Valuation of Ecological Benefits: Improving the Science Behind Policy Decisions

PROCEEDINGS OF

SESSION II: CLEANING OUR COASTAL WATERS: EXAMINATIONS OF THE BENEFITS OF IMPROVED WATER QUALITY

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DISCLAIMER

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I. Introduction

The United States Environmental Protection Agency's (EPA) Office of Water is responsible for regulating and monitoring national water quality. In order to make sound policy decisions, policy makers need information on the benefits, costs, and other effects of alternative options for addressing environmental problems. In the case of policies affecting water quality, estimates of the public's willingness to pay for improvements in fresh water quality generally begin with estimates provided by Mitchell and Carson (1993). This study, however, does not address salt water areas.

The coasts and estuaries comprise a substantial part of our national resource base; these coastal areas are depended upon for the aesthetic, economic, ecosystem, and recreational services they provide. For example, gross annual income from coastal commercial fisheries is close to $2 billion (1998$). However, coastal areas are also the most highly developed and populated areas in the nation. This narrow fringe–comprising 17% of the contiguous U.S. land area–is home to more than 53% of the nation's population. Further, this coastal population is increasing by 3,600 people per day, giving a projected total increase of 27 million people between now and 2015 (NOAA, 1998).

As coastal population has increased, the environmental quality of some of these areas has declined or is threatened. Serious water pollution problems persist and, as such, many future water policies will likely focus on coastal areas. The lack of estimates of the benefits of improvements to these areas makes designing effective policies particularly difficult.

The purpose of this study is to estimate willingness to pay for water quality improvements in California's coastal waters. Currently, States, tribes, and other jurisdictions measure water quality by determining if water bodies are clean enough to support basic uses, such as swimming, fishing, and aquatic life support. Thus, this study will estimate willingness

[1]Prior to her death in 2000, Elizabeth McClelland was heavily involved in the project. The authors also wish to thank Kevin Boyle, Don Dillman, George Parsons, and V. Kerry Smith for their reviews of various drafts of the survey.

to pay for improvements coinciding with these uses.[2] The remainder of the paper provides some information on EPA's valuation of water quality improvements, detailed descriptions of the survey development process, information on the final version of the survey, a discussion of the supporting theoretical model, as well as preliminary results.

II. Valuing Changes in Water Quality

Up to this point, changes in surface water quality have been valued using a Mitchell and Carson (1993) study carried out in 1983. Mitchell and Carson determined respondents' willingness to pay to improve water quality from boatable (the lowest rung on the heirarchical water quality ladder developed by Resources For the Future) to fishable (sport fishing only, no concern about consumability); and from fishable to swimable.[3] The water quality ladder defined these uses in terms of conventional pollutants (dissolved oxygen, BOD, TSS, etc.). However, this study is not appropriate for valuing changes in coastal water for a number of reasons. First, these values were obtained for inland fresh waters only and cannot be used to value coastal water quality improvements. Second, toxic substances and nutrients were excluded from the study since the water quality ladder only concerns conventional pollutants.

In addition, the water quality ladder is now an out-of-date conceptual framework. EPA provides water quality information in The National Water Quality Inventory Report to Congress (305(b) report). These documents provide information on the Nation's water quality, identifies widespread water quality problems of national significance, and describes various programs implemented to restore and protect our waters. The 305(b) Report's use designations are now more complex. Not only do they deal with issues concerning the consumability of fish and shell-fish (often constrained by toxic substances), they also deal with the health of aquatic environments (affected not only by conventional pollutants but also by toxics and nutrients). This increase in complexity obviates the use of a hierarchical ladder because different uses are affected by different combinations and concentrations of the three main types of contaminants in a non-hierarchical manner. Some contaminants affect some uses while others affect other uses. For example, the presence of pathogens, a conventional pollutant, in water restricts swimming and shellfish consumption, but would have little or no effect on the health of the aquatic

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[2]Although we will ultimately hope to develop specialized surveys that elicit residents' willingness to pay for improvements for each of the uses in each coastal state and one survey that elicits inland residents willingness to pay for improvements in coastal waters, this paper describes the development of only one of the state specific versions, California. The combination of these surveys will provide us with coastal residents' willingness to pay to improve home-state coastal water and inland residents willingness to pay to improve coastal water. We will not capture coastal residents' willingness to pay to improve out-of-state coastal water. These values may be elicited through another but similar project.

[3]EPA has also funded a freshwater quality valuation survey. The survey, developed under the lead of Kip Viscusi, received final clearance from the Office of Management and Budget in 2004.

environment.

Additionally, the National Water Pollution Control Assessment Model, under development by Research Triangle Institute for EPA, determines the number of river and shoreline miles, and estuary and lake square miles, that would meet the various use designations given different concentrations of contaminants. This model is expected to evaluate the prospective changes in water coastal quality that would be brought about by different regulations or other initiatives. Our survey has been developed to provide meaningful estimates of the value of improvements to coastal waters, given the structure of the model; hence, water quality improvements are described in percentage terms and separate values are obtained for each use.

III. Development of Survey Instrument

The survey instrument was developed over the course of two years through a series of focus groups and protocol interviews primarily conducted in coastal states. The instrument has also evolved dramatically as a result of feedback received from a peer review panel consisting of Kevin Boyle, Don Dillman, George Parsons, and V. Kerry Smith.

Six initial focus groups were held in four areas of the country - Edison, NJ (1); Santa Monica, CA (2); Washington, DC area (2) and one in a completely non-coastal environment (St. Louis, MO). The first focus group was held in Edison, followed by those in Saint Louis, Santa Monica, and Washington, DC respectively. These focus groups were held primarily to learn what qualities the public values in coastal water, whether or not respondents are familiar with certain terms, and to test early versions of descriptive text and valuation questions.

A. Initial Design

During initial phases of the project, it was thought that the survey would have multiple sets of valuation questions, treating coastal water and estuarine water separately. Hence, one important purpose of the first two focus groups was to gauge participant's familiarity with the term "estuary." Discussions pertaining to coastal water concentrated on participants' uses and experiences and, as expected, participants had no difficulty answering questions concerning coastal water. When the discussion focused on estuarine waters, however, it became readily apparent that participants had little understanding of the term and that the survey would need to provide respondents with some background information on this topic. Specifically, participants in the first focus group were generally unfamiliar with the term. Only one participant knew that an estuary is an area of transition between fresh and salt water. Similarly, none of the participants in the second focus group could define the term "estuary" and very few had heard of the term. During these groups, a more detailed explanation of estuaries, their uses and locations was given to participants by the facilitator. After these explanations were provided, participants noted that they were familiar with and/or had visited several estuaries including Tampa Bay, Chesapeake Bay, and Puget Sound. Many participants correctly noted that there is no "bright line" between coastal water and estuarine water and it is virtually impossible to improve one type of water without improving the other. Hence, later versions of the survey combine the two types of water and discuss them at the same time.

B. Early Survey Draft

The first draft of the questionnaire was written in March 2000. Appendix 1 contains portions of this initial survey. This draft questionnaire was structured in four parts: introduction, willingness to pay for water quality improvements, use descriptions and allocation, and demographic questions. We intended to distribute this questionnaire to a nationally representative sample using a phone-mail-phone administration mode. We planned to develop two versions of this questionnaire -- one for coastal states and one for inland states -- to elicit willingness to pay values for national coastal water improvements. An allocation question would allow us to attribute values for different uses.

The introduction began with a warm-up question asking respondents to select the three most important environmental problems in their state from a list. This was followed by a definition of coastal waters and descriptions of estuaries and near-shore waters, giving features, natural uses, recreational uses, commercial uses and examples. Each description was then followed by several questions designed to elicit the respondent's familiarity with each water type.

The second section of the questionnaire began with a second ranking question in which respondents were asked to select the three most important *coastal* environmental problems in their home state. A description of water quality in the United States followed, including a brief explanation of the government's rating system and the largest sources of coastal water pollution. Water quality was described as "good" if the water supports each of three uses: swimming, production of fish and shellfish safe for consumption, and diversity of aquatic life. The questionnaire then provided the number of miles of shoreline and the area classified as estuaries in the U.S., together with the percentage of total coastal waters classified as "good" and "not good". The three sources of coastal water pollution were identified as agriculture, industries, and households and short lists of examples of the types of pollution contributed by each source were given (e.g., runoff of crop fertilizers and pesticides for agriculture and runoff of lawn fertilizers and pesticides for households).

A coastal water improvement program was then introduced preceded by a brief statement indicating that if nothing is done conditions can at best be expected to remain the same but may worsen due to increases in population. The program was described in rather vague terms but was couched as being led by "agencies in charge of coastal water quality, fish and wildlife." The program would clean up half of the "not good" areas so that only 20% remain categorized as such. A broad list of possible clean-up efforts that could be included as part of the program were provided, including activities such as removing sources of pollution, planting water-side vegetation to absorb run-off, etc. This program description was then followed by a single referendum question in which respondents were asked to state whether or not they would vote for or against the program if it costs their household $X per month in the form of increased federal taxes.

The third section of the questionnaire zeroed in on the three uses and attempted to elicit the respondent's preferences across the three uses. A description of each of the three uses and the hazards of using coastal waters classified as not supporting each particular use followed. The necessity for different types of clean-up efforts to remedy problems affecting each of the three uses was then explained in an attempt to educate respondents to the fact that, in some sense, clean-up efforts are separable across the three uses. An allocation question in which respondents were asked to allocate each dollar spent on coastal water clean-up across the three uses rounds out the third section of the questionnaire. Our thought was that this question would ultimately be used to attribute values for coastal water improvements by use.

The fourth and final section of the questionnaire contains standard demographic questions and questions regarding the respondent's recreational activities.

C. Protocol Interviews

Several versions of the draft questionnaire were tested through a series of four sets of protocol interviews in coastal states on the east coast - Tampa, Portland (Maine), Baltimore, and Richmond. In each location, at least two versions of the survey instrument were tested in 18 completed interviews. Respondents were provided with a copy of a survey and asked to complete it to the best of their ability. Once the respondent completed the paper version of the questionnaire, an interviewer went through the questionnaire with the respondent to discuss his/her responses and thoughts regarding the questions.

Experience in Tampa, Florida

The protocol interviews held in Tampa marked the first time potential respondents reviewed the survey instruments. For this occasion, we developed two versions of the survey instrument with the most marked changes occurring in the willingness to pay scenario and the description of the clean-up efforts by use. One version established a permanent increase in monthly federal taxes to pay for the proposed coastal water improvement program. The other described the increase in monthly taxes as occurring over a five-year period and provided much more detail (including examples) of how and why improving coastal waters for each use would require different clean-up efforts.

Reactions to the survey instrument were varied. While some respondents found the survey interesting, others found it tedious and difficult to follow. It was apparent after reviewing all of the comments that many changes needed to be made. In addition to numerous simplifying wording changes, we identified areas requiring major revision.

A flaw in the survey concerned the description of coastal water uses and the allocation question. A number of participants were confused by the allocation exercise and failed to complete it properly. Those participants that understood the exercise, in general, summarily rejected the separability of clean-up efforts, believing instead that by allocating more funds to creating a diverse aquatic environment, they would ultimately be improving coastal water conditions for swimming and production of fish and shellfish safe for human consumption as well. Our attempts at providing convincing information to the contrary failed. Those respondents who received the version with the additional information still felt that they would get "more bang for their buck" if they allocated the entire sum to creating a diverse aquatic environment, even though they purportedly read and understood the additional paragraphs.

Experience in Portland, Maine

Armed with the feedback from Tampa, we revised our survey instruments substantially. We dramatically changed the formatting of the survey, making it more "user friendly." Complicated skip patterns were replaced with arrows and new headings were introduced to help set the questions apart from the information presented. While these changes certainly made the survey instrument more visually appealing, the more important changes were to the willingness to pay scenario and the allocation question.

After much discussion, we decided to abandon the referendum style question devised for the Tampa interviews and substantially revise the allocation question. While we felt it was still important to obtain values for coastal water improvements by use, we decided to attempt to elicit these values directly rather than through the allocation question. This change would require reordering the information presented in the questionnaire so that a discussion of the various uses preceded the willingness to pay questions. In order to convince respondents of the contribution of households to the degradation of coastal waters, we added the following statement:

> Much of the pollution affecting estuaries and near-shore waters is caused by the every day living habits of the American people. Although the amount each household adds to the problem of coastal water pollution may seem small, **together** residential communities have a **large negative impact** on coastal water quality.

We also decided that we should attempt to obtain values for local improvements, compared to national improvements, for each use in coastal states. Rather than provide respondents with general information regarding the condition of coastal waters in the U.S., we revised the background information preceding our scenario to include a table showing the percent of coastal waters as well as the number of miles of coastal waters that were rated as good for each of the three uses. We then replaced our referendum style question with a series of three scenarios, each describing a program that would improve coastal waters for a particular use. Each scenario was accompanied by a table showing the current coastal water conditions by use and the expected improvement brought about by the program in question. The row containing the use for which conditions would be improved was shaded to draw attention to the change. A double-bounded dichotomous choice question eliciting the respondent's willingness to pay for the improvement through an increase in income taxes rounded out the scenario.

Since this new version of the survey instrument would allow the estimation of willingness to pay values for percent changes in coastal water improvements by use, we no longer needed to rely on the allocation question to obtain these values. Still, we decided to include a different allocation question for use in coastal states to elicit respondents' preferences for local versus national coastal water improvement programs. For respondents in these states living within 100 miles of coastal waters, we devised a question in which respondents would be asked to allocate funds for improving each of the three uses across local (affecting coastal conditions within 100 miles of their home) and national programs.

We developed two basic versions of the new questionnaire for testing in Portland, Maine. The most marked difference in the two versions was the inclusion of a willingness to pay question in one version in which the program improved coastal water for all three uses.

The reactions to our two survey instruments from the participants in Portland were encouraging. The respondents reacted positively to our new layout and simplified wording, reporting generally that the questions were easy to read and understand. In addition, respondents were much more willing to accept that households were large contributors (if not the largest contributors) to the degradation of the coastal environment.

The feedback on our new willingness to pay questions was equally positive. Respondents found the table format outlining the "before" and "after"conditions easy to follow and comprehend. Even those respondents who admitted that they did not believe it was possible to improve conditions for only one use without affecting conditions for all three uses reported to focus on the highlighted use when answering the willingness to pay questions.

The allocation question continued to be a problem for some respondents. While several respondents did not understand the allocation exercise at all, failing to perform any allocation whatsoever, others were not certain whether they were to allocate funds across national and local programs for each use or allocate funds across uses separately for national programs and then local programs.

Experience in Richmond, Virginia

In spite of the progress we made in the versions tested in Portland, Maine, we came away with three major concerns. First, we were concerned that respondents were not considering the magnitude of the improvements in the willingness to pay questions but rather were focusing simply on the use that was being affected by the program. While we were not prepared to abandon the question format yet, we knew we needed to test the willingness to pay questions more carefully in the next round of protocol interviews. Second, we were concerned that respondents in coastal states were responding to the willingness to pay questions as if the programs were affecting local coastal water conditions rather than national coastal water conditions. This too would need closer scrutiny in the next round of interviews. Finally, we recognized that we needed to revise the allocation question if we hoped to get meaningful and useful responses. In addition to formatting changes, we realized that we would need to change our definition of "local." We realized that respondents generally had difficulty discerning which coastal waters were within 100 miles of their homes and we recognized that it would be difficult for us to determine which households in our sample lived within 100 miles of coastal waters. We found in our discussions with respondents that it was easier for them to envision and discuss state coastal water conditions than those in a smaller area.

After considerable reflection, we decided to develop state-specific versions of the questionnaire that could be used to elicit willingness to pay values for improvements to state coastal waters. Although we realized that developing and administering separate state-specific versions of the questionnaire would considerably increase the costs of survey administration, we remained unconvinced that our allocation question could obtain equivalent "local" values. The state-specific versions of the questionnaire would be similar to the "national" version with the primary differences being that the scenarios would provide "before" and "after" conditions specific to a state and that no allocation question would be asked.

We also began to consider a more flexible mode of administration: the internet. Several survey firms currently offer the option of internet survey administration. These firms have recruited panels of potential respondents (in exchange for internet access) from which they are able to draw representative samples. This administration mode allows great potential for tailoring surveys to specific categories of respondents. As information about these survey firms spread, we became more and more intrigued with the idea of conducting a computer-based, internet survey as opposed to a mail survey. This survey mode would allow us greater flexibility in question presentation and would allow us to easily tailor survey instruments to particular states.

We developed and tested our first state-specific version of the survey instrument in Richmond, Virginia along side a national version of the survey instrument containing a number of formatting changes. Again, the survey instrument was met with generally positive feedback. Our fears regarding the focus on the use affected rather than on magnitude of the improvement in our willingness to pay questions was confirmed, however. Respondents reported not paying much attention to either the percent change or the number of miles affected by each program. Rather, they reported being concerned primarily with the use enjoying the improvement. The formatting changes to the allocation question in the national version of the questionnaire improved the performance of the question.

Experience in Baltimore, Maryland

Because our willingness to pay question continued to meet with difficulties, we decided to change our approach yet again. Rather than present a program that affects only one use and ask a double-bounded dichotomous choice question to elicit willingness to pay, we decided to employ a conjoint approach. We modified our survey instrument so that in each scenario we present the respondent with two programs, each affecting the percent of water considered "good" for each use by a different amount. The effects of the two programs and the monthly costs to the household for each are shown in a table accompanying each scenario. The respondent is then asked to choose between the two programs with the status quo (no program) also provided as an option. By varying the percent of miles affected by each program as well as the uses affected, we will arrive at a willingness to pay for a percent improvement for each use. Each respondent will be asked to answer four questions of this sort.

For our protocol interviews in Baltimore, Maryland, we again developed both a national and a state specific version of the questionnaire. The conjoint approach was used in both versions. In general, this approach met with great success. Respondents seemed to focus on all aspects of the program – the uses affected, the magnitude of the changes, baseline conditions, and cost – before answering.

D. Computerized Versions of the Survey

Following our protocol interviews in Baltimore, Maryland, we made minor wording changes to the survey and then began the process of having the our "pen and paper"survey computerized. The benefits of using this mode of administration are numerous. First, using a computerized format for the survey simplifies the process for respondents in that confusing skip patterns are eliminated. The respondent sees only those questions that pertain to him. Computerized surveys also create the potential for greater use of colorful and more meaningful graphics to enhance the survey. In addition, the threat of interviewer bias is eliminated. Finally, the administration time is significantly reduced in that completed interviews are automatically downloaded to a database, simplifying the data cleaning process and allowing quick turn-around.

