BENEFITS FROM IMPROVEMENTS
IN
CHESAPEAKE BAY WATER QUALITY

Volume III
of
BENEFIT ANALYSIS USING INDIRECT OR IMPUTED MARKET METHODS

(Budget Period II)

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Forward

This is the second of two reports constituting the final report for budget period II of Cooperative Agreement #811043-01-0, which was initiated and supported by the Environmental Protection Agency. From the beginning, this cooperative agreement haa dealt with improving methods of measuring the benefits of environmental improvements. Budget period I of the agreement produced two documents which considered theoretical, conceptual and methodological issues involved. in using hedonic models (Vol. I) and recreational demand models (Vol. 11) evaluating environmental improvements.

The second budget period's work has extended the work of the first, especially in the area of recreational demand models. Volume I of budget period II's final report looks at the theoretical issues of measuring the benefits of quality changes, the conceptual issues surrounding perceptions of water quality and methodological issues related to estimating models with sample selection problems.

The report which follows is the second part of budget period II's final report. This report provides information on the recreational activities which take place on the Bay, as well as the monetary values people place on these activities. While not commissioned with the intent of helping in the process of revising the Bay plans, we hope that the discussions in this report will do just that.

Executive Summary

For more than ten years, the Chesapeake Bay has been the focus of an impressive amount of research and an array of environmental programs. The Chesapeake Bay Program, a cooperative effort by the federal government, Maryland, Virginia, Pennsylvania, and the District of Columbia, represents a coordinated commitment to enhancement of the water quality of the Chesapeake Bay.

Large commitments of money have been made to clean up the Chesapeake Bay. Yet there is little understanding of the nature and extent of the benefits which are derived from these massive commitments. Raising this issue does not imply that either the programs are misguided or need to be justified on some benefit-cost criterion, for many believe that the cleanup process is an expression of a fundamental morality that despoiling our surroundings is wrong. But understanding more precisely how *people* benefit from cleaner water in the Bay can help in allocating resources to clean up the water, for funds must be allocated temporally, spatially and functionally. Perhaps knowledge about the benefits from water quality improvements can help with those decisions.

Even though the returns from the Program derive from human benefits--human use and human health--the specific objectives and implementation strategies are designed to affect chemical and biological characteristics of the Bay. The connection between human benefits on the one hand and reductions of nutrients and toxic materials" on the other remains implicit. Perhaps the clearest link is between human use and fisheries and wildlife management. Here the vehicle for linking the strategy and the goal is at least understandable, even if the details of this linkage remain indistinct. In other cases, however, we are left confused as to how the policies impact on humans and how we would *ever* measure the success of these policies in terms *of* their achievements.

Thie report attempts to focus attention on the human use of the Chesapeake Bay. It describes something about the nature and level of that use. It also considers what we know and what we do not know about the relationship between chemical and biological characteristics of the Bay and human use. This relationship must be understood in order to address the more complex measurement of human benefits.

One objective *of* the report is to provide estimates *of* values *of* Chesapeake Bay recreational activities and willingness-to-pay estimates of improvements in water quality associated with these activities. Available data has been used together with what is known about estimating environmental benefits. While Chapters 3, 4, 5 and 6 reflect our beat efforts at this task, it should be kept in mind that benefit estimates have an elusive nature. A number of different studies have been assembled, and an array of methods and specifications has been used to provide as much information as is currently available on the topic.

The benefit estimates themselves do not represent this report's most important contribution, however. We seek to describe, model and to some extent explain recreational uses of the Chesapeake. We may have serious doubts about the precision of willingness-h-pay estimates, but we still learned a great deal about the factors which matter to people in using the Bay, the obstacles to their increased enjoyment of the" Bay and the distributional implications of improving the Bay.

Specific information contained in this report includes:

- Maryland boaters, beach users and sportfishermen alter their behavior in response to poor water quality, as scientifically measured.

- Demographic factors, such es income and location of residence, influence observed use of the Bay.

- Cent ingent valuat ion experiments (hypothetical responses) reveal an " annual wi 11 ingness to pay in increased taxes of over $100 mi 11 ion for improvements in Chesapeake Bay water quality.

- Observed behavior of Maryland western shore beach users reveal an annual willingness to pay for 20 percent improvements in water quality of between $2 million and $26 million.

- Many of the gains from water quality improvement are concentrated in the area of heaviest use around Annapolis, Maryland.

The estimates give magnitudes for the annual benefits to residents of the Baltimore-Waehington area of improving water quality in the Bay in the range of from $10 million to over $100 million. There are numerous sources of error and random elements in these estimates, and several activities and populations have been omitted. But based on these numbers, it seems plausible to estimate that the annual returns to cleaning up the Chesapeake are at least of this order of magnitude.

The long-run annual benefits will be higher than these estimates, however. Firat, as people learn that the Bay has become cleaner, they will adjust their preferences toward Bay recreation. This is especially true of people who do not currently use the Bay and are largely excluded from the analysis. Second, the population and income of the area have grown since 1984, and both are likely to grow more, increasing the demand for and value of improvements in water quality. Finally, we have ignored the value (both use and existence value) which households outaide the Baltimore-Washington area may have for the Bay. The Chesapeake Bay is a nationally prominent resource. Its improved health is of value to many who will never use it.

In conclusion, we hope this volume will provide a stimulus to decision makers to refocus attention on human uses of the Bay. Human uses and the protection of human health have always been the central theme of clean water legislation, but because of difficulties in relating these to specific standards, they have often dropped from sight in the formation of the actual programs. We hope to shed some light on ways in which Bay cleanup policies might be related to the behavior and preferences of actual and potential users of the Bay.

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Chapter 1

Environmental Programs for the Chesapeake Bay

Over the past ten years, the Chesapeake Bay has been the focus of an impressive amount of research and the beneficiary of a great many environmental programs. Concentrated *efforts* began in 1976 when the Congress directed the U. S. Environmental Protection Agency to conduct a five-year study of the Bay's resources and water quality. The study, which focused on three major problems of the Bay--nutrient overenrichment, toxic substances? and the decline of submerged aquatic vegetation--prompted action. In 1983 the three surrounding states, the District of Columbia, and the federal government signed a pact, the Chesapeake Bay Agreement *of* 1983, committing them to improve and protect water quality *of* the Chesapeake Bay through coordinated environmental enhancement activities. In late 1987 a new agreement was signed.

The State of the Bay's Water Quality

Concern over the Chesapeake Bay stems from declines in direct and indirect measures of the quality *of* the Bay's waters. The most apparent measures are related to the productivity of the Bay. Reduction in fish landings, combined with an awareness *of* the increasing loads *of* pollutants and their consequences, led scientists to assess the Bay's water quality.

The use *of* the term "qualit y" in assessing the Bay connotes a set of standards goals, or ideals with which the current conditions *of* the Bay can be compared. The quality of the water depends on one's standards, and the relevant standards depend on intended uses and frame of reference. For example, if the most desired use of the water were for transportation, then the Bay's current water quality would be quite satisfactory. At the other extreme, if one's standards are derived relative to the state *of* the Chesapeake Bay three centuries ago, its current quality is clearly too low.

Since the thrust of the Chesapeake Bay program cornea from observed declines in ecosystem productivity, it is useful to summarize the nature *of* those declines. Summary measures give the status of the Bay as a whole, but mask considerable differences in quality between the upper and lower Bay and among the various river systems and inlets of the Bay. The following measures suggest the nature *of* the thinking that led to the conclusion that the Chesapeake Bay waa declining in quality.

There are two kinds of evidence of the historical decline in the Bay's water quality. First there are scientific measures which are indicators of impairment *of* the Bay as a functioning ecos ystem. *A* common measure of water quality is the level *of* dissolved oxygen in the water. This is oxygen available to various plant and animal life. Its absence can eliminte higher forms of life from ecosystems. Studies have shown that the extent *of* water with little or no dissolved oxygen has increased by 15-fold in the last 30 years.

Another indicator of water quality is the level of nutrients (nitrogen and phosphorus, mainly). These nutrients, while not harmful per se, enhance algal growth, whose decay increases the demand for oxygen. The increase of nutrients in the Bay's waters is an indirect consequence of population growth, changing technology and industrial and agricultural expansion in the area.

The decline in submerged aquatic vegetation (SAV) is another indicator of the decline in the Bay's water quality. The decline in SAV is connected with turbidity and growth of epiphytes and phytoplankton, by excessive nutrification. The loss of SAV means less suitable habitat for spawning finfish and shellfish. There are of course many other indirect measures of the declining health of the Bay. They all reinforce the notion that human factors are destroying the traditional ecological linkages of the Bay.

There are other signs of declining water quality more cogent to the lay public. Landings of well-known anadromous species such as rockfish and shad have dropped precipitously in the past several decades. Oyster harvest and oyster reproduction have also declined in the past decade. There is some ambiguity in the use of landings as a measure of water quality, of course. A considerable increase in effort devoted to harvesting fish has happened to coincide with the increase of effluents over time. Further, natural phenomena such as hurricane Agnes (1972) induce cyclical variations in finfish and shellfish reproduction. Nevertheless, there can be little doubt that the quality of the Chesapeake Bay's waters has declined, both in terms of the ecological health of the estuary and the benefits to humans of its use.

The Current Environmental Programs

The foundation of the Chesapeake Bay Program is the Clean Water Act, the ongoing federal environmental legislation dealing with water. Under the Clean Water Act, appropriations have been made available annually to the Chesapeake Bay Program, providing both its operating budget and its grant funds. The relationship between the federal legislation and Chesapeake Bay activities goes beyond funding, of course, since the Clean Water Act establishes the guidelines by which states then set specific water quality standards. The Water Quality Standards Handbook is the most recent document which contains the guidelines prepared by EPA to assist states in implementing 1983 revisions of the water quality regulations.

The Handbook defines acceptable approaches by which water quality baaed effluent limitations may be determined. Whether the pollutant specific or biomonitoring approach is taken, however, states must adopt criteria which are sufficient to protect the "designated uses" of a water body. Determination of designted uses requires an "attainability analysis," i.e. physical, chemical and biological studies to identify the suitable potential uses of the water and to determine whether these uses have been impaired. There is, throughout, a clear sense of the central position which human use activities should play in the setting of standards and the overriding obligation states should feel toward the protection of human health where 'people are involved in recreational uses of aquatic resources.

The first plan of the Chesapeake Bay Commission waa the Chesapeake Bay Restoration and Protection Plan of September 1985. This is currently the central document describing the goals of the Chesapeake Bay Program and the means by which these goals are being achieved. The general goals as stated in the plan are to

> "Improve and protect the water quality and living resources of the Chesapeake Bay estuarine system (in order) to restore and maintain the Bay's ecological integrity, productivity, and beneficial uses and to protect public health." [1]

The goals of the Restoration and Protection Plan are broad, and include both ecological and human health, as well as productive use by humans. By and large, however, there is no clear connection between the goals of the Bay Program which emphasize human health and human use and the means by which humans benefit from implementation.

To accomplish the broad goals, specific objectives and implementation strategies have been developed. Many of these strategies are designed to reduce or control nutrients. Major strategies to control point sources of nutrienta include plane to provide grants to design, construct, operate and maintain sewage treatment facilities, and plans to support phosphorous removal projects at treatment plants. Plans to support nitrogen removal at treatment plants have not been proposed, except for an experimental project conducted by the State of Maryland in the Patuxent estuary.

The primary stratagy established to control non-point sources of nutrients to the Bay has been to subsidize the implementation of "Best Management Practices" (BMPs) to reduce runoff from urban, forested, and in particular, agricultural lands. Mar yland, Virginia, and Pennsylvania have instituted cost-sharing programs to promote agricultural BMPs. Among the agricultural BMPs supported through cost-sharing have been: strip cropping, buffer stripping, terrace and diversion construction, animal waste system installation, and reduced tillage planting. Some of these practices are employed to reduce sediment, pesticide, and herbicide runoff, as well as nutrient runoff. A secondary strategy to control non-point source pollution is to control urban runoff, in particular combined sewer overflows. Tactics to control combined sewer overflow include revamping of sewer systems and building holding ponds. The state of Maryland has also enacted legislation banning the use of phosphate detergents and controlling development along the Bay's shoreline.

The Chesapeake Bay Restoration and Protection Plan hae enacted a series of additional policies to reduce or control the level of toxic materials in the Bay, Among these policies are programs to support pretreatment plans to reduce the discharge of metals and organics from sewage treatment plants resulting from industrial sources, to fund dechlorination processes to reduce chlorine discharges into critical finfish and shellfish areas, and to implement oil spill response plans.

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[1] Chesapeake Executive Council, Chesapeake Bay Restoration and Protection Plan, U. S. Environmental Protection Agency, Sept. 1985.

Lastly, the Chesapeake Bay Restoration and Protection plan has instituted a series of policies designed directly to "provide for the restoration and protection of living resources and their habitats and ecological relationships"[2] in the Chesapeake. Among these policies were programs to develop comprehensive fisheries management plans, expand oyster repletion activities, improve waterfowl and wildlife habitat, and re-establish submerged aquatic vegetation.

There is no "clear connection between the implementation strategies mentioned above and the goals of the Chesapeake Bay Program. The goals of the program are couched in terms of human benefits--human health and human use--but the specific objectives and implementation strategies are designed to affect chemical and biological characteristics of the Bay. The connection between human benefits on the one hand and reductions of nutrients and toxic materials on the other remains implicit, unsubstantiated and unarticulated. Perhaps the clearest connection is between human use and fisheries and wildlife management. Here the vehicle for linking the strategy and the goal is at least understandable? even if the details of this linkage remain indistinct. In other cases, however, we are left confused as to how the policies impact on humans and how we would ever measure the success of these policies in terms of their achievement of the Program's goals. In implementation, the focus on human use seems to have been lost.

The Role of This Report

This report attempts to focus attention on the human use of the Chesapeake Bay. The report describes something about the nature and level of that use. It also considers what we know and what we do not know about the relationship between chemical and biological characteristic of the Bay and human use. This relationship must be understood in order to grapple with the more complex measurement of human benefits.

Large commitments of money have been made to clean up the Chesapeake Bay. Yet there is little understanding of the nature and extent of the benefits which are derived from these massive commitments. How do people gain from the cleanup? Asking this question does not imply that either the programs are misguided or need to be justified on some benefit-cost criterion, for many believe that the cleanup process is an expression of a fundamental morality that despoiling our surroundings is wrong. Whataver the motivation for environment. al improvement, we believe that understanding more precisely how people benefit from cleaner water in the Bay can help in allocating resources to clean up the water. Moral imperative are of limited usefulness in the tactics of cleaning up the Bay, Even with commitments for a cleanup of the Bay, one must allocate those funds temporally, spatially and functionally. Perhaps knowledge about the benefits from water quality improvements can help with those decisions.

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[2] Chesapeake Bay Restoration and Protection Plan, Chapter 2, page 1,

One of our objectives is to provide some initial estimates of values of Chesapeake Bay recreational activities and willingness-to-pay estimates of improvements in water quality associated with these activities. We have used available data together with what we know about estimating environmental benefits (see Bockstael, Hanemann and Strand, 1985; and McConnell, Bockstael and Strand, 1987) to determine these "ball park" willingness-b-pay figures. While Chapters 3, 4, 5 and 6 reflect our best efforts at this task, it should be kept in mind that benefit estimates have an elusive nature. Much has been written about the imprecision of non-market benefit estimation, and we will have more to say on the question in this report. The usual difficulties are compounded by generally sketchy data. No new surveys were conducted for this study, and only one of the surveys used in the subsequent chapters was designed with benefit estimation in mind. Nonetheless we have put together a number of different studies and have used an array of methods and specifications to provide as much information as is currently available on the topic. We provide estimates of aggregate benefits for a variety of recreational activities. We have also tried to provide information on the relative magnitudes of benefits which are likely to accrue to different groups of users and to improvements in different geographical areas.

The benefit estimates themselves do not represent this report's most important contributions however. We seek to describe, model and to some extent explain recreational uses of the Chesapeake. The report represents an attempt to begin to understand the preferences and behavior of individuals toward the Bay. Models of behavior are essential to benefit estimation. Even in the face of huge uncertainty over benefit estimates, the underlying behavioral models can provide useful and reliable information. We may have serious doubts about the precision of willingness-to-pay estimates, but we can still learn a great deal about the factors which matter to people in using the Bay, the obstacles to their increased enjoyment of the Bay and the distributional implications of improving the Bay.

The Restoration and Protection Plan is an interim plan, "the first iteration of the planning effort implemented in response to this commitment." As such it is a first move in the direction of Chesapeake Bay improvements but it is sub ject to revision and fine-tuning as goals of environmental improvement become clearer and information about problems, technology and costs becomes more sophisticated.

What we hope this volume will provide is a stimulus to decision makers to refocus attention on human uses of the Bay, as the goals and the strategies for achieving these goals are fine-tuned in the coming year. Human uses and the protection of human health have always been the central theme of clean water legislation, but because of difficulties in relating these to specific standards, they have often dropped from sight in the formation of the actual programs, We hope to shed some light on ways in which Bay cleanup policies might be related to the behavior and preferences of actual and potential users of the Bay.

This report on the Chesapeake Bay is part of a larger EPA Cooperative Agreement. The initial agreement dealt with improving methods of measuring the benefits of environmental improvement. and did not deal with the Chesapeake Bay. This report provides information on the recreational activities which take place on the Bay, as well as the monetary values people place on these activities. While not commissioned with the intent of helping in the process of revising the Bay plans, we hope that the discussions in this report will do just that.

Chapter 2

The Role of Human Use Activities in Defining Goals and Strategies for the Chesapeake Bay

According to the EPA's Water Quality Standards Handbook, "States must adopt water quality criteria sufficient to protect designated uses." In the process of developing standards, if water body assessments are called for, they must "characterize present uses, uses impaired or precluded, and the reasons why uses are impaired or precluded."

The definition of designated uses which must be protected remains a murky issue. Underlying much of the document is the implicit assumption that chemical, physical and biological parameters can be used to define uses. On the other hand there is some acknowledgement of the reality that human activity does not necessarily align itself 'with physical and chemical water properties:

> "The basis of this policy is that the States and EPA have an obligation to do as much as possible to protect the health of the public even though it may not make sense to encourage use of a stream for swimming or wading because of physical conditions. In certain instances, particularly urban areas, people will use whatever water bodies are available for recreation."

At the heart of the dilemma is the disparity between the goals which are couched in terms of human uses and the targets of policy actions which are callibrated in ambient pollution levels. There is no one-to-one mapping between human use and scientific measurement. Failure to come to terms with their relationship has lead to something of a schizophrenia about human activity and scientific measurement in the Water Quality Standards. This schizophrenia is not unlike that found in the recreational demand literature which typically seeks to value environmental amenities by relating behavior to changes in ambient pollution levels without explaining how people perceive pollution.

The connection between human activity and scientific measures of ambient water quality is further obscured by the considerable ambiguity one finds in both these discussions about the ways in which individuals gain from water quality improvements. In the EPA Water Quality Standards Handbook, we find repeatad reference to protecting "uses," i.e. recreational activities, and at the same time a sense of obligation to protect human health. One might argue that these two concepts are coincidental, that we are interested in the health of humans as they participate in recreational activities in the Bay. In terms of pollutants which the individual can see (or smell or learn about in some less direct way), an individual's criteria for using the Bay are likely to exceed those minimum standards required to avoid health risks. On the other hand, the individual is totally unaware of health risks stemming from pollutants which cannot be easily detected. Thus many recreation decisions are not directly guided by quality characteristics associated with health standards.

Whether modelling recreational decisions or developing standards, we face a dilemma when we try to link water quality and human behavior. The obvious way to measure water quality is through chemical and physical readings perhaps supplemented by assessments of the biological resources. But water quality improvement is undertaken to enhance society's welfare which is recognized as deriving, in large part, from human use. Does human use respond to the changes in the chemical and physical composition of the water which physical and biological sciences measure? Are factors which affect their health the sole factors which matter to people? Can people perceive changes in these measures?

These questions not only plague benefit measurement, they are central to environmental policy making. If gods are fundamentally human oriented and standards are scientifically based, then the disparity between the two must be resolved for environmental regulation to achieve its potential. In what follows we present evidence about the human side of the problem.

First we present descriptive information on the variation in household perceptions of the Bay based on two surveys. These survey results do not reveal anything about the formation of perceptions however. To gain some insight into this process, we use the focus group approach, The material discussed in an earlier volume of this report is summarized in this chapter, and insights from our focus group experience are offered which are specific to water quality in the Chesapeake. From these various sources, we draw some implications for environmental policy.

Systematic Evidence of the Link Between Percept.ions and Behavior

Evidence on what people think of the water quality of the Chesapeake and how they behave toward the Bay comes from two surveys: an on-site survey of beach users and a telephone survey (Figure 2.1). Our telephone survey was conducted May 1, 1984 to September 1, 1984, Research Triangle Institute (RTI) collected data for the University of Maryland on recreational use and perceptions of the Chesapeake Bay using a random telephone survey. The telephone survey was planned and executed jointly with an on-site survey of beach users at western shore Chesapeake beaches. The 1,044 households with completed interviews were residents of the Baltimore and Washington SMSA's. Demographic, attitudinal and use data were obtained. Chapter 3 reports on the analysis of use patterns and activities derived from the telephone survey. It also provides estimates of willingness to pay for Bay improvements.

In this chapter the attitudinal information obtained from the telephone survey is examined. This survey allows inferences to be made about the impact of perceptions on decisions to use the Bay. It also facilitates expansion of sample patterns of behavior and perceptions to the population.

The phone survey provides information about broad perceptions of the Bay, but without details about regional variation in quality. Specific regional information comes from the user survey, which gathers data about patterns of use and perceptions for 408 users of twelve beaches on the western shore of the Chesapeake. The user survey is described in detail in Chapter 4 of this volume.

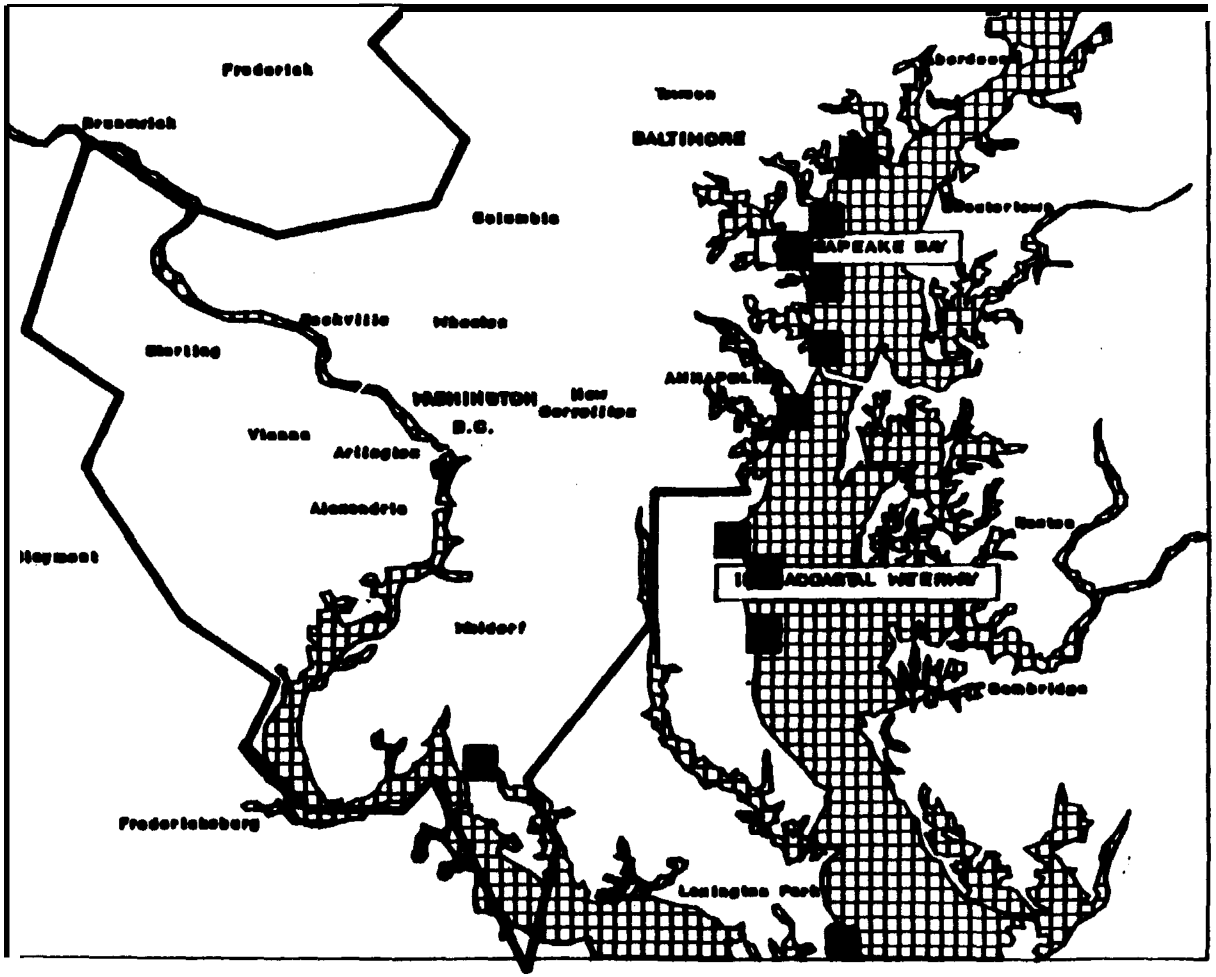


Figure 2.1

The Sampling Region for the Telephone Survey ( ) and the Beaches ( ) Used in the Intercept Survey

Some General Attitudinal Patterns

Several important patterns emerged from the telephone sample. Forty-three percent of the households responded that they had used (31%) or intended to use (12%) the Chesapeake Bay for recreation in 1984. For the users, boating (73% of users), sightseeing (69%), beach use (66%), swimming (64%), and fishing (56%) were quite popular activities. Hunting (5%) and other uses (20%) were not as prevalent responses. The percent of the Bay users who visited eastern shore beaches (44%) was nearly the same as the percentage who visited western shore beaches (47%). Most of the users (81%) also visited ocean beaches in 1984.

Among those who did not use the Bay, reasons for non-use included:

Not interested in water-related recreation (40% of non-users)
Too busy to use (25%)
Takes too long to get there (20%)
Unable to use for health reasons (6%)
Water quality unacceptable (5%)
Costs too much (5%)
Too crowded (3%)
Too many jellyfish (3%)
Other (31%)

Personal preferences and the scarcity of households' leisure time were important considerations. Trip costs and poor water quality were not cited as often (5% of the time) but were still recognized as reasons.

The fact that only 5 percent of our telephone sample stated that the Chesapeake Bay water quality was responsible for their nonparticipation may diminish one's assessment of the role of water quality to Chesapeake citizens. For one thing, water quality in the Bay is not homogeneous--it varies substantially and respondents in our sample recognized the differences. Suppose respondents living in Annapolis believe Annapolis' water to be unsuitable for swimming but water at Pt. Lookout to be suitable. These individuals may respond that time was the prohibiting factor. It takes nearly three hours to travel from Annapolis to Pt. Lookout. From another perspective, people who do not visit the Bay because of time constraints may know little about the Bay's water quality and will not cite water quality as a problem.

A number of other questions were included in both surveys to learn more about perceptions of water quality. For example, we asked telephone respondents,

> "Do you consider the water quality in the Chesapeake to be acceptable or unacceptable for swimming and/or other water activities?"

Only 43 percent of the telephone respondents answered "acceptable," Alternatively stated, 57 percent of a random sample from the Baltimore and Washington SMSA's found the Bay water quality unacceptable for swimming and/or other water activities.

A similar question was asked in the user survey concerning specific western shore beaches with which the respondent was familiar. Even here there was negative reaction to the water quality, especially at certain beaches. We discovered, in fact, that some households found the Bay's water quality unacceptable? but nonetheless used it. There are several explanations for this apparent inconsistency, It is possible that households may find the water unacceptable for certain kinds of activities (swimming) but not for others (beach use or boating). Households may find the water quality acceptable for activities with short duration or during certain seasons of the year when the Bay appears cleaner. Finally, as mentioned earlier, the question abstracts entirely from the natural heterogeneity of the Bay. Some areas may be unacceptable to just about everyone while others may appear clean to the majority.

Some insight was provided by the user survey into the specific factors considered important in visiting a Chesapeake public beach. We asked individuals to rank each of five factors on a scale of one to five, with five being the most important to them. The weighted averages and medians were:

	Mean	Median
Presence of floating debris or oil	4.32	5
Presence of odors	3.44	4
Presence of jellyfish	3.41	3
Presence of cloudy water	1.97	2
Presence of seaweed and other aquatic plants	1.85	1

These numbers indicate that floating debris and oil is the major quality criterion, with odors and jellyfish being the next most important.

The question was re-analyzed by considering the differential responses of users who came into contact with the water (swimmers and waders) and those who did not (sunbathers, etc.). The contact users cited odor as the most important or the second most important criterion 56 percent of the time, whereas non-users cited it as highly important only 16 percent of the time. On the other hand, the presence of jellyfish was considered to rank as the first or second factor for the non-contact users 84 percent of the time but only 37 percent for individuals who were in contact with the water. These results are somewhat difficult to interpret because we cannot determine cause and effect. Logically, those moat bothered by jellyfish are likely to refrain from entering the water. However, those who go into the water are more likely than those who don't to detect unpleasant odors.

In any event, of the five factors deemed important and perceivable to beach users, three are characteristics which could be linked with water quality. It is interesting, for the purpose of keeping our perspective, that a natural factor (jellyfish) ranks among the unpleasant features of the Bay.

Two Propositions about Water Quality and Behavior

To investigate the relation between current water quality and the use of the Bay, we examined two simple propositions.

Proposition 1: The percentage of respondents at a particular beach who find the water quality unacceptable is related to water quality as measured by scientific water quality readings at the site.

Proposition 2: An individual's use of the Bay is related to his/her assessment of whether the water quality is acceptable.

Affirmation of Proposition. 1 implies a positive relationship between individual behavior and the objective measures of water quality upon which environmental policy is based. Proposition 2, if true, indicates that people are consistent in matching their behavior to their perceptions of water quality. Both propositions are important in making the connection between environmental improvements and behavior-based benefit measures.

The Bay is a well studied ecosystem and has been the focus of much attention by the U. S. Environmental Protection Agency and the states of Maryland and Virginia (e.g. U. S. EPA, 1983). Also, Maryland counties on the western shore sample water at the beaches on a monthly basis in compliance with Maryland health requirements. These various sources provide objective measures of water quality at the Chesapeake beaches, and allow examination of the relationship between users' perceptions and objective measures at the beaches visited.

As mentioned earlier, the user survey instrument contained a question asking respondents to judge whether specific beaches on the western shore were acceptable or unacceptable for swimming or other water related activities. To answer, the respondent was not required to have used the beach but only to be familiar with it. The water quality at Sandy Point State Park was familiar to the largest percentage of people (63 percent), whereas only one person knew about the water quality at Camp Merrick. The percentage of those familiar with a beach who found the water quality at that beach acceptable varied from 94 percent at Rocky Point State Park to 12 percent at a Baltimore Park, a beach used primarily by picnickers.

As a guide to the sample's responsiveness to water quality, the percentage of people not finding the water quality acceptable (PCNA) at a beach was regressed on the moot probable fecal coliform count (FCC) for that beach. The fecal coliform counts were collected at the beaches during the swimming season by county off icials. Unfortunately, the FCC measurement was available for only nine of our twelve beaches.

One might argue that individuals would have no way of perceiving fecal colif orm. However, a high FCC might manifest itself in odors or may be correlated with other factors which cause visible changes in the water. Of course, periodically high counts could cause a beach to be occasionally closed by the health officials, a practice that could "brand" the water quality at certain beaches. Since there were five examples of beach closures, the estimation of a relationship between PCNA and FCC should serve as a small test of the ability of individual to perceive factors correlated with FCC.

To assure that obvious restrictions on the PCNA and FCC variables were not violated by our functional form, a Weibull distribution was assumed:

$$PCNA = 1 - \exp[-(FCC/\delta)^{\bullet}), \tag{2.1}$$

where $\bullet$ is the shape parameter and δ is the scale parameter. Using a non-linear least squares routine, we obtained parameter estimates of 2,537 and .49 for δ and $\bullet$ respectively with ratios of parameter values to standard errors greater than two in both cases (see Table 2.1). These results support Proposition I. There is an apparent connection between objective measures of water quality at a beach and households' perceptions that water quality at the beach is acceptable.

Table 2.1
Parameter Estimates and Standard Errors
for Weibull Distribution

Coefficient	$\bullet$	δ
Estimate	.495	2,537.
St andard Error	.095	923.

The value of the shape parameter suggests that the percent of beach users who find water quality unacceptable is concave in the water quality variable. (A sufficient condition for concavity is $\bullet < 1$, $\delta > 0$.) To find the fecal coliform level for a given level of acceptance, equation (1) is inverted and estimated coefficients inserted

$$FCC = 2,537 \cdot (-\ln(PCNA))^{2.02}.$$

For an acceptance rate of 90 percent, the estimated maximum median fecal coliform count is in the order of 25 fecal coliform per 100 ml. At fecal coliform counts of 200, 75 percent of the users are estimated to accept the quality. At counts of 1,200, this estimated ratio drops to 50 percent.

The second proposition was tested using the telephone survey response. Households were asked whether anyone in their household had changed (stopped or started) swimming patterns in the Chesapeake because of water quality. Two hundred seven of the 1,044 telephone respondents stated they had stopped, and 26 stated they had started. Of those who stopped, 75 percent believed the water quality was unacceptable. In comparison, 53 percent of those who did not change thought the water quality was unacceptable. Finally, the water quality was believed unacceptable by 42 percent of those who started to swim.

We regressed the individual binary response as to whether or not they stopped swimming against their acceptance of the water quality. The following logistic probability model was estimated:

$$P = \{1 + \exp[\alpha_0 + \alpha_1 WQP]$$

where

$$P = \begin{cases} 0 \text{ if the household stopped using the Bay} \\ 1 \text{ if the household did not stop} \end{cases}$$

$$WQP = \text{water quality perception (1 if acceptable, 0 otherwise)}$$

A maximum likelihood estimation approach produced the effects reported in Table 2.2. Water quality perception appeared to have a positive statistically significant impact on whether the household continued swimming, indicating some relationship between users' perceptions *of* water quality and their use of the water. This result provides support for Proposition 2 that behavior is related to perceptions. Nonetheless, some people who consider water quality unacceptable are still observed to swim.

