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Virginia's pelagic recreational fishery: Biological, socioeconomic and fishery components

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VIRGINIA'S PELAGIC RECREATIONAL FISHERY: BIOLOGICAL, SOCIOECONOMIC AND FISHERY COMPONENTS

A Dissertation

Presented to

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In Partial Fulfillment

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by

Eleanor A. Bochenek

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APPROVAL SHEET

This dissertation is submitted in partial fulfillment of

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ABSTRACT

Catch, effort, fleet size and boat owner expenditure data were collected on Virginia's recreational marlin/tuna fishery for the 1983-1985 seasons. Some additional information was collected for the 1986 season. Logbooks, dockside interviews and a telephone survey were evaluated to determine which method was the most efficient and effective for collecting and estimating catch and effort for Virginia's pelagic recreational fishery.

In 1984, logbooks were used to collect catch and effort data and fishing effort was estimated using Bochenek's method. Very few fishermen returned their logbooks and as a result this data is probably less reliable than the data collected in other years. Due to the poor return of logbooks, this method should not be used to assess Virginia's pelagic recreational fishery.

For the 1985 season, Figley's telephone survey (1984) was compared to the NMFS dockside interview technique for large pelagics. Both the telephone survey using Figley's technique (1984) and dockside interviews using Bochenek's method for calculating effort appear to provide similar estimates of projected total catch. However, the dockside method is very labor intensive, costly and fraught with problems in estimating fishing effort. Only two researchers were required to conduct telephone interviews. Dockside interviews bias fishing effort toward charter boats and trips in which fish are caught. Manpower constraints also limit the number of port locations which can be sampled. Many private boats and even some charter boats are missed during the dockside sampling effort.

The telephone survey technique using Figley's method for estimating effort appears to be a better method for analyzing Virginia's recreational marlin/tuna fishery. If telephone interviewing will not work in an area and dockside sampling methods must be relied upon to study the pelagic fishery, Bochenek's method appears to produce a better estimate of fishing effort.

Using Figley's (1984) mark-recapture technique, Virginia's pelagic recreational fleet was estimated at 455 and 774 vessels in 1983 and 1985, respectively. Boat owner expenditures for this fleet were estimated at $3,863,045 in 1983, $4,057,020 in 1984 and $5,538,191 in 1985.

Bluefin tuna were caught at sea surface temperatures (SST) ranging from 58-83 F but seem to prefer SST of 70 to 75 F. Yellowfin tuna were caught at SST ranging from 68-86 F with the majority landed at SST of 76-80 F. White marlin appear to prefer SST of 74 to 81 F.

VIRGINIA'S PELAGIC RECREATIONAL FISHERY: BIOLOGICAL, SOCIOECONOMIC AND FISHERY COMPONENTS

CHAPTER 1

OVERVIEW OF THE DISSERTATION

INTRODUCTION

History

Recreational fishing for billfishes (Families Istiophoridae and Xiphiidae) and tunas (Family Scombridae) commenced in the early 1900's. By the 1920's, this sport had become popular with an elite, wealthy group of anglers who fished off the coasts of Florida, the Bahamas and southern California. Offshore recreational fishing, along the east coast from Cape Cod, Massachusetts to Cape Hatteras, North Carolina began in the 1920's for bluefin tuna (Thunnus thynnus). Most of the fishing occurred within 32 km of the shore (Figley 1984). In the summer of 1935, a white marlin (Tetrapturus albidus) was caught by a recreational fisherman off the coast of Ocean City, Maryland. By 1936, there were twelve charter boats, from Ocean City, actively angling for white marlin (DeSylva 1959). Fishing began out of Virginia ports (Chincoteague) in 1937 (Hutchinson 1985). After World War II, the recreational pelagic fishery grew rapidly in popularity due to the increased availability of faster and newly designed tuna and billfish boats coupled with better navigational and depth finding electronic gear (DeSylva 1974). The number of charter and private boats fishing for white marlin increased over the years and Ocean City, Maryland became known as the "White Marlin Capitol Of The World" (Figley 1984).

Virginia's pelagic recreational fishery continues to expand in popularity and in boat size with an estimated fleet of 455 boats in 1983 (Figley 1984). Rudee and Lynnhaven Inlets in Virginia Beach and Wachapreague Inlet on the Eastern Shore are the primary centers of activity. Virginia's recreational marlin/tuna fishery begins in June and extends into October. Recreational fishermen, both commercial (charter boats) and private, primarily seek juvenile bluefin tuna (Thunnus thynnus) early in the season, followed by yellowfin tuna (Thunnus albacares), white marlin (Tetrapturus albidus) and blue marlin (Makaira nigricans). Sailfish (Istiophorous platypterus), bigeye tuna (Thunnus obesus), albacore (Thunnus alalunga) and blackfin tuna (Thunnus atlanticus) are rarely taken. Other pelagic fishes which can be caught are wahoo (Acanthocybium solanderi), common dolphin (Coryphaena hippurus), mako (Isurus sp.) and other shark sps., skipjack tuna (Katsuwonis pelamis), Atlantic bonito (Sarda sarda), little tunny or false albacore (Euthynnus alletteratus), king mackerel (Scomberomorus cavalla) and bluefish (Pomatomus saltatrix). Fishing grounds range from approximately 32 to 128 km off the coasts of Virginia, Maryland and North Carolina (Figure 1). Virginia's recreational marlin/tuna fishery is a trolling fishery and both tuna and billfish can be caught on the same fishing grounds and on the same trip.

Tuna Distribution

Yellowfin tuna are distributed throughout the world in

subtropical and tropical seas except for the Mediterranean Sea (Collete and Nauen 1983). Off the eastern U.S. and Canada, yellowfin tuna are usually found on the Continental Shelf, but may also occur near the Gulf Stream (Squire 1962b).

Northern bluefin tuna consist of two subspecies, one in the Atlantic Ocean (Thunnus thynnus thynnus) and one in the Pacific Ocean (Thunnus thynnus orientalis). In the western Atlantic Ocean, the northern bluefin tuna is distributed from Labrador and Newfoundland to the Gulf of Mexico, Caribbean Sea and off Venezuela and Brazil. In the eastern Atlantic Ocean, this tuna occurs in waters from Norway to the Canary Islands and the Mediterranean Sea. A small population is also found off South Africa (Collete and Nauen 1983). The northern bluefin tuna is epipelagic and usually oceanic but seasonally strays near the coast (Collette and Nauen 1983). During June through October, bluefin tuna are common on the Continental Shelf off the eastern U.S. and Canada (Squire 1962b).

White and Blue Marlin Distribution

White marlin range throughout most of the Atlantic Ocean from latitude 35 S to 45 N, including the Gulf of Mexico and the Caribbean Sea (Mather et al. 1975). The Atlantic blue marlin (Makaira nigricans) is distributed throughout the temperate but predominately in the tropical waters of the Atlantic Ocean. This oceanic species is especially abundant in the western tropical Atlantic Ocean and absent from the Mediterranean Sea (Joseph et al. 1988).

Fisheries Management

In the past, fisheries management had been concerned with commercial fisheries interests while virtually ignoring the marine recreational fishery, even though the marine recreational fishery for pelagic species has rapidly increased over the years (Figley 1984). In 1976, the United States enacted the Fishery Conservation and Management Act (FCMA) (P.L. 94-265) which created a 200 mile fisheries zone under U.S. jurisdiction and compelled fisheries managers to also consider recreational fishermens' interests. Eight Regional Fisheries Management Councils were established to formulate management plans for those fish species under U.S. jurisdiction. Pelagic species such as white and blue marlin come under the FCMA, but not the tunas. In adopting a management plan for these fishes, the Regional Management Councils must give full and equitable treatment to recreational fishermen and also consider economic, social and ecological factors in formulating management plans.

Since 1969, the United States has been a member of the International Commission for the Conservation of Atlantic Tunas (ICCAT). This commission is responsible for collecting and collating information needed to manage tuna and tuna-like stocks in the Atlantic Ocean and adjacent seas and for formulating management recommendations. The commission has four panels which are responsible for different species: the first panel is concerned with yellowfin and skipjack tuna; the second panel is responsible for the temperate tunas (northern bluefin tuna and albacore); the third panel deals with

southern bluefin tuna (Thunnus maccoyii) and albacore; and the fourth panel addresses bigeye tuna, Atlantic bonito and the billfishes (Blondin 1983). Management recommendations by ICCAT are implemented and enforced by member countries.

Fisheries

Off the east coast of the United States, both recreational and commercial fisheries exist for bluefin tuna. Parks and Beardsley (1977) presented a good history of the bluefin tuna fishery in the western Atlantic. Recreational fishermen pursue bluefin tuna from Maine to North Carolina and along the western Bahamas and eastern coast of Canada (Baglin 1982). For the commercial fishery, purse seining takes place from Massachusetts to North Carolina, handlining and harpooning occur off of Maine and Massachusetts and an extensive Japanese longline fleet operated off the east coast of the U.S. and the Gulf of Mexico (Baglin 1982) until the 1980's. Currently, Japanese longliners can only fish in areas further than 100 miles from the coast north of Cape Lookout, North Carolina from June through November and observers are required on each vessel. Japanese longliners did not catch an Atlantic bluefin tuna from the Fishery Conservation Zone (FCZ) during January through September 1983. For any month, only three or fewer longliners were operating in the FCZ (Lillestolen 1983). In 1984, there were never more than two Japanese longliners in the FCZ during any one month (Lillestolen 1984). No directed longline fishery for bluefin tuna is allowed. However, U.S. longliners, with permits, can

take incidental catches of Atlantic bluefin tuna. When the quota for the incidental catch (145 metric tons) is reached, all bluefin tuna must be released.

In 1974, with stocks of Atlantic bluefin tuna continuing to decline, ICCAT formulated management recommendations. These were implemented by member nations but did not reverse the decline in the western Atlantic bluefin tuna stock. Additional measures were taken in 1982 to stop the decrease (Rothschild 1984). However, recent catch data indicate that the stock is still declining (Sakagawa 1988).

Current information available on the stock structure of white and blue marlin is inadequate for assessing the status of the stock (SAFMC 1988). Lack of information continues to impede stock assessment (Lillestolen 1984, 1983; Conser 1982; Joseph 1979). White and blue marlin are an incidental catch of longliners. Prior to the regulation of foreign longliners large numbers of white and blue marlin were landed. For example, the blue marlin was heavily exploited during the 1960's and 1970's and may now be starting a recovery (Lillestolen 1983; SAFMC 1988). The white marlin stock may be declining as indicated by low catch-per-unit-of-effort (SAFMC 1988).

Atlantic billfishes are currently managed under a fisheries management plan by the National Marine Fisheries Service (NMFS). Minimum size limits have been placed on the recreational harvest of billfishes. All foreign and U.S. commercial fishermen fishing within U.S. waters must release

every billfish landed. Only a small commercial fishery is allowed in Puerto Rico (SAFMC 1988). The U.S., Japan, Cuba, Taiwan, Venezuela, Senegal and Ghana harvest billfish in the Atlantic Ocean. The U.S. is primarily a recreational fishery, but the other countries are high seas longliners fishing mostly for tunas (Lillestolen 1984). In 1982, the U.S. harvested only ten percent of the blue and white marlin catch (Lillestolen 1984). During the 1970's, the recreational catch of billfishes for the western North Atlantic was 25,000 to 85,000 fish (Joseph 1979).

According to Sakagawa et al. (1977), the yellowfin-skipjack tuna fishery is the largest tuna fishery in the Atlantic Ocean. Both foreign and domestic fleets of longliners participate in the fishery along the U.S. coast. Recreational fishermen catch yellowfin, skipjack and bigeye tuna and albacore in the Atlantic Ocean.

Various authors have proposed a number of improvements which should be implemented to properly manage billfish and tuna stocks (Conser 1982; Joseph 1979; DeSylva 1974). Better qualitative and quantitative information should be obtained on all the fisheries to aid in resolving the sociological conflicts between recreational and commercial fishermen (Conser 1982; Joseph 1979; DeSylva 1974) and the resource must be regulated throughout its range (Joseph 1979). Fisheries managers should also consider placing the tunas under the FCMA. There is a lack of knowledge on the physical, chemical and biological characteristics of the fishing grounds (DeSylva

1974). Better methods must be developed for distributing the allowable catch to the various user groups and nations (Joseph 1979). More life history information should be obtained on all the species (Conser 1982; Joseph 1979).

Therefore, both international and domestic management councils and commissions must consider pelagic recreational fisheries in formulating their management plans. Fleming (1983) states that sociological, biological and economic factors as well as fishermen's views and interests must be considered in offshore fishery management. Conflicts do exist between commercial and recreational fishermen. For example, recreational fishermen compete with purse seiners for Atlantic bluefin tuna in the mid-Atlantic region during the summer (Sakagawa 1975). Conser (1982) discusses the conflict between the recreational and commercial billfish fishery.

Recreational Fisheries Studies

Very few studies have been undertaken to sample the pelagic recreational fishery off the east coast of the United States. This fishery consists of both commercial (charter boats) and private recreational fishing vessels. Charter boat fleets are much easier to study because the majority of them are concentrated in certain ports and have fixed hours of fishing. However, private vessels may be launched from ramps, marina slips and/or be docked at private homes. This mobility and problems with identifying private vessel users makes this group extremely difficult to study.

State and federal governments should have a better grasp of the pelagic recreational fishery. This fishery continues to expand and has an impact on various state and federal economies. Large numbers of commercially and recreationally important species such as yellowfin and bluefin tuna, white and blue marlin and associated pelagic fishes are harvested by recreational anglers. To properly manage these species, data on catch and effort, number of anglers and boats and socioeconomic aspects of this recreational fishery must be collected. Complete information is necessary for accurately measuring optimum yield (OY). Optimum yield is defined as the number of fish which will provide the greatest overall benefit to the Nation in terms of food production and recreational opportunities. In calculating OY, managers must also consider economic, social, ecological and biological factors (Zuboy and Jones 1980). In the past, managers have only utilized commercial landings and roughly estimated or ignored the recreational catch to assess a given stock.

Many researchers have conducted studies on the recreational pelagic fishery of the western North Atlantic Ocean and the Gulf of Mexico (Prince et al. 1986, 1985; Prince and Bertolino 1987; Williams et al. 1984; Lopez et al. 1984; Lopez 1981; Hamm and Slater 1979; Beardsley and Conser 1976; Erdman 1957; Buller and Spear 1950). In North Carolina, emphasis has been placed on the charter boat sport fishery (Manooch and Laws 1979; Manooch and Ross 1979; Abbas 1978; Rose and Hassler 1960). Only one survey analyzing both the

charter and private boat recreational fishery in North Carolina waters has been conducted (Fahy 1965). Considerable data has been gathered on the recreational billfish fishery in the Gulf of Mexico (Pristas 1982, 1981, 1979; Nakamura and Rivas 1974). Figley and Long (1982, 1981) and Brown and Ofiera (1987) studied the New Jersey Canyon fishery. Brusher and Palko (1986) surveyed the charter boat fishery in the southeastern United States. The Texas charter boat fishery was investigated by McEachran (1984).

Various studies have been conducted on Virginia's pelagic recreational fishery. Early efforts concentrated on the charter and head boat fishery (Marshall and Lucy 1981; Richards 1965). Through the NMFS Port Sampling Program for Large Pelagics, Birdsong (1982, 1981, 1980) expanded data collection efforts on Virginia's fishery. Figley (1984) introduced a different sampling approach to study the 1983 fishery, utilizing telephone and mail surveys to estimate total fishing effort and catch. The Virginia data base has been expanded to include the 1986 and 1987 seasons (Bochenek et al. 1989; Lucy et al. 1988).

In 1978, Virginia's 110 boat charter fleet was estimated to have a total economic impact of $4.7 million (Marshall and Lucy 1981). Sport fishermen from other states are attracted to Virginia localities such as Wachapreague and Virginia Beach, because of their reputation for good offshore recreational fishing. This influx of anglers and their families contributes to local and state economies. Virginia's

pelagic recreational fishery is an important local and state resource which should be assessed and evaluated. Information generated from such studies will directly benefit these localities by helping determine the need for new boat ramps, marinas, hotels and other facilities to support this growing fishery. To effectively maintain or even improve the quality of its offshore fishery, Virginia and its principal recreational fishery ports must better understand the fishery and the magnitude of the impact.

This study had the following objectives:

1. To evaluate the effectiveness of different survey techniques and determine the most efficient survey method for analyzing the recreational pelagic fishery (Chapters 2 and 3).
2. To generate data on the size of the recreatonal pelagic fleet and catch/effort of Virginia's recreational pelagic fishery and assess catch trends over three consecutive years (Chapters 2, 3 and 4).
3. To determine expenditures of Virginia's offshore recreational fishery for three consecutive years (Chapter 5).
4. To determine whether there is a pattern between sea surface temperature and recreational catches of yellowfin tuna, juvenile bluefin tuna and white marlin (Chapter 6).

RESULTS AND DISCUSSION

Chapter 2

In this chapter, logbook and dockside interviews were conducted to determine the effectiveness of these techniques in collecting data on Virginia's pelagic recreational fishery. With the logbook method, a very poor return rate of logbooks was recorded for all months of the study. The logbook technique using Bochenek's method for calculating effort appears to provide reasonable estimates of projected total catch for Virginia's recreational marlin/tuna fishery. However, this information is probably less reliable than the data collected in 1983 using the telephone survey technique (Figely 1984) because of the poor return rate of logbooks. The logbook technique is less costly and requires fewer reporting aides than using dockside and telephone interviews to collect the data. However, a good updated list of names and addresses of Virginia marlin/tuna boat captains/owners must be maintained for this technique to work. Therefore, this method needs to be tried again after a good rapport has been established with offshore fishermen. If another poor response rate is obtained then this method should not be used.

When comparing dockside and logbook data from Rudee Inlet-based trips, actual catch/boat trip for bluefin and yellowfin tuna, white marlin and all pelagic species was significantly different. Dolphin actual catch/boat trip was

not significantly different. Catches reported in logbooks appear to be higher than those reported in dockside interviews for these species. Only nine more boat trips were recorded in logbook than in dockside data sets. This difference in catch/boat trip may be due to the dockside data set containing only private boat trips and the logbook data consisting of both private and charter boat trips. Charter captains being more experienced anglers tend to catch more fish than private captains (personal observation). In addition, boat captains returning their logs may be better and more experienced fishermen.

In future studies, dockside and logbook surveys need to include both private and charter boat captains. All boat captains whether participating in the logbook survey or not should be interviewed at the docks as a check on logbook reported catches. Such a study could be performed on a small segment of the fishery such as at Rudee Inlet or Wachapreague for a shorter period of time than for the entire season.

Chapter 3

In this chapter, Figley's telephone survey technque (1984) was compared to dockside interviews for the 1985 season. Both the telephone survey using Figley's technique (1984) and dockside interviews using Bochenek's method for calculating effort appear to provide similar estimates of projected total catch for the recreational marlin/tuna fishery. However, the dockside method is very labor intensive, costly and fraught with problems in estimating

fishing effort. In 1985, one port sampler covered Wachapreague Inlet every weekday and weekend, one port sampler covered Rudee Inlet on Thursday and Friday and two to three port samplers covered Rudee Inlet on weekends and during major tournaments. Only two researchers were required to conduct telephone interviews. Dockside interviews bias fishing effort toward charter boats and trips in which fish are caught (personal observation). Manpower constraints also limit the number of port locations which can be sampled. Many private boats and even some charter boats are missed during the dockside sampling effort.

Therefore, the telephone survey technique using Figley's method for estimating effort appears to be a better method for analyzing Virginia's recreational marlin/tuna fishery. Recall trips are not needed to estimate monthly fishing effort. An updated list of marlin/tuna boat captains must be maintained. New boat owners and addresses and length-weight data can be collected at the docks during major tournaments. If telephone interviewing will not work in an area and dockside sampling methods must be relied upon to study the pelagic fishery, Bochenek's method appears to produce a better estimate of fishing effort.

Chapter 4

Catch trends were analyzed for the 1983-1986 seasons in this chapter. For bluefin tuna, excluding the 1984 season, 1986 seems to have been the best year when comparing actual catches, catch/boat hour and catch/boat trip. Most of these

fish were caught during June and July for 1983-1986 seasons at fishing grounds located in 10 to 20 fathoms of water off the Virginia Coast. The majority of yellowfin tuna were landed during July and August and annual catches were high for all years of the study. Peak months for landing white marlin were July, August and September for most of the years sampled. Estimated annual white marlin catches were the highest in 1983 and 1984. Blue marlin are rarely caught by Virginia's offshore fleet and the greatest catches were reported for the 1985 and 1986 seasons. Yellowfin tuna and white and blue marlin were usually caught further offshore than bluefin tuna at fishing locations in 20 to over 1000 fathoms of water.

Only the 1983, 1985 and 1986 data sets appear comprehensive enough to be used in defining baseline catch rates for Virginia's pelagic recreational fishery. The offshore recreational survey needs to be continued so that more definitive data will be available to establish catch rate trends for these important fishes. This information is critical for assessing the stock size of these big game fishes so that ICCAT and the United States Management Councils can better manage these important fishes in the future.

Chapter 5

Socioeconomic characteristics of the offshore fishery for the 1983-1985 seasons are presented in this chapter. Virginia's pelagic recreational marlin/tuna fishery is an important contributor to Virginia's as well as other states' economies. The distances (20 to 80 nautical miles) which must

be travelled to reach the offshore fishing grounds and the size of the fleet result in significant expenses. Through this intensive three year study utilizing logbooks, telephone and dockside surveys and mail questionnaires, I have characterized the fishery and derived estimated boat owner expenditures associated with marlin/tuna fishing trips departing from Virginia ports. In addition, expenditures associated with owning and operating a marlin/tuna vessel have been developed.

Overall annual expenditures of Virginia's marlin/tuna fishery excluding initial purchase price of boat and all outfittings, original value of all marlin/tuna tackle and charter fees were estimated at $3,863,045 in 1983, $4,057,020 in 1984 and $5,538,191 in 1985. These values are underestimated because they do not include annual estimates for the costs of new or replacement rods, reels, lines, lures, gaffs, and other tackle; fishing club dues; auto fuel expenses; tolls, food and beverages and lodging. These expenditures need to be addressed in future studies. The initial purchase price of boats and their outfittings, as well as the original value of all gear and tackle were not included in overall yearly expenditures because these expenditures were not solicited on an annual basis. Charter fees were not an expense to boat owner/captains and were also not included.

In 1984, expenditure information was collected for the Virginia Beach Marlin Tournament. Fifty-five boats ranging in length from 26-63 feet (7.9-19.2 m) fished in the 1984

Virginia Beach Marlin Tournament and carried a mean of five anglers per boat. Projected total expenses for this tournament were estimted at $150,664.

At this time, economic data is not collected in a manner that permits the economic impact to be attributed to the states in which the expenses were incurred. This data needs to be collected annually and in more depth so that information can be made available to fisheries managers to justify the recreational users' share of the tuna and billfish fisheries. In addition, the data must be made available to Virginia state/local government officials so they can determine the overall importance of the fishery and the ways in which its growing needs can be better met in the near future.

Chapter 6

In chapter 6, sea surface temperatures (SST) and catches of yellowfin and bluefin tuna and white marlin are discussed. Bluefin tuna catches appear to peak near the third week of June. These fish are caught at SST ranging from 58-83 F but seem to prefer SST of 70 to 75 F. Yellowfin tuna prefer warmer water than bluefin tuna and were caught at SST ranging from 68-86 F with most of the yellowfin tuna landed at SST of 76-80 F. Early September appears to be the best time to land a white marlin off of Virginia. These fish seem to prefer SST of 74 to 81 F.

Most of Virginia's pelagic recreational fishermen were not interested in SST during the initial years of this study, but by 1986 most fishermen had installed SST gauges aboard

their vessels for use in locating fronts and proper SST. More offshore fishermen are realizing the importance of warm core eddies and are interested in using satellite information to determine were to fish (Eggleston 1988). Further research needs to be conducted off the East Coast of the United States to determine the affects forage availability, SST, fronts and warm core eddies have on the distribution of these important game species. In addition, future studies need to be undertaken to learn how the Chesapeake Bay Plume affects catches of yellowfin and bluefin tuna off Virginia.

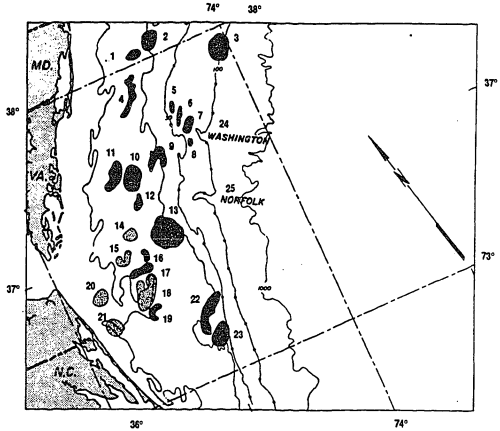
OVERALL CONCLUSIONS

Due to the poor return rate of logbooks, this method does not appear to provide adequate information on Virginia's pelagic recreational fishery. However, since these fishermen have been actively participating in this on-going study, they may be more likely to participate in a logbook survey now. Therefore, this method needs to be reattempted and if poor return rates are again reported this method should not be used. The telephone survey utilizing Figley's method and dockside survey utilizing Bochenek's method for estimating effort appear to provide reasonable estimates of projected catches for Virginia's pelagic recreational fishery. Virginia's marlin/tuna fishery had overall annual trip expenditures of over five million dollars for the 1985 season.

The evolution of this study over the last few years has culminated in better and more comprehensive information on Virignia's pelagic recreational fishery. As more data is collected and analyzed using either Figley's telephone survey technique (1984) or dockside interviews with Bochenek's method for estmating effort, trends will be determined for this important fishery. This continued effort will provide managers with essential information to aid them in the formulation of management plans for tunas, billfishes and other pelagic species. This research project has provided important catch and effort and socioecnomic data on Virginia's

offshore recreational fishery and resulted in a better understanding of the magnitude of its influence on both fish stocks and local and state economies.

Figure 1. Major fishing areas for Virginia's marlin/tuna fishery.



Tuna and Billfish Grounds Off Virginia

1. Jackspot
2. The Fingers
3. Poor Man's Canyon
4. Lumps
5. First Lump
6. Second Lump
7. Rockpile
8. 29 Fathom Lumps
9. 20 Fathom Fingers
10. 21 Mile Hill
11. No Name
12. 26 Mile Hill(Hambone)
13. The Fingers
14. Triangle Wrecks
15. Fishhook
16. Hot Dog
17. Southeast Lumps
18. Horseshoe
19. Boomerang
20. V Buoy
21. 4A Buoy
22. Cigar
23. Honey Hole
24. Washington Canyon
25. Norfolk Canyon

CHAPTER 2

EVALUATION OF LOGBOOKS FOR COLLECTING DATA ON VIRGINIA'S MARLIN/TUNA FISHERY AND A COMPARISON OF DOCKSIDE AND LOGBOOK TECHNIQUES FOR RUDEE INLET-BASED TRIPS

INTRODUCTION

Virginia's pelagic recreational fishery was analyzed in 1983 using telephone and mail survey techniques developed by Figley (1984). Catch and effort and estimated fleet size for Virginia's 1984 pelagic recreational fishery is also needed so that fishery managers can properly assess the stocks of white and blue marlin and tunas. Due to reduced funding for 1984 a logbook technique was developed to obtain most of this data and Figley's (1984) mail survey was also used. In addition, Lucy et al. (in prep.) conducted an economic and catch assessment of Rudee Inlet's 1984 boat-based fishery. This study was then able to compare dockside and logbook techniques for Rudee Inlet-based marlin/tuna trips and evaluate the logbook technique.

The main objectives of this portion of the study were:

1. To evaluate the use of logbooks for collecting catch data on Virginia's pelagic recreational fishery.
2. To compare logbook and dockside interview techniques for marlin/tuna trips based from Rudee Inlet.
3. To estimate fleet size, catch rates and total catches for Virginia's pelagic recreational fishery.

METHODS

In 1984, logbooks were used to collect information on Virginia's pelagic recreational fishery and the technique analyzed. In addition, Lucy et al. (in prep.) conducted a study to document Rudee Inlet's contribution to Virginia's inshore and offshore recreational boat-based fishery. As a result of this concurrent study, logbook and dockside interview techniques for Rudee Inlet based marlin/tuna trips were evaluated and compared.

A logbook consisting of catch logs (Appendix) was mailed monthly from June through October to all boat captains who participated in the 1983 study of Virginia's pelagic recreational fishery (Figley 1984) and to any new boat captains identified during the fishing season. Boat captains were asked to complete one log for every marlin/tuna trip made in their own boat or boats during the month and return the logs in the stamped envelope provided at the end of each month. In the June mailing, participants were also asked to fill out a log for each marlin/tuna trip taken during May and return these forms with the June logs. Logbooks collected information on catch and release of each species, hours fished (actual trolling or drifting time), location of capture, date of capture, number of anglers, trip type (charter or private trip) and inlet departed from. An index card was kept on each boat captain; listing his name, address, boat name and length

and whether the boat was a private or charter vessel. If a captain owned more than one marlin/tuna boat, each vessel was listed along with the above information on the card. Cards were filed alphabetically by the captain's last name. Another card was filled out for each boat; listing the boat name, charter or private vessel, boat length and captain's name. Boats which had no name were listed under "No Name" in the file. These cards were filed alphabetically by boat name and used for determining fleet size. If a boat captain returned the logbooks and said he was not fishing this year his name and boat cards were placed in an inactive file.

Fishing effort (no. of trips) was calculated using Bochenek's method (Bochenek and Lucy 1988) of: $A/B = C/X$ where: A = number of different boats that fished that month from logbooks; B = number of trips those boats made that month; C = estimated number of boats in the total fleet; and X = estimated number of trips made that month. Total estimated fishing effort for the season was derived by summing monthly effort estimates.

An average monthly catch per boat trip was calculated for each species using catch information obtained for each trip taken during that month. Monthly average catch/boat trip for each species was multiplied by estimated total fleet fishing effort for a given month to calculate projected total monthly catch for that species. Seasonal catch of each species was determined by summing projected monthly catches.

At the end of the fishing season, an economic questionnaire (Appendix) was mailed to all boat captains who had participated in the logbook study. If a captain owned more than one vessel, he was given a form to fill out for each vessel. After one month, a post card was mailed to each captain reminding them to return their forms. All responses to the economic survey were anonymous, so no follow-up survey of non-responding fishermen was conducted. Very few questionnaires were returned by the postal service as undeliverable. Captains were asked to name ten boats from their homeport which were known to marlin/tuna fish during the season. All active boats identified during the year from logbook interviews were considered "marked" boats. From the mail questionnaire, any new boats named, i.e. those previously unidentified during the year, were designated "unmarked" boats for purposes of the boat population estimate. All unmarked boats were checked against the file of inactive boats and if any of the unmarked boats listed were inactive boats, they were removed from the unmarked boat list. Boat population estimates were then calculated using the Frequency of Capture Method and the Lincoln-Peterson Index (Giles 1971); these two estimates were then averaged (Figley 1984). On the economic questionnaire, boat captains were also asked to record the number of trips their boat made for marlin/tuna during 1984. This question was used to validate estimated fishing effort for logbook data.

Dockside interviews were collected at Owl's Creek public boat ramp and Rudee Inlet's marina slips and/or fuel docks as boats returned from a day of marlin/tuna fishing from the last week of June through September. For each week, port samplers interviewed at Rudee Inlet every weekend and two weekdays. The two weekdays were randomly selected prior to the study. Port samplers did not interview during periods of inclement weather. Only private boats which were not already in the logbook survey were interviewed. Boat captains were asked the same information as collected in the logbook forms. At the end of the interview, captains were asked if they would like to participate in the logbook study. For those captains who expressed an interest in joining the logbook survey, their names and addresses were obtained and logbook forms and a stamped envelope were given to them. These captains were then incorporated into the logbook survey. Mean catch/boat trip was calculated for dockside data in the same manner as logbook data.

