

# Valuing Food Safety and Nutrition

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PART THREE: A Closer Look at  
Performing Contingent Valuation

**13. Anglers' Willingness to Pay for  
Information About Chemical Residues in  
Sport Fish: Design of a CV Questionnaire**

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## Anglers' Willingness to Pay for Information About Chemical Residues in Sport Fish: Design of a CV Questionnaire

*Douglas J. Krieger and John P. Hoehn<sup>1</sup>*

The contingent valuation (CV) approach asks individuals their willingness to pay (WTP) for a good in a hypothetical market setting. The resulting WTP estimates are conditioned on the assumption that respondents' stated choices correspond to their behavior in actual markets. Consumer behavior in actual markets depends on a variety of factors. These include characteristics of the good, characteristics of the payment, and the market itself (Fischhoff and Furby 1988). These factors exist explicitly in a hypothetical market only if they are described by the researcher. If a CV survey does not adequately describe the factors relevant to a decision, stated behavior will depend on what the respondent *assumes*. These assumptions may not correspond to the environment envisioned by the researcher. If respondents perceive a different market setting than the researcher intends, stated WTP may not reflect the values desired.

The challenge of successful CV research is to clearly communicate a market setting that most respondents interpret as the researcher intends. A clear description of all relevant aspects of the good, the payment, and a credible market, and clearly worded questions will reduce ambiguity and facilitate successful communication (Mitchell and Carson 1989). Thus, the design of the CV survey—the language, descriptions, and questions used—is crucial to obtaining good data.

The implementation of a survey may also affect the quality and quantity of usable responses. Important considerations for a mail survey include the physical appearance of the survey instrument; the wording, order, and format of questions; the timing of mailings; and the process of following up on those who are slow to respond (Dillman 1978).

This chapter focuses on the design and implementation of a CV mail survey to assess anglers' WTP for information about chemical residues in sport fish. It illustrates the importance of pretesting to determine what aspects of the market description are important and to assess potential respondents' interpretation of specific questions and response choices. The first two sections outline the conceptual and policy setting for the survey design. The first reviews Michigan's current advisory program and two proposed alternatives. The second briefly outlines the conceptual definition of information value. The core of the chapter focuses on the process of designing the questionnaire. A summary section reviews our primary conclusions with respect to CV survey design.

### **Contaminants in Michigan's Sport Fish**

Tests of sport fish in the Great Lakes region have detected traces of chemical residues. In sufficient doses some of these chemicals are suspected of causing adverse human health effects. In response to this problem, state and provincial governments bordering the Great Lakes provide anglers with information about chemical residues in fish. These warnings typically take the form of *public health advisories*. These advisories list sites and species known to be contaminated and offer advice on how to reduce the risk of exposure (Hesse 1990).

Michigan's advisory is issued by the Department of Public Health (MDPH) and printed in the annual fishing guide distributed by the Michigan Department of Natural Resources (MDNR). The current advisory contains a brief description of some chemicals found in Michigan's fish, their sources, and possible health effects. It also warns that concentrations of contaminants are likely to be higher in larger or older fish, predator species, fatty fish, and carp or catfish. It suggests that anglers who intend to eat their catch should trim and cook them to remove fat. A pictorial presentation illustrates the suggested method of trimming fish.

The advisory also contains a table listing sites that have been found to be contaminated. Each entry cites the species and sizes that are contaminated, the specific chemical responsible for the advisory, and specific consumption advice. Depending on the extent of contamination, the advisory suggests either (1) no consumption, or (2) restricting consumption to no more than one meal per week. It also implies that no consumption restrictions are necessary for sites or species not mentioned in the advisory. It warns nursing mothers, pregnant women, women who intend to have children, and children under the age of 15 against eating any fish from either of the restricted categories (Hesse 1990). Since 1989 the advisory has also included a special warning about mercury in inland lakes. Because of widespread mercury contamination, the advisory warns anglers

against eating more than one meal per week of specific species and sizes of fish from *any* inland lake.

### ***Advisory Alternatives***

The advisories issued by various jurisdictions in the Great Lakes region differ in a number of dimensions (Foran and Vanderploeg 1989, Hesse 1990). These differences suggest a feasible set of alternatives to Michigan's current advisories. Probably the greatest difference between existing advisories is the treatment of sites where tested fish are found *not* to contain dangerous levels of contaminants. The advisories from Ontario and Minnesota include a list of such sites. However, most advisories (Michigan's included) tell anglers only about the sites and species that contain chemical concentrations exceeding state standards.

Alternatives to Michigan's current advisory range from eliminating the advisory program altogether to an expanded program similar to Ontario's. Not all of these alternatives are politically or fiscally feasible. Discussions with state officials revealed two informational changes that could be incorporated in future advisory programs.<sup>2</sup> First, the current advisory program only partially discloses test results. It does not tell anglers about tested sites where chemical residues are not found or are below state standards. Alternatively, the advisory could fully disclose test results—provide a list of contaminated sites *and* a list of sites that posed little or no health risk. Since the current testing program already generates a list of relatively safe sites, printing costs are the primary constraint in implementing a full disclosure program.

A second alternative is to test a greater number of sites with either full or partial disclosure of test results. Michigan contains over 5,800 publicly accessible fishing sites. The current budget permits testing about 30 of these sites each year.<sup>3</sup> Information about a greater number of sites would provide anglers a broader base of knowledge about the risks associated with their fishing choices. With this information they could make choices more consistent with their preferences for risk bearing. Survey results suggest that anglers are interested in information about a greater number of sites (Ontario Ministries of the Environment and Natural Resources 1990).