Table 2.2
Effect *of* Perceptions on Use

Effect	Estimate (a_l)	Standard Error
Intercept	1.54	.1?
Water Quality Perception	.57	.13

Sample Size = 503

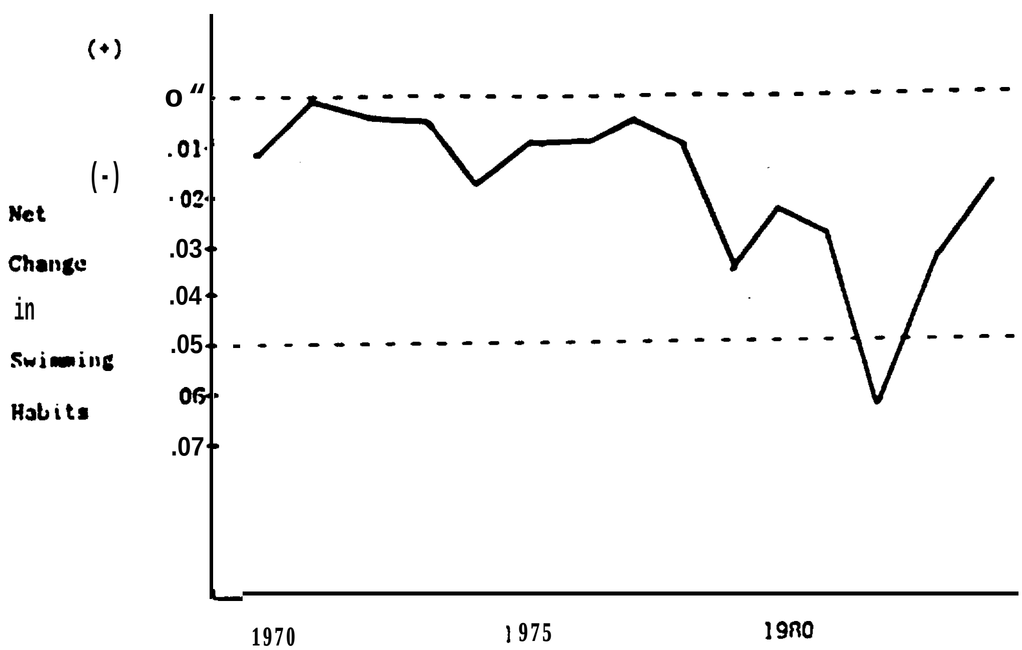
Additional insight into the first proposition can be gained from an analysis of temporal changes in household habits of using the Chesapeake. It is the consensus among scientists that the water quality of the Chesapeake fell substantially over the period 1950-1980 (EPA, 1983). The living resources of the Bay have been used as a primary indicator *of* this decline. Submerged aquatic vegetation and anadromous fish stocks are among those living resources whose dramatic decrease over this period has been cited. If we can show that contemporaneous with the decline in objective measures of water quality, individuals were more likely to quit using the Bay, we have additional indirect evidence of the link between behavior and water quality,

Responses from the telephone survey were used to develop a time series on the percentage of households who changed their swimming participation. The procedure was fairly complicated since the size of the population eligible to change its behavior varied from year to year. That is, consideration had to be made for how long the household had lived in the Chesapeake region and whether they had previously stopped swimming. For example, households responding that they stopped swimming in 1979 clearly were not eligible to stop again in 1982.

The time series is shown in Figure 2.2. Approximately one percent of the eligible households stopped swimming each year in the early 1970's. This increased to around *five* percent per year in the early 1980's. The trend is definitely one of increasing non-participation in swimming over the time in which it is believed that declines in water quality were occurring. Although the overall pattern is a diminishing one, there appears to be a possible modification of the trend near the end of the period.

Figure 2.2

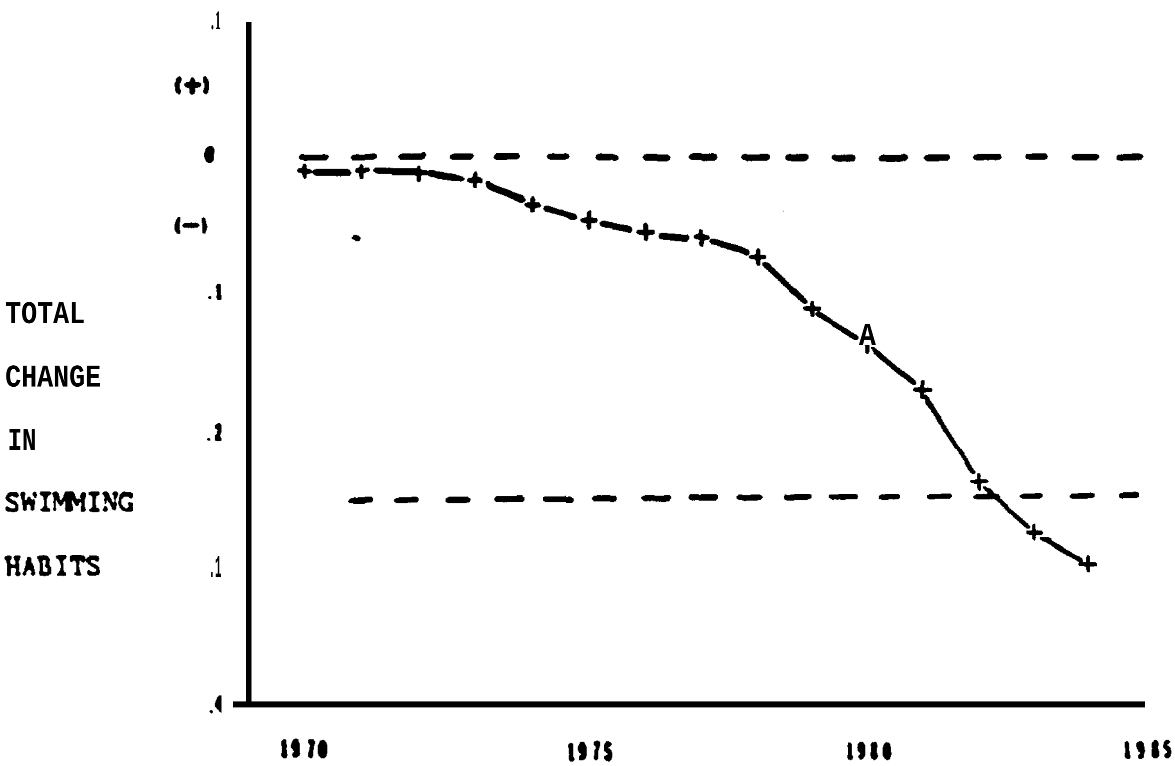
Annual Net Change in Swimming Habits
1970-1984



If one is bold enough to assume no reversals in habit for a particular household, the individual percentages can be combined to show the cumulative effect of water quality change on a given 1970 population of households (Figure 2.3). With this assumption, 30 percent of households that had been in the area in 1970 would have had a ❑ember who ceased swimming by 1984.

Figure 2.3

Cumulative Net Change in Swimming Habi ts
for a Popu ation in Residence in 1970 and Remaining in Res dence unti l 1984



The decline is interesting for a number of reasons, but mostly because it shows the potential stock of individuals who could be enticed to return to the Bay if water quality were improved. Benefits from water quality improvements will derive *from* increased desirability of current recreational trips, more (of these higher quality) trips taken by current users, and finally trips taken by those who are currently non-users but are enticed into the activity by higher quality. The above analysis suggests that water quality improvements could, over a sufficiently long time, attract a large number of new (or returning) users. To the extent that demand analysis is based on current use and fails to predict accurately this potentially large number of new entrants, benefit estimates will be understated.

Results of Some Focus Group Experiences

The above evidence about the relationship among (a) use of the Bay, (b) subjective perceptions of the Bay's water quality, and (c) objective measures of specific attributes of water quality in the Bay suggests in general that changes in water quality have an effect on behavior. In subsequent chapters we show how economists can use information about changes - in behavior induced by quality changes to assess the economic gains from water quality improvement.

Good theory, convincing benefit measurements, and effective environmental policy do not require that individuals act knowingly and mechanically in response to changes in ambient quality. In fact, casual observations suggest that many people have only vague notions about environmental quality, and act unconsciously in response to changes in quality. However, much can be gained by understanding better the link between perceptions and behavioral changes. How are perceptions formed? Which aspects of water quality, objectively measured, matter most to people? These and other questions about the formation of perceptions require some insight into individual motives.

Traditional research methods have not been very helpful in obtaining these insights. In contrast, focus groups (Reynolds and Johnson; Caldor; Desvousges and Smith) have been found to be a useful means *of* investigating the existence and formation of subjective perceptions on environmental issues and marketing questions. Focus groups are group interviews conducted in the form of informal discussion sessions under the guidance *of* a neutral moderator. Participants are encouraged to talk at will and describe personal experiences, anecdotes, and acquired knowledge. The moderator merely encourage participation by all, mediates arguments and spurs conversation and thought through questions carefully designed to give direction to the discussion. By encouraging participants to reveal thought processes and levels *of* awareness, their motives begin to emerge.

For this study we conducted two focus groups *of* a quite different nature. The groups were made up of 10 to 15 individuals who had some common association with one another. Each session lasted about one and a half hours. In each group there were Chesapeake Bay users and nonusers; however, the groups were chosen so as to be heavily weighted towards people familiar with the Bay.

One focus group consisted of students at the University of Maryland in College Park, who were members of a wildlife conservation group. Many of these students had taken environmentally related courses. A number of these students had grown up in close proximity to the Chesapeake Bay, as active users of the Bay.

The second group consisted of residents of neighborhoods along the western shore of the Chesapeake in the vicinity of Plum Point, Maryland. Their participation was solicited through an announcement in a local newspaper. Many, although not all, of the individuals were retired, and all lived near the shore year round. Their backgrounds and education were quite varied.

These groups were polar in several respects. The college group was young, formally educated in many scientific and environmental matters, and tended to be active users of the Bay. The Plum Point group was older, often retired, not necessarily fluent in scientific and technical matters, and often somewhat passive in their use of the Bay. The groups shared the characteristics of having no small children and not being actively engaged in building careers.

In each case, the moderator presented a formal introduction indicating the general purpose of the gathering and the underlying research. The introduction was notably vague so as not to bias subsequent responses. For the remainder of the session the moderator rained questions but did not attempt to confine individuals' responses. All individual were asked to respond to moat of the questions so as to avoid dominance by one or two people.

Examples of the types of questions raised were the following:

What does water quality mean to you?
How do you know when the water quality is poor?
What activities do you pursue on the Chesapeake?
Has the water quality gotten worse over time?
What do you think is the moat serious cause of pollution in the Bay?
Is water quality different in different parts of the Bay?

Initially, we had several questions in mind which we hoped the focus groups could help us answer. These included the following:

1. What sources of information do people use in forming their perceptions of water quality in the Chesapeake Bay?

2. What factors affect their interpretation of this information (e.g. past experience, attitudes), i.e. what is their standard based upon?

3. In what way does the water quality of the Chesapeake affect people; i.e., in what sense do they lose when water quality deteriorates?

4. Do their perceptions affect their behavior and how quickly can behavior be expected to change in response to environment changes?

Our focus group results suggest the following answers to these questions.

Question 1.

Appearance was by far the most frequently mentioned signal of water quality deterioration. Whether or not the individual had been exposed to scientific information on the subject, he was most likely to report that how the water looked, felt and smelled were his most important indicators. Even individuals who no longer used the Bay or certain sections of the Bay based their decisions on the water's appearance during their last visit.

Without exception, individuals used clarity of the water as an indicator. The degree of transparent y of" the water was taken for granted to be a measure of quality. A few individuals, particularly those living on the Bay all year, noted seasonal differences in clarity, but still used this as their first quality indicator. Other factors which signalled poor water quality were the nature of the bottom, discoloration of the shoreline, froth on the water? floating debris (including man-made) and dead fish. Smell was a clear signal of poor water quality, but odors were not common, and visual appearance was used as a more discriminating indicator.

The second most common signal of pollution was "guilt by association." Individuals frequently stated that they deduced that water quality would be poor in sections close to activities which they reasoned would generate pollution. Such activities included sewage treatment plants, housing and industrial developments, marinas and other heavy concentrations of boats, and farms (particularly with livestock). These deductions took place in both groups but were of a slightly different nature. The college-age group was relatively more concerned with agricultural operation and with contamination from boat sewage. The older group seemed to consider development -- with or without sewage treatment -- of greatest concern. Some of this difference can be accounted for by the spatial location and familiarity of the two groups. The Plum Point group knew local conditions well but were relatively immobile and had limited experience with the rest of the Bay. In contrast, the college students were heavy boat users and therefore extremely mobile. They tended to have personal experience along large portions of the Bay and its tributaries. Graphic examples of manure pond overflows, run-off from pig farms, etc., were offered. Residents of the Plum Point area would have little exposure to agricultural runoff, more common to the upper Bay.

Television, radio and newspapers were the next most common external source of information. Rarely waa specific information about local Bay conditions gleaned from the media. Instead, these sources create a general awareness of environmental problems. In large part the inferences about activities which create pollution were baaed on information gathered from these secondary sources.

It was clear that at least some individuals were privy to more objective and scientific information than that available in the public media, although the distinction between types of information sources was not always made clear. Many of the college students had taken courses and subscribed to scientific journals. They were able to draw more sophisticated deductions about links between water quality and surrounding land uses. Also, these individuals tended to be distrustful of information obtained from the media.

The final signal of pollution also depended on deduction. Individuals noticed changes in the amount and diversity of wildlife in and around the Bay and concluded that these changes were the result of water quality changes. Specifically mentioned were crabs, turtles, and ducks. One individual associated a decline in the diversity of finfish species with water quality deterioration, Another individual argued that increases in fish prices were due to pollution.

Question 2.

Different individuals seemed to interpret similar information in different ways. Factors which affected their interpretation included their past experience and general attitudes. When individuals react to the appearance of something, they must, by definition, be comparing it to a standard. More often than not, the standard used by these groups was past experience, although occasionally individuals seemed to be operating with a less personal standard such as pictures of clean water in mountain lakes. Frequently individuals compared the appearance of the water to what they (accurately or not) remembered experiencing as a child. With the exception of one individual (of the older group), everyone remembered the Bay water being cleaner when they were children. This was true of the 18- and 19-year-olds as well as the 50- and 60-year-olds. When questioned, individuals admitted that both maturity and publicity had raised their level of consciousness about water quality but still insisted that water quality was poorer now than when they were children. Also, the college studenta noticed some improvement over the last few years -- in terms of fewer dead fish and birds, less heavy oil present, and the cleanup of dumps along the tributaries — although they thought the water was dirtier now than ten years ago.

Individuals' interpretationa of information were also clear] y affected by their general attitudes -- level of trust in political and entrepreneurial forces and confidence in technology. Among the college students, some indicated distrust for political processes and commercial enterprises to the extent that they believed everything was polluted, whether or not they could see it, These individuals stated that they would need hard scientific evidence to be convinced that improvements had been made. At the other extreme, notably in the older group, a few individuals indicated a trust in the scientific community, regulator y processes and technology, fueling that the populace would be protected from unsafe conditions through cleanup activities. Some indicated resignation to the trade-off between the environment and development. In all cases attitudes affected how individuals interpreted the same sensory and media information.

Question 3.

Individuals perceived themselves to be affected by water quality in a number of ways. It was clear from the discussions that both groups were apprehensive about going into water they perceived to be dirty. A distinction was made between wading and swimming, as many indicated that they did not dare submerge their heads in water they thought to be polluted. Also many wore shoes when wading to avoid contact with the bottom. While only a few actually mentioned bacteria and potential illness, most seemed to have health and safety factors in mind.

It is difficult to separate this apprehension from the general unpleasantness associated with unattractive water. No doubt we are conditioned to link clarity with cleanliness and cleanliness with health. Nonetheless, it seems that even if the individuals were convinced there were no health risks, they would consider themselves hurt by water quality deterioration. Many mentioned the unpleasant *feel of* the bottom and the sticky film that swimmers feel on their skin after bathing. Others mentioned that clear water allowed them activities such as seeing living organisms in the water, activities which were precluded by murky water. Still others who never entered the water but only walked along it reported the experience more pleasurable when the water looked cleaner. In fact, some gave up the activity when the water looked dirty.

What is interesting however is that no one mentioned toxics or heavy metals. Some were aware *of* the term nutrients, and most connected this with turbidity, algal blooms and slimy bottoms. Others emphasized oil spills. Particularly in the older group, individuals expected that pollution could be seen. Those individuals seemed most conscious of health risks, yet indicated they felt safe going swimming on days when the water looked clear. Few indicated apprehension about health *effects* from unseen pollutants.

Lasses also accrued to individuals through perceived reductions in angler and duck hunting success. Many complained of a decline in the quality of fishing, crabbing and duck hunting. Others complained of the reduced variety of finfish available in the Bay. Among the college students were some who professed a concern for the wildlife in situ. That is, some individuals indicated reduced enjoyment of non-consumptive wildlife uses.

Individuals also indicated a fear of eating fish and shellfish caught in polluted waters. For many individuals low catch rates were irrelevant because they did not dare eat fish caught in local waters.

Interestingly, one individual who did not use the Bay for any recreational activity indicated that he really did not care what happened to the water quality in the Chesapeake. His only concern was the quality *of* his drinking water. Here is a real world example *of* the concept of "weak complementarit y." Weak complementarily is said to characterize an individual's preferences if he does not care about the quality of a resource that he does not use.

Question 4,

Earlier *in* this chapter, survey results were shown to support the empirical relation between behavior and perceptions. However, frequently inconsistent behavior was observed--some individuals perceived the water quality to be poor but continued to use it. The focus groups shed some light on these anomalies.

With only a few exceptions, the individuals in both focus groups were familiar with . the Bay and were recreational users of one sort or another. Also, with only a few exceptions, the individuals were deeply concerned about the water quality of the Bay. In most circumstances individuals had not given up all forms of recreational use, but they had reduced that use and curtailed some activities altogether,

We can model an individual's behavior as changing in three ways *in* response to perceived changes in water quality: he can alter the choice of whether to participate in an activity, he can alter the sites at which he recreates, and he can alter the frequency *of* recreation.

The two groups revealed different types *of* reactions to water quality deterioration. The younger, more mobile group stopped going to certain places which they perceived to be worse. The older, less mobile, group stopped participating in certain activities which they perceived to be sensitive to water quality, particularly swimming. They also curtailed their fish and crab catch to avoid eating contaminated fish. In both groups, there appeared to be a frequency dimension to individuals' reactions as well. Many who found the water quality too poor for swimming generally indicated they would go in on especially hot days or on days when the water looked especially clear. The latter suggests that the degree of intra-seasonal variation in pollution and other causes of turbidity will *affect* the frequency *of* participation in a recreational activity. Of course only those who live near the shore can assess the water clarity before incurring the costs of the recreational trip.

While there is no firm evidence for this, many individuals seemed to participate more in recreational activities than they believed wise. In many cases, it was because they had been participating in these activities for years and resisted giving them up and because they perceived no suitable alternative. In contrast, some individuals had curtailed certain activities because of bad experiences and indicated that it would take very convincing evidence to bring them back. All of this suggests that the response of behavior to perceptions may be significant but may also be a delayed response.

Summary of Focus Group Experience

In summary, we can construct a set of hypotheses about perception formation. The list would include

10 Individual associate the quality *of* the water with its appearance -- specifically its clarity and color.

2. Individuals associate the quality with the amount of floating (man-made) debris and dead organisms.

3. Individuals associate quality with angler success rates.

4. Individuala deduce quality from surrounding land and water uses.

5. Individuals infer things about the quality of water from general publicity about the environment and/or technology change.

6. Individuals learn specifics about quality from scientific publications, educational experiences.

The more exposure individuals had to information of the sort included in (5) and (6) , the more likely were they to deduce things about water quality from surrounding activities. Nonetheless, items (1) and (2) in the above list dominated, irrespective of age, education, etc.

Individuals perceived themselves to be harmed by poor water quality through a number of routes:

1. The individual's recreational experience is degraded by unpleasant appearances floating debris, etc.

2. The individual fears health and safety risks.

3. The individual believes poor water quality reduces catch rates and variety of species.

4. The individual fears eating fish from areas with poor water quality.

It is worthy of note that both unpleasant appearance and poor fishing conditions harm individual but also serve M signals *of poor* water quality. These signals carry with them suspicions *of* further losses in the form of health risks from contact with the water or from eating contaminated fish.

Conclusions

In this chapter we set out to explore the relationship between human activities and the water quality of the Bay. This relationship is important for the Chesapeake Bay Program for several reasons. First, human use of the Bay is the ultimate goal of devoting resources to improving the quality *of* the Bay. Gaining some sense that people change their use of the Bay with changes in water quality suggests that Bay clean-up strategies can have significant value. Second, economists' benefit measures of improvements in water quality are based primarily on changes in behavior. Knowing that households have some sense *of* water quality and are affected by this sense *of* water quality when deciding how to allocate their scarce time and resources gives support to the methodology of benefit measurement.

We have explored the relationships between perceptions and human activities in two ways. From two surveys, a phone survey of households and an on-site survey of beach users, the relationship between objective measures of quality and perceptions of quality and behavior has been examined. The telephone survey supports the relationships in several ways. Households that perceive water quality as unacceptable are more likely to quit using the Bay. The telephone survey also shows an implicit but positive correlation between the likelihood *of* quitting and the Bay's water quality. The user survey also provided support for the perceptions link. This survey shows positive correlation between measures of fecal coliform at each of nine beaches and the proportion of households that found each beach unacceptable.

The focus groups provide insight into how people judge the quality of water and why they change their behavior in response to quality changes. A variety of sensible motives contribute to behavior changes. People smell, feel and see the water and its surroundings. They react when they learn about changes in water quality from newspapers television and other media.

Of particular importance to policy makers is the clear signal that individuals suffer from water quality deterioration in more than one way. Many regulation are implicitly based on health standards, yet health effects are only part of the story. Irrespective of health risks, individuals were uniformly adament in arguing that recreation in water perceived to be dirty is less enjoyable. This dimension is not totally independent of health concerns, however, since dirty water was additionally considered to be a signal for health risks. The word "risk" is a key one. Whether or not a given state of water quality does in fact present a health risk, the individual suffers from the uncertainty associated with not being able to assess the risk himself. While we do not go into this problem in great depth in this study, it is important to keep a few things in mind. Uncertainty is <u>ceteris paribus</u> undesirable, and there are two sources of uncertainty involved here. One is the uncertainty associated with not knowing what is in the water and whether it is potentially harmful. The second is the uncertainty associated with the actual onset of adverse health consequences if indeed the water was potentially harmful.

The losses described above pertain to water use that involves contact. There are still more ways in which individuals perceive themselves to be harmed by poor water quality. The enjoyment associated with any activity within sight of the Bay is claimed to be diminished if the water appears dirty. Finally, to the extent that poor water quality reduces fish abundance and species variability y, sportfishermen see themselves harmed. Finally, even if fish catches aren't reduced, perceived poor water quality suggests health risks associated with eating fish catch.

Together the -two sources of information provide support for the inferences which we draw in the following chapters. Individuals are aware of water quality, change their behavior in response to water quality changes, and derive benefits when the quality of the Bay is improved.

Chapter 3

Recreational Use of the Bay and Willingness to Pay Estimates for Improvement to the Bay se a Whole

A variety of methods have been used to analyze the welfare effects of water quality improvements. In the introduction to this chapter, a brief description of the two basic approaches is offered to prepare the reader for the methods used in this and following chapters. A more thorough examination of one of the methods? contingent market valuation? is offered in Cummings, Brookshire and Schulze. Bockstael, Hanemann and Strand supply a thorough examination of the other method, indirect market valuation,

The indirect market approach uses individual behavior in related markets to infer values of non-marketed goods. For the case in question, water quality, the researcher observes the demand for goods that are related to water quality, such as recreational tripe. The usefulness of the approach depends on the responsiveness of behavior toward water quality. If individuals value good water qualit y, the y will be drawn to goods or activities associated with high quality water end will be willing to travel farther and incur greater costs for this improved experience. Their behavior can be observed, and from this, values deduced. One drawback to this approach is that assumptions regarding behavior must be made in order to assess values. This results in untestable restrictions on behavior implicitly or explicitly imposed in the modelling process.

Contingent market analysis involves the establishment, in the interviewee's mind, of a fictitious or hypothetical market circumstance. The interviewee is asked to respond to the circumstance in a hypothetical manner. By establishing a scenario to explain the respondent's answers, the researcher is able to deduce characteristics of the respondents preferences.

The "average" willingness to pay or sell is the predominant value obtained in most contingent valuation exercises. A question or series of questions is designed to elicit the respondent[s] (hypothetical) bid *for or* against the policy in question. The approach can be directed very specifically to the good or quality change to be valued, and thus, in theory, elicit the amount of money needed to keep the individual at the same level of satisfaction before and after an event. The questions can be quite specific and may therefore define precisely the event or policy to be assessed. The disadvantage of the approach is its hypothetical nature. Rarely is it possible to test the validity of the response. through observations on behavior. In addition, the specific valuation problem may be so remote from the respondent's market valuation experiences as to leave him unable to respond reliably.

Contingent valuation has been deemed a useful technique (see Cummings, Brookshire and Schulze) provided it is applied to problems which are closely associated with common market valuation experiences. Car-son and Mitchell present evidence of stable contingent valuation estimates for national benefits of clean freshwater in the U. S.

It seems reasonable to attempt some contingent valuation for the Chesapeake Bay problem as long as caution is exercised in the interpretation of the results. For us, derivation of the contingent values thus obtained is not intended as an end unto itself, but rather information to support the results of additional analyses.

Recreational Use of the Bay

During the summer of 1984, a telephone survey of over 1,000 households in the Washington, D. C. and Baltimore Statistical Metropolitan Sample Areas (SMSA's) was conducted. A description of procedures can be found in Appendix A. Appendix B is a copy of the survey instrument. One objective of the survey was to provide a complete inventory of beach use by residents in the Baltimore/Washington SMSA's (see Figure 2.1), which include the District of Columbia, several counties and incorporated cities in Northern Virginia and much of central and southern Maryland. Restricting the geographical area in this way biases the sample of individuals toward urban residents. However, this area includes a large percentage of the population surrounding the Bay.

In the subsequent discussion, the percentage figures reflect the sample response rates corrected by sampling weights to define unbiased estimates. The projected total number of households purported below to participate in various activities are estimated as the product of these weighted response rates and the approximately two million households residing in the Baltimore/Washington SMSA (the 1980 Census reported 1,876,144 households).

On the basis of the telephone survey, 43 percent of the region's households are estimated to have used or intended to use the Bay for some recreational activity in 1984. Participation rates varied across the region (see Table 3.1) with Anne Arundel County having the highest percentage use (69%) and the District of Columbia the lowest (21%). Of the remaining areas, Northern Virginia had the next lowest participation rate (37%) and Montgomery County the next highest rate of participation (48%).

The households used the Bay for a variety of recreational activities. Swimming/beach use was the most popular, with a projected 740,000 households participating. The next most popular activity was boating which attracted a projected 620,000 households. Sightseeing (estimated 586,000 households) and fishing (estimated 477)000 households) were also very popular. The projected number of households who used the Bay in conjunction with hunting totalled only about 45,000. There were an estimated 170,000 households that reported other uses of the Bay.

As one might expect, households often participate in more than one activity. For the major use activities of swimming, fishing and boating, Table 3.2 shows the percentage of respondents who participated in one activity or more. Roughly speaking, about one-third of the households participated in all three activities, one-third participated in two of the three activities, and the remaining one-third participated in a single activity. This distinction has importance for benefit estimation; if any one household's participation were limited to only one activity, independent behavioral studies of each activity

Table 3.1

Participation Rate[a] in Chesapeake Bay Activities
By Activity and Area, 1984

	Northern Virginia[b]	District of Columbia	Montgomery count y	Prince George's end Charles Count iea	Anne Arundel Count y	Baltimore[c]	Others[d]
% Participation in CB Activity (1984)	22	9	37	34	60	36	36
% Participate or' Intend to Participate	37	21	48	46	69	45	42
% Participate CB Fishing	12	8	16	18	33	19	21
% Participate CB Swimming	10	R	24	21	33	23	23
% Participate CB Boating	17	8	26	24	4B	24	33
% Participate CB Hunting	1	0	1	0	5	2	3

[a]Weighted percentage, representing a random sample of Baltimore-Washington, D.C. SMSA's.

[b]Includes Fairfax, Arlington, Prince William and Loudon counties and the cities of Alexandria, Fairfax and Falls Church.

[c]Includes Baltimore City and portions of Howard and Baltimore counties.

[d]Includes Carroll and Harford counties and portions of Howard and Baltimore counties.

Table 3.2

Joint Participation Rates[a] in Chesapeake Bay Activities
By Activity and Region, 1984

	One Activity			Two Activities			Three Activities
	Fishing	Swimming[b]	Boating	Fishing Swimming	Fishing Boating	Swimming Boating	Fishing Swimming Boating
Overall	3	14	10	9	9	20	34
Northern Virginia	3	15	11	6	9	15	38
District of Columbia		10		15	5	15	54
Montgomery County	1	22	12	8	9	22	26
Prince George's and Charles counties	8	17	7	7	11	19	31
Anne Arundel County	3	3	10	7	10	34	33
Baltimore City and County	3	13	9	12	6	20	37
Other Maryland	3		15	4	20	18	40

[a] Weighted percentages, representing a random ample of the Baltimore-Washington, D.C. SMSA's.

[b] Swimming includes beach use.

could be aggregated to provide the basis *of a* total benefit estimation for improved water quality. Multiple participation and the interdependence among activities prevents straightforward addition of benefits calculated in demand studies of individual activities.

While it may be necessary eventually to undertake a comprehensive benefit analysis of all Bay activities? there is enough current information to shed some light on the value of the recreational use of the Bay. Independent studies are useful, if for no other reason than to establish "conditional" relationships between activities and key factors. This may facilitate future studies by isolating key factors for which information is critical. Moreover, by analyzing a series of partial systems, bounds may be established on the total potential benefits.

Aggregate Willingness to Pay

This portion of the chapter employs the contingent valuation technique to value improvements in water quality in the Chesapeake Bay. The hypothetical circumstance posed to survey resondents involves the alteration of the Bay's water quality from its current condition to an improved condition which, in the respondent's view, is acceptable for swimming. . Because individuals' perceptions of water quality are not easily linked to objective measures (see Chapter 2) and because individuals do not easily understand these scientific measures, the hypothetical circumstance was framed in terms of the respondent's acceptability. This limits the specific application of the results, since there is no simple way to determine at what point clean-up efforts raise the water quality to an acceptable level for everyone. However, the evidence presented in Chapter 2 offers some guidance as well as some historical perspective.

The households responding to the contingent valuation experiment are a subset of the telephone survey of the Baltimore-Washington SMSA's. Each of the randomly selected households was asked:

> "Do you consider the water quality in the Chesapeake to be acceptable or unacceptable for swimming and/or other water activities?"

Of the 959 respondents, over one-half (57 percent) found the water quality unacceptable. 'l'hose who responded that it was unacceptable were asked:

> "Would you be willing to pay ($A) in extra state or federal taxes per year if the water quality were improved so that you found it acceptable to swim in the Chesapeake?"

The amount of money ($A) was varied randomly from $5 to $50 over the sample. The percentage of respondents who answered "yes" is shown in Table 3.3.

Table 3.3

Percent of People Willing to Pay Additional Taxes
for Acceptable Water Quality for Swimming, by Amount of Tax

Amount of Tax Increase	$5	$10	$15	$20	$25	$30	$35	$40	$45	$50
Percent of Respondents Willing To Pay Tax Increase	64	66	63	70	58	46	57	47	47	53

If sample sizes were big enough, monotonically decreasing percentages over the entire range would likely be revealed. Nonetheless, the percentages are in general declining as the amount of the tax increases. Of those who were presented a tax of $5, $10, $15, or $20, an average of 66 percent agreed (hypothetically) to accept the tax burden in exchange for acceptable water quality. Of those presented a tax of $25, $30, $35, or $40, the average percentage dropped to 52 percent.

Analysis of Willingness to Pay Responses

Hanemann (1984) describes a method for analyzing a central tendency in willingness to pay from questions with "yes" or "no" answers. Let the respondent derive utility from the nonmarket good, water quality, and from money income (y) which can be used to purchase marketed goods. Also let a vector (x) of individual characteristics affect his utility. Utility is given by $u_1(1,y;x)$ when the water quality is acceptable and $U_0(0,y;x)$ when it is not. The functions u_1, and u_0 are not known, and thus are considered stochastic to the researcher; That is

(3.1) $$u_j(j, y;x) = v(j,y; x) + \nu_j \qquad j = 0,1$$

where ν_j are independently and identically distributed random variables with mean zero.

When offered swimmable water at a tax of $A, the individual will accept the tax providing that

(3.2) $$v(1, y-A; x) + \nu_1 \geq v(0, y;x) + \nu_0$$

and decline otherwise. In this framework, the individual's response becomes a random variable with probability density

$$p_0 = \Pr\{\text{accept tax in exchange for swimmable water}\}$$

$$= \Pr\{v(1, y-A; x) - v(0, y;x) \bullet \nu_0 - \nu_1\}$$

$$p_1 = \Pr\{\text{not accept tax in exchange for swimmable water}\} = 1 - p_0.$$

Define $\eta = \nu_0 \cdot \nu_1$ and let $F_\eta(\cdot)$ be the cumulative distribution function of η. Then the probability of accepting the tax in exchange for swimmable water equals $F_\eta(\Delta v)$ where Δv is the difference between the deterministic portions of the utility function in the two states (see equation (3.2)}.

At this point any of a number of utility functions, individual characteristics, and density functions to complete the analysis could be chosen. Like Hanemann, we chose a logistic cumulation distribution function. Also, we chose a linear function (see Sellar, Chavas and Stoll for the limitations of this form) for v(0), such that

$$\text{(3.3)} \qquad v(j, y) = \alpha_j + \beta\, y, \qquad \beta > 0$$

where the arguments of x have been temporarily suppressed. The difference, Δv, is $(a_1 - \alpha_0) - \beta A$, which gives a probability model of the form

$$\text{(3.4)} \qquad F(\eta) = \prod_{i \varepsilon S_1} F(-\alpha_0 + \alpha_1 - \beta A_i) \prod_{i \varepsilon S_0} [1 - F(-\alpha_0 + \alpha_1 - \beta A_i)]$$

where So is the set of individuals refusing to pay the tax, and S_1 its the set accepting the tax.

Conceptually, we sought the value A for which

$$\text{(3.5)} \qquad u(1, y-A; x) = u(0, y;x).$$

Combining equations (3.2) and (3.3) produces the result that when (3.5) holds, A is defined as the following

$$A = [(a, - \alpha_0)(-\dot{\eta})]/\beta \cdot$$

Since η is random, so is A. To evaluate A we chose to take its expectation, assuming α_0, α_1, and β to be constants, which yields

$$E[A] = (\alpha_1 - \alpha_0)/\beta. \tag{3.6}$$

Thus, $(\alpha_1 - \alpha_0)/\beta$ is the expected (or average) tax that would make an individual just indifferent to paying the tax in exchange for acceptable water quality and not paying the tax but forgoing good water quality. Now we need estimates of the parameters α_1, α_0, and β to get a value for E[A].

