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The Economic Value of Saltwater Angling in Virginia

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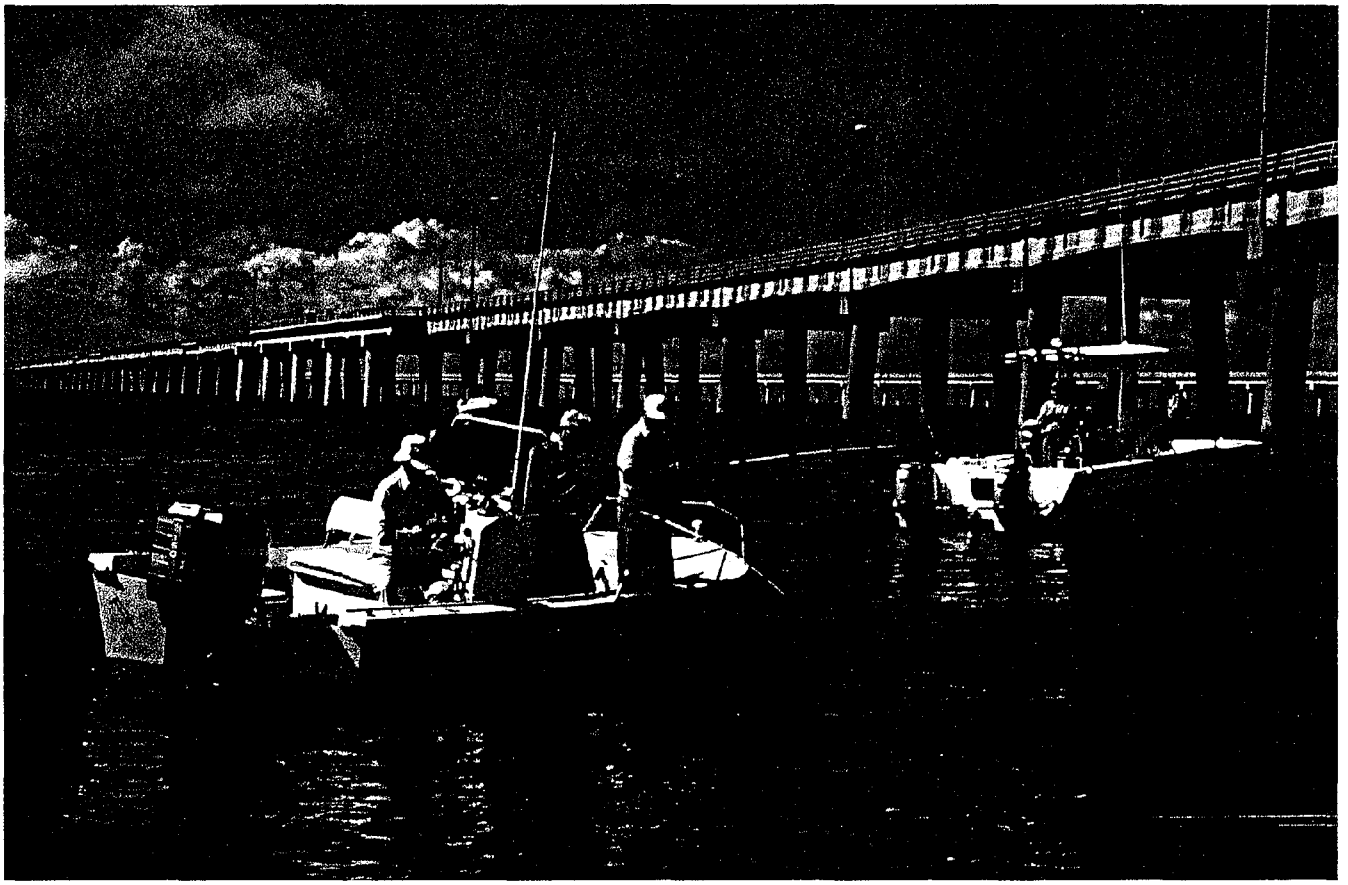

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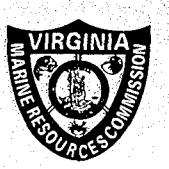

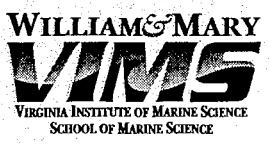

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Executive Summary

This report provides results of an economic valuation study of saltwater recreational angling in Virginia. The study was funded by the Virginia Marine Resources Commission, Virginia Saltwater Recreational Fishing Development Fund. The study was initiated in November 1994 as part of a two-tiered study. The first tier determined the economic impacts of saltwater angling; those results are presented in Kirkley and Kerstetter (1997) "Saltwater Angling and Its Economic Importance to Virginia." This report presents the results of the second part of the two-tiered study—determination of the economic value or net benefits of saltwater angling in Virginia.

The notion of economic value is quite different than that of economic importance or impacts. The first study examined the amount of economic activity generated by saltwater angling in Virginia. Impacts or economic activity were measured in terms of sales or output, income generated, and full-time employment generated by angling. To an administrator or planner, impacts may be viewed as benefits. In economic terms, however, such measures do not equal the true economic value or benefit of a good, service, or economic activity. The true economic value is a measure of what individuals would be willing to pay for the good or service less what they actually have to pay. We call this consumer surplus.

In this report, we present estimates of the true value—consumer surplus—anglers received from recreational angling in Virginia in 1996. The estimates are based on an analysis of data obtained from intercept or fields surveys and follow-up telephone surveys. In essence, standard analytical techniques for estimating the economic value of saltwater angling were used to estimate the benefits from angling in Virginia.

In 1996, saltwater anglers received approximately $353.3 million in consumer surplus or value from saltwater angling in Virginia. An angler taking a fishing trip aboard a boat received $137 per trip, and an angler making a trip from shore received about $73 per trip. After expenditures, anglers making trips from boats received about $256.9 million in benefits, and anglers making fishing trips from shore received $102.5 million in net benefits.

Not surprising, anglers targeting gamefish received the highest economic value relative to other species or species' groupings. In 1996, anglers targeting gamefish received $204.2 million in net benefits. Anglers targeting spot and croaker received $70.6 million in net benefits. The species providing the third highest level of benefits for recreational anglers was summer flounder; anglers received $42.8 million from fishing for summer flounder. Anglers indicating no desired or preferred species—random or non-targeted species—received $23.1 million in economic value from recreational fishing.

On a per pound basis, bluefish generated the highest value per pound—$60.61 for boat fishing and $24.98 for shore fishing. This was likely the result of the considerable scarcity of bluefish in 1996. Striped bass, which would be expected to generate the highest economic value, generated only $10.93 per pound in economic value for boat fishing and $3.31 per pound for shore fishing. The relative difference in the size and availability of bluefish and striped bass, however, should be considered when evaluating the per pound values of selected species. Sea trout had the second highest value per pound in 1996 ($47.83 for boat fishing and $22.91 for shore fishing). The economic value per pound from catching croaker and spot were $19.93 for boat fishing and $6.29 for shore fishing. The economic value of catching a pound of summer flounder equaled $13.66 for boat fishing and $3.39 for shore fishing in 1996.

Last, the economic value of being able to catch one more fish of a given species or species' grouping was determined to be quite high in 1996. If boat anglers had been able to catch, actually retain, one more striped bass in 1996, they would have received about $60.00 in net benefits. If boat anglers had been able to retain one more bottomfish, they would have received $11 in economic value. Boat anglers able to catch one more summer flounder would have received $17 in economic value. Boat anglers catching one more spot or croaker would have received $11 in economic value. Relative to shore fishing, anglers catching one more fish would have received the following values for the following species: (1) bottomfish—$2.60, (2) gamefish—$14.00, (3) summer flounder—$4.00, (4) spot and croaker—$2.60, and (5) random or non-targeted species—$1.65.