Statistical Analysis

Catch data collected by logbooks and dockside interviews were not normally distributed and various transformations were attempted but none normalized the data. Therefore, nonparametric statistics were used. Mann-Whitney U-tests corrected for ties were performed to compare catch/boat trip on a Prime computer using SPSS-X (SPSS Inc. 1986).

RESULTS AND DISCUSSION

Logbooks

During the 1984 season, the main launching point for Virginia-based marlin/tuna trips was Rudee Inlet, Virginia Beach (56%) followed by Wachapreague (22%) and Lynnhaven (20%) Inlets. Other minor ports accounted for the remaining 2% of the trips. However, Rudee Inlet (64%) was the main launching point and Lynnhaven Inlet (20%) second and Wachapreague Inlet (12%) third for the 1983 season. Rudee Inlet houses four marinas, private slips associated with local homes and a public boat ramp at Owl's Creek, Virginia Beach. Virginia Beach is a popular resort area and summer tourism supports many charter businesses for pelagic and nearshore fishing. Wachapreague, on Virginia's Eastern Shore, has several small marinas and two public boat ramps which utilize Wachapreague Inlet. Wachapreague also supports a charter fleet for both offshore and nearshore fishing. Many Maryland and New Jersey residents dock their boats at Wachapreague during the summer. Lynnhaven Inlet in Virginia Beach houses several local marinas, a dry storage facility and one public boat launch which is currently being repaired/replaced. Quinby, Hampton, Sand Shoals, Oyster, Poquoson and Chincoteague are a few of the minor ports utilized by the offshore fleet.

Trolling dead baits or artifical lures on or near the surface is the primary technique used by Virginia's offshore

anglers to catch tuna and billfish. Marlin/tuna vessels carried a mean of 4.0 (SD 1.3) anglers and trolled an average of 6.2 (SD 1.5) hours per boat trip. These values were very similar to the numbers reported for the 1983 telephone survey (Figley 1984).

The economic questionnaire was mailed to 374 boat captains and 96 forms returned with 99% of the forms usable for determining the boat population estimate. Virginia's recreational marlin/tuna fleet was estimated to consist of 666 boats; 53 were charter vessels. Using the same mark-recapture technique in 1983, Virginia's recreational marlin/tuna fleet consisted of 455 boats and of these 40 were charter vessels (Figley 1984). The fleet estimate for 1983 and 1984 likely excluded boats which had no names, since the mail survey requested that captains "name" other boats in the fishery. This problem was rectified during the study of the 1987 fishery. Overall, Figley's (1984) mark-recapture technique for determining fleet size appears to give a reliable estimate based upon observations made during the dockside interview process.

For June, 264 logbooks were mailed and by the end of the study 374 logbooks were mailed to boat captains. For all months, less than 18% of the boat captains returned their logbooks. A total of 377 trips were recorded in the returned logbooks for May through October comprising 105 charter and 272 private trips taken from Virginia ports. Most of the trips left from Rudee Inlet. June and July were the peak

months of fishing with 138 and 125 trips recorded, respectively. Only eight trips in May and one trip in October were taken by boat captains responding to the survey (Table 1). Such a poor return of logbooks by offshore fishermen indicates that this method is not good for sampling Virginia's pelagic recreational fishery. However, this was only the second year of contacting Virginia's pelagic recreational fishermen and a good rapport had not been established at the onset of the 1984 study. This survey methodology may work after the fishermen have developed a respect and trust for the scientists conducting the ongoing study of this fishery.

Fishing effort (no. trips) was only estimated for June through September (Table 2) because so few trips were recorded for May and October. June, July and August were the peak fishing months with 1,876, 1,936 and 1,754 estimated trips taken, respectively. Fewer trips would be made in May, September and October because of poor weather and the charter fleet is less active during these months. In addition, most of the pelagic fishes do not arrive on the fishing grounds used by Virginia anglers until June. Total estimated effort for the 1984 season was 6,648 trips. This rate of fishing is not supported by economic questionnaire results were captains indicated that their boats averaged 12.1 marlin/tuna trips per year (SD 1.3) for a total estimated effort of 8,059 trips (12.1 trips/boat X 666 estimated boats in the fleet). However, only 95 economic questionnaires were returned and this rate of fishing effort (8,059 trips) may not be

representative of the fishery. Boat captains who returned their questionnaires fished most weekends and those boat captains who made fewer trips may not have answered the economic questionnaire. Excluding economic questionnaire results, Bochenek's method for estimating effort for logbooks appears to give a reliable estimate of fishing effort for Virginia's marlin/tuna fleet especially when compared to total estimated effort for 1983, 1985 and 1986 seasons (Chap 3 and 4).

Actual Catches (Logbook data)

Actual catches include both kept and released fishes. For all pelagic species landed, June and July were the peak months with 1,582 and 1,277 fishes landed, respectively. Most of the marlin/tuna fleet concentrate on school bluefin tuna during June and yellowfin and bluefin tuna during July at fishing locations 20-80 km off the coasts of Virginia and North Carolina (Figure 1, Chap 1).

Bluefin tuna. Bluefin tuna were caught from May through August (Table 3) with June being the peak month with 719 fish landed with a mean catch/boat trip of 5.21 followed by July with 263 fish caught and a mean catch/boat trip of 2.10. During June and July, anglers released approximately 9% of their bluefin tuna catch. Only one fish was reported caught in May and 20 fish were landed in August.

Yellowfin tuna. Fishermen caught a total of 930 yellowfin tuna from May through September (Table 3). July was the peak month for catching yellowfin tuna with 575 fish taken

and a mean catch/boat trip of 4.60. August was second with 213 yellowfin tuna caught and a mean catch/boat trip of 2.70. A total of 26 yellowfin tuna were released during the 1984 season.

White marlin. A total of 75 white marlin were reported caught during June through September (Table 3). Most of the white marlin were taken during July with an average catch/boat trip of 0.21 fish and during August with an average catch/boat trip of 0.51 fish. During June and September, one and eight white marlin were reported landed, repsectively.

Blue marlin. For the entire fishing season, only one blue marlin was caught with a mean catch/boat trip of 0.02 fish (Table 3). This fish was landed in August and was released by the angler. In most years, blue marlin are infrequently caught, but are the most prized gamefish of Virginia's pelagic recreational fishermen.

Dolphin (Common dolphin). Fishermen caught a total of 246 dolphin during May through September. Peak catches were reported in July with 93 fish landed and in August with 126 fish landed. Dolphin are usually an incidental catch of anglers trolling for tuna and billfish, but quite often are the only fish caught during a trip.

Overall. Other minor pelagic species caught during this study were false albacore (little tunny), skipjack tuna, Atlantic bonito, bluefish, wahoo, mako shark, albacore and king mackerel (Table 3). For all pelagic species landed, a total of 3,815 fishes were landed by offshore fishermen. The

greatest mean catch/boat trip for all pelagic species landed was 12.61 fishes during September. Only 377 marlin/tuna trips were recorded in logbook returns for the entire 1984 season. As a result of this small sample size the data was not partitioned by charter and private trips. Since captains were not asked whether they had fished during a tournament comparisons could not be made between nontournament and tournament catches. With the logbook technique, fewer zero catch trips were probably reported which may have resulted in higher catch estimates.

Projected Catch (Logbook data)

Projected catches (Table 4) were not calculated for May or October because so few actual trips were recorded in the logbooks for these months. For all pelagic species, a projected total of 54,414 fishes were landed from June through September. During June through September, projected total catches were 9,566 bluefin tuna, 16,553 yellowfin tuna, 23 blue marlin, 1,670 white marlin and 8,079 dolphin. A total of 11 blue marlin were reported caught in the Virginia Saltwater Fishing Tournament records and this study calculated a projected catch of 23 blue marlin for the entire season (Table 5). Other species often caught were skipjack tuna and bluefish with projected catches of approximately 5,800 fish for each species (Table 4).

Marlin Releases (Logbook data)

Only one blue marlin was reported caught in logbook returns and released during the 1984 season (Table 5).

Therefore, release percentages for the projected catch of blue marlin could not be calculated. Release rates of 35% (1983) and 32% (1986) were estimated for blue marlin for the U.S. recreational fishery (SAFMC 1988). Figley (1984) estimated 46 (37%) blue marlin were released by Virginia anglers during the 1983 fishing season.

For white marlin released by Virginia anglers, 1984 logbook data reported a higher release rate (79%) than estimated release rates of 45% (1986) and 61% (1983) for the U.S. recreational fishery (SAFMC 1988). However, Figley (1984) estimated a release rate of 82% for Virginia fishermen during the 1983 season. Applying this release rate to projected catch indicated that a total of 1,319 white marlin were released during the 1984 fishing season (Table 5).

White marlin must weigh at least 50 pounds or be released and blue marlin must weigh a minimum of 250 pounds or be released to be considered a citation and reported in the Virginia Saltwater Fishing Tournament. This tournament reports a higher percentage of releases for white marlin than indicated by this study (Table 5). The percentage of releases for the tournament may not actually reflect the true percentage rates as shown by logbook data, but may be biased upward because anglers will release fish that do not meet the minimum citation weight and still receive a citation. White and blue marlin brought to the docks that do not meet the minimum citation weight will not be documented in the records and this would raise the release percentages. Fishermen may

not report all their marlin catches, especially if they catch more than one in a day and not all fishermen participate in the tournament which may account for the lower number of marlin landed in the tournament records.

Rudee Inlet-based trips (Logbook and dockside data)

For the logbook data, 216 (57.3%) of the 377 trips utilized Rudee Inlet (Table 1) and consisted of 164 private and 52 charter trips. Only private trips originating from Rudee Inlet were recorded in dockside interviews and a total of 197 trips were obtained (Table 6). The majority of trips were taken in June and August for dockside data and in June and July for logbook data. As reported in logbooks (L) and dockside interviews (D), marlin/tuna vessels carried a mean of 4.0 (SD 1.25) (L) and 3.9 (SD 1.30) (D) anglers per trip and trolled (actual fishing time) an average of 6.5 (SD 1.22) (L) and 7.5 (SD 9.70) (D) hours per trip. The greater standard deviation for mean hours fished per trip for dockside data may be due to private vessels having more flexible fishing schedules than charter boats who tend to have fixed hours of actual fishing.

Actual catches include kept and released fish. For bluefin and yellowfin tuna and white marlin, catch/boat trip was significantly different between dockside and logbook data (Table 7). However, dolphin catches were not significantly different between dockside and logbook data (Table 7). Actual catches for bluefin tuna were 275 and 637 fish, yellowfin tuna were 108 and 292 fish, white marlin were 22 and 56 fish and

dolphin were 88 and 129 fish for dockside and logbook data, repsectively (Table 8 and 9). Only blue marlin landings were the same for each survey with one fish reported caught. Total actual catch for all pelagic species landed was 1,818 and 847 fishes for logbook and dockside data, respectively (Table 8 and 9). For all pelagic species landed, catch/boat trip was significantly different between logbook and dockside data (Table 7). Only nine more boat trips were recorded in logbook data than in dockside data. Therefore, total catch of all pelagic species, bluefin and yellowfin tuna and white marlin should not have differed by such a large number of fish. Boat captains returning logbooks may not be reporting all zero or poor catch trips and/or may be better fishermen. Boat captains who did not return logs may have caught less fish than those who returned their logs. During dockside interviewing, port samplers attempted to interview all private boat captains regardless of the number of fish they caught. No charter trips were recorded in dockside interviews. Charter captains are more experienced fishermen and catch more fish than private anglers (personal observation). Since sample size was relatively small for logbook trips based from Rudee Inlet, charter and private catch/boat trip was not compared. While at the docks, port samplers also asked boat captains to participate in the logbook survey and those who participated may have been more conscientious and better fishermen leaving less interested and inexperienced fishermen to be interviewed at the docks.

A total of 18 (6.6%) bluefin tuna, 13 (59.1%) white marlin and zero (0%) blue marlin were released by anglers interviewed at the docks (Table 9). The release rate of 59% for white marlin for 1984 dockside data was higher than estimated release rates of 45% (1986) and slightly lower than estimated release rates of 61% (1983) for the U.S. recreational fishery (SAFMC 1988).

CONCLUSIONS

When comparing dockside and logbook data collected for Rudee Inlet-based trips, actual catch/boat trip for bluefin and yellowfin tuna, white marlin and all pelagic species landed was significantly different. Dolphin actual catch/boat trip was not significantly different. Catches reported in logbooks appear to be higher than those from dockside interviews for these species. Only nine more boat trips were recorded in logbook than in dockside data sets. This difference in catch/boat trip may be due to the dockside data set containing only private boat trips and logbook data consisting of both private and charter boat trips. Charter captains being more experienced anglers catch more fish than private captains (personal observation). In addition, boat captains returning their logs may be better and more experienced fishermen. Future studies, using dockside and logbook surveys, should be conducted on both private and charter boat captains. All boat captains whether participating in the logbook survey or not should be interviewed at the docks as a check on logbook reported catches. Such a study could be performed on a small segment of the fishery such as at Rudee Inlet or Wachapreague for a shorter period of time than for the entire season.

The logbook technique using Bochenek's method for calculating effort appears to provide reasonable estimates of

projected total catch for the recreational marlin/tuna fishery especially when compared to 1983, 1985 and 1986 seasons. The logbook technique is less costly and requires fewer reporting aides than using dockside and telephone interviews to collect the data. However, a good updated list of names and addresses of Virginia marlin/tuna boat captains/owners must be maintained and the majority of these fishermen must be willing to participate in the logbook survey for this technique to work. Therefore, this method should be tried again after a good rapport has been established with offshore fishermen. If another poor response rate is obtained then this method should not be used. New boat captains/owners must be identified and length-weight information obtained. This data can be collected by going to the docks during major tournament weekends. Offshore fishing club rosters are another good source for updating the boat captain/owner list.

To reduce sampling error, sampling effort could be partitioned by inlet, charter and private or tournament and nontournament. Other sampling strategies need to be compared to the logbook technique to develop the best methodology for estimating catches for Virginia's recreational marlin/tuna fishery. Some other methods which need to be investigated are non-random intercepts and a roving clerk method.

Table 1. Total number of trips taken by charter and private boat captains for all inlets as recorded in logbook returns for 1984 season.

Month	No. Boats	Charter Trips	Private Trips	Total Trips	% Trips From Rudee Inlet
May	6	1	7	8	75.0%
Jun	49	23	115	138	65.2%
Jul	43	51	74	125	44.8%
Aug	30	26	53	79	59.5%
Sep	16	4	22	26	65.4%
Oct	1	0	1	1	0%
Totals	145	105	272	377	

Table 2. Estimated effort (No. trips) using Bochenek's method for 1984 logbook data for all inlets.

MONTH	ESTIMATED EFFORT
Jun	1,876
Jul	1,936
Aug	1,754
Sep	1,082
Total	6,648

Table 3. Actual catch by speices by month for 1984 logbook data for all inlets. No. Caught = Kept + Released.

MAY (8 TRIPS)

Species	Mean Catch Per Boat Trip	Standard Deviation	No. Caught	No. Released
Bluefin tuna	0.12	0.35	1	0
Yellowfin tuna	2.25	1.03	18	0
False albacore	1.37	3.11	11	0
Skipjack	0.12	0.35	1	0
Dolphin	0.12	0.35	1	0
Bluefish	5.25	8.96	42	0
TOTAL ALL FISHES	9.25	7.59	74	0

JUNE (138 TRIPS)

Species	Mean Catch Per Boat Trip	Standard Deviation	No. Caught	No. Released
White marlin	0.01	0.08	1	1
Bluefin tuna	5.21	5.30	719	64
Yellowfin tuna	0.65	2.23	90	1
Albacore	0.06	0.54	8	0
False albacore	0.99	3.70	137	45
Atlantic bonito	0.02	0.19	3	0
Skipjack	0.08	0.58	11	0
King mackerel	0.06	0.31	8	0
Wahoo	0.01	0.17	2	0
Dolphin	0.05	0.29	6	0
Bluefish	4.32	5.93	596	188
Mako shark	0.01	0.08	1	0
TOTAL ALL FISHES	11.46	9.06	1,582	299

JULY (125 TRIPS)

Species	Mean Catch Per Boat Trip	Standard Deviation	No. Caught	No. Released
White marlin	0.21	0.57	26	22
Bluefin tuna	2.10	3.42	263	8
Yellowfin tuna	4.60	6.01	575	23
Bigeye tuna	0.05	0.33	6	0
Albacore	0.03	0.28	4	3
False albacore	0.05	0.28	6	3
Skipjack	1.49	3.42	186	5
King mackerel	0.06	0.28	8	0
Wahoo	0.07	0.34	9	0
Dolphin	0.74	1.56	93	5

Table 3. Continued.

Bluefish	0.78	2.53	98	26
Mako Shark	0.02	0.15	3	0
TOTAL ALL FISHES	10.22	7.90	1,277	95

AUGUST (79 TRIPS)

Species	Mean Catch Per Boat Trip	Standard Deviation	No. Caught	No. Released
Blue marlin	0.01	0.11	1	1
White marlin	0.51	0.87	40	29
Bluefin tuna	0.25	1.51	20	0
Yellowfin tuna	2.70	5.26	213	1
False albacore	0.96	3.85	76	20
Skipjack	1.37	3.45	108	3
Wahoo	0.18	0.42	14	0
Dolphin	1.60	3.20	126	0
Bluefish	0.13	1.12	10	10
TOTAL ALL FISHES	7.73	8.67	608	64

SEPTEMBER (26 TRIPS)

Species	Mean Catch Per Boat Trip	Standard Deviation	No. Caught	No. Released
White marlin	0.31	0.47	8	7
Yellowfin tuna	1.31	2.07	34	1
False albacore	10.31	21.42	268	23
Skipjack	0.15	0.46	4	0
King mackerel	0.23	0.65	6	0
Wahoo	0.31	0.68	8	0
Dolphin	0.77	1.70	20	0
TOTAL ALL FISHES	12.61	18.63	348	31
GRAND TOTAL ALL FISHES			3,815	489

Table 4. Projected total catch by species by month for all inlets for 1984 logbook data.

Species	JUNE	JULY	AUGUST	SEPTEMBER	TOTAL
Blue marlin	0	0	23	0	23
White marlin	6	444	887	333	1,670
Bluefin tuna	4,626	4,496	444	0	9,566
Yellowfin tuna	579	9,830	4,729	1,415	16,553
Bigeye tuna	0	103	67	0	170
Albacore	51	68	0	0	119
False albacore	882	103	1,687	1,115	3,787
Atlantic bonito	19	0	0	41	60
Skipjack	71	3,180	2,398	167	5,816
King mackerel	51	137	0	250	438
Wahoo	151	727	730	735	2,343
Dolphin	43	1,590	5,614	832	8,079
Bluefish	3,835	1,675	223	0	5,733
Mako shark	6	51	0	0	57
TOTALS	10,320	22,404	16,802	4,888	54,414

Table 5. Catch and release data for white and blue marlin comparing logbook data for all inlets to Virginia Saltwater Fishing Tournament (VSFT) citation records* for 1984 season. Number released in parenthesis.

LOGBOOK INTERVIEWS

Species	Actual Catch	% Released	Projected Catch
W. marlin	75(59)	79%	1,670(1,319)
B. marlin	1(1)	NA	23(NA)

STATE TOURNAMENT

Species	Actual Catch	% Released
W. marlin	406	86%
B. marlin	11	82%

NA Not applicable
*Virginia Saltwater Fishing Tournament (VSFT) 1984

Table 6. Monthly private trips taken from Rudee Inlet as recorded in 1984 dockside interviews.

MONTH	NO. TRIPS
June	79
July	35
August	54
September	29
Total	197

Table 7. Mann-Whitney U-test comparing catch/boat trip (CPUE) for dockside interviews (DOC) and logbooks (LOG) for trips taken from Rudee Inlet during 1984 season, alpha = 0.05, two-tailed.

Null Hypothesis	Cases	Z	Significance
LOG Allspecies CPUE = DOC Allspecies CPUE	413	6.653	sig
LOG Bluefin CPUE = DOC Bluefin CPUE*	384	1.999	sig
LOG Yellowfin CPUE = DOC Yellowfin CPUE	413	4.163	sig
LOG White marlin CPUE = DOC White marlin CPUE	413	3.066	sig
LOG Dolphin CPUE = DOC Dolphin CPUE	413	1.509	n.s.

*Only includes trips taken from May - August for logbook and dockside data
sig significantly different
n.s. not significantly different

Table 8. Actual catch by species by month for 1984 logbook data for Rudee Inlet trips. No. Caught = Kept + Released.

JUNE (90 TRIPS)

Species	Mean Catch Per Boat Trip	Standard Deviation	No. Caught
White marlin	0.01	0.10	1
Bluefin tuna	5.74	5.70	517
Yellowfin tuna	0.39	1.61	35
Albacore	0.02	0.21	2
False albacore	0.87	3.85	78
Atlantic bonito	0.01	0.10	1
Skipjack	0.08	0.64	7
King mackerel	0.08	0.37	7
Dolphin	0.04	0.33	4
Bluefish	5.01	6.60	451
Mako shark	0.01	0.10	1
TOTAL ALL FISHES	12.27	9.65	1,104

JULY (56 TRIPS)

Species	Mean Catch Per Boat Trip	Standard Deviation	No. Caught
White marlin	0.29	0.59	16
Bluefin tuna	2.12	3.60	119
Yellowfin tuna	3.02	4.54	169
Albacore	0.05	0.40	3
False albacore	0.05	0.30	3
Skipjack	0.37	1.00	21
King mackerel	0.05	0.23	3
Wahoo	0.12	0.43	7
Dolphin	0.87	1.55	49
Bluefish	1.18	3.28	66
Mako shark	0.02	0.13	1
TOTAL ALL FISHES	8.07	5.72	457

AUGUST (47 TRIPS)

Species	Mean Catch Per Boat Trip	Standard Deviation	No. Caught
Blue marlin	0.02	0.15	1
White marlin	1.68	0.91	32
Bluefin tuna	0.02	0.15	1

Table 8. Continued.

Yellowfin tuna	1.43	3.05	67
False albacore	0.25	1.34	12
Skipjack	0.04	0.20	2
Wahoo	0.23	0.48	11
Dolphin	1.28	1.69	60
Bluefish	0.21	1.46	10
TOTAL ALL FISHES	4.17	4.48	196

SEPTEMBER (17 TRIPS)

Species	Mean Catch Per Boat Trip	Standard Deviation	No. Caught
White marlin	0.41	0.51	7
Yellowfin tuna	1.23	1.82	21
False albacore	0.29	1.21	5
Skipjack	0.06	0.24	1
King mackerel	0.23	0.75	4
Wahoo	0.41	0.79	7
Dolphin	0.94	1.98	16
TOTAL ALL FISHES	3.71	3.12	61

GRAND TOTAL ALL FISHES 1,818

Table 9. Monthly actual catch by species for 1984 dockside data for Rudee Inlet trips. No. Caught = Kept + Released.

JUNE (79 TRIPS)

Species	Mean Catch Per Boat Trip	Standard Deviation	No. Caught	No. Released
Bluefin tuna	2.87	3.01	227	16
Yellowfin tuna	0.11	0.53	9	0
Tuna sps.	0.25	1.51	20	0
King mackerel	0.01	0.11	1	0
Bluefish	2.23	3.80	174	50
TOTAL ALL FISHES	5.50	5.17	431	66

JULY (35 TRIPS)

Species	Mean Catch Per Boat Trip	Standard Deviation	No. Caught	No. Released
White marlin	0.03	0.17	1	0
Bluefin tuna	1.31	2.31	46	2
Yellowfin tuna	1.03	2.53	36	0
Albacore	0.06	0.34	2	0
Tuna sps.	0.14	0.84	5	0
Atlantic bonito	0.03	0.17	1	0
Skipjack	0.20	1.02	7	0
King mackerel	0.06	0.24	2	0
Dolphin	0.37	0.94	13	0
Bluefish	2.23	3.46	78	23
TOTAL ALL FISHES	5.83	4.46	191	25

AUGUST (54 TRIPS)

Species	Mean Catch Per Boat Trip	Standard Deviation	No. Caught	No. Released
Blue marlin	0.02	0.14	1	0
White marlin	0.31	0.58	17	11
Bluefin tuna	0.04	0.19	2	0
Yellowfin tuna	1.00	3.99	54	0
False albacore	0.09	0.56	5	1
Wahoo	0.18	0.44	10	0
Dolphin	0.70	1.09	38	0
Bluefish	0.17	0.99	9	2
TOTAL ALL FISHES	3.10	4.00	136	14

Table 9. Continued.

SEPTEMBER (29 TRIPS)

Species	Mean Catch Per Boat Trip	Standard Deviation	No. Caught	No. Released
White marlin	0.14	0.44	4	2
Yellowfin tuna	0.31	0.71	9	0
Albacore	0.48	2.10	14	0
Tuna sps.	0.10	0.56	3	0
False albacore	0.41	1.27	12	1
Atlantic bonito	0.10	0.41	3	0
Skipjack	0.03	0.19	1	0
Wahoo	0.17	0.47	5	1
Dolphin	1.28	2.89	37	0
Mako shark	0.03	0.19	1	0
TOTAL ALL FISHES	3.10	4.00	89	4
GRAND TOTAL ALL FISHES			847	109

CHAPTER 3

A COMPARISON OF TELEPHONE AND DOCKSIDE SAMPLING METHODS FOR ANALYZING VIRGINIA'S RECREATIONAL MARLIN/TUNA FISHERY

INTRODUCTION

Catch and effort and fleet size for Virginia's pelagic recreational fishery are needed by fishery managers to properly assess the stocks of white and blue marlin and tunas. In 1983, Figley (1984) utilized a telephone and mail survey to obtain this information. During 1984, this fishery was analyzed using logbooks, Figley's (1984) mail survey and some dockside interviews for Rudee Inlet-based trips (Chap 2). In 1985, more NMFS funding was available and dockside and telephone surveys were employed to collect information on Virginia's pelagic recreational fishery. Comparisons were made between 1985 sampling methodologies to determine which method provides the best data for this offshore sport fishery. The main objectives of this portion of the study were:

1. To evaluate and compare dockside and telephone survey techniques for analyzing Virginia's pelagic recreational fishery.
2. To estimate fleet size, catch rates and total catches for the recreational pelagic fishery.

METHODS

During 1985, two sampling strategies were used to obtain catch and effort data on Virginia's pelagic recreational fishery: the random telephone survey of Figley (1984); and the dockside interview technique for large pelagics of the NMFS. Results of the data collection effort were compared to determine how each method characterized the fishery.

Telephone Survey

Figley's (1984) random telephone survey was used and modified. Study participants were obtained from fishing club rosters, sign-up sheets placed in marinas and tackle shops throughout Virginia which were known to cater to offshore fishermen, contacts made dockside during fishing tournaments and names obtained during the 1983 and 1984 studies of Virginia's pelagic recreational fishery (Chap 2; Figley 1984). An index card was kept on each boat captain; listing his name, address, phone number, boat name and length and whether the boat was a charter or private fishing vessel. When a boat had more than one captain, the phone number and name of the second captain was also placed at the bottom of the card. If a captain owned more than one tuna/marlin fishing vessel, each vessel was listed along with the above information on the card. Cards were filed in alphabetical order by the primary captain's last name. When the captain was called on the telephone for the first time, he was asked whether he planned

to make at least three trips for tuna/marlin from a Virginia port during the 1985 season. A minimum number of three trips was set to eliminate boat captains who occasionally fish for marlin/tuna. If the captain did not plan to fish that year or only fished one or two times he was placed in an inactive file and called again the next year. For active boat captains, a separate card was filled out for each boat listing the boat name, charter or private vessel, boat length and the primary and secondary captain's names and then filed alphabetically by boat name. This boat list was later used for determining fleet size.

In 1985, random telephone interviews were conducted for various wave dates from June through October. Wave dates are sampling periods consisting of a week to a month in which boat captains called on the telephone were asked to recall the number of trips they made in their own boats for that particular time frame. The 1983 and 1984 studies of this fishery (Chap 2; Figley 1984) indicated that June, July and August were the peak fishing months. Therefore, wave dates varied in length depending upon the intensity of fishing activity. Every wave date always began on a Monday and ended on a Sunday so that weekends would fall within the same wave date. Wave dates were weekly during the heaviest fishing period (June through August). The first wave date was June 1st through June 9th and subsequent wave dates were each a week long (second wave 6/10 - 6/16) through August. For September, wave dates were biweekly and for October the wave

date was for one month. The 1983 random telephone survey of this fishery (Figley 1984) indicated that biweekly wave dates for September and a monthly wave date for October would adequately represent the fishery.

Forty-five captains of charter and privately owned boats who fished for tuna or billfish were contacted for each wave date. When captains owned more than one marlin/tuna vessel, the captain would be counted more than once for that wave date. For example, Captain Smith owns two boats and his name would be counted twice toward the total of 45 captains contacted for that wave date. A random numbers table was used to select, from the file, sixty boat captains by their last name to be called on Monday through Thursday evenings the week following the last Sunday in the wave date (ex. second wave 6/10 - 6/16, telephone calls were made 6/17-20 for this wave). When the first forty-five captains were contacted the remaining uncalled captain's cards were refiled. If the primary captain could not be reached an attempt was made to call the secondary captain. Only during June and July, captains' names were selected randomly without replacement so that nearly all identified captains in the fleet would be contacted at least once. For August through October, boat captains were sampled with replacement, but the same boat captain was never called more than once in each month. After being contacted, the wave date was marked on the back of each card and the card refiled. The same captain was contacted no more than three times during the fishing season.

Boat captains were asked to recall the number of marlin/tuna trips they had taken aboard their own boat from Virginia ports during a particular wave date. As long as a boat left from a Virginia port, it could fish anywhere off the coasts of Maryland, Virginia, or North Carolina and the trip would be counted for that particular wave date. If a captain owned more than one marlin/tuna vessel trip data was recorded for each vessel. This information was then used to calculate fishing effort (fishing trips). Catch data was then recorded for each trip taken in that particular wave date. If trips were made prior to the specified wave date ("recall trips"), these trips were noted and fishing effort was estimated with and without recall trips. Catch data were recorded for recall trips for as far back as the captain could readily remember the trip information (usually no more than two weeks unless a log book was maintained). If a captain, contacted by telephone, had previously been interviewed dockside about a given fishing trip, wave date fishing effort was recorded but catch data was only recorded for the dockside interview to avoid duplication of catch data between dockside and telephone interviews. The following catch information was collected: number of fish caught and released by species; hours fished; location and date of capture; number of anglers and lines fished; inlet departed from; and trip type (private or charter) (Appendix I).

Total fishing effort (fishing trips) was calculated following Figley (1984): for each wave date, the number of

trips made by each boat from Virginia ports was divided by the number of days in the wave date. Resulting estimates of individual boat effort were grouped into monthly intervals. Wave dates which overlapped two months were assigned to the month in which the majority of the wave date's days fell (ex. wave Aug 29 - Sep 4, assigned to September). For each month an average number of trips per day per boat was estimated. Total monthly fishing effort was then calculated from the product of: average number of trips per day per boat for a given month, estimated total number of boats in Virginia's marlin/tuna fleet and the number of days included in the wave dates designating each month. Total estimated fishing effort for the season was derived by summing monthly effort estimates.

Average monthly catch per boat trip was calculated for each species using catch information obtained for each trip taken during the wave dates for that month and catch data recorded for recall trips that fell within that month. Monthly average catch per boat trip for each species was multiplied by estimated total fleet fishing effort for a given month to calculate projected total monthly catch for that species. Overall seasonal catch of each species was determined by summing projected monthly catches.

Dockside Survey

Dockside interviews were also conducted from June through early October at Wachapreague and Rudee Inlets. The 1983 and 1984 studies (Chap 2; Figley 1984) demonstrated that these

two inlets were the main centers of activity for Virginia's marlin/tuna fleet. Trip information was collected weekly (Thursday through Sunday) at the public boat ramp and marinas at Rudee Inlet and daily at the marinas and boat ramps in Wachapreague. Due to limited manpower and monetary constraints for covering Rudee Inlet and since Thursday through Sunday has been shown to be the peak time for offshore trips at this Inlet, Rudee Inlet was only sampled during these week days. Data were collected at all major Virginia tuna/billfish tournaments. The telephone interview catch form was also used to collect catch data at the docks. Fishing effort (trips) was calculated using Figley's method (1984) and Bochenek's method. Bochenek's method was: $A/B = C/X$ where: A = number of different boats that fished that month from interviews; B = number of trips those boats made that month; C = estimated number of boats in the total fleet; and X = estimated number of trips made that month. Bochenek's method for estimating fishing effort was also applied to telephone data.