### **The Value of Information About Chemical Residues in Fish**

Information about potential risks to health has value because it helps people prevent mistakes. A mistake is an action taken in ignorance that a person would not have chosen if informed. Consider an angler who chooses among attributes of fishing so as to maximize utility. Characteristics that might affect anglers' utility include the species, number, and size of fish caught (Vaughan and Russell 1982), aesthetic and physical characteristics of a fishing site, or the presence or

absence of chemical residues in the fish (Kikuchi 1986). Suppose the angler also cares about his or her state of health. The angler understands that health depends, in part, on exposure to chemical residues in fish. However, exposure is a random variable that depends on the unknown level of contamination in fish consumed.

With uncertainty about the state of contamination,  $s$ , the angler chooses attributes of fishing,  $q = \{q_1, q_2, \dots, q_J\}$ , to maximize *expected* utility over the perceived distribution of  $s$ ,  $P(s)$ . Define  $q^*$  as the optimal choice given beliefs  $P(s)$ . With  $q^*$ , the angler achieves an expected utility of:

$$(1) \quad \int u(q^*, h(q^*, s))P(s)ds = P_r P_r$$

where  $u(\cdot)$  is the utility function and  $h(\cdot)$  relates behavior and perceived contamination to health. Define this utility level as the *prior utility of the prior act*,  $P_r P_r$ .

Now suppose the angler receives a message,  $y$  (new information in the advisory), that changes beliefs about the distribution of  $s$ . Represent these new beliefs by the Bayesian *posterior* distribution,  $P(s|y)$ , contingent on message  $y$ . Given new perceptions of contamination, the angler may believe his or her behavior prior to receipt of the message to be a mistake. The utility associated with the mistake is:

$$(2) \quad \int u(q^*, h(q^*, s))P(s|y)ds = P_o P_r .$$

The prior optimal act is a mistake because it is evaluated relative to posterior perceptions of contamination. Define this utility as the *posterior utility of the prior act*,  $P_o P_r$ .

Given new beliefs about contamination, the angler may wish to change behavior. Define optimal behavior after receipt of message  $y$  by  $q^y$ . The utility associated with the posterior optimal behavior is:

$$(3) \quad \int u(q^y, h(q^y, s))P(s|y)ds = P_o P_o .$$

Define this as the *posterior utility of the posterior act*,  $P_o P_o$ .

The value of information is the difference in utility it makes possible relative to a state of ignorance. However, the definition of prior utility must be considered with care. Realized prior utility depends on the *actual* distribution of  $s$ . Define this as  $P(s')$ . For illustration, suppose  $P(s')$  represents a greater risk of contamination than  $P(s)$ . The following analysis applies as well to the case where  $P(s')$  represents a lower risk than  $P(s)$ . Ignorance of actual risks

$P(s')$  does not shield uninformed anglers from actual conditions. Both informed and uninformed anglers face possible future health effects determined by  $P(s')$ . The advantage of being informed is the opportunity to adjust behavior. To avoid issues of risk perception, assume that informed anglers perceive risks accurately (i.e.,  $P(s|y) = P(s')$ ). The value of message  $y$  is the difference between the expected utility when informed,  $P_oP_o$ , and the expected utility of a mistake,  $P_oP_r$ :

$$(4) \quad v_y = \int u(q^y, h(q^y, s))P(s|y) ds - \int u(q^*, h(q^*, s))P(s|y) ds.$$

By definition,  $q^y$  represents optimal behavior given beliefs  $P(s|y)$ . Therefore, the first term on the right-hand side of equation 4 is at least as large as the second and the value of message  $y$  must be nonnegative.

The utility values derived above can be expressed in terms of WTP using the expenditure function. Suppose improvements in the advisory alter perceptions of risk from chemical residues in fish. WTP for the additional information is the change in income required to maintain utility under posterior risk perceptions when behavioral adjustment is not permitted (Foster and Just 1989). Thus WTP for the current advisory, testing more sites, or full disclosure is the compensation anglers would require to continue their prior behavior after they are aware of the new information.

### Contingent Valuation Survey Design and Implementation

A contingent valuation survey designed to elicit WTP for advisory alternatives must first clearly communicate ideas to potential respondents. This means that questions must use language and concepts that are familiar and meaningful to anglers. We used three focus groups to explore how anglers think about chemical residues in fish, the language they use to talk about it, and how they think about and respond to the current advisory. Insights from focus groups aided in designing a draft questionnaire to assess anglers' WTP for advisory information.

We pretested the draft questionnaire in personal interviews with twelve anglers. Participants were asked to talk through their response to the questionnaire. The interviews identified questions that were unclear or ambiguous and helped assess the adequacy of response choices. They were particularly useful in identifying assumptions respondents made about factors not explicitly mentioned in the questionnaire. They also helped identify irrelevant and redundant questions that could be removed or combined with other questions, thus reducing the length of the questionnaire. The process reduced a wordy and visually intimidating questionnaire of 46 questions to a clear and interesting

survey containing 15 questions. The remainder of this section highlights some of the more important lessons learned in focus groups and interviews and illustrates how they influenced the form of specific questions.

### ***Eliciting WTP***

We used a referendum format to elicit WTP. The referendum approach presents respondents with the dichotomous choice of voting for or against a program offered at a specified cost. The approach produces binary yes/no responses instead of the direct dollar amounts generated by methods such as bidding games, payment cards, or open-ended formats. We used the referendum format for two reasons. First, it is probably easier for respondents than open-ended questions (McConnell 1990, Hanemann 1985). The decision to accept or reject a good at a given price is the most common type of market transaction people make. Second, people are familiar with the idea of voting on public programs. Ballots often contain measures offering public goods such as schools, water systems, sewer systems, or roads, for a given increase in taxes or fees (Mitchell and Carson 1989). Also, Hoehn and Randall (1987) conclude that the referendum format reduces the incentives for strategic over- or understatement of WTP.