Why Should We Care About the Economic Value of Angling?

Economic Value vs. Economic Impact

Fishery administrators typically view the importance of economic activities such as recreational angling in terms of how much an economic activity contributes to total sales, income received, jobs generated, and tax revenues received by a locality. While such measures of impacts may indicate the size of recreational angling, they do not represent the true value or the importance of a good or service, such as recreational angling, to society, or in the case of Virginia, to the citizens of the Commonwealth.

Frequently the argument is made that sportfishing stimulates economic activity and/or new development in a coastal area and these are benefits. Economic activity, per se, is not a measure of net wellbeing. The appropriate measure is the increased profits and income generated. However, one must take care to do complete accounting. If the profits are made in one area and are offset by decreased profits in another, then there is no gain. Local gains are obviously of interest to local governments but should not necessarily be a factor in state or national government decision-making. The more appropriate measure is the economic value of the resource to the state or nation.

The true economic value of the opportunity to consume a good or service to society should reflect what is being received net of what alternatives are being foregone (Lipton et al. 1994). Another way of saying this is that activities such as saltwater angling typically have economic value in that anglers would be willing to pay more for the opportunity to fish than they actually have to pay; anglers receive benefits or value in excess of what they pay to go fishing. We can measure the value of these trade-offs in terms of income change. Value is reflected in peoples' willingness to make a trade-off, and the willingness to make a trade-off is reflected in peoples' willingness to pay some amount of money for access to recreational angling (Kahn 1998).

The concept of economic value is a necessary component for adequately addressing the problem of allocating marine resources among competing groups of users–a problem of growing concern to natural resource managers. More important, however, is that The Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) establishes the legal right of the trustees of natural resources to collect damages from firms or individuals that release hazardous substances which damage or destroy environmental resources (Kahn 1998). In order to collect damages, however, the trustees must establish the existence of damages in terms of economic value. Recently, the federal government and various state and local jurisdictions have indicated a need to have information on the economic value for the purpose of prosecuting fishery violations.

While the concept of economic value, as defined above, is the appropriate concept for resource allocation decisions and the mandated measure to be used in natural resource damage cases, local governments often have reasons for being interested in economic impact measures as well. Saltwater angling is big business in Virginia and contributes nearly $0.5 billion in sales and almost 11,000 full-time jobs to the economy of Virginia (Kirkley and Kerstetter 1997). Our purpose here is to examine issues of economic value and leave readers interested in economic impact analysis to examine the previous literature.

Contents and Organization of Study

This report provides estimates of the economic value, in terms of willingness to pay derived by individuals and citizens of the Commonwealth from saltwater recreational angling. Valuations are presented relative to species or groups of species and mode or type (e.g., private boat, charter boat, and shore) of saltwater angling. Estimates are based on willingness to pay and the travel cost approach, techniques long used by economists. The travel cost approach was proposed in Hotelling (1947) and most recently summarized and discussed relative to advantages and disadvantages in Bockstael et al. (1986), Freeman (1993), Lipton et al. (1994), and Kahn (1998).

The report is organized as follows: (1) Section II provides a discussion of saltwater recreational angling and the various species caught by anglers in Virginia; (2) Section III discusses the travel cost and related methods and procedures used to collect data for this study; (3) Section IV presents estimates of the economic values of the various species caught in Virginia; and (4) Section V provides a summary and conclusions. A technical appendix, Appendix I, is also included. Appendix I provides the specifications and estimates upon which the economic values are estimated.

Saltwater Angling in Virginia

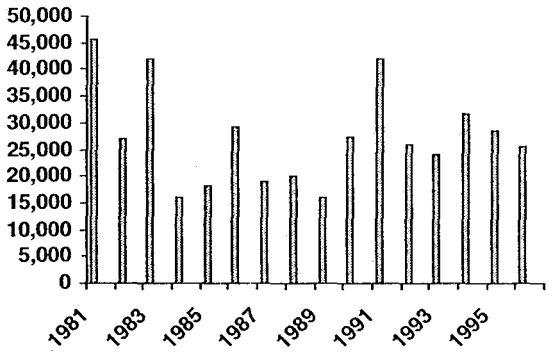
The Recreational Species

Virginians and out-of-state anglers can catch a plethora of different species in the marine waters of the state. The National Marine Fisheries Service lists more than 60 species or groups of species that are frequently caught by saltwater anglers in Virginia. Inshore or within the territorial limits of Virginia (all water out to three miles), species such as spot, croaker, bluefish, striped bass, various skates and rays, gray trout or weakfish, speckled trout, tarpon, cobia, summer flounder, sea bass, tautog, butterfish, spadefish, scup, Atlantic mackerel, king mackerel, Spanish mackerel, black and red drum, sheepshead, whiting, amberjack, and numerous sharks are frequently caught during the year. Offshore, numerous gamefish are also regularly caught. The popular offshore species include dolphin (often called "mahi-mahi" to distinguish it from the completely unrelated marine mammal), tautog, bonita, bluefin and yellowfin tuna, albacore, blue and white marlin, sailfish, and various sharks. Given the large diversity and availability of recreational species, anglers have the opportunity to engage in saltwater angling all year long.

The catch of all species, in terms of number of fish caught, retained, or released has generally declined over time (Figure 1). Since 1994, there has been an even more pronounced decreased in the number of fish caught by recreational anglers. In terms of the weight of fish caught and retained, there also has been a decline (Figure 2); the National Marine Fisheries Service does not provide estimates of the weight of fish discarded or not retained. Between 1981 and 1996, the weight declined from 25.9 to 9.6 million pounds or by 63 percent. There is an overall declining trend between 1984 and 1996, but the actual poundage caught increased from 9.5 to 9.6 million pounds.

The more popular species caught in Virginia by recreational anglers include spot, croaker, summer flounder, bluefish, striped bass, black and red drum, gray trout or weakfish, speckled trout, and king and Spanish mackerel (Figure 3). Although anglers have typically caught more croaker, spot, and summer flounder, striped bass has once again become popular since the relaxation of more stringent regulations on catching and keeping striped bass.

Figure 1. Total Number of Fish Caught by Virginia Anglers, 1981-1996



Source of Data: National Marine Fisheries Service

Figure 2. Weight of Saltwater Sport Fish Caught and Retained, 1981-1996

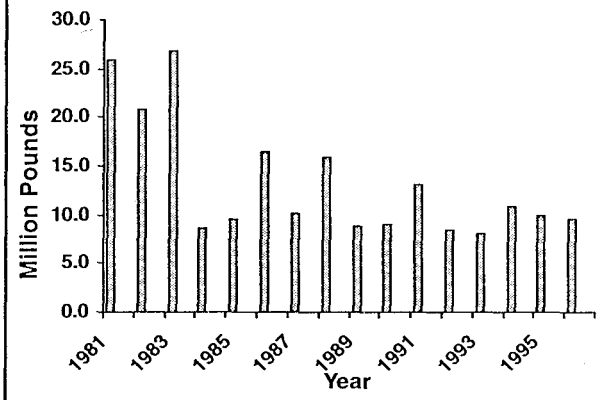
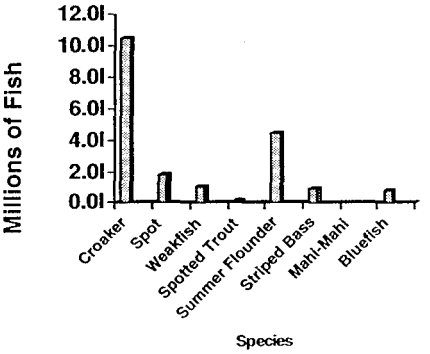