We decided to have the pilot survey administered by Knowledge Networks, a California-based survey firm, to a random sample of approximately 600 California residents via WebTV. Knowledge Networks maintains a large, national panel of respondents recruited through a random process. Potential respondents are contacted by mail and provided introductory materials about the company, together with a small monetary incentive for reading the materials. Recipients are then contacted by phone and invited to enroll in the panel, along with other household members. Panel members are provided the WebTV hardware and a monthly subscription to the service which provides internet access. In exchange, respondents are asked to complete surveys via the internet on a regular basis. Knowledge Networks maintains that its panel is fairly representative of the population.[4]

Knowledge Networks has a sizable panel enrolled in California enabling us to conduct a pilot survey in that state in addition to a full scale survey should changes need to be made to the survey following the pilot. In order to test the computerized version fully, we decided to conduct protocol interviews with panel members. We began tailoring our state specific version to California, with the most dramatic changes to the survey taking place in four different areas. First, because Knowledge Networks collects a variety of demographic questions on a regular basis from panel members and makes this information available to its clients, we were able to dramatically shorten the demographic section of the survey. Second, our peer review panel suggested that we add questions from established national surveys in order to both gauge the representativeness of our sample and match our respondents with respondents to these larger surveys. In response to this suggestion, we added questions from the Panel Study of Income Dynamics and from the National Survey on Recreation and the Environment. Third, we added more detailed information on the quality of California's coastal waters and added more information on the quality of coastal water in other states. Fourth, many of the initial questions were re-ordered in order to improve the flow of the survey.

Once the survey was computerized, we conducted protocol interviews with approximately 16 of Knowledge Network's panel members. Each participant took the survey as

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[4]More information about Knowledge Networks can be obtained from the company's website: www.knowledgenetworks.com.

though in their own home and then went through a detailed debriefing session. Respondents took approximately 30 minutes to complete the survey and most said it was quite interesting. It was clear that respondents were able to understand all of the information provided in the survey.

Minor changes were made to the survey as a result of the protocol interviews. These included eliminating an initial series of questions that asked respondents' opinions concerning a variety of state issues or problems. It was initially thought that this would be a good introductory question for respondents, but most found it difficult. This, along with the fact that it increased the length of the survey while not providing us with vital data, led us to remove this set of questions. Another area of the survey that needed improvement concerned the information provided about other coastal states as a comparison. Data included for North Carolina was found to be incorrect and many respondents noted that it was surprising that the water quality in North Carolina was so low. Further, we needed to adjust the placement of information for states that do not report water quality information to avoid confusion. Initially, the way in which we conveyed this information suggested that these states had no water rated as good.

IV. Description of Survey Instrument

The pilot survey took place in California using the survey instrument described in more detail below. The survey instrument is specific to the state of California and can be used to estimate willingness to pay for water quality improvements by three specific uses: swimming, production of fish and shellfish safe for human consumption, and support of diverse aquatic life.[5]

The California survey instrument is described in more detail below. In general, the questionnaire is comprised of four distinct parts: an introductory section, a section focusing specifically on California's coastal waters, a section containing the choice questions, and finally a section containing standard questions about labor market activity. A hard copy of the survey is provided in Appendix 2.

A. Part 1: Introduction

The first section of the survey provides respondents with a definition of coastal waters and a detailed description of their natural, commercial and recreational uses. Following a

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[5]Once analysis of the pilot data is complete and we are convinced of the adequacy of the questionnaire, we hope to develop parallel versions of the survey instrument for the remaining 20 coastal states as well as a version for inland states. The coastal state versions of the survey will elicit resident's willingness to pay for coastal water improvements within the state. The inland version of the survey will elicit willingness to pay for coastal water improvements generally. While we will not be able to gauge willingness to pay of coastal state residents for improvements outside of their state of residence from the surveys we plan to develop, we anticipate that the information gathered from these surveys will provide potentially useful information for benefits analysis all the same.

welcome statement, and a general definition of coastal waters, the respondent is provided with use information in a simple table (see Figure 1). This table is followed by a map highlighting all of the coastal states in the 48 contiguous states in the U.S. (see Figure 2).

The respondents' familiarity with coastal waters is then gauged through a series of questions about recent trips to coastal waters and water recreation activities. For those respondents who report visiting coastal areas in the last 12 months, detailed information about the number of days participating in each of the activities is collected, including the number of days in California. A number of these questions are borrowed from the National Survey on Recreation, allowing direct comparison of results. Similar information is collected for freshwater recreation activities.

B. Part 2: California's Coastal Waters

This section delves into a respondent's familiarity with pollution sources as well as his perception of California's coastal water quality. In addition, it defines and describes the three use categories and the water quality rating system employed by the EPA.

This section begins by showing a map of California's coastline with various coastal water areas specifically indicated on the map (see Figure 3). Respondents are then asked about the location of their primary residence with respect to coastal waters and the location of other properties the household might own. Length of residence in California is also requested.

Respondents are then provided with a list of potential environmental problems that could affect coastal waters and are asked to rate the seriousness of each problem for the state of California on a scale from 1 to 5. Problems included in this list range from animal waste runoff, to discharges and overflows from sewage treatment plants, to beach erosion. The list of problems includes industrial, agricultural, and household sources of coastal water pollution and is provided to each respondent in a randomized fashion. Following the list of potential coastal water problems, respondents are asked to indicate which source (industry, agriculture or households) is the largest source of coastal water pollution in California in their view. They are also asked to report whether they believe coastal water quality has improved or not in the last five years.

The water quality rating system used by federal and state governments is then described to the respondents and information is given on the ratings California's coastal waters have received for the three defined uses of swimming, production of fish and shellfish that are safe for human consumption, and support of diverse aquatic life (including fish, shellfish, plants, mammals, birds, etc. that live near aquatic environments). Information on California's coastal waters is provided in pie charts, an example of which is shown in Figure 4. The information provided is taken directly from The National Water Quality Inventory Report to Congress (305(b) report).

Comparisons of California's water quality by use with that of other coastal states is provided in a series of three bar charts -- one for each use-- showing the ranking of states by water quality level. An example of the bar charts is shown in Figure 5.

The final question in this section asks respondents to indicate which of the three uses is the most important to them.

C. Part 3: Choice Questions

The third part of the questionnaire is comprised of the choice questions. Respondents are presented with a series of five questions in which they are asked to select between two programs to improve coastal water quality. In each choice set, respondents are also able to select the status quo, should they find neither of the two programs satisfactory. Each of the two programs has an associated household tax increase to cover the cost of implementation.

Information regarding water quality across three use definitions (swimming, production of fish and shellfish deemed safe for human consumption, and the support of diverse aquatic life) under each program, including the status quo, is provided in tabular format together with the cost to each household for each program. Color is used in the table to help respondents distinguish between the three alternatives. The programs differ, not only in the level of household tax, but the degree to which they improve water quality across the three use definitions. A sample question is provided in Figure 6.

The questions are structured in such a way as to facilitate comparison between the programs with at most two water quality attributes varying at different levels across the two new programs being introduced. In some instances, however, respondents are asked to choose between two programs that offer varying magnitudes of uniform changes across uses. Each of every respondent's five responses will be treated as a separate observation.

D. Part 4: Demographic Information

The fourth and final section of the survey is comprised of demographic questions. The series of demographic questions required in our survey instrument is curtailed due to the availability of this information from Knowledge Networks. As noted above, Knowledge Networks collects and routinely updates standard demographic information on each panel member and makes this available to its clients. In so doing, burden on the panel members is reduced and the length of the survey shortened.

V. Economic Model

In choice experiments such as ours, individuals are typically asked to choose from alternatives with varying attributes from a choice set. In making their selections, respondents weigh the importance of the different attributes and implicitly trade one characteristic for another, selecting the alternative that provides them with the greatest utility. The probability of choosing any specific alternative can then be modeled straightforwardly using standard random utility models. These types of models have been used to ascertain the value of beaches (Parsons et al. 2000), water quality in freshwater lakes (Needelman and Kealy, 1995; Bockstael, Hannemann and Kling, 1987), and woodland caribou habitat enhancement (Adamowicz et al., 1998).

A. Basic Model

Consider the following representation of an individual's utility associated with program *i*:

$$U_i = \beta x_i + \varepsilon_i \tag{1}$$

where x_i is a vector of explanatory variables, including program attributes, cost of the program and other individual characteristics. Effects of unobserved variables are captured by ε_i, a random term distributed as iid extreme value (weibull). A decision maker will choose program *i* from his choice set *J* if that alternative provides greater utility than the other two alternatives: $U_i > U_j$ for all $j \neq i$.

The probability that an individual chooses program *i* from set *J* is given by:

$$\Pr(i) = \frac{\exp(\beta x_i)}{\sum_{j \in J} \exp(\beta x_j)} \tag{2}$$

where the numerator is the exponential of the utility associated with program *i* and the denominator is the sum, over all programs in the choice set, of the exponential utility associated with each possible program. These probabilities are then entered in a standard likelihood function of the following form:

$$L = \prod_{n=1}^{N} \prod_{j=1}^{J} \Pr_{jn}^{\delta_{jn}} \tag{3}$$

where δ_{in} =1 (for $i \in J$) if individual *n* selects program *i* and =0 otherwise. Parameters are selected so as to maximize *L*.

One advantage of choice experiments such as ours relative to traditional contingent valuation is that they allow researchers to infer the value of the specific attributes in addition to situational changes. Random utility models do not allow direct estimation of the value of particular attributes; rather, the researcher must estimate the probability that a specific alternative will be selected and can then infer the value of the various characteristics using the estimation results. Once estimated, the model results can be used to estimate welfare changes associated with the improvement or decline of specific attributes.

Ultimately, we are interested in estimating the welfare changes associated with improvements in water quality for the three use definitions in California. The gain in consumer surplus associated with an improvement in the quality of water for swimming, for instance, can be calculated as the change in expected utility divided by the individual's marginal utility of income given by

$$W^s = \frac{\ln \sum_{i=1}^{J} \exp(X_i^* \beta) - \ln \sum_{i=1}^{J} \exp(X_i \beta)}{\beta_{tax}} \quad (4)$$

where β_{tax} is the marginal utility of income estimated in the logit model, X_i is the vector of water quality measures under the status quo, and X_i* is the vector of water quality with improved quality of waters for swimming.

VI. Data and Preliminary Results

The survey was fielded to 746 Knowledge Networks panel members in two waves, the first (a pretest) on June 4, 2004 and the second on July 1, 2004. Data collection continued through August 1, 2004. The pretest was fielded to 141 Knowledge Networks panel members. In late June, we examined respondents' answers to survey questions and in addition to precoding several open ended questions, determined that no changes needed to be made to the conjoint design in the survey instrument. We received 606 completes, yielding a completion rate of 81%. Table 1 contains descriptive statistics for the full dataset.

Table 1 Descriptive Statistics n=606				
Variable	Mean	Std Dev	Min	Max
Male	0.50	0.50	0	1
Age	43.16	15.54	18	96
Household size	2.66	1.41	1	10
Income	52681.00	40095	2500	187500
Black	0.05	0.22	0	1
Hispanic	0.28	0.45	0	1
Other minority	0.14	0.35	0	1
Children	0.30	0.46	0	1
Recreational swimmer in past 12 months	0.25	0.43	0	1
Recreational fisher in past 12 months	0.10	0.30	0	1
Recreational boater in past 12 months	0.16	0.37	0	1
Observed wildlife in past 12 moths	0.49	0.50	0	1
Eat seafood at least one time per month	0.60	0.49	0	1

Preliminary conditional logit model results are promising and consistent with expectations (Table 2). Regarding the choice specific attributes, as the cost associated with the programs increases, respondents are less likely to choose a program over status quo conditions. In addition, as the miles good for swimming, fishing, and aquatic life support associated with the programs presented to respondents increases, respondents are more likely to choose a program over the status quo. The interpretation of the remaining variables in the regression is slightly different as the variables represent individual specific attributes. As income increases respondents are more likely to move away from the status quo, males are more likely to choose the status quo. As age and household size increase, respondents are more likely to choose a program. Only three of the included participation variables are significant - recreational fishers and boaters, and those eating seafood are more likely to choose a program over the status quo.

As these results are extremely preliminary, we plan to continue exploring alternative models, to estimate elasticities of probabilities with respect to program cost, and to develop willingness to pay estimates for improvements in the percent of miles good for each of the three uses explored in the survey.

Table 2 Preliminary Model Results Conditional Logit n=606		
Variable	Estimate	T-Value
Cost	-0.008***	-8.93
Miles good for swimming	0.04***	4.54
Miles good for fishing	0.05***	5.53
Miles good for supporting aquatic life	0.11***	12.63
Male	0.23***	2.60
Age	0.01***	5.55
Household size	0.10***	3.22
Income	-3.04 10-6***	-2.73
Black	0.26	1.21
Hispanic	-0.09	-0.91
Other minority	0.20	1.50
Recreational swimmer in past 12 months	-0.18*	-1.63
Recreational fisher in past 12 months	-0.01	-0.04
Recreational boater in past 12 months	-0.22*	-1.63
Observed wildlife in past 12 moths	-0.8	-0.89
Eat seafood at least one time per month	-0.17*	-1.81
*** significant at 1% * significant at 10% Log Likelihood -2402		

Figure 1: Description of Coastal Waters

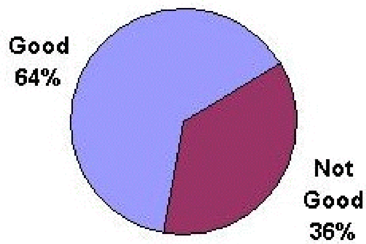
More Information on Coastal Waters:	
Coastal waters may have:	shallow waters, marshes, sandy beaches, mud and sand flats, rocky shores, oyster reefs, river deltas, tidal pools, sea grass beds and swamps.
Natural uses include:	food, shelter and breeding grounds for many fish, shellfish, mammals and shorebirds.
Recreational uses include:	boating, fishing, shell-fishing, swimming, snorkeling and bird-watching.
Commercial uses include:	ports and marinas supporting shipping and industrial uses; breeding grounds for some commercial fish and shellfish.
Examples of coastal waters are:	the water along Chesapeake Bay, Clearwater Beach (Florida), Ocean City (Maryland), Venice Beach (California), Galveston Bay, Puget Sound, San Francisco Bay, Tampa Bay and lots of smaller bays and inlets where freshwaters and saltwaters mix.

Continue

Figure 3 Map of California

Figure 2: Map showing states with coastal waters in the contiguous states in the U.S.

Figure 4: Sample Pie Chart Showing Coastal Water Quality of California Waters by Use



Production of fish and shellfish that are safe to eat

Figure 5:
Sample Bar Chart Comparing the Quality of California's Coastal Waters with Other Coastal States

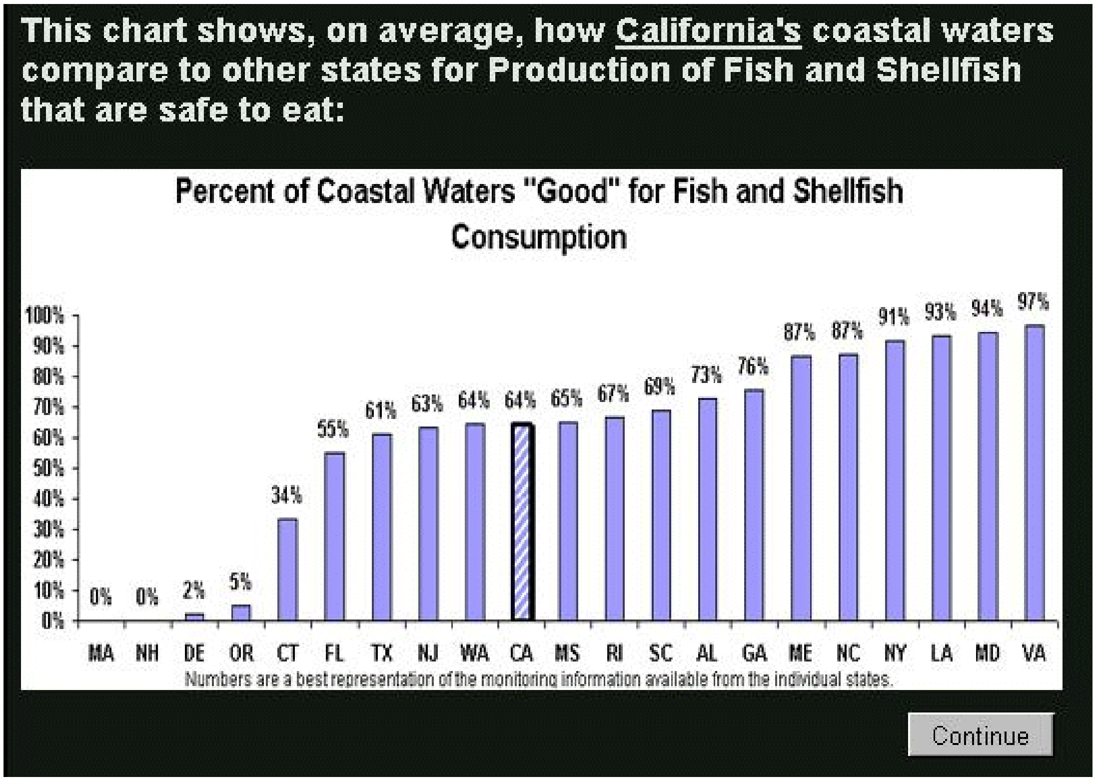


Figure 6: Sample Choice Question

	Your Three Choices and How They Would Affect the Quality of California's Coastal Waters Percent of California's Coastal Waters Rated as "Good"		
	Present Conditions	**Program 1 (Conditions after 3 years)**	**Program 2 (Conditions after 3 years)**
Swimming	42% of miles are good	5% gain to 47% good	0% gain to 42% good
Fish and shellfish safe for eating	64% of miles are good	5% gain to 69% good	0% gain to 64% good
Habitat to support a large number of different kinds of fish, birds, mammals and plants	52% of miles are good	5% gain to 57% good	0% gain to 52% good
Yearly Tax Change for your household (permanent tax)	No increase in taxes	Your taxes increase by $80 per year	Your taxes increase by $40 per year

Which one of the options listed in the table above would you choose?