<u>Results of Analysis. By Subgroups of Respondents</u>

In developing the theory it was admitted that individual characteristics (designated by the vector x) were likely to affect the utility function which in turn would affect the parameters in (3.6). Some of these characteristics are strictly idiosyncratic and not worth trying to model, but others may be associated with identifiable subgroups of the population. Three means of subdividing the population suggest themselves--by household income, by race and by Bay user/nonuser. In the sample obtained in 1984 there was sufficient correlation between race and income to make the separate treatment of these infeasible. Additionally, it was difficult to subdivide the population by income because income appears in the data set as a continuous variable and arbitrarily dividing it into ranges did not prove useful.

After some preliminary logit analysis, a modification of the model shown in (3.4) was estimated. One modification entailed making the $(\alpha_1 - \alpha_0)$ depend on whether someone in the household had used or intended to use the Chesapeake Bay in 1984. A variable (D_1) was included to reflect use. This approach allows us to test whether users value the change in the Bay's water quality more than non-users, ceteria paribus. The other modification involved making the bid coefficient, β, depend on the racial classification. Because there is a wide disparity in income between whites and non-whites (average of $40,000 annually vs. average of $25,000), the marginal utility of income, which β represents, maY be different for the two groups. Use of a binary variable (D_2) in conjunction with the tax variable permitted an examination of the effect of race on the marginal utility of income.

The results of the estimation are reported in Table 3.4. The amount of the tax significantly reduced the probability that a respondent would agree to pay the annual tax increase. Also significant were the use/intercept interaction variable and the tax/race interaction variable. Both users and wh ites were more likely to accept the tax increase.

Table 3.4

Logistic Model Estimates Related to the Probability a Respondent Will Accept a Tax Increase

Variable[a]	Estimated Coefficient	Standard Error	t-ratio
Constant $(\alpha_1 - \alpha_0)$	.385	.222	1.73
D_1 · Constant	1.084	.202	4.77
Amount of Tax	- .043	.009	- 5.3?
D_2 " tax	.035	.007 "	4.78

Chi-squared = 47.10

[a]D_1, D_2 represent binary variables for the use of the Bay and white racial characteristics, respectively.

The above results are difficult to interpret because of the high correlation between race and income. It should not be assumed that whites, ceteris paribus, have a higher willingness to pay for water quality. There is insufficient data, however, to test the separate *effects* of income and race. To determine whether willingness to pay changes by income classes, the analysis was reworked and estimates for the expected value of *A* were obtained for five arbitrarily defined income classes ($0-$20,000; $20,000-$50,000; $50,000-$80,000; over $80,000; income not reported). We thus assumed the utility function (3.3) was linear in income only within the ranges described above. Additionally we allowed the $(\alpha_1 - \alpha_0)$ estimate to vary depending on whether an individual was a user or non-user during 1984.

The results are shown in Tables 3.5 and 3.6. The coefficients are of the proper sign although. their statistical significance is not overwhelming. Income classes, however, do appear to be an important determinant of the willingness to pay. The results in Table 3.4 suggest that willingness to pay at first rises with income and then falls with the highest willingness to pay coming from the middle income group ($20,000-$50,000).

Returning to the stronger results of Table 3.4, but bearing in mind the correlation between race and income, the expected willingness to pay of a randomly chosen individual in each of *four* subgroups is computed and presented in Table 3.7. The values are divided on the basis of use and racial composition of the household. In addition, standard errors for the calculations are shown. They are computed on a first-order approximation basis (Kendall and Stuart, pages 228-332) assuming independence of coefficients. A problem arises with the estimate of expected willingness to pay by white users of the Bay. The expected value is substantially out. of the range of the tax increase asked in the survey. Because it is computed as a ratio of estimated coefficients, there is nothing to guarantee the value will lie within the range of values used in the questionnaire. However, predictions which fall outside

Table 3.5

Estimates of Utility Parameters by Income Group

Income Class	$\hat{\alpha_1 - \alpha_0}$ Users	Non-users	$\hat{\beta}$	Sample Size	Likelihood Ratio
$0 - $20,000	1.282 (1.89)"	.833 (1.72)	.028 (1.73)	99	19.35
$20,000- $50,000	1.652 (2.96)	.968 (2.04)	.012 (.81)	200	11.05
$50,000 - $80,000	1.695 (.98)	1.471 (2.80)	.017 (.95)	101	42.33 .
Over $80,000	1.157 (2.81)	.543 (1.24)	.013 (.90)	22	5'?.79
Income not reported	.533 (1.53)	.200 (.42)	.016 (1.11)	93	9.68

W-statistic in parenthesis

Table 3.6

Expected Value of Willingness to Pay
for Acceptable Water Quality for Swimming by Income Group and User Group,
1984.

Income Class	Expected Value of Willingness to Pay: Average for All	Average for Users	Average for Non-users
o - $20,000	$ 38.54	$ 45.94	$29.85
$20,000-$50,000	108.60	134.25	78.48
$50,000-$60,000	95.16	101.20	88.08
over $80,000	66.'44	89.00	41.77
not reported	22.26	32.64	12.25

Table 3.7

Estimated Willingness to Pay for Acceptable Water Quality by Participation and Racial Composition of Household 1984.

Participation Status	Expected Willingness to Pay Racial Composition	
	White	Non-White
User	$183.63 (55.12)[a]	$34.16 (10.40)
Non-User	$48.13 (10.25)	$ 8.95 (2.53)

[a] Standard deviation in parentheses

the range are less reliable. The results suggest that a wider range of tax increases would have yielded more confidence in the estimates' accuracy. Individual willingness to pay bids for water quality improvements appear to have a larger range (i.e. take on larger values) than we anticipated when constructing the survey.

In Table 3.8 the average willingness to pay for each subpopulation is combined with estimates of the subpopulation size to project total willingness to pay figures. The values are based on the telephone sample estimate that 57 percent of the population find Chesapeake Bay water quality unacceptable and on the sample percentages of white users (27%), white non-users (35%), non-white users (16%) and non-white non-users (21%).

Expected values as well as optimistic and pessimistic values are shown. The optimistic (pessimistic) value is derived using the expected value of willingness to pay plus (minus) one standard deviation. On the basis of these estimates, we could argue a reasonable range of willingness to pay values of $60 million to slightly over $100 million. Care must be exercised when considering the standard deviation, as it is computed as an approximation and is not associated with the normal distribution. The values shown, however, represent an "order of magnitude" contingent valuation estimate of willingness to pay for improved water quality.

Table 3.8

Estimated Aggregate[a] Willingness to Pay for Water Quality Acceptable for Swimming, by Classification and Scenarios
1984

Willingness to Pay	Scenario		
	"Average"[b]	"Optimistic"[c]	"Pessimistic"[d]
	---- ---- --- Thousand $ ----------		
User			
White	55,838	72,595	39,081
Non-white	6,164	8,020	4,271
Non-user			
White	19,505	23,641	15,409
Non-white	2,105	2,720	1,514
Aggregate	83,612	106,976	60,275

[a]Baltimore-Washington SMSA population
[b]Based on expected willingness to pay
[c]Based on expected willingness to pay plus one standard deviation
[d]Based on expected willingness to pay minus one standard deviation

Regional Comparisons

Stretching the data somewhat further, one can also examine geographical patterns of responses. The logistic model wae re-estimated using sub-samples grouped by region: the Southeast region (Prince George's County, Charles County, Anne Arundel County and the District of Columbia), the Western region (Northern Virginia, Montgomery County) and the Northern region (Baltimore

City and County, Howard County, and Harford County). The sub-samples represent groups, each of which exhibits reasonable internal homogeneity, for which we have at least one-hundred and fifty responses. Even with these conditions, however, the statistical results are less significant than the earlier ones because of the smaller sample size.

The results suggest regional similarities and differences (Table 3.9). Some consistency is evident as signs on all coefficients are the same for all regions. Thus an increase in the hypothetical tax decreases the probability of acceptance of the tax associated with water quality improvement. Additionally the effect of participation and race on willingness to pay for the improvement is consistent across all regions.

Table 3.9

Logistic Model Estimates Related to the Probability a Respondent Will Accept a Tax Increase to Improve Chesapeake Bay Water Quality, by Geographic Area

Variable	Southeast [a]	West [b]	North [c]
Constant	.334 (.94) [d]	.71 (.46)	.12 (.30)
D_1 " constant	.78 (2.36)	1.02 (2.49)	1.67 (4.77)
Amount of Tax	-.050 (3.33)	-.070 (3.04)	-.023 (1.77)
D_2 . Tax	.041 (3.15)	.060 (3.00)	.015 (1.36)
Chi-squared for likelihood ratio	36.5	37.2	48.6

[a] Dist. of Columbia and Counties of Prince George's, Charles and Anne Arundel
[b] Northern Virginia and Montgomery County
[c] Baltimore City and Counties of Baltimore, Harford and Howard
[d] t-ratio in parentheses

There are, however, systematic differences across regions. Users from the Northern region are willing to pay on average substantially more than those from the southeast or western regions. The figures for nonusers are less disparate across regions, with those for the West region somewhat larger. The estimated willingness to pay figures are presented in Table 3.10.

Table 3.10

Estimated Willingness to Pay for Acceptable Water Quality by Region, Participation, and Racial Composition of Household, 1984.

Household Characteristic	Region		
	Southeast	West	North
White, User	$124	$133	$224
Non-White, User	22	25	77
Non-White, Non-user	7	10	5
White, Non-user	3'?	55	15

Existence Value

In the preceding contingent valuation experiment we present non-zero willingness to pay estimates for non-users as well as users. There are a number of reasons why non-users may be willing to pay for improved water quality. One of these reasons has been labelled existence value by non-market benefit analysts (Krutilla) and stems from early experiences applying benefit cost analysis to water resources projects. Individuals who never use a resource either directly or indirectly <u>and</u> never intend to uae it may still be willing to pay to improve ita quality or assure its existence. Formal studies of existence value are limited, but some empirical evidence exists. Fisher and Raucher (1984) suggest that nonuse benefita (including both option value and existence value) are some fraction of the use value of water quality changes. Other research (e.g., Walsh et al., 1985; Schulze et al., 1983) suggests that existence value may be greater than use value, and sometimes substantially so.

Existence value is a frequently cited concept in the literature, and several studies have attempted to derive explicit estimates of existence value associated with water quality (Mitchell and Carson, 1981; Cronin, 1982; Walsh et al., 1978; Desvousges et al., 1983). Nonetheless, no consensus exists on the models which underlie the measurement. Behaviorally based methods of welfare measurement are unsatisfactory because, by definition, existence value is unconnected with behavior. Suspicion surrounds contingent valuation estimates of existence value because these estimates are even less susceptible to proof or disproof than contingent valuation estimates of use values. Even more to the point, the success of a contingent valuation approach depends on well defined questions. Without a clear idea of the motivations behind existence value, properly focused questions are difficult to define.

The Existence Value Experiment

In this section we present some preliminary results of an experiment designed to shed some light on the motives behind existence value for the Chesapeake Bay. The sample frame was derived from the phone survey described above. The households contacted randomly by phone were asked if they would complete an additional mail survey. Of the 1,044 contacted, 741 agreed to fill out and return a brief mail questionnaire regarding water quality in the Chesapeake Bay, and of these 741 households, 282 actually returned the questionnaires. Because only about 70 percent of those contacted agreed to receive the mail questionnaire, and only 38 percent of those who agreed actually returned these questionnaires, these results should not be taken as representative of the population sampled but as useful for gaining preliminary y insigh ts into willingness to pay motives.

The 282 respondents were grouped as users or non-users. Users were defined as all respondents who currently use the Bay or thought they might do so in the future. Respondents who felt certain that they would not use the Bay for recreation at any time in the future were defined as non-users. Non-users accounted for 16.3 percent of the respondents.

Respondents were asked to consider a series of situations concerning public beaches surrounding the Chesapeake Bay. They were asked to assume that water quality at these beaches had fallen below a level acceptable for swimming, They were told that a project could be undertaken that would clean the beaches so that a water quality level acceptable for swimming was achieved and maintained. The respondents were then asked the following question under four scenarios:

"Would you prefer that the clean-up project be undertaken?"

Scenario 1, No additional information.

Scenario 2. Access to the beaches by the public is permanently denied so that even if clean, the beaches will not be used.

Scenario 3. If the project is undertaken, taxes would be raised so much that nearly everyone prefers that the project is <u>not</u> undertaken. These taxes would be paid by individuals <u>other than</u> the respondent.

Scenario 4. If the project is not undertaken, funds would instead be used to improve hospital services in selected communities surrounding the Bay. Of all the people who care, half want the beaches cleaned, and half want improved hospital services, The respondent himself would never need to visit any of the improved hospitals.

The proportion of "yes" responses for users and non-users under each scenario is given in Table 3.11.

Table 3.11

Summary Results of Contingent Valuation Experiment on Existence Value

Scenario Number	Proportion of Yes Responses: Users [a]	Standard Error of Difference	Proportion of Yes Responses: Non-users [b]	Standard Error of Difference
1	.96		.83	
2	.70	.032	.69 .	.088
3	.71	.032	.67	.088
4	.49	.035	.37	.091

[a]The number of users in the sample of respondents is 236.
[b]The number of nonusers in the sample of respondents is 46.
[c]This is the standard error of the difference between the proportion in Scenario 1 and the proportion in the given scenario.

Interpretation of the Results

In order to interpret the responses reported in Table 3.11, it is necessary first to consider the 'potential motives for existence value. Two broad motives may be discerned: intrinsic and altruistic. Existence value based on intrinsic motives stems from a concern about the state of the world. Concern about the order of things may cause people to suffer simply by learning about pollution incidents. What has been called the "environmental ethic" is closely linked with the intrinsic motive.

Of concern here is the second of the two motives: altruism. People can gain value from the enhanced wellbeing of others (individualistic altruism). An extensive discussion of these altruistic motivations can be found in Madariaga and McConnell (1987).

Responses to the question under Scenario 1 are used as a control to be compared with responses under Scenarios 2 through 4, where Scenario 1 is purposely ambiguous about 'project costs. As expected, moat respondents preferred that the project be undertaken under Scenario 1. Interpreting non-user responses of "yes" as evidence of existence value, the relatively high number of non-users giving positive responses is consistent with the results of previous studies that have found evidence of existence value.

With access to beaches denied under Scenario 2, the number of "yes" responses to the question predictably declined. Since the number of non-user responses of '*yes" declined when access was denied, it appears that existence value, at least to some individuals, is related to others' use. Thus, altruism may , be one motive that underlies existence value. However, even with access denied, most respondenta preferred that the project be undertaken. This may reflect the presence of a number of motivational including an environmental ethic. Finally, it is interesting to note the closeness of user and non-user group responses under Scenario 2. Since with access denied there can be *no* users, "yes" responses from the user group will also indicate positive existence value. In this scenario, the proportion *of* users and non-users exhibiting existence value was nearly identical.

Scenario 3 is similar to Scenario 2 in that both attempt to eliminate altruistic motives. In this scenario, the Bay can be used after the cleanup, but other individuals will be forced to pay more than what the improved water quality is worth to them. The similarity *of* proportions in Scenarios 2 and 3 supports the notion that the Chesapeake resource is valued for its own sake. In Scenario 2, about 70 percent of the people support the project despite the fact that there is no *use* and hence no direct use value. In Scenario 3, roughly the same proportion supports the project even though there is no net value to the users.

Under Scenario 4 the number *of "yes"* responses *fell* dramatically compared with the responses under Scenario 1. Since less than half *of* the non-users preferred that the cleanup project be undertaken, it appears that the improved hospital services are on average at least as valuable as clean water in the Bay.

The individuals were instructed that they would not need the services of the hospital, themselves, so it is tempting to label their value for the improved hospital services as existence value. However, the entire value of the hospital services may be due to altruistic motives while individuals appear to have motives beyond altruism for Chesapeake water quality improvements.

Conclusions

The underlying motives for *existence value* matter to the proper design and interpretation of contingent valuation experiments. The preliminary results concerning *existence* value associated with the Chesapeake Bay suggest some ambiguity about its motivation. People are willing to pay for water quality improvements in the Bay, but how much they are willing to pay depends on the specific nature *of* the opportunities foregone by doing so. Among other considerations, these suggest attention should be paid to the methods for financing the cleanup *of* the Bay.

Chapter 4

The Effect of Chesapeake Bay Water Quality on Beach Use

The previous chapter contains a range of benefits from improved Chesapeake Bay water quality, based on a contingent valuation experiment. Although there is substantial evidence to suggest that the responses to the hypothetical questions were not random but rather associated with households' use of the Bay and racial/income strata, problems still exist with the approach. Follow-up questioning revealed households did not consider alternative uses of tax increases (e.g. improvements in other public goods such as hospitals, roads, etc.). Moreover, the subjective nature of the water quality measurement used in the contingent valuation question does not lend itself easily to policy analysis, based as it is on objective (scientific) measures of water quality. Finally, the values represent aggregate values, indistinguishable on the basis of type of recreation or geographic location of pollution. Knowledge of user group and geographical impacts of programs can provide a depth and richness of understanding important in the political process.

The remaining chapters are devoted to providing analyses of the observed behavior of households based on data gathered in previous studies which are specific to different recreational activities. The analyses use cross-sectional information on households to model beach use, boating and recreational fishing. Once demand functions are estimated, benefits from access and from changes in water quality are assessed for each of these activities.

This chapter contains a cross-sectional analysis of beach use on the western shore of Maryland. It draws from the random telephone survey of the Baltimore-Washington SMSA's and a stratified random survey of twelve public beaches on Maryland's western shore. As such, the analysis is not comprehensive of all beach use in Maryland but rather the use of the public areas in one portion of the Bay by the citizens in the surrounding environs of the two large metropolitan areas closest to the Bay.

A number of approaches to estimating recreational response to environmental quality changes have evolved. Many of these depend first on the estimation of demand for recreational activities which are closely linked to the environmental resource in question. The recreational demand models currently in use have grown out of the union of neoclassical demand theory and the travel cost model proposed by Hotelling and employed extensively by recreational economists for the paat several decades. The principal contribution of the travel cost model is found in the use of the travel cost to the recreational sita as the principal component in constructing a "price" for the recreational commodity. The simple travel cost model can be derived from a neoclassical utility maximization framework, as can more complex models which incorporate added dimensions to the problem (see Bockstael, Strand and Hanemann, 1986).

One particularly important modification of the simple model is the introduction of quality characteristics of recreational sites (see Volume I of this report for the theory). If the recreational demand model is to be used to estimate the value of environmental quality improvements then individuals' behavioral responses to changes in quality must be modelled. This requires observing behavior in the context of differing levels of environmental quality, which can generally be done only by examining recreation behavior at a given point in time over a group of sites which vary in quality.

The procedure can lead to a number of specific methods of analysis (see Kling, Bockstael and Strand, 1985), each imposing a different set of restrictions/assumptions on recreational behavior. While there is no concensus regarding the "correct" model, the two most prominent. models in the literature can be categorized as the (modified) neoclassical model and the discrete choice model. The neoclassical model has the form of the traditional demand system, with quantities being a function of prices and water quality. The model is modified in some way to facilitate the inclusion of water quality parameters which do not tend to vary for a given site over the population, Additionally, demands are generally treated independently. A common approach is the varying parameter model (VPM), as put forth by Smith, Desvousges and McGivney (1986). Here, independent single-site models of recreational trip demand are estimated, and the estimates of the intercept and price coefficient are correlated with the site's water quality. Then, in policy analysis, changes in water quality change the intercept and slope of the demand curve, thereby influencing quantity consumed and the welfare derived from recreational activities.

The discrete choice model (DCM) has also taken many forma (e. g., Caulkins; Morey and Rowe) but the form employed by Bockstael, Hanemann and Strand is representative. In this model, the individual is viewed as having a number of choice occasions upon which to select a site. The selection of site is discrete in the sense that only one site is chosen per choice occasion. Site characteristics such as travel cost, water quality and facilities are used to explain the choice of a site on any given occasion. A composite "value" reflecting the desirability of available choices is computed from the discrete choice estimation, and this is used with other factors to estimate the number of choice occasions.

Although both models are behaviorally based, there are advantages and disadvantages associated with both. The varying parameter model starts from the assumption that the demand functions for trips to sites are interior solutions to a utility maximization process. The discrete choice model, however, starts from the viewpoint that, on any given occasion, an individual chooses among a finite set of alternative sites. Neither approach is perfectly satisfactory. In the DC model, the link between the number of choice occasions and the site selection per choice occasion is ad hoc. With the VP model, the demand for any one site does not adequately reflect the alternatives. Additionally, the fact that individuals do not visit all sites is inconsistent with the implicit theory and must be handled econometrically. Kling has employed Monte Carlo studies to examine the performance of these models. Not surprisingly, her results suggest that the VP model excels when most recreationalists tend to visit almost all alternative sites in a season, and the DC model excels when most tend to visit one or only a few sites in a season.

Most recreational data sets will be characterized by something between the two extremes, however neither model has an obvious advantage, and no tractable model is perfectly consistent with this situation.

In this chapter both the varying parameter and discrete choice models are applied to western shore beach use in Maryland. In subsequent chapters only the varying parameters model will be applied since neither the boating nor fishing data can support the data intensive discrete choice model. The data on beach use at western shore beaches is relatively rich, however. Both types of models will utilize this same data set of Chesapeake Bay beach users in the subsequent analysis. The results will be a range of values which suggest orders of magnitude for welfare measures of hypothetical changes in water quality.

The Survey and the Data

This section is devoted to a description of the survey of Chesapeake Beach Use conducted in 1984. Unlike the data used in analyses of boating and fishing in Chapters 5 and 6, the data used in this chapter were collected during an earlier budget period of this cooperative agreement. Great care was taken with the sampling frame to improve confidence in the results. Because the survey itself is important to the project, the content and procedures are described extensively in Appendix C. A copy of the survey instrument can be found in Appendix D.

From May 26, 1984 to August 19, 1984, Research Triangle Institute (RTI) interviewed individuals on the western shore beaches in Maryland. The study population consisted of all residents of the Baltimore and Washington, D. C., SMSA'S, age 14 or older, that used these beaches for recreation in 1984. More specifically, the population was limited to recreational users of the following 12 beaches:

	Strata	
Beach	Geographic	Size
1. Sandy Point	north	large
2. Point Lookout	south	large
3. Fort Smallwood	north	small
4. Miami	north	small
5. Rocky Point	north	small
6. Elm's Beach	south	small
7. Bay Ridge	south	large
8. Kurtz	north	smell
9. Breezy Point	south	small
10. Rod & Reel	south	small
11. Morgantown	south	small
12. North Beach	south	small

Four hundred and eight individuals were interviewed at the beach to learn of their recreational patterns and perception of water quality at these beaches. These individuals were randomly selected from sample beaches and days. The sampling design can be described as a two-stage stratified sample in which a probability y sample of beaches and days was selected , and a random systematic sample of persons was interviewed at each sample site (day-beach combination) .

The User Intercept Survey Questionnaire was designed to record and collect the following:

- Frequency of visits made to beaches on the western shore of the Chesapeake
- Activities that the respondent (and his/her family) participated in when visiting beaches
- Activities not participated in and the reason why they *were* not
- Cast related to a typical trip to each beach that the respondent had visited since January 1, 1984
- The respondent's perception of the quality *of* the beach and the beach facilities at each beach with which he/she was familiar
- Factors that influenced a respondent's decision to visit or not visit a beach
- The respondent's willingness to continue to visit the sample site if costs related to the use *of* the beach were to rise.

In addition, a series of demographic questions was included to enable analysts to establish profiles of beach users.

The Data

Household Trips

Respondents were asked, on-site, how many trips they had taken in 1984 prior to the interview and how many they intended to take during the rest of 1984. Follow-up telephone interviews at the end of the seaeon obtained complete 1984 trip information for 251 *of* the 408 beach users interviewed. For the remaining households, information was obtained solely on-site.

To assure consistency in our trip measurement, the end of the season information was compared with in-season response so that a correction factor could be applied to households with only "in-season" information." Using data from the largest beach (Sand y Point), a regression of end-of-season trips (x_e) on reported plus intended trips during the season (x_r) yielded:

$$x_e = .686 + .632x_r + \varepsilon \qquad R^2 \cdot .89 \qquad (n = 148) \tag{4.1}$$
$$(1..40) \quad (35.00)$$

where the t-statistics are in parentheses. Equation (4.1) was used to predict total trips to a site from on-site information for households that did not receive follow-up inteviews. The combination of a fairly small constant term and a coefficient on x_r which is less than one suggests that households tend to report intentions in excess of trips later realized.

Access Costs and Time Costs

Previous studies (e.g. Bockstael, Hanemann, and Strand, 1986) have considered travel costs to include the person's (or household's) monetary costs of travel as well as the opportunity costs of their time. Distance to a site, transformed into transportation costs is a feature common to all visitors. However, those individuals who forego income in order to take time to recreate incur monetary expenses in excess of transportation costs. For these individualist these costs can be measured as the foregone wage rate times the time spent accessing the activity.

For households without employed persona or with employed persons with fixed work schedules, there is no direct loss of income incurred when recreation is undertaken. The opportunity cost of recreation time for these individuals is the value of foregone alternative activities. Unfortunately, opportunity costs will vary over individuals in ways which are not observable. The only observable factor related to the total opportunity cost of the recreation experience will be the time spent traveling and recreating. Even this measurement is troublesome, however, since the on-site portion of this time also measures the amount of the recreational good consumed. To avoid many of these complications we employ only round-trip travel time as a surrogate for opportunity costs in these cases.

In addition to these access costs, most western shore beaches have an admittance fee which must be added to the other costs of traveling to the site. Often the fee will vary depending on the day of the week and size of party.

Water Quality

The Chessie System environmental quality data, maintained by EPA's Chesapeake Bay program, were' used to construct the water quality measures. Turbidity, bacteria counts, total suspended solids, total nitrogen, total phosphorous, and total chlorophyll A are among the potential indicators of water quality to which beach demand might be sensitive, Since these exhibited a high degree of collinearity, two variables were extracted from the data set to use in this analysis: total nitrogen and total phosphorus. A good case can be made for using these variables. Studies of the Bay conducted by the U. S. Environmental Protection Agency indicate that perhaps the most significant problem facing Bay restoration and protection efforts is nutrient over-enrichment of Bay waters. Excessive nutrient levels may be the partial cause of decreased submerged aquatic vegetation, which in turn has adverse effects on the food chain and on the habitat for many fish species. Further, over-enrichment leads to lower dissolved oxygen levels which have additional adverse effects on fish stocks, degrading the appearance of the water as well.

High collinearity y between nitrogen and phosphorus readings prevented separate inclusion of both variables in the analysis. The product of nitrogen and phosphorus was used to avoid this problem and to capture the interactive nature of these nutrients.

In each case, mean monthly water quality levels from April through September 19?7 were calculated for areas of twelve counties contiguous to the Bay, The summer months were chosen because they represent the peak of recreational activity. Complete data over regions of the Bay were available for only some years, 1977 being the closest to the survey year. The relative water quality readings across the Bay are unlikely to be considerably different between the two years, even if the absolute readings are different. Additionally, individuals' decisions are unlikely to be related solely to water quality in the current year, but will be based on a cumulative learning process which includes past observations as well. Consequently, there is no obvious correct choice, and the errors associated with using data from any one year are unclear.

Other Variables

Additional factors are known to influence recreation activity, including the ownership of certain types of household capital equipment. Boats, recreational vehicles and swimming pools are the types of capital equipment which may affect the use of beaches on the western shore. Some of these beaches have boat-launch facilities, some camp sites, while others offer good swimming possibilities. Years living in the area, previous recreational history, family size and participation are some other factors which may be important.

The Varying Parameter Model

To formalize the model of behavior. the individual is assumed to maximize a constrained utility function which is a function of number of trips taken to each of n quality-differentiated sites, the qualit y characteristics of each site, and a Hicksian good. Thus

$$(4.2) \qquad \max u(x, q, z) \qquad \text{s.t. } px + z = y$$

where x is an n-dimensional vector of trips to the n sites, p is a corresponding vector of costs of accessing the sites, q is a matrix of variables q_{ij}, $i = 1,\ldots,n$ and $j = 1,\ldots,m$, where q_{ij} is the level of the j^{th} quality characteristic at the i^{th} site, z is the Hicksian good, and y is income. To simplify notation in this section, we will assume that there is only one quality characteristic, and thus $m = 1$, and q represents the vector of values of the one quality characteristic across sites.

Problem (4.2) defines n demand functions, each of which may be a function of all *n* prices, n quality levels, and income:

$$x_i = g_i(p, q, y) \qquad i = 1,\ldots,n. \tag{4.3}$$

This model cannot be estimated with cross-section data. Imagine having observations on S individuals who visit site i. Own price (p_i) and substitute prices (p_k, $k \neq i$) will typically vary across individuals if they come to site i from different geographical areas. However, there will be no variation in the quality characteristic at site i (q_i) across the S individuals, nor will there by any variation across individual in the characteristics of other sites (q_k, $k \neq i$). With no variation in the q_i's across observations, their coefficients cannot be estimated, and nothing can be learned about behavioral response to quality changes.

There are *several* methods for resolving the dilemma presented above. Some of them build on the model presented in (4.3) (these are described in Kling, Bockstael and Strand, 1985), while others rely on discrete choice models (see Bockstael, Hanemann and Strand, 1986). The method used in this section, the varying parameters model, falls in the former category and *follows* similar methods applied by Vaughan and Russell (1982); Smith, Desvousges and McGivney (1983); and Smith and Desvousges (1985).

One way to motivate the varying parameters model is to consider *a* simple linear form such as:

$$x_i = \beta_{0i} + \sum_{k=1}^{n} \beta_{1ik} p_k + \beta_{2i} y + \varepsilon_i \qquad i = 1,\ldots,n, \tag{4.4}$$

but to further assume that the parameters in site demand functions are deterministic functions of the quality characteristics. For example, the β's might be linear functions of the q's:

$$\begin{aligned}
\beta_{0i} &= \gamma_0 + \gamma_1 q_i + \sum_{j \neq i} \gamma_{2j} q_j, \\
\beta_{1ik} &= \alpha_{0k} + \alpha_{1k} q_i + \sum_{j \neq i} \alpha_{2kj} q_j, \qquad k = 1,\ldots,n, \\
\beta_{2i} &= \delta_0 + \delta_1 q_i + \sum_{j \neq i} \delta_{2j} q_j.
\end{aligned} \tag{4.5}$$

The model in (4.4) and (4.5) implies that variations in demand parameters across sites (i.e., variations in the β_{0i}'s, β_{1i}'s, etc.) correspond to variations in own-site attributes (q_i) and substitute-site attributes (q_j, $j \neq i$). Specifically, the above model implies a demand for trips to site i of the following form:

$$(4.6) \qquad x_i = (70 + \gamma_1 q_i + \Sigma \gamma_{2j} q_j) + \sum_{k=1}^{n} ({}^{a}0k + \alpha_{1k} q_i + \Sigma \alpha_{2kj} q_j) p_k$$

$$+ (\delta_0 + \delta_1 q_i + \Sigma \delta_{2j} q_j) y + \varepsilon_i .$$

Even though the model can be collapsed into *one* expression as in {4.6), the estimation procedure usually involves two steps: the regression of trips to each site on prices and income (e.g., *n* separate regressions) and the regression *of* the coefficients from the first n- regressions on the quality characteristics *of* the sites. The second step requires the application of generalized least squares because *of* the properties *of* the error structure implicit in the estimation *of* (4.5) which must use estimated parameters ($\hat{\beta}$'s) in place of the true β's.

The first-stage estimation procedure is further complicated by the need to correct *for a* censored sample bias. Moat consumer demand problems analyzed with household data encounter this problem. A random sample *of* households will *reveal* a certain (often substantial) number of households that do not consume the good in question and thus have zero as the value of their dependent variable. In the sample, there will therefore be many observations concentrated around zero. Neither omitting the zero observations, nor including them in an OLS regression, will produce unbiased estimates.

Tobin analyzed this problem in 1958 and produced the first of several approaches to handling the problem. His approach applied to the first stage of our varying parameters model characterizes the problem in the following way:

$$(4.7) \qquad x_i = \beta_0 + \Sigma \beta_{1j} p_j + \beta_2 y + \varepsilon \qquad \text{if } \beta_0 + \Sigma \beta_{1j} p_j + \beta_2 y + \varepsilon > 0$$

$$x_i = 0 \qquad \text{otherwise.}$$

While ε may be distributed as a normal, x will not be. The estimation of the β's therefore requires maximum likelihood techniques, where the likelihood function is given by

$$(4.8) \qquad L = \prod_{x>0} \frac{1}{\sigma} \phi\left(\frac{x - z\beta}{\sigma}\right) \prod_{x=0} \Phi\left(\frac{-z\beta}{\sigma}\right)$$

where $z\beta$ is the right-hand side of (4.4), σ is the standard deviation of ε, and ϕ and Φ are, respectively, the density function and the distribution function of the standard normal.

The Varying Parameter Model Estimates

Of the twelve mentioned beaches, there was sufficient data to estimate demand functions for only nine. For two beaches, Kurtz Pleasure Beach and North Beach, there were less than 20 respondents. Additionally, Breezy Point had only 24 observations, and over 10 percent of these were more than one-day trips. We were, however, able to separate the Chesapeake Beach location into two sites, the Chesapeake Beach proper and the Rod and Reel Club beach. Thus there were ten sites initially considered in the analysis.

The arithmetic means of the variables used in the model are shown in Table 4.1. The average is taken over persons actually visiting the site. The largest average number of trips per user occurs at Rocky Point, whereas the smallest occurs at Porter's New Beach. Point Lookout requires on average the greatest monetary and time expenditures for access, whereas Fort Smallwood and Rock y Point have the least average monetary costs *per* user. Table 4.1 also reports, for each beach, the percentage of users owning certain types *of* recreational equipment. The percentage of beach users owning boats ranged from a low *of* 12 percent at Bay Ridge to a high *of* 19 percent at Porter's New Beach and Miami Beach. The range was larger for recreational vehicle ownership, with as much as a quarter to a third *of* users at Chesapeake Beach, Rod and Reel, Bay Ridge, Point Lookout and Morgantown being recreational vehicle owners.

There are a number of methods for incorporating substitute site information into recreational demand models (see Bockstael, Hanemann and Kling, 1986), none of which is completely satisfactory. The approach taken here is to identify for each site and each individual <u>one</u> substitute beach. Average access costs and time costs for a substitute beach are included in Table 4.1. For each individual and each beach, the designated substitute beach is the least cost alternative.

The initial set *of* regressions was run using equation (4.4) as the behavioral model and a tobit estimation procedure as the statistical basis. In some cases, multicollinearity among the cost and time variables required eliminating one or both *of* the substitute cost variables. In the case of Morgantown, the small number of observations gave such *poor* results that the site was dropped from the model. The results reported in Table 4.2 were generated using the LIMDEP statistical package and an IBM 4341 computer.