Figure 3. Number of Fish Caught by Selected Species, 1996

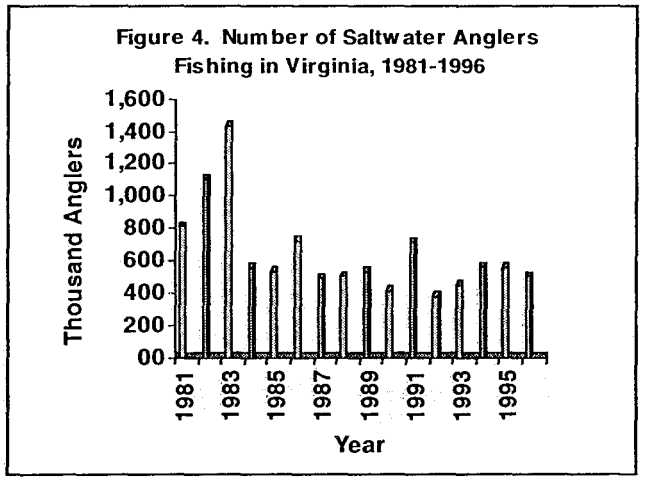


Between 1985, when there were very restrictive regulations on striped bass, and 1996, the number of striped bass or rockfish caught by anglers increased from 3,001 to 969,519 fish. Alternatively, the number of stripers caught, retained, or released increased by a factor of 323 or by 32,206.5 percent. The catch of croaker and spot, typically the highest number of fish caught by anglers, increased and decreased by 711% and 91.4% between 1981 and 1996, respectively. The catch of croaker and spot, like most saltwater species of Virginia, however, tend to display wide variations in catch from year to year. The abundance and availability of nearly all the species are quite sensitive to changes in water temperature, salinity, and environmental factors. An extensive description of the biological characteristics,

Virginia and World gamefish records, and trends in species catches are provided in Kirkley and Kerstetter (1997).

The Saltwater Anglers

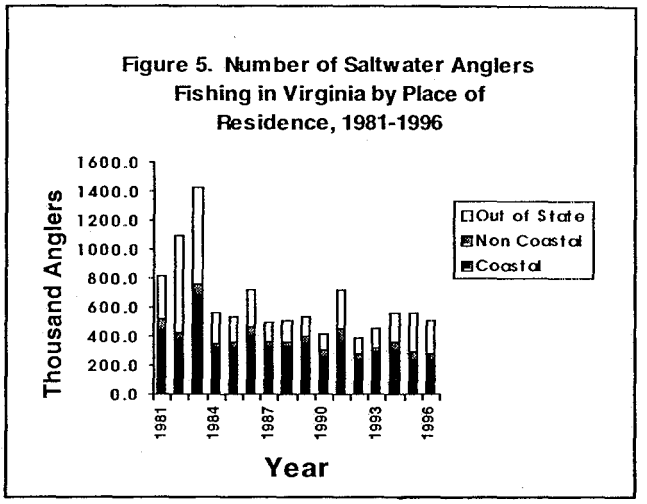
The total number of anglers varied considerably between 1981 and 1996 (Figure 4). The National Marine Fisheries Service estimates there were 811,930 anglers in 1981 and 507,092 saltwater anglers in 1996. From 1981 to 1983, the number of anglers increased from 0.8 million anglers to 1.4 million anglers, an all-time high. There are some disturbing patterns in the annual number of anglers for Virginia. While the total number of salt and freshwater anglers for the United States has increased over time, the number of saltwater anglers fishing in Virginia has decreased since 1981 and steadily since 1994.



The apparent decline in the number of saltwater anglers is consistent with the national patterns of recreational participation. The U.S. Fish and Wildlife Service reports that the total number of hunters and anglers 16 years and older in the United States remained nearly constant between 1991 and 1996. The U.S. Fish and Wildlife service estimates, however, that since 1991, expenditures on hunting, fishing, bird watching, and other wildlife-related recreation increased by more than 59 percent. Expenditures by hunters and anglers increased by 69 percent between 1991 and 1996.

The National Marine Fisheries Service estimates that 507,092 anglers saltwater fished in Virginia in 1996. The State of Virginia requires anglers to purchase an annual saltwater fishing license. Licenses are not required for individuals 15 years and younger, older than 65, or fishing from the angler's own property. In addition, many public and private piers have licenses for the entire pier. Also, boat licenses that allow all anglers to fish from a boat may be obtained. The Virginia Game and Inland Fisheries agency reports that 39,422 saltwater licenses were sold in 1996.

The residential distribution of anglers has changed little since 1981. In 1981, 54 percent of all anglers were residents of coastal counties (defined to be a county within 50 miles of the coast); 10 percent were non-coastal residents; and 36 percent were out-of-state residents (Figure 5). In 1996, 47 percent of all anglers were coastal residents; 7 percent were non-coastal residents; and 45 percent were from out of state. The actual number of anglers in all categories, however, dramatically declined between 1981 and 1996. Declines were most notable for coastal and non-coastal residents. Since 1993, the number of coastal and non-coastal anglers steadily declined; the number of out of state resident anglers, however, increased.



What can be said about some of the characteristics of Virginia saltwater anglers? Steinback and O'Neil (1998) in a report for the National Marine Fisheries Service provide a summary of several characteristics of Virginia anglers. They found that nearly 69% of Virginia anglers were between 26 and 55 years old in 1994–21% were between 26 and 35; 25% were between 36 and 45; and 23% were between 46 and 55.

In terms of education, the percent of anglers having a high school education is similar to that found for other states along the northeast Atlantic coast. In 1994, about 41% of all saltwater anglers in Virginia had a high school education. The percent of Virginia anglers having a college degree or post graduate work, however, was lower than that found for most other states; 20% of all Virginia anglers reported having a college degree or post graduate work.

The racial distribution of saltwater anglers in Virginia was slightly different from the distribution found for other states by Steinback and O'Neil. Nearly 86% of all anglers were Caucasian; the percentage of Caucasian anglers in all other states between Maryland and Maine ranged between 88 and 96%. Virginia also had the highest percent of African American black anglers; nearly 11% of the angling population was black.

The household income of Virginia anglers was similar to the household incomes of anglers in other

states. Approximately 26% of Virginia anglers had household incomes between $30,000 and $45,000; for other states, the percent of anglers having the same range of income varied between 25 and 30%. Relative to anglers with household incomes below $30,000, nearly 30% of Virginia anglers fell into this category. Only two states–Maine and Delaware–had a larger percentage of anglers with incomes less than $30,000.

Steinback and O'Neil provide some interesting statistics of angler years of experience. Virginia closely follows the distribution of angler years of experience in other states relative to five-year increments. In 1994, 14% of Virginia anglers reported having between 11 and 15 years of experience; the range of percent distribution in other states was from 11 to 15% of all anglers. Interestingly, Virginia had a relatively low percentage of anglers over the age of 55, but one of the highest percentages of anglers with 30 or more years of angling experience.

In contrast to many of the demographic patterns about saltwater anglers, expenditures by Virginia anglers were quite different than the expenditures by anglers in other states. In 1994, anglers spent an average of $51 on boat fees, $12 on travel, and $22 on lodging (lodging expenditures per night for anglers who actually paid for lodging averaged $38). In comparison, anglers in the state of Rhode Island—with the highest individual angler expenditures spent an average of $102 on boat fees, $8.00 on travel, $25.00 on lodging ($46.00 for anglers who actually paid for lodging). In addition to the summary of expenditures provided by Steinback and O'Neil, Kirkley and Kerstetter provide a summary and analysis of expenditures by Virginia saltwater anglers in 1994.

Of all the states between Maine and Virginia, Virginia anglers had the highest percentage of anglers who owned a boat and used it for recreational fishing. In 1994, 57% of all Virginia saltwater anglers reported owning a boat and using it for recreational fishing. Fifty-three percent of all anglers from Maine, Connecticut, Delaware, and Maryland reported owning a boat and using it for recreational fishing.