For dockside and telephone data, the number of hours trolled was rounded down to the nearest whole hour because the NMFS Large Pelagics Survey Program required that the data be entered in this manner. Since bluefin tuna are not caught after mid-August, effort was only calculated from June to when the last bluefin tuna was caught.

Boat Population Estimate

At the end of the fishing season, an economic questionnaire (Appendix I) was mailed to all identified active boat captains. If a captain owned more than one vessel, he received a form to fill out for each vessel. After one month, a post card was mailed to each captain reminding them to return their forms. Captains were asked to name ten boats from their homeport which were known to marlin/tuna fish during the season. All active boats identified during the year by dockside and/or telephone interviews were considered "marked" boats. From the mail questionnaire, any new boats named, i.e. those previously unidentified during the year, were designated "unmarked" boats for purposes of the boat population estimate. All unmarked boats were checked against the file of inactive boats and if any of the unmarked boats listed were actually inactive boats, they were removed from the unmarked boat list. Boat population estimates were then calculated using the Frequency of Capture Method and the Lincoln-Peterson Index (Giles 1971); these two estimates were then averaged (Figley 1984). On the economic questionnaire, boat captains were also asked to record the number of trips their boat made for marlin/tuna during 1985. This question was used to validate estimated fishing effort for both dockside and telephone data.

Statistical Analysis

Catch data collected by telephone and dockside interviews were not normally distributed and various transformations were attempted but none normalized the data. Therefore,

nonparametric statistics were used. Mann-Whitney U-tests corrected for ties were performed to compare catch/boat trip and trips/day/boat on a Prime computer using SPSS-X (SPSS Inc. 1986).

RESULTS AND DISCUSSION

Fleet Characteristics

During the 1985 season, the main launching point for Virginia-based marlin/tuna trips was Rudee Inlet, Virginia Beach (64%) followed by Wachapreague (30%) and Lynnhaven (3%) Inlets. Other minor ports such as Little Creek, Quinby, Hampton, Sand Shoals, Oyster, Poquoson and Chincoteague accounted for the remaining 3% of the trips.

As reported in telephone interviews (P) and dockside interviews (D), marlin/tuna vessels carried a mean of 5.3 (SD 10.9) (P) and 5.4 (SD10.5) (D) anglers per trip; fished an average of 5.9 (SD 5.5) (P) and 6.3 (SD 7.9) (D) lines; and trolled an average of 6.0 (SD 1.5) (P) and 6.1 (SD 1.4) (D) hours per trip. At the end of the fishing season, 453 socioeconomic questionnaires were mailed to boat owners active in the marlin/tuna fishery and a response rate of 44% was achieved with 97.5% of the forms usable for determining the boat population. Virginia's recreational marlin/tuna fleet was estimated at 774 boats; 68 were charter vessels. Rudee Inlet had the largest charter boat fleet followed by Wachapreague with 47 and 16 vessels, respectively. A few charter boats also operated from Quinby, Chincoteague and Oyster. Using the same estimate technique in 1983, Virginia's recreational marlin/tuna fleet consisted of 455 boats and of these 40 were charter vessels (Figley 1984).

However, 1983 was the first year the study was implemented and the boat owners list was in its first year of development. The marlin/tuna fishery was also analyzed in 1984 (Chap 2). In 1985, with the increased number of boat owners in the study, a better boat population estimate was obtained than in previous years. The fleet estimate for 1985 and previous years likely excluded boats which had no names, since the mail survey requested that captains "name" other boats in the fishery. This problem was rectified during the study of the 1987 fishery, by asking boat owners in the mail survey to list the names of either captains or boats in the fishery. Overall, this mark-recapture technique for determining fleet size appears to give a reliable estimate based upon observations of the fleet at the docks and the estimates obtained in 1983 and 1984 (Chaps 2 and 4).

Fishing Effort

Telephone Sampling Program. In 1985, 674 boat captains were contacted by telephone accounting for 86 charter and 218 private marlin/tuna trips. The greatest number of interviews was obtained in July, followed by June and then August (Table 1). A total of 34 captains contacted on the telephone were also interviewed dockside for at least one of their trips. The greatest overlap in such contacts occurred during tournaments. When boat captains participated in a tournament and were called on the telephone for that particular wave date, quite often information on at least one of those captain's trips were collected dockside. In all cases of

overlapping interviews, catch information was only recorded in the dockside data set to avoid duplication of catch data. Future studies should obtain catch data for both dockside and telephone interviews and compare the results. An average of two (SD 2.0) captains were interviewed both dockside and on the telephone for a particular wave date. Fishery reporting aides were unable to interview all boat captains at the docks because of not interviewing at the docks each day and the difficulty in trying to reach every boat captain that returns to port that particular day. As a result, port samplers did not collect information on every trip a boat captain made during a particular wave date. Therefore, the telephone interview process appears to be the better method for calculating fishing effort because this method collects all the trip information for each boat captain for that particular wave date.

Figley (1984) included recall trips in estimating fishing effort. In this study the techniques of using and not using recall trips were compared. When wave date trips were summed for each month, there was no significant difference between fishing effort (trips/day/boat) using recall trips and not using recall trips for all months tested (Table 2a). Recall trip data was used to estimate fishing effort, however, to maintain consistency with data collected in 1983 by Figley (1984). Projected total fishing effort was 5,527 trips using recall trip data and 4,586 trips without recall trip data.

The greatest fishing effort occurred in June and July (Table 3).

When monthly charter and private boat effort (trips/day/boat, without recall) were compared, there were significant differences in effort between boat types for June, July and August, but not for September (Table 2b). As documented in 1983 (Figley 1984), 1984 (Chap 2) and this study, most private boats marlin/tuna fish on weekends and holidays while charter vessels tend to fish daily. By September and October weather becomes a factor affecting the number of trips taken offshore and the charter fleet also becomes less active.

A total of 1,309 trips for the 1985 season was calculated using Bochenek's method as compared to 5,527 trips using Figley's technique (Table 3). Bochenek's method appears to underestimate effort for the telephone data since the 774 boats in the fleet had to make at least three trips during the season to be included in the study (3X774 = 2,322 trips as a minimum number). In addition dockside samplers collected information on 1,138 trips while interviewing only on Thursday through Sunday at Rudee Inlet and daily at Wachapreague Inlet. Dockside interviewers did not obtain data on trips taken during Monday through Wednesday at Rudee Inlet, did not interview at other ports and missed some trips during the interview process at both inlets. When using random telephone surveys, if a large number of boat owners contacted did not fish in that particular wave date this resulted in far fewer

trips taken for that month and reduced the overall estimate. Bochenek's method does not calculate a mean number of trips for a given month and does not multiply the data by the number of days in a given month which may result in a lower number of trips than with Figley's method. Based on these arguments, Figley's method appears to better estimate total effort for the telephone survey.

Dockside Sampling Program. In 1985, 1,138 dockside interviews were completed of which 481 were charter trips. Most trips occurred in July followed by June and August (Table 1). A greater proportion of dockside interviews consisted of charter trips (43.2%) than for telephone interviews (28.2%). Total effort calculated from dockside interviews using Figley's and Bochenek's methods was 16,285 and 5,969 trips, respectively (Table 3). Figley's technique appears to overestimate effort determined from dockside interview data, because boats in the fleet would have had to average over 20 trips each to account for such effort (16,285 trips). This rate of fishing was not supported by mail questionnaire results were captains indicated that their boats averaged 13.5 trips/year (SD 13.1) with a two-tailed 95% confidence interval about the mean of 11.6 to 15.3 trips/year. Using this confidence interval, total trips would have ranged from 8,669 to 11,842 trips/year. Using Bochenek's method for dockside data, effort was calculated as 5,969 trips which was very similar to effort calculated using Figley's method for telephone data of 5,527 trips (Table 3).

Dockside data collection efforts favor charter trips because these boats are concentrated in a few ports and marinas, whereas private boats are widely dispersed among different marinas, private slips and launching ramps. The telephone survey reaches boat captains who may be unavailable at the docks. Fishing effort is difficult to determine using dockside interviews since the researcher does not know how many boats went fishing for pelagics rather than for other species or just went for a boat ride. Boat captains are also reluctant to provide trip information if they did not catch fish, often quickly leaving the docks which would bias the dockside data set to trips in which fish were caught. Some fishing activity occurs during May and October and on week days when no dockside samplers are present which would result in missed information.

Actual Catches (Includes kept and released fish)

For all pelagic species landed, June was the most important month for both dockside and telephone data with 2,045 and 606 fishes landed, respectively (Tables 4 and 5). Most of the marlin/tuna fleet concentrate on school bluefin tuna during this month at fishing locations 20-80 nautical miles off the coast (Figure 1 Chap 1).

Bluefin tuna. Bluefin tuna were only caught in June and July (Tables 4 and 5) with June being the peak month with 85 fish recorded in telephone interviews and 731 fish recorded in dockside interviews. There was a significant difference in catch/boat trip between dockside and telephone interview data

(Table 6). Bluefin tuna catch/boat trip averaged 2.02 fish (SD 2.83) for June and 0.31 fish (SD 0.90) for July for dockside data and averaged 0.92 fish (SD 1.63) for June and 0.31 fish (SD 0.90) for July for telephone data. Higher catches recorded at the docks may be due to sampling more charter boat captains who catch more bluefin tuna than private boat captains (personal observation). During dockside interviews, fewer zero catch trips are recorded and sampling is not random. Therefore, dockside data tends to be biased toward interviewing captains who caught fish. The telephone interview technique reduces this sampling bias.

There was a significant difference in charter and private catch rates of bluefin tuna between dockside and telephone data sets and in charter catch rates of bluefin tuna within and between dockside and telephone data sets (Table 6). Only private catch rates of bluefin tuna were not significantly different between dockside and telephone data sets. Since charter and private catch/boat trip were significantly different future investigators may want to stratify the data sets by private and charter catches.

Yellowfin tuna. Yellowfin tuna were caught during June through October. July was the peak month for yellowfin tuna with 489 fish landed with a mean catch/boat trip of 1.26 fish (SD 3.14) in the dockside data set and 107 landed with a mean catch/boat trip of 2.61 fish (SD 3.69) in the telephone data set (Tables 4 and 5). Overall, yellowfin tuna catch rates were not significantly different between dockside and

telephone data sets and were not significantly different between and within charter and private telephone and dockside data sets (Table 6).

White marlin. From telephone interviews, no white marlin were landed in June but dockside interviews recorded 5 white marlin landed with a mean catch/boat trip of 0.01 fish (Tables 4 and 5). July, August and September were the peak months for white marlin catches recorded in dockside interviews and July was the peak month for catches of white marlin recorded in telephone interviews (Tables 4 and 5). More white marlin landings were reported from dockside than from telephone interviews. These higher catches are likely attributed to numerous marlin tournaments occurring during August and September, resulting in higher catches from dockside sampling effort. However, when white marlin catch rates were compared between dockside and telephone data sets, there was no significant difference between the two (Table 6). In addition, there was no significant difference in charter and private catch rates of white marlin between and within dockside and telephone data sets (Table 6).

Prince et al. (1987) reported a total of 307 white marlin landed on the East Coast from Virginia northward during the 1985 fishing season. For this study, a total of 120 white marlin were caught by Virginia anglers during 1985. These totals consisted of combined dockside and telephone interview actual catches. Therefore, Virginia fishermen are estimated

to have caught 39% of the entire Northeast Region's catch of white marlin.

Blue marlin. A total of 21 and 8 blue marlin were landed by fishermen as reported in dockside and telephone data, respectively (Tables 4 and 5). More blue marlin catches were recorded from dockside than from telephone interviews which may again be the result of dockside data including more marlin tournament trips. Mean catch rates were so low that statistical tests were not performed on the data.

Virginia marlin/tuna fishermen landed 29 blue marlin (combined catches for dockside and telephone interviews). Prince et al. (1987) reported 82 blue marlin landed (combined telephone and dockside catches) for Virginia northward. Therefore, Virginia recreational fishermen landed an estimated 35% of the Northeast Region's catch of blue marlin.

Sailfish. Sailfish are rarely caught by Virginia marlin/tuna fishermen as indicated by both dockside and telephone data (Tables 4 and 5) with a total of 5 sailfish landed. Virginia waters are the northern most range of this species. Mean catch rates were so low that statistical tests were not performed.

Dolphin. Catch data reported from dockside and telephone interviews show that dolphin were caught in every month sampled. The greatest catches of dolphin, for both dockside and telephone interviews, were during August and September (Tables 4 and 5). These fish are an incidental catch of anglers trolling for tuna and billfish, but quite often are

the only fish caught. Overall, dolphin catch rates were not significantly different between and within telephone and dockside data sets and were not significantly different between and within charter and private catch rates for telephone and dockside data sets (Table 6).

Overall. For all pelagic species landed, catch/boat trip was not significantly different between telephone and dockside actual catches (Table 6). Some other miscellaneous species caught during this study were dusky and mako sharks, wahoo, skipjack tuna, Atlantic bonito, false albacore, bluefish and king mackerel (Tables 4 and 5). When tournament catch rate was compared to nontournament catch rate for both dockside and telephone interview data, tournament catch/boat trip was significantly greater (Table 6). More experienced anglers tend to fish in tournaments and the competition is greater than during nontournaments (personal observations) which may account for the higher catch rates. Since tournament catch rates were significantly greater, the catch data could be partitioned, by tournament and nontournament catches, to calculate projected total catches in future studies of this fishery.

Projected Catch

Incorporating recall trips into calculations of projected catches from the telephone data set did not alter the magnitude of estimated total catches of billfish, tuna, dolphin and all pelagic species landed (Appendix II). For example, projected total catches in July for white marlin with

and without recall trips were 166 and 142 fish, respectively. Since effort was not significantly different with or without recall trips and projected total catches do not appear to be different, recall trips do not need to be collected or used in the calculations.

Figley's method appears to provide good estimates of projected total catch for telephone interview data but not for dockside interview data. When Bochenek's method is used to calculate total catch from dockside and telephone interview data, this method appears to provide good estimates for dockside data but not for telephone data (Table 7). Projected total catches, for all species landed for telephone data using Figley's technique, were 42,995 fishes and for dockside data using Bochenek's method were 43,628 fishes.

For white marlin, projected total catches were 326 fish using telephone data (Figley's technique) and 651 fish using dockside data (Bochenek's technique) (Table 7). Bochenek's method, when used to calculate projected total catches for white marlin from dockside interviews resulted in a much higher estimate. Since actual catch rates determined for white marlin from dockside and telephone interview data sets were not significantly different, it is not clear why projected total catches differed by a factor of two. The difference in how effort was calculated for telephone and dockside data may account for the differences in white marlin projected total catches. For blue marlin projected total catch, estimates were similar for telephone (Figley's

technique) and dockside (Bochenek's technique) data, with 133 and 112 estimated, respectively (Table 7).

Projected total catches for white and blue marlin may be too high for Virginia's fishery because fewer billfish were recorded caught by anglers in the Virginia Saltwater Fishing Tournament. However, all billfish caught may not be reported for a citation. This problem needs to be addressed in future studies. A question could be added to the socioeconomic questionnaire asking fishermen to report the total number of white and blue marlin landed on their boat for that particular season. These values could be used to compare the Virginia Saltwater Fishing Tournament data to catches reported for that year for telephone and/or dockside data sets.

Projected total catches for bluefin tuna reported in the telephone data set (Figley's technique) were 2,197 fish and for dockside data set (Bochenek's method) were 4,659 fish (Table 7). Bluefin tuna mean catch/boat trip was significantly different between dockside and telephone data sets. Therefore, projected catch estimates for this species would also be different between the two data sets. Yellowfin tuna projected total catches were very similar between dockside and telephone data sets with 8,185 fish and 8,980 fish landed, respectively (Table 7). Mean catch/boat trip of yellowfin tuna was not significantly different between dockside and telephone data sets indicating that projected catches are probably not different.

Dolphin projected catches for dockside and telephone data sets were 13,750 fish and 9,169 fish, respectively (Table 7). These projected catches are probably not different, since the values only differ by a factor of 1.5 and mean catch/boat trip between the two data sets was not significantly different. Telephone data analyzed by Figley's technique and dockside data analyzed by Bochenek's method appear to give similar results and either method can be used to estimate total catches for the marlin/tuna fishery.

Marlin Releases

For white and blue marlin actual catches, telephone data indicate higher release rates than dockside data (Table 8). This difference may be attributed to the fact that dockside data included a greater proportion of tournament interviews than did that collected by telephone. More billfish are usually brought to the docks to be weighed during tournaments than nontournaments (personal observation). For white marlin released by Virginia anglers, telephone data indicated a higher release rate (68%) and dockside data a lower release rate (44%) than estimated release rates of 45% (1986) and 61% (1983) for the U.S. recreational fishery (SAFMC 1988). Applying these release rates to projected catches indicated that a total of 222 (telephone data) and 286 (dockside data) white marlin were released. For blue marlin, the telephone data indicated a 71% release rate compared to a 38% rate from dockside data, corresponding to 94 and 43 fish, respectively, when applying the rates to projected catch estimates.

However, release rates of 35% (1983) and 32% (1986) were estimated for blue marlin for the U.S. recreational fishery (SAFMC 1988).

White marlin must weigh at least 50 pounds or be released and blue marlin must weigh a minimum of 250 pounds or be released to be considered a citation for the Virginia Saltwater Fishing Tournament until 1989 when the weights were raised to 60 pounds for white marlin and 350 pounds for blue marlin. This tournament reports a higher percentage of releases for both blue and white marlin than indicated by this study (Table 8). The percentage of releases for the tournament may not really reflect the true percentage rates as shown by telephone and dockside data, but may be biased upward because anglers will release fish that do not meet the minimum weight and still receive a citation. White and blue marlin brought to the docks that do not meet the minimum citation weight will not be recorded in the records and this would raise the release percentages. Fishermen may not report all their marlin catches, especially if they catch more than one in a day and many fishermen do not participate in the tournament which may account for the lower number of marlin landed in the tournament records (personal observation).Other Studies

For the 1985 season, the NMFS combined telephone and dockside catches to calculate a monthly mean catch/boat trip for each species. Monthly effort was calculated from the telephone data using Figley's technique (1984). Projected

catches were estimated by multiplying the mean catch/boat trip for each species by the effort for that month (Steve Turner, NMFS, SEFC, personal communication, 1988). Projected billfish and tuna catches, using this method, are currently not available (Steve Turner, NMFS, SEFC, personal communication, 1988). When NMFS calculates projected catches in this manner, the estimate obtained maoverestimate projected catches. This study noted that telephone and dockside actual catches for all species landed, yellowfin tuna, dolphin and white marlin were compared catch/boat trip was not significantly different between the two methods (Table 6). In addition, this study documented that Figley's effort technique when applied to dockside data appears to overestimate total effort which would probably result in higher catch estimates for the NMFS study. The 1985 marlin/tuna fleet was estimated at 774 boats and these vessels would have to make at least 20 trips each to account for the effort calculation using Figley's method for dockside effort. This type of fishing effort was not supported by mail questionnaire results. The data indicate that if dockside catches are to be used to project total catches that Bochenek's method be used. The NMFS technique must also take into consideration that duplication of data may occur when combining both dockside and telephone interview catches. In conclusion, the NMFS technique appears to overestimate projected catches.

Birdsong (1982, 1981, 1980) collected data on the U.S. Atlantic bluefin tuna and billfish fishery. Aerial surveys

and dockside counts were used to estimate fishing effort. Aerial survey results were based upon the assumption that no half day fishing trips are taken by Virginia recreational marlin/tuna fishermen. Results of this study and personal observations indicate that some bluefin tuna trips and an occasional marlin/tuna trip will be less than a full day. The use of aerial surveys is difficult because marlin/tuna fishermen can be spread over a wide sampling area from Poor Man's Canyon to the Cigar and Fingers. The marlin season runs from June through October and Birdsong only sampled through July and included approximatley three major tournaments. Projected catch estimates were not provided in the Birdsong report so comparisons could not be made with this study.

CONCLUSIONS

Both the telephone survey using Figley's technique (1984) and dockside interviews using Bochenek's method for calculating effort appear to provide similar estimates of projected total catch for the recreational marlin/tuna fishery. However, the dockside method is very labor intensive, costly and fraught with problems in estimating fishing effort. In 1985, one port sampler covered Wachapreague Inlet every weekday and weekend, one port sampler covered Rudee Inlet on Thursday and Friday and two to three port samplers covered Rudee Inlet on weekends and during major tournaments. Only two researchers were required to conduct telephone interviews. Dockside interviews bias fishing effort toward charter boats and trips in which fish are caught (personal observation). Manpower constraints also limit the number of port locations which can be sampled. Many private boats and even some charter boats are missed during the dockside sampling effort.

Therefore, the telephone survey technique using Figley's method for estimating effort appears to be a better method for analyzing Virginia's recreational marlin/tuna fishery. Recall trips are not needed to estimate monthly fishing effort. An updated list of marlin/tuna boat captains must be maintained. New boat owners and addresses and length-weight data can be collected at the docks during major tournaments. If telephone

interviewing will not work in an area and dockside sampling methods must be relied upon to study the pelagic fishery, Bochenek's method appears to produce a better estimate of fishing effort.

To reduce sampling error, sampling effort could be partitioned by inlet, charter and private or tournament and nontournament. Other sampling strategies need to be compared to the telephone and dockside technique to develop the best methodology for estimating catches for the recreational marlin/tuna fishery. Some other methods which need to be investigated are non-random intercepts and roving clerk method.

Table 1. Number of charter and private trips sampled by month for dockside and telephone interviews.

TELEPHONE INTERVIEWS

Month	Charter trips	Private trips	Total
May	0	2	2
June	24	68	92
July	31	74	105
August	17	45	62
September	12	27	39
October	2	2	4
TOTALS	86	218	304

DOCKSIDE INTERVIEWS

Month	Charter trips	Private trips	Total
May	0	2	2
June	182	180	363*
July	151	259	411*
August	110	131	241
September	38	83	121
October	0	0	0
TOTALS	481	655	1138

* Does not add because one trip was not designated charter or private

Table 2a. Mann-Whitney U-test comparing monthly effort (no. trips/day/boat) with and without recall trips for telephone interview data, alpha=.05, 2-tailed test.

Null Hypothesis	Cases	Z	Significance
June trips with recall =	199		
June trips without recall	179		
Total	378	1.594	n.s.
July trips with recall =	209		
July trips without recall	180		
Total	389	1.601	n.s.
Aug trips with recall =	202		
Aug trips without recall	180		
Total	382	1.935	n.s.
Sep trips with recall =	91		
Sep trips without recall	90		
Total	181	0.121	n.s.

n.s. not significant
* significantly different

Table 2b. Mann-Whitney U-test comparing monthly effort (no. trips/day/boat) for charter (C) and private (P) telephone interviews, without recall trips, alpha=0.05, two-tailed test.

Null Hypothesis	Cases	Z	Significance
June C effort =	29		
June P effort	150		
Total	179	2.592	*
July C effort =	21		
July P effort	159		
	179	4.981	*
August C effort =	27		
August P effort	153		
Total	180	2.219	*
Sept C effort =	10		
Sept P effort	80		
Total	90	0.540	n.s.

n.s. not significant
* significantly different

Table 3. A comparison of estimated effort (No. of trips) for each month between dockside and telephone interview data for 1985, charter and private effort combined, and includes recall trip data. Effort was calculated using Figley's (1984) and Bochenek's technique. No dockside interviews collected in October 1985.

Figley's Method

Month	Telephone Effort With recall	Telephone Effort No recall	Dockside Effort
June	1,767	1,454	4,876
July	1,842	1,582	4,356
August	1,373	1,046	5,211
September	466	455	1,842
October	79	49	-
Totals	5,527	4,586	16,285

Bochenek's Method

Month	Telephone Effort	Dockside Effort
June	436	1,861
July	463	1,552
August	269	1,504
September	119	1,052
October	22	-
Totals	1,309	5,969

Table 4. Monthly actual catches by speices for 1985 dockside interviews. No. Caught = Kept + Released.

JUNE DOCKSIDE INTERVIEWS (363 TRIPS)

Species	Mean Catch Per Boat Trip	Standard Deviation	No. Caught	No. Released
Blue marlin	0.003*	0.05	1	0
White marlin	0.01	0.12	5	3
Sailfish	0.003*	0.05	1	0
Bluefin tuna	2.02	2.83	731	1
Yellowfin tuna	2.92	3.21	143	0
Other tuna	0.005*	0.10	2	0
False albacore	0.86	3.06	311	27
Atlantic bonito	0.17	0.62	61	0
Skipjack	0.01	0.09	3	0
King mackerel	0.02	0.16	9	0
Wahoo	0.01	0.12	5	0
Dolphin	0.17	1.25	60	1
Bluefish	4.95	5.74	713	38
TOTAL ALL FISHES			2,045	70

JULY DOCKSIDE INTERVIEWS (411 TRIPS)

Species	Mean Catch Per Boat Trip	Standard Deviation	No. Caught	No. Released
Blue marlin	0.03	0.16	10	4
White marlin	0.08	0.28	29	16
Bluefin tuna	0.58	1.74	225	1
Yellowfin tuna	1.26	3.14	489	49
Albacore	0.003*	0.05	1	0
Other tuna	0.003*	0.05	1	0
False albacore	0.05	0.28	20	0
Atlantic bonito	0.04	0.27	16	1
Skipjack	0.34	1.29	133	1
King mackerel	0.04	0.23	16	1
Wahoo	0.03	0.17	12	0
Dolphin	0.91	3.94	355	26
Bluefish	0.76	3.72	294	55
Mako shark	0.01	0.09	3	0
Dusky shark	0.003*	0.05	1	0
TOTAL ALL FISHES			1,605	154

Table 4. Continued.

AUGUST DOCKSIDE INTERVIEWS (241 TRIPS)

Species	Mean Catch Per Boat Trip	Standard Deviation	No. Caught	No. Released
Blue marlin	0.03	0.18	8	3
White marlin	0.14	0.38	33	23
Sailfish	0.004*	0.06	1	0
Yellowfin tuna	0.68	1.23	165	0
Albacore	0.004*	0.06	1	0
False albacore	0.35	1.67	86	0
Atlantic bonito	0.09	1.35	23	0
Skipjack	0.23	0.81	57	0
King mackerel	0.02	0.32	5	0
Wahoo	0.08	0.28	19	0
Dolphin	3.02	7.71	730	1
Bluefish	0.04	0.52	9	0
Barracuda	0.004*	0.06	1	0
Shark gen.	0.01	0.09	2	0
Dusky shark	0.004*	0.06	1	
TOTAL ALL FISHES			1,141	27

SEPTEMBER DOCKSIDE INTERVIEWS (121 TRIPS)

Species	Mean Catch Per Boat Trip	Standard Deviation	No. Caught	No. Released
Blue marlin	0.02	0.13	2	1
White marlin	0.28	0.68	34	2
Sailfish	0.01	0.09	1	0
Yellowfin tuna	0.54	1.03	66	0
Tuna gen.	0.01	0.09	1	1
False albacore	0.67	3.49	82	2
Atlantic bonito	0.08	0.82	10	0
Skipjack	0.02	0.20	3	0
King mackerel	0.02	0.15	3	0
Wahoo	0.05	0.28	6	0
Dolphin	7.11	15.82	867	1
Bluefish	0.02	0.18	2	0
TOTAL ALL FISHES			1,077	7

*Mean catch/boat trip values for these species had to be carried to three decimal places because values were so low

Table 5. Monthly actual catches by species for telephone interview data using recall trips. No. Caught = Kept + Released.

JUNE TELEPHONE INTERVIEWS (92 TRIPS)

Species	Mean Catch Per Boat Trip	Standard Deviation	No. Caught	No. Released
Bluefin tuna	0.92	1.63	85	0
Yellowfin tuna	0.63	1.86	57	6
False albacore	2.31	7.48	213	93
Atlantic bonito	0.24	0.73	22	2
Dolphin	0.43	1.38	40	3
Bluefish	8.54	9.71	188	95
Mako shark	0.01	0.10	1	0
TOTAL ALL FISHES			606	199

JULY TELEPHONE INTERVIEWS (105 TRIPS)

Species	Mean Catch Per Boat Trip	Standard Deviation	No. Caught	No. Released
Blue marlin	0.03	0.16	3	2
White marlin	0.09	0.37	10	6
Sailfish	0.02	0.14	2	0
Bluefin tuna	0.31	0.90	34	0
Yellowfin tuna	2.61	3.69	107	1
False albacore	0.04	0.30	4	3
Atlantic bonito	0.08	0.41	9	1
Skipjack	0.14	0.70	15	2
King mackerel	1.33	0.58	4	0
Wahoo	0.05	0.25	5	0
Dolphin	0.93	4.06	101	1
Bluefish	0.18	0.82	19	1
Mako shark	0.02	0.14	2	1
Shark gen.	0.01	0.10	1	1
TOTAL ALL FISHES			316	19

AUGUST TELEPHONE INTERVIEWS (62 TRIPS)

Species	Mean Catch Per Boat Trip	Standard Deviation	No. Caught	No. Released
Blue marlin	0.03	0.18	2	1
White marlin	0.08	0.27	5	4
Yellowfin tuna	1.23	2.11	76	0
Tuna gen.	0.03	0.25	2	0
False albacore	0.11	0.65	7	0
Atlantic bonito	0.05	0.38	3	0
Skipjack	0.10	0.39	6	0
Wahoo	0.02	0.13	1	0
Dolphin	3.13	6.90	194	2
TOTAL ALL FISHES			296	7

Table 5. Continued.

SEPTEMBER TELEPHONE INTERVIEWS (39 TRIPS)

Species	Mean Catch Per Boat Trip	Standard Deviation	No. Caught	No. Released
Blue marlin	0.08	0.27	3	2
White marlin	0.10	0.39	4	3
Yellowfin tuna	0.95	1.90	36	0
False albacore	0.84	2.43	32	0
Atlantic bonito	0.32	1.95	12	12
Skipjack	0.05	0.32	2	0
King mackerel	0.26	0.79	10	0
Wahoo	0.05	0.23	2	0
Dolphin	4.32	8.35	164	0
Bluefish	0.05	0.32	2	0
TOTAL ALL FISHES			267	17

OCTOBER TELEPHONE INTERVIEWS (4 TRIPS)

Species	Mean Catch Per Boat Trip	Standard Deviation	No. Caught	No. Released
Yellowfin tuna	1.67	2.65	15	0
Blackfin tuna	0.22	0.67	2	0
False Albacore	0.78	2.33	7	0
King mackerel	1.11	2.98	10	0
Dolphin	4.89	8.08	45	0
TOTAL ALL FISHES			79	0

Table 6. Mann-Whitney U-Test comparing catch/boat trip (CPUE) for telephone (TEL) and dockside (DOC) interviews conducted during 1985 season, alpha = 0.05, C = Charter trip, P = private trip, allspecies=all pelagic species landed, tournno=none tournament catches and tournyes=tournament catches.

Null Hypothesis	Cases	Z	Significance	one or two-tailed
TEL allspecies CPUE = DOC allspecies CPUE	1441	0.524	n.s.	two
TEL tournyes CPUE =** TEL tournno CPUE	304	2.371	sig	one
DOC tournyes CPUE =** DOC tournno CPUE	1137	9.965	sig	one
TEL tournyes CPUE = DOC tournyes CPUE	368	1.018	n.s.	two
TEL tournno CPUE = DOC tournno CPUE	1073	2.125	sig	two
TEL white marlin CPUE = DOC white marlin CPUE	1273	0.779	n.s.	two
C TEL white marlin CPUE = P TEL white marlin CPUE	227	0.061	n.s.	two
C DOC white marlin CPUE = P DOC white marlin CPUE	1101	1.021	n.s.	two
C TEL white marlin CPUE = C DOC white marlin CPUE	529	0.598	n.s.	two
P TEL white marlin CPUE = P DOC white marlin CPUE	799	0.166	n.s.	two
TEL bluefin tuna CPUE = DOC bluefin tuna CPUE*	944	3.664	sig	two
C TEL bluefin tuna CPUE = P TEL bluefin tuna CPUE*	187	2.091	sig	two
C DOC bluefin tuna CPUE = P DOC bluefin tuna CPUE*	757	10.094	sig	two

Table 6. Continued.