The questionnaire described an alternative to the current advisory and specified a cost in terms of a *permanent* annual increase in the cost of a fishing license. The license fee payment vehicle is appealing primarily because fees are collected by the state and people link them directly to spending on state programs. We tested an alternative payment vehicle in focus groups and interviews—a separate advisory booklet offered for sale where fishing licenses are sold. The booklet did not adequately capture WTP for information because it is difficult to restrict access. Many people stated they would read the booklet without buying it or they would share one with friends. The following comments are typical reactions to the booklet:

"We couldn't [buy the booklet] or we'd have to go in with some friends or go borrow somebody's book."

"And I think that's what would happen. I think a lot of people would stand at the counter and look up their section and then go on."

"I'd probably stand there and look through it, look up my site, and set it back down."

By contrast, the license fee payment is more difficult to avoid if respondents wish to continue fishing.

The license fee payment vehicle also had drawbacks. Several focus group participants thought it unlikely that the money collected would actually be used to improve advisories. As a basis for their beliefs, they cited several past

examples where the state reallocated collected funds. One participant phrased his concerns as follows:

"I wouldn't mind paying a little bit more in a fishing license if they earmarked that's what it's going for. . . . if they're not taking money away from the other part of the license to do something else with."

For the final questionnaire, we chose the license fee payment vehicle over the booklet. To control for objections to using a license fee increase, the questionnaire explicitly asked whether respondents objected to the license fee as a method of raising money for advisories.

**WTP Question Format.** A challenge in this particular survey was to clearly explain subtle changes in a complex public program. To obtain valid measures of WTP for changes in the advisory, respondents must first clearly understand the content of the current advisory. Focus groups revealed that many anglers believed that most sites had been tested. In reality, the state has tested fewer than three percent of all sites. Thus, anglers generally have greater confidence in the scope of advisory information than is warranted by actual testing.

To provide anglers with an accurate and common point of reference, the questionnaire described the information content of the current advisory program. One dimension of information content is the proportion of sites tested. The initial WTP questions (reproduced in Figure 13.1) told respondents how many sites had actually been tested. However, the questions did not adequately identify the total number of sites. In the absence of an explicit denominator, respondents made different assumptions about the proportion of sites tested under a proposed program. Discussion with MDNR officials produced a more explicit definition of sites used in the final questionnaire.

In addition to a clearer definition of sites, the interviews also prompted substantial revisions in question wording and format to improve clarity. The initial format of the three WTP questions did not adequately emphasize the information content of the current advisory, how the current advisory differed from proposed alternatives, or differences between alternatives.

To remedy these problems, we further revised the question format. The final questionnaire explained details of the current program and some possible improvements on a separate page (see Figure 13.2). The suggested improvements corresponded to the alternatives of full disclosure and increased testing. Interview results were particularly useful in improving the brevity and clarity of the description. Interview participants quickly and accurately picked up the important features of the current advisory program from the written description when it was presented separately from the WTP questions.

The page facing the description of the current advisory contained a description of alternative programs and the WTP question. Focus group results suggested that listing advisory programs in tabular form provided a clearer

FIGURE 13.1 Initial Wording of WTP Questions

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1. Fish from all of Michigan's Great Lakes have been tested for chemical residues. Michigan also contains 11,000 or so inland lakes and over 36,000 miles of rivers and streams. Only **331** tests have been conducted on these inland waters.

The current advisory contains a list of water bodies where fish have been found to be **unsafe**. Water bodies that have been tested and found to be **safe** are not listed in the advisory.

Suppose the state could no longer afford to test fish and print advisories unless fishing license fees were increased. Would you rather, (1) **eliminate** the current advisory program and keep fishing license costs the same, or (2) **keep** the advisory if it meant increasing license costs by **\$3.00**? (Circle one number)

1. **Eliminate the advisory**
2. **Keep the advisory**

2. Suppose that an up-to-date list of **600** sites that had been tested and found to be **safe** could be printed in the advisory if money for printing was available.

Would you rather, (1) **keep** advisories as they are and keep fishing license costs the same, or (2) **include** a list of **600** safe sites if it meant increasing license costs by **\$2.00**? (Circle one number)

1. **Keep advisories the same**
2. **Include list of safe sites**

3. Only **331** tests for chemical residues have been conducted in Michigan's inland waters. About 30 new sites are tested each year.

Suppose more sites could be tested if license fees were increased.

Would you rather, (1) **continue** to test about **30** sites per year and keep fishing license costs the same, or (2) **increase** testing to **100** new sites per year if it meant increasing license costs by **\$4.00**? (Circle one number)

1. **Continue current testing**
  2. **Increase testing**
- 

comparison for respondents. Many participants said they were more likely to read and easily understand information presented in tables. The resulting tabular comparison of an intermediate form of the WTP questions depicted in

FIGURE 13.2 Final Description of Current Advisory

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### Michigan's Public Health Advisory

There are more than 5,800 public fishing sites in Michigan—2,200 sites on rivers and streams, 3,600 inland lakes, and the Great Lakes. The state has tested 350 of these sites for chemical residues in fish. About 30 new sites are tested each year.

The current public health advisory tells you:

- that you should not eat too much fish from *any* inland lake because of widespread mercury contamination, and
- it lists 50 sites where fish contain chemical residues *above* state limits.

The advisory does not tell you about:

- the 300 tested sites where chemical residues *do not* exist or are *below* state limits.

The advisory program could be changed:

- The advisory could list tested sites where chemical residues *do not* exist or are *below* state limits.
- More than 30 new sites could be tested each year.

These changes would increase the amount of information in the advisory but they would also cost more money.

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Figure 13.3 increased the ease with which respondents were able to compare programs. However, some respondents still failed to view the programs as independent. When asked for WTP for testing more sites they might say, "Well, if I'm already paying X dollars to list safe sites. . ."

The final form of the WTP questions (reproduced in Figure 13.4) asked respondents to value only *one* program alternative. The proposed alternative tested more sites and either partially or fully disclosed test results. The final wording of the WTP questions also clarified the decision context and placed more emphasis on voting as a choice mechanism.