The distribution of anglers taking day trips vs. extended trips (spending at least one night) was also quite different on a state by state basis. In Virginia, 80% of the anglers reported taking day trips. Nearly 97% of all Connecticut anglers took day trips. The percent distribution of anglers taking day trips and overnight trips was quite similar for Maryland and Virginia. The state with the lowest percent of day trips and highest percent of overnight trips was Delaware.

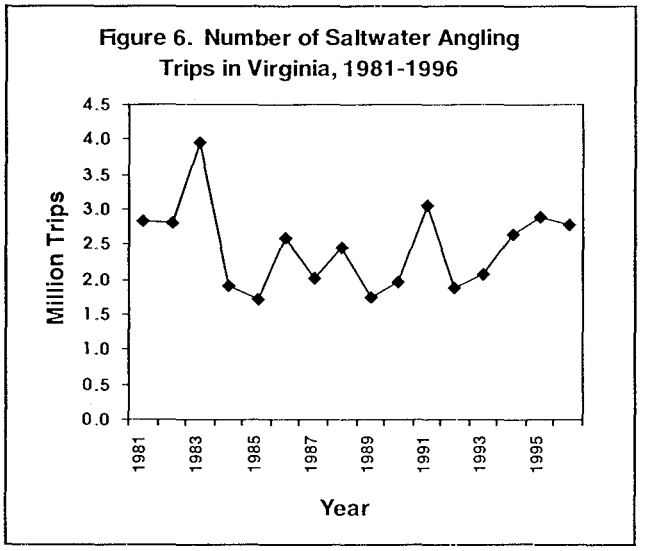
Relative to anglers ranking of fishing compared to other outdoor activities, Steinback and O'Neil found that 70% of the anglers from Virginia, New York, and Connecticut reported that fishing was the most important outdoor activity. Only 50% of the anglers in Maine reported fishing as "most important."

Participation and Mode of Saltwater Angling

The National Marine Fisheries Service (NMFS) reports estimated number of angler trips by three major categories or modes: (1) private and rental boats; (2) shore and pier; and (3) party and charter boat. In addition, NMFS reports estimated number of trips by body of water: (1) inland; (2) ocean out to less than or equal to three miles; and (3) greater than three miles from shore in the ocean.

Over the period 1981 to 1996, the number of annual angling trips in Virginia varied considerably, and yet, were nearly the same at the beginning and end of the 1981 to 1996 time period (Figure 6). In 1981, anglers took a total of 2.83 million trips; in 1996, anglers took 2.79 million trips. The most number of trips occurred in 1983 when anglers took an estimated 3.97 million trips. The overall trend in number of total trips is a slight decline. The trend between 1984 and 1996, however, suggests an increase in the annual number of angling trips. The apparent abnormally high number of trips in 1983 and 1991 may be the result of randomness in sampling or in angler behavior.

Figure 6. Number of Saltwater Angling Trips in Virginia, 1981-1996



Although there is some rental boat activity in Virginia, most trips are taken aboard privately owned boats (Table 1). In 1996, 62.8% of all saltwater angling trips were made aboard privately owned or rental boats. This is in stark contrast to 1981 when only 40.9% of all trips were taken aboard privately owned or rental boats. Since 1992, the number of trips from private or rental boats has increased, with the exception of 1996 which exhibited a slight decrease in the number of trips taken aboard privately owned or rental boats.

When the number of trips taken aboard party or charter boats is considered, we once again find extreme variation in the number of trips on an annual basis. In 1981, anglers took 232,390 trips aboard a party or charter boat; the number of trips taken aboard party of

Table 1. Distribution of Total Trips in Virginia, by Mode and Year, 1981-1996.

Year	Total Number of Trips	Percent of Total Trips by Mode		
		Private/Rental	Party/Charter	Shore
1981	2828448	40.9	8.2	50.9
1982	2795857	34.1	45.3	20.6
1983	3967312	35.1	8.8	56.1
1984	1918751	58.4	6.8	34.7
1985	1717595	58.0	9.6	32.4
1986	2578928	65.8	8.9	25.4
1987	2028075	65.7	7.6	26.7
1988	2461821	67.0	6.1	26.9
1989	1748811	67.2	4.1	28.7
1990	1962276	66.3	6.3	27.4
1991	3044585	58.5	6.0	35.5
1992	1877642	63.2	3.8	33.0
1993	2067787	58.8	4.9	36.3
1994	2634221	63.9	6.2	29.9
1995	2885403	61.9	5.2	32.8
1996	2786200	62.8	4.5	32.7

charter boats equaled 8.2% of all saltwater angling trips in Virginia in 1982. In 1982, the number of trips aboard a party or charter boat increased to 1.3 million, which equaled 45.3% of all saltwater angling trips in that year. In 1996, the number of trips taken by anglers on party or charter boats equaled 124,777 trips; the number of party or charter boat trips has steadily declined since 1994.

It might be anticipated that the number of trips taken by shore anglers would be greater than all other modes of fishing in Virginia. Virginia has numerous public and private piers and easily accessible beaches and shore-based angling is typically less expensive than other modes of angling. Yet, the number of trips taken by shore-based anglers was only slightly more than one-half of the trips taken by anglers aboard privately owned or rental boats in 1996. Since 1992, except for 1996, the number of trips taken by shore-based anglers has steadily increased. In 1982, shore-based trips accounted for 50.9% of all angling trips; in 1996, shore-based trips were responsible for only 32.7% of all trips in Virginia.

What About Areas Fished?

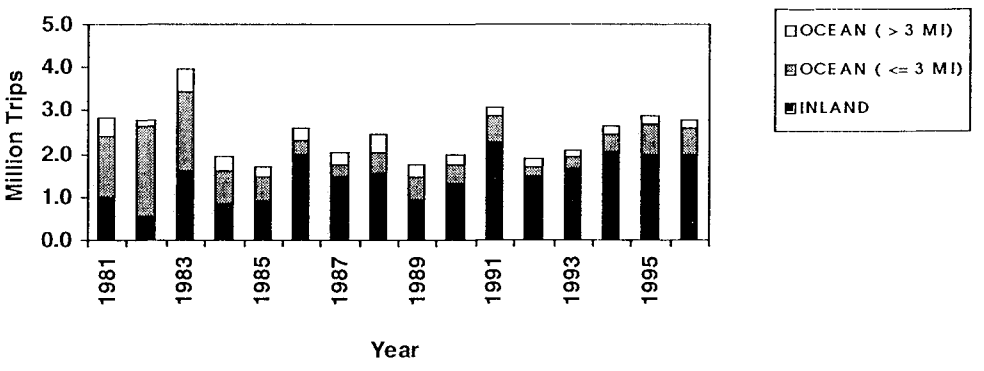
Anglers fishing in Virginia have a wide array of possible areas to fish. Besides the Chesapeake Bay, there are numerous rivers or tributaries. Then there is the inshore portion of the Atlantic Ocean. And of course, there is the offshore area of the ocean.

Not surprisingly, saltwater anglers take the majority of their trips in the Bay and tributaries (Figure 7). Fishing the Bay and tributaries is typically more convenient and less expensive than fishing the ocean waters where larger boats and usually heavier tackle are required. Since 1985, the number of trips taken in the Bay and tributaries have consistently exceeded 50% of the total number of angling trips. Prior to 1985, however, the majority of the total number of trips were reported by anglers to be taken in the inshore ocean area. In 1981, anglers made 974,139 trips in inland waters or the in the Bay and tributaries. In comparison, anglers made nearly 2 million trips in the Bay and tributaries in 1996; the number of trips taken in the inland waters accounted for 71.7% of all trips made in 1996.