As indicated earlier, the total sample of beach users is 408 individuals. The tobit estimation for any beach j includes both users *of* beach j (non-limit observations) and individuals who were in the beach sample but did not use beach j. The number of observations in each tobit estimation differs from beach to beach however, because some individuals had missing cost data for some beaches.

Table 4.1

Average Values of Regression Variables for Visitors by Beach

Beach	Tripe (#/yr)	Beach: Access coats ($)	Beach: Access Time (hr)	Substitute Beach: Access coats ($)	Substitute Beach: Access Time (hr)	Ownership: Boat (%)	Ownership: Recreation Vehicle (%)	Ownership: Swimming Pool (%)
Sandy Point	8.06	15.98	1.29	12.09	.84	15	18	18
Fort Smallwood	5.83	8.66	1.11	6.38	.69	14	20	14
Chesapeake Beach	2.87	18.79	1.45	11.30	.84	17	28	17
Rod & Reel	6.42	22.80	1*58	13.61	.87	13	33	25
Bay Ridge	7.33	15.75	1.14	10.84	.84	12	28	12
Point Lookout	3.85	36.42	2.73	13.10	1.03	17	30	12
Rocky Point	10.20	9.07	.93	6.43	.55	13	12	20
Porter's New Beach	2.92	9.50	.72	5.81	.49	19	11	11
Miami	5.16	11.81	.86	4.82	.59	19	17	17
Morgantown	7.71	26.09	1.22	9.80	1.02	17	35	09

Table 4.2
Tobit Estimates for Beach Demand Model, by Beach[a]

Beach	Constant	Beach: Access Costs	Beach: Access Time	Substitute Beach: Access Costs	Substitute Beach: Access Time	Ownership: Boat	Ownership: Rec. Veh.	Ownership: Swim. Pool	σ	Nonlimit/ Limit Observations
Sandy Point	8.17	-.35	-4.85	.24	2.47				14.85	243/139
	(2.83)[b]	(-4.07)	(-3.61)	(2.86)	(1.15)				(57.59)	
Fort Smallwood	.16	-.53	-4.24	.34					9.52	41/198
	(.05)	(-2.86)	(-2.58)	(1.14)					(11.61)	
Rod & Reel	-10.44	-.10	-1.51	.29					9.72	22/201
	(-2.18)	(-.84)	(-1.28)	(1.25)					(5.47)	
Rocky Point	10.29	-.47	-5.63					3.55	12.41	87/66
	(2.04)	(1.45)	(-2.38)					(1.36)	(19.00)	
Chesapeake Beach	-3.96	.18	-1.19	.19			3.23		6.16	46/272
	(-1.89)	(-2.19)	(-1.76)	(1.80)			(2.58)		(10.00)	
Porter's New Beach	-.70	-.29	-1.28	.31		1.54		2.04	3.43	25/118
	(-.31)	(-2.21)	(-1.28)	(1.10)		(1.32)		(1.31)	(5.15)	
Point Lookout	3.49	-.05	-1.72	.12	4.55	2.19	2.98	-1.76	5.96	82/262
	(-2.72)	(-5.62)	(4.72)	(3.35)	(5.41)	(1.69)	(2.50)	(-1.21)	(15.14)	
Miami	-2.20	-.09	-1.27				4.37		7.42	50/121
	(-1.45)	(-1.35)	(-1.18)				(2.46)		(10.06)	
Bay Ridge	-6.96	-.78	-9.63	.83	7.40	-6.19	7.55	-5.67	18.06	61/292
	(1.16)	(-4.90)	(-3.50)	(3.19)	(1.96)	(-1.00)	(1.50)	(-1.13)	(17.56)	

[a] No coefficients were significantly different from zero for Morgantown site.
[b] t-ratios in parentheses

The estimated coefficients on own-price (travel cost) were all *of* the expected sign, and most were statistically significant from zero. Beaches for which a reasonably large on-site sample was obtained yielded the most significant estimates. Small sample effects of multicollinearity among the price and time variables likely caused the large standard errors for Miami, Rod and Reel, etc. In some instances, the multicollinearity was sufficiently troublesome that only the own-price and own-time variables were considered. Obtaining results for as many beaches as possible was critical because the sample size in the second-stage estimation equals the number of beaches in the first stage.

The results of the second-stage estimation, i.e. the estimation of equation (4.5), were obtained from a weighted least squares procedure in which the weights were $1/u_{p_j}$, the inverse of the standard error of the own-price coefficient for each beach. The estimated equations are:

(4.10)
$$\beta_{1j} = \underset{(-.04)}{-.0308} - \underset{(-2.22)}{.00020}\, TNP_j$$

$$\beta_{0j} = \underset{(-1.10)}{-2.66} - \underset{(-.001)}{.0016}\, TNP_j$$

where TNP is the water quality variable defined earlier, and the values in parentheses are t-ratios.

The results show no significant relationship between water quality and the intercepts of the beach-use demand equations but a significant relationship between water quality and the coefficients on travel cost. The poorer the water quality (i.e. the higher the level of TNP), the larger the negative response *of* beach users to travel costs. This results in a pivoting inward of the demand curve as water quality deteriorates and a pivoting outward with improvements. The results are in accordance with the proposition that poor water quality lowers beach users willingness to pay for access to beaches.

Estimated Benefit Changes

The analysis above describes the behavioral response of the average western shore beach user to the change in water quality. From this information and information on the number of users of the beaches, we are able to determine some estimates of benefits of hypothetical improvements in water quality to the average user *of* each beach. We are also able to expand to the total population of beach users.

Three hypothetical changes in the environmental variables are considered, a 10 percent and a 20 percent decrease (environmental improvement) in the environmental (pollution) variables, and a 20 percent increase (environmental degradation). Since we will want to assess the *effects* of the change, we will want to calculate consumer surplus before and after the change. The formula for individual i's consumer surplus from site j is given by the following when the demand function is linear

$$(4.11) \qquad CS_{ij} = (x_{ij})^2/(-2\beta_{j1}),$$

where x_{ij} is i's demand for trips to j and β_{j1} is the coefficient on cost of access in the j^{th} site demand function. For a given hypothetical change in water quality at beach j, the weighted average change in consumer surplus over the sample is calculated:

$$(4.12) \quad ACS = \sum_{i=1}^{N_j}[(x_{ij}(q_j^1))^2/(-2\beta_{j1}(q_j^1)) - (x_{ij}(q_j^0))^2/(-2\beta_{j1}(q_j^0))]*k_i/N_j$$

where k_i is the weight, q_j^0 and q_j^1 are the levels of water quality before and after the change, and the notation xl $_j$ (q_j) and $\beta_{j1}(q_j)$ implies that both demand and the coefficient on travel cost are functions of the level of water quality. N_j is the size of the sample of beach users used to estimate the tobit equation for beach j. The sample includes all 408 observations minus those for which information about beach j was unavailable.

Calculating consumer surplus for hypothetical environmental circumstances (equation 4.12) thus requires values for $x^0 = x(q^0)$, $\beta^0(q^0)$, $x^1 = x(q^1)$, and $\beta^1 = \beta(q^1)$. The first step in assessing the hypothetical changes is to use the results of model (4.10) to predict $\hat{\beta}_{j1}(q_j^1)$, that is to predict the new travel cost coefficient given the hypothetical change in water quality. The coefficients $\hat{\beta}_{j1}(q_j^0)$ and $\hat{\beta}_{j2}(q_j^1)$ are then used to determine values for demand, i.e. x_j^0 and x_j^1.

Prediction of the demand for trips is complicated because the demand function was initially estimated using a Tobit procedure. Recall the model underlying the Tobit,

$$x^* = \beta'z + \varepsilon \qquad \varepsilon \sim N(0, \sigma^2)$$

where values of $x^* < 0$ are censored and observed as zeroes, so that

$$x = \beta'z + \varepsilon \qquad \text{when } \beta'z + \varepsilon > 0$$

and

$$x = 0 \qquad \text{otherwise.}$$

Given the underlying model, the systematic portion of (4.4) cannot be used as the expected value 1OCUIY of x, The Tobit predicting equation given below adjusts for the censored nature of the dependent variable:

$$E(x_{ij}) = \Phi\left(\frac{\hat{\beta}'z}{\hat{\sigma}}\right)\hat{\beta}'z + \hat{\sigma}\phi\left(\frac{\hat{\beta}'z}{\hat{\sigma}}\right) \tag{4.13}$$

where z is a vector of explanatory variables and ϕ and Φ are the density and cumulative distribution functions for the standard normal, respectively, The first term represents the conditional expectation of trips given that the person participates times the probability that the person participates. The second term corrects for non-normality because of potential truncation.

There are two ways of obtaining the "before" and "after" x's for the consumer surplus functions. One way is to use the predicting equation (4.13) to calculate both $\hat{x}^0$ and $\hat{x}^1$ values. The second method is to accept the observed x as x^0 and then to adjust this x by $\hat{x}^1 - \hat{x}^0$ to reflect the hypothetical change in water quality to obtain the estimated x^1. (See Bockstael and Strand, 1986, for details of the two approaches.)

Because there is no clear theoretical reason to choose one approach over the other, we calculate the results both ways. Both methods use formula (4. 11) to calculate the change in average consumer surplus. However, Method A calculates trip values as

$$\hat{x}^0_{ij} = \Phi\left(\frac{\hat{\beta}^{0\prime}_j z_{ij}}{\hat{\sigma}}\right)\hat{\beta}^{0\prime}_j z_{ij} + \hat{\sigma}\phi\left(\frac{\hat{\beta}^{0\prime}_j z_{ij}}{\hat{\sigma}}\right) \tag{4. 14}$$

and

$$\hat{x}^1_{ij} = \Phi\left(\frac{\hat{\beta}^{1\prime}_j z_{ij}}{\hat{\sigma}}\right)\hat{\beta}^{1\prime}_j z_{ij} + \hat{\sigma}\phi\left(\frac{\hat{\beta}^{1\prime}_j z_{ij}}{\hat{\sigma}}\right) \tag{4.15}$$

where the z_{ij} are the explanatory variables in the j^{th} beach's regression (see Table 4.2). Method B calculates the demand for trips in the following way:

$$x^0_{ij} = \text{observed value of } x_{ij}$$

and

$$x^1_{ij} = x^0_{ij} + \hat{x}^1_{ij} - \hat{x}^0_{ij}$$

where $\hat{x}^1_{ij}$ and $\hat{x}^0_{ij}$ are defined in (4. 14) and (4. 15).

Tables 4.3 - 4.5 summarize the average beach users benefits and losses from the hypothetical changes in the nitrogen and phosphorus concentrations in the Chesapeake Bay. The first and fourth columns in each table represent the base line *average consumer* surplus over the entire sample *of* beach users

Table 4.3

Annual Benefits per Beach User from a 20 Percent Decrease in Pollutant, by Beach
1984

Beach	Calculation Method A[a]			Calculation Method B[b]		
	Consumer Surplus Before	Consumer Surplus After	Benefits	Consumer Surplus Before	Consumer Surplus After	Benefits
Sandy Point	133.94	169.03	35.09	342.04	379.33	37.06
Fort Smallwood	.82	5.17	4.35	57.69	73.13	15.44
Chesapeake Beach	36.32	43.88	7.56	57.89	60.77	2.88
Rod & Reel Club	10.32	16.19	5.87	259.81	284.08	24.27
Porter's New Beach	5.95	8.45	2.50	12.20	12.34	1.14
Rocky Point	80.38	89.53	9.15	179.65	191.02	11.34
Point Lookout	15.86	22.61	6.75	315.27	415.06	99.79
Bay Ridge	178.18	204.76	26.58	171.64	178.98	7.34
Miami Beach	5.38	10.27	4.89	220.68	304.99	84.31

[a] With Method A, the average consumer surplus for a change in quality at beach j is taken over a sample which includes all beech users whether or not they visited beach j.

[b] With Method B, the average consumer surplus for a change in quality at beach j is taken over a sample which includes <u>only</u> users of beach j.

Table 4.4

Annual Benefits per Beach User from a 10 Percent Decrease in Pollutant, by Beach
1984

Beach	Calculation Method A[a]			Calculation Method B[b]		
	Consumer Surplus Before	After	Benefits	Consumer Surplus Before	After	Benefits
Sandy Point	133.94	150.39	16.45	342.04	363.35	21.31
Fort Smallwood	.82	1.50	.68	57.69	69.28	11.59
Chesapeake Beach	36.32	39.96	3.64	57.88	61.11	3.22
Rod & Reel Club	10.32	13.00	2.68	259.81	277.73	17.92
Porter's New Beach	5.95	7.12	1.17	12.20	13.55	1.35
Rocky Point	80.38	84.82	4.44	179.65	186.63	6.98
Point Lookout	15.86	18.73	2.87	315.27	363.61	48.34
Bay Ridge	178.18	191.08	12.90	171.46	176.55	5.09
Miami Beach	5.38	7.34	1.96	220.68	261.16	40.48

[a]With Method A, the average consumer surplus for a change in quality at beach j is taken over a sample which includes all beach users whether or not they visited beach j.

[b]With Method B, the average consumer surplus for a change in quality at beach j is taken over a sample-which includes <u>only</u> users of beach j.

Table 4.5

Annual Losses per Beach User from a 2.0 Percent Increase in Pollutant, by Beach
1984

	Calculation Method A[a]			Calculation Method B[b]		
Beach	Consumer Surplus Before	After	Losses	Consumer Surplus Before	After	Losses
Sandy Point	133.94	106.54	(27.40)	342.04	311.26	(30.78)
Fort Smallwood	.82	.29	(.53)	57.69	47.63	(10.06)
Chesapeake Beach	36.32	29.81	(6.51)	57.88	55.27	(2.62)
Rod & Reel Club	10.32	6.25	(4.07)	259.81	239.35	(20.46)
Porter's New Beach	5.95	4.05	(1.90)	12.20	11.24	(.96)
Rocky Point	80.38	72.26	(8.12)	179.65	166.81	(12.84)
Point Lookout	15.86	11.92	(3.94)	315.27	253.41	(61.86)
Bay Ridge	178.18	154.56	(23.62)	171.64	164.55	(7.09)
Miami Beach	5.38	3.06	(2.32)	220.68	172.41	(48.27)

[a]With Method A, the average consumer surplus for a change in quality at beach j is taken over a sample which includes all beach users whether or not they" visited beach j.

[b]With Method B, the average consumer surplus for a change in quality at beach j is taken over a sample which includes only users of beach j.

for use of each beach, calculated using each of the two methods mentioned above. The second and fifth columns show the average consumer surplus per beach user in the sample following a water quality change at each beach. The third and sixth columns represent the change in surplus for the average beach user associated with a water quality change at each beach.

The method of calculation makes a good deal of difference for some beaches, especially Point Lookout, Miami Beach and Rod and Reel. Recalling the econometric results in Table 4.2, the estimated demand equations for these three are price inelastic relative to other beaches; that is, the absolute values of their price coefficients are quite small. When demand is very inelastic, big differences are likely between the mean consumer surplus and the consumer surplus associated with the mean number of tripe (see Bockstael and Strand).

The average consumer surplus values are expanded to the entire Baltimore-Washington SMSA's in Table 4,6. This was accomplished by knowing that the 1980 number of regional households was 1,977,000 (census of the U. S., 1980), by determining from a contemporaneous phone survey that 47 percent of the regional population used western shore beaches" and by knowing the percentage of western shore beach users who used each beach. Large aggregate benefits are associated with Sandy Point (in both methods of calculation) because of the very large number of households that visit that beach. Whereas 21 percent of the population used western shore beaches, over half used Sandy Point. When expanding to households, Sandy Point has nearly twice as many users as any other beach.

The Discrete/Continuous Choice Model

The utility maximizing model in (4.2) and the resulting demand functions in (4.3) are an apt description of the individual's decision problem only if he chooses positive values for <u>all</u> x_i (i.e., if he is at interior solutions in all the markets). It is not an adequate description if corner solutions arise (i.e., $x_i = 0$). The discrete choice model is appropriate when an individual chooses one from a finite set of alternatives, by comparing the available alternatives. The discrete choice model presented here is amended to include a component which describes the demand for trips as well as the discrete choice among trips on any choice occasion.

<u>The Choice Among Sites</u>

The first part of the model involves the estimation of the household's choice among sites. It will be important here to capture those elements which vary over sites. McFadden (1976) provides a utility theoretic framework for employing the multinominal logit model which is applicable to a discrete choice problem of this sort. For further discussion of its application to recreation demand, see Bockstael, Hanemann and Strand (1986).

Table 4.6

Aggregate Benefits/Losses to Users from Changes in Chesapeake Bay Water Quality, by Beach
1984

	Calculation Method A			Calculation Method B		
	Change			Change		
	Improvement		Degradation	Improvement		Degradation
Beach	20%	10%	20%	20%	10%	20%
	. . . . Thousands $					
Sandy Point	14,064	6,602	(11,001)	9,967	4,704	(8,009)
Fort Smallwood	1,744	275	(212)	1,576	651	(781)
Chesapeake Beach	3,038	1,462	(2,612)	680	329	(597)
Rod & Reel Club	2,356	1,075	(1,632)	1,316	626	(1,089)
Porter's New Beach	1,006	468	(750)	52	24	(40)
Rocky Point	3,673	1,781	(3,258)	923	449	(824)
Point Lookout	2,708	1,153	(1,577)	12,484	5,375	(7,520)
Bay Ridge	10,667	5,176	(9,484)	823	397	(710)
Miami Beach	1,963	788	(931)	3,975	1,674	(2,255)

Suppose we call V_i^* a latent variable denoting the level of indirect utility associated with the ith alternative. The observed variable Y_i has the property that

$$Y_i = 1 \quad \text{if } V_i^* = \max(V_1^*, V_2^*, \ldots, V_M^*)$$
$$Y_i = 0 \quad \text{otherwise.}$$

Indirect utility associated with the ith alternative is some function of z_i, a vector of attributes of the ith alternative so that $V_i^* = V_i(z_i) + \varepsilon_i$. The random component is generally attributed to the systematic? but unmeasurable, variation in tastes and omitted variables. Thus, each household has a level of error which, in a sense, remains with it over time. If the ε's are independently and identicaly distributed with type I extreme value distribution (Weibull), then it is well known that

$$\text{Prob}\,(Y_i=1 \mid z) = \frac{e^{V_i}}{\sum_{j=1}^{M} e^{V_j}},$$

(see Maddala 1983; McFadden, 1973; Domencich and McFadden, 1975). The likelihood function for the sample is

$$L = \prod_{i=1}^{M} \left[\frac{e^{V_i}}{\sum_j e^{V_j}}\right]^{g_i}$$

where gi = 1 if i is chosen, $g_i = 0$ otherwise.

The multinominal logit has a property which in some circumstances is useful but in others is unrealistic. The model presented above implicitly assumes independence of irrelevant alternatives, i.e. the relative odds of choosing any pair of alternatives remains constant no matter what happens in the remainder of the choice set. Thus, this model allows for no specific pattern of correlation among the errors associated with the alternatives; it denies--and in fact is violated by--any particular similarities within groups of alternatives.

McFadden (1978) has shown that a more general nested logit model specifically incorporating varying correlations among the errors associated with the alternatives can also be derived from a stochastic utility maximization framework (see also Maddala, 1983). If the ε's have a generalized extreme value distribution then a pattern of correlation among the choices can be allowed. McFadden defines a probabilistic choice model

$$P_1 = \frac{e^{V_i} G_i(e^{V_1}, \ldots, e^{V_N})}{G(e^{V_1}, \ldots, e^{V_N})}$$

here G_i is the partial of G with respect to the i^{th} argument and $G(e^{V_1}, \ldots e^{V_N})$ has certain properties which imply that

$$F(\varepsilon_1, \ldots, \varepsilon_n) = \exp\{-G(e^{-\varepsilon_1}, \ldots, e^{-\varepsilon_n})\}$$

is a multivariate extreme value distribution. When $G(e^{V_1}, \ldots, e^{V_N})$ is defined Σe^{V_i}, then the model reduces to the ordinary multinornial logit (MNL) described above. However when

$$G(Y) = \sum_{m=1}^{M} a_m \left(\sum_{i \in S} e^{V_i/(1-\delta_m)} \right)^{1-\delta_m}$$

where there are M subsets of the N alternatives and $0 \leq \delta_m < 1$, then a general pattern of dependence among the alternatives is allowed. The parameters, δ_m, can be interpreted as an index of the similarity within groups.

Suppose we were to classify the alternatives into these M groups where δ_m denotes the set of alternatives in group m, and we were interested in the probability of choosing some alternative i. Then

$$P_i = \sum_{m=1}^{M} P(i|S_m) \cdot P(S_m),$$

where

$$P(i|S_m) = \begin{cases} \dfrac{e^{V_i/(1-\delta_m)}}{\sum_{j \in S_m} e^{V_{jm}/(1-\delta_m)}} & \text{if } i \in S_m \\ 0 & \text{Otherwise} \end{cases}$$

and

$$P(S_m) = \frac{a_m \left(\sum_{j \in S_m} e^{V_{jm}/(1-\delta_m)} \right)^{1-\delta_m}}{\sum_{n=1}^{M} a_n \left(\sum_{k \in S_n} e^{V_{kn}/(1-\delta_n)} \right)^{1-\delta_n}}$$

The above GEV model is useful in many applied discrete choice problems. Frequently, alternatives group themselves in obvious patterns of substitutability. If they do, it is both convenient and appropriate to estimate the GEV model. It is appropriate because the results of an ordinary MNL will violate the independence of irrelevant alternatives asumption if such a pattern actually exists. It is convenient because it reduces the number of alternatives included at each stage.

Let us make the estimation process explicit. In the problem at hand, individuals are choosing among ten beaches. Two of these beaches are qualitatively different. They are state parks, larger and providing more services than the local beaches. Now we can view the choice problem as a two-level nested one: the choice between state park or local beach (m = 1, 2) and the choice among beaches within each group. Consider a redefinition of V_i:

$$V_{im} = \theta' Z_{im} + \psi' W_m$$

where the Z's denote attributes associated with all sites and the W's are attributes associated with the state park and local beach choice. Also let us assume that δ_m is identical within all groups and equal to δ

Now define a variable, I_m, in the following way:

(4.16) $$I_m = \ln \left\{ \sum_{i \in S_m} e^{\theta' Z_{im}/(1-\delta)} \right\}.$$

Then the probabilities above can be rewritten as

(4.17) $$P_{i|m} = \frac{e^{\theta' Z_{im}/(1-\delta)}}{\sum_{k \in S_m} e^{\theta' Z_{km}/(1-\delta)}}$$

and

(4.18) $$P_m = \frac{e^{\psi' W_m + (1-\delta) I_m}}{\sum_{j=1}^{M} e^{\psi' W_j + (1-\delta) I_j}}$$

The variable I_m is sometimes termed an inclusive value (see McFadden, 1978) . and serves as an index of the relative value of the alternatives included in subgroup m.

As expressed in (4.17) and (4.18), the probabilities of interest can be estimated using MNL proced urea. First, the $P_{i|m}$ are estimated with M independent applications of the multinominal logit. Note that at this stage θ is not recoverable, but can be estimated only up to a scale factor of $1-\delta$. From the results of (4.17), the inclusive prices (4.16) are calculated and incorporated as variables in the second level of estimation (4.18). Here the ψ's and the δ are estimated.

A δ outside the unit interval is inconsistent with the underlying utility theoretic model and suggests misspecification (see McFadden). The parameter δ is an index of similarity of alternatives within groups not present across groups. A value of one for 15 indicates that alternatives within a group are perfect substitutes. Thus, all relevant choice involves choice among groups. A value of zero for δ implies there is no special similarity of alternatives within groups and thus no particular gain from using a nested GEV model.

Two-step estimation, i.e. the estimation of (4.17) and (4.18) independently, is not necessarily efficient. Amemiya (1973) explores this property of the model and presents a correction factor. However, even Amemiya suggests that the cost in computational complexity is probably not worth the gains. We consider McFadden's estimation method adequate and use it to estimate a GEV model in the next section.

Estimation of the Discrete Choice Among Beaches

The two-tiered discrete choice model considers the individual choosing between two categories of sites (state park and local beach sites) and then choosing among beaches within the desired category. The state park beaches are located at Sandy Point (adjacent to the Chesapeake Bay Bridge) and Point Lookout (at the mouth of the Potomac), whereas the local beaches are defined to include Fort Smallwood, Bay Ridge, Kurtz's Pleasure Beach, Miami Beach, Morgantown Beach, Porter's New Beach, Rod and Reel Club Beach, North Beach and Chesapeake Beach.

In estimating the model, however, the decision among sites within each category is dealt with first. In assessing the available sites within a category on a choice occasion, the household chooses on the basis of certain household attributes in combination with specific site characteristics. These are denoted Z_{ji} and are defined for one model as:

Z_{1i} = access costs in \$ to site i, calculated using distance (d_i) from the household's origin to the site[1] ($Z_{1i} = 1.088 + .049*d_i - .000074d_i^2$) plus the entrance fee plus the wages lost from traveling if the individual had directly foregone income to visit the site;

Z_{2i} = access time (in minutes) to site i, calculated using distance from the household'a origin to the site[2] ($Z_{2i} = .7 + .02d_i$);

Z_{3i} = water pollution index for site i (see description page 18);

---

[1] Exact formula was determined by regressing reported costs against distance.

[2] Exact formula was determined by 'regressing- reported travel time against distance.

Z_{4i} = the availability of recreational vehicle facilities at site i (0 if not available, 1 if available) times whether the household owned a recreational vehicle (0 if not owned, 1 if owned);

Z_{5i} = the availability of fishing facilities at site i times whether the household owned fishing equipment;

Z^*, = the availability of boat launch facilities at site i times whether the household owned a boat.

The first stage of the estimation is reported in Table 4.7. The results indicate that relatively large monetary and time costs negatively influence the probability of choosing a beach. Water pollution also has a negative influence as does fishing facilities. Presumably, fishing activity draws the household members away from the beach. Boat facilities and recreational vehicle facilities improve the probability that someone owning a boat or RV will attend beaches with facilities for that equipment.

The second tier of the discrete decision involves whether individuals select a state park (with many activities) or a local beach. The factors hypothesized to be important in deciding to visit a state park were thought to be the years the household had visited western shore beaches (WI), whether the intercepted household had more than one family member in the party (w_2), the size of the group intercepted (w,) and the inclusive value (I_m) derived from the first-stage estimation. People with a larger history of beach use in the area would be more likely to learn of the smaller beaches and hence be less likely to use the state parks. On the other hand, the state parks usually offer a greater variety of activities, and thus families and large parties might be more likely to attend them.

The results of the estimations are presented in Table 4.8. The hypotheses about the choice between state parks and local beaches were not rejected. Signs of coefficients were as expected and coefficients statistically significant.

The estimated coefficient on the inclusive value term is .152 yielding an estimate of .848 for δ. This is significantly different from zero suggesting that there are gains from using the nested model.. There is considerably more similarity among beaches within the two categories than *across* the categories. Had the nested model not been used, the independence of irrelevant alternative assumption would certainly have been violated. The estimate of δ is also significantly different from one, suggesting that beaches within groups, although similar, are not perfect substitutes,

Table 4.7
Logit Regression for Selection Among Sites

Estimate	Access cost Z_{1i}	Access Time Z_{2i}	Water Pollution Z_{3i}	Recreational Vehicle Z_{4i}	Fishing Activity Z_{5i}	Boat Facilities Z_{6i}
	Variable					
Coefficient	-.072	-*75	-.00037	1.06	-2.09	1.14
(t-statistic)	(-5.30)	(-8.63)	(-4.00)	(1.93)	(-5.28)	(2.10)

Chi-squared = 311.2

Table 4.8
Logit Analysis for Selection Between State Parks and Local Beaches

Estimate	Inclusive Value I_m	Years Attending Western Shore Beaches W_1	Family Members W_2	Party Size W_3
	Variable			
Coefficient	.152	-.019	.261	.024
(t-statistic)	(9.26)	(-8.34)	(4.85)	(12. 79)

Chi-squared = 28.07

The Number of Trips Decision

There is no operational model that generally treats utility maximization with non-negativity constraints (Bockstael et al., 1986, Chapter 8). There exists no utility theoretic means of linking the discrete choice model of site choice on each choice occasion to a continuous choice model of demand for trips (i.e., demand for choice occasions.)

When one decides to use a nonclassical continuous demand function for the demand for recreational trips (irrespective of site), a problem immediately arises in determining the appropriate choice of explanatory variables. Since costs and quality vary across sites and since individuals are observed choosing more than one site in a season, which site's price and quality should be included?

The approach taken here is to consider the number of trips to western shore beaches as a function of a number of explanatory variables and an inclusive value type variable calculated from the second stage of the discrete choice model. This was originally suggested by Hanemann (1978) and was used in Bockstael et al. (1986). Thus when water quality changes, the inclusive value changes and influences the number of trips. In this sense, "the discrete and continuous decisions are linked , although not in a utility theoretic way. The discrete/continuous choice model has the advantage of emphasizing the substitutability of sites but does appear to underestimate the response of demand for trips to changes in cost and quality at one or more sites.

Based on the results of the discrete choice estimations, a new inclusive value (In) which includes the factors in the choice among sites and the choice between state parks and local beaches is calculated. This value, along with the individual's income (INC, income or full income if at interior in the labor market), discretional y time available (DT, if at corner in the labor market) and the number of trips to western shore beaches in the previous year (x_{t-1}), is used to estimate the 1984 total number of trips per household to western shore beaches (x_t).

The higher an individual's inclusive value, the more attractive are his beach alternatives (e.g. good beaches are cheaper to get to) and the more trips he is likely to take. Additionally, beach use habits (as reflected in previous trips) would likely lead to more trips. Whether income and discretionary time positively or negatively affect the number of trips depends on whether a day trip to western shore beaches is a normal (positive effect) or inferior (negative effect) good.

The results of an ordinary least squares regression are given in Table 4.9. The expected signs occur, and the results indicate a western shore trip is an inferior good, both with respect to income and time. The predictive powers of the equation are especially good considering the cross-sectional nature of the data.

Table 4.9
ordinary Least Squares Regression for "Choice Occasions" or Trips

Estimate	constant	Inclusive Value I_N	Lagged Trips x_{t-1}	Income INC	Discretionary Time DT
Coefficient	.442	4.06	.516	-.028	-.981
(t-statistic)		(2.92)	(8.70)	(-2.79)	(-4.80)

$R^2 = .35$
F-value (4,253) = 36.30

Estimated Benefit Changes

The ultimate purpose of the modelling effort is to estimate the benefits associated with improvements in water quality. Formulas for deriving welfare measures in the context of discrete choice models of random utility maximization have been developed by Hanemann (1982, 1984). It is generally the compensating and/or equivalent variation of the quality change which is taken as a useful measure of benefits. Selecting the compensating variation (C), this measure can be defined by the following expression:

$$v(p^0, q^0, y) = v(p^0, q^1, y - c)$$

where again v is the indirect utility function, p and *q* are vectors of site prices and qualities, and y is income.

The compensating variation is *now* defined by

$$v(p^0, q^0, y; \varepsilon) = v(p^0, q^1, y - C; \varepsilon),$$

where ε is random, and as a result C is now a random variable. Depending on how one chooses to take account of this randomness, three different measures of compensating variation can be defined. In the case of GEV models the median value of C coincides with the C which equates the expected values of the indirect utility functions (Hanemann, 1978). It is this measure which we calculate in the subsequent illustration.

In our problem, using the previous notation,

$$G\left(e^{v_1}, \ldots e^{v_N}\right) = \left(\sum_{j \varepsilon J_s} e^{v_j/(1-\delta)}\right)^{1-\delta} + \left(\sum_{j \varepsilon J_1} e^{v_j/(1-\delta)}\right)^{1-\delta}$$

where J_s is the set of state park sites and J_l is the set of local beach sites; where $v = \theta' Z_{im} + \psi' W_m$; Z_{im} are factors which vary over sites; and W_m are factors which vary between state park and local beach sites. Thus

$$G\left(e^{v_1}, \ldots, e^{v_N}\right) = \sum_{s=1}^{2} e^{\psi' W_s + (1-\delta) I_s}$$

where

$$I_s = \ln \left| \sum_{i \varepsilon s} e^{\theta' Z_{is}/(1-\delta)} \right| .$$

Then the expected value of the indirect utility function equals

$$v(w^0, z^0, y) = \ln G(e^{v_1^0}, \ldots, e^{v_N^0}) + k,$$

where k is a constant.

Now consider a change in quality which causes w^0 and z^0 to change to w^1 and z^1. The compensating variation measure (C') defined above is given by

$$v(w^0, z^0, y) = v(w^1, z^1, y-C')$$

or

$$\ln G\left[e^{v_1^0(y, z^0, w^0)}, \ldots, e^{v_N^0(y, z^0, w^0)}\right]$$

$$= \ln G\left[e^{v_1^1(y-C', z^1, w^1)}, \ldots, e^{v_N^1(y-C', z^1, w^1)}\right]$$

There is no closed-form solution for compensating variation in this case, but Hanemann (1982) shows that the compensating variation per choice occasion of this change *can be* approximated as:

$$\text{(14)} \qquad \Delta CS = \frac{\sum_{j \varepsilon J} e^{v_j^0} - \sum_{j \varepsilon J} e^{v_j^1}}{\sum_{j \varepsilon J} \gamma_j e^{v_j^1}}$$

where the set J includes the two cases: state and local beaches, γ is the element of the • vector which serves as the price coefficient, and $v_j^q = \psi' w_j^q + (1-\delta) I_j^q$. To expand to annual welfare change, this value is multiplied by the number of choice occasions estimated in the continuous choice model.

These equations were used to estimate the benefits from hypothetical water quality changes. To be consistent with the varying parameters model estimates, we considered a 20 percent reduction and a 20 percent increase in water pollution. The values associated with the changes are $1.08 per trip and $4,70 per household user of western shore beaches. Given that 20 percent of the households used western shore beaches (about 401,000 households), the total gains from a 20 percent improvement in water quality were estimated to be nearly $2 million annually. The estimated loss for a 20 percent degradation was approximately the same.

Discussion

Reiterating, the purpose for our work was to offer benefit estimates based on different methods so as to provide a range of reasonable values. The two models derive from two different conceptualizations of the recreationalists' decisions. The continuous, neoclassical model (represented here by the varying parameters model) is strictly correct only if interior solutions characterize demand for each site, with all individuals attending all sites, Another drawback of this model is that, because of the econometric functions estimated, total benefits cannot legitimately be added across sites. This sort of aggregation provides upwardly biased results.

The discrete/continuous choice model, on the other hand, begins by emphasizing the corner-solution nature of the decision on each choice occasion. Thus, the substitutability among sites receives special attention. The decision about number of trips per season is not well integrated into the estimation process. These models tend to provide low estimates of aggregate benefits because the effect of water quality improvements on demand for trips is not well accounted for by the ad hoc inclusive value variables in the trips equation.