A number of respondents throughout the pretest process voiced strong feelings about the integrity of the MDNR. Typical of these responses were:

FIGURE 13.3 Intermediate Form of WTP Questions

Table 1—Advisory Programs and their Cost to You

Program Options	Current Advisory	Program A	Program B
Lists tested sites where nonmercury residues pose little or no health risk.	No	No	Yes
Number of new sites tested each year.	0	30	0
Cost to you in higher license fees.	\$0	\$5	\$3

In the next two questions suppose anglers could vote on Programs A and B. Vote *for* the program if it is worth the additional cost to you. Vote *against* the program if it is not worth the additional cost. Think about how important these programs are compared to other ways you could spend your limited budget.

1. Would you vote for Program A if it permanently increased your yearly license cost by \$5.00, or vote against it and keep the Current Advisory at no additional cost?
  1. **Vote for Program A**
  2. **Vote against Program A and keep Current Advisory**
  
2. Would you vote for Program B if it permanently increased your license cost by \$3.00, or vote against it and keep the Current Advisory at no additional cost?
  1. **Vote for Program B**
  2. **Vote against Program B and keep Current Advisory**

"People come from all over the United States to fish here and if the state DNR tells people just how contaminated some of these fish are, that would scare a lot of them away."

"I think the DNR is more politicized than the Department of Health. They listen to too many special interests. . ."

In general, respondents seemed to view the MDNR as the source of the advisory even though the advisories are actually issued by the MDPH. When questioned,

FIGURE 13.4 Final Form of WTP Question

**Your Vote on Advisory Programs**

The table below shows two advisory programs. The "Current Advisory" is Michigan's current advisory program. "Program A" is a different program that could be put in place.

Program Options	Current Advisory	Program A
Lists tested sites where chemical residues are <i>above</i> state limits?	Yes	Yes
Lists tested sites where chemical residues do not exist or are <i>below</i> state limits?	No	Yes
Number of new sites tested each year.	30	400
Cost to you in higher fishing license fees.	\$0.00	\$4.00

Suppose the Michigan Department of Natural Resources (DNR) sent you a ballot to vote "for" or "against" Program A. If a majority vote "for" Program A, it will replace the Current Advisory. If a majority vote "against" Program A, the Current Advisory will be continued.

9. Would you vote for Program A if it permanently increased your yearly license cost by \$4.00, or vote against it and keep the Current Advisory at no additional license cost?

1. **Vote for Program A**
2. **Vote against Program A and keep Current Advisory**
3. **Don't know or no opinion**

respondents seemed to trust the MDPH more than the MDNR to provide unbiased information. To facilitate analysis of the importance of the information source, the final questionnaire was designed as a split sample with both the MDNR and MDPH as the stated source of the advisory.

Finally, to make the questionnaire less intimidating and more easily read, the format was increased from a booklet measuring 5½ by 8½ inches to one

measuring 8½ by 11 inches and the type size increased. Appendix 13.A reproduces the complete text of the final questionnaire.

A comparison of WTP estimates from the pretest and final surveys emphasizes the importance of clear descriptions of the contingent market. The pretest survey used the questions of Figure 13.1 to ask for respondent's WTP for (1) continuation of the current advisory program, (2) a partial disclosure program that tested either 100 or 300 sites per year, and (3) a full disclosure program that listed either 200 or 600 safe sites. An open-ended question that asked for respondents' maximum WTP followed each of the questions. Table 13.1 lists mean WTP values for each program offered in the pretest. Statistical analysis reveals no significant difference in WTP between mean bids for any of the programs described at a 1 percent level of significance.

The similarity of the mean bids suggests that respondents may not have understood or responded to the differences between programs. The uniformity of bids within surveys further supports the notion that respondents did not interpret the programs as intended. A majority of respondents (72 percent) stated the same WTP for full as for partial disclosure advisories and 56 percent stated identical WTP for the current advisory, full disclosure, and partial disclosure with increased testing. This result seems remarkable given the significant quantitative differences between proposed programs. However, the result could arise if respondents (1) understand the differences but do not perceive them to be large, (2) understand the differences but do not view them as essential to the good or program to be valued, or (3) do not clearly perceive the differences due to poor question design.

The pretest process improved respondents' comprehension of the differences between program alternatives. Final estimates exhibited a significant difference in WTP between full and partial disclosure programs. They also revealed a significant positive marginal WTP for testing more sites with full disclosure. In this case study, meaningful WTP responses depended crucially on a clear description of the contingent market. Pretesting, in turn, was a necessary step

TABLE 13.1 Pretest WTP Means

Program	Number of Sites	Mean WTP
Partial Disclosure	30	\$3.49
Partial Disclosure	100	\$3.57
Partial Disclosure	300	\$3.06
Full Disclosure	200	\$2.82
Full Disclosure	600	\$2.95

in the evolution of a clear survey. In retrospect, had the research proceeded from the initial draft of the survey without pretesting, many questions would not have measured intended concepts and the empirical results would likely have been meaningless.

**Experimental Design.** The questionnaire described alternative programs in terms of (1) the number of new sites tested each year, (2) whether safe sites were listed, and (3) the cost in higher license fees. The experimental design consisted of combinations of three different testing levels, ten levels of program costs, whether safe sites were listed or not, and the state agency responsible for the advisory. A complete factorial design over these factors defined 120 unique combinations that were used for the final questionnaires.

The questionnaire offered testing levels of 110, 620, and 1,240 new sites per year. These levels represented a range that was physically feasible for the state. Program costs were derived from the results of a mail pretest of 200 licensed anglers in the Lansing, Michigan area. The pretest asked WTP for program alternatives in an open-ended format. The final referendum format set bid levels at decile boundaries from the cumulative distribution of open-ended pretest bids. The final survey used bid amounts of \$.40, \$.95, \$1.45, \$1.90, \$2.85, \$4.10, \$5.55, \$8.75, \$14.50, and \$41.00. We chose the high bid in hopes of eliminating any positive response, thus avoiding the problem of arbitrarily truncating the empirical distribution.