Select one answer only

- Present Conditions: No change in your taxes, and the percent of coastal waters that is good for each purpose stays the same as it is now
- Program 1: Your taxes increase $80 per year to get the improvements shown under this program
- Program 2: Your taxes increase $40 per year to get the improvements shown under this program
- Don't know

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Appendix 1: Portions of Initial Draft

WATER QUALITY IN THE UNITED STATES

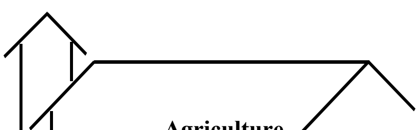
The government rates water as either ***good*** or ***not good***.

Water quality is ***good*** if the ocean shoreline or estuary
- is a safe place to swim,
- has fish and shellfish that are safe to eat, and
- supports many kinds of plants, fish, and other aquatic life.

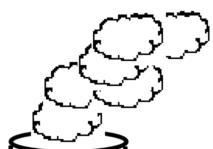
Water quality is ***not good*** if the ocean shoreline or estuary
- is an unsafe place to swim due to pollution,
- has fish and shellfish that are unsafe to eat due to pollution, or
- supports only a small number of different kinds of plants, fish and other aquatic life.

Of our nation's more than 58,000 miles of ocean shoreline and 34,000 square miles of estuaries,
- 60 % are rated "good"
- 40% are rated"not good"

Much of the pollution affecting estuaries and near-shore waters is caused by the every day living habits of the American people. Some of the largest sources of pollution include:



Agriculture
- Runoff of crop fertilizers and pesticides
- Runoff of animal waste from fields and pastures
- Overflows from animal waste holding areas

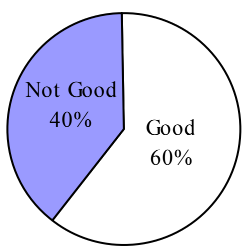


Industries
- Overflows from sewage treatment plants
- Discharges from industrial processes

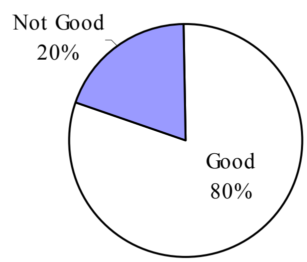
Households
- Runoff of automobile grease and oil
- Runoff of lawn fertilizers and pesticides
- Overflows from septic systems
- Runoff of paints and chemicals
- Seepage of household waste from landfills

Existing fines on industry and taxes support current water quality levels, but in order to improve the quality of the water, additional funds are needed. If nothing more is done, conditions can, at best, be expected to remain the same but may worsen due to increased population.

Before the Program



After the Program



Suppose a program were proposed where the agencies in charge of coastal water quality, fish, and wildlife were to clean half of the "not good" areas so that the percent "good" would be 80%.

The program would likely take three years before noticeable results could be seen.

Methods for clean-up depend upon the exact problem but would include things like:

- removing sources of pollution
- planting water-side vegetation to absorb run-off
- controlling runoff and seepage from areas with pollution
- protecting sensitive environmental areas.

5-1 Keeping in mind that your household would have less money each month to spend on other things, would you vote for or against the program if the cost to your household would be a permanent $100 per month in increased federal taxes (that is, $1200 per year). (Please check one.)

❒ For ❒ Against ❒ Don't know

5-2 What is the maximum you would be willing to pay per month for this program? __________

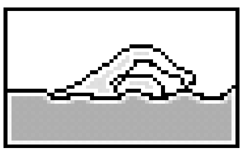
5-3 Please take a few minutes to tell us why you voted the way you did.

WAYS TO IMPROVE COASTAL WATER

For those areas of the coast where the water quality is "not good," the clean-up efforts in the program we talked about above will depend upon the type of water quality problem that exists, and the importance that persons like yourself place on various uses.

For those areas of the coast that have water that is "not good," there are 3 specific ways that our coastal waters could be improved:

- Making water swimmable,
- Making fish and shellfish safe to eat,
- Creating a diverse environment.



Making coastal water swimmable

Making coastal water swimmable means getting rid of the types of pollutants that can make people sick when they go swimming. Sometimes direct contact with the polluted water can cause illnesses such as stomach illnesses, earaches or infections.

6-1 Have you ever heard of coastal beaches being closed to swimmers because of polluted waters? (Please check one.)

❒ Yes ❒ No ❒ Don't know

If **no** or **don't know**, please skip question 6-2. If **yes**, please answer question 6-2.

6-2 Has a beach you were visiting ever been closed to swimmers because of polluted waters? (Please check one.)

❒ Yes ❒ No ❒ Don't know

Making fish and shellfish safe to eat

Making fish and shellfish safe to eat means getting rid of the types of pollutants that build up in the bodies of some fish and shellfish that can make people sick in the short and long run. Eating raw, contaminated fish or shellfish can cause stomach illnesses. Eating large amounts of contaminated fish or shellfish over a long period of time (even when cooked) can cause other long-term serious health problems such as cancer and liver disease.

6-3 Have you ever heard about fish advisories that limit the amount of coastal fish or shellfish that should be eaten because of polluted waters? (Please check one.)

❒ Yes ❒ No ❒ Don't know

6-4 Have you ever limited the amount of coastal fish or shellfish you've eaten or refrained from eating coastal fish or shellfish as a result of a fish advisory issued because of polluted waters?

(Please check one.)

❒ Yes ❒ No ❒ Don't know

Creating a diverse environment in the water

Creating a diverse environment means getting rid of the types of pollutants that keep many plants, fish, and other life from living in water. Although some fish and plants can live in polluted waters, cleaning up the waters will allow a greater number of different types of fish and aquatic life to thrive.

6-5 Have you ever been to an estuary or near-shore area that is a "wildlife refuge," "protected wetland," "bird sanctuary" or similar restricted access area? (Please check one.)

❒ Yes ❒ No ❒ Don't know

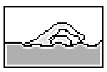
Clean-up effort

Cleaning up coastal waters for each of these purposes requires a different kind of effort. While some efforts will affect more than one use, each of the uses must be approached separately to affect a change for that use. This is because the types of pollutants that make swimming unsafe are different from the types of pollutants that make fish and shellfish unsafe to eat. These are different from the pollutants that keep the environment in the water from being diverse.

This means it is possible to improve conditions in coastal water so that it is swimmable but this same water may still not be able to support a diverse environment. This same water may also still not be good enough to support fish and shellfish that are safe for people to eat.

It is also possible to improve conditions in the coastal waters and estuaries so that the fish and shellfish caught in these waters are safe to eat, without increasing the kinds of fish and aquatic life that are able to survive in the waters. These same waters may still not be safe for humans to swim in even though the fish caught in these waters are safe to eat.

RATING OF USES



7-1 Please take a moment to think about the three ways of improving coastal water we have discussed. In your opinion, how much of each dollar spent on coastal water clean-up should go to each of the three improvement categories? (Please write percent in box.)

Improvement Category	**Percent of $1 spent on clean-up**
Making coastal water swimmable	%
Making the fish and shellfish that live in coastal water safe to eat	%
Creating a diverse environment in coastal water	%
Total (should add to 100%)	100 %

APPENDIX 2: QUESTIONNAIRE

California Survey

Thank you for agreeing to help us by completing this survey. This survey asks for your opinions about coastal waters in California. Your opinions and those of others completing this survey are <u>very important</u> and may be used to help prioritize programs that may affect your local area. There are no right or wrong answers; we are simply interested in your opinions and your experiences.

OMB Approval No: 2090-0024
Approval Expires 01/31/2005

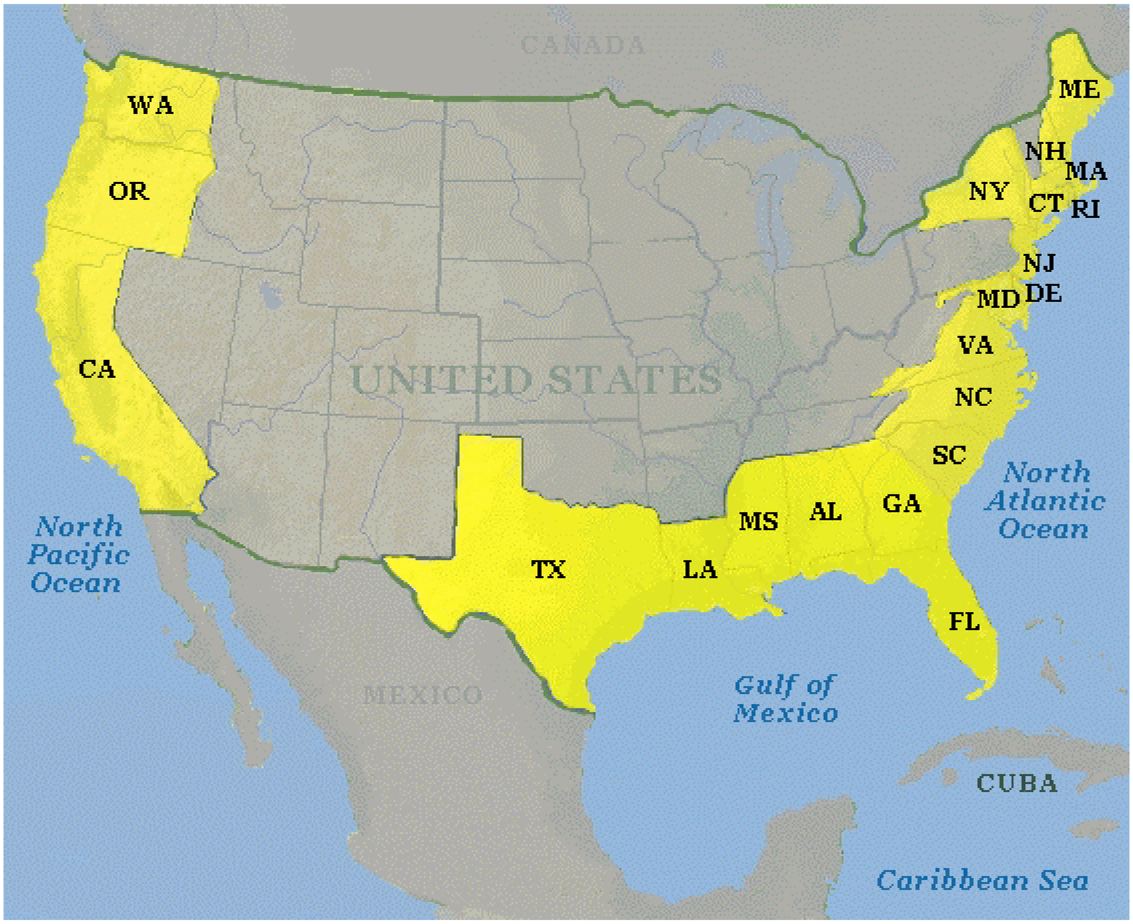
According to the Paperwork Reduction Act of 1995, an agency may not conduct or sponsor, and a person is not required to respond to, a collection of information unless it displays a valid OMB control number. The valid OMB control number for this information collection is xx-xx. The time required to complete this information collection is estimated to average between 20 and 30 minutes.

We'd like to start by giving you some information about coastal waters and asking about your experiences. By coastal waters we mean the shallow salt waters within two miles of shorelines of oceans, bays, seas, or gulfs including the areas where freshwater rivers mix with saltwater.
The next screen contains more information about coastal waters.

More Information on Coastal Waters:

Coastal waters may have:	shallow waters, marshes, sandy beaches, mud and sand flats, rocky shores, oyster reefs, river deltas, tidal pools, sea grass beds and swamps.
Natural uses include:	food, shelter and breeding grounds for many fish, shellfish, mammals and shorebirds.
Recreational uses include:	boating, fishing, shell-fishing, swimming, snorkeling and bird-watching.
Commercial uses include:	ports and marinas supporting shipping and industrial uses; breeding grounds for some commercial fish and shellfish.
Examples of coastal waters are:	the water along Chesapeake Bay, Clearwater Beach (Florida), Ocean City (Maryland), Venice Beach (California), Galveston Bay, Puget Sound, San Francisco Bay, Tampa Bay and lots of smaller bays and inlets where freshwaters and saltwaters mix.

Of the 48 contiguous states in the US, 21 have coastal waters. These states are shown in yellow on the map.



Q1 In the past 12 months, have you visited <u>any</u> coastal waters for recreation or pleasure in one or more of the 21 coastal states shown on the map? *(select one answer only)*

- ❐ Yes **(skip to Q3)**
- ❐ No
- ❐ Don't know **(skip to Q5)**

Q2 Have you ever visited any coastal waters in any of the 21 coastal states shown on the map? *(select one answer only)*

- ❐ Yes
- ❐ No **(skip to Q5)**
- ❐ Don't know **(skip to Q5)**

Q3 Does your household own a boat that is used <u>primarily on coastal waters</u>? *(select one answer only)*

- ❐ Yes
- ❐ No **(skip to Q5)**
- ❐ Don't know **(skip to Q5)**

Q4 For which activity do you use your boat the most on coastal waters? *(select one answer only)*

- ❒ Recreational fishing
- ❒ Recreational boating
- ❒ Commercial fishing
- ❒ Chartered boat rides
- ❒ Chartered fishing trips
- ❒ Other (please specify ________________________________)
- ❒ Don't know

Q5 How often do you eat seafood? *(select one answer only)*

- ❒ More than 3 times per week
- ❒ 2-3 times per week
- ❒ 1 time per week
- ❒ 2-3 times per month
- ❒ 1 time per month
- ❒ Less than once per month
- ❒ Never **(skip to Q8)**
- ❒ Don't know **(skip to Q8)**

Q6 About how much money per *month* do you spend on seafood that you personally eat? *(select one answer only)*

- ❒ Less than $5
- ❒ Between $5 and $9.99
- ❒ Between $10 and $19.99
- ❒ Between $20 and $29.99
- ❒ Between $30 and $39.99
- ❒ Between $40 and $49.99
- ❒ More than $50
- ❒ Don't know

Q7 Does any of the seafood you eat come from California waters? *(select one answer only)*

- ❒ Yes
- ❒ No
- ❒ Don't know

Q8 Have you ever heard about fish advisories that limit the amount of coastal fish or shellfish from California that one should eat because of pollution? *(select one answer only)*

- ❒ Yes
- ❒ No
- ❒ Don't know

Q9 If Q1 = No or Don't know, skip to instructions before Q9h

[For the following activities in Q9, if 0 days or "Don't recall" is selected, skip to the next activity. If 0 days or "Don't recall" is selected for trips in California, skip to the next activity.

The next few questions are about your coastal water recreation activities over the last year. During the last 12 months, on how many different days did you personally participate in each of the following activities? ***(select one answer from each row in the grid) (Randomize order)***

		Number of Different Days in the Last 12 Months						
		0 days	1-2 days	3-5 days	6-10 days	11-20 days	More than 20 days	Don't recall number of days
a.	Fish in coastal waters? (up to 2 miles from shore)	❒	❒	❒	❒	❒	❒	❒
a_1	If a >0 then ask: How many of these days were single-day trips in California?	❒	❒	❒	❒	❒	❒	❒

If single day trips in California >0 then ask:

Thinking about your most recent single-day fishing trip to coastal water in California, what was the name of the coastal fishing site you visited on this most recent trip?

Name_________

What is the name of the city or town closest to (Name)?

City/Town_______________

About how many miles is (Name) from your home?

Miles ___________

About how long did it take you to get from your home to (Name)?

Hours _____ Minutes _______

	Number of Different Days in the Last 12 Months						
	0 days	1-2 days	3-5 days	6-10 days	11-20 days	More than 20 days	Don't recall number of days
(if a_1>0, then ask) Did you eat any of the fish you caught on this trip? ❒ Yes ❒ No, didn't eat any fish ❒ No, didn't catch any fish ❒ Don't know							
b. deep-sea fish (more than 2 miles from shore)?	❒	❒	❒	❒	❒	❒	❒
If b>0 then ask:							
How many of these days were single-day trips in California?	❒	❒	❒	❒	❒	❒	❒
c. boat or sail on coastal waters?	❒	❒	❒	❒	❒	❒	❒
If c>0 then ask:							
How many of these days were single-day trips in California?	❒	❒	❒	❒	❒	❒	❒

If single day trips in California >0 then ask:

Thinking about your most recent single-day boating trip to coastal water in California, what was the name of the coastal boating site you visited on this most recent trip?

Name_________

What is the name of the city or town closest to (Name)?

City/Town_______________

About how many miles is (Name) from your home?

Miles ___________

About how long did it take you to get from your home to (Name)?

	0 days	1-2 days	3-5 days	6-10 days	11-20 days	More than 20 days	Don't recall number of days
Number of Different Days in the Last 12 Months							
Hours _____ Minutes _______							
d. visit a beach on coastal waters for any outdoor recreation activities?	❒	❒	❒	❒	❒	❒	❒
If d>0 then ask:							
How many of these days were single-day trips in California?	❒	❒	❒	❒	❒	❒	❒
e. swim in coastal waters?	❒	❒	❒	❒	❒	❒	❒
If e>0 then ask:							
How many of these days were single-day trips in California?	❒	❒	❒	❒	❒	❒	❒
If single day trips in California >0 then ask:							
Thinking about your most recent single-day swimming trip to coastal water in California, what was the name of the coastal swimming site you visited on this most recent trip?							
Name_________							
What is the name of the city or town closest to (Name)?							
City/Town_______________							
About how many miles is (Name) from your home?							
Miles ___________							
About how long did it take you to get from your home to (Name)?							
Hours _____ Minutes _______							
f. observe wildlife near coastal waters?	❒	❒	❒	❒	❒	❒	❒
If f>0 then ask:							
How many of these days were single-	❒	❒	❒	❒	❒	❒	❒

	Number of Different Days in the Last 12 Months						
	0 days	1-2 days	3-5 days	6-10 days	11-20 days	More than 20 days	Don't recall number of days
day trips in California?							

Q9g [ask only if Q1 = 1] **Thinking about the number of days you spent participating in each of the coastal water activities we asked about, would you say that this was a typical recreational year for you?** *(select one answer only)*

- ❒ Yes (skip to instructions before Q9h)
- ❒ No
- ❒ Don't know (skip to instructions before Q9h)

Briefly explain why the past 12 months were not a typical recreational year for you?

____

This next set of questions asks about *freshwater* recreation activities. By "freshwater" we mean waters in inland lakes, ponds, rivers, streams, etc., excluding areas where freshwaters and saltwaters mix.