In contrast to the number of trips taken in the Bay and tributaries, the number of trips made within three miles of the ocean coastal area declined considerably between 1981 and 1996. In 1981, anglers made 1.4 million trips within three miles of the ocean coast; anglers took 590,216 trips in 1996. Since 1992, however, there has generally been an increase in the number of trips taken within three miles of the coast. In 1982, trips taken within three miles of the coast accounted for 74.4% of all saltwater angling trips. In 1996, trips made within three miles of the coasts, accounted for 21.2% of all trips.

Offshore trips, during which large gamefish such as white and blue marlin, bluefin and yellowfin tuna, albacore, and sailfish are sought, typically entail larger and more expensive fishing boats. In terms of the percentage of all trips made by saltwater anglers, the number of trips made in the offshore areas have typically been quite small compared to the percentage of trips taken in other areas. In 1981, trips made in the offshore areas accounted for 14.4%; in 1996, offshore trips accounted for only 7.1 percent of all trips. Over time, the number of offshore trips has generally declined; since 1993, however, the number of offshore trips has increased.

Figure 7. Number of Saltwater Angling Trips in Virginia by Area Fished, 1981-1996



Determining the Economic Value of Saltwater Angling

Measures of Economic Value

To many individuals, the economic value of any economic activity is the number of jobs, the level of expenditures, or the amount of sales generated. Such measures, however, are simply economic impacts of an activity; that is, they measure the size of the activity in terms of market transactions. Unfortunately, such measures do not indicate the true economic value or worth of a good or service, and especially the economic value of a natural resource or activity such as recreational angling.

If one ignores the distribution of income, economists have shown that the best allocation of resources is the one that provides the highest economic value. Economic value emphasizes human preferences. It is a measure of the maximum amount of an asset that an individual would be willing to give up to obtain some good, service, or state of the world. The best measure of the value of the fishery resource includes two parts. The first is the willingness of anglers to pay for access to this resource minus what they must pay (or forego) to get access. The second is the amount of revenues commercial fishermen earn minus the cost of harvests and the foregone profits of harvests in other fisheries.

When a consumer purchases a good or service in a well- defined market, the price paid does not always equal the price the consumer might have been willing to pay. What the consumer actually pays is a result of market forces in which supply equals demand. The supply reflects the preferences of producers to sell various quantities at various prices, and the demand reflects the preferences of consumers to purchase various quantities are various prices. The market-clearing price is established by the equilibrium between demand and supply; the market price is the price actually paid by the consumer.

When the consumer would have been willing to pay more than the market clearing price, the consumer receives a surplus equal to the maximum amount the consumer was willing to pay less the amount actually paid. This surplus is called consumer surplus and represents the net value of the good to the consumer. Alternatively, we may talk about consumer surplus in terms of net willingness to pay (WTP) which represents the maximum amount a consumer would be willing to pay to acquire a given quantity of a given good or service less what they actually paid.

Given that many goods, services, or states of the world cannot be purchased from well-defined markets, we must have some way or ways to measure the economic value or benefits. Although there are numerous measures of economic value that can be used as a measure, the measure that we use in this study is consumer surplus.

There, of course, is another aspect of valuation. What if a consumer owns or holds rights to a good or service? For example, a homeowner is selling a house. The homeowner already owns the home. What would be the minimum amount the owner would be willing to accept for the home? Economists typically refer to this as a willingness to accept or to surrender measure of value. The difference between the amount the owner received for the house and the minimal amount the owner would have accepted is a surplus and represents a net benefit to the owner.

Numerous methods may be used to determine the economic value of non-market goods and services, and especially saltwater angling in Virginia. Of the various methods that deduce people's willingness to pay from their behavior, the travel cost method is the most commonly used. The contingent valuation method is the most common direct technique. Lipton et al. (1995) provide an excellent discussion, with examples, of the various methods for determining economic value.

A more extensive discussion of the various measures and approaches is available in the following workings: (1) Bockstael et al. (1986, 1987, and 1988); (2) Mitchell and Carson (1989); (3) Freeman (1979); (4) McConnell (1983); (5) Just et al. (1982); (6) Johansson (1993); (7) Bentkover et al. (1986); (8) Layard and Glaister (1994); and (9) Kahn (1998).

Determining the Economic Value of Saltwater Angling in Virginia

For the purpose of determining the economic value of saltwater recreational angling in Virginia, we use the travel cost method. The travel cost method is a widely accepted approach for determining economic values of recreation; it is not, however, without it critics and criticisms. A common criticism is that there must be some easily observed behavior in order to reveal values. Another common criticism is that the approach is statistically complicated; this criticism, while valid, is less important today with the wide availability of various statistical algorithms. Last, there remain issues about the sensitivity of the estimates relative to the available data and the mathematical form of the equation which must be estimated.

With the travel cost model, it is assumed that visitors to a particular recreational site or fishing area incur economic costs in terms of time and related travel expenses. These expenditures per trip act like a market price for the recreational experience provided by the site or recreational activity. By obtaining information on the attributes of the trip, the necessary costs to take the trip, and the number of visits to a site, a demand relationship relating number of visits and cost per trip may be obtained. From the estimated travel cost demand model,

estimates of maximum willingness to pay and actual expenditures may be obtained and used to estimate consumer surplus or the economic value of recreational angling.

In the present study, there are two basic aspects to the travel cost demand analysis. Initially, we relate number of visits to a site to expected catch rates. This relationship is important to be able to estimate how number of visits and value might change in response to changes in resource abundance or regulations on the number of fish one might be allowed to catch. We next relate expenditures to number of trips. The two relationships are estimated by statistical procedures widely used to estimate the travel cost model.

Initially, the travel cost demand is estimated for a representative consumer or angler. In order to obtain an aggregate value or the value to all anglers, we use a population expansion factor. We subsequently obtain estimates of the economic value of saltwater angling in Virginia for all saltwater anglers.

Data for Estimating the Travel Cost Models

Data were obtained from an intercept or field survey and a follow-up telephone survey of individual anglers agreeing to be interviewed via telephone. The survey was conducted in 1995 and 1996 and was added onto the National Marine Fisheries Service recreational survey. This add-on was done to minimize survey costs and ensure a large number of useful responses. The survey was conducted when fishing was most active in Virginia. The NMFS recreational survey is divided into five two-month surveys; our survey followed the NMFS two-month wave sampling strategy. The two-month periods are March-April, May-June, July-August, September-October, and November-December.

The survey collected information on anglers' characteristics, such as travel costs per trip, boat ownership, number of rods per angler, hours of work per week per angler, as well as whether the angler fished from shore or from a boat. The means for these variables are given in Table 2. Anglers were divided into two modes of fishing because valuations are like to differ by mode of fishing. More avid anglers face different catch rates and different conditions when they fish from boats. In contrast, shore fishing can be more casual, undertaken with less preparation, and is less imperiled by random weather events.

Table 2. Angler Characteristics by Type of Fishing, Weighed by the Reciprocal of Trips*

Angler Characteristic	Boat Fishing (Private or Party/Charter)	Shore Fishing
Number of Trips	3.03	3.57
Travel and Fishing Costs	$34.13	$23.64
Percent of Anglers:		
Not Targeting Any Species	23.5%	
Targeting Croaker	16.6%	24.8
Rods per Angler	5.9	4.9
Percent of Anglers Owning A Boat	47.8%	-

[a]Weighing by the reciprocal of trips corrects for the sampling bias of intercepting more frequently anglers who take more trips.