The distribution of bids and the number of questionnaires prepared with each bid amount can influence the statistical properties of the WTP estimator (Duffield and Patterson 1991, Boyle et al. 1988, Kanninen 1993, Cooper 1993). Strategies to minimize the variance of the WTP estimator use prior knowledge about the distribution of WTP to attempt to cluster bids around the true mean WTP. This minimizes the number of surveys "wasted" on bids far from the mean. This study employed a mail pretest to gain some prior knowledge about the distribution of WTP. However, it does not attempt an optimal allocation of bids. The pretest asked valuation questions that were somewhat different than those used in the final survey. The questionable quality of the pretest data relative to the final WTP questions seemed to dictate a conservative approach that reduced the risk of clustering many offered bids around a point far from the true mean.

Focus group results also raised an important consideration in the choice of bid amounts. When asked their WTP for a particular program, participants' responses were often conditioned on their perceptions of a reasonable cost for providing the program. They seemed concerned that they were getting their money's worth and not paying more than their fair share. The following responses illustrate the nature of this concern.

"Well, I have no idea how much this [publishing a list of safe sites] costs so it's really kind of hard to sit here and hem and haw over how many dimes I would ... actually give towards it."

"... for a 30 page pamphlet or somethin', five bucks, well, they're just making money off it."

"What's it cost to test a site? ... So, how many fishing licenses do they sell in a year? I mean, if they tack on 50 cents a fishing license, how much money..."

Fortunately, the bids determined from the pretest corresponded reasonably well to estimates of actual program costs. State officials estimated that about 100 additional sites could be tested for each \$1.00 increase in license fees. This implies actual costs ranging from about \$1.10 to \$12.40 for the testing levels used in the questionnaire.

### ***Explanatory Variables***

In addition to the advisory program characteristics discussed above, three classes of variables influence anglers' WTP for advisory alternatives. These are (1) the possibility of behavioral change to avert risk, (2) the perceived accuracy of advisories, and (3) the perceived severity of health consequences resulting from consumption of contaminated fish. This section reviews the development of selected questions to measure these explanatory variables. The section emphasizes the role of focus groups and pretest interviews in creating meaningful questions.

***Behavioral Change.*** The questionnaire assessed *anticipated* behavioral change resulting from listing safe sites or testing more sites. The advisory suggests a number of changes in behavior that can reduce risk. We used focus groups to explore which of these actions anglers were aware of and which they were likely to use. These focus group discussions influenced the form of pretest questions dealing with behavioral change.

Pretest questions asked if respondents would make a specific behavioral change in response to a given change in the advisory. Interviews revealed that response choices were not rich enough. Participants often mentioned behaviors that were not included among the response categories. As an example of the issues that arose when designing these questions, consider the question used to assess behavioral response to full disclosure of test results. Figure 13.5 lists both the pretest and final versions of this question.

The final version improves on the pretest version in two ways. First, the answer to the question will likely depend on whether a respondent believes the sites they use will be listed as safe or not. The pretest version provides no means to determine what assumptions respondents make regarding the sites they use. Second, the pretest version seems to lead the respondent by asking for response to a specific behavioral change we believed to be important. The final version lets respondents choose from a more comprehensive list of behavioral changes that focus groups and interviews suggested were relevant to anglers.

FIGURE 13.5 Behavioral Change Questions

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Initial Question

1. If sites that were tested and found to be **safe** were listed in the "Public Health Advisory" would you try to fish at those sites rather than sites that were not listed? (Circle one number)
  1. **Yes**
  2. **No**

Final Question

1. In addition to the list of unsafe sites, suppose the advisory listed all tested sites where chemical residues in fish did not exist or were below state limits. If your favorite sites had *not* been tested would you...? (Circle all that apply)
    1. **Continue to fish at your favorite sites**
    2. **Stop eating fish from your favorite sites**
    3. **Fish only at sites where chemical residues are below state limits**
    4. **When choosing a new site, be more likely to go to a site where chemical residues were below state limits**
- 

**Risk.** We made few changes in the format of questions aimed at assessing risk perceptions between the pretest and final versions of the questionnaire. The questionnaire asked respondents for their guess about the probability of having health problems someday because of chemical residues in fish. Response categories covered a roughly logarithmic scale. These were:

- |                   |                       |
|-------------------|-----------------------|
| 1. no chance      | 6. 1 in 100           |
| 2. 1 in a million | 7. 1 in 10            |
| 3. 1 in 100,000   | 8. 1 in 5             |
| 4. 1 in 10,000    | 9. 1 in 2             |
| 5. 1 in 1,000     | 10. certain to happen |

Focus group and interview participants generally perceived very small risks associated with chemical residues in fish. The logarithmic scale concentrates responses around small risks and follows the approach of other studies designed to measure small perceived risks (van Ravenswaay and Hoehn 1991).

People generally found this question difficult. Subsequent interviews focused on the source of difficulty. In general, respondents had little difficulty

interpreting risks as stated. One participant interpreted the logarithmic scale as linear but soon realized his mistake. The hesitation in responding to the question arose primarily from uncertainty about the accuracy of the guess. A typical reaction when asked to guess about the probability of a health problem was:

"I don't know. . . . really, really slim I think. I don't think it's no chance. I'll guess one in a million. I'm really not sure."

The final version of the questionnaire followed this question by asking how sure people were of their guess.

**Information Accuracy.** The conceptual model identifies three factors that may affect the perceived accuracy of the advisories. These are (1) the perceived accuracy of tests to identify chemical residues in fish, (2) the adequacy of scientific knowledge linking exposure to health effects, and (3) trust in the state to impartially report test results. Interviews and the mail pretest revealed that few people questioned the accuracy of the tests themselves. Consequently, this question was eliminated from the final questionnaire. Pretesting resulted in relatively minor changes in the wording and format of questions addressing the other two sources of perceived accuracy.