During the last 12 months, on how many different days did you personally participate in each of the following activities? *(select one answer from each row in the grid) (Randomize order)*

	0 days	1-2 days	3-5 days	6-10 days	11-20 days	More than 20 days	Don't recall number of days
h. fish in a *freshwater* lake, pond, river or stream?	❒	❒	❒	❒	❒	❒	❒
i. boat or sail on a *freshwater* lake, pond, river or stream?	❒	❒	❒	❒	❒	❒	❒
j. visit a beach on a *freshwater* body for any outdoor recreation activities?	❒	❒	❒	❒	❒	❒	❒
k. swim in a *freshwater* lake, pond, river or stream?	❒	❒	❒	❒	❒	❒	❒
l. observe wildlife near a *freshwater* lake, pond, river, or stream?	❒	❒	❒	❒	❒	❒	❒

Now we would like to ask you about <u>coastal waters in California</u>. Here is a map showing the California coast.

Q10 Is your primary residence located within 10 miles of coastal waters? ***(select one answer only)***

- ❒ Yes
- ❒ No
- ❒ Don't know

Q11 Aside from your primary residence, does your household own any property in California within 10 miles of coastal waters? *(select one answer only)*

- ❒ Yes
- ❒ No (skip to Q13)
- ❒ Don't know (skip to Q13)

Q12 What other type of coastal property does your household own?*(select all that apply)*

- ❒ Residential, single family home
- ❒ Residential, condominium -- one unit
- ❒ Residential, condominium -- multiple units
- ❒ Residential, apartment building
- ❒ Commercial
- ❒ Don't know

Q13 How long have you lived in California? *(select one answer only)*

- ❒ **Less than 1 year**
- ❒ **1-5 years**
- ❒ **6-10 years**
- ❒ **11-20 years**
- ❒ **Over 20 years**
- ❒ **Don't know**

Q14 The next question is about problems that may be affecting coastal waters in California. Please rate the seriousness of each problem by selecting a number from 1 to 5, with 1 meaning "not at all serious" and 5 meaning "very serious." *(select one answer from each row in the grid) (Randomize order)*

How would you rate the seriousness of each of the following problems in California in terms of its impact on coastal waters?	Not at all Serious 1	2	3	4	Very Serious 5	Don't know
pesticide and fertilizer runoff from farm areas	❒	❒	❒	❒	❒	❒
discharges and overflows from sewage treatment plants	❒	❒	❒	❒	❒	❒
discharges from oil refineries and other industrial waste	❒	❒	❒	❒	❒	❒
seepage of waste from landfills	❒	❒	❒	❒	❒	❒
storm water runoff from roads and highways	❒	❒	❒	❒	❒	❒
pollution from commercial shipping (including oil and chemical spills)	❒	❒	❒	❒	❒	❒
pollution from recreational boats (including oil and gasoline spills and debris)	❒	❒	❒	❒	❒	❒
litter and other debris	❒	❒	❒	❒	❒	❒
animal waste runoff from farms and ranches	❒	❒	❒	❒	❒	❒
beach erosion	❒	❒	❒	❒	❒	❒

other (please specify__________________) ❒ ❒ ❒ ❒ ❒ | ❒

Q15 Most coastal water pollution comes from one or more of the following sources. Which one of these do you believe is the largest source of <u>coastal water pollution</u> <u>in California</u>? *(select one answer only) (Randomize order)*

❒ <u>Agriculture sources</u> including runoff of crop fertilizers and pesticides, runoff of animal waste from fields and pastures, and overflows from animal waste storage areas.

❒ <u>Industry sources</u> including overflows from sewage treatment plants, discharges from industrial processes, absorption of waste into the soil at landfills, accidents, and spills.

❒ <u>Household sources</u> including runoff of automobile grease and oil, runoff of lawn fertilizers and pesticides, overflows from septic systems, runoff of paints and chemicals, and absorption of waste into the soil at landfills.

❒ Don't know

Q16 Now, we would like to ask you about coastal waters in California.

Would you say that in the last five years California's coastal waters have gotten cleaner, stayed the same, or gotten dirtier? *(select one answer only)*

❒ Gotten cleaner in the last five years
❒ Stayed the same in the last five years
❒ Gotten dirtier in the last five years
❒ Don't know

Q17 Which one of the following is your <u>main</u> source of information on the condition of California's coastal waters? *(select one answer only)*

❒ Newspapers
❒ Magazines
❒ Television broadcast news
❒ Internet
❒ Personal experience
❒ Friends and family

The federal government and states use information on pollution concentrations to rate the quality of coastal waters for different uses.

Coastal water is rated as "good" or "not good" based on its ability to support the following three uses:

- **recreational swimming**
- **the production of fish and shellfish that are safe for people to eat**
- **the ability to support a large number of different kinds of fish, birds, mammals and plants.**

The following describes what it means for water to be “good” for each use.

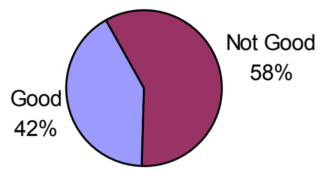
- **Recreational swimming:**
  If water is “good” for recreational swimming it means that it is free from the types of pollutants that make people sick (stomach illnesses, earaches, rashes or infections, and in rare cases long-term health effects) when they go swimming. In other words, if water is rated “good” for swimming, people can swim in the water without risk of illness.

- **Fish and shellfish safe for eating:**
  If water is rated “good” for fish and shellfish consumption it means that the fish are free from contamination that can make people sick. Some types of pollutants build up in the bodies of some fish and shellfish and can cause stomach illnesses and other health problems in people.

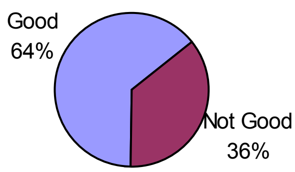
- **Large number of different kinds of fish, birds, mammals and plants:**
  If water is rated “good” for supporting large numbers of different kinds of life, it means that the water is free from the types of pollutants that keep many fish, birds, mammals and plants from living in water. In other words, “good” water allows a greater number of different kinds of fish and aquatic life to thrive.

  For each of the uses above, water is considered “not good” if it does not support the use all of the time because of pollution.

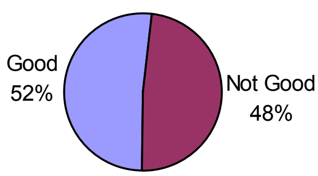
The pie charts below show the percent of California coastal waters that, on average, is "good" and "not good" for each of the three uses.



Swimming



Production of fish and shellfish that are safe to eat

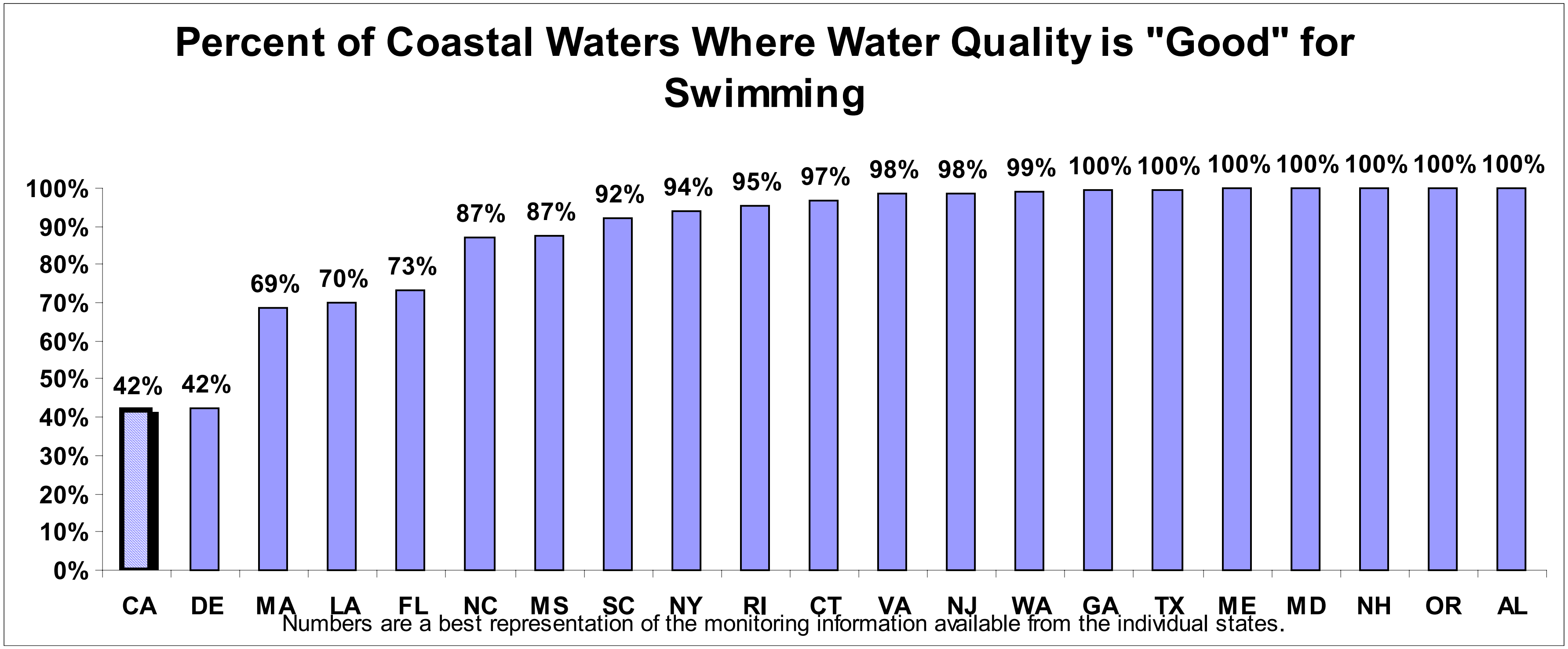


Supports a large number of different kinds of fish, birds, mammals and plants

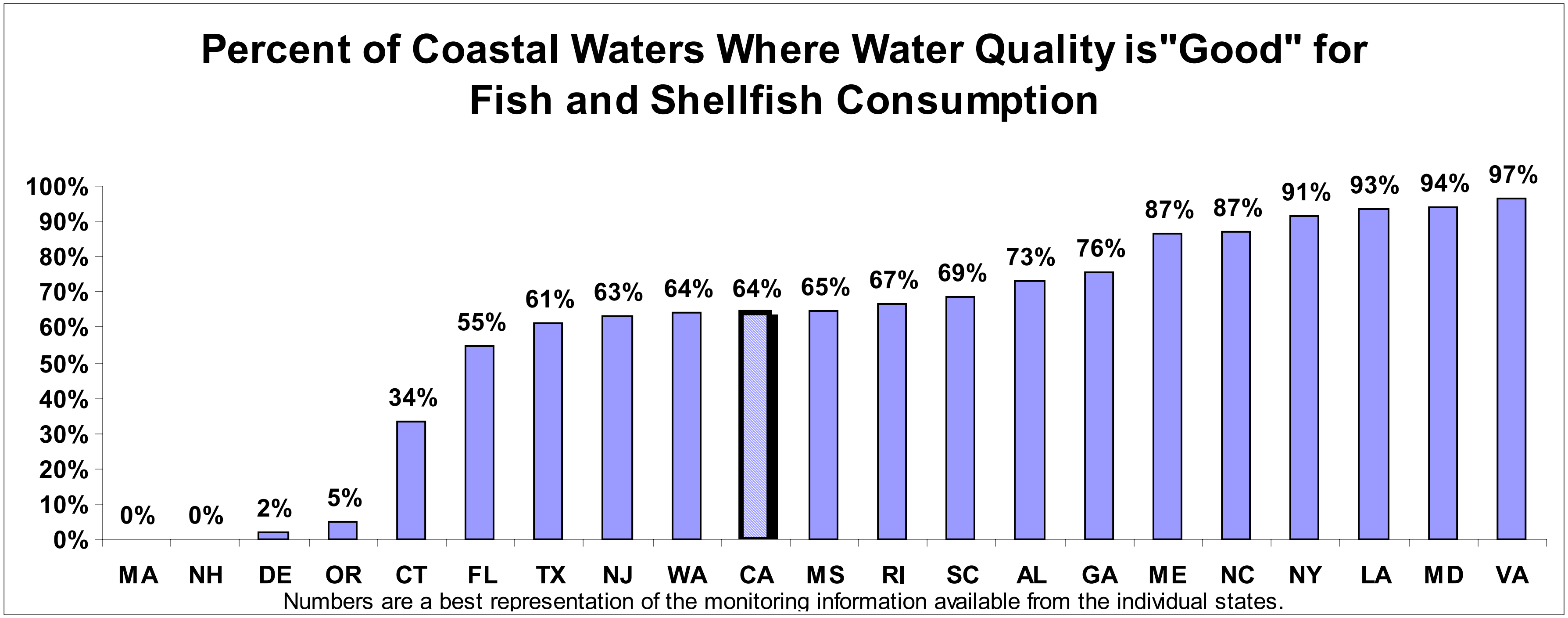
Q18 For which of the three uses we just described is water quality the most important to you? *(select one answer only)*

- ❒ Recreational swimming
- ❒ Fish and shellfish safe for eating
- ❒ Large number of different kinds of fish, birds, mammals, and plants
- ❒ Don’t know

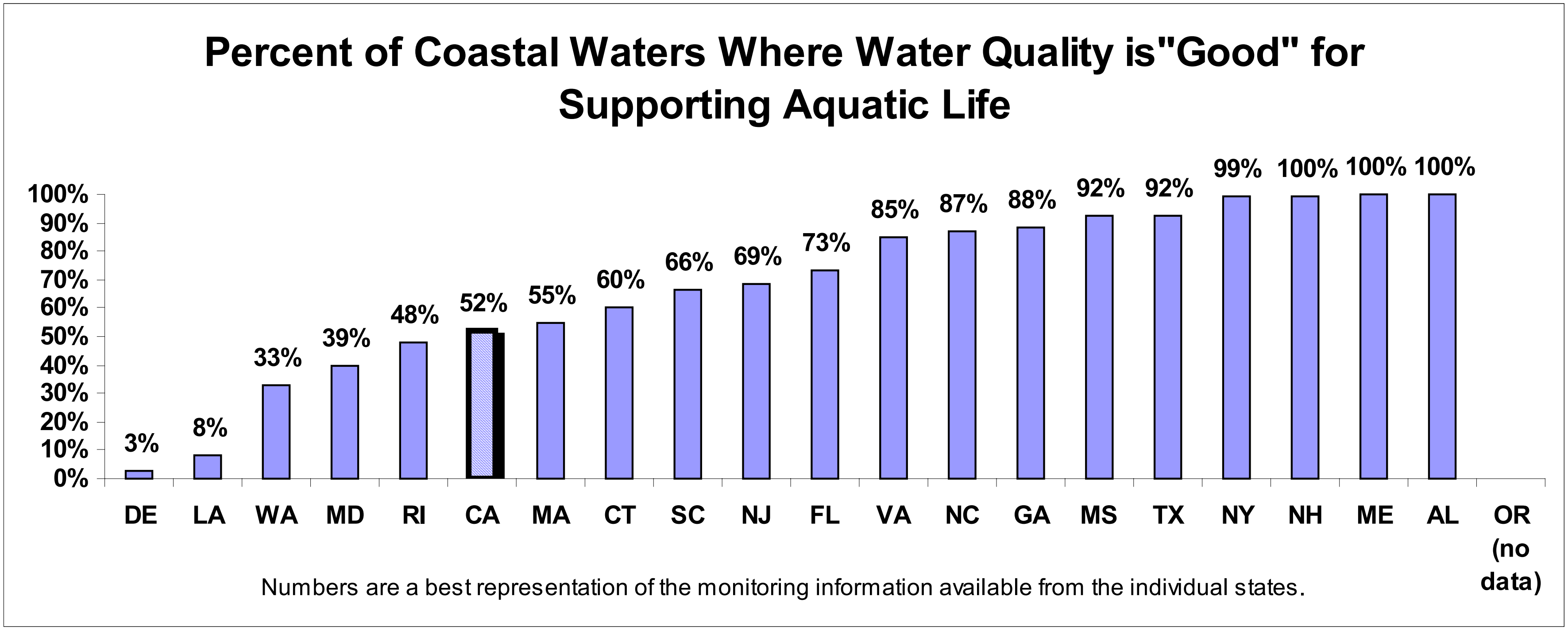
This chart shows, on average, how the water quality of California's coastal waters compare to the water quality of other states for Swimming:



This chart shows, on average, how the water quality of California's coastal waters compare to the water quality of other states for the Production of Fish and Shellfish that are safe to eat:



This chart shows, on average, how the water quality of California's coastal waters compare to the water quality of other states for supporting large numbers of different kinds of fish, birds, mammals and plants:



Now we would like to know whether or not you would support a program that increases the percent of California's coastal waters that are "good" for swimming, eating fish and shellfish, and supporting a large number of different kinds of wildlife.

Currently, taxes on households, industries, and agriculture as well as fines on agriculture and industry pay for the programs that support current water quality. If nothing more is done, the quality of coastal waters will remain about the same.

To improve the quality of the water, new programs will be needed as well as new funds to pay for them.

On the next several screens, we will give you information on programs that improve California's coastal waters. You will be asked to compare two programs at a time with the present conditions and to select which program, if any, you prefer.

The table on the next screen shows the percent of coastal waters that will improve under each of two new programs and the taxes required from each household to fund the new programs.

As you make your choice, please keep in mind the following:

- **Even though each program improves coastal waters in different ways, both would take three years before the improved water returns to "good."**
- **Neither program would improve the quality of freshwater lakes and rivers or coastal waters in other states where swimming and fishing may take place or where a healthy aquatic environment may exist.**
- **Selecting a program means that your household would have less money to spend on other things.**
- **It is already possible in some places in California to swim in and eat the fish from the same coastal waters. These same waters in some cases may also support a healthy aquatic environment.**

	Your Three Choices and How They Would Affect the Quality of California's Coastal Waters **Percent of California's Coastal Waters Rated as "Good"**		
	Present Conditions	**Program 1 (Conditions after 3 years)**	**Program 2 (Conditions after 3 years)**
Swimming	42% of miles are good	_% gain to __% good	_% gain to __% good
Fish and shellfish safe for eating	64% of miles are good	_% gain to __% good	_% gain to __% good
Habitat to support a large number of different kinds of fish, birds, mammals and plants	52% of miles are good	_% gain to __% good	_% gain to __% good
Yearly Tax Change for your household (permanent tax)	No Increase in Taxes	Your taxes increase by $___ per year	Your taxes increase by $___ per year

Q19 Which one of the options listed in the table above would you choose? *(select one answer only)*

- ❒ Present Conditions: No change in your taxes, and the percent of coastal water that is "good" for each purpose stays the same as it is now
- ❒ Program 1: Your taxes increase by $___ [fill with program 1 amount] per year to get the improvements shown under this program
- ❒ Program 2: Your taxes increase by $___ [fill with program 2 amount] per year to get the improvements shown under this program
- ❒ Don't know

For those that choose the Present Conditions (Q19==1):

19A. You chose Present Conditions over the two programs offered. Which of the following reasons BEST describes why you made this choice? (*select one answer only*)

1. The improvements were not large enough for the money.
2. I am satisfied with the way things are now.
3. I am opposed to higher taxes.
4. I do not believe the programs will work as stated.
5. I do not have enough information to make a good decision.
6. I do not trust the government to run the programs well.
7. Someone else should pay for the improvements.
8. Other (Please specify _____________)

For those that choose a program (Q19==2 OR 3):

19b. Which of the following reasons BEST describes why you chose this program? (*select one answer only*)

1. The program I selected was less expensive than the other but still provided some improvements.
2. The program I selected was more expensive than the other but provided larger improvements in areas I care about.
3. The program I selected provided larger improvements than the other in areas I care about.
4. I am most concerned about improvements for swimming and picked the program with the largest improvement in this area.
5. I am most concerned about seafood consumption and picked the program with the largest improvement in this area.
6. I am most concerned about wildlife habitat and picked the program with the largest improvement in this area.
7. I was indifferent between the programs but wanted to pick something.
8. Other (Please specify __________)

The screen before the next choice questions should read:
Now consider two <u>different</u> programs – programs 3 and 4. As before, the table on the next screen shows the percent of coastal waters that will improve under each new program and the taxes required from each household to fund the new programs.