The estimated benefit change resulting from changes in Chesapeake Bay water quality at the western shore beaches is presented in Table 4.10 for the two models. Predictably, the varying parameter model offers the largest change.

Table 4.10
Comparison of Benefits Based on a Varying Parameter Model and Discrete/Continuous Choice

Model	Change: 20 Percent Improvement	Change: 20 Percent Degradation
	(in thousands)	
Varying Parameter upper bound	$26,160	- $25,839
Discrete/Cent inuous Choice	$ 1,885	- $1,884

Chapter 5

Recreational Boating and the Benefits of Improved Water Quality

Boating is an especially important part of any study of Chesapeake Bay recreation. As the second most popular recreational activity in our telephone sample of Bay users (second only to beach use), 34 percent of the area's households participated in boating activities on the Chesapeake in 1984. This represents nearly three-quarters of the households who used the Bay for recreational activities. Its importance is further supported by the large number of registered boats in Maryland (as many as 134,000 in 1981) and by the fact that of the approximately 15 million Person-trips taken on boats in Maryland waters in 1979, 90 percent (or 13.5 million) were taken on estuarine waters of the Bay or its tributaries (Harmon and Associates, 1983).

In this chapter we examine the behavior of Chesapeake boaters and estimate the value to boaters from improved water quality. Since no new survey could be initiated for this purpose, the data upon which the analysis rests are drawn from a 1983 boat owners survey which waa made available by the Sea Grant Program and the Department of Recreation at the University of Maryland.

A Profile of Boaters and Boat Owners

The Boat Owners Survey

In 1983 a survey of boaters was sponsored by the Universit y of Maryland Sea Grant Program and the Maryland Coastal Zone Management Program. It consisted of a mail survey of 2515 registered boat owners in Maryland. The design of the sample provided equal representation to owners of boats kept in slips and owners who trailered their boats. The questionnaire, which sought a variety of information about the household and ita boating activities, achieved a response rate of approximately 70 percent.

The boat owners' survey provides different but complementary information to the telephone survey conducted by RTI and described in Chapter 3, as it samples a different population and uses a different sampling scheme. The Sea Grant survey draws only from the population of registered boat owners. From the telephone survey, which is a random sample of the population, we can identify not only those who own boats but also those who uae the Bay for boating whether they own a boat or not. The telephone survey provides information about non-boaters, as well. It does not, however, provide detailed information about boating behavior. Consequently, it is the boat owner survey which will provide most of the data for analysis.

Boaters and Boat Owner Characteristics

Information from both the boat owner survey and the random telephone survey helps describe boating in Maryland. For example, a comparison of

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Boaters and Boat Owner Characteristics

Information from both the boat owner survey and the random telephone survey helps describe boating in Maryland. For example, a comparison of those households in the telephone survey who reported that they used the Bay for boating with those who did not revealed no significant differences in family size or years lived in the area but did suggest considerable differences in income and race (ace Table 5.1). The average of boaters' incomes waa significantly higher than the non-boaters' average, and a significantly higher percentage of boaters were white. Interestingly, this significant difference in income appears in the Prince Georges/Anne Arundel/Calvert Counties area (southeastern region) but not in Northern Virginia/Montgomery Count y (western region) or in the Baltimore area (northern region). Likewise, when broken down by subarea the difference in racial composition appears evident in the southeastern and *western* subareas but not in the northern subarea.

Some information can be extracted from the telephone survey about boat ownership as well. Once again *average* family size and years in the area were not *significantly* different over the two groups, but average income and the racial composition of the sample were (see Table 5.2).

The design *of* the boat owners survey permits a distinction to be drawn between individuala who trailer their boats and those who keep their boats in the water during the season (either at marinas, docks or moorings). The distinction between individual in these groups is important to establish, since the decisions they face are quite different and their behavior must be analyzed separately. Additionally, we shall see that *profiles of* both boats and owners differ somewhat between the two groups. The sampling design was stratified to contact approximately equal numbers from the two groups. Of those who returned questionaires, 718 trailered their boats and 788 kept their boata in the water during the season.

Some interesting features of these two groups are presented in Table 6.3. By far the most common type of boat in the trailered boat sample is a runabout. For obvious reasons, the sample of trailered boats contains very few with cabins (4 percent). It also contains few sailboats (only 6 percent), but this is not a representative figure, since sailboats which do not use auxiliary motors are not required to register in Maryland and thus would not be part of the population sampled. Of boats kept in the water, runabouts (at 33 percent) remain the single moat common class and sailboats (at 31 percent) represent a close second. Once again sailboats with no auxiliary power are likely to be under-repreaented in the sample. However, this distortion will affect the trailered group more, as the boats kept in the water are larger and more likely to have auxiliary engines. Combining cabin cruisers and cruising sailboats, half the boats in the non-trailered sample are cruising boats presumably outfitted for more than one-day trips.

Aa the difference in the type of boat *in* the two groups suggests, the average size and the average value of boats kept in the water are significantly larger than the averages for trailered boats. Additionally, the average income of boat owners in the two groups is significantly different, with trailered boat owners having *on* average lower incomes.

Returning to the telephone survey which provides data on boaters and not just boat owners, we can learn something about the geographical distribution

Table 5.1

Average Characteristics of Boaters and Non-Boaters
in BaMmore/Washington SMSA, 1984
from random telephone survey

	Boaters	Non-boaters
Average Family Size	3.31	3.47
Average Years Lived in Area	29	26
Average Household Income[s]	$46,858	$37,063
By Area:		
Northern Va. /Montgomery Cty., Md.	$50,576	$41, 471
Prince George's, Anne Arundel, Calvert Ctya. , Md.*	50, 2S8	28,083
Bait imore County	41,824	38,211
Percent White*	88%	74%
By Area:		
Northern Va. /Montgomery Cty. , Md.*	97%"	77%
Prince Georges, Anne Arundel, Calvert Ctya. , Md.*	83%	64%
Balt imore County	87%	80%

*Means of two samples are significantly different at 99% level
source : Telephone Survey, Research Triangle Institute, 1984

Table 5.2

Average Characteristics of Boat Owners and Non-Boat Owners
in Balttmore/Washington SMSA, 1984

	Boat owners	Non-boat Owners
Average Family Size	3.67	3.27
Average Years Lived in Area	28.6	28.2
Average Household Income*	$56,511	$40,931
Percent White*	94	81

*Means of two samples are significantly different at 99% level.
Source: Telephone Survey, Research Triangle Inst itute, 1984.

Table 5.3
Characteristics of Boats and Boat Owners
from Boat Owners' Survey, 1983

	Trailered Boats	Boats Kept in Water
Total number responding to question of where boat kept	718	788
By boat type		
Runabout	445 (63%)	251 (33%)
Cabin Cruiser	23 (3%)	182 (24%)
Cruising Sail	4 (1%)	199 (26%)
Day Sail	32 (5%)	38 (5%)
Workboat	124 (17%)	38 (5%)
Houseboat	1 (<1%)	13 (2%)
Rowboat	47 (7%)	25 (3%)
Other	35 (5%)	22 (3%)
NA	7	20
Used boats for swimming at least sometimes	360 (51%)[a]	555 (73%)[a]
Used boats for swimming usually or always	133 (19%)[a]	235 (16%)[a]
Used boats for swimming always	41 (6%)[a]	41 (5%)[a]
Used boats for fishing at least sometimes	656 (94%)[a]	582 (76%)[a]
Used boats for fishing usually or always	502 (72%)[a]	290 (38%)[a]
Used boats for fishing always	302 (43%)[a]	107 (14%)'
Average Income of Owner[b]	$38,000	$51,000
Average Current Boat Value[b]	$14,000	$25,000
Average Boat Length[b]	16 feet	23 feet

[a]Numbers in parentheses are percent of those answering question in each stratified sample who gave this response.
[b]Means of two stratified samples are significantly different at 99 percent level.

Source: Maryland Boat Owners Survey, 1983

of households interested in this activity. The geographical distribution of boaters within the state tells us something about the importance of thie activity to different population subgroups. From the telephone survey it is clear that boating is an important activity to Maryland residents throughout the state; it is the first or second moat popular recreational activity on the Bay in each of the geographical •ubareaa of the study. However, as might be expected, boaters are moat commonly residents of counties contiguous to the Bay. A good example is the large proportion of Anne Arundel residents who participate in *boating.* Extrapolating *from* our survey suggests that almost half of the households in Anne Arundel County had at least one member who went boating on the Bay in 1984.

Table 5.4 contains residence data gleaned from the boat owners survey for boat owners, by trailered and nontrailered classes. The values shown in this table indicate the distribution of residence counties among those who responded to this question in the boat owners survey. Of those who reported residence, 64 percent *of* each group lived in counties contiguous to the Bay. Approximately 60 percent of the respondents came from the four most populated counties in the state - Baltimore, Anne Arundel, Montgomery and Prince Georges. A final interesting feature of the sample is that about 5 percent of the respondents lived out-of-state even though they registered their boats in Maryland.

The fact that boating is often the vehicle for other Bay recreational activities makes the analysis of boating both important and complex. The incidence of multiple activities is critical because participation in the complementary activities of swimming and fishing may make boaters more sensitive to water quality. Additionally, the overlap of activities complicates benefit estimation when benefits are aggregated over activities.

From the boat owners' survey we can learn something about the importance *of* these multiple activity trips. Table 5.5 reports frequencies *of* responses to questions regarding these complementary activities. One striking feature of these answers is that fishing is extremely important to those registered boat owners who trailer their boats. In fact almost *all* (94 percent) of the trailered boat owners who responded to the question indicated that they fished at least occasionally from their boats, and almost half (43 percent) claimed to fish on every trip. Fishing was less important among the non-trailered boat owners, although three-quarters of them indicated that they fished from *their* boats at least Occasionally. About the same percentage of this group indicated they sometimes ueed their boats for swimming. Fewer, about half, of the trailered boat owners sometimes used their boats for swimming.

Table 5.4
Number of Trailered Boats and Boats Kept in the Water,
By Residence, 1983.

Residence	Trailered Boats		Boats Kept in Water	
Baltimore		162 (24%)*		144 (20%)
Anne Arundel		99 (15%)		184 (25%)
Montgomery		64 (9%)		60 (8%)
Prince George's		71 (11%)		28 (4%)
Calvert	17 (3%)		14 (2%)	
St. Mary's	25 (4%)		25 (3%)	
Charles	23 (3%)		7 (l%)	
Lower Western Shore - Total		65 (10%)		46 (6%)
Cecil	12 (2%)		11 (1%)	
Harford	27 (4%)		20 (3%)	
Kent	7 (1%)		5 (1%)	
Upper Bay - Total		46 (7%)		36 (5%)
Dorcester	8 (1%)		9 (1%)	
Queen Anne	13 (2X)		12 (2%)	
Somerset	5 (1%)		2 (<1%)	
Talbot	9 (1%)		30 (4%)	
Wicomico	21 (3%)		9 (l%)	
Eastern Shore - Total		56 (8%)		62 (8%)
Carol ine	7 (1%)		2 (<1%)	
Worcester	10 (1%)		9 (l%)	
Carrel	11 (2%)		4 (1%)	
Allegheny	0		3 (<1%)	
Frederick	16 (2%)		7 (1%)	
Garrett	0?		5 (1%)	
Howard	19 (3%)		14 (2%)	
Washington	20 (3%)		6 (1%)	
Other - Total		83 (12%)		50 (8%)
Pennsylvania		13 (2%)		67 (9%)
Virginia		10 (1%)		36 (5%)
District of Columbia		6 (l%)		18 (2%)
Not Identified		43		57
TOTAL		718		788

*Numbers in parentheses represent percent of those answering questions in each stratified sample who gave this response.

Source: Maryland Boat Owners Survey, 1983

Table 5.5

Percent of Boaters Who Fish or Swim While Boating
Boat *Owners'* Survey, 1983

	Occasionally	Usual ly	Always	At Least Occasionall y[a]
Trailered boats:				
Fish while boating	22%	29%	43%	94%
Swim while boating	33%	13%	6%	52x
Non-trailered boats:				
Fish while boating	38%	24%	14%	76%
Swim while boating	42%	25%	5%	72%

● Total of other columns
Source: Maryland Boat Owners Survey, 1883

The Importance of Water Quality to Boaters

It is useful to consider the qualitative evidence that exists to support the notion that water quality does in fact matter to boaters. Some evidence to this effect *can be* found in the 1983 boat owners survey. Tables 5.6 and 5.7 present a compilation of responses to a series of questions about *factors* important in the selection of boating areas. As can be *aeon* from these tables, boat owners who trailered their boats considered water quality to be the moat important factor in choosing boating area. Water quality waa considered "very important" or at least "moderately important" by the non-trailered boat owners more often than any other factor except water depth. The latter is often a physical constraint for the larger boats found in marinas. Comparing the two subgroups, i.e. those who considered water quality "moderately" or "very" important and those who did not, it is interesting to note that the former had on average significantly higher incomes and *more* valuable boats.

The Behavior of Boat Owners Who Trailer Their Boats

The *General* Model

We are interested in modelling two types of decisions that owners of trailered boats make in a season. One of these is the commonly modelled *economic* decision of how many trips the individual takes. The second haa to do with the location to which the boat owner takes his boat. This subgroup of boat owners is *far* more flexible in the short run than those who keep their boats in the water during the season, because on a day to day basis they can

Table 5.6 Factors Cited Most Important
in the Selection of a Boating Area in Maryland, 1983

Percent Response from 718 Boat Owners Who Trailer Their Boats

Factor	Not Important	Slightly Important	Moderately Important	Very Important	No Response
Water Quality	11.1	9.3	33.0	42.2	3.1
Water Depth	16.3	13.2	29.5	36.4	3.3
Natural Beauty	15.7	17.5	34.0	28.1	4.6
Easy Access	13.8	20.1	35.7	26.7	3.8
Lack of Congest ion	19.5	16.7	32.0	27.4	4.3

Source: Maryland Boat Owners Survey, 1983

Table 5.7 Factors Cited Moat Important
in the Selection of a Boating Area in Maryland, 1983

Responses from 788 Boat Owners Who Keep Their Boats in Marinas

Factor	% Not Important	% Slightly Important	% Moderately Important	% Very Important	% No Response
Water Depth	7.7	8.9	24.4	54.9	4.1
Water. Quality	9.3	10.0	35.7	39.7	5.3
Natural Beauty	9.8	13.3	41.0	31.2	4.7
Protected Anchorage	23.5	15.1	31.5	25.1	4.8
Lack of Congest ion	19.9	17.4	37.2	20.4	5.1

Source: Maryland Boat Owners Survey, 1983

alter the boating area by trailering to different launch sites. Of course, the farther they must trailer the boat, the more costly (in both time and money) will be the trip. Responses to the survey indicate that factors besides costs are important in choosing boating area. Specifically, water quality was considered the moat important factor in this choice, Thus we analyze the demand for trips to different sites with measurably different water quality. This gives us some basis to deduce how demand might change if water quality were to change at different sites.

In order to accomplish this, a model of multiple site demand is designed to accommodate differing qualities across sites but to require no more data than is available from the boat owners' survey and Chesapeake Bay water quality data. Given these limitations and a desire for consistency of analysis across recreational activities, the varying parameters model presented as the first method of analysis in Chapter 4 is used.

The model takes the *following* form. The demand for trips to each site j is estimated as a function *of* the coat to individual i of accessing the site (c_{ij}), substitute site ace-a costs (s_{ij}), and other exogenous variables associated with the individual (z_i):

$$x_{ij} = f^j(c_{ij}, s_{ij}, z_i; \beta_j) \qquad \text{for all } i, \tag{5.1}$$

where f^j is the demand function for the j^{th} site, β_j is the vector of parameters in each of the site demand functions to be estimated.

Equation (5.1), which is the first stage of the varying parameters model, can not be estimated using ordinary least squares methods. The sample upon which the estimation is baaed includes a large number of zero values for the dependent variable. As described earlier in this volume, ordinary least squares applied to censored samples will produce biased estimators. As described in the last chapter, Tobit estimation procedures are used to correct for the problem.

The second stage of the model relates the set of β parameters in the site demand functions to the site water quality characteristics (a vector w_j). In this way the demand for a site is implicitly modelled as a function 'of the site's characteristics. The second stage model is *of* the form:

$$\beta_{kj} = g^k(w_j) \qquad \textit{for } \text{all } j, \tag{5.2}$$

where k indexes the specific β coefficient within the demand equations and j indexes the site demand. Again the application of ordinary least squares is not optimal. The above model likely suffers from heteroskedasticity (see Desvousges, Smith, and McGivney, 19S3) which will produce Inefficient estimators. To correct for the expected heteroskedasticity, the entire equation can be multiplied by the reciprocal of the standard error *of* the respective estimated Coefficient Thus, if σ_{kj} is the standard *error* of the estimated coefficient β_{kj} *from* the Tobit estimation Of the demand *for* site j, then the second stage model corrected for heteroskedasticity can be written

$$(5.3) \qquad \beta_{kj}/\sigma_{kj} = g^k(w_k/\sigma_{kj})$$

for each of the $k=1,\ldots,K$ β coefficients from the first stage.

The Data

The arguments of equation (5.1) which were determined to be relevant for the analysis include the coat of access to the site, the coat of access to a substitute site, and the value *of the* boat. The latter variable waa chosen as a surrogate for two very important factors. Boat value and income are highly correlated , so boat value serves as a surrogate for income level, a variable which is normally rather difficult to obtain with accuracy. Boat value alao will be highly correlated with boat sise which haa an *effect on the site* choice. Since boat length and income are correlated, including them separately in the equation produces unresolvable multicollinearity.

The coat of access variable is the roundtrip cost, including time coat. Costs vary across boaters for several reasons. Obviously the county of origin influences costs, for the further the county is *from* the launch site, the higher the coat of travel. The cost variables include time costs, computed as one-half the individual's average hourly wage (income/2080) time. the distance traveled divided by 40 miles per hour. Finally the money cost of trailering a boat depends on the size of the individual's boat. The coat per mile of trailering a boat was estimated, using coat and boat length information from the data set, as -.78 + .08 *(boat length). The final coat variable includes the toll for the Bay Bridge, when relevant.

To calculate the substitute cost, the above formula waa applied to the closest cite not chosen. While a vector *of* costs *to* all alternative sites might be considered preferable, there are several practical problems with including such a vector in the regression, especiall y severe multicollinearity.

Not all observations on boat owners who trailered their boats were ueed because *of* heterogeneity of respondents and incomplete data. Observations were deleted if the individual did not use his boat for any trip. in 1983 or if he did not report launch sites or location of residence. Additionally, those who reported their residence to be a distant state, precluding day trips to the Bay, were deleted. Finally, to make the sample relatively homogeneous, sailboats were excluded from the analysis. The latter accounted ultimately for only seventeen deletions. The final sample included 408 observations.

The above information. waa obtained from the boat owners' survey. However, this data source does not include any information about either perceived or measurable water quality at various sites. Once again the Chessie system provided the *environmental data,* and the environmental quality variable used was the product of nitrogen and phosphorus, as in Chapter 3.

The Estimated Model

For the first stage of the model, the parameters in the following functional form are estimated:

$$x_{ij} = \beta_{0j} + \beta_{1j}\, c_{ij} + \beta_{2j}\, s_{ij} + \beta_{3j}\, b_i + \varepsilon_{ij} \tag{5.4}$$

where x_{ij} is trips to site j, c_{ij} is cost to site j, s_{ij} is cost to next best alternative to site j, and b_i is boat value, all for individual i.

The first stage results for each of the twelve sites are presented in Table 5.8, The results are remarkably consistent across sites. The own price coefficients are all negative and significantly different from zero at the 99% level of confidence. Substitute price coefficients are universally positive and significantly different from zero for eight of the twelve sites. The coefficient on boat value is significantly different from zero for seven of the sites and in each of theaa cases haa a positive sign, suggesting that wealthier people and/or people with bigger boats take more boating trips, ceteris paribus.

Demand is relatively inelastic with respect to substitute price and boat value (i.e. a 1 percent change in either of these causes a less than 1 percent change in the demand for trips). However, the demand for trips to a site is quite elastic with respect to the cost of accessing the site, with own price elasticity ranging from -1.5 to -7.0.

In the second stage, there are as many equations as there are parameter from the first stage which we wish to allow to vary with the environmental factors. Since we have no particular a priori information as to what parameters might vary, we can model each as a function of the environmental variables and allow the test statistics to determine the outcome.

The second stage model is given by

$$\beta_{kj} = \alpha_0 + \alpha_1\, TNP_j + \nu_j \tag{5.5}$$

and the results are presented in Table 5.9. The product of nitrogen and phosphorous serves as the environmental variable. The regression of the own coat coefficients from the linear first stage model on these environmental variables produced good results. The coefficient is significantly different from zero and negative. The negative sign suggests that the demand curve becomes less steep with increasing levels of pollutant.

Neither the constant term nor the coefficient on boat value yielded significant second stage results. Even though the coefficient of substitute price waa associated with a significant negative coefficient on the environmental variable, allowing this coefficient to vary had no appreciable effect on the welfare results. As a consequence, in the remainder of the analysis we allow only the coefficient on own price to vary wtth environmental quality. The results suggest that an increase in pollution would tend to have the effect of pivoting inward the demand for trips to the site.

TABLE 5.8

Estimated Tobit Demand Coefficients: Maryland Counties 1983

county	Estimated Coefficients (Variable)[a]				non-limit observations
	$\hat{\beta}_1$ (cost/trip)	$\hat{\beta}_2$ (substitute cost/trip)	$\hat{\beta}_3$ (boat value 1000's)	$\hat{\beta}_0$ (constant)	
Anne Arundel	-.13	.03	1.29	-2.21	142
	(8.75)[b]	(3.42)	(5.94)	(1.61)	
Baltimore	-.43	-.02	1.78	-1.94	75
	(9.21)	(1.13)	(4.01)	(.77)	
Calvert	-.14	.08	1.84	-27.14	44
	(4.14)	(13.70)	(3.45)	(7.21)	
Cecil	-.22	.04	2.12	-16.44	17
	(4.84)	(1.54)	(3.09)	(3.87)	
Charles	-.34	.07	2.75	.49	38
	(8.41)	(3.77)	(6.79)	(.19)	
Dorchester	-.09	.08	.66	-34.38	30
	(2.86)	(2.69)	(.78)	(6.68)	
Harford	-.15	.05	1.51	-12.21	36
	(5.55)	(2.63)	(1.67)	(3.74)	
Kent	-.25	.11	.14	-18.25	28
	(4.94)	(3.57)	(.14)	(3.45)	
Queen Anne's	-.27	.07	.12	-3.83	36
	(6.17)	(2.88)	(.19)	(1.03)	
St. Marys	-.11	.05	1.25	-9.46	67
	(6.40)	(3.12)	(2.94)	(3.31)	
Somerset	-.12	-.03	2.81	-37.20	24
	(4.76)	(.58)	(3.13)	(6.64)	
Wicomico	-.15	.05	1.02	-7.03	26
	(6.93)	(1.58)	(1.71)	(2.02)	

[a]Each equation is estimated with the 496 boaters who trailer their boats.
[b]Absolute values of t-statistics in parentheses

Table 5.9

Estimation Results from Second Stage

	Constant	TNP
Regression of trip coat coefficient	-.0887 (4.29)*	-.000102 (3.54)
Regression of substitute cost coefficient	.0682 (7.47)	-.000016 (1.78)
Regression of constant	-19.414 (4.14)	.007338 (1.93)

* absolute values of t-statistics in parentheses

Modelling the Behavior of Boat Owners Who Do Not Trailer Their Boats

Boat owners who keep their boats in the water during the season are far more restricted in the short run as to the quality of the water that they can easily enjoy. To alter the area in which they boat they must take long trips in their boats or they must change mooring arrangement. We do not have access to information that would allow us to model either of these decisions. None of our data allows us to observe these individual making trade-offs between water quality and other goods or money. As a consequence we can not deduce from observations on their behavior how they might value improvements in water quality.

What we can do however is to learn something about their demand for boating and their use of the Chesapeake, which in itself is useful information for the policy maker. In this section we estimate the demand for boating trip. by boaters who keep their boats in marinas. Since we are interested in the short run decision of how many tripe to take, the relevant cost variable is the variable cost of a trip. Given the information available, we can approximate the money and time costs of travel to the marina. Explanatory variables which may shift the demand function include income and the size (or value) of the boat.

The boats in the marina subgroup are somewhat heterogeneous. For one thing, about half are sail boats and half are motor boats. Consequently we might wish to teat whether the demand functions for the two groups are significantly different.

The results of thin analysis are reportad in Table 5.10. The coefficient on coot is negative, as expected, and significantly different from zero. The coefficient on boat value is positive, indicating that, all else equal, boaters with more expensive boats take more trips. Income appears not to affect systematically the demand for trips.

Table 5.10

Estimated Demand for Boating Trip.
Boats Kept in Marinas

Explanation Variable	Coefficient	t-statistic
Cost	-1.046	-3.93
Boat Value ($1, 000)	.357	1.94
Income ($1,000)	.148	.66
Sailboat Index[a]	-23.596	-2.27
Cost Sailboat Index	.615	2.16
Constant	63.363	6.66

R^2 = .109
# of Observations = 240

[a]Variable equals 1 if boat is sailboat, O otherwise

Both the constant term and the cost coefficient shift significantly for individuals who own sail boats. The demand function for non-sail boat trips is given by

TRPS = 63.36- 1.05 coat + .36 boat value + .15 income

where boat value and income are in thousands of dollars. The sail boat demand for trips is given by

TRPS = 39.77- .43 cost + .35 boat value + .15 income.

At the same cost and boat value, sailboat owner. demand fewer trips, and their demand for trips appears to be rim-e inelastic.

Because of the eventual need to aggregate behavior over recreational activities, it would also be useful to know whether those boaters who ● penal a large portion of their time fishing have significantly different demands from those who do not. These results are presented in Table 15.11. It appears that the two groups demands are different. For any given cost and boat value, fishermen demand more trips and their demand tends to be more elastic. Fishermen}. demand is given by

TRIPS = 73.61- 1.32 coat + .35 boat value + .15 income

and demand by non-fishermen is

TRIPS = 43.00- .51 cost + .35 boat value + .15 income.

Table 5.11

Estimated Demand for Boating Trips, Fishing Behavior
Boats Kept in Marinas

Explanatory Variable	Coefficient	t-statistic
Trip Coat	-.506	-3.86
Boat Value ($1,000)	.350	1.90
Income ($1,000)	.148	.88
Fishing Index[a]	30.535	2.8s
Coat Fishing Index	-.815	-1.82
Constant	43.085	3.81
R^2 = .116		

[a] Variable equals 1 if boater fishes on boating tripe "usually" or "always," 0 otherwise.

calculating Estimates of the Benefits of Water Quality Improvements for the Trailered Boat Sample

Because we have bean able to estimate the demand for boating trips by boaters who trailer their boats to different areas as *functions of* costs and the water quality in those areas, we can estimate welfare gains and losses from water quality changes to this group. Unfortunately no observable behavior of the boaters who keep their boats in the *water* allows us to deduce anything about the value they place on improved water quality.

As in the previous chapter, three different changes in the environmental variables are considered. In one caae we impose a 20 percent decrease (environmental improvement) in the environmental (pollution) variables. Subsequent experiments include a 10 percent decrease and a 20 *percent* increase (environmental degradation).

Additionally, two different calculation procedures are provided, identical to those used With the varying parameters model in Chapter 4. The two methods of calculating "before" and "after" trip demands yield two sets of average consumer surplus estimate. before and after the environment change and, consequently, two sets of benefit (or leas) estimates due to the environmental change. (A description of these methods can be found in Chapter 4.) The estimates are reported in Tables 5.12? 5.13, and 5.14 for the 10 percent improvement 20 percent improvement and 20 percent deterioration in the water quality variable, respectively. The average consumer surplus figures are per boater (trailered boats, only) per season for the designated site. Thus the first entry in Table 5.12 is an estimate of the value of access to sites in Anne Arundel County per boater in the sample.

In examining the consumer surplus figures, it is well to keep in mind that these benefit estimates are affected by the probability that a boater will go to a particular site, the number of trips taken, given that the boater goes to the site, as well as the size of the own-price coefficient. The figures in columns 3 and 6 are estimates per boater of how the value of access to a site changes with changes in the environmental variable. These surpluses are not additive across sites. That is, if we want to consider the effects of a ten-percent decrease in TNP throughout the Chesapeake Bay, we cannot add surplus changes across sites. Each estimate of surplus per boater by site assumes that the water quality at other sites remains fixed. The bias which would be created by simple aggregation across sites depends on price and quality elasticities and is of unknown size.

What do all these calculation say about the value of reductions in the nitrogen/phosphorus variable? We can estimate the aggregate benefits of changes in TNP from Tables 5.12, 5.13, and 5.14 by expanding these estimates from the sample to the population of boat owners who trailer their boats. Consider St. Mary's County. We have two estimates of the increase in ● Urplus associated with a 10 percent decrease in TNP. These suggest a range of between $1 and $5 per boater per season. If there are about 80,000 boaters who trailer in Maryland (about the number estimated by Harmon and Associates for 1983), we would estimate a change in total surplus in the range of $575,000 to $1,400,000 annually for a 20 percent reduction in TNP at the sites that Anne Arundel County comprises. This calculation assumes that the original sample from which the benefit estimate. were derived is representative of the boater population as a whole.

The results in these tables eeem at least plausible. For example, surpluses appear highest for western shore waters, those moat easily accessed by the concentration of population in the state. The surplus figures for any given site are not especially large, but this is to be expected since when boaters have the ability to substitute relatively cheaply among sites, very high surpluses at any one site would violate some prior expectations on the size of benefits. While the magnitudes of returna from changes in TNP are not extremely large on a per-boater basis, in the aggregate they are quite substantial

Table 5.12

Per Boater Annual Benefits from a 10% Decrease in Pollutant in each Geographical Area

County with Water Quality Change	Calculation Method A			Calculation Method B		
	Consumer Surplus Before Change	Consumer Surplus After Change	Benefits	Consumer Surplus Before Change	Consumer Surplus After Change	Benefits
Anne Arundel	$30.01	$33.30	$3.29	$119.05	$127.46	$8.41
Baltimore	15.07	17.38	2.32	49.83	54.95	5.12
Calvert	17.50	18.60	1.11	108.57	111.38	2.81
Cecil	4.80	5.43	.63	18.55	19.51	.96
Charles	38.79	46.05	7.26	38.34	43.40	5.05
Dorcester	1.61	1.78	.17	75.72	78.15	2.43
Harford	3.45	3.89	.45	47.24	49.63	2.38
Kent	24.08	27.09	3.00	73.71	76.86	3.15
Queen Anne's	26.17	28.99	2.81	51.74	53.98	2.24
St. Mary's	14.80	16.03	1.23	139.22	“143.71	4.49
Somerset	7.17	7.60	.44	99.18	101.95	2.77
Wicomico	7.87	8.60	.73	32.82	34.53	1.71

Table 5.13
Per Boater Annual Benefits from a 20% Decrease in Pollutant
in each Geographical Area

Count y with Water Quality Change	Calculation Method A			Calculation Method B		
	Consumer Surplus Before Change	Consumer Surplus After Change	Benefits	Consumer Surplus Before Change	Consumer Surplus After Change	Benefits
Anne Arundel	$30.01	$37.17	$7.16	$119.05	$137.05	$18.01
Baltimore	15.07	20.33	5.26	49.83	61.20	11.37
Calvert	17.50	19.79	2.30	108.57	114.35	5.78
Cecil	4.80	6.17	1.38	18.55	20.60	2.06
Charles	38.79	55.54	16.75	38.34	50.13	11.79
Dorcester	1.61	1.98	.37	75.72	80.74	5.03
Harford	3.45	4.41	.97	47.24	52.27	5.03
Kent	24.08	30.51	6.42	73.71	80.38	6.67
Queen Anne's	26.17	32.18	6.00	51.74	56.51	4.76
St. Mary's	14.80	17.40	2.61	139.22	148.54	9.32
Somerset	7.17	8.08	.91	99.18	104.88	5.70
Wicomico	7.87	9.46	1.59	32.82	36.44	3.62

Table 5.14
Per Boater Annual Losses from a 20% Increase in Pollutant
in each Geographical Area

County with Water Quality Change	Calculation Method A: Consumer Surplus Before Change	Calculation Method A: Consumer Surplus After Change	Calculation Method A: Losses	Calculation Method B: Consumer Surplus Before Change	Calculation Method B: Consumer Surplus After Change	Calculation Method B: Losses
Anne Arundel	$30.01	$24.76	$5.24	$119.05	$105.07	$13.98
Baltimore	15.07	11.68	3.38	49.83	41.96	7.87
Calvert	17.50	15.51	1.99	108.57	103.98	5.19
Cecil	4.80	3.80	1.00	18.55	16.93	1.62
Charles	38.79	28.78	10.01	38.34	31.51	6.83
Dorcester	1.61	1.33	.28	75.72	71.30	4.42
Harford	3.45	2.74	.71	47.24	43.12	4.13
Kent	24.08	19.12	4.96	73.71	68.34	5.37
Queen Anne's	26.17	21.48	4.70	51.74	47.93	3.81
St. Mary's	14.80	12.70	2.09	139.22	131.10	8.12
Somerset	7.17	6.40	.77	99.18	94.08	5.10
Wicomico	7.87	6.68	1.19	32.82	29.88	2.94

Chapter 6

The Benefits for Recreational Fishing: Striped Bass

This chapter provides come preliminary estimates of the increase in benefits to sport anglers from increases in water quality. We use a portion of the 1980 National Survey of Fishing, Hunting and Wildlife Related Recreation, referred to as USFWS data, to estimate the demand for and value of fishing for striped bass in Maryland. This survey, while not designed for these purposes, is the only data aet currently available which enables us to investigate the recreational fishing of the Chesapeake. Striped bass is the only specie. important to the Chesapeake Bay recreational fishery for which there is sufficiently detailed-catch information to link water quality changes to the benefits of sportfishing.

The link between improved water quality and changes in recreational fishing demand depends on the ecological connection between water quality and catch rates and the behavioral connection betwean catch rates and fishing activities. Descriptive and analytic studies of the Bay have focused on the impacts of water pollution on the density and productivity of fish stocks. Lower dissolved oxygen, declines in SAV, and increases in water toxicants all appear to have an impact on fish stocks. Further, where records are kept for commercial fisheries, there haa been a substantial decline in landings per unit effort, especially for those species which spawn in the Bay or ita tributaries

It is plausible to expect considerable benefits to recreational fishermen from improvements in water quality. The number of recreational anglers is quite large, baaed on information from the primary sources of data on saltwater recreational fishing in Maryland. Estimates of saltwater fishing participation in Maryland during 1980 range from 539,000 anglers over 16 years of age taking 4.1 million trips to somewhat over 800,000 anglers of all age. taking 2.7 million trips (U. S. Fish and Wildlife Service and Bureau of Census; U. S. National Marine Fisheries Service; William et al.). According to NMFS and State of Maryland data, each saltwater angler took approximately three trips, while USFWS estimates approximately 7.6 trip. and 9.0 days fished per angler.