The questionnaire obtained poor measures of perceived accuracy. Perhaps the most severe problem is that it measured separate dimensions of accuracy—beliefs about the accuracy of scientific knowledge and the perceived accuracy of reporting. Measures of only some of the individual dimensions of perceived accuracy identify some of the anglers who believe the advisory to be inaccurate but not those who believe it to be accurate. For instance, a belief that any single dimension is inaccurate implies a belief that the advisory as a whole is inaccurate. Therefore, a respondent who believes any measured dimension to be inaccurate believes the advisory to be inaccurate. However, a respondent who believes all measured dimensions to be accurate may still believe the advisory to be inaccurate if they question the accuracy of an unmeasured dimension. Because the questionnaire does not measure all dimensions of perceived accuracy, it does not identify respondents who believe the advisory to be accurate.

### ***Sampling Frame and Survey Implementation***

Chemical residues in Michigan's fish potentially affect three groups of individuals. These include current licensed anglers, those who do not fish but would if residues were not present, and those who do not fish but eat fish caught by others. For practical and conceptual reasons, this research focused on currently licensed anglers. From a practical perspective, licensed anglers are an easy group to identify—names and addresses are obtained by the MDNR when a license is purchased. Those who do not fish because of chemical residues and

those who eat fish caught by others are relatively difficult and expensive to identify.

The group who would fish if contaminants were not present is likely small. A casual examination of fishing license sales records revealed no noticeable decrease associated with the appearance of the advisories in 1970. The sampling frame does not include this group because of the difficulty and expense of identifying and reaching them.

The number of people who eat fish caught by others is difficult to assess. This includes fish purchased in restaurants and stores and fish received from acquaintances who fish. Twenty percent of New York anglers reported giving away some of their catch (Knuth and Velicer 1990). Furthermore, commercial fishing operations in Michigan landed 15.7 million pounds of fish in the Great Lakes in 1988 (Michigan Department of Natural Resources 1990). This research examines the value of public health advisories designed to influence sport angling behavior. Thus, while the group of people who consume fish they do not catch is potentially large, they are not as likely to be directly influenced by the advisory.

The sampling frame for this research consisted of individuals who purchased a Michigan fishing license for the 1991 fishing season.<sup>4</sup> The Fisheries Division of the MDNR provided a random sample of 1,578 anglers licensed to fish in 1991. For each angler we obtained name, address, birth date, and type of license purchased. Rodabaugh (1987) reports that 12.5-14.5 percent of surveyed anglers fished without purchasing a license. This figure reflects the actions of anglers who reside within one mile of the Shiawassee River and may represent the more casual anglers. Whatever the composition of this group, this survey will not include them.

Design and implementation of the survey followed Dillman's (1978) total design method (TDM). The TDM stresses the many small details which, when taken together, have a potentially large impact on response rates and the quality of data from mail and phone surveys. Following the TDM, we sent the first mailing of 1,578 questionnaires on Tuesday, February 9, 1993. One week after the initial mailing we sent a reminder postcard to prompt response and to thank those who may already have responded.

Three weeks after the initial mailing, we sent a second copy of the survey to the 1,012 members of the sample population who had not yet returned a completed questionnaire. Finally, seven weeks after the first mailing, we sent a third copy of the questionnaire by certified mail to the 576 people who had not yet responded. Of the 1,578 questionnaires originally sent, 230 were returned as undeliverable yielding a final sample of 1,348 anglers. The survey achieved an overall response rate of 73.4 percent. Figure 13.6 graphs the pattern of returns and illustrates the effect of each contact with respondents.

Each contact prompted an increase in overall response. However, the magnitude of the response decreased with each contact as the remaining individuals

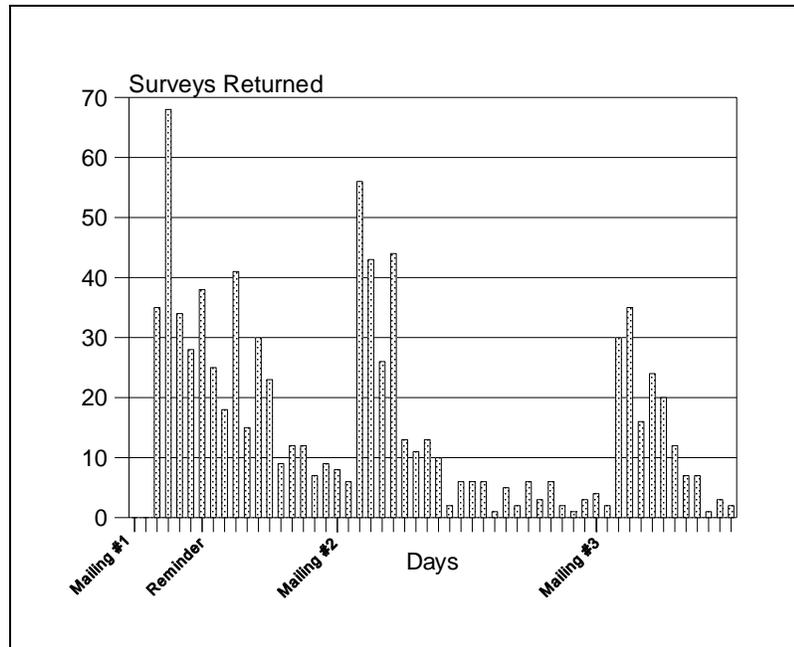


FIGURE 13.6 Pattern of Survey Response

were less inclined to complete the questionnaire. The first mailing obtained a response rate of 30 percent; the second, 25 percent; and the third, 24 percent. It is surprising that the final mailing elicited almost the same rate of response as the second. The following comment from a returned questionnaire suggests that the use of certified mail may have increased response rates relative to regular mail:

"In-as-much that you have gone to the expense of sending this via certified mail, I felt that it would behoove me to fill out and return. . . . I do admire your efforts in safeguarding the health and safety of Michigan sportsmen."