C TEL bluefin tuna CPUE = C DOC bluefin tuna CPUE*	371	3.273	sig	two
P TEL bluefin tuna CPUE = P DOC bluefin tuna CPUE*	573	0.790	n.s.	two
TEL yellowfin tuna CPUE = DOC yellowfin tuna CPUE	1438	1.360	n.s.	two
C TEL yellowfin tuna CPUE = P TEL yellowfin tuna CPUE	384	1.847	n.s.	two
C DOC yellowfin tuna CPUE = P DOC yellowfin tuna CPUE	1135	1.732	n.s.	two
C TEL yellowfin tuna CPUE = C DOC yellowfin tuna CPUE	647	1.218	n.s.	two
P TEL yellowfin tuna CPUE = P DOC yellowfin tuna CPUE	872	0.320	n.s.	two
TEL dolphin CPUE = DOC dolphin CPUE	1406	1.981	n.s.	two
C TEL dolphin CPUE = P TEL dolphin CPUE	303	1.318	n.s.	two
C DOC dolphin CPUE = P DOC dolphin CPUE	1127	1.356	n.s.	two
C TEL dolphin CPUE = C DOC dolphin CPUE	553	1.308	n.s.	two
P TEL dolphin CPUE = P DOC dolphin CPUE	877	1.256	n.s.	two

* Bluefin tuna catch data for June 1 - July 21, 1985.
** H1:Tournyes > Tournno
n.s. not significant
sig significantly different

Table 7. Projected total catches for all species landed by month for phone and dockside interviews for 1985 using Figley's method (1984) and Bochenek's method. NA = Unable to calculate due to lack of data. Telephone data includes catches from past wave dates.

	JUNE			
	PHONE		DOCKSIDE	
	Figley's	Bochenek	Figley's	Bochenek
Blue marlin	0	0	14	5
White marlin	0	0	68	26
Sailfish	0	0	14	5
Bluefin tuna	1,626	401	985	3,759
Yellowfin tuna	1,113	275	14,238	5,434
Other tuna	0	0	27	10
False albacore	4,082	1,007	4,193	1,600
Atlantic bonito	424	105	829	316
Skipjack	0	0	40	15
King mackerel	0	0	122	46
Wahoo	0	0	68	26
Dolphin	760	187	829	316
Bluefish	15,090	3,723	24,136	9,211
Mako shark	19	5	0	0
TOTAL ALL FISHES	23,114	5,703	45,563	20,769
	JULY			
	PHONE		DOCKSIDE	
	Figley's	Bochenek	Figley's	Bochenek
Blue marlin	52	13	113	40
White marlin	166	42	335	119
Sailfish	35	9	0	0
Bluefin tuna	571	143	2,526	900
Yellowfin tuna	4,808	1,208	5,489	1,955
Albacore	0	0	222	4
Other tuna	0	0	11	4
False albacore	68	17	222	79
Atlantic bonito	153	38	179	64
Skipjack	258	65	1,481	528
King mackerel	1,068	616	179	64
Wahoo	85	21	135	48
Dolphin	1,713	431	3,964	1,412
Mako shark	35	9	33	12
Dusky shark	0	0	222	79
Shark gen.	17	4	0	0
TOTAL ALL FISHES	9,361	2,699	18,422	6,487

Table 7. Continued.

	August			
	PHONE		DOCKSIDE	
	Figley's	Bochenek	Figley's	Bochenek
Blue marlin	44	9	172	50
White marlin	111	22	729	211
Sailfish	0	0	21	6
Yellowfin tuna	1,689	331	3,543	1,023
Albacore	0	0	21	6
Tuna gen.	44	9	0	0
False albacore	151	30	1,824	526
Atlantic bonito	66	13	495	143
Skipjack	133	26	1,198	346
King mackerel	0	0	109	32
Wahoo	22	4	406	117
Dolphin	4,297	842	15,737	4,542
Bluefish	0	0	193	56
Shark gen.	0	0	43	12
Dusky shark	0	0	21	6
Barracuda	0	0	214	6
TOTAL ALL FISHES	6,557	1,286	24,726	7,082

	September			
	PHONE		DOCKSIDE	
	Figley's	Bochenek	Figley's	Bochenek
Blue marlin	37	9	29	17
White marlin	49	12	516	295
Sailfish	0	0	15	9
Yellowfin tuna	443	113	995	568
Other tuna	0	0	15	9
False albacore	391	100	1,234	705
Atlantic bonito	149	38	151	86
Skipjack	25	6	46	26
King mackerel	121	31	46	26
Wahoo	25	6	90	52
Dolphin	2,013	514	13,097	7,480
Bluefish	25	6	30	17
TOTAL ALL FISHES	3,278	835	16,264	9,290

Table 7. Continued.

	OCTOBER			
	PHONE		DOCKSIDE	
	Figley's	Bochenek	Figley's	Bochenek
Yellowfin tuna	132	37	NA	NA
Blackfin tuna	17	5		
False albacore	62	17		
King mackerel	88	24		
Dolphin	386	108		
TOTAL ALL FISHES	685	191		
GRAND TOTAL	42,995	10,714	104,975	43,628

Table 8. Catch and release data for white and blue marlin and sailfish comparing dockside (using Bochenek's method) and telephone (using Figley's method) interview actual and projected catches (Includes kept + released fish) and releases to the Virginia State tournament citation records*. Recall trips were included in telephone data. Number released in parenthesis.

	STUDY INTERVIEWS					
	Actual Catch		% Released		Projected Catch	
Species	Phone	Dock	Phone	Dock	Phone	Dock
W. marlin	19(13)	101(44)	68%	44%	326(222)	651(286)
B. marlin	7(5)	21(8)	71%	38%	133(94)	112(43)
Sailfish	2(0)	3(0)	0%	0%	35(0)	20(0)

	STATE TOURNAMENT	
Species	Total Caught	% Released
W. marlin	167	81%
B. marlin	26	65%
Sailfish	4	75%

*Virginia Saltwater Fishing Tournament 1985

CHAPTER 4

CATCH TRENDS FOR KEY SPECIES FOR 1983-1986 SEASONS WITH ADDITIONAL DATA PROVIDED FOR 1983 AND 1986 SEASONS

INTRODUCTION

Key species in Virginia's pelagic recreational fishery are bluefin and yellowfin tuna, white and blue marlin and dolphin. These species are caught by trolling artificial lures or natural baits near or on the water surface from June through October at various locations ranging from 20 to 80 nautical miles off the coasts of Virginia, Maryland and North Carolina (Figure 1, Chap 1). The main objective of this portion of the study was to determine catch trends for key species for 1983-1986 seasons.

METHODS

In 1983, Figley's method for calculating catch and effort was used for telephone collected data (Figley 1984). In comparing this analysis to Figley's (1984) report, discrepancies were noted in the calculated effort values. Figley (pers. com.) stated that the wave dates that overlapped two months had been weighted. The actual method used to calculate the weighting factor could not be determined. As a result, no weighting factor was used in the data analysis. Therefore, this study's 1983 effort values vary slightly from his report and these differences carry through to projected monthly and total catches. In 1984, logbooks were used to obtain catch and effort data for this fishery (Chap 2). Figley's telephone method and dockside surveys were employed to collect catch and effort data in 1985 (Chap 3) and the same methodology was used again in 1986. However, more effort was expended to differentiate catches of key species by fishing locations and sea surface temperatures. Catch per unit of effort was calculated as catch/boat trip and catch/boat hour. Catch/boat hour consists of actual trolling time when lines are in the water fishing excluding running time. More detailed methods are presented in Chapters 2 and 3. For all tables and figures, the following abbreviatons were used to represent the different methods in which data were collected: (P) for telephone interviews, (L) for logbooks and (D) for

dockside interviews.

Catch data collected through logbooks and dockside and telephone interviews were not normally distributed and various transformations were attempted but none normalized the data. Therefore, nonparametric statistical tests, namely, Kruskal-Wallis test using chi squared corrected for ties and Mann-Whitney U test corrected for ties were used to compare catch/boat trip and catch/boat hour between different years. All analyses were performed on a Prime computer using SPSS-X (SPSS Inc. 1986).

RESULTS AND DISCUSSION

Characteristics of 1983 and 1986 fishing seasons

In 1983, telephone interviews were conducted and a total of 431 Virginia-based marlin/tuna trips were obtained of which 26.5% were private boat trips. A total of 892 (50.2% charter trips) and 212 (23.1% charter trips) Virginia-based marlin/tuna trips were obtained through dockside and telephone interviews conducted in 1986 (Appendix Table 2). This data indicates that charter boats tend to make more offshore fishing trips than private vessels.

Dockside interviews appear to bias fishing effort toward charter boat captains because of their easy accessibility and rather constant fishing times. Private boat captains are difficult to contact because many of these vessels do not have fixed hours of fishing and can dock or trailer their vessel to various locations. Telephone interviews are random and appear to give a better representation of the fishery, particularly the private boat component.

Rudee Inlet, Virginia Beach was the main launching point for the majority of trips taken from Virginia ports. Lynnhaven Inlet, Virginia Beach and Wachapreague Inlet on Virginia's Eastern Shore were also important launching points for 1983 and 1986. Out-of-State ports used by Virginia's fleet, during 1983-1986, were Oregon and Hatteras Inlets, North Carolina; Ocean City, Maryland; and occassionally Indian

River Inlet, Delaware and a few ports in Florida and New Jersey.

Estimates of Virginia's recreational marlin/tuna fleet increased from 455 boats in 1983 to 886 boats in 1986 (Appendix Table 3). There are two probable explanations for this increase. A larger sample of boats was interviewed each year resulting in a broader data base from which more reasonable estimates of the boat population could be calculated. New boats entering the fishery appear to outnumber those lost to attrition. Charter vessels comprised approximately 8% of the total fleet for 1983-1986 seasons (Appendix Table 3). As of 1986, a large portion of Virginia's marlin/tuna fleet seems to have been identified and the boat population estimates are not expected to increase much in subsequent years.

For the 1983 season, marlin/tuna vessels carried a mean of 4.4 (SD 1.3) anglers and trolled an average 6.3 (SD 1.4) hours per trip. As reported in 1986 telephone interviews (P) and dockside interviews (D), marlin/tuna boats carried a mean of 3.8 (SD 1.3) (P) and 4.3 (SD 1.5) anglers, fished an average of 5.8 (SD 1.2) (P) (D) lines and trolled an average of 6.3 (SD 1.4) (P) and 6.1 (SD 1.4) (D) hours per trip. These values were very similar to those reported for 1984 and 1985 seasons (Chaps 2 and 3).

The projected annual number of Virginia-based marlin/tuna trips was 5,952 trips in 1983 using telephone interview data. In 1986, the fleet made an estimated 7,103 and 6,747

marlin/tuna trips as calculated from telephone and dockside interview data, respectively. These projected effort values appear to be consistent with those reported for other years of this study (Appendix Table 4).

Actual and projected catches for the 1983 and 1986 seasons are reported in Tables 1 and 2. The majority of bluefin tuna were landed in June for both years. A total of 481 bluefin tuna were recorded caught in 1983 and projected catches were estimated at 6,047 fish. In 1986, a total of 144 and 1,362 bluefin tuna were reported caught in telephone and dockside interviews, respectively. Projected catches (includes kept and released fish) were 4,949 bluefin tuna for telephone interview data and 9,458 bluefin tuna for dockside interview data. Projected landings for yellowfin tuna were 5,467 fish during 1983 and 11,246 fish during 1986 for telephone interview data and 7,546 fish for dockside interview data. Yellowfin tuna were landed from June through October for 1983 and 1986 seasons. White marlin were caught from June through October in 1983 and from July through September in 1986. Projected total catches of white marlin were 2,418 fish in 1983 and 545 fish in 1986 for telephone interview data. Seven hundred and eighty-three fish were projected caught in 1986 for dockside interview data. A total of 109 white marlin were released in 1983. In 1986, fishermen reported releasing 64 white marlin in dockside interviews and 15 white marlin in telephone interviews. Very few blue marlin were landed in 1983 and 1986. Projected blue marlin catches were 136 fish in

1983. A total of 166 and 160 blue marlin were projected caught in 1986 based upon telephone and dockside intervews, respectively. Other pelagic species landed were true albacore, skipjack tuna, barracuda, blackfin tuna, bluefish, bigeye tuna, false albacore, king mackerel, mako shark, sailfish and wahoo. No sailfish were caught in 1983 but two were reported caught in 1986 (Table 2).

Area Fished

Early in the fishing season, usually June and July, Virginia's pelagic recreational marlin/tuna fleet fishes primarily for juvenile bluefin tuna (mostly one to two year olds) at the 21 Mile Hill, 26 Mile Hill, Fish Hook, Horseshoe, Hot Dog, Lumps, Southeast Lumps and other areas located in 10 to 20 fathoms of water off the Virginia Coast (Figure 1, Chap 1). By July, yellowfin and bluefin tuna, white and blue marlin and dolphin become the target species and are caught from 10 fathoms to the 1000 fathom curve. Bluefin tuna tend to concentrate on shoals or areas of uneven bottom closer to shore. Yellowfin tuna and white and blue marlin can be caught in the same areas as bluefin tuna but are usually taken on fishing grounds ranging from 20 fathoms to Norfolk and Washington Canyons (Figure 1, Chap 1). In July and sometimes into August bluefin and yellowfin tuna are taken on the same fishing grounds such as the 21 and 26 Mile Hills. During 1983 and 1984 the 26 Mile Hill was a popular area and during 1985 and 1986 the 21 Mile Hill was a good location for catching bluefin and yellowfin tuna. As the water warms in July

schools of bluefin tuna migrate north and the fishery switches to yellowfin tuna and white and blue marlin. Popular areas for catching these latter species were the Cigar for 1983-1986, Fingers in 1986, Norfolk Canyon in 1984-1986 and Washington Canyon in 1986 (Table 3). Many captains fish more than one area, e.g. during 1983 many captains fished both the Norfolk Canyon and the Fingers in a single trip; Table 3 only accounts for trips in which one area was fished.

Catch Trends For Key Species

Bluefin tuna. In Virginia's pelagic recreational fishery, schooling juvenile bluefin tuna are targeted from late May to the end of July. Peak catches usually are highest in June and early July and decrease by late July or early August as the water becomes too warm for this species. The greatest number of bluefin tuna were landed during June for all years of the study except 1984 when the greatest number were taken during June and July. In 1983 and 1984, a few bluefin tuna were caught in August (Chap 2 and 3; Table 1). During June of 1984, 1985 and 1986 larger numbers of bluefin tuna (719, 731 and 983 fish, respectively) were brought to the docks compared to 1983. For all years of the study, annual projected catches are presented in Figures 1 and 2. Projected annual catch estimates were the highest in 1984 with 9,566 fish followed closely by 9,458 fish for 1986 dockside data (Chap 2 and 3). Lowest projected catches were recorded for 1985 season with fewer fish caught especially in July compared to other years. In June 1984 logbooks, boat captains reported

the greatest catch rates of bluefin tuna with 5.21 (SD 5.30) caught per boat trip and 0.90 (SD 0.93) caught per boat hour (Chaps 2 and 3). These higher catch rates may be biased upward because of the relatively poor logbook returns in 1984. These returns appear to only reflect successful trips and omitted zero catch trips.

Excluding 1984, 1986 seems to have been the best year for bluefin tuna when comparing catch rates (Chaps 2 and 3; Table 4). There was a significant difference in annual bluefin tuna catch\boat trip and catch/boat hour between years for all sampling techniques (Tables 5 through 8). Brown and Ofiera (1987) reported projected totals of 5,470 and 2,127 school bluefin tuna caught by New Jersey recreational anglers during 1986 using a mail and telephone survey, respectively. This study using telephone and dockside surveys calculated total catches of 4,949 and 9,458 fish, respectively. The New Jersey fishery made an estimated 11,443 offshore big-game trips (Brown and Ofiera 1987) as compared to projected total trips for the Virginia fishery of 7,103 for the telephone survey data and 6,747 for the dockside survey data.

The NMFS (1986) estimated that recreational fishermen along the east coast caught a total of 11,631 juvenile bluefin tuna during the 1985 season. During June and July of 1985, 2,499 of these fish were primarily caught off of Virginia. During August through October, 9,132 of these fish were landed by New Jersey and New York anglers. This study indicates that 1985 was the poorest year for bluefin tuna landings off

Virginia. The 1985 data indicate that when Virginia has a poor bluefin tuna year New York and New Jersey can have a good tuna year. Since different sampling strategies were used, it is difficult to determine whether some years represent a decline in the bluefin tuna or that the number of fish caught were similar for all years of the study but the method of calculating catch and effort accounted for the difference. Bluefin tuna may have migrated north sooner in 1985 and therefore were not available to the Virginia fishery, resulting in fewer fish caught. As more catch and effort data are collected annually using the same sampling strategies better data will be available to assess catch trends for Virginia's pelagic recreational fishery.

The NMFS (1988) reports that the stock of juvenile bluefin tuna (age one to nine) have declined and that without proper management will continue to decline. Therefore the collection of catch data on Virginia's bluefin tuna fishery is needed by fisheries managers to continue monitoring the status of this important game fish.

Yellowfin Tuna. Some yellowfin tuna are caught during June, September and October but the majority are landed during July and August Annual projected catches of yellowfin tuna ranged from 5,467 fish in 1983 to 16,553 fish in 1984 (Chaps 2 and 3; Figures 3 and 4). The 1984 values are probably too high and are the result of too few logbooks returned and very few zero catch trips being reported. There was a significant difference in annual yellowfin tuna catch/boat trip and

catch/boat hour between years for all sampling techniques (Tables 5 through 8). Brown and Ofiera (1987) also estimated 1986 catches for yellowfin tuna taken by New Jersey recreational fishermen and reported a total of 21,497 fish caught using a telephone survey and 30,203 fish caught using a mail survey. Of the key pelagic species, the yellowfin tuna was the most frequently caught by New Jersey (Brown and Ofiera 1987) and Virginia anglers during the 1986 season. The NMFS believes that the yelllowfin tuna is at or approaching MSY (NMFS 1988). Therefore, recreational catches of this species needs to be annually monitored so that fisheries managers can properly assess the status of the stock in the western Atlantic Ocean.

White marlin. The most common billfish found in Virginia offshore waters is the white marlin. Occasionally blue marlin are caught and even more rarely sailfish. Surface trolling of artificial lures and dead baits are the main method used by Virginia's recreational fishery to catch billfish. These fish prefer warmer waters of the Gulf Stream. The current information available on the stock structure of white marlin is inadequate for assessing the status of the stock (SAFMC 1988). Therefore, the information collected in this study will contribute to the managment of this important game fish. White marlin are taken from June through October usually in waters from the 20 fathom curve to beyond Norfolk and Washington Canyons. Peak months for landing white marlin were July, August and September for most of the years sampled. The

fewest white marlin were landed in 1986 and 1985. Estimated annual catches were highest in 1983 and 1984 with the majority of the fish taken during September in 1983 and during August in 1984 (Chaps 2 and 3; Table 1). Projected catches, for all years of the study, are presented in Figures 5 and 6. Although Virginia's projected catches of white marlin declined in 1986 compared to earlier years, the Virginia fishery accounted for more white marlin in fewer trips than the New Jersey recreational fishery (Brown and Ofiera 1987).

The NMFS (1987) reports that recreational billfishermen caught a total of 483 white marlin from the northen Gulf of Mexico in 1986 with a release rate of 41.2%. This study reported a total of 90 white marlin caught (Table 1) (combined dockside and telephone catches) of which 88% were released by Virginia's pelagic recreational fishery during the 1986 season. For the 1984 season, the NMFS Oceanic Pelagics Program reported that 843 white marlin were caught by recreational fishermen off the U.S. East Coast (Bertolino et al. 1985) and this study documented that Virginia anglers caught 75 white marlin. Monthly mean catch/boat hour and mean catch/boat trip values were extremely low for all years of the study as compared to other pelagic species such as yellowfin tuna (Chaps 2 and 3; Table 4). No significant difference was found when comparing the poor catch rates, both catch/boat trip and catch/boat hour, of white marlin for 1985 and 1986 dockside collected data (Tables 5 and 6). However, when annual catch rates were compared among all years, the rates

were significantly different (Tables 7 and 8). White marlin catch rates were very low for all years of this study indicating that Virginia anglers are less likely to land a white marlin than some of the other pelagic species such as yellowfin tuna. The data indicate that few white marlin have been available to the fishery and that this trend is continuing.

As documented in this study (Chaps 2 and 3; Table 1), Virginia's recreational marlin/tuna fishermen tend to release a higher percentage of white marlin than the east coast recreational fishing fleet (SAFMC, 1988). With the exception of 1985 dockside collected data, the rate of white marlin released annually was better than 70 percent as compared to 45 percent for the East Coast Fishery (SAFMC 1988).

Blue marlin. No blue marlin were reported caught in June 1983, 1984 and 1986. However, one blue marlin was landed in June of 1985. The greatest number of blue marlin were caught during July and August for the 1985 season and during July for the 1986 season. Only one blue marlin was reported landed during the 1984 season (Chaps 2 and 3, Table 1). Mean catch/boat trip and catch/boat hour were so small that statistical tests were not performed on the data (Chaps 2 and 3, Table 4). Projected annual catches of blue marlin were the greatest in 1986 with approximately 160 estimated caught from telephone and dockside interviews and the lowest in 1984 with 23 estimated caught from logbook data (Chaps 2 and 3, Table 1 and Figures 7 and 8). Excluding the 1984 season because of

the poor return rate of logbook data, projected annual catches of blue marlin appear to have remained fairly constant with a range of 112 to 166 fish caught. Total catch by the recreational fishery in the Gulf of Mexico has increased since 1977. The following total catches of blue marlin were reported for the Gulf of Mexico: 307 fish in 1983, 347 fish in 1984, 458 fish in 1985 and 443 fish in 1986 (SAFMC 1988). This study does not show an increase in blue marlin catches for the Virginia recreational fishery. For New Jersey, Brown and Ofiera (1987) reported projected estimates of 46 and 41 fish landed using mail and telephone survey data collected in 1986, respectively. This study reports that the Virginia fishery accounted for more fish in fewer trips than the New Jersey fishery during the 1986 season.

As documented in this study, blue marlin exhibited a very low catch and release rate. In 1984, only one blue marlin was caught and released. Release rates for 1983, 1985 and 1986 ranged from 38 to 64 percent with an overall four year average of 69 percent (Chap 2 and 3, Table 1). Virginia State Citation Records similarly documented an overall four year mean release rate of 67.5 percent (VSFT 1983-1986). With new minimum length regulations for blue marlin catches becoming effective in the 1989 season, more blue marlin should be released.

Dolphin. Most of the dolphin landed were small "chicken" dolphin and the majority of these fish were associated with floating objects. Dolphin are frequently caught on the same

fishing grounds as white marlin and yellowfin tuna. Large catches of dolphin were recorded for 1985 and 1986 seasons. Greatest catches were reported in July, August and September. Projected annual catches were good for all years of the study ranging from 4,354 to 13,750 fish (Chaps 2 and 3; Table 1). Dolphin projected catches have increased since the first year of this study (1983) indicating that more dolphin may be available to the fishery. Annual catch/boat trip and catch/boat hour were signficantly different between years (Tables 5-8). Brusher and Palko (1986) surveyed the charter boat fishery from the southeastern United States (North Carolina to Texas) in 1984 and reported that dolphin were the most often caught pelagic species with 24,047 fish landed. Dolphin, while significant to Virginia's pelagic fishery, seem to account for a major component of the more southern states offshore fisheries.

All Pelagic Species Combined. A summary of overall success rates of the offshore recreational fishery is presented in Table 9. Pelagic fishes that are represented include any species that might be caught while trolling for tuna and billfish. The following pelagic species may be taken: yellowfin, bluefin, bigeye, true albacore, skipjack and blackfin tuna; false albacore; Atlantic bonito; white and blue marlin; sailfish; dolphin; king mackerel and other mackerel species; wahoo; bluefish; barricuda; and mako, hammerhead and blue sharks. The greatest number of fishes caught was recorded in 1985 and 1986 dockside interviews.

More interviews were conducted at the docks than over the telephone which may account for the greater number of fishes reported caught in the dockside data set. In addition, the dockside survey contained more tournament collected information than the telephone survey and the data indicate that more fish tend to be caught during tournaments (Chap 3). There was a significant difference in annual catch/boat trip and catch/boat hour for all pelagic species between all years (Table 5 through 8). Monthly mean catch/boat trip for all pelagic species landed was very high for the 1984 season and the lowest for the 1983 season (Table 9). The higher catch rates reported in 1984 may be due to boat captains only reporting successful fishing trips in their logbook returns. For all years except 1986, the highest catch rates were reported in June and September excluding the month of October because so few trips were taken. In June, large numbers of bluefin tuna, bluefish and false albacore were caught whereas in September the majority of fish caught were dolphin and sometimes king mackerel. When all species which can be landed by marlin/tuna fishermen are considered good catch rates were calculated for all months of the study.

The same problems discussed for bluefin tuna apply to catches of each of the key species because different sampling strategies were used to collect the data for different years of the study. When more annual catch data is collected using a standard technique or techniques better catch trend information will then be available. The data presented in

this study provides a baseline for comparisons with future catch information which fishery management agencies need to continuously collect on the East Coast fishery so appropriate management laws can be formulated.

Catches Of Key Species By Area Fished

For key areas fished, actual catches for 1983 and 1984 and combined actual catches from telephone and dockside interview data for 1985 and 1986 are presented in Table 10. This table reflects only those catches of key species that could be specifically attributed to a particular fishing ground and only those areas where large catches were reported.

Some of the key areas fished for bluefin tuna were the Hot Dog, 21 and 26 Mile Hills, Lumps and SE Lumps, Fish Hook and 20 Fathom Finger. For these fishing areas, the majority of bluefin tuna were landed in June and July for most years of the study. In 1984 many bluefin tuna were landed in June at the Hot Dog. Another important fishing ground was the 21 Mile Hill where high catches were reported during June and July of 1985 and 1986. The Lumps, SE Lumps area was also good for catching bluefin tuna during June of 1984 and 1985 (Table 10). Bluefin tuna were consistently caught at the 21 and 26 Mile Hills and the Hot Dog for most years of this study. 1986 appears to have been a good year for catching bluefin tuna at the Hot Dog and 21 and 26 Mile Hills.

Good yellowfin tuna catches were reported at the Cigar, Hot Dog and Norfolk Canyon for most years of this study (Table 10). Greatest yellowfin tuna landings were reported during

July and August of 1985 and 1986 at the Cigar, during July 1984 at the Hot Dog and during July of 1985 and 1986 at Norfolk Canyon.

The majority of blue and white marlin catches for 1985 and 1986 were at the Cigar and Norfolk Canyon (Table 10). The best months for catching a blue marlin at these hot spots were during July, August and September for 1985 season and during July and August for 1986 season. Peak catches of white marlin were reported in July, August and September.

Besides these fishing areas there are other hot spots that annually produce good catches of key species. For example, the Washington Canyon, Triple Zero Line (Loran C), Fingers, Horseshoe and Boomerang are other hot spots (Figure 1, Chap 1).

CONCLUSIONS

For bluefin tuna, excluding the 1984 season, 1986 was the best year for bluefin tuna when comparing actual catches, catch/boat hour and catch/boat trip. Most of these fish were caught during June and July for 1983-1986 seasons at fishing grounds located in 10 to 20 fathoms of water off the Virginia Coast. The majority of yellowfin tuna were landed during July and August and annual catches were high for all years of the study. Peak months for landing white marlin were July, August and September for most of the years sampled. Estimated annual white marlin catches were the highest in 1983 and 1984. Blue marlin are rarely caught by Virginia's offshore fleet and the greatest catches were reported for 1985 and 1986 seasons. Yellowfin tuna and white and blue marlin were usually caught further offshore than bluefin tuna at fishing locations in 20 to over 1000 fathoms of water.

Only the 1983, 1985 and 1986 data sets appear comprehensive enough to be used in defining baseline catch rates for Virginia's pelagic recreational fishery. The offshore recreational survey needs to be continued so that more definitive data will be available to establish catch rate trends for these important fishes. This information is critical for assessing the stock size of these big game fishes so that ICCAT and the United States Management Councils can better manage these important fishes in the future.

Figure 1. Projected catches of bluefin tuna for 1983 (P), 1984 (L), 1985 (P) and 1986 (P) seasons.

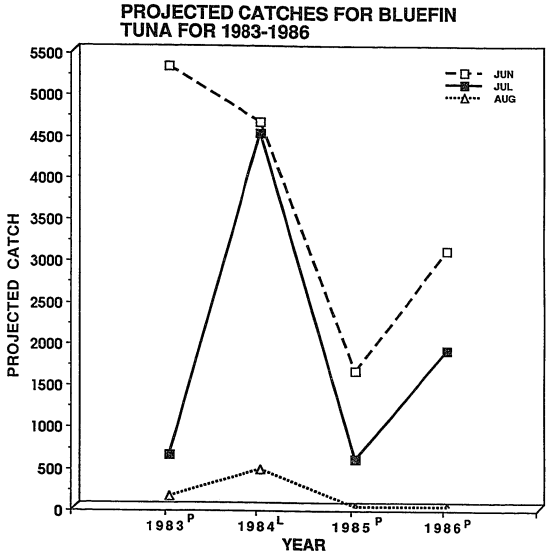


Figure 2. Projected catches of bluefin tuna for 1984 (L), 1985 (D) and 1986 (D) seasons.

PROJECTED CATCHES FOR BLUEFIN TUNA FOR 1984-1986

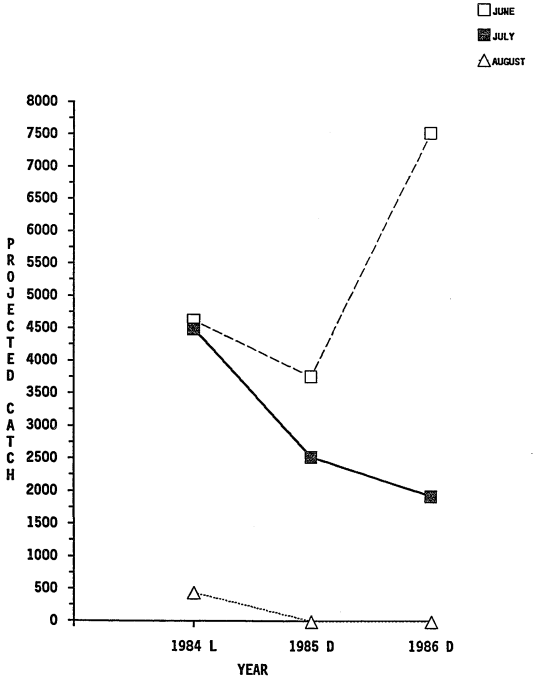


Figure 3. Projected catches of yellowfin tuna for 1983 (P), 1984 (L), 1985 (P) and 1986 (P) seasons.