Data were also collected on success rates. Information on the angler's success rate is necessary to know how anglers adjust their behavior to changes in success. The measure of success used in this analysis is the catch rate which was calculated using data obtained from prior National Marine Fisheries Service (NMFS) recreational surveys and our field survey. The NMFS survey record species, weights, and lengths of fish from randomly selected anglers. Data were available from surveys conducted over the past 15 years. We used the number of fish as the catch rate, rather than weight, because weight data tend to be less reliable indicators of angler success (Table 3).

Table 3. Catch Rates by Mode of Fishing-Number of Fish

Historical Mean Catch Rate	Boat Fishing	Shore Fishing
Gamefish	0.44	0.12
Bottomfish[a]	1.00	1.19
Summer flounder	1.36	N/A
Random or Non-targeted	1.12	0.81

[a]The catch rate for bottomfish includes tautog, croaker, spot, and summer flounder for shorefishing, but only tautog, croaker, and spot for boatfishing. In effect, bottomfish are not completely aggregated for boat fishing.

The Economic Value of Saltwater Angling in Virginia

The Economic Value of Saltwater Sport Fishing in Virginia

Rather then present the economic analysis and valuation typical of most economic valuation studies, we focus on asking and answering questions relative to the important aspects of the valuation of saltwater angling in Virginia. We initially discuss different types of economic measures. Subsequently, we present the dollar value estimates of the benefits of saltwater angling in Virginia.

Question 1: The first question we pose is "Why doesn't the report present benefits in terms of jobs created, taxes received, sales, and income earned from fishing?" These are, after all, measures of the economic importance of saltwater angling. They are also the indicators most commonly used by local governments and legislators to infer benefits of economic activities.

While the number of jobs, level of sales, income earned, and taxes received are important to the state and local economies and are viewed as benefits by economic planners, these are not measures of the true value of a good or service. If individuals do not spend their money on angling, they will spend it on something else. That something else, in fact, may generate more jobs, earnings, and tax revenues than generated by angler expenditures. It may not, however, generate more value to the individual. As discussed earlier, value is a measure of the maximum amount of money an individual might be willing to pay to be allowed to do something. It is the net gain to making recreational fishing available. In this report, we use the term value to indicate the net benefit in monetary units to an angler from being able to engage in angling. The net benefit is equal to the total value an angler receives from angling less the expenditures paid to fish. Kirkley and Kerstetter (1997) provide an extensive assessment of the economic impacts of Virginia's saltwater sport fisheries.

Question 2: The report provides calculations of something called consumer surplus and then indicates that this is a measure of benefits or the true value to society of sport fishing. What exactly is consumer surplus?

Consumer surplus equals the total amount, in monetary terms, an angler would be willing to spend to engage in recreational fishing less the expenditures actually made by the angler.

Question 3: Recreational angling is often viewed as folks just engaging in a good time. If individuals could not go sport fishing, wouldn't they just do something else and be just as happy?

Yes and no! If anglers could not go fishing, they would do something else. They would not, however, be as happy, because they have shown by revealed behavior what their first choice was. If we consider that the decision to take a fishing trip reflects a decision by an angler consistent with wants and needs, we find that the decision was one that maximized the happiness of the angler subject to whatever limitations the angler faced. Any constraint on the decision must result in less happiness to the angler.

Question 4: What is the economic value or benefit of saltwater angling in Virginia?

Using information collected for this study and summarized in the technical appendix of this report, we estimate that the total net benefits or value of saltwater angling in Virginia to anglers equaled $353.5 million in 1996. This means that after deducting for expenditures, anglers received $353.5 million in benefits from saltwater angling in 1996.

Question 5: What is a day of sportfishing in Virginia worth to an angler?

It is not a simple matter to assign a value for a typical day of sport fishing in Virginia. There are different types of sport fishing and different species of fish to catch. An average value for all types of saltwater fishing trips is $92.19 per trip. The average value or consumer surplus per trip for a boat fishing trip is $137.00, and the average value for a shore fishing trip is $73.00.

Question 6: Are there differences in the economic value to Virginia anglers that arise from different types of saltwater angling? For example, which type of fishing has the highest economic value—fishing from the shore or fishing from a boat?

In 1996, the total value, or benefits less expenditures, received by anglers from boat fishing was $256.9 million. Anglers fishing from the shore received $102.5 million in value or net benefits.

Question 7: Boat ownership is often thought to be critically important to the satisfaction derived from sport fishing in Virginia? Does boat ownership influence the economic value per angler per trip?

Owners of boats value catching extra fish at approximately the same level as others. The boat angler who owns a boat has more trips and higher consumer surplus per trip. Using the estimated demand curve, we find that expected trips would be 6.75 trips for the boat owner rather than 3.04 for a non-boat-owner and the annual consumer surplus is estimated to be $925, up from $416. When buying a boat, the angler clearly expects to gain in terms of the amenities of fishing. Access to

fishing generates boat activity. If fishing quality were to decline significantly, then we might expect significant reductions in boat activity.

Anglers from boats typically invest time and money in catching fish, and tend to be much more avid anglers. This is reflected in their consumer surplus. On average, boat anglers demonstrate a willingness to pay of $137 per trip for access to fishing. However, anglers from shore do enjoy fishing, and they reveal themselves willing to pay $73 per trip on average for the right of access.

Question 8: Anglers travel from all over the state of Virginia as well as from areas outside Virginia to engage in recreational fishing, are there differences in the economic value per trip per angler between anglers living nearshore and anglers living far away from each access? Alternatively, does the distance an angler has to travel to engage in sport fishing really make a difference in terms of the economic value?

Those anglers who face lower costs of fishing by virtue of where they live have higher values of fishing. For example, an angler who lives 50 miles farther from shore than another angler would on average experience an approximately $20 per trip higher cost. This would imply that the angler living farther from the shore would not take as many trips nor have as high an annual willingness to pay as anglers living closer.

Question 9: If the cost of sport fishing per trip were to increase for each angler, would the increase actually affect the amount of economic value received by the angler from sport fishing in Virginia?

Sports anglers enjoy access to fishing, and gain from this access, because they can fish at lower costs than if they had to pay for access. Given the demand curves, we can approximate the losses of having to pay higher costs. Suppose that an angler living 10 miles from the shore experiences a gasoline price increase equivalent to 5 cents per mile. This implies a $1 increase in the cost per trip, given the 20-mile roundtrip. For a shore angler averaging 3.5 trips per two-month period, this implies an upper bound of $3.50 for the loss in the value of access (and possibly fewer trips). Price increases cause net losses in well being, even accounting for the fact that sellers of resources may gain.

Question 10: What are the economic values to sport anglers of the major saltwater recreational species of Virginia?

Since the data collected for the study were limited relative to each species caught by an angler, we were restricted to assessing the economic value of five species groupings: (1) bottomfish, (2) gamefish, (3) summer flounder, (4) croaker and spot, and (5) random or non-targeted species.

Bottomfish include tautog, seabass, and other species (e.g., red and black drum). Gamefish include striped bass, bluefish, sea trout, cobia, king mackerel, large offshore gamefish, nearshore gamefish, and other species. Random or non-targeted species reflects those species caught during trips that anglers indicated no preferred species or no species-directed fishing activity.

We consider three species-specific valuations: (1) the value of all trips for which anglers attempted to catch particular species or a group of species; (2) the value to an angler of catching one pound of the species (i.e., the value in terms of a per-pound basis); and (3) the value received by an angler of catching one more fish of a particular type.

10a. What is the economic value of each species caught in 1996?

Providing an answer to the question of what is the economic value of each species is quite complicated. First, it is necessary to know the number of directed fishing trips (i.e., the number of trips for which anglers indicated they were specifically targeting or trying to catch a particular species). We must have information on the expenditures by directed trip. We also must consider the species contribution to random or non-targeted trips.