The third contact also ran the risk of angering some people. The following comment expresses a common theme a bit more creatively than usual. This was written on the cover letter and returned without a completed questionnaire:

"You can take this as my answer, if I were interested in answering this questionnaire I would have sent the first one back. . . . Now that you've wasted enough of the taxpayer's money to mail me three envelopes @ \$1.52 each, you can save us all some money and use this paper constructively the next time you visit your favorite john. Thank you very much for *your* time."

In spite of some negative responses, the certified mailing resulted in 150 additional completed questionnaires. This represents 15 percent of the overall response.

### **Conclusion**

More than anything else, this study emphasized the importance of interaction with potential respondents prior to and during the process of writing a questionnaire. Without such interaction, researchers must trust that respondents interpret questions and responses as they themselves do. They must also take for granted that questions are clear and unambiguous and do not elicit strong emotions or beliefs that may influence responses. Such assumptions in this study would have been a mistake. Pretest participants routinely interpreted questions, made assumptions, and reached conclusions that were unanticipated and inconsistent with the intended focus of a question.

Focus groups and repeated one-on-one interviews refined the draft questionnaires. Revisions generated a set of questions that were interpreted in a like manner by most respondents. They also ensured that questions evoked interpretations consistent with our intentions. For example, revisions to the WTP question corrected an erroneous interpretation of the current advisory, clarified the differences between advisory alternatives, and eliminated the problem of interdependent valuation of several programs. Also, revisions of questions about anticipated behavioral change included a richer set of response choices that corresponded to those actually perceived as options by anglers.

Revisions based on pretesting improved the quality of data obtained from the CV survey. Mean WTP estimates from the mail pretest exhibited no significant variation across programs or levels of testing. However, final estimates of WTP were consistent with theoretical expectations: WTP for a partial disclosure program was not significantly different from zero, WTP for full disclosure was positive and significant, and the marginal value of testing an additional site with full disclosure was positive.

### **Notes**

1. The authors would like to thank the Michigan Sea Grant College Program for support of this project
2. Personal communication with John Hesse, Chief, Environmental Health Assessment Division, Michigan Department of Public Health.
3. The size of the monitoring program is constrained primarily by the budget for chemical analysis which in 1992 totaled \$320,000.
4. Michigan fishing licenses are valid through the end of March of the year following their issue.

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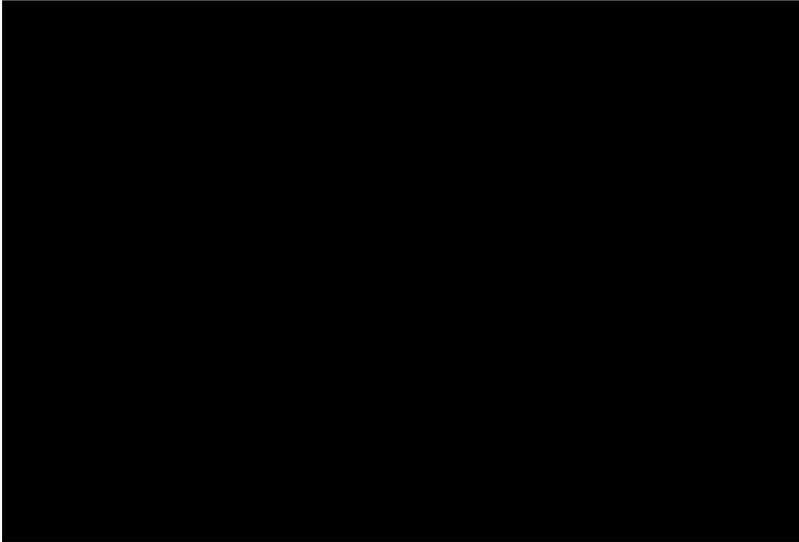
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Appendix 13.A

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**MICHIGAN'S  
SPORT FISH  
CONSUMPTION  
ADVISORIES**



1. Do you regularly do any of the following? (Circle all that apply)
  1. **Firearm or bow hunting**
  2. **Bird or wildlife viewing**
  3. **Camping**
  4. **None of the above**
  
2. About how many times per year do you fish at the following types of sites? (Fill in numbers)
  1. \_\_\_\_\_ **Great Lakes**
  2. \_\_\_\_\_ **Inland lakes or ponds**
  3. \_\_\_\_\_ **Rivers or streams**
  4. \_\_\_\_\_ **Other**
  
3. On average, throughout the year, about how often do you eat fish that you catch in Michigan? (Circle one number)
  1. **I do not eat fish that I catch**
  2. **Less than one meal per week**
  3. **About one meal per week**
  4. **Two or more meals per week**
  
4. What do you think is the chance that *you* will someday have health problems because of chemical residues in Michigan's sport fish? (Circle one number)
 

1. <b>No chance</b>	6. <b>1 in 100</b>
2. <b>1 in a million</b>	7. <b>1 in 10</b>
3. <b>1 in 100,000</b>	8. <b>1 in 5</b>
4. <b>1 in 10,000</b>	9. <b>1 in 2</b>
5. <b>1 in 1,000</b>	10. <b>Certain to happen</b>

5. How certain are you that your guess about the chance of a health effect is correct? (Circle one number)

1. **Very uncertain**
2. **Somewhat uncertain**
3. **Somewhat certain**
4. **Very certain**
5. **I have no idea**

*The public health advisory from the 1992 Fishing Guide is included with this questionnaire. Questions that mention the "advisory" refer to this insert.*

6. Has the advisory helped you to avoid health problems from chemical residues in fish? (Circle one number)

1. **Yes**
2. **No**
3. **I don't know**

7. As a result of the advice in the advisory, do you . . . (Circle all that apply)

1. **I have not read the advisory**
2. **Eat fish less often**
3. **Fish at different places**
4. **Eat smaller fish**
5. **Eat different kinds of fish**
6. **Prepare fish to eat differently**
7. **Do nothing differently**

8. Are you concerned about chemical residues or other contaminants in other foods that you eat? (Circle one number)

1. **Not at all concerned**
2. **Somewhat unconcerned**
3. **Somewhat concerned**
4. **Very concerned**

### Michigan's Public Health Advisory

There are more than 5,800 public fishing sites in Michigan. These include 2,200 sites on rivers and streams, 3,600 inland lakes, and the Great Lakes. The state has tested 350 of these sites for chemical residues in fish. About 30 new sites are tested each year.

