be successful," said Jon Lucy, coordinator for the study.

The work is primarily funded through Sport Fish Restoration (Wallop-Breaux) Funds administered by VMRC.

Lucy and Charles Barr, a graduate student working on the project, have identified approximately 100 fishermen who periodically fish the various wreck and artificial reef sites. A much larger cross section of fishermen is required for the study to meet its objective of defining utilization and productivity of the sites.

Lucy is requesting that fishermen, who fish the reef sites, contact him at VIMS. Fishermen who contact Lucy will be randomly called at various times during the fishing season for brief information about recent wreck or artificial reef trips. All information on catches will be kept confidential and only summarized in the study report.

Lucy and Barr recently mailed flyers to marinas and Virginia Saltwater Fishing Tournament weigh stations concerning the study's need to identify fishermen. Fishermen who have yet to be contacted by the researchers are encouraged to place their name on these flyers, which then will be returned to VIMS. Fishermen may also contact Lucy at the following address: Reef Fishing Study, Virginia Institute of Marine Science, Gloucester Point, VA 23062. Lucy can also be reached during the work week at (804) 642-7166 or after work hours and on weekends by leaving a message on the Institute's answering service (804) 642-7000.

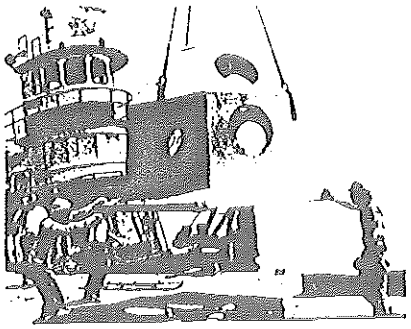
Reef sites included in the study are the Light Tower Reef, Triangle Wrecks Reef, Parramore Reef and the test reef sites established by Old Dominion University under contract to VMRC. One test reef site is located off Parramore Island on the Eastern Shore. Others are located inside Chesapeake Bay just north of Cape Charles and off Gynn's Island near Deltaville. A diagramatic chart of reef sites and their Loran coordinates is available free upon request.

Appendix B. (cont.) The Fisherman, Delaware, Virginia, Maryland Edition, DELMAF Publ. Corp. Sag Harbor, N.Y.

after-school seminars for teachers who are interested in furthering their knowledge for future teaching about the Bay. There is no cost to the classroom teacher, and participating teachers receive packets of information about the Bay. According to Lee Lawrence, the Bay Team is a "foot in the door" in bringing water resources education into Virginia's curriculum.

The Bay Team has achieved national recognition from the Environmental Protection Agency (EPA) as one of eight outstanding environmental education programs. The Bay Team is administered by the Virginia Institute of Marine Science through a grant from Virginia's Council on the Environment. For more information or to request an in-school visit, write to: The Bay Team, Virginia Institute of Marine Science, Gloucester Point, VA 23062.

New Artificial Reef Site for Virginia Fishermen



Bob Gammisch

Virginia's artificial reef program recently expanded fishing opportunities for recreational fishermen in the lower Chesapeake Bay. Coordinated by the Virginia Marine Resources Commission (VMRC), the reef program used "Wallop-Breaux" Sport Fish Restoration Funds to establish its third bay reef site in July. Consisting of forty concrete igloo structures and designated as the East Ocean View Reef, the buoyed site is located 2,500 yards west of the entrance to Little Creek off the Ocean View area in Norfolk (site is shown on NOAA Charts No. 12220, 12221, 12256).

The new reef is located on the site of an earlier experimental reef project initiated in the late 1960's by Old Dominion University (ODU) and local recreational fishing interests. Approximately one hundred wrecked car bodies and at least one menhaden vessel were initially placed on the site. Prior to deployment of the igloos, a side-scan sonar survey of the site was conducted by the Virginia Institute of Marine Science (VIMS). ODU researchers dove on the site to take sediment samples and to help verify the sonar survey results. As expected, only portions of the original materials remained in the area. By fall the site is expected to begin attracting sea bass and tautog. Spot, croaker and trout may also be attracted to the reef.

The design of the concrete igloos is the result of a three-year study conducted on test reefs established by ODU under contract to VMRC. These 11,000-pound, dome-shaped structures, approximately twelve feet in diameter at the base and seven feet high, have proven to be stable, staying in place on test reef sites in the Bay off Gwynn's Island and Cape Charles, as well as off Parramore Island on the Eastern Shore. "The redevelopment of this site is especially significant in that the concrete igloos were specifically developed for use as artificial reef structures," according to Mr. Mike Meier, fisheries reef manager for VMRC.