Anglers received a total economic value of $353.3 million in net benefits from recreational angling in 1996 (Table 4). Gamefish generated the largest net benefits ($204.2 million). As might be expected, boat anglers received the largest net benefits from gamefish ($134.3 million). In contrast, shore anglers directing their fishing towards gamefish received $69.9 million in economic value. After gamefish, croaker and spot had the highest

Table 4. Economic Value of Selected Saltwater Species, 1996.

Species[a]	Valuation Relative to Fishing Mode		Total Valuation
	Boat	Shore	
Bottomfish	$ 10,014,000	$ 2,796,000	$ 12,810,000
Gamefish	134,303,000	69,911,000	204,214,000
Summer Flounder	33,421,000	9,341,000	42,772,000
Croaker and Spot	55,192,000	15,421,000	70,613,000
Random or Non-Targeted Species	18,046,000	5,042,000	23,088,000
Total	$250,976,000	$102,511,000	$353,487,000

[a] Bottomfish include tautog, spot, seabass, and other species (e.g., red and black drum. Gamefish include striped bass, bluefish, sea trout, cobia, king mackerel, large offshore gamefish, nearshore gamefish, and other species. Random or non-targeted species reflects those trips for which anglers indicated no preferred species or no species-directed fishing activity.

economic value in 1996. The total economic value was $70.6 million; boat anglers received $55.2 million and shore anglers received $15.4 million in economic value. Summer flounder was third in economic value ($42.8 million); boat anglers received $33.4 million while shore-based anglers received $9.3 million in economic value. Random or non-targeted species provided $23.1 million in economic value. Boat trips with no targeted species received $18.0 million and shore anglers received $5.0 million in value. Boat and shore-based anglers targeting bottomfish received $12.8 million in economic value in 1996.

10b. What is the economic value of each species on a per pound basis.

This is also a difficult question to answer, but one that is very frequently asked. The difficulty of answering this question lies in the fact that the marginal valuation of each species varies in accordance with the potential size that may be caught relative to the size actually caught. For example, the value per pound of a forty pound striped bass is likely to be higher than the per pound value of a 4 pound striped bass. Our data set lacks sufficient clarity to adequately value every species and aggregate groupings on a per pound basis. We therefore limit our value per pound to identified species and make no attempt to value the various species groupings on a per pound basis (Table 5). We also assess the economic value only with respect to what was caught and retained; we cannot assess the economic value relative to discards because no weight data for discards are available. Our estimates reflect the average economic value received per angler per pound of each species caught and retained.

The economic valuations reflect the size differences as well as the cost of fishing from a boat vs. from the shore. Typically, the fish caught from shore fishing weigh less than those caught fishing from a boat. While striped bass and other gamefish tend to have the highest value relative to all trips taken by anglers, bluefish and sea trout top the list when assessed on a per pound basis. The large value for bluefish likely reflects the increasing scarcity of bluefish and the increasing abundance of striped bass. Simply, anglers receive more value per pound of bluefish caught than they do per pound of striped bass caught because striped bass are more highly abundant and easy to catch since the resource increased. Also, the catch of striped bass is limited to two per day and the striped bass have been quite large. This is a problem with attempting to impute a value on a per pound basis; simply, lower economic values on a per pound basis will be associated with larger fish of a given species. Sea trout has always been a highly desired fish, but it was relatively scarce in 1995 and 1996 which is the time period of this study. The high value thus probably reflects the scarcity value of sea trout. The high value of croaker and spot relative to other species is surprising given the recent abundance of the two species. Again, however, the high value illustrates the potential problems of attempting to impose an economic value on a per pound basis.

Table 5. Economic Value on a Per Pound Basis of Selected Species

Species	Value by Fishing Mode	
	Boat Fishing	Shore Fishing
Black Sea Bass	$12.27	$ 6.19
Bluefish	60.61	24.98
Croaker and Spot	19.93	6.29
Sea Trout[a]	47.83	22.91
Striped Bass	10.93	3.31
Summer Flounder	13.66	3.39
Tautog	3.15	1.57

[a]Sea trout includes weakfish and speckled sea trout.

10c. A remaining question and one that is frequently asked is what is the value of being able to catch one fish? That is, what would it be worth to the angler to be able to catch one more fish per trip? This type of question, while being of interest to anglers, is also very important relative to allocation decisions. For example, what if a management agency was considering increasing or decreasing a daily creel limit or quota. How much would the angler gain or lose in benefits or economic value.

Obtaining the necessary information to assess the economic value of being allowed to catch one more fish is considerably easier than obtaining the information necessary for assessing the economic value on a per pound basis. Our survey directly questioned the angler about how much they would be willing to pay to catch one more fish per trip.

As shown in Table 6 (on page 12), anglers receive the greatest value from being able to capture on more gamefish. This result is likely indicative of the creel limits imposed on striped bass and sea trout. For the boat mode of fishing, the high value also reflects the desire by anglers to be able to catch one more of the large offshore gamefish such as a marlin or tuna. Summer flounder provides the second highest value per trip associated with being able to catch one more fish; the value for summer flounder also likely reflects the creel limit regulations. The relatively low values for croaker and spot are likely indicative of the fact that there are no creel or size limits for either of the two species and both species are typically highly abundant and easily caught.

Table 6. Economic Value of Selected Saltwater Species (Catching One More Fish)

Species[a]	Valuation Relative to Fishing Mode	
	Boat	Shore
Bottomfish	$11.00	$ 2.60
Gamefish	56.00	14.00
Summer Flounder	17.00	4.00
Croaker	11.00	2.60
Random or Non-Targeted Species	7.00	1.65

[a]Bottomfish include tautog, croaker, spot, seabass, summer flounder, and other species (e.g., red drum) for shore fishing, and only seabass, tautog, croaker, spot, and other species (e.g., red and black drum) for boatfishing. Gamefish include bluefish, striped bass, sea trout, cobia, king mackerel, large offshore gamefish, and other nearshore gamefish species for boatfishing.

Summary and Conclusions

Saltwater angling generates considerable economic value for Virginia anglers. In 1996, anglers received approximately $353.5 million in benefits from saltwater angling. The average value per trip per angler, relative to all types of fishing, was approximately $92.19. An angler making fishing trips from a boat received $137 in net benefits, and an angler making a shore trip received about $73.00.

The highest net benefits were associated with fishing for gamefish ($204.2 million). The second highest level of net benefits were derived from fishing for croaker and spot ($70.6 million). Fishing for summer flounder generated about $42.8 million in net benefits. Fishing for various bottomfish generated the lowest net benefits for anglers ($12.8 million). Anglers simply fishing with no intended or stated desired species received $23.1 million in net benefits.

The value or net benefit per pound per species was surprisingly high for some species. Bluefish, which were once highly abundant in the Chesapeake Bay, generated the highest net benefit to anglers in 1996 ($60.61 per pound). The very high value relative to some of the other species examined is very likely associated with the scarcity of the resource. Striped bass, which was expected to have the highest value, had a relatively low per pound value; the low value was very likely associated with the extremely high abundance and availability of striped bass in 1996. Sea trout was determined to have the second highest value per pound of the species examined.

An important result of the study was the net benefits or value received by an angler if allowed to catch one more fish. The value of being allowed to catch one more fish is perhaps the most critical element for making allocative decisions (i.e., dividing up the resource among competing user groups). In this study, the highest value was for gamefish which includes striped bass. The economic value of being able to catch one more game fish (e.g., striped bass) was estimated to equal $60.00 in 1996 for an angler fishing from a boat; the value to an angler fishing from the shore was estimated to equal $14.00. These high values are probably the result of restrictive creel limits on striped bass. If anglers could catch one more summer flounder, another species subject to restrictive limits on the number and size of fish caught, they would receive $17.00 in net benefits (total value less additional expenditures).