As you make your choice, please keep in mind the following:

- **Even though each program improves coastal waters in different ways, both would take three years before the improved water returns to "good."**
- **Neither program would improve the quality of freshwater lakes and rivers or coastal waters in other states where swimming and fishing may take place or where a healthy aquatic environment may exist.**
- **Selecting a program means that your household would have less money to spend on other things.**
- **It is already possible in some places in California to swim in and eat the fish from the same coastal waters. These same waters in some cases may also support a healthy aquatic environment.**

The screen before the third choice questions should read:
Now consider two <u>different</u> programs – programs 5 and 6. As before, the table on the next screen shows the percent of coastal waters that will improve under each new program and the taxes required from each household to fund the new programs.

As you make your choice, please keep in mind the following:

- **Even though each program improves coastal waters in different ways, both would take three years before the improved water returns to "good."**
- **Neither program would improve the quality of freshwater lakes and rivers or coastal waters in other states where swimming and fishing may take place or where a healthy aquatic environment may exist.**
- **Selecting a program means that your household would have less money to spend on other things.**
- **It is already possible in some places in California to swim in and eat the fish from the same coastal waters. These same waters in some cases may also support a healthy aquatic environment.**

The screen before the fourth choice questions should read:
Now consider two <u>different</u> programs – programs 7 and 8. As before, the table on the next screen shows the percent of coastal waters that will improve under each new program and the taxes required from each household to fund the new programs.

As you make your choice, please keep in mind the following:

- **Even though each program improves coastal waters in different ways, both would take three years before the improved water returns to "good."**
- **Neither program would improve the quality of freshwater lakes and rivers or coastal waters in other states where swimming and fishing may take place or where a healthy aquatic environment may exist.**
- **Selecting a program means that your household would have less money to spend on other things.**
- **It is already possible in some places in California to swim in and eat the fish from the same coastal waters. These same waters in some cases may also support a healthy aquatic environment.**

The screen before the last choice question should read:

Now consider two <u>final</u> programs – programs 9 and 10. As before, the table on the next screen shows the percent of coastal waters that will improve under each program and the taxes required from each household to fund the new programs.

As you make your choice, please keep in mind the following:

- **Even though each program improves coastal waters in different ways, both would take three years before the improved water returns to "good."**
- **Neither program would improve the quality of freshwater lakes and rivers or coastal waters in other states where swimming and fishing may take place or where a healthy aquatic environment may exist.**
- **Selecting a program means that your household would have less money to spend on other things.**
- **It is already possible in some places in California to swim in and eat the fish from the same coastal waters. These same waters in some cases may also support a healthy aquatic environment.**

See attached excel spreadsheet for tax and percent changes for all versions.

Q20a In the last few questions we asked you to consider different programs that would improve coastal water quality. Did you think the improvements would take place in a specific part of California? *(select one answer only)*

❒ Yes (please let us know where you thought the improvements would take place___)
❒ No (skip to Q21a)
❒ Don't Know (skip to Q21a)

Q20b Why did you think the improvements would take place here?

____

Q20c Would you have answered differently if the improvements were to take place somewhere else in California? *(select one answer only)*

❒ Yes
❒ No
❒ Don't Know

(If Q1=”yes”)

Q20d Given that you have limited time and resources, if you could not enjoy coastal water recreational activities at the location of your choice, would you look for another location or would you engage in other activities?

- ❒ Look for another location
- ❒ Do other activities (e.g., swim at neighborhood pool or fresh water lake, fish in freshwater stream or river, play tennis, go shopping, etc.)

Q21a In the questions that asked you to consider different programs that would improve coastal water quality suppose that we told you that all improvements in swimming would take place in “bays,” “estuaries,” or “inlets” rather than in California’s ocean waters directly. Do you think you would have answered these questions differently? *(select one answer only)*

- ❒ Yes
- ❒ No (skip to Q22)
- ❒ Don’t Know (skip to Q22)

Q21b Please take a moment to tell us why?

____

Q21c When we asked you to choose between different programs for improving the water quality of California’s coastal waters, was there anything about the questions or descriptions that seemed confusing?

- ❒ Yes-→What was confusing? ____
- ❒ No

Q21d When we asked you to choose between different programs for improving the water quality of California’s coastal waters, did the programs and their impacts seem believable?

- ❒ Yes
- ❒ No-→Why not? ____

Q21e1. Of the following issues, which do you consider the most important?

- ❒ Pollution of drinking water
- ❒ Pollution of rivers, lakes and reservoirs
- ❒ Contamination of soil
- ❒ Air pollution
- ❒ The loss of natural habitat for wildlife
- ❒ Coastal Water pollution
- ❒ Extinction of plant and animal species

- ❒ Urban sprawl and loss of open spaces

[Only show items that were not selected in previous questions]
Q21e2-Q21e7. Of the remaining issues, which do you consider the most important?

- ❒ Pollution of drinking water
- ❒ Pollution of rivers, lakes and reservoirs
- ❒ Contamination of soil
- ❒ Air pollution
- ❒ The loss of natural habitat for wildlife
- ❒ Coastal Water pollution
- ❒ Extinction of plant and animal species
- ❒ Urban sprawl and loss of open spaces

We would now like to learn a little bit more about you and your household. This last set of questions is for background purposes only. We would like to remind you that all information you provide will be confidential, and your name will not be associated with any responses in this survey.

Q22 Are you a member of an environmental, conservation or outdoor sporting organization? *(select one answer only)*

- ❒ Yes
- ❒ No
- ❒ Don't know

Q40 How many people in your household contributed to your income in 2003?

____________ Number of people

Standard Knowledge Networks Questions

Do you have any comments on the survey in general?

____

Thank You!! We appreciate your help with this important study.
Please feel free to share any comments you have about this survey or the topic of water quality.

The Recreational Benefits of Improvements in New England's Water Quality: A Regional RUM Analysis

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1. Introduction

The purpose of this paper is to measure the economic benefits to recreation from improved water quality in six northeastern states. The states include Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, and Connecticut. All lakes, rivers, and coasts (oceans and bays) in the region are included in the analysis. The benefits are measured using separate random utility maximization (RUM) models for fishing, boating, swimming, and viewing. All models are for day-trip recreation which accounts for approximately 77% of all water based recreation trips in the region. The models are estimated using data from the 1994 National Survey of Recreation and the Environment (NSRE) and water quality modeling simulations based on the National Water Pollution Control Assessment Model, Version 1.1 (NWPCAM1.1) (RTI, 2000).

We consider three welfare scenarios in our analysis. The first two are hypothetical. They assume that all water bodies in the region attain some minimum level of quality. We consider a moderate and then a high level of quality defined by levels of biological oxygen demand, dissolved oxygen, total suspended solids, and fecal coliforms. The third scenario considers a simulation of the actual improvement realized under the Clean Water Act through 1994.

Our paper is organized into 4 sections. Section 2 lays out the RUM models. Section 3 discusses our application and the data. Section 4 presents the parameter estimates and welfare results. Section 5 restates some of the important caveats in our analysis.

2. The Model

We estimate separate models for fishing, boating, swimming, and viewing. Each is estimated in two stages: participation and site choice. The participation model considers the total number of trips a person makes over the season. Site choice considers the site chosen for the last trip taken. A site is a lake, segment of a river, or segment of a coastline. The two models are linked using an approach suggested by Bockstael, Hanemann, and Kling (1987) and latter adapted by Hausman, Leonard, and McFadden (1995).

It is easiest to describe the model beginning with site choice. An individual is assumed to visit one of S possible recreation sites on a given day. Let $i = 1,..., S$ denote a site. Each site i gives a person utility U_i . This site utility depends on the cost of reaching the site and the characteristics of the site

(1) $$U_i = tc_i \beta_{tc} + x_i \beta_x + \varepsilon_i$$

where tc_i is the trip cost of reaching site i , x_i is a vector of characteristics of site i , and ε_i is a random term. The βs are parameters to be estimated. The vector x_i includes characteristics of the sites that matter to individuals when making site choice – water quality, access and so forth.

A person is assumed to visit the site that gives the highest utility. That utility is called the person's trip utility and is defined as

(2) $$V = Max\{U_1, U_2,....,U_S\}.$$

Substituting equation (1) into (2) gives

$$(3) \qquad V = Max\{tc_1\,\beta_{tc} + x_1\,\beta_x + \varepsilon_1, tc_2\,\beta_{tc} + x_2\,\beta_x + \varepsilon_2, ..., tc_S\,\beta_{tc} + x_S\,\beta_x + \varepsilon_S\}$$

Now consider a change a water quality at one or more sites. Assume that x_i represents site characteristics at site *i* without an improvement in water quality and assume that x^*_i represents site characteristics at site *i* with an improvement. Only the element pertaining to water quality in x_i has changed between the two states of the world. For some sites there may be no change.

Without the change in water quality a person's trip utility is V shown in equation (3). With the change in water quality and assuming the change only takes place at sites 1 and 2, trip utility is

$$(4) \qquad V^* = Max\{tc_1\,\beta_{tc} + x^*_1\,\beta_x + \varepsilon_1, tc_2\,\beta_{tc} + x_2\,\beta_x + \varepsilon_2, ..., tc_S\,\beta_{tc} + x_S\,\beta_x + \varepsilon_S\}$$

The change in utility due the water quality improvement is

$$(5) \qquad \Delta w = V^* - V \;.$$

If a person visits site *k* without the improvement in water quality, but chooses to visit site 1 now that it is cleaner, trip utility increases by $\Delta w = U^*_1 - U_k$. If the person visited site 1 without the water improvement and continues to visit site 1 with the improvement, trip utility increases by $\Delta w = U^*_1 - U_1$. The person makes the same trip but enjoys cleaner water. If the person visited site *k* without the improvement and continues to visit site k after the improvement there is no change in welfare. Perhaps sites 1 and 2 are located far from the person's home or have other features the person dislikes. Finally, if there is a relative change in water quality at sites 1 and 2, the person may shift from one site to the other and have a change in welfare. For example, a shift from site 1 to 2 would give an increase of $U^*_2 - U_1$. In any case all of these pathways to utility change are captured in equation (5) in Δw.

The change in trip utility is converted to money terms by dividing Δw. by the negative of the coefficient on trip cost. In the RUM model $-\beta_{tc}$ is a measure of the marginal utility of income. It tells us how much an individual's site utility would increase if trip cost were to decline for that trip. The increase in welfare due to an improvement in water quality at sites 1 and 2 is

$$(6) \qquad cs = \Delta w \,/ -\beta_{tc} \;.$$

In application, we use an expected value for Δw. because its actual value is random and unknown. To see this substitute equations (3) and (4) into equation (5). Assume the parameters β are known or estimated. Since each site utility has a random component ε_i, Δw . and *cs* must also be random. For this reason, the statistical expected values of V and V^* are used in application. The expected increase in welfare due to a water quality improvement is

$$(7) \qquad cs = \{E(V^*) - E(V)\} / -\beta_{tc}$$

where E denotes an expected value over the site utilities and will depend on the distribution of the errors terms in each site utility. Equation (7) gives a per trip value for the change in water quality.

The site choice model is usually estimated using some form of a multinomial logit model. We use a simple logit model in our application. A person's probability of visiting site k on a given choice occasion in a simple logit model is

$$(8) \qquad pr(k) = \exp(tc_k\beta_{tc} + x_k\beta_x) / \sum\exp(tc_i\beta_{tc} + x_i\beta_x) .$$

This form applies for any site and implies the following log-likelihood function

$$(9) \qquad \Lambda(\beta) = \prod\prod d_i^j \ln pr(i)$$

where $d_i^j = 1$ if individual j visited site i and $d_i^j = 0$ if not. The $pr(i)$ in equation (9) takes the form shown in equation (8). This function gives the likelihood of observing the patterns of visits actually observed a dataset. The parameters β are chosen to maximize $\Lambda(\beta)$. These estimated parameters, in turn, may be used to estimate per trip welfare shown in equation (7). In the simple logit model expected trip utility takes the form

$$(10) \qquad E(V) = \ln\sum\exp(tc_i\beta_{tc} + x_i\beta_x) .$$

This is sometimes called the 'inclusive value'. The per trip value of a water quality improvement then is

$$(11) \qquad \text{cs} = \{ \ln\sum\exp(tc_i\beta_{tc} + x^*_i\beta_x) - \ln\sum\exp(tc_i\beta_{tc} + x_i\beta_x)\} / -\beta_{tc}$$

where x^*_i is with the improvement and x_i is without.

Our participation decision models the number of trips an individual takes during a year. The participation function takes the Poisson form

$$(12) \qquad pr(R_j = r_j) = e^{-\lambda j}\lambda^{rj}_j / y_j! \qquad\qquad \ln\lambda_j = \alpha_u(\hat{\Gamma}_j) + \alpha_z z_j$$

where r_j is the number of trips taken by person j during the season. $\hat{\Gamma}_j = E(\hat{V}) / -\hat{\beta}_{tc}$ is a monetized utility index or consumer surplus for a recreation trip predicted using the parameter estimates from the site choice model. The vector z_j is a set of individual characteristics for person j believed to influence trip taking, like family size, age and so forth.

This is Hausman, Leonard, and McFadden's (1995) formulation of the participation model. It is a simple adaptation of Bockstael, Hanemann, and Kling's (1987) model. The adaptation is the monetization of the expected utility. Since this is a linear transformation of a scalar, the models are the same. The transformation merely rescales the parameter estimate on the index. Neither model is strictly utility theoretic.

Using an estimated participation model in a Poisson form, Hausman, Leonard, and McFadden (1995) show that the annual change in welfare due an improvement in water quality like that discussed above is

(13) $CS = (\hat{r}^{*}_{j} - \hat{r}_{j}) / \hat{\alpha}_{u}$

where $\hat{r}^{*}_{j}$ and $\hat{r}_{j}$ are predicted values of trips for person *j* from the participation model with and without the change in water quality, and $\hat{\alpha}_{u}$ is the coefficient on $\hat{I}_{j} = E(\hat{V}) / -\hat{\beta}_{tc}$ in the same model. See Parsons, Jakus, and Tomasi (1999) for more detail on the participation function.

3. Application and Data

Our application is to six northeastern states: Maine, New Hampshire, Vermont, Massachusetts, Connecticut, and Rhode Island. All rivers, lakes, and coasts in the region are included in the analysis. The data are from two sources. The trip and respondent characteristic data are from the 1994 National Survey of Recreation and the Environment (NSRE94). The site characteristic data were developed using NWPCAM1.1, a national water quality simulation model that is built around the RF1 river/stream network database (EPA's Reach File 1).

In the NSRE94 individuals throughout the United States were contacted at random by phone and asked to report the total number of day and overnight trips taken separately for viewing, boating, fishing, and swimming at domestic water-based recreation sites over the past twelve months. See Appendix A for the survey questions defining recreation uses. Each person was also asked to report the site visited on the last trip for each type of recreation and to report the location of his or her hometown. As usual demographic data were gathered for each respondent. This included income, age, job status, family size, and other characteristics. Our sample includes all individuals surveyed from the six northeastern states. Our sample size is 632. Table 1 presents descriptive statistics over the sample population. Our analysis is for day trips only. The participation rates and average number of trips for each type of recreation are

Recreation Use	Percent of the Sample Taking at Least One Day Trip to a Water-based Recreation Site Over the Past 12 Months (n = 632)	Average Number of Day Trips Taken by People Taking at Least One Trip During the Year
Viewing	25%	7.08
Boating	14	8.80
Fishing	12	10.06
Swimming	24	10.05

These rates are from the general population and exclude overnight trips. About 77% of all trips were day-trips. Our analysis accounts for most of the day-trips taken to sites in the region -- less than 3% of the "last trips" in the NSRE94 to the six states were taken by residents outside the region. The average distances traveled on a day trip in our sample and average distance to all sites in the choice set are

Recreation Use	Average Distance Traveled On Day Trips (miles)	Average Distance to all Sites in the Choice Set (miles)
Viewing	72	104
Boating	61	104
Fishing	50	104
Swimming	54	104

The maximum distance to a site in the choice set is 200 miles. Again, these are day trips only and ignore trips taken by persons outside the region.

The site characteristic data were constructed using NWPCAM 1.1 and the EPA's RF1 database. There are 20,925 rivers, 2,975 lakes, and 1,231 coasts in the data set. A site on a river is defined as a stretch of river from one confluence to another without a major tributary, lake, or population center intervening. If a major tributary, lake, or population center is passed, a new site is defined. A coastal site is defined as the coastal line along a bay or ocean between the mouth of a major river or beginning of a new municipality and the mouth of another major river or beginning of a new municipality. The lake data set is all major lakes and ponds in the region. A single lake, no matter how large, is never divided into more than one site.

Site-specific water quality data were estimated using NWPCAM 1.1 (RTI, 2000). In this model, place-specific pollutant loadings from both point and nonpoint sources across the nation are linked and routed through the RF1 surface water network. The model incorporates a hydrodynamic and water quality modeling algorithm that allows it to estimate instream pollutant concentration throughout the network for dissolved oxygen (DO), biological oxygen demand (BOD), total suspended solids (TSS) and fecal coliform bacteria (FCB).