As part of an ongoing Wallop-Breaux funded study of fishing success rates on the state's artificial reefs, VIMS' researchers are seeking to identify fishermen using the East Ocean View Reef.

The VIMS study, beginning in the late fall of 1986, has to date obtained fishing information from over two hundred boat owners who fish the state reefs. Through random telephone interviews, VIMS' scientists are seeking to learn which reef sites are producing the most successful fishing trips. The telephone interviews are brief, no longer than 5 to 7 minutes, and are designed to gain information on fishing trips made to any reef site during the two-week period preceeding the call. Interviewers ask questions such as how long the reef site was fished, how many rods were used, what was caught, the state of the tide and current, water temperature and depth of the water. Also, researchers are interested in learning which part of the reef was fished: Were catches made directly over the reef structure or around the perimeter of the reef?

VIMS needs to broaden its existing list of identified boat owners fishing reef sites both in the Bay as well as those offshore (the Light Tower, Triangle Wreck, and Parramore Reefs). The study requires information from a large cross-section of reef/wreck fishermen to adequately document how the reefs are performing. "The VIMS' study is designed to take advantage of fishermen's knowledge and fishing experience," says the study's coordinator, Mr. Jon Lucy. "By permitting VIMS' researchers to contact them about reef fishing trips, recreational fishermen are contributing to future improvements in the artificial reef program."

If not already contacted by Lucy or graduate assistant, Charles Barr, boat owners periodically fishing the Bay or offshore artificial reef sites are requested to get in touch with the VIMS' researchers. Charts with Loran coordinates of the reef sites, as well as locations of major wrecks and obstructions found out to 30 miles offshore of Virginia Beach, can be obtained by contacting: Artificial Reef Study, Sea Grant Advisory Services, Virginia Institute of Marine Science, Gloucester Point, VA 23062, (804) 642-7166.

For more information about the reef program, contact Mr. Mike Meier, Fisheries Reef Manager for VMRC, P. O. Box 756, Newport News, VA 23607, (804) 247-2263.

Appendix C. Virginia Marine Resources Bulletin article on Wallop-Breaux reef study. Va. Mar. Res. Bull. 19(3) Fall 1987: 20-21, VA. Sea Grant College Program, VIMS

1987 ARTIFICIAL REEF STUDY TELEPHONE LOG

DATE_____ CAPT_____ BOAT_____ LENGTH_____

PRIVATE___ CHARTER___ PORT_____ TARG SPEC_____ # ANGLERS_____

AREA1_____ H2O TEMP_____ DEPTH (FT) _____ #OTHER BOATS FISHING REEF_____

RODS____ #HOOKS/ROD_____ BAIT_____

TIME STARTED FISHING_____ HOURS: ANCHORED_____ DRIFT_____ TROLL_____

STAGE OF TIDE_____ BOTTOM CURRENT_____

OTHER INFO_____

AREA2_____ H2O TEMP_____ DEPTH (FT) _____ #OTHER BOATS FISHING REEF_____

RODS____ #HOOKS/ROD_____ BAIT_____

TIME STARTED FISHING_____ HOURS ANCHORED_____ DRIFT_____ TROLL_____

STAGE OF TIDE_____ BOTTOM CURRENT_____

OTHER INFO_____

SPECIES HOOKED	# KEPT	AVG. WT.	# RELEASED	AVG. WT.	CATCH/AREA FISHED
Sea bass					
Tautog					
Flounder					
Porgy(Scup)					
Grouper:_____					
Gray trout					
Spot					
Croaker					
Bluefish					
Cobia					
Amberjack					
Jacks_____					
Spadefish					
Triggerfish					
Tuna:_____					
King Mackerel					
Spanish Mackerel					
Rays					
Skates					
Shark:_____					
Other:_____					

SEA CONDITIONS AND WATER CLARITY_____

FISHING STRATEGY EACH AREA_____

HOW MANY YEARS HAVE YOU WRECK FISHED____ WHAT ARTIFICIAL REEFS FISHED_____

FISHING EXPERIENCE QUALITY RATING: POOR ( ) FAIR ( ) GOOD ( ) VERY GOOD ( ) EXCELLENT ( )

Appendix D. Telephone survey instrument for 1987 sampling effort.