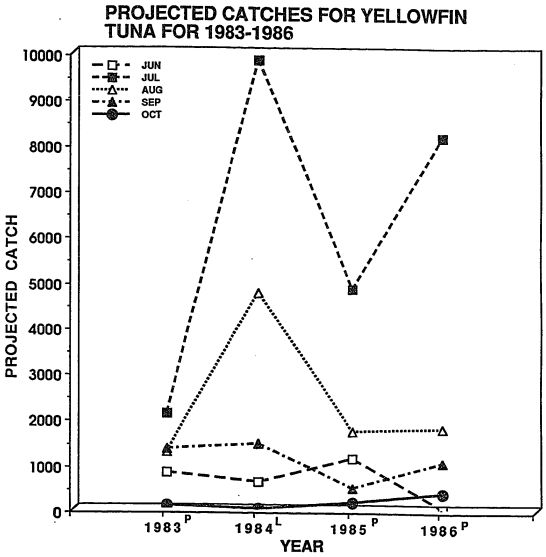
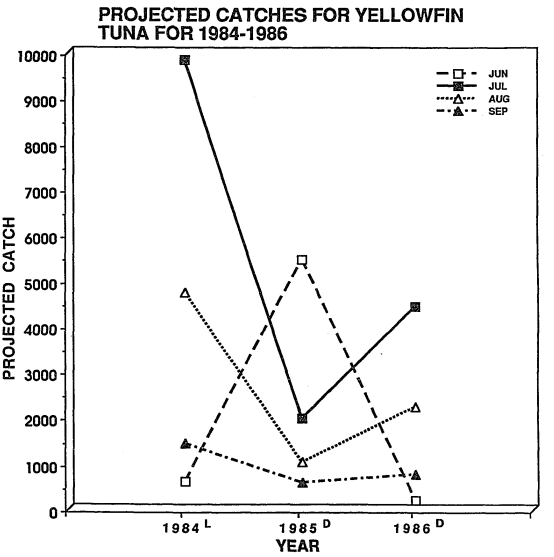


Figure 4. Projected catches of yellowfin tuna for 1984 (L), 1985 (D) and 1986 (D) seasons.



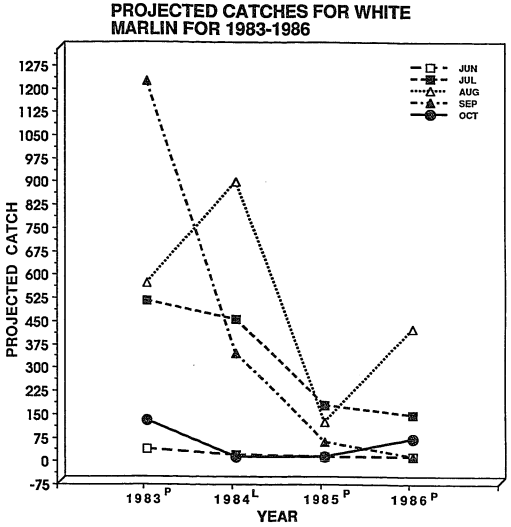


Figure 5. Projected catches of white marlin for 1983 (P), 1984 (L), 1985 (P) and 1986 (P) seasons.

Figure 6. Projected catches of white marlin for 1984 (L), 1985 (D) and 1986 (D) seasons.

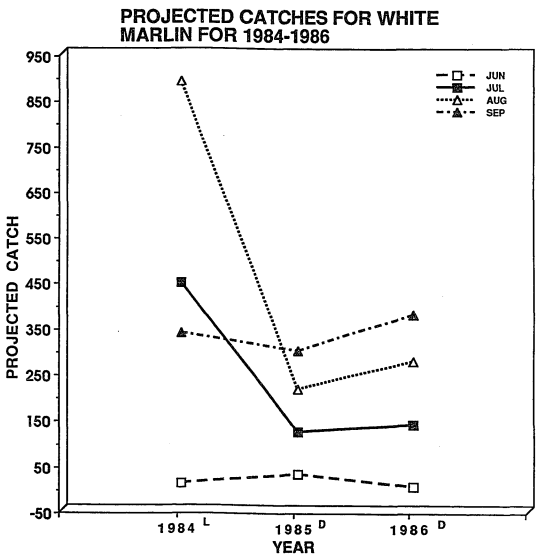


Figure 7. Projected catches of blue marlin for 1983 (P), 1984 (L), 1985 (P) and 1986 (P) seasons.

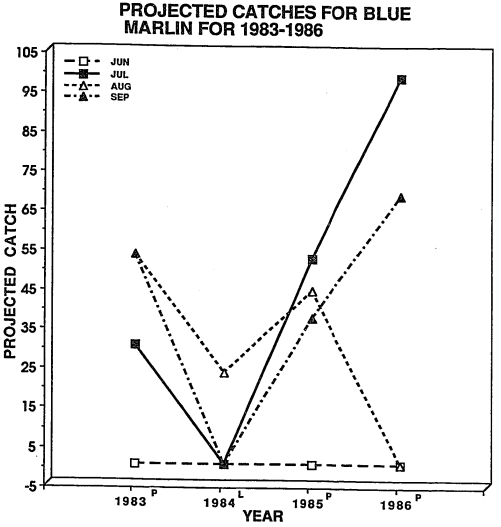


Figure 8. Projected catches of blue marlin for 1984 (L), 1985 (D) and 1986 (D) seasons.

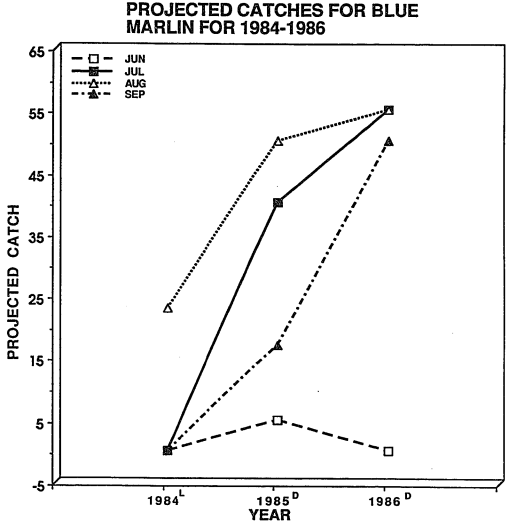


Table 1. Monthly actual and projected catches of key species for 1983 and 1986 season. Monthly releases of white and blue marlin. P = Telephone, D = dockside.

Bluefin Tuna

	1983(P)	1986(P)	1986(D)
June			
Actual	410	87	983
Projected	5304	3080	7534
July			
Actual	64	57	379
Projected	620	1869	1924
August			
Actual	7	0	0
Projected	123	0	0
Total			
Actual	481	144	1362
Projected	6047	4949	9458
Releases	-	1	5

Yellowfin Tuna

	1983(P)	1986(P)	1986(D)
June			
Actual	61	0	23
Projected	789	0	177
July			
Actual	213	243	867
Projected	2073	8132	4412
August			
Actual	61	51	203
Projected	1246	1753	2217
September			
Actual	34	34	43
Projected	1300	1013	740
October			
Actual	2	2	-
Projected	59	348	-
Total			
Actual	371	372	1136
Projected	5467	11246	7546
Releases	-	0	14

Table 1. Continued.

White Marlin

	1983(P)	1986(P)	1986(D)
June			
Actual	2	0	0
Projected	26	0	0
Releases	0	0	0
July			
Actual	52	4	25
Projected	504	132	136
Releases	40	3	22
August			
Actual	31	12	27
Projected	561	413	273
Releases	26	12	24
September			
Actual	45	0	22
Projected	1210	0	374
Releases	39	0	18
October			
Actual	4	0	-
Projected	117	0	-
Releases	4	0	-
Total			
Actual	134	16	74
Projected	2418	545	783
Releases	109	15	64

Blue Marlin

	1983(P)	1986(P)	1986(D)
June			
Actual	0	0	0
Projected	0	0	0
Releases	0	0	0
July			
Actual	3	3	11
Projected	30	98	55
Releases	2	2	7
August			
Actual	3	0	5
Projected	53	0	55
Releases	2	0	3

Table 1. Continued.

September			
Actual	2	2	4
Projected	53	68	50
Releases	1	1	2
October			
Actual	0	0	-
Projected	0	0	-
Releases	0	0	-
Total			
Actual	8	5	20
Projected	136	166	160
Releases	5	3	12

Dolphin

	1983(P)	1986(P)	1986(D)
June			
Actual	38	1	31
Projected	492	35	239
July			
Actual	80	355	377
Projected	774	4935	1914
August			
Actual	59	135	166
Projected	1142	4761	1813
September			
Actual	68	52	90
Projected	1829	1756	1550
October			
Actual	4	2	-
Projected	117	29	-
Total			
Actual	249	545	664
Projected	4354	11516	5516
Releases	-	0	2

Table 2. Annual actual catches of other pelagic fishes for 1983 and 1986 seasons. Catches were combined for dockside and telephone surveys for 1986 season.

	Actual Catches	
	1983	1986
Albacore tuna	8	3
Atlantic bonito	45	107
Barracuda	*	9
Blackfin tuna	0	0
Bluefish	*	830
Bigeye tuna	0	1
False albacore	115	285
King mackerel	64	100
Mako shark	2	7
Sailfish	0	2
Skipjack tuna	88	940
Wahoo	66	27

*Not recorded for that year

Table 3. Number of marlin/tuna trips to key areas for 1983-1986 fishing seasons. Trips only include those trips were boats fished only one area.

	NUMBER OF TRIPS					
Area	1983	1984	1985		1986	
	P	L	D	P	D	P
Cigar	15	27	254	93	131	49
Fingers	1				29	19
Fish Hook			14	15	31	
Horseshoe			31		18	
Hot Dog		68	60	21	84	14
Lumps, SE Lumps		44	38		21	
Norfolk Canyon		69	234	72	134	36
20 Fathom Finger		20	73	15	31	
21 Mile Hill			159	16	135	17
26 Mile Hill	194	37	24	7	40	8
1000 Fathom Curve Triangle Wrecks	17					2
Triple Zero					44	7
V-Buoy	9					
Washington Canyon					21	4
Fingers, Hot Dog	1					

Table 4. Monthly mean catch/boat hour for key species landed for Virginia-based marlin/tuna trips for 1983-1986 fishing seasons and monthly mean catch/boat trip for 1983 and 1986 fishing seasons. Standard deviation in parenthesis.

Bluefin Tuna

	1983(P)	1984(L)	1985(P)	1985(D)	1986(P)	1986(D)
June						
Mean catch/boat hour	0.53(0.63)	0.90(0.93)	0.17(0.31)	0.36(0.51)	0.47(0.65)	0.70(0.81)
Mean catch/boat trip	3.28(3.79)	2.35(2.96)	3.92(4.21)			
July						
Mean catch/boat hour	0.05(0.15)	0.35(0.58)	0.06(0.19)	0.10(0.31)	0.11(0.30)	0.18(0.40)
Mean catch/boat trip	0.31(0.82)				0.55(1.46)	0.95(2.05)
August						
Mean catch/boat hour	0.02(0.13)	0.05(0.21)	0.004(0.03)	0	0	0
Mean catch/boat trip	0.12(0.79)				0	0

Yellowfin Tuna

	1983(P)	1984(L)	1985(P)	1985(D)	1986(P)	1986(D)
June						
Mean catch/boat hour	0.08(0.34)	0.10(0.36)	0.16(0.35)	0.06(0.25)	0	0.02(0.11)
Mean catch/boat trip	0.49(2.01)				0	0.09(0.62)
July						
Mean catch/boat hour	0.17(0.35)	0.85(1.30)	0.24(0.53)	0.19(0.46)	0.38(0.48)	0.39(0.87)
Mean catch/boat trip	1.04(2.26)				2.41(3.04)	2.17(3.66)

Table 4. Continued.

August						
Mean catch/boat hour	0.19(0.25)	0.51(1.16)	0.23(0.32)	0.12(0.21)	0.20(0.29)	0.22(0.38)
Mean catch/boat trip	1.20(1.63)				1.31(1.79)	1.37(2.38)
September						
Mean catch/boat hour	0.13(0.19)	0.23(0.34)	0.18(0.34)	0.11(0.18)	0.20(0.29)	0.11(0.25)
Mean catch/boat trip	0.87(1.24)				1.20(1.78)	0.63(1.48)
October						
Mean catch/boat hour	0.04(0.13)	-	0.30(0.56)	-	2.40(1.70)	-
Mean catch/boat trip	0.22(0.67)	-	0	12.00(8.49)	-	

White Marlin

	1983(P)	1984(L)	1985(P)	1985(D)	1986(P)	1986(D)
June						
Mean catch/boat hour	0.002(0.02)	0.001(0.01)	0	0.003(0.03)	0	0
Mean catch/boat trip	0.02 (0.13)				0	0
July						
Mean catch/boat hour	0.04(0.09)	0.03(0.10)	0.02(0.07)	0.01(0.05)	0.01(0.03)	0.01(0.05)
Mean catch/boat trip	0.25(0.57)				0.04(0.19)	0.07(0.30)
August						
Mean catch/boat hour	0.08(0.14)	0.07(0.12)	0.00*	0.02(0.06)	0.05(0.11)	0.09(0.01)
Mean catch/boat trip	0.54(0.90)				0.31(0.66)	0.17(0.54)
September						
Mean catch/boat hour	0.17(0.23)	0.04(0.07)	0.02(0.07)	0.05(0.12)	0	0.11(0.01)
Mean catch/boat trip	1.15(1.68)				0	0.32(0.61)
October						
Mean catch/boat hour	0.06(0.17)	-				
Mean catch/boat trip	0.44(1.33)	-	-			

*Negligible value

Table 4. Continued.

Blue Marlin

	1983(P)	1984(L)	1985(P)	1985(D)	1986(P)	1986(D)
June						
Mean catch/boat hour	0	0	0	0.00*	0	0
Mean catch/boat trip	0			0.003(0.05)	0	0
July						
Mean catch/boat hour	0.00*(0.02)	0	0.00*(0.03)	0.00*(0.03)	0.01(0.03)	0.00*(0.03)
Mean catch/boat trip	0.01(0.12)				0.03(0.17)	0.03(0.16)
August						
Mean catch/boat hour	0.01(0.03)	0.00*(0.01)	0.00*	0.01(0.03)	0	0.01(0.03)
Mean catch/boat trip	0.05(0.22)				0	0.03(0.16)
September						
Mean catch/boat hour	0.01(0.04)	0	0.01(0.05)	0.00*(0.02)	0.01(0.05)	0.01(0.03)
Mean catch/boat trip	0.05(0.22)	0			0.08(0.28)	0.04(0.21)

*Negligible value

Dolphin

	1983(P)	1984(L)	1985(P)	1985(D)	1986(P)	1986(D)
June						
Mean catch/boat hour	0.05(0.52)	0.01(0.05)	0.15(0.41)	0.03(0.38)	0.004(0.02)	0.02(0.07)
Mean catch/boat trip	0.30(3.14)				0.03(0.16)	0.12(0.49)
July						
Mean catch/boat hour	0.06(0.18)	0.12(0.27)	0.25(1.08)	0.13(0.54)	0.23(0.62)	0.14(0.61)
Mean catch/boat trip	0.39(1.30)				0.91(3.94)	0.94(4.33)

Table 4. Continued.

August						
Mean catch/boat hour	0.18(0.36)	0.23(0.57)	0.84(1.73)	0.50(1.28)	0.52(1.79)	0.18(0.53)
Mean catch/boat trip	1.10(2.23)				3.55(12.53)	1.12(3.31)
September						
Mean catch/boat hour	0.27(0.75)	0.14(0.31)	0.58(0.99)	1.02(2.16)	0.33(0.57)	0.21(0.63)
Mean catch/boat trip	1.74(4.90)				2.08(3.48)	1.32(4.06)
October						
Mean catch/boat hour	0.06(0.17)	-	0.99(1.52)	-	0.20(0.28)	-
Mean catch/boat trip	0.44(1.33)	-	4.89(8.08)	-	1.00(1.41)	-

Table 5. Mann-Whitney U-test comparing catch/boat trip (CPUE) for dockside interviews for 1985 and 1986 seasons, alpha = 0.05, two-tailed. Sig=significant; n.s.=not significant.

Null Hypothesis	Cases	Z	Significance
1985 Allspecies CPUE =	1137		
1986 Allspecies CPUE	877	6.923	sig
1985 Bluefin CPUE =	757		
1986 Bluefin CPUE	652	4.298	sig
1985 Yellowfin CPUE =	1135		
1986 Yellowfin CPUE	867	3.265	sig
1985 White marlin CPUE =	1046		
1986 White marlin CPUE	869	1.326	n.s.
1985 Dolphin CPUE =	1101		
1986 Dolphin CPUE	868	4.051	sig

Table 6. Mann-Whitney U-test comparing catch/boat hour (CPUE) for dockside interviews for 1985 and 1986 seasons, alpha = 0.05, two-tailed. Sig significant, n.s. not significant.

Null Hypothesis	Cases	Z	Significance
1985 Allspecies CPUE =	1122		
1986 Allspecies CPUE	857	7.276	sig
1985 Bluefin CPUE =	753		
1986 Bluefin CPUE	652	4.430	sig
1985 Yellowfin CPUE =	1118		
1986 Yellowfin CPUE	867	3.042	sig
1985 White marlin CPUE =	1046		
1986 White marlin CPUE	869	1.319	n.s.
1985 Dolphin CPUE =	1082		
1986 Dolphin CPUE	868	3.972	sig

Table 7. Kruskal-Wallis Tests (using chi squared corrected for ties) comparing annual catch/boat trip (CPUE) for telephone (TEL) and dockside (DOC) interview data and logbook (LOG) data for 1983-1986 seasons, alpha=0.05, allspecies=all pelagic species landed. Sig=significant; n.s.=not significant.

NULL HYPOTHESIS	x^2	Significance
1983 TEL Allspecies CPUE=		
1985 TEL Allspecies CPUE=		
1986 TEL Allspecies CPUE	14.217	sig
1983 TEL Bluefin CPUE=		
1985 TEL Bluefin CPUE=		
1986 TEL Bluefin CPUE	9.847	sig
1983 TEL Yellowfin CPUE=		
1985 TEL Yellowfin CPUE=		
1986 TEL Yellowfin CPUE	18.686	sig
1983 TEL White marlin CPUE=		
1985 TEL White marlin CPUE=		
1986 TEL White marlin CPUE	32.168	sig
1983 TEL Dolphin CPUE=		
1985 TEL Dolphin CPUE=		
1986 TEL Dolphin CPUE	35.984	sig
1983 TEL Allspecies CPUE=		
1984 LOG Allspecies CPUE=		
1985 TEL Allspecies CPUE=		
1986 TEL Allspecies CPUE	193.857	sig
1983 TEL Bluefin CPUE=		
1984 LOG Bluefin CPUE=		
1985 TEL Bluefin CPUE=		
1986 TEL Bluefin CPUE	45.880	sig
1983 TEL Yellowfin CPUE=		
1984 LOG Yellowfin CPUE=		
1985 TEL Yellowfin CPUE=		
1986 TEL Yellowfin CPUE	29.325	sig
1983 TEL White marlin CPUE=		
1984 LOG White marlin CPUE=		
1985 TEL White marlin CPUE=		
1986 TEL White marlin CPUE	32.008	sig

Table 7. Continued.

1983	TEL	Dolphin CPUE=		
1984	LOG	Dolphin CPUE=		
1985	TEL	Dolphin CPUE=		
1986	TEL	Dolphin CPUE	37.058	sig
1983	TEL	Allspecies CPUE=		
1984	LOG	Allspecies CPUE=		
1985	DOC	Allspecies CPUE=		
1986	DOC	Allspecies CPUE	238.324	sig
1983	TEL	Bluefin CPUE=		
1984	LOG	Bluefin CPUE=		
1985	DOC	Bluefin CPUE=		
1986	DOC	Bluefin CPUE	45.756	sig
1983	TEL	Yellowfin CPUE=		
1984	LOG	Yellowfin CPUE=		
1985	DOC	Yellowfin CPUE=		
1986	DOC	Yellowfin CPUE	37.447	sig
1983	TEL	White marlin CPUE=		
1984	LOG	White marlin CPUE=		
1985	DOC	White marlin CPUE=		
1986	DOC	White marlin CPUE	62.326	sig
1983	TEL	Dolphin CPUE=		
1984	LOG	Dolphin CPUE=		
1985	DOC	Dolphin CPUE=		
1986	DOC	Dolphin CPUE	39.668	sig

Table 8. Kruskal-Wallis Tests (using chi squared corrected for ties) comparing ANNUAL CATCH/BOAT HOUR (CPUE) for telephone (TEL) and dockside (DOC) interview data and logbook (LOG) data for 1983-1986 seasons, alpha=0.05, allspecies=all pelagic species landed. Sig=significant difference; n.s.=not significant.

NULL HYPOTHESIS	x^2	Significance
1983 TEL Allspecies CPUE=		
1985 TEL Allspecies CPUE=		
1986 TEL Allspecies CPUE	14.659	sig
1983 TEL Bluefin CPUE=		
1985 TEL Bluefin CPUE=		
1986 TEL Bluefin CPUE	9.057	sig
1983 TEL Yellowfin CPUE=		
1985 TEL Yellowfin CPUE=		
1986 TEL Yellowfin CPUE	17.737	sig
1983 TEL White marlin CPUE=		
1985 TEL White marlin CPUE=		
1986 TEL White marlin CPUE	32.815	sig
1983 TEL Dolphin CPUE=		
1985 TEL Dolphin CPUE=		
1986 TEL Dolphin CPUE	36.247	sig
1983 TEL Allspecies CPUE=		
1984 LOG Allspecies CPUE=		
1985 TEL Allspecies CPUE=		
1986 TEL Allspecies CPUE	184.044	sig
1983 TEL Bluefin CPUE=		
1984 LOG Bluefin CPUE=		
1985 TEL Bluefin CPUE=		
1986 TEL Bluefin CPUE	65.000	sig
1983 TEL Yellowfin CPUE=		
1984 LOG Yellowfin CPUE=		
1985 TEL Yellowfin CPUE=		
1986 TEL Yellowfin CPUE	28.817	sig
1983 TEL White marlin CPUE=		
1984 LOG White marlin CPUE=		
1985 TEL White marlin CPUE=		
1986 TEL White marlin CPUE	32.775	sig

Table 8. Continued.

1983	TEL Dolphin CPUE=		
1984	LOG Dolphin CPUE=		
1985	TEL Dolphin CPUE=		
1986	TEL Dolphin CPUE	37.248	sig
1983	TEL Allspecies CPUE=		
1984	LOG Allspecies CPUE=		
1985	DOC Allspecies CPUE=		
1986	DOC Allspecies CPUE	230.102	sig
1983	TEL Bluefin CPUE=		
1984	LOG Bluefin CPUE=		
1985	DOC Bluefin CPUE=		
1986	DOC Bluefin CPUE	46.983	sig
1983	TEL Yellowfin CPUE=		
1984	LOG Yellowfin CPUE=		
1985	DOC Yellowfin CPUE=		
1986	DOC Yellowfin CPUE	35.186	sig
1983	TEL White marlin CPUE=		
1984	LOG White marlin CPUE=		
1985	DOC White marlin CPUE=		
1986	DOC White marlin CPUE	62.326	sig
1983	TEL Dolphin CPUE=		
1984	LOG Dolphin CPUE=		
1985	DOC Dolphin CPUE=		
1986	DOC Dolphin CPUE	38.982	sig

Table 9. Actual catch per boat trip by month for all pelagic species landed for 1983-1986 seasons. All pelagic species include: yellowfin, bluefin, bigeye, albacore, skipjack and blackfin tuna; false albacore; Atlantic bonito; white and blue marlin; sailfish; dolphin; barricuda; king mackerel; bluefish; wahoo; and mako, hammerhead and blue sharks. Standard deviations in parentheses.

	All Pelagic Species					
	1983(P)	1984(L)	1985(P)	1985(D)	1986(P)	1986(D)
June						
Mean catch/boat trip	5.11(6.46)	11.46(9.06)	6.49(9.89)	5.69(6.86)	6.53(5.86)	8.60(7.17)
No. fish caught	639	1582	606	2045	235	2125
No. trips taken	125	138	92	363	36	247
July						
Mean catch/boat trip	2.64(3.47)	10.22(7.90)	2.98(5.01)	3.94(6.87)	5.43(6.26)	5.89(7.89)
No. fish caught	541	1277	316	1605	538	2374
No. trips taken	203	125	105	411	99	403
August						
Mean catch/boat trip	3.58(3.53)	7.73(8.67)	4.77(7.09)	4.78(8.44)	5.54(12.28)	4.66(7.10)
No. fish caught	193	611	296	1141	216	718
No. trips taken	55	79	62	241	39	154
September						
Mean catch/boat trip	5.44(7.87)	12.62(18.63)	7.05(8.81)	8.07(14.08)	4.08(3.79)	2.31(4.29)
No. fish caught	212	328	267	1077	102	166
No. trips taken	39	26	39	121	25	72
October						
Mean catch/boat trip	8.44(9.00)	--	15.00(11.58)	--	13.50(6.36)	--
No. fish caught	76	--	79	--	27	
No. trips taken	9	1	4	--	2	--
Total Season	1449	3798	1564	5868	1118	5383

Table 10. Actual catches of key species and all pelagic species by month for areas fished during 1983-1986 seasons. For 1985 and 1986, actual catches reported in dockside and telephone interviews were combined. These tables only reflect those catches of key species that could be specifically attributed to a particular fishing ground and only those areas supporting large catches are reported.

BLUEFIN TUNA

Hot Dog

	1983	1984	1985	1986
June				
Actual Catch	-	209	98	331
Number of trips	-	32	60	72
July				
Actual Catch	-	127	17	21
Number of trips	-	31	21	23
August				
Actual Catch	-	0	0	0
Number of trips	-	2	0	0
Total Caught	-	336	115	352
Total Trips	-	65	81	95

26 Mile Hill

	1983	1984	1985	1986
June				
Actual Catch	24	52	53	158
Number of trips	110	11	30	27
July				
Actual Catch	56	88	0	49
Number of trips	74	16	1	19
August				
Actual Catch	7	9	0	0
Number of trips	5	9	0	0
Total Caught	87	149	53	207
Total Trips	189	36	31	46

Table 10. Continued.

21 Mile Hill

	1983	1984	1985	1986
June				
Actual Catch	-	-	229	274
Number of trips	-	-	86	56
July				
Actual Catch	-	-	184	262
Number of trips	-	-	81	86
August				
Actual Catch	-	-	0	0
Number of trips	-	-	6	0
Total Caught	-	-	413	536
Total Trips	-	-	173	142

Lumps, SE Lumps

	1983	1984	1985	1986
June				
Actual Catch	-	244	139	59
Number of trips	-	42	35	15
July				
Actual Catch	-	5	0	0
Number of trips	-	2	3	7
August				
Actual Catch	-	0	0	0
Number of trips	-	0	0	0
Total Caught	-	249	139	59
Total Trips	-	44	38	21

Fish Hook

	1983	1984	1985	1986
June				
Actual Catch	-	-	35	23
Number of trips	-	-	22	18
July				
Actual Catch	-	-	2	1
Number of trips	-	-	7	4
August				
Actual Catch	-	-	0	0
Number of trips	-	-	0	9
Total Caught	-	-	37	24
Total Trips	-	-	29	31

Table 10. Continued.

20 Fathom Finger

	1983	1984	1985	1986
June				
Actual Catch	-	0	5	0
Number of trips	-	0	6	2
July				
Actual Catch	-	7	5	0
Number of trips	-	15	47	28
August				
Actual Catch	-	10	0	0
Number of trips	-	5	29	1
Total Caught	-	17	10	0
Total Trips	-	20	82	31

YELLOWFIN TUNA

Cigar

	1983	1984	1985	1986
May				
Actual Catch	0	17	7	0
Number of trips	0	4	2	6
June				
Actual Catch	17	21	87	5
Number of trips	9	4	45	2
July				
Actual Catch	2	26	169	437
Number of trips	6	5	109	111
August				
Actual Catch	0	1	108	118
Number of trips	0	10	107	49
September				
Actual Catch	0	10	65	13
Number of trips	0	6	80	10
Total Caught	19	75	436	444
Total Trips	15	29	343	137

Table 10. Continued.

Hot Dog

	1983	1984	1985	1986
June				
Actual Catch	-	32	8	-
Number of trips	-	32	60	-
July				
Actual Catch	-	100	2	-
Number of trips	-	31	21	-
August				
Actual Catch	-	6	0	-
Number of trips	-	2	0	-
September				
Actual Catch	-	5	0	-
Number of trips	-	2	0	-
Total Caught	-	143	10	-
Total Trips	-	68	81	-

Norfolk Canyon

	1983	1984	1985	1986
June				
Actual Catch	-	18	35	6
Number of trips	-	2	10	1
July				
Actual Catch	-	84	209	211
Number of trips	-	25	127	77
August				
Actual Catch	-	25	74	55
Number of trips	-	33	121	54
September				
Actual Catch	-	12	34	10
Number of trips	-	9	47	19
Total Caught	-	139	352	282
Total Trips	-	69	305	151

20 Fathom Finger

	1983	1984	1985	1986
June				
Actual Catch	-	0	24	8
Number of trips	-	0	6	2
July				
Actual Catch	-	183	101	64
Number of trips	-	15	47	28

Table 10. Continued.

August				
Actual Catch	-	54	41	0
Number of trips	-	5	28	1
September				
Actual Catch	-	0	1	0
Number of trips	-	0	7	0
Total Caught	-	237	167	72
Total Trips	-	20	88	31

WHITE MARLIN

Cigar

	1983	1984	1985	1986
June				
Actual Catch	0	0	0	0
Number of trips	9	4	45	12
July				
Actual Catch	1	2	9	13
Number of trips	6	5	109	111
August				
Actual Catch	0	4	12	9
Number of trips	0	10	108	49
September				
Actual Catch	0	8	27	3
Number of trips	0	6	80	20
Total Caught	1	14	48	25
Total Trips	15	25	342	192

Norfolk Canyon

	1983	1984	1985	1986
June				
Actual Catch	-	1	3	0
Number of trips	-	2	10	8
July				
Actual Catch	-	15	20	3
Number of trips	-	24	127	89
August				
Actual Catch	-	34	23	16
Number of trips	-	31	121	54
September				
Actual Catch	-	5	10	2
Number of trips	-	8	47	19
Total Caught	-	55	56	21
Total Trips	-	25	305	170

Table 10. Continued.

BLUE MARLIN

Cigar

	1983	1984	1985	1986
June				
Actual Catch	-	0	0	0
Number of trips	-	4	45	12
July				
Actual Catch	-	0	0	11
Number of trips	-	5	109	141
August				
Actual Catch	-	1	1	0
Number of trips	-	10	108	49
September				
Actual Catch	-	0	3	0
Number of trips	-	6	80	20
Total Caught	-	1	4	11
Total Trips	-	25	342	192

Norfolk Canyon

	1983	1984	1985	1986
June				
Actual Catch	-	0	1	0
Number of trips	-	2	10	8
July				
Actual Catch	-	2	8	0
Number of trips	-	24	127	89
August				
Actual Catch	-	0	5	4
Number of trips	-	31	121	54
September				
Actual Catch	-	0	2	2
Number of trips	-	8	47	19
Total Caught	-	2	16	6
Total Trips	-	25	305	170

CHAPTER 5

SOCIOECONOMIC CHARACTERISTICS OF VIRGINIA'S PELAGIC RECREATIONAL FISHERY FOR 1983-1985 SEASONS

INTRODUCTION

Marlin and tuna fishing can be an expensive pasttime. Most offshore fishermen own boats at least 20 feet (9.3 m) in length and have sophisticated electronic navigation equipment on board. High quality rods and reels are required to withstand the rigors of offshore fishing. Fishing lures and other tackle, as well as ice and bait, add to the expense. Traveling from 20 to over 80 nautical miles off the coasts of Virginia, Maryland and North Carolina result in substantial fuel expenses. These are just a few of the costs; there are many others. Virginia's recreational marlin/tuna fleet has been estimated at 455 boats in 1983 (Figley 1984), 666 boats in 1984 (Chap 2) and 774 boats in 1985 (Chap 3). The pelagic recreational fishery also consists of a growing charter boat componet with 40, 53 and 68 charter vessels identified in 1983-1985, respectively (Figley 1984; Chap 2; Chap 3). This fishery contributes substantially to local, state and regional economies.

The main objective of this portion of the study was to determine expenditures of Virginia's offshore recreational fishery for 1983-1985 seasons.