Although the present study determined the economic benefit or value of saltwater recreational angling in Virginia, there remain important gaps in the study. First, no attempt was made to estimate the economic value of catching different size fish. Knowing the economic value per species relative to size of fish caught is critical for regulating fisheries. In general, the value per fish caught is higher for larger fish than it is for smaller fish. In this study, we were unable to obtain the information necessary for estimating the economic value per fish caught relative to different size categories. This type of analysis, however, was not proposed in the original study.

Another factor that complicated the study was the different bodies of water fished by saltwater anglers. Although it was necessary to estimate the demand by water body fished, we made no attempt to summarize results of these estimates. If the results of these estimates were to be provided in this report, the report would probably exceed 200 pages in length. A 200-page report is simply not a practical size document for general consumption.

If there is to be any future analyses of the economic value of recreational angling in Virginia, it should focus on the following: (1) determining the economic value by species and size or age category; (2) assessing the economic value by water body; (3) differentiating the economic value received by angler relative to area of residence (e.g., near shore, inland, and out of state); (4) assessing the economic value to anglers who frequently fish from their personal property; and (5) a more in-depth study of those anglers who do not regularly target species or have no desired species preference.

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Appendix

The Estimated Travel Cost Demand Functions.

There are two equations estimated, one for boat anglers and one for shore anglers. These equations are estimated in the form of a Poisson. That is, there are modeled as if the number of trips could be 1, 2, 3, etc. The Poisson means that the number of trips is a random variable distributed as if Poisson. The number of trips recorded is by two-month period, so that each of the demand curves may be considered 'two-month' demand curves. (The models are tested for over-dispersion that leads to a negative binomial, but the hypothesis of no over-dispersion cannot be rejected.) The expected value of trips per two-month period is given by the following functional form:

$$E(\text{trips}) = \exp(x\beta)$$

where x is a vector of independent variables that influence the demand for trips—travel cost, catch rates, boat ownership, etc and β is a vector of coefficients that represent the influence of the independent variables on number of trips taken. The vector β is different for each equation. It is estimated by maximum likelihood methods, with weights equal to the reciprocal of the number of trips. The following table gives the estimated parameters for each equation.

These equations are reasonable given the number of observations for each type of fishing. Boat fishing is positively influenced by boat ownership, not surprisingly, and the historic catch rate for gamefish. For boatfishing, the catch rate on summer flounder has a greater effect on trips than the catch rate on other bottomfish, but summer flounder is not as strong an influence as the gamefish catch rate. Travel costs influence it negatively. Travel costs also influence shorefishing negatively and the historic catch rate for gamefish increases the demand for shorefishing. The catch rate for bottomfish is negative but not significantly different from zero.

A. The value of access. Anglers who pay less than they would be willing to pay to go fishing receive consumer surplus or value. This consumer surplus is the value of access, which is essentially the area underneath an angler's demand curve. Using the expected value of trips, we can calculate the consumer surplus as the area under a demand curve:

$$\text{Consumer surplus} = \int_0^{p^*} \exp(\beta_0 + \beta_1)dp = -\text{trips}/\beta_1$$

In this equation, the quantity $x\beta$ is equal to $\beta^* + \beta_1 p$, where p is the current travel cost paid by the angler and β^* includes the other independent variables. The coefficient β_1 is the coefficient of the travel cost, that is the influence of travel cost on the demand for trips. Since demand curves are sloping downward, this coefficient will be negative. In the travel cost row of the estimated equations, the coefficients are -.0073 and -.0136 for boatfishing and shorefishing. The calculation required according to the expression given in the equation is to divide the number of trips by the negative of the coefficient on the travel cost. Note that if the consumer surplus for access is divided by the number of trips, the result is consumer surplus per trip, which turns out to equal $-1/\beta_1$. This result is well known for this particular functional form. It states that the consumer surplus per trip equals the reciprocal of the coefficient on

Table A1. Estimated Models for Boat and Shore Fishing

Factors	Private Boat and Party/ Charter Demand	Shore Demand
	Truncated Poisson	Truncated Poisson
Travel and Fishing Costs	-.0073[a] (-3.55)	-0.0136 (-2.38)
Historic Mean Catch of Gamefish	0.572 (8.45)	0.216 (1.29)
Historic Mean Catch of Bottomfish[b]	0.077 (1.45)	-0.090 (1.45)
Historic Mean Catch of Summer Flounder	0.131 (3.62)	-
Historic Mean Catch of All Fish by Non-targeting Anglers	0.049 (0.58)	-
Angler not targeting species	-0.398 (-0.99)	-.174 (1.73)
Angler targeting croaker	-1.219 (-3.95)	-
Boat Ownership	0.806 (4.96)	-
Rods Owned	-	0.081 (5.03)
Constant	0.355 (2.82)	1.28 (4.89)
Variance Estimate[c]	Not significant[c]	Not significant[c]

[a]T-statistics in parentheses.
[b]The bottomfish historic catch rate combines tautog, croaker and summer flounder for shore fishing, but includes only tautog and croaker for boat fishing.
[c]The test for a nonzero variance is a test for the negative binomial.

the travel cost. This implies that the value (or consumer surplus) per trip for boat fishing is $137 and for shorefishing, $73.

The calculations for consumer surplus for boat fishing and shore fishing are based on the β_1's from the travel cost equations and the trips from Table 1 in the text.

Consumer surplus at mean trips for boatfishing =

3.04/.0073=$416.

Consumer surplus at mean trips for shorefishing =

3.57/.0136=$262.

The $416 figure for boatfishing means that for an average two month period, the angler would be willing to pay $416 rather than go without fishing. Similarly for shorefishing, $262 represents the maximum amount an angler fishing from the shore would pay rather than go without fishing. It is important to understand that if we multiply these two-month values by six to get an annual value, we probably underestimate the annual value. If an angler were to give up fishing in one two-month period, the value of the additional fishing opportunities would be enhanced.

B. Variations in the Value of Access. It is obvious that some anglers like fishing better than others. Often this difference in preferences is purely random, a consequence of a galaxy of unobserved influences. However, the estimated equations provide some evidence of systematic variation. For example, if an angler is a shore angler but does not target a species, perhaps indicating less experience or interest in fishing, the demand for fishing trips becomes trips*(exp(-.174)), where trips is the expected level of trips for anglers who are otherwise identical but do seek a species. If we take the trips as the mean for shore fishing at 3.57, then the trips for non-seekers becomes 3.57*exp(-.174)=3.57*.84=3. On average, for a two- month period, this condition of not seeking a species implies that demand averages 3 trips rather than 3.57 trips. This also means that consumer surplus averages $220, down from $262. By similar reasoning we can show that a boat angler who owns a boat has more trips and higher consumer surplus. The expected trips would be 6.75 rather than 3.04 and the consumer surplus would be $925, up from $416. When buying a boat, the angler clearly expects to gain in terms of the amenities of fishing.

C. The Value of Increasing Catch Rates. This value comes from the explanatory role of historic catch rates in the estimated equations. Let's suppose that anglers expect to catch one more fish per trip, for each trip. By historical standards, this is quite a large increase. For example, Table 3 of the text shows that historic catch rates for the different species groups for different kinds of fishing. An increase of one fish per trip would mean over a 200 percent increase for gamefish. We can estimate the value per trip to a typical angler by finding the average consumer surplus for two fish and subtracting from it the average consumer surplus of the original catch of one fish. This number tell us what an angler would pay on average, on a per trip basis, for one more fish.

For example, in the boat fishing equation, the coefficient on mean game fish catch rate is .572. Starting from the mean trips of 3.04, a 50% increase in this mean catch rate would raise trips to 3.04*exp(.572*.5*.44) $\approx$ 3.45. This expansion in demand would increase the consumer surplus of the representative angler from $416 to $472 per two month period or by $56.00 for one more fish. Similar calculations can be made for other species groups.