In our application we estimate separate models for each recreation type. Because of the large number of sites in each person's choice set, we estimate the model using a random draw of sites. Each person's choice set includes his or her actually chosen site plus 36 other randomly drawn sites. Each choice set for estimation is composed of 12 rivers, 12 lakes, and 12 coasts. See Parsons and Kealy (1992) for more on estimation with randomly drawn choice sets.

Each model considers four basic attributes for site utility in equation (1): trip cost, resource type, choice set size, and water quality. Trip cost is the sum of travel and time cost

(14) $tc = (.35 + rtdist) + (income / 2040) * (rtdist / 40)$

where rtdist is round trip distance and income is annual income. Round trip dist is the linear distance between each site and a person's hometown. Travel cost is assumed to be 35 cents per mile. The opportunity cost of an hour is approximated using annual income divided by 2040 which is the typical number of hours worked in a year. The average travel speed is assumed to be 40 miles per hour.

Resource type is a set of dummy variables distinguishing river, lake and coastal sites. Choice set size is a control variable to account for the fact that even though each person has the same number of alternatives in the choice set in estimation (36 sites), in reality some will have far more than others. Persons with larger choice sets, all else constant, are more likely to take a trip.

Water quality is defined as low, medium, or high. This is an index based on the levels of biological oxygen demand, total suspended solids, dissolved oxygen, and fecal coliform. The cut offs for high and medium are

	Biological Oxygen Demand (mg/L)	Total Suspended Solids (mg/L)	Dissolved Oxygen (% saturation)	Fecal Coliforms (MPN/100mL)
High Water Quality	<1.5	<10	>.83	<200
Medium Water Quality	<4	<100	>.45	<2,000

All four object measures must be below (or above in the case of dissolved oxygen) the cutoffs shown before the site is classified as having that quality level. If any single characteristic falls short of its cut off for medium quality, the site is classified as low quality. Sites with low water quality have no plant or animal life and often have visible signs of pollution (trash, oil). Site with medium water quality have some game fishing and usually few visible signs of pollution. Sites with high water quality are suitable for extensive human contact, have the highest natural aesthetic, and support high quality sport fisheries.

The water quality data are based on NPWCAM1.1 pollutant loading data and water quality modeling results (for mid-1990's conditions). Coastal water quality is based on the predicted water quality at the mouths of nearby rivers. In some instances, watershed averages are used when data were missing from the simulation results. The distribution of water quality across sites is

	Percent of all Rivers	Percent of all Lakes	Percent of all Coasts
High Quality	49.9%	28.5%	30.8%
Medium Quality	36.4	59.9	37.7
Low Quality	13.7	11.6	31.5

Site utility takes the following form in our application

$$(15)\qquad U^m_i = \beta^m_{tc} tc_i + \beta^m_r riv_i + \beta^m_c cst_i + \beta^m_{hi} hwq_i + \beta^m_{mid} mwq_i + \ln(size) + \varepsilon^m_i$$

where *i* denotes a site and m denotes a recreation use (*m* = viewing, boating, fishing, or swimming). The choice set size variable is estimated with its coefficient set equal to one since it is entered as a weighting factor only. This gives us 20 parameters to estimate in the site choice model -- 5 parameters in each of the four models. More complex versions of the model which included site size, separate measures for each objective water quality measure in our index, and an intermediate step in water quality between our high and medium gave rise to models that failed to converge and in the isolated cases where convergence was achieved gave results that ran strongly against our priors.

Four participation models, one for each recreation use, were estimated separately in Poisson form and included the attributes shown in Table 1. The expected utility index $(\hat{I}_j / -\beta_{tc})$ in these regressions was constructed from the relevant site choice stage. All participants and nonparticipants were included in each regression. Attempts to estimate the model by full information maximum likelihood, once again, lead to convergence problems. The results shown here are based on sequential estimation.

We consider three welfare scenarios using our model. The first two assume water quality at all sites attains some minimum level. The first assumes water quality attains at least a medium level as defined above at all sites in the region. Under this scenario 13.7% of all rivers, 11.6% of all lakes, and 31.5% of all coasts realize water quality improvements. The second assumes water quality attains a high level of quality at all sites. This is a significant improvement in water quality in the region affecting 50.1% of all rivers, 71.5% of all lakes, and 69.2% of all coasts over the six northeastern states.

The last scenario considers the water quality we are likely to have realized in 1994 in the absence of the Clean Water Act and assuming no state, local, or judicial controls were otherwise established. In this scenario we assume water quality improves from a hypothetical ‘no-CWA’ state of the world to current conditions. This is approximately the recreational benefits realized due to the existence of the Clean Water Act in 1994. The ‘no-CWA’ conditions were estimated using the same simulation model used to estimate current conditions. Pollutant loadings were adjusted in that model to reflect loads likely to have been attained in the absence of the Clean Water Act. To get an idea of how the CWA simulation is changing water quality in the model, consider the following table. The table reports the value of the ratio

$$\frac{\text{Number of sites at quality level wq with the improvement}}{\text{Number of sites at quality level wq without the improvement}}$$

where wq = low, medium or high. The table shows the degree of shift from lower to higher quality sites.

	River Ratio	Lake Ratio	Coast Ratio
high	1.25	1.44	1.10
medium	1.01	.94	1.17
low	.56	.07	.79

The next section presents the parameter estimates and welfare results for each of these scenarios.

4. Parameter Estimates and Welfare Results

The parameter estimates for the site choice model are shown in Table 2. For the most part, the signs are as expected. The coefficient on trip cost is negative and significant in all four models. Recall that this variable is used as the marginal utility of income and is important in converting measures of utility change into dollars. The coefficients on the resource type dummies suggest that coasts, all else constant, are the most important resource for recreation use. Recall that lake is the excluded category so the resource type coefficients are interpreted relative to lakes. The coefficient on coast is highest for viewing and lowest for fishing. The coefficient on river suggests that river sites, all else constant, are the lowest valued among the three resource types except for boating. There are a number of large rivers in the region where boating is quite popular. This, no doubt, accounts for the result on boating. The negative river coefficient for swimming is largest capturing the infrequent use of rivers in this activity.

The coefficient on middle WQ is positive and significant in two of the four models – fishing and swimming. This implies that moving from low to middle level water quality imparts benefits mostly to fishing and swimming uses. Between these two recreation types the utility is increased most for fishing. Boating also has a positive but insignificant coefficient on middle WQ. Viewing has a negative and insignificant coefficient. Modest improvements in water quality appear to yield little or no increase in utility for these recreation uses.

The coefficient on high WQ is positive and significant in all four models as one would expect. The coefficients also show that high water quality gives higher utility than middle water quality. Again, going from low to high water quality, the utility increase is greatest for fishing and swimming. However, the coefficients on viewing and boating imply utility increases for these recreation uses as well. It is interesting to note that for fishing most of the increase in utility comes from moving from low to middle water quality. For viewing and boating almost all of the utility increase comes from moving from middle to high water quality.

The results of the Poisson models are shown in Table 3. The coefficient on the monetized utility index (expected utility or inclusive value from the site choice stage divided by the negative of the 13 coefficient on trip cost) is positive in all four regressions. This coefficient gives us some idea of how responsive participation in each recreation use will be to improvements in water quality. Viewing and fishing participation are the most responsive to improvements. Swimming is somewhat less responsive and boating shows little if any responsiveness.

Income has a positive effect on viewing, boating, and fishing participation and a negative affect on swimming. Urbanities have lower participation rates in all uses, all else constant, but the effect is insignificant in the viewing model. As one ages the probability of participating in all four recreation uses decreases. Retired folks have a higher probability of participating in boating and fishing and a lower probability in viewing and swimming. Men have higher probabilities of participating in boating and fishing, and women in viewing and swimming. Education level increases ones probability of participating in all uses except for fishing where it has a negative and significant affect on participation. Unemployed also increases the probability for all uses except fishing but the coefficient is insignificant. Being a student increases the likelihood that you will participate in viewing and swimming. Being a homemaker increases your likelihood for swimming only. Larger families have higher probabilities for viewing and boating. Having more leisure hours increases one's probability of participating in all uses but fishing. And finally, owning a boating dramatically increases one's probability of boating and fishing and to a lesser extent viewing. We excluded boat ownership from the swimming model.

Now we turn to annual benefit estimates for water quality improvements. The annual average per person benefits over all resource types for our three scenarios are as follow

	Viewing	Boating	Fishing	Swimming
All sites improve to middle WQ	—	$.04	$3.14	$5.44
All sites improve to high WQ	$31.45	$8.25	$8.26	$70.47
Improvements due to Clean Water Act (CWA)	$.47	$.62	$2.40	$5.59

These averages include participants and nonparticipants and are computed using equation (13).[1] The first two scenarios use current conditions as the baseline. The CWA scenario uses pre-CWA water quality as the baseline. Table 5 shows the same results for each scenario by recreation use and separately for improvements to rivers only, lakes only, and coasts only.

For modest improvements in water quality (to middle WQ) almost all of the benefits go to fishing and swimming. The annual fishing benefit is about $3 per person. The annual swimming benefit is about $5. Again, this includes participants and nonparticipants. Table 5 shows a negative benefit for viewing due to the negative coefficient on middle WQ in the view model. In the table above, I have simply recorded no benefit for viewing. Table 5 also shows that most of the swimming benefit is coming from cleaning up the coast, and most of the fishing benefit is coming from the clean up of coasts and lakes.

For significant improvements in water quality (to high WQ), all four recreation uses realize benefits and the benefits are must larger. Swimming and viewing are the highest at $70 and $31 per person. Boating and fishing are about $8 per person. For fishing 38% this benefit is realized in moving from low to middle quality, and 62% is realized in moving from middle to high quality. For swimming the same incremental benefits are 8% and 92%. And, as noted earlier for viewing and boating, nearly all of the benefit is realized in the second increment. Most the benefits are coming through a clean up of the coastlines.

[1]Per trip values using equation (11) are also provided Table 4. Since annual values are typically of more interest for policy we focus our discuss on these.

For improvements due the Clean Water Act, all recreation uses realize benefits. Swimming and fishing are the largest at $6 and $2 per person. Viewing and boating are positive but less than $1 per person. In this case the source of most of the benefits are the rivers and lakes where the CWA has had it largest effect.

Table 6 shows aggregate benefits for each scenario. These are calculated by multiplying the mean per person benefit for each state by its population in 1994 over the age of 16. All numbers are in 1994 dollars. Summarizing Table 6, we have

	All sites Attain medium WQ	All sites attain high WQ	Due to the Clean Water Act
Total Benefit in Millions of 1994 Dollars	$77	$1,295	$99
Distribution of Total Benefits by recreation use:			
Viewing	0%	26%	5%
Boating	0%	7%	7%
Fishing	36%	7%	26%
Swimming	63%	60%	61%

The aggregate benefits to the region range from $ 77 million for improvements to medium water quality to $1.3 billion for improvements to high water quality. Again the benefits go mostly to swimming and fishing for a medium clean-up. The benefits go mostly to swimming and viewing for improvements to high water quality. Overnight trips, non-recreation use, and nonuse values are excluded from these numbers.

The aggregate benefits due to the Clean Water Act in 1994 dollars are $99 million. These estimates assume the controls set by the Act are not in place and are not replaced by any state, local or judicial controls. The estimates are based on RTI's simulation model. The benefits go mostly to fishing and swimming.

5. Caveats

While our models give plausible results for broad changes in water quality across the region, several caveats in the research are worth repeating.

◊ Using finer measures of water quality in the RUM model persistently led to complications in the econometrics, usually a model that failed to converge. By finer measures, we mean using the objective water quality variables separately and having an intermediate step between high and medium quality.

◊ More complex specifications (nested and mixed logit models), models with more site characteristics, and estimating by full information maximum likelihood, also created problems with convergence and implausible parameter estimates.

◊ There is no coastal water quality simulation model per se. The RTI model essentially uses water quality estimated from the mouths of rivers near coastal sites. And, the coastlines are by far the most aggregated sites. Since coastlines were the source of many of the benefits, caution is warranted.

◊ Water quality data at a site level were not available for many lakes in our data set. For these lakes we used a watershed average water quality.

◊ Our baseline pre-CWA water quality levels assume no local, state, or judicial action in the absence of the CWA. This is an extreme position that leads to some overstatement of the benefits attributed to the CWA.

◊ Our benefits measures exclude overnight trips, non-recreation uses of the water, some smaller water bodies, and nonuse value. This leads to some understatement of the benefits for each scenario.

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Table 1: Descriptive Statistics

	Description	Sample Mean
Income	Annual income	$56,574
Urban	Urban dummy (=1 if live in an urban area)	.18
Age	Age	43
Retired	Retirement dummy (=1 if retired)	.18
Gender	Gender (=1 if male)	.42
Education	Level of education (scale 1-5)	4.4
Unemployed	Unemployment dummy (=1 if unemployed)	.13
Student	Student dummy (=1 if full time student)	.10
Homemaker	Homemaker dummy (=1 if homemaker)	.22
Family Size	Number of people in family at home	2.9
Leisure Hours	Leisure hours per week	21.8

Table 2: Random Utility Model of Site Choice

	Viewing	Boating	Fishing	Swimming
Price	-.042 (33.1)	-.062 (24.8)	-.055 (21.1)	-.030 (36.0)
River	-.090 (5.6)	.716 (3.9)	-.689 (4.4)	-5.489 (7.7)
Coast	4.59 (37.7)	3.54 (24.1)	1.865 (11.2)	3.69 (44.2)
High WQ	.421 (2.56)	.496 (1.73)	.912 (3.16)	.881 (6.7)
Middle WQ	-.136 (1.4)	.016 (0.1)	.898 (4.94)	.325 (3.6)
Log-Likelihood	-.335	-5.13	-4.91	-13.44

Table 3: Poisson Participation Model

	Viewing	**Boating**	**Fishing**	**Swimming**
LOG INCLUSIVE/β_{tc}	0.0064 (13.498)	0.0012 (1.226)	0.0051 (5.772)	0.0017 (5.006)
INCOME	0.98E-06 (1.459)	0.31E-05 (3.664)	0.77E-05 (10.942)	-0.24E-05 (-3.873)
URBAN	-0.0134 (-0.222)	-0.8017 (-6.269)	-0.8967 (-8.321)	-0.1391 (-2.291)
AGE	-0.0125 (-6.249)	-0.0230 (-7.541)	-0.0212 (-8.570)	-0.0145 (-7.248)
RETIRED	-0.5016 (-3.663)	1.1352 (5.069)	0.5027 (3.576)	-0.8049 (-6.642)
GENDER	-0.4950 (-9.869)	0.1895 (2.568)	1.2663 (15.552)	-0.2319 (-4.724)
EDUCATION	0.1314 (9.000)	0.0406 (1.848)	-0.1668 (-8.981)	0.2254 (16.362)
UNEMPLOYMENT	-0.6402 (-4.955)	-0.6904 (-3.356)	0.0602 (0.534)	-0.2889 (-2.586)
STUDENT	0.6564 (10.351)	-0.3914 (-3.220)	-0.5052 (-4.611)	0.2846 (4.351)
HOMEMAKER	-0.6104 (-8.014)	-1.0769 (-6.087)	0.0310 (0.243)	0.3243 (5.616)
FAMILY SIZE	-0.0407 (-2.673)	-0.1185 (-4.285)	0.0642 (3.516)	0.1240 (11.243)
LEISURE HOURS	0.0081 (8.444)	0.0040 (3.353)	-0.0037 (-2.339)	0.0079 (8.889)
BOAT OWNED	0.5422 (4.400)	2.7759 (34.360)	1.7806 (26.152)	--
Log-Likelihood	-3708	-1176	-2229	-3878

Table 4: Mean Per Trip Benefits Per Person (1994$)

	Viewing	Boating	Fishing	Swimming
Due to Clean Water Act:				
All Sites	$0.22	$0.49	$1.45	$1.69
Rivers Only	0.10	0.28	0.45	0.01
Lakes Only	0.13	0.12	0.58	0.72
Coasts Only	-0.03	0.07	0.38	0.93
Sites Attain Middle WQ:				
All Sites	-0.48	0.03	1.67	1.48
Rivers Only	-0.01	0.003	0.13	0.0006
Lakes Only	-0.05	0.007	0.87	0.31
Coasts Only	-0.41	0.02	0.70	1.19
Sites Attain High WQ:				
All Sites	9.75	5.99	3.87	19.43
Rivers Only	0.82	1.82	0.76	0.03
Lakes Only	2.17	1.63	1.10	5.96
Coasts Only	7.41	3.07	2.19	15.29

Table 5: Mean Annual Benefits Per Person (1994$)

	Viewing	Boating	Fishing	Swimming
Due to Clean Water Act:				
All Sites	$0.47	$0.62	$2.40	$5.59
Rivers Only	0.21	0.36	0.72	0.03
Lakes Only	0.38	0.17	0.95	2.58
Coasts Only	-0.13	0.07	0.65	3.04
Sites Attain Middle WQ:				
All Sites	-1.61	0.04	3.14	5.44
Rivers Only	-0.02	0.003	0.54	0.002
Lakes Only	-0.15	0.01	1.29	1.06
Coasts Only	-1.43	0.03	1.34	4.41
Sites Attain High WQ:				
All Sites	31.45	8.25	8.26	70.47
Rivers Only	2.25	2.51	1.86	0.11
Lakes Only	6.21	2.39	1.73	21.20
Coasts Only	24.67	4.01	4.39	55.50

Table 6: Annual Aggregate Benefits (millions of 1994$)

	Viewing	Boating	Fishing	Swimming	Total
Due to Clean Water Act:					
All Sites	$5.120	$6.893	$26.298	$61.085	$99.333
Rivers Only	2.336	3.990	7.921	0.292	14.539
Lakes Only	4.198	1.850	10.431	28.271	44.749
Coasts Only	-1.410	0.744	7.077	33.214	39.625
Sites Attain Middle WQ:					
All Sites	-17.614	0.418	34.340	59.490	76.634
Rivers Only	-0.242	0.035	5.903	0.019	5.715
Lakes Only	-1.650	0.092	14.151	11.639	24.233
Coasts Only	-15.691	0.290	14.688	48.220	47.506
Sites Attain High WQ:					
All Sites	344.015	90.268	90.318	770.725	1295.326
Rivers Only	24.558	27.499	20.312	1.152	73.520
Lakes Only	67.958	26.128	18.939	231.838	344.863
Coasts Only	269.766	43.815	48.028	606.958	968.567

Appendix A
Survey Questions Defining Four Recreation Uses

Boating

Did you leave from your home to take any trips or outings where the primary purpose was to go boating in the last 12 months? Boating inludes trips to go motorboating, sailing, windsurfing, canoeing or kayaking, rowing, tubing or other floating. Please do not include trips taken for any other primary purpose such as swimming, fishing, or to just be near water.