The current public health advisory tells you:

- that you should not eat too much fish from *any* inland lake because of widespread mercury contamination, and
- it lists 50 sites where fish contain chemical residues *above* state limits.

The advisory does not tell you about:

- the 300 tested sites where chemical residues *do not* exist or are *below* state limits.

The advisory program could be changed.

- In addition to the list of sites where chemical residues are *above* state limits, the advisory could list tested sites where chemical residues *do not* exist or are *below* state limits.
- More than 30 new sites could be tested each year.

These changes would increase the amount of information in the advisory but they would also cost more money.

### Your Vote on Advisory Programs

The table below shows two advisory programs. The "Current Advisory" is Michigan's current advisory program. "Program A" is a different program that could be put in place.

Program Options	Current Advisory	Program A
Lists tested sites where chemical residues are <i>above</i> state limits?	Yes	Yes
Lists tested sites where chemical residues do not exist or are <i>below</i> state limits?	No	Yes
Number of new sites tested each year.	30	110
Cost to you in higher fishing license fees.	\$0.00	\$.40

Suppose the Michigan Department of Natural Resources (DNR) sent you a ballot to vote "for" or "against" Program A. If a majority of anglers vote "for" Program A, it will replace the Current Advisory. If a majority vote "against" Program A, the Current Advisory will be continued.

9. Would you vote for Program A if it permanently increased your yearly license cost by \$.40, or vote against it and keep the Current Advisory at no additional license cost?

1. **Vote for Program A**
2. **Vote against Program A and keep Current Advisory**
3. **Don't know or no opinion**

10. Do you agree or disagree with the following statements?

**Circle best response**

It is OK to increase fishing license fees to pay for better public health advisories.

Strongly Agree    Somewhat Agree    Somewhat Disagree    Strongly Disagree    No Opinion

The health risks from chemical residues in fish are well understood by scientists.

Strongly Agree    Somewhat Agree    Somewhat Disagree    Strongly Disagree    No Opinion

If chemical residues in fish made someone sick, the illness would probably be fatal.

Strongly Agree    Somewhat Agree    Somewhat Disagree    Strongly Disagree    No Opinion

The advisory understates the health risks from chemical residues in Michigan's fish.

Strongly Agree    Somewhat Agree    Somewhat Disagree    Strongly Disagree    No Opinion

11. In addition to the list of unsafe sites, suppose the advisory listed all tested sites where chemical residues in fish did not exist or were below state limits. If your favorite site had *not* been tested would you . . .? (Circle all that apply)

1. Continue to fish at your favorite sites
2. Stop eating fish from your favorite sites
3. Fish only at sites where chemical residues are below state limits
4. When choosing a new site, be more likely to go to a site where chemical residues were below state limits

12. What would you do if next year's advisory said you should not eat any of your favorite species of fish from your favorite site? (Circle all that apply)

1. I would still fish at the site
2. I would eat fewer fish from the site

3. **I would not eat fish from the site**
  4. **I would fish at a different site**
  5. **I would stop fishing**
13. Which of the following groups do you trust to provide the *best* information about contaminants in Michigan's sport fish? (Circle one number)
1. **Federal government**
  2. **State government**
  3. **A well known consumer's group**
  4. **An environmental group**
  5. **A university laboratory**
  6. **Other \_\_\_\_\_**
14. What is the highest grade of school you have finished? (Circle one number)
1. **Grade school only**
  2. **Did not finish high school**
  3. **High school or GED**
  4. **Vocational or technical school**
  5. **Some college**
  6. **College graduate (BS or BA)**
  7. **Some graduate or professional school**
  8. **Graduate degree (PhD, MD, MA, MBA)**
15. What choice below best describes your household's expected before-tax income from all sources for 1993? (Circle one number)
- |                                |                                   |
|--------------------------------|-----------------------------------|
| 1. <b>\$0 to \$9,999</b>       | 8. <b>\$70,000 to \$79,999</b>    |
| 2. <b>\$10,000 to \$19,999</b> | 9. <b>\$80,000 to \$89,999</b>    |
| 3. <b>\$20,000 to \$29,999</b> | 10. <b>\$90,000 to \$99,999</b>   |
| 4. <b>\$30,000 to \$39,999</b> | 11. <b>\$100,000 to \$109,999</b> |
| 5. <b>\$40,000 to \$49,999</b> | 12. <b>\$110,000 to \$149,999</b> |
| 6. <b>\$50,000 to \$59,999</b> | 13. <b>\$150,000 to \$199,999</b> |
| 7. <b>\$60,000 to \$69,999</b> | 14. <b>\$200,000 and above</b>    |

*If you have any comments about this questionnaire please write them on this page.*

*When you are finished with the questionnaire please fold it in half, place it in the enclosed business reply envelope, and return to:*

*Douglas Krieger  
Project Director  
Department of Agricultural Economics  
Michigan State University  
East Lansing, MI 48824-1039*

*Thank you very much for your help.*

*Chlorine bleach used in the paper industry contributes to dioxins in Michigan waters. This questionnaire is printed on recycled paper made from 100% post consumer stock and processed without chlorine bleach.*