Data on striped bass fishing are somewhat more difficult to obtain. According to the Maryland Department of Natural Resources, roughly 203,000 of the saltwater trips were for striped bass. Our analysis of the USFWS data indicates that 239,000 anglers (over 16 years of age) fished for striped bass in Maryland and Sussex County, Delaware, fishing for approximately 2.1 million days, or roughly 8.8 days per angler. Estimates of the striped baas recreational catch in Maryland range from 211,000 to 377,000 fish, a total weight of 200 to 474 metric tons. The USFWS data are not well suited for estimating aggregate catch, because the survey used waa designed primarily for other purpose., even though catches are self-reported by respondents for come saltwater species, notably striped bass.

Table 6.1 provides some descriptive information about the sample of anglers which was analyzed in this portion of the study. The sample was partitioned into two groups baaed on whether the individual fished for striped bass or not. Individuals in the two subsamples are very similar in the amount of fishing and hunting done and in their experience, income, age, education, and other demographic makeup. Striped baea fishermen, on average, showed a slightly higher propensity to own a boat and to allocate more money to hunting and fishing activities, though these differences are not significantly different from zero due to the high within-subsample variation.

Table 6.1

Characteristics of Striped Bass Fishermen and Other Fishermen and/or Hunters in the Sample

	Striped Baaa Fishermen	Non-Striped Baaa Fishermen
Number of Individual in Sample	184	576
Average Number of Days Fishing, Striped Baas	11 daya	0 days
Average Number of Days Fishing, All Species	28 daya	2'7 daye
Percent Who Also Hunted	41%	37%
Average Number of Days, Hunting	17 daya	15 days
Average Years of Fishing Experience	24 years	24 years
Average Age When First Fished	10	12
Percent Owning Inboard Boat	19%	7%
Percent Owning Outboard Boat	42%	28%
Percent owning Other Boat	17%	12%
Average Household Income	$28,300	$27,600
Average Fishing/Hunting Budget in 1980	$982	$588
Average Age[a]	38	38
Average Years of Schooling	13 years	13 years
Percent Working in Job or Business	70%	73%
Percent from Urban Areas	44%	38%

[a]The sample is for individuals 16 yeara of age and over.

A Description of the Data

The 1980 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation was the source data for analysis. Of the available data sets on Chesapeake Bay sportfishing, the portions of this survey relating to saltwater recreational fishing in Maryland, and by Maryland residents, offered the best prospects for modelling the effects of water quality improvements. This data set contained the essential variables for estimating recreational fishing demand functions, including information on (a) trips taken by destination; (b) costs incurred by recreationists for goods and services used in recreation; (c) household income; and (d) catch rates reported by anglers for certain species.

The survey consisted of two parts. The first was a telephone screening of households, predominantly by telephone interviews, to collect demographic characteristics and to determine the hunting, fishing, and non-consumptive recreation activities of household members during 1980. The second part was a detailed questionnaire administered (typically in person) to selected individuals who indicated they had hunted or fished in 1880, collecting information on activities and expenditures. Of the 30,300 fishermen and hunters and 6,000 non-consumptive users interviewed nationwide, 760 pursued some or all of these activities in Maryland. These 760 individuals were the subject of this analysis.

Of the 760 who hunted, fished or Participate in non-consumptive wildlife-related activities in Maryland, 456 indicated they participated in some form of saltwater fishing. Catch rate estimates were only obtained for a limited number of saltwater and estuarine species, with striped baas the only recorded species relevant to Maryland. One hundred eighty-four individuals indicated they fished for striped baas in 1960.

The survey waa designed to provide estimates of recreation activities and expenditures at the state level, and states were divided into large subregions for purpose. of identifying trip destinations. Maryland was divided into four such regions, three of which border the Chesapeake and were the location of striped bass fishing. Broadly defined, the four areas are: the Southeastern Chesapeake region, Northern Chesapeake, Southwestern Chesapeake, and Northwestern Maryland. Significant numbers of Maryland residents also fished for striped baaa in Sussex County, Delaware. Of the 184 striped bass fishermen in the sample, 16 reported fishing in Delaware, 46 indicated they fished for striped baaa in the Northern Chesapeake, 59 fished in the Southeastern Chesapeake region, and 86 in the Southwestern Chesapeake (Table 6.2).

The data aet includes days fished for ● trtped bass and other species, rather than number of trips by specie., the latter being the preferable measure for travel cost models. The survey did, however, include the total number of trips to each region. Aggregating over all areas to get total trips and all species to get total days fished, it was determined that anglers took about 4.1 million trips and fished about 4.8 million days, yielding an average of 1.17 days/trip. Thus, the two measures may not be bad approximations of one another.

Table 6.2

Sample Distribution Number of Fishermen, Days of Striped Bass Fishing in 1880, and Catch Rate, By Regions

Region	Number Who Visitad	Mean Striped Baas Days	Mean Catch Rate Fish/Day
Sussex DE	16	6.8	4.4
Northern Chesapeake[a]	46	9.6	4.9
Southeastern Chesapeake[b]	59	11.3	3.3
Southwestern Chesapeake	88	8.8	2.8

[a]Baltimore City and Bait imore, Carroll , Cecil , Harford, Kent , and Queen Anne's counties.
[b]Carol ine, Dorcester, Somerset, Talbot, Wicomico, and Worcester count ies.
[c]Anne Arundel, Calvert, Charles, Howard, Montgomery, Prince George's, and St. Mary's counties.

While detailed information was collected on costs of travel, lodging, food, fees, and other expenses incurred during recreation trip., these costs were not area specific; instead total expenditures over all saltwater fishing trips to all areas (regardless of species sought) were collected for eaoh cost category. The variable cost of trips to a single area could be determined only by prorating total variable costs according to distance travelled. The method ueed in this analysis waa to determine the total miles travelled by the individual for all saltwater fishing trip. in 1980, aa the sum of products of round trip miles travelled to (the usual fishing location in) each area and the number of trips taken to each area, The fraction of total variable fishing expenses prorated for eaoh trip to each site waa the round trip miles travelled to the site divided by total miles travelled. The money coat of a trip to each site waa this fraction times the reported total variable costs for saltwater fishing. Expressed as a formula,

$$MC_{ij} = [M_{ij}/\sum_{k=1}^{n} M_{ik}\theta_{ik}]VC_i$$

where MC_{ij} is the money coat of a trip by individual i to area j, M_{ij} is the round trip miles travelled by individual i to area j, θ_{ij} is the number of trips individual i takes to area j, VC_i is individual i'. reported saltwater fishing variable costs, and there are n areaa.

The coat of time spent in recreation is also an important determinant of demand. The survey data were not ideal for determining this coat because no information was collected on the time spent in travel or at the site on each trip. However, miles traveled is a reasonably good proxy for time spent in travel. The procedure used here waa to assume an average rate of speed during travel of 40 miles per hour and that the annual household income divided by the number of hours in the average full-time work year (2,040) was a suitable approximation for the wage rate. Then, the value of time travelled was determined as the product of the amount of time spent in travel and 40 percent of the wage rate. Expressed as a formula,

$$TC_j = \left[\frac{M_{ij}}{40}\right](.4)\left[\frac{y_i}{2,040}\right]$$

$$= M_{ij}\left[\frac{y_i}{204,000}\right],$$

where TC_{ij} is the time coat for individual i travelling to area j, y_i is the household of person i, and M_{ij} is, again, round-trip miles. Of course, this is a rather arbitrary formulation for time cost based on a series of restrictive assumptions, but preferable ways of treating the value of time were not possible given the available data. The full price of a trip is then calculated as the sum of the time and money prices for each individual $TP_i = MC_i + TC_i$.

In the survey, respondents were asked to estimate their average catch rate per day for selected species. Unfortunately, there was a lag of up to a year or more between the time the fishing trip was taken and the time the questionnaire was answered. There is evidence (e.g. Deuel, Hiett and Worrall) that fishermen do not accurately remember numbers of fish caught or their sizes well beyond a period of a few months. A comparison of the USFWS data and data collected by the State of Maryland suggests that the USFWS data might contain an upward bias in reported catch rates. The sample and population average catch rates were both somewhat over three striped bass per day, which is considerably higher than the State of Maryland data which suggests a catch rate for the came period of one striped bass per day. When the sample catch rates were extrapolated to estimate total 1980 catch, the estimate was an order of magnitude or more larger than the published estimates noted in the introduction, although some of this difference may be attributable to difference. in estimates baaed on total trips versus total days. The fact that sample catch rates do not predict aggregate catch well does not invalidate their uae as quality indicators, however. As indicators of the quality factors which signal individuals' fishing decisions, sample catch rates may perform quite well.

The survey data contained a categorical variable measure of household income. A second measure was also calculated: total budget for fishing and hunting recreation, the sum of all fishing and hunting-related expenditures in 1980. If the individual has a weakly separable utility function and determines first the total amount of income to allocate to hunting and fishing recreation, the fishing and hunting budget is a more relevant income constraint than overall household income. The fishing/hunting budget measure, however, is subject to potential errors Of measurement, both from faulty recall by respondents and from year-to-year fluctuations due to purchase of major durable goods.

The Basic Model

For a variety of reasons, the model we estimate for recreational fishing is different from the recreational beach uee and boating model. In the beach use and boating estimations , trip data existed for a number of quality-differentiated sites. In the fishing data, trips are available only by region. There are only four of these regions, and each is large so there can easily be as much variation within any region M there in among the regions. Further, 164 of the 184 striped bass anglers in the sample visited only one region. Rather than estimating four demand curves, we have estimated a single equation where the dependent variable is the sum of the trips to all sites.

The handling of the quality variables differs al- For recreational boating, w. ueed a varying Parameter model because the quality variable, scientific measures of water quality, varied across sites but not across individuals. The quality variable in recreational fishing, catch rate, varies across individuals. Consequently, we need not use a varying parameter model. Instead we uee the observation on the reported catch in arena where the individual took his trips. The data set includes many individuals who did not fish for striped bass. For these individual, costs and catch rates were inferred.

The fishing model estimated waa

$$x_i = \beta_0 + \beta_1 TC_i + \beta_2 CR_i + \beta_3 IB_i + \beta_4 CB_i + \beta_5 BD_i \tag{6.1}$$

where xi is the number of days taken by the i^{th} individual, TC_i is the individual'. full coat (in dollars per trip) of striped bass fishing, CR_i is the catch rate (fish per day), IB_i and OB_i are (0,1) variables denoting availability of an inboard or outboard boat for fishing, respectively; and BD_i is the individual'. fishing/hunting budget in dollar. per year.

No substitute sites were specified in the model because the regions were so broadly defined that they might not in fact act as substitutes for each other. There is probably extensive substitution among sites within each region that cannot be captured at all given the level of aggregation we face; and the sample data indicates that only about 10 percent of respondents visited more than one region. Instead, the price and catch rate for Participant who visited more than one site were calculated as the mean of price. and catch rate. at each region visited, weighted by the day. fished.

Only slightly more than one-quarter of the respondents who either hunted or fished in Maryland reported having fished for striped bass. This level of non-participation implies a serious censored variables problem. There are several ways of handling this problem in recreational demand models. We explore these approaches in Chapter 4 of Volume I of this report. For the current task of estimating fisheries demand models, we choose the following simple Tobit formulation:

$$(6.2) \qquad x = \begin{cases} \beta' z + \varepsilon & \beta' z + \varepsilon > 0 \\ 0 & \beta' z + \varepsilon \leq 0 \end{cases}$$

where z is the vector of explanatory variable.. The Tobit model imposes come rather extreme restrictions on individual behavior that more general sample selection models avoid. But for preliminary results, we accept these restrictions for the sake of simplicit y.

Determining the relevant price and catch rate for non-participants was problematic. For these individuals, it was not known which of the four price-quality combinations were moat relevant to their decision to go/not go striped bass fishing. In the application we used the minimum price to access a striped bass "site" and its corresponding catch rate.

Welfare measures are calculated, in principle, the " same way as for the varying parameter. model. That is, the benefits of an increase in catch rates are given by the change in consumer'a ● mplua which, for the linear model above, is

$$(6.3) \qquad \Delta CS = \frac{x^2(CR^1)}{-2\hat{\beta}_1} - \frac{x^2(CR^0)}{-2\hat{\beta}_1}$$

where β_1 is the *own-price* coefficient, and x is the individual's trip level.

Empirical Results

The model in equations (6.1) and (6.2) was estimated using the maximum likelihood method of LIMDEP. Table 6.3 gives the results which will be used for preliminary benefit estimation, along with the sample means of the variables. The results in Table 6.3 are for a model in which actual catch rates reported were used for participant, and a predicted catch rate was used for non-participants. We also estimated a model in which predicted catch rates were used for every individual In the latter estimation, the coefficient estimates remained basically unchanged, but the standard *error* on the catch rate *coefficient* increased resulting in a t-statistic of about 1.3.

The coefficient estimates all have intuitively correct signs, and they are different from zero at better than the 5 percent significance level. Having an inboard motorboat seems to induce more striped bass tripa than having an outboard motorboat. The own-price elasticity for Participant is about minus one, while the catch rata elasticit y for participant is about .10,

Table 6.3

Tobit Estimation of the Demand for Striped Bass Fishing

Explanatory Variable	Coefficient Estimate	t-statistic	Mean of Variable
Constant (C)	-10.6	-5.79	1.00
Own price ('IT)	-.336	-7.52	$27.2
Catch rate (CR)	.337	2.13	3.2 fish/day
Inboard Motor (IB)	12.65	4.49	.10
Outboard Motor (OB)	6.66	3.47	.31
Budget (FHB)	1.40	3.04	. 70($000)

$\hat{\sigma}^2 = 18.3$
N = 760

We can use the estimated coefficients in Table 6.3 to estimate welfare effects of increases in catch rates. As in Chapters 4 and 5, two estimates of consumer surplus are provided. Method A employs predicted trips plus changes in predictions whereas Method B uses actual trips plus changes in predictions.

It is rather eaay to expand sample results to the population, since the Fish and Wildlife Survey includes sample weight or sample expansion factors. These weights account for the fact that different population strata are sampled disproportionately. Consumer's surplua for the population is simply the weighted sum of the surpluses of the sample observation:

$$\text{(6.4)} \qquad Cs = \sum_{1}^{s} \frac{-(x^i)^2}{2\beta_1} f_i$$

where s is the sample size and f_i is the expansion factor.

Table 6.4 gives the estimates of aggregate surplus. The first column is the estimate of the value of access to striped baas fishing as it was perceived in 1880, baaed on 1980 prices. The actual and predicted estimates differ substantially, with the actual being more than three time. larger than the predicted.

Table 6.4

Aggregate Consumers' Surplus for Striped Bass Fishing:
Effect of Changing Catch Rates, 1960

(Population of Maryland Hunters and Fishermen)

	Aggregate Consumer Surplus for Access	Surplus Change with Change in Catch Rate		
		20% Decrease	10% Increase	20% Increase
	. . . .	Thousands of Dollars	. . . .	
Predicted (Method A)	14,652	-572	314	1,501
Actual (Method B)	54,196	-422	231	4s1

The second, third and fourth columns in Table 6.4 give the net impact of a 20 percent reduction, 10 percent increase and 20 percent increase, respectively, in the striped baa. catch rate compared with the level perceived in 1960. Here the actual and predicted results are closer, especially for the 10 percent changes.

The numbers that are most interesting for environmental policy on the Chesapeake are found in the third and fourth columns. These figures are rough estimate. of the dollar amount people who currently fish or hunt in Maryland might gain annually from improving striped baas fishing.

There are a number of complicating factors which cannot be integrated into our preliminary calculations of benefit estimates. First, consider how long it would take for environmental policy to produce a ● ubdantid, sustainable increase in catch rate. Reduction in effluents for one year will have only a small effect. To improve ambient water quality enough to bring about better striped bass reproduction and survival could take many years.

The second question relates to the role of expectations regarding catch. Aaide from the likely bias and high noise in the catch rate estimate, what respondents report is the ox post realisation of catch rates, while their decisions regarding whether, when, and how frequently to go are baaed on expectation about the catch rate, ex ante. Consequently, while recalled ex post catch rate is the best quality variable we could obtain for striped baas fishing, we need to be skeptical about its implications for the relationship between days taken and expected catch rate.

The second question concerning these benefit estimates is whether, given sufficiently improved ambient water quality, the catch rates are sustainable. The answer is no. Better catch rates induce more fishing and hence more harvest. Since there is some evidence that overharvesting is partly responsible for the decline in fish populations to begin with, it is likely that healthier stocks will induce more harvesting. The long run equilibrium will result in higher than current benefits, but smaller than the benefits which implicitly assume that the increase in fishing effort will have no long run effects on fish stocks.

Last, it is worth remembering that the benefit estimates are baaed on a sample of households that hunted or fished in Maryland in 1980. If there are people who currently do not hunt or fish, but would go striped bass fishing if the fishing improved sufficiently, then the annual benefit estimates are an underestimate.

chapter 7

Conclusions

Restoration of Chesapeake Bay water quality requires substantial resources on the part of public agencies, private firms and households. There are many choices to be made in implementing programs to clean up the Bay. This report haa described acme of the activities which would benefit from the enhancement *of* Bay water quality. Chapters 2 and 3 described ways in which people think about the Bay and benefit *from* better water quality. Chapters 4 through 6 contain descriptions of come recreational activities which would gain from improved water quality. All of these chapters provide estimated willingness to pay *from potential* improvements.

In deriving benefits, sometimes we 1000 eight *of* the informational content of the models behind the *benefit* estimates, the estimated demand functions themselves. Chapters 2 through 6 contain substantial new information about the structure of demand *for* recreational activities associated with the Chesapeake Bay. In nearly every instance where sufficient data were available, recreators responded to travel and time costs in a manner consistent with our theoretical model. They were also observed to be responsive to even the crudest of water quality measures. Additionally, demographic variables such as income, race, and boat ownership were observed to influence behavior. As we turn to the benefit estimates, the reader is reminded not to consider the "bottom-he" benefit figures as the only value of this report.

Demand *for* Chesapeake Bay Recreational Activities

The data and modelling exercises described in Chapters 3 through 6 provide a good picture *of* the recreational use of the Chesapeake Bay. Chapter 3 includes an overall picture of Chesapeake recreational activities derived from a random sample of all households in the Baltimore/Washington SMSA's (BWSMSA). This survey revealed that a full 43 percent of the BWSMSA population used the Bay or intended to use it for recreation in 19S4. Geographical distribution of users showed *Anne* Arundel County residents (69 percent) moat likely to be Bay users and District of Columbia residents (21 percent) to be least likely (ace Table 3.1). The moat common recreational activities were fishing, swimming and boating, with about a third of the Bay users participating *in* all three activities. Of these activities, swimming was enjoyed by more people than either of the other two, with 77 percent of users participating. In the remaining chapters, each of these activities was looked at in greater detail using specific surveys of subsamples of the population.

In Chaptar 4, wa provide two types of demand models *for* western shore beach uae activity. Each draw. on an on-site sample *of* beach users at western shore beaches in the summer of 19S4. The varying parameter model is a modification of traditional demand models where the demands for tripe to each cite are treated largely independently, but the difference in parameters across sites are attributed in part to site characteristic. The discrete choice model explains the choice among cites directly, as a function of site characteristics, but does not handle the total number of trips well. Each type *of* model gives a good description of one aspect *of* the recreational decision.

From the results in Chapter 4 it is char that both money and time access costs are extremely important in determining demand for trips to any given beach, as are the costs of accessing alternative beaches. Whether or not an individual owns a boat or recreational vehicle also affects demand for a subset of beaches, those which have facilities for these capital goods. Demand functions for trips to a site tend to pivot inward, becoming more elastic, with declining water quality.

The results of the nested multinominal logit or discrete choice model of beach use suggested acme similar and acme additional characteristics of demand for this activity. Once again, money and time costs of access were important this time in explaining the choice among sites. Additionally, the availability of boating and recreational vehicle facilities increased the likelihood of a boat or recreational vehicle owner to choose a site. An *interesting* hypothesis was tested regarding the differential substitutability among local beaches and among state beaches vis-à-vis the substitutability between local and state beaches. Beach users seemed to consider local beaches closer substitutes for one another than for state beaches. Individual with larger parties or families were more likely to attend state beaches where a variety *of activities* were available. The longer an individual had attended western shore beaches, the more likely he was to use local rather than state beaches.

Chapter 5 provides a rather extensive profile of boaters and boat owners derived from a survey of boaters sponsored by Maryland Sea Grant and Maryland Coastal Zone Management and from the BWSMSA telephone survey. The boater survey subsample includes registered boat owners in Maryland. The profile includes an analysis of characteristics which distinguish boat owners from others and looks at these distinguishing characteristics b y geographical area. Average household income, for example, is higher for boat owners than non-owners, but this difference is only ● tatiatically significant in *Prince* Georges, Anne Arundel and Calvert counties.

Considering the boats themselves, a different profile characterizes those which are kept in the water all season (in marinas, moored, etc.) than characterizes boats which are trailered. As would be expected, trailered boats are significantly smaller and less valuable, they are more likely to be runabouts or workboats and their owners are likely to have less income than the owners of boats kept in the water. Almost all trailered boats were used for *fishing* at least Occasionally. About three-quarters of the non-trailered boats were used for swimming at least Occasionally.

Table 5.4 summarizes the boat owners survey by county of residence, revealing *more* about the geographical distribution of Bay users. Residents of Baltimore and Anne Arundel counties accounted for 39 pecent of the trailered boats and 45 percent of the non-trailered boats with Prince Georges County and Montgomery County residents accounting for another 20 percent *of* trailered and 12 percent of non-trailered boats.

The last of the descriptive information suggests the importance of water quality to boaters. Water quality was considered either moderately or *very* important in the selection of a boating area by 75 percent of the trailered boat owners and by 76 percent *of* the non-trailered boat owners, A varying parameters model similar to the one used in Chapter 4 revealed that trailered boat owners' demand for trips from launch sites was affected by access costs to the launch site and costs of accessing alternative sites. In general, the demand for trips to any given site was Positively affected by the value of the boat; i.e., individuals with more valuable boats took more trips. The demand function for any given site tended to pivot inward and become more elastic as water quality declined.

Owners of boats kept in the water do not choose launch sites when they take a trip, and consequently we have no way of knowing where they boat. As a result we cannot model their decisions in response to varying water quality. For these individuals? simple demand functions were estimated. Factors which significantly affected their demand for boating trip. included the coat of a trip (negatively) and the value of the boat (positively). Additionally it was determined that sailboat owners tend to take fewer trips and their demand for trips is more price inelastic. Finally, boat owners who fish while boating tend to demand more trips and their demand tend. to be more price elastic.

In Chapter 6 information about sportfishing on the Bay is presented. Estimates of sportfishing activity vary by data source and range from 539,000 to 900,000 anglers in 19S0 and from 2.7 million to 4.1 million trips for that came year. The two prominent sources of information on sportfishing are the U. S. Fish and Wildlife Hunting and Fishing Survey and the U. S. National Marine Fisheries Survey.

Our analysis in this chapter concentrated on ● tripod bass fishing since this was the only species important to Chesapeake recreational fishing for which ● ufflciently detailed data existed. One source (U. S. Fish and Wildlife) reports that in 1960, 239,000 anglers fished for striped bass in Maryland and Sussex County, Delaware and fished 2.1 million days in total. Table 6.1 presents come descriptive statistics of striped bass fishermen and other Chesapeake Bay fishermen.

In the analytical section of Chapter 6, demand for sportfishing trips was modelled as a function of the individual'. trip costs, catch rates, his annual fishing/hunting budget and indices of types of boat ownership. All variables affected the demand for trip. in the expected direction, with owners of inboard motorboat likely to take more trips than those with outboard (presumably smaller) motorboat.

Estimates of Benefits from Water Quality Improvements

While the analysis of the demand for recreational activities is worthwhile in ita own right, more information about the size of rewards from Bay restoration can be obtained, There are several reasons for computing aggregate willingness to pay rather than simply providing descriptive measures such as recreational use days. Obviously such measures cannot be compared to the costs of restoration; they cannot even be added across activities. A day of fishing is different from a day of swimming, and changes in water quality have different effects on the benefits derived from the two activities. Further, as we observed in Chapter 3, there is some willingness to pay for clean water by people who do not use the Bay. If we limit ourselves to descriptive measures such as user days, we ignore the returns to people who value cleaner water but do not uae it. Consequently, we have taken a first step toward the logical, albeit venturesome, task of estimating the aggregate benefits of improving the Bay's water quality.

Caveats

The aggregation of benefits across activities and for the population at large is venturesome because it is so filled with known difficulties. We can take a systematic view of these potential errors by recalling the links between environmental policies designed to reduce effluent pollution and the benefits of environmental improvements. Policies influence effluents directly through regulations and indirectly through changes in incentives. Reductions in effluents will eventually improve the ambient water quality. Improvements in ambient quality when perceived by individuals eventually lead to changes in behavior toward the Bay, implying benefits. Further, when non-users perceive improvements in the ambient water qualit y, they too will be better off. There is potential for errors in the measurement of each link in this process.

The analysis of the previous chapters has concentrated on the connection between ambient quality and economic benefits. It rests, however, on the relationship between environmental policy, effluents, and ambient quality. The considerable debate regarding the connection between effluents and ambient quality suggests the potential for honest differences of opinion on the nature of the ecological links. Similar uncertainty over the behavioral and perception links exists.

While a complete catalog of the sources of potential error would take an entire chapter, we describe broadly what we think the major difficulties are. If the problems inherent in explaining the link between policy and ambient quality are ignored, the foremost uncertainty is between ambient quality and behavior. Recall briefly how this link waa estimated. For boating and beach uae we used a varying parameters model to estimate the relationship between the product of total phosphorus and nitrogen readings in 1977 and trips in 19S4. There is clearly substantial room for error in this relationship.

First, since people cannot perceive nitrogen and phosphorus, we must assume that the nitrogen and phosphorus are approximate measures of the ambient quality. It is not unreasonable to expect such a relationship to hold in principle. Chapter 2 describes ways in which individuals form perceptions of water quality. Some of the deductive and media-baaed means by which individuals form quality perceptions may be directly related to effluent discharges. Others, such as stimulants of sensory perceptions, may be highly correlated with, or even caused by, nitrogen and phosphorus levels. Previous studies which have attempted to link behavior to individual ambient water quality indicator. (e.g. Binckley and Hanemann) have detected a correspondence. Chapter 2 describes acme evidence which supports this , hypothesized link derived from our telephone survey of the BWSMSA and the field survey of western shore beaches. Through the telephone a significant relationship waa detected between a household perception of the water quality in the Bay and ita likelihood to quit using the Bay. Additionally, a significant relationship appeared between objective measures of the Bay's water quality over time and the proportion of households who atopped using the Bay for recreation because they perceived the Bay's water quality to be unacceptable. Finally, the user (field) survey showed a positive correlation between measures of fecal coliform at each of nine beaches and the proportion of households that found each beach unacceptable.

A further difficulty is the seven years which separate the nitrogen/phosphorus readings and the recreational behavior, since 1977 was the latest year for which complete information was available. While this is clearly a source of potential error, there are a few reasons why it might not be as bad as it seems. For one thing, the relative levels across different regions of the Bay may have remained approximately constant even if absolute levels have changed. Additionally, it is not clear what year or combinations of years would be correct in signaling the recreational behavior stimulated by water quality because behavior is probably largely affected by prior experiences.

Since we are really explaining choices among sites of different quality, our behavioral models depend more on the relative levels of ambient water quality rather than on absolute levels; and if relative levels have remained fairly constant, our behavioral models are likely to be quite good. Extracting benefit measures from these models, however, must be done with caution since the absolute levels of nitrogen and phosphorus readings used may not be trustworthy y.

For recreational fishing the problem is in some waya a little simpler. Here we use the catch rate experienced by the individual for 1980, the year the trips were taken. There is of course a complex and uncertain chain of relationships between improvements in ambient quality and growth in the density of fish stocks. There is further uncertainty in the connection between fish stocks and catch rates. These are largely, although not completely, problems of biology and are not addressed here, but nonetheless remain as imperfectly understood links in the system.

Restricting our comments entirely to the behavioral realm does not eliminate these uncertainties and potential sources of modelling error. In what sense is the catch rate in the year the trip. were taken a good measure of quality? Fishermen may value higher catch rates but their demand (behavior) for tripa this year may be baaed on catch rates experienced in previous years. When the quality of the good is uncertain to the consumer, there may be one eat of quality indicators that stimulate demand and another which affect the benefits derived from consumption. Further, there is no guarantee that catch rate is the only (or moat important) variable which determines the enjoyment of trips to catch fish. For example, catching one five-pound striped baaa may be batter than catching two two-pound stripers.

In addition to the severe difficulties in inferring the relationships between ambient quality, there are two other significant sources of error in computing aggregate benefits. First, there is the problem of sampling and non-sampling error associated with the measurement of the number of trips per participant and the number of participant in each activity, M well as measurements of exogenous variables such as costs per trip. The boating survey is a good example of non-sampling error for trips. This survey waa a mail survey, so in a sense the respondents are volunteers. The return rate was 70 percent. We have no way of knowing whether those who completed their questionnaire. were representative of the boating population as a whole or if there is a built-in sample selection bias.

We have also used only segments of the total population in our analysis of benefits. The boaters were limited to those who trailer their boats, the fishermen to those who fish for striped bass and the beach users to those who use public-access western shore beaches. In the boating and fishing analysis we have excluded non-Maryland households. In the contingent valuation and beach uae analysis, only 20 percent of Virginia's population wae included and about 80 percent of Maryland's households. In every instance, a major portion of users is excluded so any estimates derived will be lower bounda.

Another source of error in aggregating benefits across activities is aggregation bias. This comes in two forms: simple doublecounting and conceptual aggregation bias. Doublecounting occurs because a ● ubatantial number of boaters also fish, and many fishermen have boats. The conceptual aggregation biaa occurs because of the jointness of choice among sites for a given activity and among activities. For example, the choice of visiting Sandy Point versus Point Lookout may depend in part on water quality. Enhancing water quality at both sites may only increase attendance at one site, making the addition of benefits across sites incorrect. A discussion of this problem is *offered in* Chapter 3, but both forms of aggregation bias are treated in detail in Chapter 5 of the conceptual volume of this report.

Finally, we must remember that we have only three activities: boating, fishing, and swimming. There are many other recreational and commercial uses of the Bay whose value is enhanced by cleaner water. For example, our analysis of fishing *rovers* only striped bass; fishing for species besides striped bass (e.g. crabbing) is widespread and not covered by our analysis. And our analysis *of* the effect of changes in water quality covers *only* trailered boats, not boats at marinas. Many other, especially more casual, activities are omitted. We have limited our analysis to boating, fishing, and swimming because we could obtain data of adequate quality only for these activities

Estimates

With these difficulties firmly in mind, we are prepared to hazard some judgments *on* the magnitude of the aggregate benefits of improving the Bay's *water* quality. Cur approach is to present low, middle and high benefits for the beach use (Chapter 4), boating (Chapter 5), and fishing (Chapter 6) and qualitatively compare those benefits with the total benefits derived from Chapter 3. Comparing the ranges of these independent sources *of* benefits will help us to form a judgment, but nothing *more,* of the magnitude of aggregate benefits.

Chapters 4 through 6 give *benefit* estimates for activities conditioned on the computational method and the proportionate change in ambient quality and catch *rate.* We adopt the convention of analyzing a 20 percent reduction in nitrogen and phosphorus for boating and beach use and a 20 percent increase in the catch rata for striped bass fishing. These changes should be interpreted loosely as considerable improvements in the quality of the Bay without attaching much significance to the absolute change in ambient readings which would be implied. In particular, one should not interpret the estimated effect of nitrogen and phosphorus as an "all else equal" effect. The change in nitrogen and phosphorus is a proxy for changes in moat ambient determinants of water quality so that the implicit assumption is that a range of ambient factors may be improving. Further, to counteract the problem of aggregating across sites for a given activity, we select as a pessimistic estimate the lowest estimate of the benefits of improving the quality by 20 percent at the one moat important site.

Table 7.1 summarizes some of the estimates of aggregate benefita for our groups of boaters, sportfishermen and beach users, translated into 1987 dollars. The variation from pessimistic to optimistic is provided by two sources: variation induced by the method of calculating benefits (i.e., using actual trips versus predicted trips) and variation caused by choosing one site rather than the sum over all sites. Recall that because each site's benefits are calculated assuming other sites' quality remains unchanged aggregating these measures over sites will produce an upwardly biased aggregate benefit. The pessimistic estimates for beach use and for boating are the lower of the two estimates of the benefits for a 20 percent improvement in water quality from Sand y Point for beach uae and Anne Arundel County for boating. One site was chosen as a lower bound because wtth only one site all (upward) aggregation bias is eliminated. The average estimates for beach use and boating are the lower of the two calculation methods for sums across all sites. The optimistic estimates are the higher of the two calculation methods for the sums across all sites. For striped bass fishing, the pessimistic estimate is the lower of the two methods of calculation. The sites have already been aggregated for the fishing case, and as we show in Chapter 5 of the accompanying volume, the nature of the aggregation bias in this case is not obvious. The optimistic estimate is the higher of the two calculation arithmetic methods and the average is the mean of the pessimistic and optimistic.

Table 7.1
Aggregate Benefits for Three Water-related Activities from a "20%" Improvement in the Chesapeake Bay's Water Quality in 1967 dollars

Activity	Benefit Estimate Pessimistic	"Average"	Optimistic
		($ Thousand)	
Public Western Shore Beach Use[a]	16, 853	34,658	44,960
Boating with Trailered Boat[b]	654	4,717	8,129
Striped Bass Sportf ishing[c]	664	1,366	2,071

[a] From Table 4.6. Pessimistic estimate is the Method B value for Sandy Point, the average is the sum of Method B values over all ten sites, and the optimistic is the sum of Method A values over all sites.

[b] From Table 5.13. All per boater estimates expanded to 60,000 boaters ' trailering boats. Pessimistic estimate is the low value (Method A) for Anne Arundel County, the average estimate is the sum of low values (Method A) across all counties and the optimistic value is the sum of high values (Method B) across all counties.

[c] From Table 6.4. Pessimistic value is the value using Method B, the "average" value is the average of the pessimistic and optimistic value, the optimistic value is the value using Method A.

The aggregate measures of willingness to pay *for* water quality improvements are revealing for several reasons. First, regardless of which benefit measure we use (pessimistic, average, or optimistic), the returns to beach use are the greatest. This ia primarily because a larger proportion of the population engages in come beach-going during the year than boating Or fishing. Additionally, this group may be more sensitive to changes in water quality than the boating-fishing group.