Fishing

Did you leave from your home to take any trips or outings where the primary purpose was to go fishing in the last 12 months? Please do not include trips taken for any other primary purpose such as swimming, boating, or to just be near water.

Swimming

Did you leave from your home to take any trips or outings where the primary purpose was to go swimming outdoors in something other than a pool in the last 12 months? Please do not include trips taken for any other primary purpose such as fishing, boating, or to just be near water.

Viewing

Did you leave from your home to take any trips or outings where the primary purpose was to visit a beach or waterside in the last 12 months? Please do not include trips taken for any other primary purpose such as fishing, boating, or swimming. Please include trips for example, your picnics, nature study outings, and vacations, where you purposely chose to be by the water.

Valuing Water Quality Changes Using a Bioeconomic Model of a Coastal Recreational Fishery

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ABSTRACT:

Most previous studies on the effects of water quality on recreational fishing have focused on a single element in the chain of effects that connect water quality changes to the welfare of anglers. Due to a scarcity of detailed water quality data, most of these studies have also been forced to examine water quality effects across large aggregated areas. The result is a large number of studies that are difficult to combine to evaluate specific water quality policies in a comprehensive manner. This paper describes a bioeconomic model of a coastal recreational fishery that combines standard models of fish population dynamics, angler catch, and recreation site choice. We use a structural modeling approach that allows us to combine a variety of data sources and provides more flexibility for evaluating various water quality policies than most previous valuation models.

First, we develop a population model that describes the influence of water quality on overall fish abundance through the effects of dissolved oxygen (DO) on the survivorship of young juvenile fish. The population model is based on data on survival, reproduction, and the effects of DO on juvenile fish from the fisheries science literature and government reports. The model is calibrated using average historic recreational harvest levels in and out of the study area and historic commercial harvest levels for the entire fishery.

Second, we estimate a catch model that describes the influence of fish abundance and water quality on anglers' average catch rates. The catch model is estimated using a combination of three data sources. First, we use monthly data on water quality conditions from 23 water quality monitoring stations distributed throughout Maryland four coastal Bays. Next, we incorporate catch data from a sample of anglers who fished for summer flounder. Each fisherman reported their date and location fished, catch, fishing methods, and some personal characteristics. Lastly, we include a measure of fish abundance from fishery-independent data collected in bottom trawl surveys, all in

Maryland's coastal bays in 2002. The disaggregated nature of this data allows us to estimate spatially and temporally varying catch rates.

Third, we estimate a recreation demand model that describes the welfare effects and changes in trip demand from changes in catch rates. The recreation demand model is based on data from a stated choice survey of anglers who fish for summer flounder on the Atlantic coast. In the survey, respondents were asked to choose between two flounder fishing trips of varying quality (catch, regulations, cost, etc.) and a "do something else" option. Using this model we estimate the value of several changes in water quality typically valued in the literature and changes in participation rates.

Next, we integrate the population, catch, and recreation demand models to create a bioeconomic model that accounts for the feedback on the fish population through changes in the overall harvest pressure in the recreational fishery on the fish stock. The bioeconomic model is used to estimate the aggregate benefits to recreational anglers from several illustrative scenarios of changes in water quality. Results indicate that improving water quality throughout the range of the species could lead to substantial increases in the fish population and associated benefits to recreational anglers from increased catch rates. Water quality improvements confined to Maryland's coastal bays alone would have much smaller impacts. Because DO appears to only weakly affect the "catchability" of summer flounder (i.e., the average angler catch conditional on fish abundance); the largest effects predicted by the model come from the long run impact of DO on fish abundance through its affect on juvenile survival. This finding suggests that studies that simply include DO measures as site characteristics (and as a proxy for short run catchability effects) may be missing the major (long term) effects of DO on fish and fishermen. Important areas for improved data collection and model development are also discussed.

Valuation of Ecological Benefits: Improving the Science Behind Policy Decisions
Workshop Sponsored by the U.S. EPA
Wyndham Washington Hotel
Washington, DC
October 26-27, 2004

Session II: Cleaning Our Coastal Waters: Examinations of the Benefits of Improved Water Quality

Discussant: Bob Leeworthy, Leader Coastal and Ocean Resource Economics Program, Special Projects, National Ocean Service, National Oceanic and Atmospheric Administration

The Value of Improvements to California's Coastal Waters: Results From a Stated-Preference Survey, by Nicole Owens and Nathalie Simon

Comments:

1. The procedures followed in designing the survey questionnaire and sample design were very good. In reviewing the paper, I was quite surprised that the same procedures were used that we at NOAA are currently using in designing a survey to value the coral reefs in Hawaii. The use of focus groups, protocol interviews (one-on-one interviews with debriefings), a large-scale pre-test, and final survey with peer review used seems to have become a standard model. And, I think the model is a good one. It appears much was learned in the process and significant changes in both questionnaire and sample design as a result.
2. The decision to switch from a contingent valuation approach to a state-preference approach appears to be a good decision. This approach seems better fitted to the problem and the approach seems to have strong scientific backing.
3. The use of an Internet Panel (Knowledge Networks) also appears to be a good decision. The use of Knowledge Networks Internet Panels has not been fully endorsed to date for policy/management application by the U.S. Office of Management and Budget (OMB). Several papers to be presented at this workshop demonstrate that Knowledge Network's Internet Panels can provide "representative samples" for a variety of applications, especially for environmental/ecological benefit estimation. So again, I think the sample design used has scientific support. As a note, we at NOAA are also planning to use Knowledge Network's Internet Panel for our study to estimate the economic value of Hawaii's Coral Reefs. We will seek nothing less than approval to apply to policy/management. Again, I believe the science presented at this workshop supports that decision.
4. I have some problems with a couple of the survey questions. Specifically, Questions 3 and 4.

   Q3. Does your household own a boat that is <u>used primarily on coastal waters</u>?
   Q4. For which activity do you use your boat <u>the most</u> on coastal waters?

__ recreational fishing
__ recreational boating
__ commercial fishing
__ charter boat rides
__ charter fishing trips
__ other (please specify) ___________________

I am not sure how this information can be used. Using the qualifier in Q3 that the boat had to be primarily used on coastal waters doesn't make sense to me. I think a great deal of information is lost for a variable, which might be an important explanatory variable.

If I use my boat 51% of the time in freshwater and 49% of the time in coastal waters, this question says it is not important to know that I use my boat 49% of the time in coastal waters. Many studies have identified boat ownership as an important variable in explaining use and use value. Conditioning use to primarily used is potentially losing important information.

A similar problem exists with Q4. Conditioning the identification of activity to the most use looses potentially important information. From 1987 to 1992, we conducted the Public Area Recreation Visitors Survey (PARVS) at 50 coastal sites from Maine to Washington. What we learned was that for coastal sites with multiple attributes, people engaged in multiple activities. And, at very few sites did a majority of users indicate that there was one activity that was the "main reason for visiting the site" or the "main activity" they participated in during the visit to the site. I would have changed to check all that apply and possibly followed this up with estimates of the number of days of each activity over the past 12 months in coastal waters. You could use responses here to identify the most important use based on relative days of use.

5. A similar problem exists for Q9. Why limit information on trips to single day trips? Are multiple-day trips of no value? In the Florida Keys, very few trips are day trips. And almost all trips are multiple activity trips with no activity being either the "main reason for the trip" or the "main activity" on the trip. Coastal water quality is critical to the Florida Keys. In 1995-96, we estimated over 2.5 million visitors spent over 13 million days in outdoor recreation activity. I think you are missing a significant amount of activity by limiting your analysis to day trips. I would agree that, because you are limiting the current application to residents of California, day trips will be a relatively high percent of trips, but I still don't understand the logic of dropping this portion of total activity dependent on coastal water quality.
6. It was never made clear why the trip questions were being asked. Will there be an attempt to do a revealed preference set of trip models using the random utility model approach? If so, was there any thought to designing a revealed preference

approach consistent with the stated-preference approach i.e., a joint estimation of RP and SP data?

Adamowicz et al (1994) combined revealed and stated preference methods for valuing environmental amenities. In 1996, the Association of Environmental and Resource Economists (AERE) workshop was devoted to this topic. Experts from the marketing and transportation fields were invited to share their experiences with combining revealed and stated preference data. Among the lessons learned was that combining revealed and stated preference data yielded better predictions of demand for a good or service across many types of goods and services. Of course we don't ever actually observe consumer's surplus, so one makes the inference that if we are predicting demand for a good or service better, we are estimating consumer's surplus better. I didn't see any mention of this in the paper.

7. The empirical results presented in the current paper are labeled as preliminary, so I didn't take them too seriously. However, I did have trouble with some of the interpretations of the conditional logit model presented in Table 2 on page 16. Only one paragraph on page 15 is presented with explanations.
   I was, at first, a little confused, but the interpretation seems to be that, for individual attributes, a positive coefficient means these factors (e.g. age, male, black and household size) increase the probability that a person will choose the status quo and a negative coefficient means these factors (e.g. income, Hispanic, eating seafood, and participation in recreation activities) increase the probability that a person will choose one of the programs (i.e., moves away from the status quo). I think a little more explanation would help here.
8. I never saw the dollar amounts used. How many values? What was the range of values? And, How were the range of values determined?

The Recreational Benefits of Improvements in New England's Water Quality: A Regional RUM Analysis, by George Parsons, Erik C. Helm and Tim Bondelid

Comments:

1. The analysis uses data from the 1994-95 National Survey on Recreation and the Environment (NSRE). I am and have been the Co-leader of NSRE since the early 1990's. It is stated in the opening paragraph of the paper "All models are for day-trip recreation which account for approximately 77% of all water based recreation trips in the region" (region being the Northeast region).
   This estimate of day-trips accounting for 77% of all water based recreation trips in the region is not correct. First, the trips were conditioned on an activity being the primary purpose of the trip. As discussed above, NOAA's work through PARVS revealed people are often not willing to say that their trips to coastal areas were based on any one activity being either the main reason for the visit or the main activity on their visit. So, the trip data obtained in NSRE 1994-95 was only a sub-set of the total number of trips. Second, even though NSRE 1994-95 included both day-trips and multiple-day trips, modeling was limited to day-trips. On this latter sub-setting, our profession seems to find multiple-day trips to be

difficult to implement with the random utility model or that modeling multiple-day trips requires a separate model. Multiple-day trips are a large proportion of total use in the coastal areas. We need to model multiple-day trips that are not conditioned on one activity being either the main reason for the trip or the main activity or we are not accounting for much of the use. Above, in my comments on the previous paper, I said that in the Florida Keys multiple-day trips, with no one activity being either the main reason for the trip or the main activity on the trip, account for almost all trips. Coastal water quality is important in the Florida Keys and we need models to deal with these issues. This is less a criticism of this paper and more a challenge offered to our profession.

2. Paper Caveats. "*Using finer measures of water quality in the RUM model persistently led to complications in the econometrics, usually a model that failed to converge*". I think this is probably related to caveat number 3 that "*there is no coastal water quality simulation model per se*". At NOAA, we currently have a project on estimating the value related to water quality changes in Southern California. In this project, we have ambient water quality measures for each beach on each day. Water quality is statistically significant in all models estimated, including full information maximum likelihood estimations. Matching up better water quality data to NSRE data is something for future research.

Valuing Water Quality Changes Using a Bioeconomic Model of a Coastal Recreation Fishery, by Matt Massey, Steve Newbold and Brad Gentner.

Comments:

1. Overall this is a very impressive effort. The underlying model seems sound. However, I don't think the actual application matches up with the model presented in equations 1-4. A bioeconomic model that doesn't explicitly model total effort and the institutional structure underlying the human system isn't a real bioeconomic model. The interplay of the biological system and the human system are fundamental. The use of calibration to account for the human system is quite clever, but it leaves me with not much confidence in the result.
   If the fishery management situation in place can be described as a common property resource with an open-access fishery, then I think we would predict that there would be "no benefits" realized from water quality improvements. The commercial and/or recreational fishermen would dissipate any benefits. I saw no discussion of the current institutional arrangement in the fishery selected for application of the model.
2. As far as I could determine, equation 3 (trip demand) was never estimated. Instead, a stated-preference model was implemented that only partially accounts for changes in trip demand. Again, a bioeconomic model that doesn't explicitly model total fishing effort is not much of a bioeconomic model.

Comments on Session II

Cleaning Our Coastal Waters:
Examination of the Benefits of Improved Water Quality

Nancy Bockstael

INTRODUCTION

The term "ecological benefits" often conjures up images of obscure and indirect pathways through which ecosystems affect humans. These are pathways that are difficult to define, and for which related behavior is difficult to observe. Yet water-based recreation, the target of much past non-market valuation activities, remains an important pathway through which ecosystem health affects humans. As such it deserves continued study.

The three preliminary analyses in this session are quite different in the commodity valued and the type of data relied on, but all three focus on measuring the benefits of water quality through traditional recreation pathways and all three use a random utility model framework to model choice and estimate welfare measures.

In what follows I will try to point out what I think to be some vulnerabilities in the current preliminary versions of these analyses. While my comments may seem diffuse, I'll attempt to organize them around two general themes:

- How is the environmental quality variable measured and how is it incorporated into an underlying model of individual preference revelation?
- Is the choice behavior underlying the use of the random utility model made clear and are welfare measures consistent with this model?

DEFINITION AND MEASUREMENT OF THE ENVIRONMENTAL QUALITY VARIABLE

Owens and Simon, '*The Value of Improvements to California's Coastal Waters: Results from a Stated-Preference Survey*'

The first of the three papers, the one by Owens and Simon, seeks a means of valuing water quality improvements in coastal waters. Contrary to what is implied in their introduction, there have been many previous attempts to do this for specific estuaries or other limited geographical extents, mostly using revealed preference data. But there is no systematic treatment of benefits from coastal water quality improvement that can be transferred to other areas and used to evaluate EPA's water quality policies at the national level. My sense is that a systematic, transferable type of analysis is the ultimate goal of Owens and Simon's work. Although this particular study targets the coastline of California only, this coastline represents a large share of the coastal waters of the US, making the geographical extent of this study quite a bit larger than most salt water recreational studies.

The intent is to estimate the benefits from coastal improvements through a stated preference exercise. Most of the paper describes the careful pre-testing process through which a well-designed survey has emerged. I have no particular expertise in survey design and will leave the critique of this survey to others, but one aspect of the survey troubles me. I am unclear as to environmental commodity being valued. The commodity might appear to be quite specific; it is an increase in the miles of California coastline that are rated "good" in terms of being safe for swimming, producing fish and shellfish that are safe for eating, or supporting habitat for "large numbers of fish, birds, mammals and plants."[1]

While there are clearly ambiguities in the last definition, the really troubling aspect of the valuation question seems to be that it does not specify *where* along California's extensive coastline these improvements would take place. This information would not necessarily be very important if the authors sought to reveal respondents non-use values for improvements in the health of ecological resources. And indeed this may be what is being sought in questions about increases in ratings of habitat. But the questions related to safety of fish consumption and ratings for swimming would certainly appear to relate to use. This interpretation is further supported by the large number of use-related questions asked in the survey, which suggests both to the survey respondent and to the rest of us that recreational *use* values are of interest to them. Yet how can a respondent give a credible use value answer to a question framed with no locational information. This is directly contradictory to the premise of travel cost models that use behavior in the face of varying travel costs to reveal demand curves whose estimation gives us consumer surplus answers. In that model, the distance to a recreational site represents a cost that cannot be counted in the surplus measure. The presence of travel costs plays a major role in the model and accounts for much of the resulting variation across people in valuation measures.

The authors ask follow-up questions about whether the respondent thought the improvements would take place in a specific part of California – and if so, where. This information may shed some light on what respondents were thinking when giving their answers and may even give the authors a way to untangle the problem. It is not so important that use and non-use values be estimated separately, but it is important that a cogent story of what is being valued can be told. For example, if people tended to respond that they did not think about where the improvements would take place, I'm not sure I would know how to interpret their bids. And if they responded that they thought these improvements would occur many miles from their home, then I would wonder if we were missing a portion of benefits attributable to use. Finally, if they assumed improvements would occur close to home, are we left with no measure of the benefits of

[1] The added miles are represented in terms of "percent increase" but the authors use this term loosely, no doubt in an attempt to make the question understandable. But it can easily convey the wrong idea to respondents. The authors appear, for example, to label a change from 40% to 50% of the coastline as a 10% increase. Perhaps wording this as an increase of 10 percentage points would be both more accurate and still understandable.

cleanup for non-locals? Any effort that can be made to resolve this ambiguity in the location of clean-up will be well worth it.

Parsons, Helm, and Bondelid, '*The Recreational Benefits of Improvements in New England's Water Quality: A Regional RUM Analysis*'

A second paper in this session, the one by Parsons, Helm, and Bondelid, is a heroic attempt to use existing information from past surveys to value water quality improvements in New England. I use the term "heroic" because this is a very difficult thing to do, and yet the returns from doing it well could be enormous. The potential contribution of this paper is in developing a means to use the data from the 1994 National Survey of Recreation and the Environment and water quality simulations from the National Water Pollution Control Assessment Model of RTI to generate systematic and comparable benefit estimates of water quality improvements for water resources throughout the U.S.

In this paper, recreationists are viewed as choosing among recreation sites represented by all lakes and stretches of riverfront and coastline within 200 miles of their home. Four water quality measures – biological oxygen demand, dissolved oxygen, total suspended solids, and fecal coliforms - are generated by the simulation model for each of the over 25,000+ sites within New England. Assuming such simulated measures are accurate, [2] we are still left with the question: by what means do recreationists perceive these water quality measures? Recreational modelers have long been concerned about possible discrepancies between the dimensions of water quality that can be measured objectively and those that people can perceive or learn about. Some signals may well connect (however loosely) the objective and perceived measures, but the form the connection takes must be thought through carefully. In this paper, the four objective measures are converted into one variable that takes on only three levels. This does not necessarily help the correspondence between objective measures and perception, since the thresholds chosen may have little to do with how people perceive water quality differences. The use of this one "tri-nary" variable is brought into further question, since it is considered equally applicable to swimming, fishing, viewing and boating decisions.[3]

Economists are continually reminded by statisticians and econometricians[4] that correlation is not causation. Put another way, unless we are fairly certain we have controlled for unobserved heterogeneity in our data, our econometric results may be reflecting the effect of omitted variables that are highly correlated with the variables of interest in our models. The paper by Helm, Parsons and Bondelid would seem especially vulnerable to this accusation. The alternative sites vary only in terms of travel

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[2] We are told that the measures for coastline are likely inaccurate because the measures are extrapolated from the nearest river mouth. This will be especially troublesome for swimming which does not tend to occur in such areas and will usually underestimate water quality because pollutants from rivers will not yet have been diluted by ocean currents.