METHODS

At the end of the 1983, 1984 and 1985 pelagic recreational fishing seasons, a socioeconomic questionnaire (Appendix I) was mailed to all active boat captains/owners who had participated in the study for that year. The 1983 study was conducted by Figley (1984) and the same questionnaire with a few more questions inserted was used in 1983-1985. If a captain owned more than one vessel, he was given a form to fill out for each vessel. After one month, a post card was mailed to each captain reminding them to return their forms. All responses to the socioeconomic survey were anonymous, so no follow-up survey of non-responding fishermen was conducted. Very few questionnaires were returned by the postal service as undeliverable.

Using economic questionnaire responses, mean expenditures per boat trip and per boat were calculated for various categories. These values were multiplied by the estimated number of boats in the fleet and/or the estimated number of trips made during the season to obtain projections of the fishery's overall expenses. Mean charter fees were multiplied by the estimated number of charter trips taken to derive an overall value for that particular segment of the fishery. Total annual economic expenditures for this fishery were calculated by summing estimated total values for each of the categories surveyed.

The Cape Henry Billfish Club sponsors an annual three day invitational marlin tournament, the "Virginia Beach Marlin Tournament", held at Rudee Inlet during Labor Day weekend. This tournament customarily attracts larger fishing vessels and is the only pelagic tournament held for three days in Virginia. After observing this tournament in 1983, researchers decided to collect fishing-related expenditures from this tournament in 1984 as part of a study of Rudee Inlet-based fishing expenditures (Lucy et al. in prep.). Funding was provided by the Cape Henry Billfish Club. Upon the recommendation of tournament officials, tournament observers on each boat were given a packet of three interview forms and were asked to fill out one for each day of the tournament. Observers interviewed boat captains about their daily trip activity and expenditures (Appendix I). Completed packets were returned to the researchers on the last day of the tournament.

RESULTS AND DISCUSSION

Fleet Characteristics

To determine the extent of annual expenditures for Virginia's pelagic recreational fishery, socioeconomic questionnaires were mailed to 264 boat captains in 1983, 374 boat captains in 1984 and 453 boat captains in 1985, resulting in response rates of 45.8%, 25.7% and 43.9%, respectively (Table 1). The poor response rate reported for the 1984 season when the logbook collection method was used may be due to the lack of personal contact with the boat captains. As a result, the information obtained in 1984 is less reliable than for the 1983 and 1985 seasons when telephone and/or dockside methods were used. At least 95% of the socioeconomic survey forms returned for 1983-1985 seasons were usable in this study (Table 1). Wegge et al. (1986) used mail questionnaires to assess the 1983 economic value of marine recreational fishing in Southern California and reported a 47.4% response rate. Brown and Ofiera (1987) also used mail questionnaires to determine the economic value of New Jersey's pelagic recreational fishery in 1986 and reported a 34.8% response rate. These response rates are similar to this study, excluding the 1984 season.

During 1983-1985, average vessel use for marlin/tuna fishing was approximately 50% of the time (Table 2) and ranged from one to 100%. A mean of approximately 12 trips per year

for 1983 and 1984 seasons and 13 trips per year for the 1985 season with a range of one to 80 trips per year were made by the Virginia fleet (Table 2). Herrick (1984) reported that Southern California billfish owners/operators averaged 16.0 billfish trips for the 1982 season. For this study, charter vessels increased their mean rate of marlin/tuna charter trips per boat from 15.2 in 1983 to 17.0 in 1984 to 26.5 in 1985 (Table 2) and the charter fleet has grown from 40 boats in 1983 to 68 boats in 1985. These higher trip rates and greater size of the charter fleet may account for the increase in the number of trips.

Main homeports for Virginia's marlin/tuna fishery are Rudee Inlet, Lynnhaven, Wachapreague and Little Creek. Some minor Virginia homeports are Quinby, Oyster, Poquoson and other areas in the Chesapeake Bay. Oregon Inlet and Hatteras in North Carolina and Ocean City, Maryland are some of the out-of-state ports used by the Virginia-based fleet. No homeport information was obtained in 1983. Rudee Inlet in Virginia Beach has consistently been the major homeport of this fleet and Lynnhaven Inlet in Virginia Beach was second in 1984 and 1985 and Wachapreague ranked third (Table 2). Telephone survey results (Chap 2 and Chap 3) also support this data. Virginia's charter fleet is primarily located at Rudee Inlet in Virginia Beach and Wachapreague on the Eastern Shore. A few charter boats work out of Quinby, Oyster and Chincoteague on the Eastern Shore and Lynnhaven Inlet in Virginia Beach.

In 1985, 89.2% of the respondents resided in Virginia and Maryland was second with 7.7%. Other residential states were New Jersey, North Carolina and Delaware (Table 3). This question was not asked in previous years.

Demographic information was only obtained in 1983 (Table 4). The mean age of boat captains was 41.7 years with a range of 23-73 years. These captains had saltwater fished on average 21.0 years with a range of 2-60 years and marlin/tuna fished on aveage 10.7 years with a range of 1-40 years. Annual incomes ranged from $10,000-19,999 to the $80,000 and over category. Over 29% of the boat captains had annual incomes of $80,000 or more. Ranked second were the $30,000-39,999 and $40,000 to 49,999 income ranges, with 16% of boat captains having either of these incomes. This question was omitted from subsequent questionnaires due to the negative criticism obtained in 1983. This information is not essential for characterizing expenditures of the fishery and better and more responses to the questionnaire would probably be obtained by not asking this question. Herrick (1984) reported that Southern California billfish boat owners/operators had a mean age of 46.5 years and averaged 16.4 years of billfishing. His data support the results obtained in this study.

In 1983, approximately 36% of the respondants also fished in other states. These captains reported fishing primarily from North Carolina ports and rarely from Maryland, Florida and New Jersey ports (Table 5). Telephone surveys also indicate that Virginia's marlin/tuna fleet frequently fishes

from North Carolina and occasionally from Maryland ports (Chap 4). This data indicates the regional character of the Virginia fishery.

For 1983-1985, the top boat make for the marlin/tuna fleet was the Seacraft. The second and third boat makes most often purchased by these recreational fishermen were the Bertram, Grady-White and Custom built. On average, these boats were built in 1976 for the 1983 season, 1977 for the 1984 season and 1978 for the 1985 season. Mean purchases of these vessels occurred in 1979, 1981 and 1982 for the 1983-1985 seasons, respectively (Table 6).

Fishing vessels ranged in length from 17 to 60 feet (5.2 to 18.3 m) with mean lengths of 30.2 feet (9.2 m) in 1983, 27.0 feet (8.2 m) in 1984 and 28.0 feet (8.5 m) in 1985. For the 1982 Southern California billfish fleet, boats averaged 25 feet (7.6 m) in length (Herrick 1984). Approximately 20% of the boats had diesel engines while the remainder were powered by gasoline engines (Table 6).

High quality tackle, including rods and reels are required for marlin/tuna fishing. In 1983 and 1984, Virginia anglers rods and reels averaged 3.7 and 3.3 years of age, respectively (Table 7).

Expenditures

In 1985, the Virginia fleet spent on average $223.90 (SD123.40) for diesel fuel per trip and $100.10 (SD 45.70) for gasoline per trip.

Marlin/tuna boat captains/owners were asked to determine annual expenditures associated with owning and operating their boats. These fishermen spent over $29,500,000 in initial purchase price of their boats and all outfittings. Annual initial boat preparation ranged from approximately $1,700,000 in 1983 to $3,000,000 in 1985. Slip rental and winter storage fees are expenses incurred by owners of non-trailerable boats. These costs varied from approximately $400,000 in 1983 to $550,000 in 1985. Most boat owners purchase boat insurance and annual expenditures were approximately $350,000 in 1983, $430,000 in 1984 and $650,000 in 1985 (Table 7).

The original value of all marlin/tuna tackle, such as rods; reels; gaffs; lures; hooks; and etc. was assessed by these fishermen for 1983-1985 fishing season. The projected value of this gear has increased from $1,644,643 in 1983 to $2,718,598 in 1985 (Table 7).

For a typical marlin/tuna trip, anglers estimated their expenses for ice, natural bait, lightsticks and other perishable items. Average expenditures for these items were $35, $38 and $43 per trip for the 1983-1985 seasons, respectively. For the 1983-1985 seasons, estimated annual expenditures were $208,915, in 1983, $251,959 in 1984 and $244,290 in 1985 (Table 7). Anglers spent a mean of $165.20 in 1983, $144.00 in 1984 and $131.5 on fuel per boat trip. Projected annual totals for fuel expenditures were $983,270, $957,312 and $755,862 for 1983-1985 seasons, respectively (Table 7). The decline in fuel expenses in 1985 does not

indicate that anglers bought less fuel but that the price of fuel decreased from 1983 to 1985 season.

For the 1983, 1984 and 1985 fishing seasons, total estimated mean marlin/tuna trip costs included fuel, bait, ice and other perishable items. These expenditures were obtained by adding projected annual ice, bait and tackle and fuel expense categories and dividing by projected number of trips (Table 7). Total projectd mean trip costs for these items were $200.30 in 1983, $181.90 in 1984 and $174.00 in 1985. These figures do not include the cost of replacing lost or damaged gear, parking fees, tolls, gasoline for automobiles and lodging. These expenditures were addressed in subsequent studies of this fishery.

Mean pelagic fishing trip expenditures for Virginia's boat captains/owners were similar in magnitude to comparable estimates for other pelagic fisheries on the east and west coasts of the United States. Herrick (1984) estimated boat owner/operator mean per trip expenses of approximately $160 for the 1982 striped marlin recreational fishery (Tetrapturus audax), discounting an additional $21 per trip spent for food and beverages. This study did not address costs for food and beverages for a marlin/tuna trip. Brown and Ofiera (1987) analyzed New Jersey's 1986 pelagic big game fishery and calculated estimated mean boat captain/owner expenses of approximately $224 per trip, discounting per trip expenses for food and beverages, fuel for automobiles, parking and tolls, lodging, launch fees, and lost/damaged gear. About half (48%)

of the fishing trips taken by the New Jersey fleet targeted marlin/yellowfin/bigeye tuna which is very similar to Virginia's fishery. Therefore, Virginia's pelagic recreational boat captain/owners per trip expenses of $200.30 in 1983, $181.90 in 1984 and $175.00 in 1985 were very similar to the figures obtained for the above studies.

Total charter fees were calculated for the 1983-1985 fishing seasons. Charter fee totals were the greatest in 1985 with $860,635 spent (Table 7). Charter fees have increased each year and more charter boats have entered the fishery since the 1983 season, therefore the 1985 season should have the greatest value.

Many Virginia fishermen participate in marlin/tuna tournaments during the fishing season. Each year the number of participants fishing in these tournaments and the number of such tournaments has increased (pers. observation). For all years surveyed, anglers spent the greatest amount on tournaments in 1984, with an estimated annual value of $309,956 (Table 7). However, these values may not have really declined in 1985 but may be equal or greater. For the 1984 season, logbooks were used to collect the data and the captains who responded to the survey were probably your tournament fishermen and fewer nontournament fishermen participated that year. Better informatin on marlin/tuna tournament fees must be obtained to reduce the variability in the data. One solution might be to reduce the standard

deviations and improve the estimates by excluding those captains who do not tournament fish from this analysis.

Overall annual expenditures of Virginia's marlin/tuna fishery excluding initial purchase price of boat and all outfittings, original value of all marlin/tuna tackle and charter fees were estimated at $3,883,827 in 1983, $4,057,020 in 1984 and $5,538,191 in 1985. These values are underestimated because they do not include annual estimates for the costs of new or replacement rods, reels, lines, lures, gaffs, and other tackle; fishing club dues; auto fuel expenses; tolls, food and beverages and lodging. These expenditures need to be addressed in future studies. The initial purchase price of boats and their outfittings, as well as the original value of all gear and tackle were not included in yearly expenditures because these expenditures were not solicited on an annual basis. Charter fees were not an expense to boat owner/captains and were also not included.

Annual estimates for initial purchase price of boats and their outfittings and original value of all gear and tackle has increased from $31,160,084 in 1983 to $38,919,975 in 1984 to $46,698,516 in 1985. While many of the boats in this fishery carry these purchase prices along from year to year, the annual increase in value may be attributed to the greater number of boats estimated to comprise the fishery, the entry of new boats to the fishery, inflation and purchase of new or upgraded boats and gear.

During 1983, Figley (1984) conducted an economic study of the mid-Atlantic region from New York to Virginia. Data collection efforts for 1983 were part of this regional study, but I re-analyzed the data and included a larger sample size than used by Figley for the Virginia data set which may explain the slight difference in values obtained by Figley and this study. For the mid-Atlantic region, the following expenditures were incurred: estimated mean costs for fully-outfitted offshore fishing vessels ranged from $69,000 to $117,000; estimated total cost of the 2,500 marlin/tuna boats was $202 million; mean offshore fishing tackle value ranged between $4,000 and $7,000 per boat; and average fuel costs ranged from $170 to $270 per trip (Figley 1984). During 1983, over $40 million was spent annually by recreational marlin/tuna fishermen in the mid-Atlantic region (Figley 1984). However, this calculation includes expenditures that were pro-rated to reflect the percentage of marlin/tuna use by the vessels and age of boats and tackle.

Virginia Beach Marlin Tournament.

Fifty-five boats ranging in length from 26-63 feet (7.9-19.2 m) fished in the 1984 Virginia Beach Marlin Tournament and carried a mean of five anglers per boat. Some boats participating in the tournament were chartered and mean fishing party size does not include any charter captains, mates or observers. Of the 55 tournament boats, 43.6% of them returned the survey forms. Falk et al. (1981) studied the Milford World Championship Weakfish Tournament held in 1981 in

Delaware and used mail questionnaires to assess the economic impact of this tournament and achieved a 75% response rate. In this study, usable expenditure data was only obtained from 29% of the tournament fleet. Mean fishing party expenditures for the three day event were: bait, ice and tackle $242.56 (SD 196.18); groceries, snacks and beverages $219.75 (SD 110.68); boat fuel $992.25 (SD367.78); car fuel $20.13 (SD 14.18); lodging $389.29 (SD 642.16); restaurants $474.69 (SD 461.58) and miscellaneous expenditures $401.67 (SD 366.78). These expenditures were expanded to represent total expenditures for the tournament fleet (Table 8). Boat fuel represented over 36% of total expenditures. Some other major expense categories were restaurants (17.3%), lodging (14.2%) and miscellaneous items (14.7%). The latter category included expenses for slip rental, boat cleaning services, purchase of clothing, etc. and some tournament entry fees. Since exact tournament fees were not known for given fishing parties and such fees appeared to be included in only a few of the returned survey forms, no adjustment was made for the tournament fees in estimating miscellaneous expenditures per fishing party. Projected total expenditures for the three day tournament were estimated at $150,664 (Table 8). Ditton and Loomis (1985) reported total direct purchases by offshore anglers fishing in the 1983 Texas International Fishing Tournament held at South Padre Island, Texas of $408,685 excluding registration fees and $431,955 with registration fees. The Texas tournament consisted of a much larger sample

size (N=166) than the Virginia tournament which may account for Texas anglers spending more than Virginia participants in the Virginia Beach Marlin Tournament.

Residential information was collected from 24 of the tournament boats. Virginia Beach residents comprised 45% of tournament fishermen. Other cities and counties in the Greater Hampton Roads area accounted for 26.6% of the fishermen and northern Virginia anglers made up 5.0%. North Carolina and New Jersey residents contributed 10.0% and 5.8%, respectively. Overall, Virginia anglers represented 79.2% of tournament participants with the remaining anglers from out-of-state.

The Virginia Beach Marlin Tournament was characterized by per angler-day expenditures of $182.67. This daily rate of tournament spending is similar to that documented for anglers participating in the 1979 Arthur Smith King Mackerel Tournament held in Little River, North Carolina, the 1983 Texas International Fishing Tournament held in South Padre Island and the 1984 Deep Sea Roundup held in Port Aransas, Texas. For these events, mean fishermen expenditures of $170-$201 per day were calculated (Ditton and Arneson 1986; Ditton and Loomis 1985).

CONCLUSIONS

Virginia's pelagic recreational marlin/tuna fishery is an important contributor to Virginia's as well as other states' economies. The nature of the fishery, especially distances of 20 to 80 nautical miles which must be travelled to reach the offshore fishing grounds and the size of the fleet result in significant expenses associated with this pasttime. Through this intensive three year study utilizing logbooks, telephone and dockside surveys and mail questionnaires, I have characterized the fishery and derived estimated boat owner expenditures associated with marlin/tuna fishing trips departing from Virginia ports. In addition, expenditures associated with owning and operating a marlin/tuna vessel have been developed.

At this time, economic data is not collected in a manner that permits the economic impact to be attributed to the states in which the expenses were incurred. This data needs to be collected annually and in more depth so that information can be made available to fisheries managers to justify the recreational users' share of the tuna and billfish fisheries. In addition, the data must be made available to Virginia state/local government officials so they can determine the overall importance of the fishery and the ways in which its growing needs can be better met in the near future.

Table 1. Number of socioeconomic questionnaires mailed, number returned and number considered useable.

Year	Number forms sent	Number returned	Percent returned	Number useable	Percent useable
1983	264	121	45.8%	115	95.0%
1984	374	96	25.7%	95	99.0%
1985	453	199	43.9%	194	97.5%

Table 2. Annual boat use and homeports for marlin/tuna (M/T) trips for 1983-1985 seasons.

Percent time boat used for M/T trips	1983	1984	1985
Mean	56.5%	57.2%	49.4%
Standard deviation	30.9%	3.5%	27.7%
No. M/T trips			
Mean/boat/yr	11.9	12.1	13.5
Standard deviation	8.7	1.3	13.1
Total*	5,414	8,059	10,449
No. M/T charter trips			
Mean/boat/yr	15.2	17.0	26.5
Standard deviation	11.9	19.4	23.6
Total**	608	901	1,802
Primary homeport			
1.	_____	Rudee	Rudee
2.	_____	Lynnhaven	Lynnhaven
3.	_____	Oregon Inlet	Wachapreague
4.	_____	Wachapreague Little Creek	_____
5.		Ocean City	

* Total=(mean no. trips)(estimated fleet size)
** Total=(mean no. trips)(no. charter boats)

Table 3. Residential states of offshore recreational fishermen participating in the 1985 socioeconomic survey.

STATE	1985
Virginia	173 (89.2%)
Maryland	15 (7.7%)
New Jersey	1 (0.5%)
North Carolina	2 (1.0%)
Delaware	1 (0.5%)
Unknown	2 (1.0%)

Table 4. Demography of recreational marlin/tuna fishermen from 1983 socioeconomic responses.

Mean Age of Boat Captains: 41.7 years (Range: 23 - 73)

Mean Number of Years Fishing In Salt Water: 21.0 years (Range: 2 - 60)

Mean Number of Years Marlin/Tuna Fishing: 10.7 years (Range: 1 - 40)

Breakdown of Annual Income:	
10,000 - 19,999	6.1%
20,000 - 29,999	10.5%
30,000 - 39,999	15.8%
40,000 - 49,999	15.8%
50,000 - 59,999	9.6%
60,000 - 69,999	5.3%
70,000 - 79,999	7.0%
80,000 & Over	29.8%
Unknown	0.1%

Table 5. Other states Virginia's pelagic recreational fleet marlin/tuna fished during 1983 season.

	State	Percentage
	None	60.9%
	Florida	0.9%
	Maryland	0.9%
	N. Carolina	36.5%
	N. Jersey	0.9%
Total	4 States	100.1%*

* Does not add to 100% due to rounding.

Table 6. Annual descriptive analyses of marlin/tuna boats for 1983-1985 seasons.

	1983	1984	1985
Year built			
Mean	1975	1977	1978
Range	1947-1983	1955-1984	1950-1985
Top Three			
1.	1979,1980	1980,1984	1979
2.	1981	1974,1975,1983	1985
3.	1974,1975	1979	1984
Year Purchased			
Mean	1979	1981	1982
Range	1949-1983	1961-1984	1961-1985
Top Three			
1.	1982	1983	1985
2.	1980	1984	1984
3.	1979	1980,1982	1983
Boat length (ft)			
Mean	30.2	27.0	28.0
Range	20-55	17-55	18-60
Top Three			
1.	23	23	23
2.	24	24	24
3.	25	25	25
Top Five Makes			
1.	Seacraft	Seacraft	Seacraft
2.	Custom Built	Bertram	Grady White
3.	Bertram, Tiara	Grady White	Bertram
4.	Formula, Searay,Viking Albemarle	Wellcraft	Wellcraft, Albemarle
5.	Searay, Hatteras	Formula	Aquasport
Fuel Type			
Diesel	-----	19.1%	22.7%
Gas	-----	76.6%	68.0%
Unknown	-----	4.3%	9.3%

Table 7. Annual and per trip expenditures for marlin/tuna trips taken during 1983-1985 seasons.

	1983	1984	1985
Purchase price of boat & outfittings			
Mean	$64,869.1	$55,035.1	$56,821.6
Standard deviation	$91,591.9	$99,678.9	$92,854.6
Total*	$29,515,441	$36,653,377	$43,979,918
Annual initial boat preparation			
Mean	$ 3,712.7	$ 2,356.8	$ 3,950.6
Standard deviation	$ 8,158.2	$ 3,932.7	$11,753.3
Total*	$1,689,278	$1,569,629	$3,057,764
Annual slip rental & winter storage			
Mean	$ 875.5	$ 806.2	$ 709.8
Standard deviation	$ 1,164.8	$ 1,649.4	$ 1,009.6
Total*	$ 398,352	$ 536,929	$ 549,385
Annual boat insurance			
Mean	$ 762.2	$ 647.5	$ 838.7
Standard deviation	$ 1,038.9	$ 836.5	$ 1,238.9
Total*	$ 346,801	$ 431,235	$ 649,154
Ice, natural bait, lightsticks, etc. per M/T trip			
Mean	$ 35.1	$ 37.9	$ 42.5
Standard deviation	$ 27.4	$ 29.6	$ 51.1
Total**	$ 208,915	$ 251,959	$ 244,290
Original value all M/T tackle			
Mean	$ 3,614.6	$ 3,403.3	$ 3,512.4
Standard deviation	$ 3,621.8	$ 3,587.6	$ 3,312.0
Total*	$1,644,643	$2,266,598	$2,718,598

Table 7. Continued.

Age of rods & reels in years			
Mean	3.7	3.3	
Standard deviation	1.9	0.2	
Fuel cost/trip			
Mean	$ 165.2	$ 144.0	$ 131.5
Standard deviation	$ 94.9	$ 108.2	$ 90.5
Total**	$ 983,270	$ 957,312	$ 755,862
Entry fees for M/T tournaments			
Mean	$ 565.3	$ 465.4	$ 364.0
Standard deviation	$ 1,242.6	$ 157.1	$ 968.5
Total*	$ 257,211	$ 309,956	$ 281,736
M/T charter fees			
Mean	$ 451.2	$ 479.6	$ 477.6
Standard deviation	$ 151.8	$ 138.2	$ 187.0
Total***	$ 274,330	$ 432,120	$ 860,635

* Total=(mean cost)(estimated fleet size)
** Total=(mean cost)(estimated number of M/T trips from Appendix V)
***Total=(mean cost)(estimated number of charter trips from Table 2)

Table 8. Mean fishing party expenses (N=16 responses) and projected total tournament expenses (N=55 tournament boats) for the 1984 Virginia Beach Marlin Tournament. Standard deviation in parentheses and range in brackets.

Expense Category	Mean fishing party expenses	Projected total expenses	Relative frequency
Bait, Ice, Tackle	$242.56 (196.18) [$50-60]	$13,286	8.8%
Groceries,Snacks, Beverages	$219.75 (110.68) [45-500]	$12,086	8.0%
Boat Fuel	$992.25 (367.78) [$588-2000]	$54,574	36.2%
Car Fuel	$ 20.13 (14.18)* [$0-50]	$ 1,107	0.7%
Lodging	$389.29 (642.16)** [$0-2000]	$21,411	14.2%
Restaurants	$474.69 (461.68) [0-1600]	$26,108	17.3%
Miscellaneous	$401.67 (366.78)*** [$0-1050]	$22,092	14.7%
TOTAL		$150,664	99.9%+

*Based upon 15 responses

**Based upon 14 responses

***Based upon 9 responses

+Does not equal 100% due to rounding

CHAPTER 6

AFFECTS OF SEA SURFACE TEMPERATURE ON BLUEFIN AND YELLOWFIN TUNA AND WHITE MARLIN RECREATIONAL CATCHES

INTRODUCTION

Tuna Distribution

Bluefin and yellowfin tuna are important commercial and game species that are caught by Virginia's recreational marlin/tuna fishermen off the Virginia coast. Yellowfin tuna exist in epipelagic, oceanic waters with temperatures ranging from 18 to 31 C and in areas above and below the thermocline (Collette and Nauen 1983). This species is harvested in commercial quantities at temperatures of 20 to 28 C (Laevastu and Rosa 1963). Off the eastern U.S. and Canada, yellowfin tuna are usually found on the Continental Shelf but may also occur near the Gulf Stream (Squire 1962b). Northern bluefin tuna (Thunnus thynnus) are found in waters from 14 to 21 C and occur in commercially fishable numbers at temperatures of 15 to 21 C (Laevastu and Rosa 1963).

Tuna distribution may be affected by currents and their strength, presence of land, water temperature, forage availability, oceanic fronts, upwelling zones, dissolved oxygen, water transparency, water masses, thermocline location, transition zones between ocean currents and vertical mixing (Collette and Nauen 1983; Rockford 1981; Sund et al 1981; Cole 1980; Barkley et al 1978; Roberts and Paul 1978; Sharp 1978; Laurs and Lynn 1977; Uda 1973; Panshin 1971; Uda 1970; Craig and Dean 1968; Hynd 1968; Blackburn 1965; Clemens and Craig 1965; Demir 1963; Flittner 1963; Laevastu and Rosa

1963; Robins 1963; Schaefer et al 1963; Clemens 1961; Radovich 1961; Murphy 1959; Nakamura and Yamanaka 1959; Hubbs 1948). The majority of tuna tend to aggregate in regions of abrupt temperature gradients at the edges of frontal zones. For example, yellowfin and bluefin tuna prefer different temperatures and can be caught in the same regions because of sharp temperature gradients. In the Atlantic Ocean, bluefin tuna are found in cooler waters on the edge of the Gulf Stream and yellowfin tuna are found in the Gulf Stream's warmer water (Squire 1962b).

Blackburn (1965) considers fronts to be very important to the ecology of tunas and other pelagic animals. Fronts are boundaries between surface waters of different densities and tend to have strong horizontal gradients of temperature and/or salinity. One or both of these water masses have a tendency to sink. Plankton aggregate in these fronts which inturn attracts larger predators to feed upon them. Tunas may be attracted to these fronts, with their specific temperatures, due to the availability of forage. Roffer (1987) studied the school bluefin tuna off the coast of Virginia and noted that daily changes in the distribution, concentration and catch-per-unit-of-effort followed the ephemeral changes in the offshore location, history and temperature gradients of the Chesapeake Bay plume frontal zone.

Sund et al. (1981) studied the northern bluefin tuna in the Pacific Ocean and found that its movements, distribution and possible availability is dependent on water temperature.

For example, off Southern California the commercial fishery was best during warm water years and poorest during cool water years. Uda (1973) has shown that northern bluefin tuna catches, off of Japan, periodically fluctuate due to intrusions of warm and cold water. Catches decline during cold surface water intrusions and increase during warm surface water intrusions. One or two year classes are affected by the cold water intrusions entering the spawning grounds. Once warm water returns good year classes develop. Regions in the Pacific Ocean with persistent warm and cold eddies are favorable fishing grounds for the northern bluefin tuna (Uda 1970).

Studies by Rockford (1981), Hynd (1968) and Robins (1963) demonstrate the affect sea surface temperature (SST) has on the distribution of the southern bluefin tuna (Thunnus maccoyii). Australian tuna fisheries utilize SST to locate southern bluefin tuna. The majority of these fish are taken in water temperatures of 16.7 to 20 C. The fish in this temperature range are usually associated with sharp discontinuities in SST or fronts. At these fronts, the SST can change up to 1.7 C in a few meters (Hynd 1968). Robins (1963) also found the greatest number of southern bluefin tuna near convergences with temperature discontinuities and along current boundaries.

Sea surface temperature is important in determining the seasonal and annual distribution and abundance of yellowfin tuna in the Pacific Ocean (Schaefer et al 1963). Sund et al.

(1981) have shown that the range of yellowfin tuna abundance in the Pacific Ocean is directly limited by water temperatures of 20 C or less in both the horizontal and vertical planes. Occasionally yellowfin tuna will be found in SST as cold as 15 C, however these fish prefer warmer SST. Yellowfin tuna also concentrate along the Equatorial Countercurrent in the North Pacific Ocean in regions with eddies. These eddies aggregate prey which then attracts the tuna (Uda 1973).

White Marlin Distribution

Another important game species sought by Virginia's pelagic recrational fishery is the white marlin. During local warm seasons, white marlin will be found in higher latitudes. As the water cools, white marlin migrate to lower latitudes. In general, white marlin exist in blue water with depths greater than 100m, SST over 22 C and salinities of 35 to 37 parts per thousand. However, some seasonal feeding concentrations and migrations may occur in waters that differ in some of these characteristics. In white marlin regions, the average air temperature is usually between 15 and 28 C, water currents range from 0.5 to 2 knots and productivity is usually low (Mather et al. 1975).

Mather et al. (1975) state that the distribution of white marlin is primarily controlled by the necessity of foraging and spawning and secondarily by environmental cues. Salinity, SST, oxygen content, plankton volume, bottom topography, water color and presence of rips or weed lines are some of the important factors affecting white marlin distribution (Mather

et al. 1975; Nakamura and Rivas 1974; Ovchinnikov 1970; DeSylva and Davis 1963; Squire 1962a; Gibbs 1957; Earle 1940).

Water temperature appears to play a critical role in white marlin distribution (Mather et al. 1975). Squire (1962a) noted that white marlin in the western North Atlantic occurred at SST of 21.1 to 28.3 C with an average SST of 24.8 C. Ovchinnikov (1970) found the optimum water temperature to be 24 C for white marlin.

Gibbs (1957) studied the monthly distribution of white marlin landed by longliners in the Gulf of Mexico and found a correlation between the 23.9 C SST isotherm and white marlin. During the summer, white marlin were concentrated over the continental slope for foraging purposes. As the water began to cool, white marlin dispersed from this region.

Earle (1940) noted that recreational fishing for white marlin off of Ocean City, Maryland was affected by decreases in SST and storms from the northeast. For example, white marlin were landed in large numbers the day prior to a sudden 6 degree drop in water temperature. The day of the decrease no white marlin were landed but once the water warmed again many white marlin were caught.

In the Mid-Atlantic Bight, the white marlin season commences at the end of June and continues through mid-September. In 1959, white marlin were not found in colder waters north of the 20 C isotherm. These marlin grounds had SST of 25.6 and 26.7 C (DeSylva and Davis 1963).

Mather et al. (1975) noted that white marlin concentrated near rips or weed lines which usually occur at interfaces between different water masses. In the Gulf of Mexico, Nakamura and Rivas (1974) found the best region for white marlin fishing to be open water followed by scattered weeds and lastly lines or rips.

In 1959, white marlin regions in the Mid-Atlantic Bight appeared to have high plankton volumes in the thermocline. White marlin may be attracted to the thermocline because of the availability of prey in that area. These fishing grounds also had higher salinities than inshore waters and low oxygen waters surrounded by high oxygen waters. Salinity, oxygen content and plankton volume are important factors affecting the presence of white marlin (DeSylva and Davis 1963).

Bottom topography also affects white marlin distribution. Important feeding concentrations of white marlin occur in areas with steep drop-offs, submarine canyons and shoals. However, these areas must also have suitable water conditions. Good fishing also takes place in many of the canyons, e.g. Norfolk and Washington Canyons, along the edge of the continental shelf (Mather et al. 1975).