A second interesting implication *of* the results, although not obvious from looking at Table 7.1, is the importance of regional variation in water quality. If we *were* able to clean up the water around Anne Arundel County only, we would still go a long way towards satisf ying some of the human needs for using the Bay. While we realize that confining a water quality improvement program to a particular locality may not be technically or ecological y feasible, any clean-up strategies which result in significant improvements in this region *of* the Bay will yield substantial benefits.

A comparison *of* the behaviorally based measures of benefits presented in Table 7.1 with benefit estimates derived from contingent valuation (ace Table 7.2) is interesting even though the valuation questions driving the two analyses are different. All of the estimates in Table 7,1 are partial estimates in that they account for only one activity and involve only ● ubaeta of the population. Table 7.2 presents contingent valuation produced benefit estimates associated with a broader but less precise hypothetical improvement: improving water quality to an “acceptable” level. The subset *of the* population includes those *in* the BWSMSA who found water quality unacceptable for swimming or related uses.

Table 7.2

Aggregate[a] Benefits from Water Quality Improvements-
Contingent Valuation
in 1984 dollars

Group	Willingness to Pay for Improved Water Quality[b] Pessimistic[c]	Average[c]	Optimistic[c]
	($ Thousand)		
User	47,254	67,582	87,870
Non-User	18,446	23.556	28.733
Total	65,700	91,137	116,603

● Population is the Washington, D. C. and Baltimore SMSA's.

[b]Wi ll ingness to accept tax increase to raise Chesapeake Bay water quality from a level unacceptable for swimming end/or other related activities to a level acceptable for swimming.

[c]The average willingness to pay plus or minus one standard error in est imate. See Table 3.8.

The numbers in Tables 701 and 7.2 give likely magnitudes for the annual benefits of improving water quality in the Bay. The numbers suggest a range of from $10 million to over $100 million, We know that there are numerous random elements in all estimates. Further, we know that several activities and populations have been omitted. But based on these numbers, it seems plausible to estimate that the annual returns to cleaning up the Chesapeake are at least of this order of magnitude. We have only the evidence presented herein to make this judgment.

In conclusion, we recapitulate the premise. Society haa undertaken an investment program. The nature of the program is the cleanup of the Chesapeake Bay. The costs of the program include such things as sewage treatment plants, funding of government programs to regulate and monitor agricultural effluents, installation of industrial waste disposal systems, restrictions on housing development, etc. The annual returns on the investment program are measured by what people are willing to pay for the improved services of the Bay. TMa is the dividend yielded by the public's investment program.

For several reasons, we think that the long-run benefits are higher than the figures Tables 7.1 and 7.2 indicate. First, as people learn that the Bay haa become clamor, they will adjust their preferences toward Bay recreation. This is especially true of people who do not currently use the Bay and are largely excluded from the analysis. Second, the population and income of the area have grown since 1984, and both are likely to grow more, increasing the demand for and value of improvements in water quality. Finally, we have ignored the value (both uae and existence value) which households outaide the BWSMSA may have for the Bay. The Chesapeake Bay is a nationally prominent resource. Its improved health is of value to many who will never use it.

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Appendix A

The Random Digit Dialing Survey Telephone Procedures

For the Random Digit Dialing Survey, three instruments (copies included in the Appendix) were developed: a two-page screening form, an 1 l-page, 28-item questionnaire, and a Record of Calls sheet.

1. Screening Form

The screening form was intended to determine the eligibility of the location served by a randomly generated telephone number. The number was printed on a label affixed to the top of the screening form. Pay phones and phones used only by businesses were not considered eligible, since people answering ouch telephones would be eligible at their residence phone.. In addition, if the household served by the phone waa not located within the counties/cities making up the selected SMSA's then that phone (residence) was not eligible. Once an eligible phone (residence) waa identified, a member of the household who waa 18 years of age or older waa required. If all residents were under 18, the screening waa completed with a member of the household who waa 14 or older.

The screening form waa composed of five sections: an Identification section consisting of an area code, telephone number, and five-digit case identification number, all printed on the aforementioned label; a brief introduction to be read by the interviewer which explained the study; a screening section which waa used to eliminate pay phones, businesses without living accommodations. and residences not located in certain specific SMSA's; a screening status section to record the screening eligibility of the location; and a questionnaire status section to record whether or not a questionnaire was completed with an eligible person.

2. Questionnaire

The Random Digit Dialing Survey Questionnaire was intended to determine the following:

Uae or intent to use the Chesapeake Bay for recreation during 1984; Reasons for nonuse;

Activities that the respondent (and his/her family) participated in while visiting beaches;

Reasons the respondent or other members of his/her family do not go in the water during visits to the western shore beaches;

Changes in swimming participation in the Chesapeake brought about by change. in the water quality;

The respondent's perception of the water quality in the Chesapeake;

The value respondents place on the Bay and how they visualize that improvement should be made and financed.

As in the User Intercept Survey, a series of demographic questions which will enable analysts to establish profiles of beach users and nonuser were included in the questionnaire.

The Random Digit Dialing Survey Questionnaire waa also divided into sections. The first, Identification, had space provided for recording the case ID number from the screening form, the telephone interviewer's initials, and the date the interview was completed. The second section, as in the User Intercept Survey, was a lengthier introduction to be read by the telephone interviewer, which went into greater detail regarding the purpose of the survey and contained statement informing the respondent of the voluntary nature of his/her participation in the study and assurances of the confidentiality of the data collected. The third section, Recreational Uae of the Chesapeake Bay, sought specific responses which would: (1) enable analysts to determine if and how the beaches were used and (2) what the overall perception of the water quality waa. Thie waa followed by a fourth and final section consisting of some 18 demographic questions.

Data Collection Methods

Two field interviewers were trained in Baltimore for the data collection of the Ueer Intercept Survey on May 25, 1884. A Field Interviewer Manual was developed (which is available upon request) and included quemtion-by-question specification, probing techniques, confidentiality procedures, refusal conversion strategies, and other measures necessary to assure the collection of standardized, quality data during the course of the field survey process. Alao covered in the manual were: background information, assignment information, sampling procedures and administrative procedures.

The final day of field work on the ueer survey was August 16, 1984. The confirmation portion of the user survey was completed on September 1. The following represents the response rates for the field work:

Table A.1

Response Rates for Beach User Survey

Sample Individual	Successfully screened	Eligible Individuals	Eligible Individuals Interviewed
468	463	414	408
(100%)	(98.79%)	(100%)	(88.55%)

Of the 468 individuals screened, 60 were not administered questionnaires for the following reasons:

Ineligible because of residence	39
Refused screening	7
Language barrier-screening	6
Other	2
Refused questionnaire	3
Language -barrier - questionnaire	3

Regarding the confirmation portion of the ueer survey, 340 of the people interviewed gave telephone numbers or come other piece of information through which contact could be made to conduct a confirmation/intention interview. Approximately 240 (71 percent) of these individuals were successfully contacted during the time period allowed.

Training of telephone interviewers for the Random Digit Dialing Survey started on July 23. A total of 11 telephone interviewer. were hired with three of these spending the majority of their time making confirmation/intention calls to participants in the User Intercept Survey.

As in the User Intercept Survey, each interviewer received a copy of a Telephone Interviewer Manual specifically developed for this phase of the project, as well as copies of the Random Digit Dialing instruments. The Telephone Interviewer Manual (available upon request) included question-by-question specification, probing techniques, confidentiality porcedures, refusal conversion ● trategiea, and other measures necessary to assure the collection of standardized, quality data during the course of the telephone ●nvey process.

Approximately 192 telephone interview. were completed with western shore beach users. The remainder consisted of approximately 804 nonusers and 48 intended users. The following two tables represent questionnaire completions per strata and final totals for screening and questionnaire status codes.

Table A.2

Questionnaire Completions Per Strata

Stratum Number	Cases Avail.	Cases Assigned	Quest. Complete	Quest. Partial	Total Quest.	Quest. Needed	Diff.
1	1,230	1,060	155	10	165	138	+ 27
2	1,100	1,000	225	7	232	220	+ 12
3	408	408	70	0	70	77	- 7
4	1,014	1,014	96	4	100	112	- 12
5	820	820	171	6	177	158	+ 19
6	1,560	1,560	293	7	300	295	+ 5
Totals	6,132	5,962	1,010	34	1,044	1,000	-44

Table A.3

Final Telephone Result Totals for Screening and Questionnaire Status Codes

Screening Status Codes	
Eligible Identified/Screener Completed	1,108
Not a Working Telephone Number	2,866
Pay Telephone	13
Business Telephone	843
No Answer After Repeated Calls	897
Telephone Not Located in Bait./Wash. SMSA	11
No Eligible Respondent Available After Repeated Calls	10
Refused to Answer Screening Questions	203
Language Barrier	9
Other	3
Questionnaire Status Codes	
Questionnaire Completed	1,010
Questionnaire Partially Completed	34
Language Barrier	0
Questionnaire Refused	63
Other	1

Appendix B

Telephone Survey instrument

CHESAPEAKE BAY BEACH USE SURVEY
TELEPHONE SCREENING FORM

A. IDENTIFICATION

TELEPHONE NUMBER (_)-____-_____ CASE ID NUMBER

B. INTRODUCTION

I am calling from the Research Triangle Institute near Raleigh, North Carolina to conduct a telephone survey about the Chesapeake Bay for the University of Maryland. To find out if I've contacted the proper type of place, I need to ask a few simple questions. First,

C. SCREENING

1. Is this telephone number (READ THE 7-DIGIT NUMBER ABOVE) in area code (READ 3-DIGIT AREA CODE ABOVE)?

No [1] (HANG UP AND DIAL NUMBER AGAIN) (1)

Yes [2]

2. Is this a pay phone?

No [1] (2)

Yes [2] (GO TO 6)

3. a. Is this telephone located in a private residence or a business?

Private residence [1] (GO TO 4a) (3)

Business [2]

b. Are there any living accomodations at this place of business?

No [1] (GO TO 6) (4)

Yes [2]

c. Do the people living there use this phone for their calls?

No [1] (GO TO 6) (5)

Yes [2]

d. Whom can I speak to one of the people who lives at this business location and uses this telephone for personal calls?

ANSWER: ______________________________

(CALL BACK IF NECESSARY TO COMPLETE SCREENING)

4. a. Are you a member of the household serviced by this telephone?

No [1]

Yes [2] (GO TO 5a)

b. When will a member of the household be available to talk to me?

ANSWER: ______________________________

(CALL BACK IF NECESSARY TO COMPLETE SCREENING)

5. a. Is this residence located in Maryland, Virginia, Washington, DC or some other place?

Maryland [1] (GO TO b) (6)

Virginia [2] (GO TO b)

Washington, DC [3] (GO TO 7)

Some other place [4] (GO TO 6)

b. In what county is this residence located?

ANSWER: ______________________ (RECORD ANSWER AND CODE BELOW) (7)

MARYLAND
(Anne Arundel, Baltimore including city, Carroll, Charles, Harford, Howard, Montgomery, Prince Georges .... [1] (GO TO 7)

VIRGINIA
(Arlington, Fairfax, Loudon, and Prince William. Also include Alexandria city, Fairfax city and Falls Church city .... [2] (GO TO 7)

6. I'm sorry but we are not interested in talking to people (at Pay telephones/at business telephones/in the ● rea where YOU live). Thank You for ● svermg my questions ● nd could I hove your 0000 in case my supervisor wants to check my work?
NAME ______________________________ (COMPLETE SCREENING STATUS IN PART D ONLY)

7. ●\ This telephone is located ● ts residence in ●● rea where we ● re interested in talking to people. Are you under 18 years of ● ge or over 18 years of ● ge?

under 18 [1] (GO TO b)

over 18 [2] (GO TO c)

b. Whoa will I be ● bLo to talk to someone over 18 years of ● ge who lives in this household? ANSUER: ______________________________
(CALL BACK IF NECESSARY TO VERIFY ANSWERS AND COMPLETE QUESTIONNAIRE. IF ALL RESIDENTS ARE UNDER 18 PROCEED WITH ANY RESIDENT 14 OR OLDER.)

c. How many telephones with different numbers, not ● xtensions, service this household? [|] (8-9)

d. May I have your name in case my supervisor wants to check my work?
NAME ______________________________ (PROCEED TO QUESTIONNAIRE BUT RETURN TO AND CODE SCREENING STATUS AND QUESTIONNAIRE STATUS AFTER QUESTIONNAIRE ADMINISTRATION.)

D. <u>SCREENING STATUS CODES</u>

Eligible Identified/Screener Completed .... [01]

Not a Working Telephone Number .... [02]

Pay Telephone .... [03]

Business Telephone .... [04] (10-11)

No Answer After Repeated Cello .... [05]

Telephone Not Located In Balt./Wash. S.M.S.A. .... [06]

No Eligible Respondent Available After Repeated Calls .... [10]

Refused To Answer Screening Questions .... [97]

Language Barrier .... [11]

Other .... m l

E. <u>QUESTIONNAIRE STATUS CODES</u>

Questionnaire Completed (No mail followup) .... [01]

Questionnaire Completed (Mail followup) .... [02]

Questionnaire Partially Completed .... [03]

Language Sorrier .... [04] (12-13)

Questionnaire Refused .... [97]

Other .... [06]

COLS. 14-73 =blank
COLS. 74-80 =CASE 01

CHESAPEAKE BAY TELEPHONE SURVEY QUESTIONNAIRE

Conducted by Research Triangle Institute
for the University of Maryland

A. IDENTIFICATION

CASE ID | | | | | |

Interviewer Initials ______________________________

Date Interview Completed | | | | | | |
Month Date

B. INTRODUCTION

As I said ● arlier, researchers ● t the University of Maryland ● re currently studying citizens' use of the Chesapeake Bay. I will ● sk you some questions regarding your recreational use of the Chesapeake Bay, particularly ● t the beaches. I ● lso have to ● sk some questions which will enable the researchers to ● stablish profiles of typical users ● nd non-users of the Bay. There is no direct benefit from taking part in this study ● nd you have the right to refuse to ● aswer ● ay or ● ll of the questions or discontinue your participation at any time. The information that you provide will be combined with that provided by other people who participate in the survey to ● ssure complete confidentiality ● nd your same will not be released or revealed to ● nyone other than authorized project staff. The results of this survey may be helpful in ● ffectively ● llocating mosey to cleaning up the Bay.

C. RECREATIONAL USE OF THE CHESAPEAKE BAY

1. Have you or any members of your household used the Chesapeake Bay for recreation in 1984?

   No . . . . [1] (GO TO Q. 2.)

   Yes . . . . . [2] (GO TO Q. 4.)

2. Do you or any members of your household intend to use the Chesapeake Bay for recreation during the rest of 1984?

   No. . . . . . . [1] (GO TO Q.3.)

   Yes . . . . . [2] (GO TO Q.4)

3. What are the reasons you and members of your household have not used and do not intend to use the Chesapeake Bay for recreation during 1984? (CODE ALL RESPONSES GIVEN INTO-THE CATEGORIES BELOW)

		CODE IF GIVEN
a.	Not interested in water related recreation	[2]
b.	Unable for health reasons	[2]
c.	Costs too much	[2]
d.	Takes too much time to get there (too far to travel).	[2]
e.	Unacceptable water quality	[2]
f.	Too many jellyfish	[2]
g.	Too crowded	[2]
h.	Have not had a chance (too busy)	[2]
i.	Other	[2]

(GO TO Q. 8.)

4. What activities did or will you (and/or members of your household) participate in while using the Chesapeake? (READ EACH OF THE FOLLOWING AND INDICATE PARTICIPATION FOR EACH ACTIVITY.)

	NO	YES
a. Fishing	1	2
b. Swimming	1	2
c. Boating	1	2
d. Hunting	1	2
e. Beach Activities	1	2
f. Sightseeing	1	2
g. Other	1	2

5. This next question also pertains to you and members of your household. During 1984 did any of you or will any of you... (READ THE FOLLOWING.)

	NO	YES
a. Visit beaches on the Eastern Shore of the Chesapeake, for example shores close to Cambridge, Salisbury or Chestertown?	1	2
b. Visit beaches on the ocean, such as Ocean City?	1	2
c. Go swimming from a boat in the Chesapeake?	1	2
d. Go swimming in public or private swimming pools? .	1	2
e. Visit beaches on the Western Shore of the Chesapeake, for example beaches near Baltimore, Annapolis, Prince Frederick or Lexington Park? . . .	1	2

(IF YES TO PART e., ASK f. IF NO TO PART e, GO TO QUESTION 8.)

	NO	YES
f. During visits to Western Shore beaches did or will anyone attend but not go in the water for any reason?	1	2

(IF YES TO PART f, GO TO Q. 6. IF NO TO PART f, GO TO Q. 7.)

6. What are the reasons you or others do not go in the water during visits to the Western Shore beaches?

Do (READ EACH PART AND CODE NO OR YES.)

		NO	YES
a.	You or they believe the water is dirty/polluted.	1	2
b.	You or they believe there are too many jellyfish . . . . , ...	1	2
c.	You or they have some other reason	1	2

7. Can you tell me which Western Shore beaches you (and your family) have visited in 1984 or plan to visit during the rest of this year? *(CHECK NO* **OR YES** FOR EACH BEACH LISTED.)

	BEACH	VISITED NO	VISITED YES
a.	Sandy Point St. Park.	1	2
b.	Fort Smallwood	1	2
c.	Bay Bridge Beach	1	2
d.	Herrington Harbor	1	2
e.	Kurtz Pleasure Beach.	1	2
f.	Camp Merrick	1	2
g.	Breezy Point Beach	1	2
h.	Chesapeake Beach.	1	2
i.	North Beach	X	2
j.	Rod and Reel Dock	1	2
k.	Point Lookout St. Park.	1	2
l.	Elm's Beach	1	2
m.	Morgantown Beach	1	2
n.	Miami Beach (Baltimore)	1	2
o.	Rocky Point Park.	1	2
p.	Conrad's Ruth Villa	1	2
q.	Porter New Park	1	2
r.	Other (SPECIFY) ______________________________	1	2

8. Have you (or members of your family who live with your) ●ver changed your swimming participation in the Chesapeake because of changes in the Bay's water quality?

No. . . . . [1] (GO TO Q. 9.) . (4(

Yes (stopped). . [2]

Yes (started). . [3]

a. In what year did you (or members of your family) last change your swimming habits in the Chesapeake because of changes in the Bay's water quality?

Year. . . . . . [|] (4

9. We would like to find out how people currently perceive the water quality in the Chesapeake Bay.

●\ Do you consider the water quality in the Chesapeake to be ● cceptable or unacceptable for swimming ● rid/or other water ● ctivities.

Acceptable . . . . [1] (4

Unacceptable . . . . . ● m

b. Do you believe the water quality varies ●t different beaches ● ions the Western Shore of the Chesapeake?

No. . . . . [1] (GO TO CHECKPOINT I.) (5

Yes . . . . [2]

c. (IF YES, SAY:) In general, which statement best describes your beliefs?

The water quality is better North of Annapolis . . [1] (5

The water quality is better South of Annapolis . . [2]

INTERVIEWER CHECKPOINT I

REFER TO QUESTION 9.A. .

WAS THE WATER QUALITY IN THE CHESAPEAKE RATED AS UN<u>ACCEPTABLE</u>?

No . . . . [1] (GO TO Q. 11.)

Yes. . . . . [2] (GO TO CHECKPOINT TABLE.)

CHECKPOINT TABLE

ENTER THE LAST DIGIT OF THE CASE **ID NUMBER HERE.** ________

IF THE LAST DIGIT IN THE CASE ID NUMBER IS	CIRCLE AND USE THIS AMOUNT IN QUESTION 10
1	$5.00
2	$10.00
3	$15.00
4	$20.00
5	$25.00
6	$30.00
7	$35.00
8	$40.00
9	$45.00
0	$50.00

10. **You indicated that in your opinion the water quality** in the Chesapeake **is** unacceptable for **swimming**. **Would** you be willing to **pay** (AMOUNT **FROM CP** TABLE) in ●xtra **state** *or* **federal** taxes **per year, if** the **water quality** were improved so that you found it ●cceptable to **swim** in the Chesapeake?

No. 01

Yes . . . . ● Zl

Don't know 98

D. BACKGROUND INFORMATION

11. The next few questions ●re ●bout you ●nd your household. How many of ●ach of the following types of people live in your household? **(READ** EACH **OF THE** FOLLOWING AND ENTER **THE NUMBER** OF EACH TYPE.)

a. Adults **(age** 18 ●nd older) . . . . [ ]

b. Children between the ●ges *of* **14** ●nd 18 . . . . . [ ]

c. Children **under age of 14** . . . . [ ]

12. What best **describes your status in the household?**

a. Grandparent. 1

b. **Parent** 2

c. Child. . . . , ... 3

d. Other relative 4

e. I live ●lone or with unrelated individuals . . . 5

13. How many years have you (and your family) lived in either Maryland, Virginia, or Washington, DC?

Number of years . . [|] (63-

14. **Do you or any other members of your household own (READ THE FOLLOWING)...**

		NO	YES	DK	RF	
a.	a boat?	01	02	98	97	(65-
b.	a boat trailer?	01	02	98	97	(67-
c.	fishing tackle (rod, reel, tackle box, etc.)?	01	02	98	97	(69-
d.	a recreational vehicle (RV)? . . .	01	02	98	97	(71-

COLS. 73-80 = CASE 01

		NO	YES	DK	RF	
e.	a swimming pool?	01	02	98	97	(1-2
f.	Other recreational items (SPECIFY)					
	______________________	01	02	98	97	(3-4
	______________________	01	02	98	97	(5-6

15. Are **you one of the** principal wage earners in *your* household, a wage earner but not the principal wage earner, or are you a homemaker, a student or retired?

a.	One of the principal wage earners in the family	1
b.	A wage earner but not the principal wage earner	2
c.	Homemaker.	3
d.	Retired.	4
e.	Student.	5
f.	Other (SPECIFY) ______________________	6

(7)

INTERVIEWER NOTE: ASK QUESTIONS 16 **THROUGH** 19 IF CODE 1 OR 2 **IS MARKED** IN QUESTION 15 OTHERWISE GO **TO QUESTION 20.**

16. How many hours **do you usually** *work per* week?

Hours . . . . . . [|] (8-

17. How many paid vacation days **will you have altogether in 1984, including** those you've already taken?

Vacation Days . . [|]

18. For a typical recreational outing, if you did not go, could you work at some paying job instead?

No 1

Yes 2

19. If you could have worked, what hourly wage might you have been paid specifically for the hours you worked?

a. $3.35/hour 01

b. $3.36 - $5.00/hour 02

c. $5.00 - $7.50 03

d. $7.50 - $10.00/hour . . . m

e. $10.00- $15.00/hour 05

f. $15.00 - $20.00/hour 06

g. $20.00 - $25.00/hour 10

h. Over $25.00/hour 11

i. Don't know 98

j. Refuse. 97

20. Are there any (other) major wage earners in your family?

No . . . . 1 (GO TO Q. 25.)

Yes 2

The next few questions are about the other major wage earner.

21. How many hours does he/she usually work per week?

Hours . . . . ____

22. How many paid vacation days will he/she have altogether in 1984?

Vacation Days . . ____

23. For the typical recreational outing, if he/she did not go could he/she work-at some paying job instead?

No 1

Yes 2

24. If he/she could have worked, what hourly rate would he/she have been paid specifically for the hours worked?

- •\ $3.35/hour 01
- b. $3.36 - $5.00/hour 02
- c. $5.00 - $7.50 03
- d. $7.50 - $10.00/hour 04
- e. $10.00 - $15.00/hour 05
- f. $15.00 - $20.00/hour 06
- g. $20.00 - $25.00/hour 10
- h. Over $25.00/hour . . . . . m
- i. Don't know 98
- j. Refuse. 97

(21·

25. We need •n •stimate of your household's income for •ll of. 1984. I will read •series of income categories. Please stop me when I read the category which best describes the total amount of income •ll members of your household will receive during 1984.

INTERVIEWER CHECKPOINT II

ENTER THE LAST DIGIT OF TIE CASE ID NUMBER HERE. ______

IF THE LAST DIGIT IS	START READING THE ANSUER CHOICES AT
1,3, s,7,9	a. less than $5,000 AND ASCEND
2,4, 6,8,0	1. over $100,000 AND DESCEND

•\	less then $5,000 . . .	01	g.	$50,000 to $60,000 . .	10
b.	$5,000 to $10,000 . .	02	h.	$60,000 to $70,000 . .	11
c.	$10,000 to $20,000 . .	03	i.	$70,000 to $80,000 , .	12
d.	$20,000 to $30,000 . .	04	j.	$80,000 to $90,000 . .	13
•.	$30,000 to $40,000 . .	05	k.’	$90,000 to $100,000. .	14
f.	$40,000 to $50,000 . .	06	1.	Over $100,000	15

Don't know 98

Refused 97

26. CODE SEX BASED ON **NAME,** PREVIOUS **ANSWERS/REMARKS OR** ASK: Are **you** female or *male?*

Female . . . . . . [1]

Hale . . . . [2] (25.

27. Which racial group **do** you identify **with?**

White . . . . [01]

Black . . . . [02]

Oriental . . . . [03] (26-

Other **(SPECIFY)** ______________________ [04]

Refused. . . . ." [97]

Don't know . . . . [98]

COLS. 28-73 = blank
COLS. 74-80 = **CASE** 02i

28. a. This is the last question. We would like to send short questionnaires about the Chesapeake Bay to people through the mail. We would include a postage paid envelope to return the completed questionnaire, so it would not cost anything to mail it back to us.

Would you be willing to receive and complete such a questionnaire?

No. . . . . . 1 (GO TO C.)

Yes . . . . . 2 (GO TO b.)

b. What is your mailing address?

(VERIFY NAME) ______________________

____
(P.O. Box/Street number and name)

____
City State Zip

ENTER CASE ID NUMBER | | | | | |

c. Thank you for taking time to answer our questions. Your responses will be very helpful in determining the status of swimming and other activities on the Chesapeake Bay.

IF YES TO 28a. ALSO SAY: When the questionnaire comes through the mail, please complete and return it as quickly as possible.

Appendix C

The User Survey and Sampling Procedures[1]

This section is devoted to a description of the sampling procedures used in a survey of Chesapeake Beach Use conducted in 1984. Unlike the data used in analyses of boating and fishing in Chapters 5 and 6, the data used in this chapter were collected during an earlier budget period of this cooperative agreement. Great care was taken with the sampling frame to improve confidence in the results. Because the survey itself is important to the project, we describe the content and procedures extensively. Copies of the survey instruments can be found in Appendix C.

From May 26, 1984 to August 19, 1984, Research Triangle Institute (RTI) interviewed individual on the western shore beaches in Maryland. The study population consisted of all residents of the Baltimore and Washington, D. C., SMSA's, age 14 or older, that used these beaches for recreation in 1984. More specifically, the population waa limited to recreational users of the following 12 beaches:

Beach	Strata: Geographic	Strata: Size
1. sandy Point	north.	large
2. Point Lookout	south	large
3. Fort Smallwood	north	smal 1
4. Miami	north	small
5. Rocky Point	north	small
6. Elm's Beach	south	small
7. Bay Ridge	south	large
8. Kurtz	north	small
9. Breezy Point	south	small
10. Rod & Reel	south	small
11. Morgantown	south	ml 1
12. North Beech	south	Oman

Four hundred and eight individuals were interviewed at the beach to learn of their recreational patterns and perception of water quality at these beaches. These individual were randomly selected from sample beaches and days. The sampling design can be described as a two-stage stratified sample in which a probability sample of beaches and days was selected, and a random systematic sample of persons was interviewed at each sample site (day-beach combination).

[1] The discussion of the sample is composed of selected excerpts from Devore, McDonald, Myers and Williams, Chesapeake Bay Beach Use Survey, Research Triangle Institute, 1984.

A sample of at least 300 completed interviews was intended so that relative sampling errors would be approximately 11 percent or less for estimating proportions of .30 or larger. This assumes that a design effect of approximately 1.5 might result because of clustering (a beach-day unit constitutes a cluster of individuals) and unequal. weighting. A self-weighting sample was sought but difficult to obtain because of errors in size measures (projected number of users for a beach-day unit).

The number of sample *primary* sampling units (PSU) waa baaed on the requirement to obtain at least 300 completed interview. such that each PS U would involve approximately one-half day of interviewing for a two-person team. To match this design, each PSU was randomly designated a. a morning or afternoon interview period, beginning at 1000 and 1300 hours, respectively. Hence, an average of eight or nine completed interview. waa expected for each of the 36 PSU's (see Table 4.1 for sample allocation).

Stratification and Sample Selection

Primary sampling unit. (PSU's) consisted of beach-day units (1,204 PSU's = 66 days x 14 locations). The 14 locations consisted of 11 beaches plus three beach locations at Sandy Point — partititioned into three segments because of its relatively large size and usage. Beaches were stratified into north (Sand y Point and beaches north) and couth (the prior listing of beaches indicates the stratification). The beaches wore further stratified by size (expected weekly usage). Large is defined as greater than 7,000 visitors per week in north beaches and greater than 3,000 in the south beaches. Additionally, days were stratified into weekdays, Saturdays, and Sundays (and holidays). The strata, their population and sample PSU counts are indicated in Table Cl.

Table C. 1
Population Counts and PSU Allocation by Stratum[1]

	Anticipated Number of Beach Visitors May 26 to August 19, 1964 (thousands)				Number of PSU's (beach-day units) Allocated to Bach Stratum			
	Sat	Sun	Weekday	Total	Sat	Sun	Weekday	Total
North/large	77	110	106	293	3	5	5	13
North/small	67	64	94	243	3a	4[2]	4	11
south/large	37	43	44	124	2	2	2[2]	6
South/small	20	24	17	61	2[2]	2	2	6
Totals	201	261	259	721	10	13	13	36

[1] Population counts are baaed on cite interviews prior to the survey, and PSU allocation is proportional to number of visitors with the *constraint* that greater or equal to two per cell are selected.

[2] One fewer resulted in these cells because of random subsampling needed in the latter part of the survey period. (A slightly larger number of interviews than expected were obtained early in the survey.)

The selection of PSU's within strata involved equal probability y for days and probability proportional to size (expected number of visitors) for beaches. Within selected PSU's, individual were selected on site with equal probabilities. Approximately eight or nine interviews were needed from each PSU. The procedure used to satisfy this ob jective waa for the interviewers to estimate the number of beach users just prior to starting time for interviewing. By comparing this estimated count to a table prepared specifically for this survey, the interviewers obtained a sampling interval and a random starting point. By using the interval and starting point in a pro-designated pattern for the entire site, a valid systematic sample of users was obtained.

Sampling Weights

Whenever observation units (in this caae the individual users) enter the sample with different probabilities, weights must be used with the observation to obtain unbiased estimates for the study population. Because of the complexities in an intercept-type survey, selection probabilities are often not known. In the present survey, however, PSU selection probabilities are known, and final-stage selection of individual can be reasonably estimated (even though a systematic sample of visitors at the site is taken), their chance of selection will vary with the amount of time spent at the beach during the sample day as well as number of visits to this and other stud y beaches during the survey period. A sampling weight for the j^{th} individual is calculated aa follows:

$$W_{ij} = p_i^{-1} p_{ij}^{-1} f_{ij} f'_{ij}$$

where

p_i = $\frac{n S_i}{d S_+}$ the "selection probability" (expected number of hits) for PSU (i);

d = the number of daya during the survey period for the particular type of day being sampled (d = 13 for Saturdays, for example);

n = number of PSU's being selected for the stratum (12 strata);

S_i = size measure for PSU (i) = the expected number of visitors for that type of day ($S_+ = \Sigma S_i$);

p_{ij} = sampling rate of users within sample PSU (i); and

f_{ij} and f'_{ij} = factors to adjust for number of houra user spent at the beach on the sample day and number of trips to the study beaches during the summer, respectively.

Note that f_{ij} and f'_{ij} are baaed in part on intentions. In *fact*, f'_{ij} is particularly uncertain if the interview is being conducted early in the season. To verify the accuracy of these intentions both to obtain selection multiplicity and to estimate related statistics, intention-based questions were verified b y telephone at the end of the season for interviews taken early in the survey.

Screening and Confirmation

A screening *form waa* designed to identify as eligible respondents only those people living in certain counties of Virginia or Maryland, or Washington, Do C. In addition, the screening process ruled out as ineligible any person who was under 14 years of age; however, if the selected sample individual was over 14 but less than 18 years of age and in the company of someone he/she lived with who was over 18 years *of* age, the *interviewer deferred to* the older individual.

The User Intercept Survey Questionnaire was designed to record and collect the following:

- Frequency of visits made to beaches on the western shore *of* the Chesapeake
- Activities that the respondent (and his/her family) participated in when visiting beaches
- Activities not participated in and the reason why they were not
- Coat related to a typical trip to each beach that the respondent had visited since January 1, 1984
- The respondent's perception of the quality of the beach and the beach facilities ● t each beach wtth which he/she was familiar
- Factors that influence a respondent's decision to visit or not visit a beach
- The respondent's willingness to continue to viait the sample site if coots related to the use of the beach were to rise.

In addition, a series of demographic questions to enable analysts to establish profiles of beach users were also included in the questionnaire.

A Confirmation/Intention Contact sheet (used in conjunction wtth a Record of Calls sheet) was developed not only to confirm the number *of* visits *to* sample beaches reported in the Intercept Survey Questionnaire, but also to ascertain the number of visits the respondents intended to make at any sample beach for the rest of 1984. The confirmation/intention *contacts were* only made with those respondents who had provided adequate information to contact them by telephone.

Data Collection Procedures

The data collection schedule originally called for a total of 36 visits to the 12 sample beaches, with an expected yield of 300 or more completed interviews. This schedule was later revised and the subsequent number of total visits wae reduced. Table C.2 shows the original data collection schedule. Those sampling days which were eliminated have been denoted by an asterisk. The resulting number of visits are summarized as follows (AM indicates interviewing beginning in the morning at 10 o'clock, and PM indicates interviewing beginning at 1 o'clock in the afternoon):

Beach Number	Beech Name	AM Visits	PM Visits	Total Visits
1	Sandy Point	5	6	11
2	Point Lookout	1	1	2
3	Fort Smallwood	1	0	1
4	Miami	0	3	3
6	Elms	0	0	0
7	Bay Ridge	0	3	3
8	Kurtz Pleasure Beach	0	1	1
9	Breezy Point	0	1	1
10	Rod and Reel Dock	1	0	1
11	Morgantown	1	1	2
12	North Beach	1	0	1
	TOTALS	12	18	30

For the User Intercept Survey, each field interviewer waa given a listing of the names, addresses, and ID numbers for each PSU (beach) in the assignment, along with area maps with the beaches marked. *In* addition, each interviewer wae given a sketch of each beach. Other materials included were the table. to determine sampling rates and listing forma *for* counting and selecting sample individuals. The interviewers always worked as a team, splitting up only to interview eligible respondents.