[3] This is in direct contrast to the Owens and Simon paper that attempts to convince people that different environmental quality criteria matter for water to be ranked safe for swimming, safe for producing edible seafood, and good for fish, bird, mammal and plant habitat.

[4] By this I mean the work often referred to as quasi-controlled experiments, matching, or exploiting regression discontinuities.

cost, the set of two dummy variables signaling whether the site is a lake, river or coastline, and the set of two dummy variables signaling the level of the 'tri-nary' water quality variable. One distance related variable and two categorical measures are hardly sufficient in describing the multiple differences in the vast number of lake, river and coastline recreational sites within 200 miles of any individual[5]. Given the size of New England, a very large proportion of the 25,000+ sites will be within 200 miles of most individuals. But the geographic size of New England is misleading, as characteristics of sites that can be expected to matter to people vary dramatically over its range, even holding the category (river, coast or lake) constant. Water temperatures and local amenities, to name only two considerations, will be drastically different over sites. How can we possibly interpret with any confidence the coefficients associated with the simple categorical water quality measures when so much is left out of the model?

The failure of attempts to model recreational decisions in the more logical nested framework, as well as the failure of more complete site descriptors to generate usable results, suggests a certain instability. It also suggests the likelihood that the model is missing something important. It would be especially illustrative if the water quality levels could be mapped. This might reveal the types of omitted variables (especially those that tend to vary spatially, such as water temperature, fish species, etc.) that need to be controlled for in making sense of this problem. With out a careful consideration of what is being left out of this model, we can have no confidence that the significant coefficients are reflecting any response to water quality variation at all.

Massey and Newbold, '*Valuing Water Quality Changes Using a Bioeconomic Model of a Coastal Recreational Fishery*'

The third paper, by Massey and Newbold, uses contingent rather than revealed behavior and draws on an already existing study rather than a new data undertaking. The particular appeal of this paper is its attention to the pathways by which changes in water quality affect recreational fishermen. In this sense, it is a particularly appropriate paper for a workshop on the Valuation of Ecological Benefits.

In this paper, the water quality variable of interest from the perspective of policy is dissolved oxygen (*DO*). In their conceptual model, the authors consider how water quality affects stock abundance (given population dynamics) and catchability at any site (given that fish may migrate to avoid areas with low dissolved oxygen). They also allow for the fact that water quality might directly affect site desirability. By giving careful attention to the biological modeling, interesting non-linearities and thresholds are induced so that dissolved oxygen measures affect recreationists' decisions in realistic ways. The result that *DO* appears only to affect fishermen through its affect on stock abundance has interesting implications. If this is true, then effects will only be realized in the long run and attempts to pick up such effects with a simple behavioral model including some simple measure of current *DO* linearly will miss the point. I do not have the expertise to

[5] Given the size of New England, all 25,000+ sites could be within 200 miles of some individuals and most individuals will have an enormous number of site alternatives defined this way.

comment on the quality of the biological modeling, but the spirit of this research seems to be just exactly what we need.

EXTRACTING WELFARE MEASURES FROM RANDOM UTILITY MODELS

The random utility model has become the workhorse of environmental valuation. These types of choice models are the rule rather than the exception in revealed preference as well as stated preference data analysis. The random utility model can be a very plausible model of behavior, since individuals often choose among discrete alternatives. In its simplest form, both estimation and welfare measurement are easy to accomplish, reducing barriers to its use. In fact, the random utility model has become so ubiquitous in the literature that I wonder whether it is not often treated too cavalierly.

All three papers in this session use a random utility framework, although one paper models stated preference responses, another contingent behavior, and a third revealed behavior. There is a tendency in these papers (as well as others in the literature) to reduce the underlying theoretical model's discussion to a boiler-plate presentation ending in the usual formula for calculating welfare measures from estimated coefficients. Paying little attention to the details of getting welfare measures from these models would be OK, if it were not for the fact that we know welfare measures in these models are sensitive to the details of the problem. Herriges and Kling recently compared welfare measures derived from a random utility model applied to exactly the same data but incorporating different functional forms and different variants of a measure of environmental quality. They also compared welfare measures across different linked models, again with different functional forms at the two stages. The results are quite startlingly different and suggest that the devil is definitely in the details.

With this is mind, let us quickly review the models estimated in the three papers. Owens and Simon estimate the parameters of a conditional indirect utility function based on stated choices among hypothetical programs that would improve different amounts of coastline in exchange for different tax payments. With parameter estimates in hand, the authors indicate that future welfare measurement will be based on the formula:

$$\frac{\ln \sum_j \exp(X_j^{*}\beta) - \ln \sum_j \exp(X_j^{0}\beta)}{(-)\beta_{tax}}$$

where the *X's* are explanatory variables from the random utility model, the β's are estimated parameters, β_{tax} is the coefficient on the tax variable, and X^0 and X^1 are the values of the explanatory variables given the status quo level of water quality and those resulting from projected improvements. The formula and definitions of the *X's* are difficult to square with the earlier definitions of the *j* subscripts which were defined as indexes of different programs (water quality improvements and public expenditures?). What is the summation really over?

An additional problem arises in the use of β_{tax}, the coefficient on the tax (i.e. cost) variable in the model. The authors refer to this as the marginal utility of income. The well-known formula for compensating variation in the context of a random utility model is really given by:

$$CV = \frac{\ln \sum_j \exp[v(y - p_j, q_j^{\;1})] - \ln \sum_j \exp[v(y - p_j, q_j^{\;0})]}{\beta_y}$$

where v is the conditional indirect utility function (conditional on the discrete choice made), q_j^0 and q_j^1 are the initial and subsequent levels of environmental quality in alternative j, y is income and p_j is the cost of alternative j. This is the definition of CV only if the errors are additive and Type I extreme value and the income minus price term enters linearly into the conditional indirect utility function. If the income minus price term does not enter linearly, then the welfare measure has no closed form solution (although it is possible, but difficult, to iteratively solve this problem.) Most important, the nature of the underlying random utility model is such that income minus price appears in the model as one term. And it is only because of this feature of the random utility model that the coefficient on price (or cost or tax payment) has the interpretation of the marginal utility of income. This fact accounts for its prominent place in the CV formula.

In their preliminary data analysis, the authors estimate a model with both price and income included separately. Space does not allow a complete discussion of the implications of this, but at the very least this compromises the interpretation of any measure such as the above since we have to ask: if the coefficient on price is (minus) the marginal utility of income, how do we interpret the coefficient on income? It may well be true that we expect substantively different behavior from different types of people and those types may be well proxied by income. But such a story requires telling and the source of differences in response needs to be made clear. If the different responses are truly due to income effects, then the simple linear form of the random utility model is inappropriate since it implies constant marginal utility of income over the range of the choices. We can't have the story both ways and some reconciliation is necessary. Admittedly the authors' analysis was purely preliminary and done without time for thought. Subsequent analysis will no doubt give much more careful treatment to the underlying theory, the underlying behavioral model, the role of income and the resulting welfare measures.

Interestingly, Massey and Newbold also include income separately from price in their model but interpret the coefficient on price rather than the coefficient on income as the marginal utility of income. Here again the underlying theoretical model is a boiler-plate presentation and not particularly relevant to the problem at hand. Massey and Newbold use a repeated nested logit model so as to be able to treat the responses to four different contingent behavior experiments in a consistent framework. Parameters are assumed to vary randomly across respondents (as in Train's mixed logit models) but to remain constant over multiple responses of the same individual. Since Herriges and Phaneuf have investigated this type of model with an error components interpretation, the authors may wish to compare their approach to that of these other authors.

While the idea of applying a repeated nested logit model to the contingent behavior data is an intriguing one, the authors realize that the data really will not support this interpretation. The repeated nested logit was developed as an internally consistent means of capturing the participation as well as the site choice dimension of the recreation decision. However, the contingent behavior experiment, which does allow the respondent to "opt out" of the choice experiment by taking no trip, is fundamentally different from a recreationist's day-to-day decision about whether to take a trip or not. Treating the contingent behavior responses as if they mimicked people's day-to-day recreation decisions is misleading. The contingent experiment contains an implicit assumption that the individual would be free to pursue recreation on every choice occasion. No information about weather, work obligations, etc. are explicitly or implicitly introduced.

More attention to the underlying theoretical model is given by Parsons, Helm and Bondelid who base their linked model on an approach originally suggested by Hausman, Leonard and McFadden. In this model a random utility model is first estimated and then a price index of sorts is calculated using the standard log sum formula divided by the coefficient on price. This pseudo-price index is included in a count model (Poisson model) of number of trips. It is now well-known that none of the linked models are internally consistent – they do not derive from a consistent theoretic model of utility maximizing behavior. Since the few models that are internally consistent have other drawbacks (e.g. inflexibility of functional form choice and difficulty of estimation of the Kuhn Tucker model), this is not necessarily a bad choice of approaches as it might approximate behavior if not be exactly utility theoretic. While linked models of this sort have some appeal, deriving the welfare measure from the participation decision rather than the random utility portion of the model is perhaps less appealing. As Smith and Herriges and Kling have shown, the pseudo-price index is not a price and can not be treated as such in the count demand function. Therefore, a consumer surplus measure that must necessarily be based on such an interpretation of the price index is questionable.

CONCLUSIONS

All three papers have the potential to contribute to the literature. Each has a particular strength and each is a good beginning in analyzing benefits from water quality improvements. In finishing these analyses the authors have several areas in which they could make their papers stronger. One has to do with improving the link between recreationists' water quality perceptions on the one hand and objective measures that policy changes are likely to affect on the other. Clearly this link induces more vulnerability in revealed than stated preference analyses, but even in the context of contingent valuation or behavior, one needs to be sure that the policy variable links clearly to a commodity the respondents are understanding and bidding for.

So much attention needs to be paid to the careful acquisition of the considerable data needed to accomplish these studies that the last steps of the benefit measurement sometimes are taken for granted. But in the end, benefit measures depend on the details, and a cavalier treatment of the random utility model will lead to indefensible welfare measures. The fact that - unlike price changes, for example - welfare consequences can never be observed even after the fact places a heavy burden on welfare economists to get the underlying story right.

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Summary of the Q&A Discussion Following Session II

Scott Swinton (Michigan State University)
Directing his question to Matt Massey, Dr. Swinton referred to the structure of the bioeconomic model that was used, which, "like any system model, has boundaries." He wondered, "If we were to try and open the boundaries a little bit further and understand what drives the driving variable of your model, which was dissolved oxygen, I'm curious about how changes in agricultural management can change water quality rather than just saying 'Okay, suppose we have bad water quality, then what does it cost us?'" Dr. Swinton closed by asking, "How would you extend that?" and "What affects dissolved oxygen and water quality?"

Matt Massey (U.S. EPA, NCEE)
Dr. Massey acknowledged that the model currently "doesn't deal with that at all—we just sort of *assume* water quality conditions and *assume* policy somewhere else affects them and makes those changes, and we just run the changes through." He continued, "It's conceivable we could add another step that would model agricultural use and residential and commercial development that would allow us to simulate changes in dissolved oxygen and runoff and those types of things." Admitting that "it would be a great thing to do," Dr. Massey went on to explained that they "had a terrible time getting the data together" just to do what they did. He said that with the recreation data they used, they had to go with stated preference data rather than with the revealed preference data they actually preferred because they just couldn't get people to cooperate in providing those data. He clarified that Steve Newbold, one of his co-authors who was "the ecologist of the group, had to throw his credentials around" to get much of the data that biologists were reluctant to share. He closed by reiterating that the idea, though "possible" and "interesting" is "kind of beyond the scope of what they're doing now."

Alan Krupnick (Resources for the Future)
Directing his comment to Nathalie Simon and Nicole Owens, Dr. Krupnick stated, "Some of us who are working on stated preference techniques have two issues that come up with your work, that we all wrestle with as well. One is the units of measurement for these attributes." Citing specifically the unit of "percentage of miles that are changed," Dr. Krupnick wondered whether, using information from focus groups or other observations they have, the researchers "could comment on that particular measure—whether you tried others—and how to communicate these things to people." He added that, "Some of Nancy's [Bockstael] comments get to this as well, about sort of the location of where these are and so on."

Dr. Krupnick went on to say, "The second part that struck me is I think that you have a very abstract program for actually bringing about these changes, and I'm wondering if people really were willing to *accept* that. It would be a *good* thing if they did, because it's hard to come up with a program that is kind of transparent to people and doesn't get in the way of their responses and meet their protests. But I'm wondering if people really did accept that because in all these programs you've got switches—you know, some help swimming more than help aquatic health, and so on. I wonder if you get much push back from people about: What are these programs? What are their components? How do we know they'll work?"

Nathalie Simon (U.S. EPA, NCEE)
Dr. Simon addressed Dr. Krupnick's first comment by saying, "Basically, we *did* try other units of measure. We started off looking at the number of miles, and then we also tried in other versions of the survey both number of miles and percentage change." She said they found that "people really were focusing on the percentage change and seemed to like that better."

In addressing the second comment, Dr. Simon said she thought that for the most part people were willing to accept the abstract program. She added that funding issues seemed to be the more critical concern—"people didn't want higher taxes for any reason." Dr. Simon closed by saying they are still working through that and still need to clean up their data.

Nicole Owens (U.S. EPA, NCEE)
Dr. Owens said, "I think Nathalie is right—most people did seem to buy the scenario." She expounded that in the survey and in their one-on-one interviews, they made an effort to ensure that people understood that "sometimes it's different kinds of contaminants that might be affecting one of these types of use."   She concluded by saying that "it was easy for people to see that it's possible to reduce or eliminate a contaminant that affects whether or not they can swim" in a particular area or to conceive of some other single-issue program, but they were not readily able to conceive of multi-concern programs, such as those that also looked at fish population or some other ecological factors.

Spencer Banzhaf (Resources for the Future)
Dr. Banzhaf requested "more discussion related to Nancy's [Bockstael] comment about putting income and cost in the model separately," and he stated his support for this approach. He continued, "It seems to me there are two ways to think about what's going on here," and he used a corollary example of modeling restaurant choice to make his point. "We see richer people going to more-expensive restaurants and different kinds of restaurants than we see poorer people. One way to model that is that rich and poor people have different marginal utilities of income—rich people can afford to go to these more-expensive types of restaurants. And so we'd model that in a certain way in the structural model, by putting in that your income affects your restaurant choice. Another possibility is that there's heterogeneity in tastes for different kinds of restaurants, and there's something about class, as well as maybe race, or education, or other kinds of internals we see—something about class and income that has certain kinds of people sorting to different kinds of places. And that piece is just really a taste shifter."   Dr. Banzhaf closed by clarifying that he was not disagreeing with Nancy's broader point that

"the devil is in the details and you have to pay attention to how you model it," but it seems to him that the choice isn't quite so obvious.

Nancy Bockstael (University of Maryland)
Dr. Bockstael stated that had she had more time she "would have gone into this very topic." She said she agrees completely that "income shows up as significant in a lot of these models, in the sense that it's really proxying for education and preferences or something like that. Moyer really has done some nice work on this, where he has viewed it as that. He has treated people in different income ranges and allowed the coefficients on various things to change in those ranges, so that you don't have the problem of introducing income continuously in a model where it's not going to make any sense. You know, you can't start with a utility theoretic model and then decide you're going to just throw whatever in. You have to have a way of introducing that that makes sense, and I think that the best way that it makes sense, from my perspective any way, is the way that Moyer uses it—shifting the parameters discreetly but allowing marginal utility to be constant over large ranges so that it's only a glitch at certain thresholds. But, I say it's proxying something else."

Patricia Casano (General Electric Company)
Prefacing her comment by clarifying that she is "*not* an economist," Ms. Casano addressed Nathalie and Nicole and said she was "struck by the results you put up indicating that 25% of the survey respondents had used coastal waters for recreational swimming; 10% had used coastal waters for fishing and that sort of thing." She said that she wasn't questioning whether the numbers were right or not but stated that they "seemed *really low*" to her and she was surprised by the indication that "less than a majority, generally speaking, of the survey respondents used coastal waters for any of the scenarios that you were looking at." Ms. Casano closed by asking, "Does *that* play into your analysis of the results at all, and if so, how?"

Nathalie Simon
Dr. Simon responded by clarifying that "those variables were measuring recreation over the last twelve months" only, not over a lifetime. However, she allowed that they still might appear low to Ms. Casano. She continued, "We *did* include them in the initial regression that we ran, so it does figure into that—it was part of that conditional logit model. But, again, we're still exploring a number of different functional forms, and we still have a lot of work to do in terms of our analysis."

Kerry Smith (North Carolina State University)
Dr. Smith expressed a multi-faceted concern with the issue raised earlier in Spencer Banzhaf's comment. He said, "The first issue I want to raise is: What income? In the second two papers, if I remember correctly, we had a repeated mixed logit and a standard model. Well, when we repeat, that implies a certain number of choice occasions that are

embedded in the no trip alternative. So, implicitly, we have to ask ourselves: What is the relevant budget for each of those *created* choice occasions? And, I don't mean these comments to be critical, because I've done the same thing—I don't know what to do. But we've got a question of *total* income versus *relevant* income for the choice that you're representing, and *that's* at *least* as important as how you introduce the income in the first place, as well as assuming how many *choices* there are—and we just fabricate that, typically."

Dr. Smith continued with his second point: "If we're going to say: Okay, income proxies for something else about people, then we've got to begin to question: What the heck is the travel cost coefficient? Because the way we can interpret that as the marginal utility of income is based on a prior set of restrictions that we've already imposed to recover that, so we're still in the scoop, I think."

"Of course the third issue that arises in these sorts of models is the link between time horizon of choice and the implicit substitution assumptions we're making as we evaluate those. This bears a little bit on what Bob [Leeworthy] was talking about: As we move to other kinds of trips, we're going to get more and more into these kinds of issues. Now, I don't think any of us has the answers, and we're not going to get the best model—the question is judging how *bad* do we get, which is essentially, I think, what Nancy's comment was: When we array all these models, how do we make a judgment about what's important and what is not important for the use of the model?"

END OF SESSION II Q&A