Hanamoto (1974) and Squire (1974) studied the distribution of striped marlin (Tetrapturus audax) off Baja and San Diego, California, respectively. Sea surface temperatures for the capture of striped marlin ranged from 16.1 to 22.8 C. Catches of striped marlin off California increased when the initial warming of the water reached an

average temperature of 20.0 C or above. When the 20.0 C and 21.1 C isotherms off of central Baja California to southern California are present more striped marlin are caught as compared to the times when these isotherms are not present (Squire 1974). One of the factors which may contribute to good fishing off Baja California is the presence of a shallow thermocline. As the shallow thermocline expanded from coastal to offshore waters in June, so did the good areas of fishing. This expanded shallow thermocline lasts through September. The shallow thermocline then begins to contract in the fall and the good fishing grounds also contract. Striped marlin are probably attracted to these regions, with a shallow thermocline, because of the abundance of food (Hanamoto 1974).

The main objective of this portion of the study was to determine whether there is a relationship between sea surface temperature and recreational catches of yellowfin tuna, juvenile bluefin tuna and white marlin.

METHODS

During 1985 and 1986 dockside and telephone interviews (See Chapter 3 and 4 for detailed methodology), Virginia's recreational marlin/tuna fishermen were asked to recall, for each trip taken, the SST for each area fished and the number of white marlin and bluefin (juvenile fish) and yellowfin tuna caught (includes kept and released fishes) and the number of white marlin raised in each area. All SST were recorded in degrees fahrenheit because fisherman's gauges report SST in these units. Weekly and overall SST and catches (includes raised white marlin) of these species were studied for the 1985 and 1986 seasons. However, only SST and catches at particular fishing grounds were evaluated for the 1985 season. There are two main bluefin tuna fishing regions located in approximately 10 fathoms of water on raised hills off the coast of Virginia, namely, the 21 and 26 Mile Hills north of the Chesapeake Bay Plume and the Fish Hook, Lumps and SE Lumps, Boomerang, Horseshoe, Hot Dog, Triangle Wrecks (GA Buoy) and Tiger Wreck (V Buoy) south of the Chesapeake Bay Plume (Figure 1, Chapter 1). During the 1985 season, SST and catches of bluefin and yellowfin tuna were analyzed on a weekly basis for the 1985 season for these two regions. White marlin and yellowfin tuna are frequently caught in Norfolk and Washington Canyons, the Cigar, The Fingers and 20 Fathom Finger. SST and catches (includes kept and released fishes

and raised white marlin) of these fishes were studied weekly for the 1985 season at these fishing grounds.

Sea surface temperature and catches of bluefin and yellowfin tuna and white marlin were plotted. Linear regressions were performed using SPSSX on a Prime Computer.

RESULTS AND DISCUSSION

Sea Surface Temperatures

Catches of yellowfin and bluefin tuna and white marlin were plotted against sea surface temeperature. No linear relationship was found for any of the species tested.

Fishermen reported catching bluefin tuna at SST ranging from 62-80 F in 1985 and from 67-83 F in 1986. The majority of bluefin tuna were caught at SST of 71-74 F in 1985 and at 70-74 F in 1986 (Figure 1). Bochenek et al. (1989) reported bluefin tuna catches, off Virginia, at SST of 65-86 F, primarily between 70 and 75 F for the 1987 season and 58-81 F, primarily between 68 and 69 F for the 1988 season. In 1988, cooler nearshore water persisted throughout the first part of the season. Laevastu and Rosa (1963) found bluefin tuna in commercially fishable numbers at SST of 59-70 F. Roffer (1987) studied recreational bluefin tuna catches off the coast of Virginia and found that the lower preferred temperature limit was 65.3 F (18.5 C) and the upper preferred temperature limit was 68.9 F (20.5 C). However, this study documented peak catches at higher temperatures than Roffer's preferred upper limit. During 1986, bluefin tuna were caught from the first week of June through the third week of July (Figure 2) whereas in 1985 bluefin tuna were taken by recreational anglers from the first week of June through July 20th (Figure 3). This pattern is typical for most fishing seasons off the

Virginia coast. Initial catches of bluefin tuna are usually made in late May or early June depending upon sea surface temperatures and the last catches made in late July or early August when the water becomes too warm for this cooler water species. Roffer (1987) also supports the interpretation that the distribution of and relative apparent abundance of these juvenile bluefin tuna along the East Coast is a function of the location of the preferred thermal habitat. He found that the arrival of the bluefin tuna off the coasts of North Carolina and Virginia paralleled the development of the surface mixed layer with surface temepratures equal to or greater than 66.2 F (19 C). These fish remain in Virginia surface waters until the SST exceed 68.9 F (20.5 C) and then occur in subsurface waters. As the landings of these fish cease in July, catches of these fish increase further north (Roffer 1987). This study noted that bluefin tuna catches usually peak near the third week of June off the Virginia Coast. The majority of bluefin tuna were caught during the second through fourth weeks of June in 1985 (Figure 3) and during the third and fourth weeks of June in 1986 (Figure 2).

Yellowfin tuna prefer warmer water than bluefin tuna, arrive off the Virginia coast in late June or early July and remain through September or October, depending on weather conditions. Bluefin and yellowfin tuna seasons overlap from late June through early July (See Chapter 4). Squire (1962b) also found bluefin and yellowfin tuna occurring in the same regions. He found bluefin tuna in cooler waters on the edge

of the Gulf Stream and yellowfin tuna in warmer waters of the Gulf Stream. This study reported yellowfin tuna landings at SST ranging from 68-86 F for the 1985 and 1986 seasons. The majority of yellowfin tuna were caught at SST of 76-80 F in 1985 and 75-82 F in 1986 (Figure 4). Peak yellowfin tuna catches occurred during the week of 7/8-14 in 1985 (Figure 5) and from 6/30-7/27 in 1986 (Figure 6). In 1987 and 1988, Bochenek et al. (1989) reported landings of yellowfin tuna occurring at SST of 70-88 F. Peak catches were reported at SST of 82-83 F and 80-82 F for the 1987 and 1988 seasons, respectively.

Virignia's pelagic recreational fishermen catch white marlin from June through October and these landings are dependent upon weather conditons both early and late in the season. In June of 1985 and 1986, the first white marlin was landed by Virginia anglers fishing off the coast of North Carolina. The white marlin season usually continues into October and Virginia fishermen usually catch many of these late season billfish off the North Carolina coast. During 1985, white marlin were landed at SST ranging from 70-80 F with the majority taken at 76-79 F (Figure 7). In 1986, white marlin were caught at SST ranging from 71-86 F, primarily at 74 and 81 F (Figure 6). Peak catches of white marlin occurred during the second week of September in 1985 (Figure 5) and during the first week of September in 1986 (Figure 6). Bochenek et al. (1989) reported white marlin landed at SST of 70-88 F and 69-85 F for the 1987 and 1988 seasons,

respectively. Peak landings occurred at SST of 82-83 F in 1987 and 80-82 F in 1988. Squire (1962b) noted that white marlin in the North Atlantic were found at SST of 70-83 F with an average SST of 77 F. Ovchinnikov (1970) found the optimum water temperature for white marlin to be 75 F. Gibbs (1957) studied the monthly distribution of white marlin landed by longliners in the Gulf of Mexico and found a correlation between the 75 F sea surface isotherm and white marlin landings. Mather et al. (1975) state that water temperatures appear to play a key role in white marlin distribution. The results of this study agree with the information collected by these researchers.

Areas Fished During the 1985 Season

Bluefin Tuna. Peak catches of bluefin tuna for the combined areas of the 26 and 21 Mile Hills occurred during the week of June 24th-30th with a total of 47 bluefin tuna landed at a mean SST of 71.3 F (sd 1.87) and SST ranging from 68 to 74 F (Table 1a). For the combined area consisting of the Hot Dog, Fish Hook, Lumps and SE Lumps, Horseshoe, Triangle Wrecks and Tiger Wreck, peak bluefin tuna catches occurred during the weeks of June 17th-23rd and June 24th-30th with a total of 168 fish landed and mean SST of 72.8 (sd 1.99) and 71.9 F (sd 2.41), respectively (Table 1b). Both fishing regions reported similar peak weeks of fishing and SST.

Yellowfin Tuna. There are two main fishing regions for yellowfin tuna, namely, the Cigar, The Fingers and 20 Fathom Finger (Region 1) located in approximately 20 fathoms of water

and the Triple Zero Line, Norfolk Canyon and Washington Canyon (Region 2) located further offshore (Figure 1, Chapter 1). Peak catches of yellowfin tuna were taken in Region 1 and Region 2 during the week of July 8th-14th at an average SST of 77.4 (sd 2.39) and 76.0 F (sd 1.70), respectively. Yellowfin tuna were landed from June 1 through October 20. Most of these fish were caught at SST ranging from 72 to 80 F (Tables 2a and 2b).

White Marlin. In Region 1, most of the white marlin were taken at SST ranging from 72 to 80 F during the week of September 16th-22nd (Table 2a). However, in Region 2 there was no peak week for catching white marlin and these fish were caught throughout the season at SST ranging from 69-81 F (Table 2b).

SST is just one factor affecting the distribution of these highly pelagic fishes. There are other factors which influence tuna and marlin distribution. Some of these factors are: forage availability, fronts, bottom topography and warm core eddies.

CONCLUSIONS

Bluefin tuna catches appear to peak near the third week of June. These fish are caught at SST ranging from 58-83 F but seem to prefer SST of 70 to 75 F. Yellowfin tuna prefer warmer water than bluefin tuna and were caught at SST ranging from 68-86 F with most of the yellowfin tuna landed at SST of 76-80 F. Early September appears to be the best time to land a white marlin off of Virginia. These fish seem to prefer SST of 74 to 81 F.

Most of Virginia's pelagic recreational fishermen were not interested in SST during the initial years of this study, but by 1986 most fishermen had installed SST gauges aboard their vessels for use in locating fronts and proper SST. More offshore fishermen are realizing the importance of warm core eddies and are interested in using satellite information to determine were to fish. Further research needs to be conducted off the East Coast of the United States to determine the affects forage availability, SST, fronts and warm core eddies have on the distribution of these important game species. In addition, future studies need to be conducted to learn how the Chesapeake Bay Plume affects catches of yellowfin and bluefin tuna off Virginia.

Figure 1. Overall catches of bluefin tuna and sea surface temperatures (F) for 1985 and 1986 seasons.

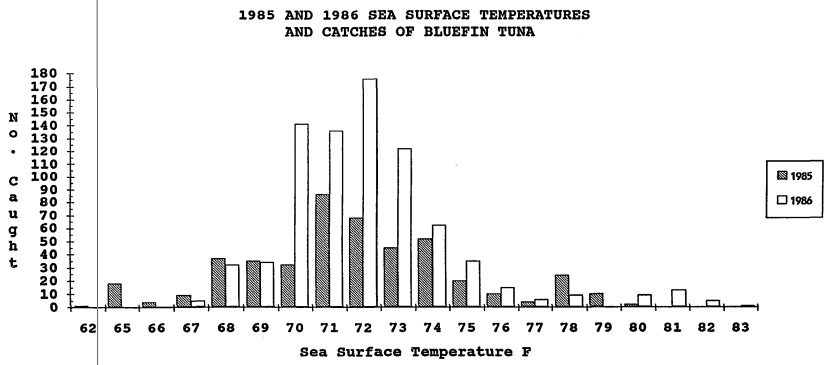
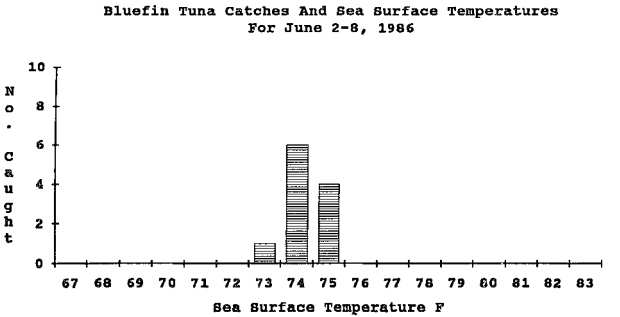
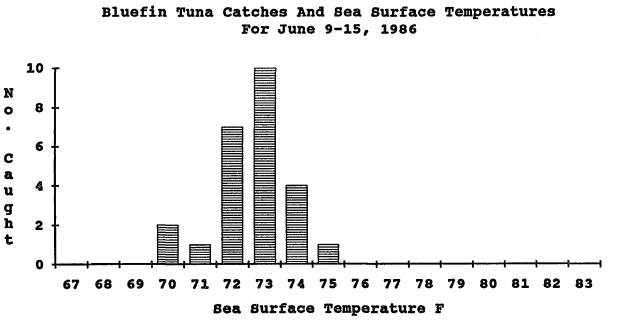
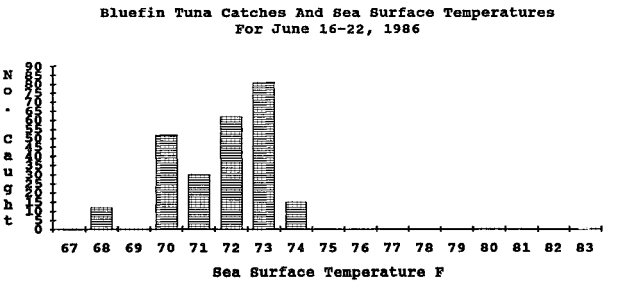
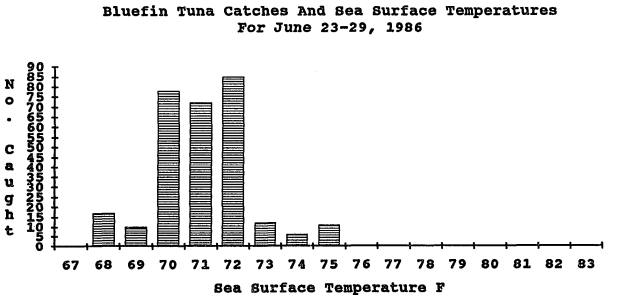


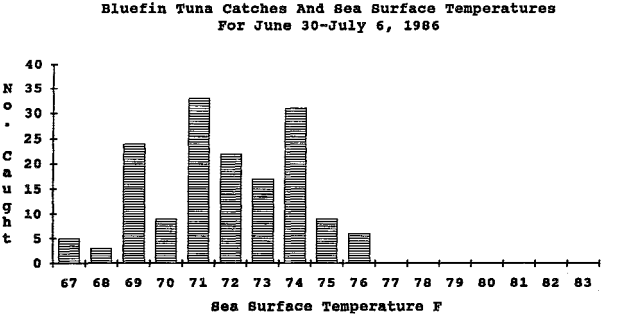
Figure 2. Weekly catches of bluefin tuna and sea surface temperatures for 1986 season.

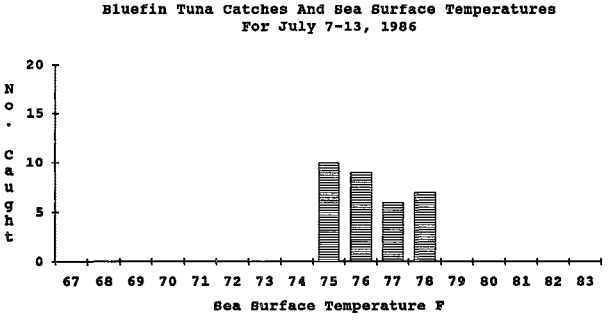












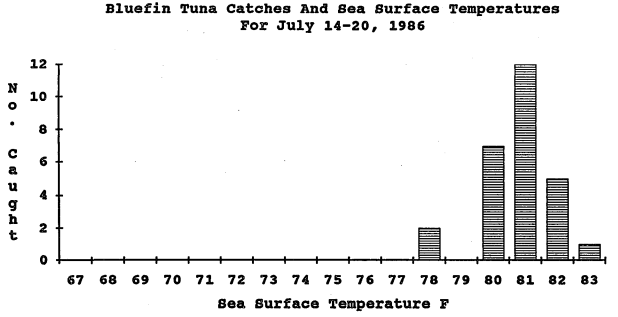
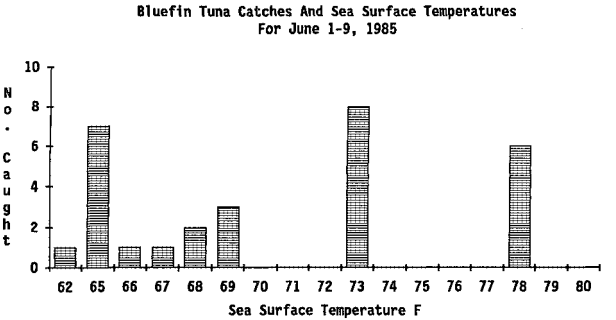
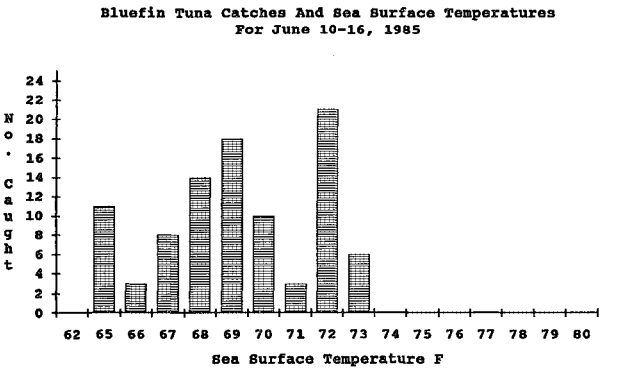
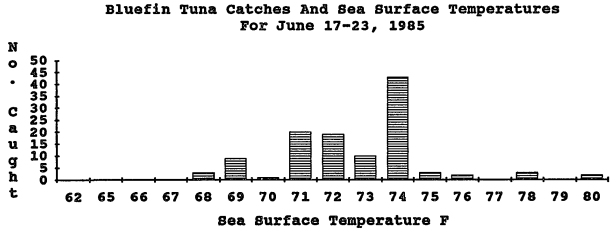
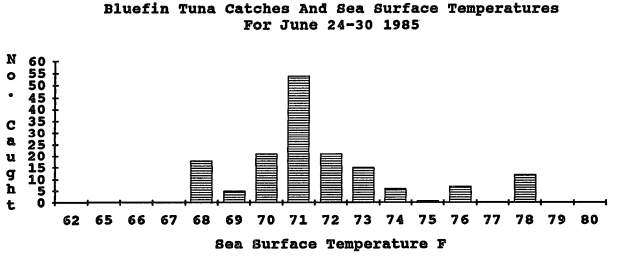


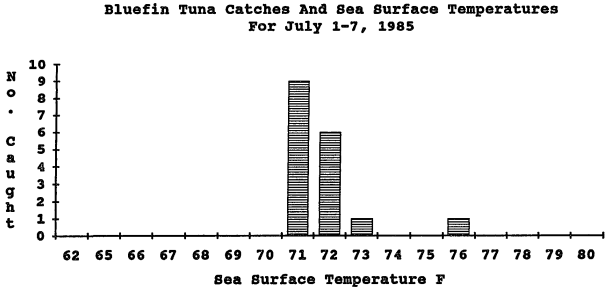
Figure 3. Weekly catches of bluefin tuna and sea surface temperatures (F) for 1985 season.

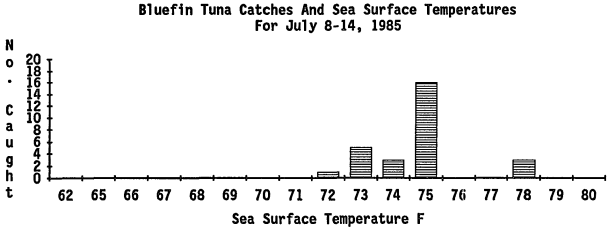












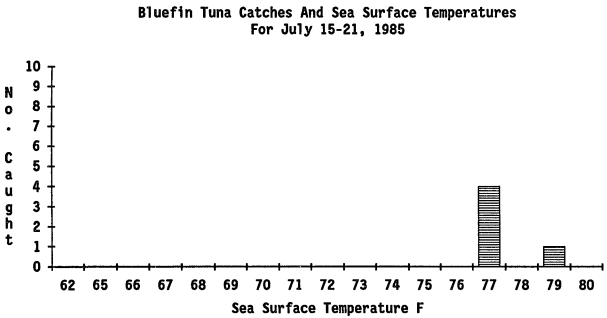


Figure 4. Overall catches of yellowfin tuna and sea surface temperatures (F) for 1985 and 1986 seasons.

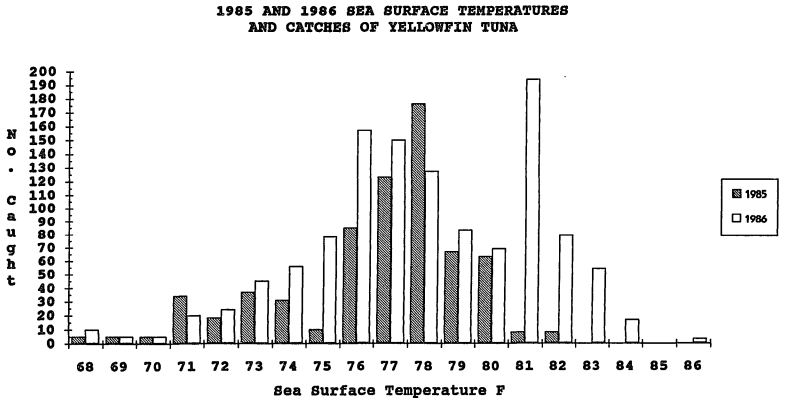
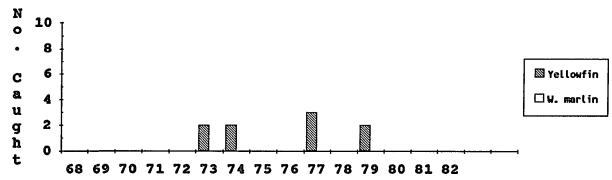


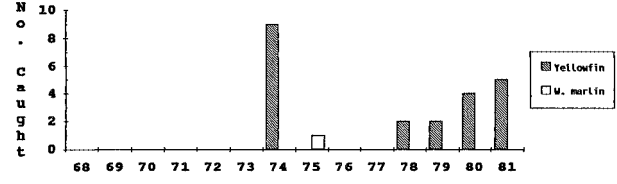
Figure 5. Weekly catches of yellowfin tuna, white marlin and sea surface temperatures (F) for 1985 season.

SEA SURFACE TEMPERATURES
AND CATCHES OF YELLOWFIN TUNA
AND WHITE MARLIN FOR JUNE 1-9, 1985



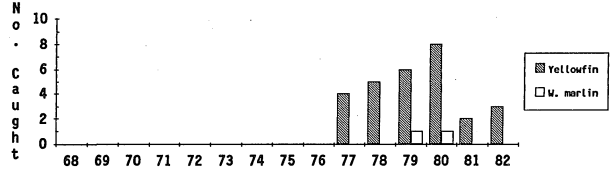
No. White Marlin Caught Includes: Kept, Released And Raised

SEA SURFACE TEMPERATURES
AND CATCHES OF YELLOWFIN TUNA
AND WHITE MARLIN FOR JUNE 10-16, 1985



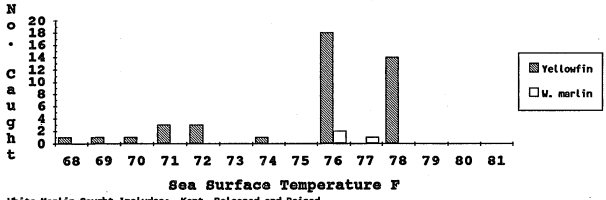
No. White Marlin Caught Includes: Kept, Released and Raised

SEA SURFACE TEMPERATURES
AND CATCHES OF YELLOWFIN TUNA
AND WHITE MARLIN FOR JUNE 17-23, 1985



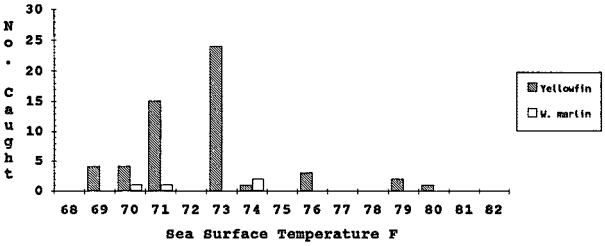
No. White Marlin Caught Includes: Kept, Released and Raised

SEA SURFACE TEMPERATURES
AND CATCHES OF YELLOWFIN TUNA
AND WHITE MARLIN FOR JUNE 24-30, 1985



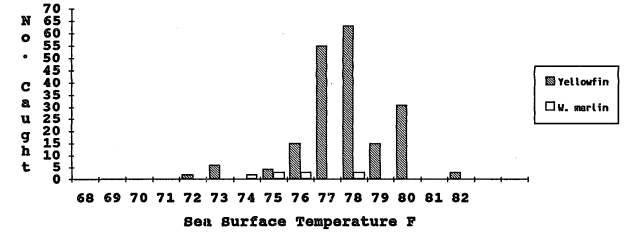
No. White Marlin Caught Includes: Kept, Released and Raised

SEA SURFACE TEMPERATURES
AND CATCHES OF YELLOWFIN TUNA
AND WHITE MARLIN FOR JULY 1-7, 1985



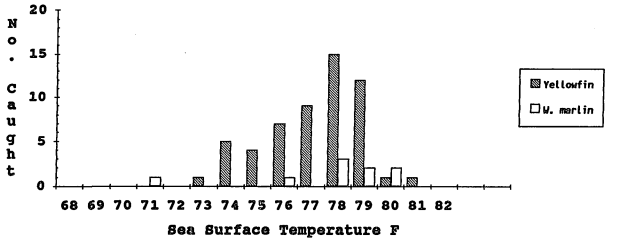
No. White Marlin Caught Incudes: Kept, Released and Raised

SEA SURFACE TEMPERATURES
AND CATCHES OF YELLOWFIN TUNA
AND WHITE MARLIN FOR JULY 8-14, 1985



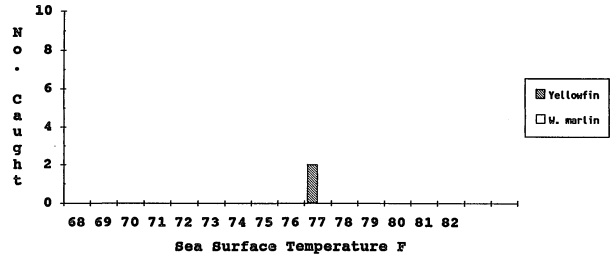
No. White Marlin Caught Inclues: Kept, Released and Raised

SEA SURFACE TEMPERATURES
AND CATCHES OF YELLOWFIN TUNA
AND WHITE MARLIN FOR JULY 15-21, 1985



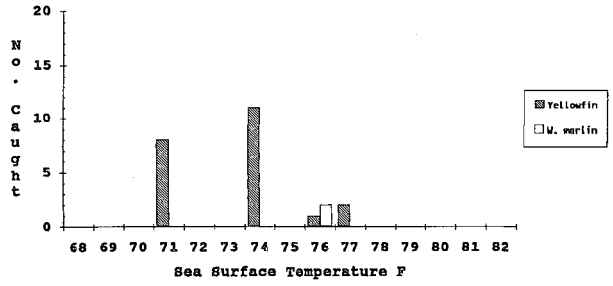
No. White Marlin Caught Incudes: Kept, Released and Raised

SEA SURFACE TEMPERATURES
AND CATCHES OF YELLOWFIN TUNA
AND WHITE MARLIN FOR JULY 22-28, 1985



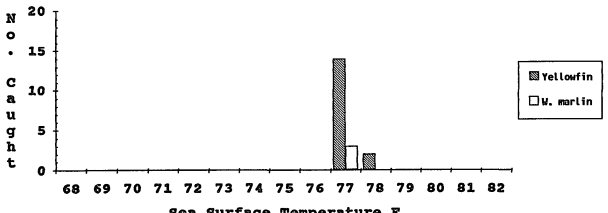
No. White Marlin Caught Includes: Kept, Released and Raised

SEA SURFACE TEMPERATURES AND CATCHES OF YELLOWFIN TUNA AND WHITE MARLIN FOR JULY 29-AUGUST 4, 1985



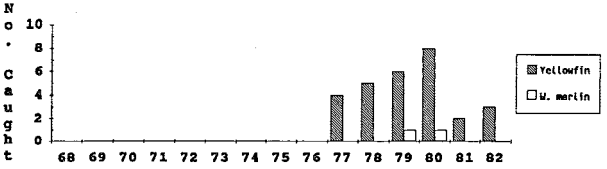
No. White Marlin Caught Includes: Kept, Released and Raised

SEA SURFACE TEMPERATURES
AND CATCHES OF YELLOWFIN TUNA
AND WHITE MARLIN FOR AUGUST 5-11, 1985



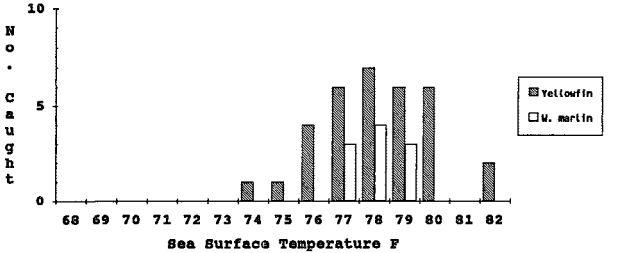
No. White Marlin Caught Includes: Kept, Released and Raised

SEA SURFACE TEMPERATURES
AND CATCHES OF YELLOWFIN TUNA
AND WHITE MARLIN FOR AUGUST 12-18, 1985



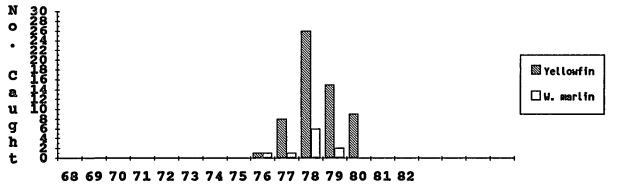
No. White Marlin Caught Includes: Kept, Released and Raised

SEA SURFACE TEMPERATURES
AND CATCHES OF YELLOWFIN TUNA
AND WHITE MARLIN FOR AUGUST 19-25, 1985



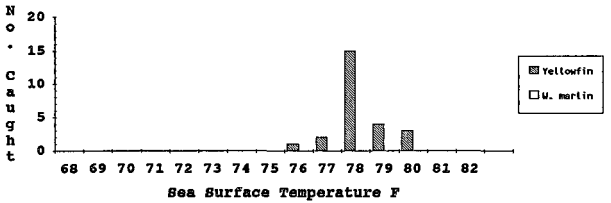
No. White Marlin Caught Includes: Kept, Released and Raised

SEA SURFACE TEMPERATURES AND CATCHES OF YELLOWFIN TUNA AND WHITE MARLIN FOR AUGUST 26-SEPTEMBER 1, 1985



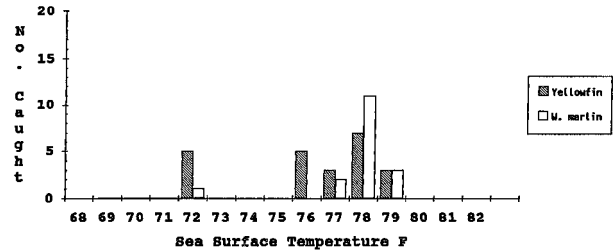
No. White Marlin Caught Includes: Kept, Released and Raised

SEA SURFACE TEMPERATURES
AND CATCHES OF YELLOWFIN TUNA
AND WHITE MARLIN FOR SEPTEMBER 2-8,1985



No. White Marlin Caught Incudes: Kept, Released and Raised

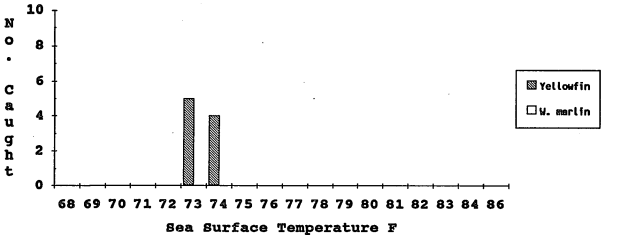
SEA SURFACE TEMPERATURES
AND CATCHES OF YELLOWFIN TUNA
AND WHITE MARLIN FOR SEPTEMBER 16-22, 1985



No. White Marlin Caught Includes: Kept, Released and Raised

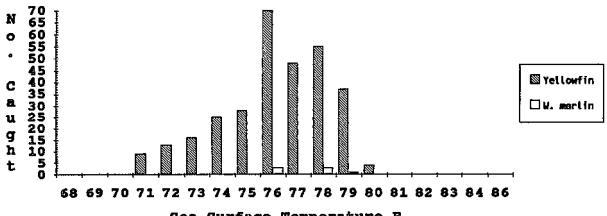
Figure 6. Weekly catches of yellowfin tuna, white marlin and sea surface temperatures (F) for 1986 season.