The *field* interviewers were asked to review their materials and determine the moat efficient route *of* travel to reach each beach. Upon arrival at a beach, they had first to check that they had correctly identified and located the precise boundaries of the area. Once this waa verified, the interviewers estimated the number of sample individual on the beach , spending no more than 30 minutes in doing ao. When the estimate was determined, they looked up that number in the table of sampling intervals. Marking the estimate and sampling interval at the top of the listing *form,* they next consulted their list of random *numbers to* determine the number of the first person to be interviewed and marked that in the space provided on the listing form. They circled the number of the randomly selected start person, counted the proper interval, and circled the last interval number as the *next* selected person. This activity continued *until* they had gone through the entire list interviewing the selected individuals.

Table C.2

Chesapeake Bay Beach Use Study Data Collection Schedule

Date	Beach Name	Beach Number	Sample Time	Date	Beach Name	Beach Number	Sample Time
May 26	Pt. Lookout	2	1300	July 8	Kurtz	8	1300
27	Morgantown	11	1000	9			
28	Miami	4	1300	10			
29	Miami	4	1300	11			
30				12	Bay Ridge	7	1300
31				13			
				14	Rocky Pt.	5	1300
June 1				15			
2				16	Miami	4	1300
3	Sandy Pt. (NofS)	1	1000	17			
4				18			
5				19			
6				20	sandy Pt. (SofS)	1	1300
7				21	sandy Pt. (SofS)	1	1300
8				22	Rod & Reel	10	1000
9				23			
10				24			
11				25			
12				26			
13				27			
14	Sandy Pt. (NofS)	1	1000	28	North Beach	12	1000*
15	Morgantown	11	1300	29	Sandy Pt. (SofS)	1	1300
16	Sandy Pt. (NofS)	1	1300	30			
17	Bay Ridge	7	1300	31			
18							
19	Sandy Pt. (NofS)	1	1300	Aug 1			
20				2	Pt. Lookout	2	1000*
21	Rocky Pt.	5	1000	3			
22	North Beach	12	1000	4	Bay Ridge	7	1300
23	Sandy Pt. (E)	1	1000	5	Ft. Smallwood	3	1000*
24	Rocky Pt.	5	1300	6			
25				7	Rocky Pt.	5	1000
26				8			
27				9			
28				10			
29				11	Kurtz	8	1300*
30	Breezy Pt.	9	1300	12	Pt. Lookout	2	1000
				13			
July 1	sandy Pt. (SofS)	1	1000	14	Sandy Pt. (E)	1	1300*
2				15			
3				16	sandy Pt. (SofS)	1	1000
4	Sandy Pt. (E)	1	1300	17			
5				18			
6				19	Sandy Pt. (NofS)	1	1000*
7							

*Originally scheduled but subsequently eliminated.

Appendix D

User Survey instrument

SCREENING FORM

I. ASSIGNMENT INFORMATION:

CASE ID #: ☐☐☐☐ **Date:** ☐☐ / ☐☐ *(1-4)* **Time:** ☐☐☐☐

Month Date (5-8)

SITE #: m Weather: S [1] PC [2] C [3] R [4]

INTERVIEWER NAME ______________________ (9)

II. **INTRODUCTION:**

Hello, my name is ______________. Researchers at the University of Maryland are currently studying citizens' use of the **Chesapeake Bay and they are looking for certain types of people to answer a** questionnaire. I would like to ask you 4 questions to **determine** if you are the type of person we are looking for. First. . .

III. ELIGIBILITY:

A. Do you currently live in Maryland, ... (20) [1] **(Go to B)**

Virginia, ... [2] **(Go to B)**

Washington, **D.C,** or . . . . [3] (To to C)

Some other place? . . . . [4] **(Go to F)**

B. What county do you live **in?** ________ (ENTER, **COMPARE** AND CODE)

MARYLAND
(Anne Arundel, Baltimore including city,
Carroll, **Charles, Harford,** Howard,
Montgomery, Prince George's) . . . . (21) [1] (Go **to C)**

VIRGINIA
(Arlington, Fairfax, **Loudoun,**
Prince William) . . . . [2] **(Go** to C)

SOME COUNTY NOT LISTED . . . . [3] (Go **to F)**

C. How old are you? *(12)*

Less than 14 **years** of age. . . . . [1] (Go to F)

Over 14, but less than 18 years of age . . . . . [2] (Go to D)

18 years **of age** or older. . . . . [3] (Go to G)

D. Did you cone here . . .**with other people including** someone you live with who is 18 *years* of age or **older?** . . . . . . (13) [1] (Go to E)

. . .**other people but none you live with who is 18 years** of age or older? . . . . [2] (Go to G)

. . .**by** your self? . . . . [3] (Go **to G)**

E. I would like to talk to the person **you** live with who as 18 years of age or older and is here with you today. Point that person out to me or tell me how and where to find him or her. (WHEN YOU LOCATE **THE** PERSON, DETERMINE ELIGIBILITY BY VERIFYING OR **REASKING** ANY OR ALL OF THE QUESTIONS IN PART III. BEFORE **YOU** BEGIN **THE QUESTIONS** READ THE INTRODUCTION TO **THE** NEW PERSON.)

F. (CODE 2 or 3 IN IV BELOW AND SAY:)

You (do not live in the area/belong to the age group) that we wish to survey on this study. Will you give me your name and telephone number in case my supervisor wants to check on my work?

NAME ______________________ TELEPHONE (   ) __________

G. (CODE 1 IN IV BELOW AND SAY:)

You are the type of person we want to interview for this study. The questions will take 15 to 20 minutes. Can we start now? (AFTER MEETING OBJECTIONS SAY:) Before I ask the questions I need to keep a record of the people I speak to. What is your name, address, and telephone number? What time did you enter the beach? What time will you leave?

NAME ______________________ TELEPHONE (   ) __________

ADDRESS ______________________ TIME ENTERED BEACH: [| | |] (14-17)

______________________ TIME LEAVING BEACH: [| | |] (18-21)

IV. RECORD OF ELIGIBILITY (Screening Status)

Eligible .... 01 (INTERVIEW AND/OR COMPLETE PART V)

Ineligible because of

Residence .... 02 (STOP. DO NOT INTERVIEW. READ STATEMENT FROM III F, RECORD INFORMATION AND TERMINATE CONTACT.)

Age 03

Refused Screening .... 97 (RECORD DETAILS IN NOTES SECTION BELOW)

Language Barrier 05

Other (Specify) 06

____

______________ (22-23)

V. RECORD OF INTERVIEW STATUS

Completed .... 01 (EDIT CASE AND SHIP TO RTI)

Partial/Breakoff .... 02 (RECORD DETAILS IN NOTES SECTION BELOW)

Refused 97

Language Barrier 04

Other: (Specify) 05

______________ (24-25)

VI. NOTES:

COLS. 26-72 = blank
COLS. 73-80 = SITE/CASE 1

____

____

____

____

____

CHESAPEAKE BAY BEACH USE SURVEY

Conducted by **Research Triangle Institute**
for the University of Maryland

NOTICE - Information contained on this form that would permit identification of any individual has been collected with a guarantee that it will be held in strict confidence and used only by persons engaged in or for purposes of this survey. All results will be summarized for groups of people and no information about individuals will be released.

A. IDENTIFICATION

SITE NO. ☐☐ **CASE ID** ☐☐☐☐

Field Interviewer Name ____________________

Date Interview Completed ______/______/______
Month Date Year

B. INTRODUCTION

As I said earlier, researchers at the University of Maryland are currently studying citizens' use of the Chesapeake Bay. I will ask you some questions regarding your recreational use of the Chesapeake Bay, particularly at the beaches. I also have to ask some questions which will enable the researchers to establish profiles of typical users of the Bay. There is no direct benefit from taking part in this study and you have the right to refuse to answer any or all of the questions or discontinue your participation at any time. The information that you provide will be combined with that provided by other people who participate in the survey to assure complete confidentiality and your name will not be released or revealed to anyone other than authorized project staff. It may be necessary to recontact you later to verify the number of times you visited beaches during the season. The results of this survey may be helpful in effectively allocating money to cleaning up the Bay.

C. BEACH UTILIZATION

1. How many of the following types of people are in your party today?

Adults (age 18 and older).	☐☐	(1-2)
Teenagers age 14 years to 18	**1 1 1**	**(3-4)**
Children under age 14	☐☐	(5-6)

2. Are you at the beach today with your family? By family I mean people who are related to you by blood, marriage, or adoption, and who live with you.

No . . . . [1] (7)

Yes . . . . [2]

3. **[SAMPLE SITE NAME]** is situated **on** the Western Shore of the Chesapeake Bay. **Since <u>January 1, 1983</u>, have** you (and members of your family who live with you) **(READ THE FOLLOWING)**

		NO	YES	
a.	Visited beaches *on* the Eastern shore **of** the Chesapeake, for example, shores close to Cambridge, **Salisbury,** or **Easton?** . , ...	1	. . . 2	(8)
b.	Visited beaches on the ocean, **such as Ocean City?**	1	2	(9)
c.	gone **swimming** *from* a boat **in** the Chesapeake?	●	m 2	(10)
d.	gone **swimming** in public or private **swimming** pools?	1	· 2	(11)

THIS **SPACE** INTENTIONALLY BLANK

4. When you visit a Western Shore beach such as this 000, do you (and members of your family who live with You) participate in (READ THE FOLLOWING)

ACTIVITY	NO (Next activity or question)	YES (Ask Q.s 4A. & 4B.)	4A. How many adults participate in (ACTIVITY)	4B. How many children & teenagers participate in (ACTIVITY)
a. swimming or wading?	1	2 (12)	(13-14)	(15-16)
b. beach activities-sunbathing, picnicking, shelling?	1	2 (17)	(18-19)	(20-21)
c. beach activities-playground?	1	2 (22)	(23-24)	(25-26)
d. boating?	1	2 (27)	(28-29)	(30-31)
e. waterskiing?	1	2 (32)	(33-34)	(35-36)
f. Other Activities? (Specify)	1	2 (37)	(38-39)	(40-41)
______	1	2 (42)	(43-44)	(45-46)
______	1	2 (47)	(48-49)	(50-51)

5. If you (or any members of your family who live with you) don't go into the water, which of the following sta... describe why? (READ THE FOLLOWING)

REASON	No (go to next reason)	YES (Ask Q.s 5A. & 5B.)	5A. How many adults do not go into the water because (REASON)?	5B. How many ch... & teenagers go into the ... because (WA...
a. Don't know how to swim	1	2 (52)	(53-54)	(55-56)
b. No bathhouse facilities at beach	1	2 (57)	(58-59)	(60-61)
c. Person's health precludes it	1	2 (62)	(63-64)	(65-66)
d. You or they believe water is dirty/polluted	1	2 (67)	(68-69)	(70-71)

COLS. 72-80 = SITU CASE 011

REASON	No (go to next reason)	YES (Ask Q.s 5A. & 5B.)	5A.	5B.
e. Too many jellyfish	1	2 (1)	(2-3)	(4-5)
f. Other reason (SPECIFY ______)	1	2 (6)	(7-8)	(9-10)

6. How many years have you (and members of your family who live with you) been coming to the beaches on the Western Shore?

Number of years . . . . I I | (12-12)

7. Have you (or anyone in your family who live with you) changed your swimming habits in the Chesapeake because of changes in the Bay's water quality?

No. . . . . 1 (GO TO Q.8)

Yes (stopped). 2

Yes (started). 3 (13)

A. In what year did you (or members of your family) last change your swimming habits in the Chesapeake because of changes in the Bay's water quality?

Year . . . . . . m (14-15)

The next few questions deal with the frequency with which you (and your family) visit beaches ●nd the cost related to-visits made to ●ach beach.

HAND RESPONDENT CARD A.

THIS SPACE INTENTIONALLY BLANK

8. Look at the beaches listed on this card. Please give me the letter that appears beside the name of each you (and your family) visited since January 1, 1983. Please include this visit to this beach. (CHECK (√) VISITED AND THEN ASK QUESTIONS 8A and 8B.

BEACH VISITED	Q.8. Chock if visited	Q.8A. How many trips did you (and your family) make to (BEACH) in 1983?	Q.8B. How Nay trips (and your famil to (BEACH) in
a. Sandy Point St. Park	m a	0748)	(:
b. Fort Smallwood	m a	m (22-23]	(:
c. Bay Ridge Beach	2 (mu)	m (27-28)	(
d. Herrington Harbor	2 (31)	m (32-33)	(
e. Kurtz Pleasure Beach	m a	m 674)	"
f. Camp Merrick	2 (41)	m (42-43)	m. (
g. Breezy Point Beach	2 (46)	m (47-48)	m.
h. Chesapeake Beach	0 2 (51)	m '(28-ss)	m.
i. North Beach	2 (56)	m (57-58)	m.
j. Rod and Reel Dock	~ (cl)	(62-63) m	m (s
k. Point Lookout St. Park	2 (66)	$7-88)	(

COLS. 71-80 = WBSITE/CA

BEACH VISITED	Q.8. Chock if visited	Q.8A.	Q.8B.
l. Elm's Beach	2 (J)	m (24)	(
m. Morgantown Sooth	2 (6)	(7-4)	m (
n. Miami South (Baltimore)	2 (11)	02-13)	" (
o. Rocky Point Park	m a	(27-18)	m (
p. Conrad's Ruth Villa	2 (21)	m (2s-23)	(2
q. Porter New Park	2 (26)	m (2748)	m. (
r. Other (SPECIFY) ____	2 (31)	32-33)	(

9. Do YOU (and your family) plan 'o take any trips to any of the beaches listed on this card during the remainder of summer?

No . . . . 1 } (GO TO 0.10) (38)
Don't know . . . . . . 8 }
Yes 2

A. Which of these beaches do You plan to visit this summer? Please give me the letter that appears beside the of ● ach beach (CHECK (√) EACH BEACH MENTIONED AND THEN ASK Q.9B FOR EACH BEACH.)

	BEACH	Q.9A. Check if plan to visit		Q.9B. How many trips do you (and your family) intend to take to (BEACH) Skis summer?	
•\	Sandy Point St. Park	2	(37)		(38-3$)
b.	Fort Smallwood	2	up)		(41-42)
c.	Bay Ridge Beach	2	(43)		(44-4s)
d.	Herrington Harbor	2	(46)	m l	(4?-48)
•.	Kurtz Pleasure Beach	2	(as)	m	(50-51)
f.	Camp Merrick	2	(52)	m.	(53-54)
g.	Breezy Point Beach	2	(55)		(56-57)
h.	Chesapeake Botch	2	(58)		(59-60)
1.	North Beach	2	(61)		.(62-43)
j.	Rod and Reel Dock	2	(64		(65-66)
k.	Point Lookout St. Park	2	(s?)	m	.W-49)
1.	Elm's Beach	2	(70)		(72-72)

COLS. 73-S0 = SITE/CASE 03

	BEACH	Q.9A. Check if plan to visit		Q.9B.	
•.	Morgantown Beach	2	(1)		(2-3)
n.	Miami Beach (Baltimore)	2	(4)		.(S-6)
0.	Rocky Point Pork	2	(7)		(4-9)
p.	Conrad's Ruth Villa	2	(10)		(11-12)
q.	Porter New Park	2	(33)		(,24-1s)
r.	Other (SPECIFY) ______	2	(1		(17-18)

INTERVIEWER NOTE: *ASK* QUESTIONS 1OA-H SEPARATELY FOR **EACH** BEACH CHECKED IN QUESTIONS 8 AND 9A.

10. **Now think ● bout** the cost of a typical (family) trip to (BEACH) in 1984.

A. **What would you say the** total ●ntrance *fee* **per day,** including parking, **would be for you (and** *your* family) ●t (BEACH)? (ENTER **AMOUNT** IN **COLUMN A BESIDE APPROPRIATE BEACHI.**

B. What is the typical coat for you (and **your** family) to travel to **(BEACH)** ? **(ENTER AMOUNT** IN COLUMN B BESIDE APPROPRIATE BEACH NAME).

c. How much will it, **cost you (and** your family) **per day** in other expenditures such ●s food, hotel or **camping** fees, ●nd entertainment ●t (w=)? (ENTER **AMOUNT** IN **COLUMN** C BESIDE APPROPRIATE **BEACH** NAME) .

D. ADD AMOUNTS ENTERED **IN COLUMNS** A-C AND ENTER TOTAL **IN COLUMN** D.

E. How much **travel time** does it typically take you (and your family) to make ●round-trip **from** your home to (BEWE)? **(ENTER TIME** IN **COLUMN E BESIDE BEACH NAME)** .

F. **How many** miles **is it round-trip from your borne to (BEACH)? (ENTER NUMBER OF MILES II? COLUMN F BESIDE BEACH** NAME).

G. How much **time** do you (and your family) typically spend on the beach **per day** when **you** visit (BEACH)? PROBE FOR ***BEST* ESTIMATE OF THE NUMBER OF HOURS AND ENTER NUMBER IN COLUMN G BESIDE BEACE NAME.**

H* What is the ●*verage* number of days that you ●nd your family spend on ●typical trip to (BEACH)? (ENTER **NUMBER** IN COLUMN H BESIDE BEACH **NAME)**.

TABLE 1

QUESTION 10

(Continued) .

	A	B		u	E	F	G	H
Beach	**Entrance Fee**	**Travel Costs**	**Other Expen**	**Total Co**	**R-T Time**	**R-T Miles**	**Time 00 Beach**	**Da I Tr**
k. **Point** Lookout St. **Park**	(1-2)	(3-6)	(7-11)	(12-17)	(18-19	(20-23)	(24-25)	(26
1. **Elm's Beach**	(28-29)	(30-33)	(34-38)	(39-44)	(45-46	(47-50)	(51-52)	(53
						COLS. 55-72 = blank COLS. 73-80 = SITE/CASE (		
0. Morgantown Beach	(1-2)	(3-6)	(7-11)	(12-17)	(18-19.	(20-23)	(24-25)	(26.
n. Miami Beach (Bolt-se)	(28-29)	(30-33)	(34-38)	(39-44)	(45-46	(47-50)	(51-52)	(53.
						COLS. 55-72 = ank COLS. 73-S0 = SITE/CASE		
0. Rocky Point Park	(1-2)	(3-6)	(7-11)	(12-17)	(18-19)	(20-23)	(24-25)	(26.
p. Conrad's Ruth Villa	(28-29)	(30-33)	(34-38)	(39-44)	(45-46)	(47-50)	(51-52)	(53.
						COLS. 55-72 = blank COLS. 73-80 = SITE/CASE		
q. Porter New Park	(1-2)	(3-6)	(7-11)	(12-17)	(18-19)	(20-23)	(24-25)	(26.
r. *Other* **(SPECIFY)** ______	(28-29)	(30-33)	(34-38)	(39-44)	(45-46)	(47-50).	(51-52)	(53.

HAND RESPONDENT CARD B

11. Please read the water quality characteristics listed on this card and rank them according to how important they are to you (and your family) when deciding whether or not to visit a beach. Please rank them on a scale of 1 to 5, with 1 being least important and 5 being most important.

		RANK	
a.	Presence of cloudy water . . . .'.	___	(55)
b.	Presence of floating debris or oil	___	(56)
c.	Presence of odors	___	(s7)
d.	Presence of jellyfish	___	(58)
e.	Presence of seaweed and other aquaticplants.	___	(59)

HAND RESPONDENT CARD C

12. Each summer jellyfish, also called sea nettles, appear in the waters of the Chesapeake Bay. Look at the statements on this card and tell me which one describes your (and your family's) behavior after jellyfish appear.

a.	Stop going to the beach when jellyfish appear	1	
b.	Still go to the beach, but less often . . .	2	(60)
c.	Continue to 80 to the beach, but don't go into the water	3	
d.	Don't consider presence of jellyfish atoll	4	

COLS. 61-72 = blank
COLS. 73-80 = SITE/CASE 12

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13* **A.** HAND RESPONDENT CARD A. We would like to find out how beach users perceive the water quality, the quality of the beach facilities, the beach quality, and crowding at the beaches on the Chesapeake Bay. Please give me the letter that appears beside the name of each beach on this card that you (and your family) are familiar with. By "familiar," I mean that you know something about the beach either by having been there or you have heard about it through some other source. Please include this beach in the ones that you mention. (CHECK COLUMN A FOR EACH BEACH MENTIONED.)

ASK QUESTIONS 13B-E SEPARATELY FOR EACH BEACH MENTIONED.

B. Do you consider the water quality at (BEACE) acceptable or unacceptable for swimming arid/or other water activities? (CHECK APPROPRIATE CODE IN COLUMN B BESIDE BEACH NAME).

C. What about the beach facilities, such as space, bathhouses, tables, swimming guards, etc. at (BEACH). Would you rste it as acceptable or unacceptable? (CHECK APPROPRIATE CODE IN COLUMN C BESIDE BEACH NAME).

D. Think about the beach itself at (BEACH). Do you feel that the quality of the beach is acceptable or unacceptable? (CHECK APPROPRIATE CODE IN COLUMN D BESIDE BEACH NAME).

E. Do you feel that the size of the crowd at (BEACH) is acceptable or unacceptable? (CHECK APPROPRIATE CODE IN COLUMN E BESIDE BEACH NAME).

TABLE 2

QUESTIONS 13A-E

Beach	A Check if familiar	Water Quality Acceptable	Water Quality Unacceptable	Beach Facilities Acceptable	Beach Facilities Unacceptable	Beach Quality Acceptable	Beach Quality Unacceptable	Crowding Acceptable	Crowding Unacceptable
Sandy Point St. Park . .	2 (1)	1	2 (2)	1	2 (3)	1	2 (4)	1	p (s)
Fort Smallwoo	2 (6)	1	2 (7)	1	2 (8)	1	2 (9)	1	2 (10
Bay Ridge Beach . . .	2 (11)	1	2 (12)	1	2 (23)	1	2 (14)	1	2 (15
. Herrington Harbor . . .	2 (16)	1	2 (17)	1	2 (18)	1	2 (19)	1	2 (20
Kurtz Pleasur Beach . . .	2 (21)	1	2 (221	1	2 (23)	1	2 (24)	1	2 (2s
. Camp Merrick	2 (26)	1	2 (27)	1	2 (28)	1	2 (w)	1	2 (30
. Breezy Point Beach . . .	2 (31)	1	2 (32)	1	2 ($3)	1	2 (s4)	1	2 (35
i. Chesapeake Death . . .	2 (36)	1	2 (37)	1	2 (381	1	2 (22)	1	2 (40
. North Beach	2 (41)	1	2 (42	1	2 (43)	1	2 (44)	1	2 (4s
Rod and Reel "tick	2 (46)	1	2 (47	1	2 (48)	1	2 (48)	1	2 (50
:. Point Lookout St. Park . .	2 (51)	1	2 (s2:	1	2 (53)	1	2 (s4)	1	2 (ss
.. Elm's Beach	2 (56)	1	2 (57	1	2 (s8;	1	2 (59)	1	2 (60
1. Morgantown Beach . . .	2 (61)	1	2 (62	1	2 (63	1	2 (64)	1	2 (65
1. Miami Beach (Baltimore)	2 (66)	1	2 (67	1	2 (68	1	2 (69)	1	2 (70
							COLS. 71-80 :	SITE/CASE	
). Rocky Point Park	2 (1)	1	2 (2	1	2 (3	1	2 (4)	1	2 (5
p. Conrad's Rut Villa . . .	2 (6)	1	2 (7	1	2 (8	1	2 (9)	1	2 (10
q. Porter New Park	2 (11)	1	2 (12	1	2 (13	1	2 (14)	1	2 (15
r. Other (SPECIFY) ______	2 (28)	1	2 (17	1	2 (18	1	2 (19)	1	2 (20

INTERVIEWER CHECKPOINT 1

CHECK THE RESPONSES TO QUESTION 8B FOR THE NUMBER OF TRIPS THE RESPONDENT HAS MADE TO TEE SAMPLE SITE IN 1984 AND QUESTION 9B FOR THE NUMBER OF' TRIPS THE RESPONDENT PLANS TO TAKE TO THE SAMPLE SITE DURING THE REMINDER OF THIS SUMMER. ADD THE NUMBER ENTERED FOR BOTH QUESTIONS AND RECORD IT HERE. →

TOTAL NUMBER OF 1984 TRIPS = __________

CHECK COLUMN D IN TABLE 1 FOR THE TOTAL COST OF A TYPICAL 1984 TRIP TO THE SAMPLE SITE. ENTER THE AMOUNT HERE →

TOTAL COST OF TYPICAL 1984 TRIP $__________

INSERT THE TOTAL NUMBER OF 1984 TRIPS AND THE TYPICAL 1984 COST PER TRIP IN THE APPROPRIATE SPACES WHEN QUESTION 14 IS ASKED.

ENTER THE LAST DIGIT OF THE CASE ID NUMBER = __________

If last digit is	Use $ amount below in Question 14
0	$50.00
1	$45.00
2	$40.00
3	$3s.00
4	$30.00
5	$25.00
6	$20.00
7	$15.00
8	$lO.OO
9	$s.00

14. According to your responses to previous questions, you (and your family) take ●bout (TOTAL NUMBER OF 1984 TRIPS) to this site per year ●t an approximate cost of (TOTAL COST OF TYPICAL 1984 TRIP) per day. If your costs per day were to rise by (USE INITIAL AMOUNT FROM TABLE ABOVE), would you still visit this site? Keep in mind that the costs of visiting other sites on the Chesapeake or participating in other ●ctivities would remain the same.

NO. 1 (21)
YES 2

IF NO, DECREASE THE DOLLAR AMOUNT IN $5.00 Increments UNTIL A "YES" ANSUER IS GIVEN. WHEN A YES ANSUER IS GIVEN, RECORD DOLLAR AMOUNT BELOW.

IF YES, INCREASE THE DOLLAR AMOUNT IN $5.00 INCREMENTS UNTIL A "NO" ANSUER IS GIVEN. WHEN A "NO" ANSUER IS GIVEN, RECORD DOLLAR AMOUNT OF LAST "YES" RESPONSE.

14. __________ DOLLARS
(22-25)

INTERVIEWER CHECKPOINT 2

ENTER THE LAST DIGIT OF THE CASE ID NUMBER = ________

If last digit is	Use $ amount below in Questions 15 and 16
1	$ 5.00
2	$10.00
3	$15.00
4	$20.00
5	$25.00
6	$30.00
7	$35.00
8	$40.00
9	$45.00
0	$50.00

15. Jellyfish ●re frequently identified ●s ●nuisance to swimmers. Would you (and your family) be willing to pay (AMOUNT FROM CP 2) per yeas in ● xtra state or federal taxes if jellyfish could be ●laminated ●s ●nuisance without ●ny ●dverse ecological ●ffects?

No. 01

Yes . . . . ● 02 (26-2?)

Don't Know . . . . ● m

INTERVIEWER CHECKPOINT 3

REFER TO COLUMN B IN TABLE 2 (QUESTIONS 13A-D)

WAS THE WATER QUALITY OF THIS SITE RATED AS UNACCEPTABLE?

No. . . . . 1 → (GO TO Q.17)

Yes . . . . ● m " (ASK Q. 16) (28)

16. You indicated that the water quality ●t this site is unacceptable for swimming. Would you be willing to pay (AMOUNT FROM CP 2) in extra state or federal taxes if the water quality were improved so that you found it ●cceptable to swim here?

No. 01

Yes 02

Don't Know . . . 98 (29-30)

17. The next few questions ●re● bout you ●nd your household. How many of each of the following types of people live in your household? (READ EACH OF THE FOLLOWING AND ENTER THE NUMBER OF EACH TYPE).

a. Adults (age 18 and older) . . . . (32-32)

b. Children between the ages of 14 and 18. . . (33-$4)

c. Children under ●ge 14 . . . . m (35-36)

18. HAND CARD D. Which of the relationships listed on this card best describes your status in your household?

●. Grandparent . . . . ● m

b. . Husband. 2

c. Wife . . . . ● | (37)

d. Child . . . . ● m

●. Other Relative . . . . ● m

f. I live● lone or with unrelated individuals . : . . ■ EJ

19. How many years have You (and your family) lived in either Maryland, Virginia or Washington; D.C.?

Number of years . . . . m (38-39)

20. Do you or ●ny other member of your household own (READ THE FOLLOWING)

		NO	YES	DK	RF	
●\	● boat?.	●	m * * m *	98	97	(40-41)
b.	● boat trailer?	●	c m = m z l *	98	97	(42-43)
c.	fishing tackle (rod, reel, tackle box, etc.)?	●	m * * m *	98	97	(44-45)
d.	● recreational vehicle (RV)?	01	02	● EEI	97	(46-47)
e.	● swimming pool?.	01	02	● 98	97	(48-49)
f.	Other recreational items (SPECIFY)					
	______________	01 ●	02	98	97	(50-51)
	______________	01	02	98	97	

21. Are you one of the principal wage earners in your household, • wage earner but not the principal wage • arner, or • re you • homemaker, a student or retired?

a. One of the principal wage earners in the family 1

b. A wage • arner but not the principal wage • arner. 6. 2

c. Homemaker 3 (52)

d. Retired 4

e. Student 5

f. Other (SPECIFY) ______________________________ . . 6

____

INTERVIEWER NOTE: ASK QUESTIONS 22 THROUGH 24 IF CODE 1 OR 2 IS MARKED IN QUESTION 21. OTHERWISE GO TO QUESTION 26.

22. How many hours do you usually work per week?

Hours. . . . . ☐☐ (53-54)

23. How many paid vacation days will you have • lto@er in 1984, including those you've • lready taken?

Vacation Days . . . . ☐☐ (5S-56)

24. For your typical trip to the beach, if you hadn't gone to the beach, could you have worked • t some job instead?

No . . . . • m (57)

Yes . . . . • m

25. If You could have worked, what hourly wage might you have been paid specifically for the hours you worked?

a.	$3.35/hour	01	
b.	$3.36-$5.00/hour	02	
c.	$5.00-$7.50/hour	03	
d.	$7.50-$10.00/hour	04	
e.	$10.00-$15.00/hour	UKI	(58-5S)
f.	$15.00-$20.00/hour	06	
g.	$20.00-$25.00/hour	10	
h.	Over $25.00/hour	11	
i.	Don't Know	98	
j.	Refuse	97	

26. *Are there any (other) major wage earners in your family with you today?*

No. . . . . EI (GO TO Q.31)

Yes . . . . | (ASK Qs. 27-30) *(60)*

The next few questions are about the other major wage earner who is with you today.

27. How many hours does he/she usually work per week?

Hours . . . . m (51-?72)

28. How many paid vacation days will he/she have altogether in 1984?

Vacation Days . . . . ☐☐ *(83-64)*

29. For the typical trip to the beach, if he/she hadn't gone to the beach, could he/she have worked at some paying job instead?

No. . . . . 1 *(65)*

Yes 2

30. If he/she could have worked, what hourly rate would he/she have been paid specifically for the hours worked?

a.	$3.35/hour	01	
b.	$3.36-$5.00/hour	02	
c.	$5.00-$7.50/hour	03	
d.	$7.50-$10.00/hour	04	
e.	$10.00-$15.00/hour	05	(66-67)
f.	$15.00-$20.00/hour	06	
g.	$20.00-$25.00/hour	07	
h.	Over $25.00/hour	11	
i.	Don't Know	98	
j.	Refuse	97	

31. HAND CARD E. Which one of the categories on this card best describes your (family's) income during 1984? Please give me the letter that appears beside the category?

a	01	g	10	
b	02	h	11	
c	03	i	12	(68-69)
d	04	j	13	
e	05	k	14	
f	06	l	15	
DK	98			
RF	97			

32. CODE SEX BY OBSERVATION.

Female	1	(70)
Male	2	

33. CODE RACE BY OBSERVATION.

White 1

Black . . . . ● m (71)

Oriental 3

Other (SPECIFY)

_______________ 4

COLS. 72-80 = ℔ SITE/CASE 141

Thank you for participating in our survey of beach users. Your responses will be helpful to us ●nd hopefully to the State ●nd Federal governments in determining the status of swimming and other ●ctivities on Chesapeake Bay.

TELEPHONE CONFIRMATION QUESTIONS

FOR EACH BEACH LISTED ASK 34. A. AND B. BEFORE GOING TO NEXT BEACH.

34. A. During 1984 how many times have you (or members of your family who live with you) visited (ENTERED NAME OF BEACH)?
RECORD ANSWER IN COLUMN A AND ASK:

B. During the remainder of 1984 how many times will you (or members of your family who live with You) visit (ENTER NAME OF BEACH)?
RECORD ANSWER IN COLUMN B AND GO TO NEXT BEACH.

	BEACH	34.A VISITS		34.B PLANNED VISITS	
a.	Sandy Point St. Park		(1-2)		(3-4)
b.	Fort Smallwood		(5-6)		(7-8)
c.	Bay Ridge Beach		(9-10)		(11-12)
d.	Herrington Harbor		(13-14)		(25-16)
e.	Kurtz Pleasure Beach		(17-18)		(19-20)
f.	Camp Merrick		(21-22)		(23-24)
g.	Breezy Point Beach		(25-28)		(27-28)
h.	Chesapeake Beach		(29-30)		(31-32)
i.	North Beach		(33-34)		(35-36)
j.	Rod and Reel Dock		(37-38)		(39-40)
k.	Point Lookout St. Park . . .		(41-42)		(43-44)
l.	Elm's Beach		(45-46)		(47-48)
m.	Morgantown Beach		(49-50)		(51-52)
n.	Miami Beach (Baltimore) . .		(53-54)		(55-56)
o.	Rocky Point Park		(57-58)		(59-60)
p.	Conrad's Ruth Villa		(61-62)		(65-64)
q.	Porter New Park		(65-66)		(67-68)
r.	Other (SPECIFY) ______		(69-70)		(71-72)

COLS. 73-80 SITE/CASE 15

AFTER PART r SAY: Thank you for taking part in the survey and talking to me today. The information you have provided will be very helpful in determining use of the Chesapeake.

CHESAPEAKE BAY BEACH USE SURVEY
TELEPHONE CONFIRMATION
SCRIPT AND INTRODUCTION

I am calling to speak with (INSERT NAHE). IF NOT THERE, FIND OUT WHEN HE/SHE WILL BE AVAILABLE. WHEN AVAILABLE SAY:

My name is (INSERT NAME) ●nd I'm calling for the University of Maryland. On (INSERT DAY AND DATE) you were interviewed ●t (INSERT THE NAME OF THE BEACH WHERE INTERVIEW TOOK PLACE) by ● lady working for the University on ● survey about the Chesapeake Bay. Do you remember that interview? (IF YES PROCEED. IF NO, TRY TO REFRESH THE RESPONDENT'S MEMORY BY TELLING HIM OR HER THE TYPE OF QUESTIONS ASKED. IF STILL NO, TERMINATE THE CALL).

I'm calling today to confirm some of the information you reported the day you were interviewed. I want to know which beaches you have visited or plan to visit on the Western Shore of the Chesapeake Bay. I will read through ● list of beaches ●nd ●sk ●bout each one individually. First,

GO TO QUESTION 34.A.