SEA SURFACE TEMPERATURES
AND CATCHES OF YELLOWFIN TUNA
AND WHITE MARLIN FOR June 16-22, 1986



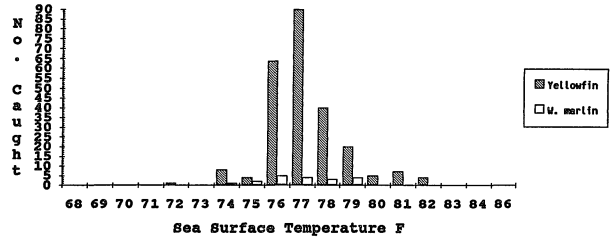
No. White Marlin Caught Includues: Kept, Released and Raised

SEA SURFACE TEMPERATURES
AND CATCHES OF YELLOWFIN TUNA
AND WHITE MARLIN FOR JUNE 30-JULY 6, 1986



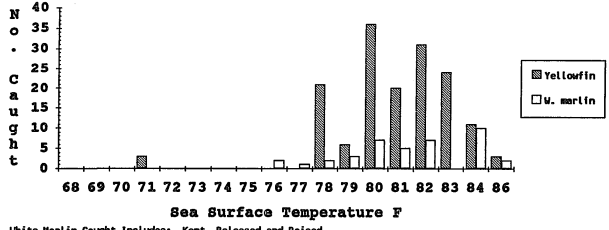
No. White Marlin Caught Includes: Kept, Released and Raised

SEA SURFACE TEMPERATURES
AND CATCHES OF YELLOWFIN TUNA
AND WHITE MARLIN FOR JULY 7-13, 1986



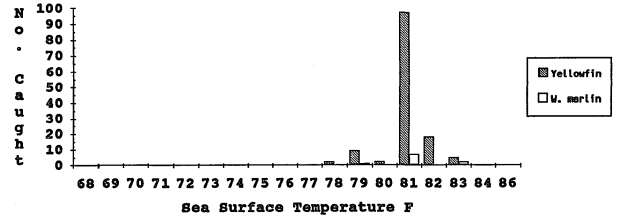
No. White Marlin Caught Includes: Kept, Released and Raised

SEA SURFACE TEMPERATURES
AND CATCHES OF YELLOWFIN TUNA
AND WHITE MARLIN FOR JULY 14-20, 1986



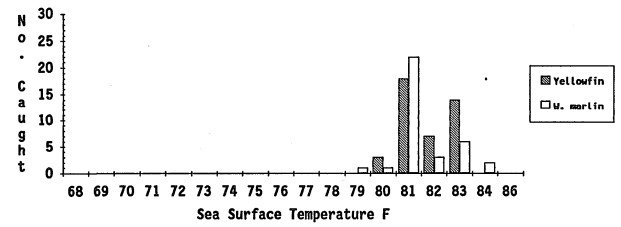
No. White Marlin Caught Includes: Kept, Released and Raised

SEA SURFACE TEMPERATURES
AND CATCHES OF YELLOWFIN TUNA
AND WHITE MARLIN FOR JULY 21-27, 1986



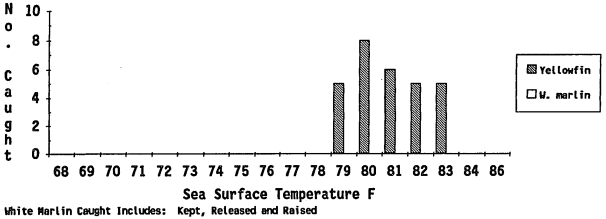
No. White Marlin Caught Includes: Kept, Released and Raised

SEA SURFACE TEMPERATURES
AND CATCHES OF YELLOWFIN TUNA
AND WHITE MARLIN FOR JULY 28-August 3, 1986



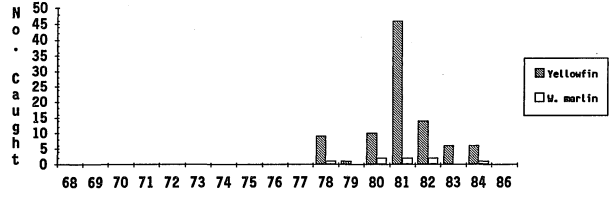
No. White Marlin Caught Includes: Kept, Released and Raised

SEA SURFACE TEMPERATURES
AND CATCHES OF YELLOWFIN TUNA
AND WHITE MARLIN FOR AUGUST 4-10, 1986



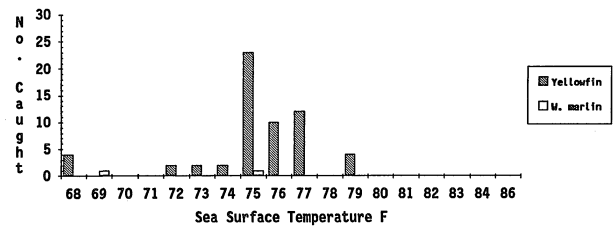
No. White Marlin Caught Includes: Kept, Released and Raised

SEA SURFACE TEMPERATURES
AND CATCHES OF YELLOWFIN TUNA
AND WHITE MARLIN FOR AUGUST 11-17, 1986



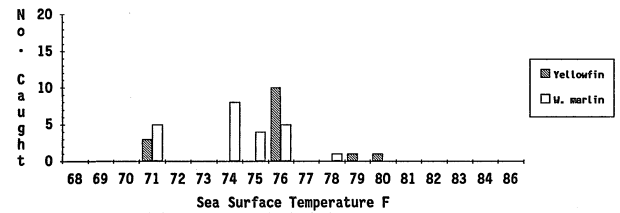
No. White Marlin Caught Includes: Kept, Released and Raised

SEA SURFACE TEMPERATURES
AND CATCHES OF YELLOWFIN TUNA
AND WHITE MARLIN FOR AUGUST 18-24, 1986

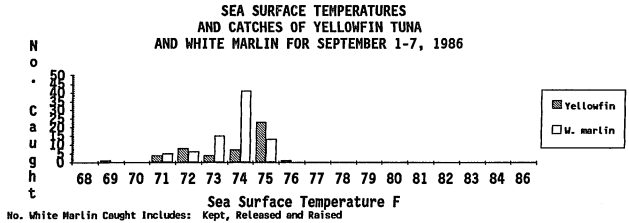


No. White Marlin Caught Includes: Kept, Released and Raised

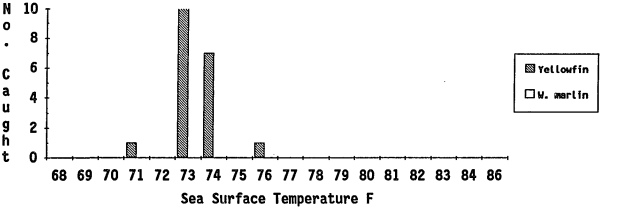
SEA SURFACE TEMPERATURES
AND CATCHES OF YELLOWFIN TUNA
AND WHITE MARLIN FOR AUGUST 25-31, 1986



No. White Marlin Caught Includes: Kept, Released and Raised



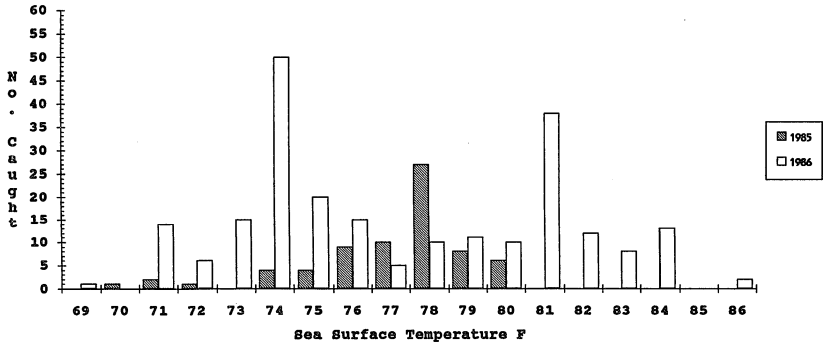
SEA SURFACE TEMPERATURES
AND CATCHES OF YELLOWFIN TUNA
AND WHITE MARLIN FOR SEPTEMBER 15-21, 1986



No. White Marlin Caught Includes: Kept, Released and Raised

Figure 7. Overall catches of white marlin and sea surface temperatures (F) for 1985 and 1986 seasons.

1985 AND 1986 SEA SURFACE TEMPERATURES AND CATCHES OF WHITE MARLIN



*Includes Kept, Released and Raised Fish

Table 1a. Weekly mean sea surface temperature (F) and catch of bluefin tuna for combined 1985 dockside and telephone interview data for the fishing region consisting of the 26 and 21 Mile Hills. No bluefin tuna were caught after July 28, 1985. Standard deviation in parenthesis.

Week	Mean SST	Min SST	Max SST	No. Bluefin Tuna Caught	Sample Size
before 6/01	-	59	-	0	1
6/01-6/09	64.8(1.27)	60	73	17	10
6/10-6/16	66.9(0.93)	61	69	22	8
6/17-6/23	71.5(1.51)	69	74	22	11
6/24-6/30	71.3(1.87)	68	74	47	9
7/01-7/07	71.5(0.58)	71	72	13	4
7/08-7/14	73.2(1.26)	72	75	18	4
7/15-7/21	77.0(0.00)	77	77	-	2
7/22-7/28	-	75	-	0	1
Total	69.6(4.34)	59	77	143	50

Bluefin tuna overall mean catch/boat trip = 2.9 (3.14)

Table 1b. Weekly mean sea surface temperature (F) and catch of bluefin tuna for combined 1985 dockside and telephone interview data for the fishing region consisting of the Hot Dog, Lumps and SE Lumps, Fish Hook, Horseshoe, Triangle Wrecks (GA Buoy) and Tiger Wreck (4A Buoy). No bluefin tuna were caught after July 28, 1985. Standard deviation in parenthesis.

Week	Mean SST	Min SST	Max SST	No. Bluefin Tuna Caught	Sample Size
6/01-6/09	68.3(0.98)	67	70	6	15
6/10-6/16	71.4(1.94)	68	76	53	13
6/17-6/23	72.8(1.99)	68	76	79	29
6/24-6/30	71.9(2.41)	68	80	89	30
7/01-7/07	71.7(0.96)	71	73	1	4
7/08-7/14	75.6(1.82)	74	78	6	5
7/15-7/21	77.0(2.65)	74	79	0	3
7/22-7/28	-	-	-	-	0
7/29-8/04	74.0(1.41)	73	75	0	2
8/05-8/11	-	-	-	-	0
8/12-8/18	-	82	-	0	1
8/19-8/25	-	79	-	-	1
Total	72.1(2.95)	67	82	103	103

Bluefin tuna overall mean catch/boat trip = 2.3 (3.38)

Table 2a. Weekly mean sea surface temperature (F) and catch of white marlin (WM) and yellowfin tuna (YF) for combined 1985 dockside and telephone interview data for the fishing region consisting of the Cigar, The Fingers and 20 Fathom Finger. Standard deviation in parenthesis.

Week	Mean SST	Min SST	Max SST	No. Caught WM	YF	Sample Size
6/01-6/09	70.2(1.28)	68	72	0	12	8
6/10-6/16	69.5(6.40)	65	74	0	9	2
6/17-6/23	75.7(3.09)	67	80	0	58	22
6/24-6/30	74.7(3.97)	70	81	0	10	14
7/01-7/07	73.2(2.86)	70	80	3	44	20
7/08-7/14	77.4(2.39)	72	80	2	80	19
7/15-7/21	78.1(2.09)	70	81	4	19	32
7/22-7/28	-	75	-	0	0	1
7/29-8/04	75.1(2.54)	71	79	1	20	7
8/05-8/11	77.2(0.80)	76	79	3	11	14
8/12-8/18	79.7(1.54)	78	82	1	19	14
8/19-8/25	77.7(1.17)	75	80	3	13	20
8/26-9/01	78.3(0.15)	76	80	3	47	43
9/02-9/08	78.6(1.85)	76	81	0	8	8
9/09-9/15	75.5(3.54)	73	78	0	2	2
9/16-9/22	77.6(1.78)	72	80	10	17	21
9/23-9/29	-	-	-	-	-	0
9/30-10/06	-	70	-	0	0	1
10/07-10/13	-	69	-	0	2	1
10/14-10/20	-	-	-	-	3	0
10/21-10/27	-	-	-	-	-	0
Total	76.7(3.07)	65	82	30	374	250

White marlin overall mean catch/boat trip = 0.1(0.42)
Yellowfin tuna overall mean catch/boat trip = 1.5(2.84)

Table 2b. Weekly mean sea surface temperature (F) and catch of white marlin (WM) and yellowfin tuna (YF) for combined 1985 dockside and telephone interview data for the fishing region consisting of Norfolk Canyon, Washington Canyon and Triple Zero Line (Loran C). Standard deviation in parenthesis.

Week	Mean SST	Min SST	Max SST	No. Caught WM	No. Caught YF	Sample Size
6/01-6/09	-	64	-	0	0	1
6/10-6/16	-	-	-	-	-	0
6/17-6/23	76.0(5.66)	72	80	0	5	2
6/24-6/30	73.7(3.37)	69	78	3	28	8
7/01-7/07	72.8(2.59)	69	76	1	5	5
7/08-7/14	76.0(1.70)	72	78	7	108	34
7/15-7/21	76.5(2.70)	69	81	5	25	28
7/22-7/28	76.0(1.41)	75	77	0	2	2
7/29-8/04	75.0(1.41)	74	76	1	2	2
8/05-8/11	77.2(0.84)	76	78	0	5	5
8/12-8/18	79.0(1.41)	77	81	1	9	7
8/19-8/25	77.4(1.58)	74	80	7	17	25
8/26-9/01	78.0(1.03)	76	80	7	14	47
9/02-9/08	79.4(1.51)	77	82	0	16	11
9/09-9/15	-	-	-	-	-	0
9/16-9/22	77.4(0.73)	76	78	7	6	9
9/23-9/29	-	69	-	0	0	1
9/30-10/31	-	-	-	-	-	0
Total	76.9(2.53)	64	82	39	242	187

White marlin overall mean catch/boat trip = 0.2 (0.50)
Yellowfin tuna overall mean catch/boat trip = 1.3 (4.02)

APPENDIX

Appendix I. Catch and socioeconomic forms for 1983-1985 seasons.

1983 - CATCH DATA -

A separate data sheet should be completed for each trip since last interview.

Captains Name _____ Interview Number_____ State(1)___

What day did you start trip: Mo.(2)_____ Day_____

What inlet did you leave from?(3)_____ State(4)_____

What ocean area(s) did you fish?_____(5)_____

How many people were on board?(6)_____

How many hours did you spend trolling?(7)_____ drifting?(8)_____

Now, I would like to know what you caught:

yellowfin tuna (9) _____

bigeye tuna (10) _____

albacore tuna (11) _____

bluefin tuna (12) _____

white marlin (13) _____

how many released? (14)_____

blue marlin (15) _____

how many released? (16)_____

swordfish, trolling (17)_____ .....drifting(18)_____

sailfish (19) _____

how many released? (20)_____

amberjack (21) _____

skipjack (22) _____

dolphin (23) _____

king mackerel (24) _____

wahoo (25) _____

mako shark (26) _____ blue(27)_____ hammerhead(28)_____

all other sharks (29)_____
(including those cut off)

tilefish (30) _____

false albacore _____

Was this a private, charter or party trip?(31)_____

1984 VIRGINIA OFFSHORE MARLIN/TUNA STUDY

Charter-Private Boat Catch and Effort Trip Log

Purpose: To collect a second year of data on fishing trips made from Virginia for marlin and tuna. This information will further document the importance of Virginia's offshore sport fishery and fishing ports.

Instructions: For the month of JULY, please complete one side of a log sheet (Questions 1-7) for each trip made for tuna or marlin. At the end of the month, please return the completed logs to Jon Lucy in the stamped envelope provided. Thank you for your cooperation.

CAPTAIN'S NAME_____BOAT NAME_____

1. What day did you fish?_____ (Month and day)

2. What inlet or port did you leave from?_____

3. What general ocean area or areas did you fish?_____
_____(Example: Cigar)

4. How many people on board were actually fishing?_____

5. How many hours did you spend trolling?_____;drifting?_____

6. What did you catch and release?

Species	Total Caught	Number Released
Yellowfin tuna		
Bigeye tuna		
True albacore		
Bluefin tuna		
White marlin		
Blue marlin		
Swordfish		
Sailfish		
Amberjack		
Skipjack		
Dolphin		
King mackerel		
Wahoo		
Bluefish		
False albacore		
Tilefish		
Mako shark		
Blue shark		
Hammerhead shark		
All other sharks (Including those cut-off)		

7. Was type trip was this? Private ( ); Charter ( )

OFFSHORE PELAGIC FISH SURVEY WORKSHEET 1985

Date:_____ Location_____ Tournament___ Dockside___ Phone___Recorder_____

Private Boat #/name_____ Charter Boat_____Captain Name____

Inlet boat left from_____.

Target species: marlin___ tuna___ bluefish___ shark___ other____
NUMBER OF TRIPS LAST YEAR TARGETED AT SMALL BLUEFIN_____

Bait: live_____ dead_____ artificial_____ No. anglers___

Lines fished____ Hours fished____ FISHING LOCATION: _____
(loran or general area)

MILES OFFSHORE: _____ Depth(ft/fa)___Water Temperature by area_____
(F)

CATCH:		Kept	Released	Area
yellowfin	4655			
bluefin	4652			
bigeye	4657			
false albacore	4653			
skipjack	4654			
Atlantic bonito	0330			
albacore	4651			
blackfin	4658			
white marlin	2177			
blue marlin	2179			
sailfish	3026			
wahoo	4710			
dolphin	1050			
king mackerel	2129			
bluefish	0230			
swordfish	4320			
mako	3505			
white	3512			
brown	3513			
dusky	3514			
blue	3504			
hammerhead	3516			
tiger	3515			
thresher	3509			
other shark	3508			
other tuna	4656			

MEASUREMENTS

Species	Length	Weight	Area	Species	Length	Weight	Area

VIRGINIA MARLIN-TUNA SPORT FISHERY STUDY

ECONOMIC VALUE OF OFFSHORE SPORTFISHING

1983

The following information will be used to estimate the economic value of recreational fishing for marlin, tuna and other big game fishes.

All information supplied on this questionnaire will be kept confidential and annonymous. Thank you. Jon Lucy

---

What boat did you use to marlin and tuna fish?

Make_____Length_____Year Built_____

What year did you purchase the boat?_____

What was the purchase price of the boat and the cost of all additional outfitting? Include:

a. the value of a trade-in, if any
b. all electronics, such as radios, depth finders, LORAN, radar
c. other fixed equipment, such as tuna towers, outriggers, fighting chairs

$_____

How much did you spend on the initial preparation, maintenance and repair of your boat during 1983 (include bottom painting, lift fees, engine work, etc.)? $_____

on slip rental and winter storage? $_____

on insurance? $_____

During a typical marlin and tuna trip:

how much did you spend on ice, natural bait, chum, lightsticks, and other perishable items? $_____

on gasoline or diesel fuel? $_____

What was the original cost of all your marlin and tuna fishing tackle, such as rods, reels, line, flying gaffs, lures, hooks, etc. $_____

What is the approximate average age in years of your rods and reels?_____years

How much did you spend in 1983 on entry fees for marlin and tuna tournaments? $_____

What percentage of the time is your boat used for marlin and tuna fishing as opposed to all other uses (other types of fishing, pleasure crusining, etc.)? _____percent

It is important to the understanding of a particular fishery such as Virginia's marlin-tuna fishery to document socioeconomic data describing the fishermen themselves. In this regard would you please complete this final information:

A) What is your age?_____ Sex? Male ( ); Female ( )

B) Approximately how many years have you actively fished for saltwater species?_____ for marlin and tuna?_____

C) What is your approximate household income before taxes (including spouse's income if also works)?

( ) under $10,000
( ) $10,000-$19,999
( ) $20,000-$29,999
( ) $30,000-$39,999
( ) $40,000-$49,999
( ) $50,000-$59,999
( ) $60,000-$69,999
( ) $70,000-$79,999
( ) $80,000 and above

D) In your opinion, what is the most important problem affecting the offshore recreational fishery for marlin and tuna?

_____

_____

_____

How many trips did your boat make for marlin or tuna during 1983? _____

During 1983, how many of the marlin and tuna trips were for charter?_____

What was the average fee charged per trip? $_____

What other states did you take your boat to fish for marlin or tuna?

State? No. Trips? State? No. Trips?

State? No. Trips? State? No. Trips?

Please list the names of up to ten other boats from your home port, regardless of size, that you know made at least one trip for marlin or tuna during 1983?

_____ _____

_____ _____

_____ _____

_____ _____

_____ _____

Your primary home port for marlin and tuna trips is?

COLLEGE OF WILLIAM AND MARY
VIRGINIA INSTITUTE OF MARINE SCIENCE
SCHOOL OF MARINE SCIENCE
Gloucester Point, Virginia 23062

CHARTERED 1693 Phone (804) 642-2111 SEA GRANT PROGRAM

RUDEE INLET AND VIRGINIA OFFSHORE MARLIN/TUNA STUDIES

ECONOMIC IMPACT OF SPORT FISHING

1984

The following information will be used to estimate the economic value of recreational fishing for marlin, tuna and other game fishes.

All information supplied on this questionnaire will be kept confidential and anonymous. Thank you.

Jon A. Lucy Jon A. Lucy

1. Please provide the following information on your boat:

   Make _____ Length _____ Year Built _____

2. What year did you purchase the boat? _____

   What was the purchase price of the boat and the cost of all additional outfittings? Include:

   a. the value of a trade-in, if any
   b. all electronics, such as radios, depth finders, LORAN, radar
   c. other fixed equipment, such as tuna towers, outriggers, fighting chairs

   Purchase Price? $_____

3. How much did you spend on the initial preparation, maintenance and repair of your boat during 1984 (include bottom painting, lift fees, engine work, etc.)? $_____

   on slip rental and winter storage? $_____

   on insurance? $_____

4. During a typical marlin and tuna trip:

   how much did you spend on ice, natural bait, chum, lightsticks, and other perishable items? $_____

   on gasoline ( ) or diesel fuel ( )? $_____
   (please check appropriate fuel)

5. What was the original cost of all your marlin and tuna fishing tackle, such as rods, reels, line, flying gaffs, lures, hooks, etc.? $_____

6. What is the approximate average age in years of your rods and reels?
_____ years

7. How much did you spend in 1984 on entry fees for marlin/tuna tournaments $_____, mackerel $_____, and shark $_____

8. What percentage of the time is your boat used for marlin and tuna fishing as opposed to all other uses (other types of fishing, pleasure cruising, etc.)? _____ percent

9. How many trips did your boat make for marlin or tuna during 1984? _____

10. During 1984, how many of the marlin and tuna trips were for charter?
_____

11. What was the average fee charged per trip? $_____

12. In what other states did you use the boat to fish for marlin or tuna?

State? No. Trips? _____ State? No. Trips? _____

State? No. Trips? _____ State? No. Trips? _____

Your primary home port or launching point for marlin and tuna trips is? (e.g., Rudee Inlet, Little Creek, etc.)?
_____

13. To assist us with our special 1984 study of Rudee Inlet sport fishing activity, please indicate below the number of trips you made out of Rudee this season according to the type of trip:

Trip Type	No. Trips Made (Rudee Only)
Mackerel	_____
Bluefish	_____
Flounder/spot/trout/etc.	_____
Shark	_____
Wreck Fishing	_____
Marlin/Tuna	_____
Other (specify species)	
_____	_____
_____	_____

14. Please list the names of up to ten other boats from your home port, regardless of size, that you know made at least one trip for marlin or tuna during 1984?

_____ _____
_____ _____
_____ _____
_____ _____
_____ _____

VIMS

THE COLLEGE OF WILLIAM AND MARY
VIRGINIA INSTITUTE OF MARINE SCIENCE
SCHOOL OF MARINE SCIENCE

Virginia Sea Grant College Program

VIRGINIA OFFSHORE MARLIN/TUNA STUDY

ECONOMIC IMPACT OF SPORT FISHING

1985

The following information will be used to estimate the economic value of recreational fishing for marlin, tuna and other game fishes.

All information supplied on this questionnaire will be kept confidential and anonymous. Thank you.

Jon A. Lucy

1. Please provide the following information on your boat:

   Make _____ Length _____ Year Built _____

2. What year did you purchase the boat? _____

   What was the purchase price of the boat and the cost of all additional outfittings? Include:

   a. the value of a trade-in, if any
   b. all electronics, such as radios, depth finders, LORAN, radar
   c. other fixed equipment, such as tuna towers, outriggers, fighting chairs

   Purchase Price? $_____

3. How much did you spend on the initial preparation, maintenance and repair of your boat during 1985 (include bottom painting, lift fees, engine work, etc.)? $_____

   on slip rental and winter storage? $_____

   on insurance? $_____

4. During a typical marlin and tuna trip:

   how much did you spend on ice, natural bait, chum, lightsticks, and other perishable items? $_____

   on gasoline ( ) or diesel fuel ( )? $_____
   (please check appropriate fuel)

5. What was the original cost of all your marlin and tuna fishing tackle, such as rods, reels, line, flying gaffs, lures, hooks, etc.? $_____

(OVER)

Gloucester Point, Virginia 23062 (804) 642-7164

6. How much did you spend in 1985 on entry fees for marlin/tuna tournaments $_____, mackerel $_____, and shark $_____

7. What percentage of the time is your boat used for marlin and tuna fishing as opposed to all other uses (other types of fishing, pleasure cruising, etc.)? _____ percent

8. How many trips did your boat make for marlin or tuna during 1985? _____

9. How many of your marlin or tuna trips were for charter? _____

10. What was the average fee charged per trip? $_____

11. In what other states did you use the boat to fish for marlin or tuna?

State? No. Trips? State? No. Trips?

State? No. Trips? State? No. Trips?

Your primary home port or launching point for marlin and tuna trips is? (e.g., Rudee Inlet, Little Creek, etc.)?

_____

12. Please list the names of up to ten other boats from your home port, regardless of size, that you know made at least one trip for marlin or tuna during 1985?

_____ _____
_____ _____
_____ _____
_____ _____
_____ _____

(This information will be used to estimate the population size of Virginia's offshore fleet).

13. Please indicate your town and state of residence (to determine geographical distribution of fishermen).

_____
(Town) (State)

VIMS Sea Grant Ecomonic Impact Survey
1985 Cape Henry Billfish Club Virginia Beach Marlin Tournament

Observer: Please complete a separate form for each angler and the boat's captain (if not a charter captain); return all forms in the envelope provided to the Tournament Committee at the end of the day.

Indicate whether this survey form is the captain ( ); Angler 1 ( ); Angler 2 ( ); Angler 3 ( ); Angler 4 ( ); Angler 5 ( ); Angler 6 ( ) PLEASE CHECK ONE.

1. What is your residence? City_____; State_____ Zip Code_____

2. How many times have you fished this tournament before this year? _____

3. How many days did you fish in this tournament? _____

4. How many nights will you have spent in the Virginia Beach area to fish the tournament? _____

5. How many family members or friends did you bring with you who did not fish in the tournament? _____

6. What type of lodging did you use while in the Virginia Beach area? _____ (your house, motel, condo, etc.)

7. For each item below please estimate the average amount of money you spent per day of tournament fishing (include only your expenses and indicate zero if no expense required).

Expenses	Amount Spent Each Day	Where Was Item Purchased? (Check One for Each Item) Home	Virginia Beach
Boat Fuel (per day)	_____	____	____
Snacks, Beer, Sodas	_____	____	____
Bait	_____	____	____
Ice	_____	____	____
Tackle	_____	____	____
Charter Fee (if any)	_____	____	____
Slip Rental	_____	____	____
Other (specify)			
_____	_____	____	____
_____	_____	____	____

8. Estimate your total share of car fuel expenses occurring in the Virginia Beach area for the tournament period. $_____

9. Estimate your total expenses for eating out during the tournament period in the Virginia Beach area (include expenses for family members, etc.). $_____

10. Estimate your total expenses for lodging (motel, condo rental, etc.) in the Virginia Beach area (include expenses for family members, etc.). $_____

Thank You!

6. How much did you spend in 1985 on entry fees for marlin/tuna tournaments $_____, mackerel $_____, and shark $_____

7. What percentage of the time is your boat used for marlin and tuna fishing as opposed to all other uses (other types of fishing, pleasure cruising, etc.)? _____ percent

8. How many trips did your boat make for marlin or tuna during 1985? _____

9. How many of your marlin or tuna trips were for charter? _____

10. What was the average fee charged per trip? $_____

11. In what other states did you use the boat to fish for marlin or tuna?

State? No. Trips? State? No. Trips?

State? No. Trips? State? No. Trips?

Your primary home port or launching point for marlin and tuna trips is? (e.g., Rudee Inlet, Little Creek, etc.)?

_____

12. Please list the names of up to ten other boats from your home port, regardless of size, that you know made at least one trip for marlin or tuna during 1985?

_____ _____
_____ _____
_____ _____
_____ _____
_____ _____

(This information will be used to estimate the population size of Virginia's offshore fleet).

13. Please indicate your town and state of residence (to determine geographical distribution of fishermen).

_____
(Town) (State)

Appendix II. Projected 1985 total catches for billfishes, tunas, dolphin and all pelagic fishes landed for telephone interviews using Figley's (1984) method. Catches estimtated using recall and not using recall trips.

	JUNE	
	Catches without recall	Catches with recall
Bluefin tuna	1,338	1,626
Yellowfin tuna	916	1,113
Dolphin	625	760
TOTAL ALL FISHES	19,022	23,114

	JULY	
	Catches without recall	Catches with recall
Blue marlin	44	52
White marlin	142	166
Sailfish	30	35
Bluefin tuna	490	571
Yellowfin tuna	4,129	4,808
Dolphin	1,471	1,713
TOTAL ALL FISHES	9,223	9,361

	AUGUST	
	Catches without recall	Catches with recall
Blue marlin	34	44
White marlin	85	111
Yellowfin tuna	1,287	1,689
Dolphin	3,274	4,297
TOTAL ALL FISHES	4,996	6,557

Appendix II. Continued.

SEPTEMBER

	Catches without recall	Catches with recall
Blue marlin	36	37
White marlin	48	49
Yellowfin tuna	432	443
Dolphin	1,966	2,013
TOTAL ALL FISHES	3,200	3,278

OCTOBER

	Catches without recall	Catches with recall
Yellowfin tuna	82	132
Dolphin	240	386
TOTAL ALL FISHES	425	685
GRAND TOTAL	36,866	42,995

Appendix III. Number of dockside and telephone interview trips and logbook trips by year for Virginia-based marlin/tuna trips.

Year	Dockside Interviews	Telephone Interviews	Logobooks Interviews	Total
1983	N/A	431	N/A	431
1984	N/A	N/A	377	377
1985	1138	304	N/A	1442
1986	892	212	N/A	1104

N/A Not applicable

Appendix IV. Annual estimates of Virginia's recreational marlin/tuna boat population.

Year	No. of Boats	No. Charter Boats
1983	455	40
1984	666	53
1985	774	68
1986	886	65

Appendix V. Estimated annual number of marlin/tuna trips based from Virginia. Past recall trips were used in calculating the telephone (P) effort (Figley 1984). Logbook (L) and dockside (D) effort calculated using Bochenek's method (Chaps 2 and 3).

	1983(P)	1984(L)	1985(P)	1985(D)	1986(P)	1986(D)
No. of trips	5952	6648	5527*	5969*	7103	6747

*1985 Telephone and dockside effort values were averaged for use in Chap 5 Table 7)

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