# EFFECTS OF THE HEALTH ADVISORY AND ADVISORY CHANGES ON FISHING HABITS AND FISH CONSUMPTION IN NEW YORK SPORT FISHERIES

by

Nancy A. Connelly, Barbara A. Knuth, and Carole A. Bisogni

Report for New York Sea Grant Institute Project No. R/FHD-2-PD

Series No. 92-9

September 1992

Human Dimensions Research Unit
Department of Natural Resources
New York State College of Agriculture and Life Sciences
A Statutory College of the State University
Fernow Hall, Cornell University, Ithaca, N.Y. 14853

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## EXECUTIVE SUMMARY

Fish consumption health advisories have been issued by state health, environmental quality, and fishery management agencies since the mid-1970's in response to concern over potential negative human health consequences of consuming sport-caught fish affected by chemical contaminants. Issuing health advisories containing recommendations about limiting sport-caught fish consumption is the primary management strategy being implemented by state fishery and health agencies to address the contaminant problem, other than long-term remediation and control activities. The purposes of this study were to (1) assess New York licensed angler awareness and knowledge about advisories and contaminants in fish, and fishing and fish-consuming behavior, and (2) identify changes in these factors that have occurred since the explanatory information in the advisory was expanded.

### Methods

A systematic sample of 2,000 licenses was selected for the license year beginning October 1, 1990 and ending September 30, 1991. All licenses that permitted either resident or nonresident fishing in New York State formed the population from which the sample was drawn.

A mail questionnaire was developed, which contained some questions similar to those asked in the most recent statewide angler survey (Connelly et al. 1990). These questions on fish preparation and cooking methods, awareness of health advisories, changes made as a result of the health advisories, and general attitude questions allowed comparison between the results of the current study and the 1988 statewide angler survey to identify effects of the updated advisory and general changes over time. Additional questions were also included in the questionnaire to measure catch and consumption of fish,

knowledge of specific health advisory information, attitudes toward health advisories, believable sources of health advisory information, and health advisory information desired by licensed anglers.

The mail survey was implemented in January, 1992. Up to three follow-up mailings were sent to nonrespondents over the course of the following month.

A nonresponse follow-up survey via telephone was conducted in March 1992 with 100 mail survey nonrespondents to provide an estimate of the degree to which nonrespondents differed from respondents. We made adjustments for nonresponse bias to population level estimates for the following variables: overall sportfish consumption, awareness of health advisory, and fish consumption suppression.

Results and Discussion

Of the 2,000 questionnaires mailed, 51 were undeliverable and 1,000 completed questionnaires were returned. This resulted in an adjusted response rate of 52.8%.

Advisory Awareness, Understanding, and Information Sources

An estimated 85% of anglers (adjusted for nonresponse bias) who purchased a license in New York in 1990-1991 were aware of the health advisory. Almost half of them said they were aware of specific species or waterbodies listed in the advisory, while the remainder were only generally or vaguely aware of the advisory. The overall percentage aware of the advisory was up from 80% in 1988. Increases in awareness since 1988 were noted for groups of special concern, including the youngest anglers, lowest income, and least educated. Use of the Fishing Regulations Guide had increased since 1988, with the Guide the most-used information source in 1991. Posted warnings were used by nonwhite anglers, low income anglers, and anglers in

households with children. Because these groups are considered among potential high-risk anglers, posted warnings should be evaluated to identify potential improvements in information content.

Respondents' knowledge of health advisory information was assessed using 20 questions which measured knowledge in each of the following 6 areas: effects of contaminants on fish, negative health effects of fish consumption, positive health effects of fish consumption, advisory recommendations, advisory process, and risk-reducing behaviors. Relatively weak knowledge areas related to the negative effects of fish consumption included knowledge about what the potential health effects are, and the time-frame over which effects may last. Knowledge of the advisory recommendation to limit fish consumption from New York waters to 1 meal per week was very low.

The combination of information sources used appeared to affect most of the areas of knowledge. In many cases, respondents using experts (New York State Department of Environmental Conservation or Department of Health personnel) as an information source were more likely to be correct than respondents using the Guide and any other source of information except experts. The Guide, therefore, appears to be an effective mechanism for educating people about advisories when compared to other information sources such as mass media (e.g., newspapers), but not as effective as personal contact with an advisory expert.

Fish Consumption

Fish consumption in relation to the advisory recommendations can be summarized as follows: 76% of anglers statewide did not eat listed species and followed the 1 meal per week maximum consumption recommendation; 4% statewide ate listed species within advisory guidelines and followed the 1

meal per week recommendation; 20% statewide exceeded the advisory recommendations in some way—15% ate listed species above the recommended levels, and 5% ate only unlisted species but more frequently than 1 meal per week.

A significant finding from the consumption data was that people who consumed above the general advisory recommendation of 52 fish meals per year maximum consumption were generally not eating listed species. The reciprocal was also true, that the majority who ate listed species above the recommended limits were not eating more than 52 sport-caught fish meals per year. In other words, the majority of anglers who consumed listed species above the recommended limit stayed within the overall recommended limit of 52 meals per year of sport-caught fish.

Of special interest to fishery and public health professionals may be the group of fish consumers eating greater quantities of listed species than recommended in the advisory. This group tended to be aware of the health advisory, as knowledgeable about the advisory as other fish consumers, and just as likely to believe health advisories provide enough information to allow anglers to make an informed decision. These high fish consumers, however, were more likely than other fish consumers to believe the health risks associated with fish consumption are minor compared to other risks, the health benefits are greater than the risks, more likely to have made changes in their fish preparation or fishing behavior, and more likely to exert personal control by using risk-reducing cleaning and cooking methods. Of the high fish consumers who did not change in response to the advisory, many felt eating fish did not pose a risk, but the majority (80%) believed the amount of fish they ate was within the recommended levels. These anglers demonstrated

the same opinions as other fish consumers regarding the level of concern the general public should feel about health risks from fish consumption, but were less concerned about the risks for themselves and their families than other fish consumers. Weinstein (1989) reported that people tend to be optimistic about hazards judged to be controllable by personal action. Choosing how to catch, clean, cook, and eat sport-caught fish is largely under individual control. To address optimistic biases associated with personal risk, Weinstein (1984) suggested health communications should not only point out risky behaviors, but also stress the link between specific behaviors and susceptibility to the risk.

Over 50% of respondents said they made changes in their fishing behaviors or fish consumption in response to the health advisories. Eating less sport-caught fish was the most common change, made by 70% of New York licensed anglers. Use of specific risk-reducing fish preparation methods has not changed since 1988. The majority of anglers use risk-reducing methods at least some of the time. Use of non risk-reducing methods also has not changed between 1988 and 1991. Fish consumption suppression is evident in New York anglers, as 47% statewide indicated they would eat more sport-caught fish if problems with contaminants did not exist.

Risk management assumptions may be better-informed as a result of this study. Thirty to 65% of anglers in various groups reported freezing or canning their sport-caught fish for later use, which may support or refute certain risk assessment assumptions about the time span over which fish consumption occurs.

Information Needs

The majority of anglers desired more information on all of the topics listed in the questionnaire. Those topics most frequently noted were cooking and cleaning methods, how to choose fishing locations, and which species of fish to eat to reduce risks. A plurality of respondents desiring more information would seek out the NYSDEC Bureau of Fisheries for that information. Of all the sources listed in the questionnaire, the Bureau was rated as most believable.

Angler opinions about the health advisory have not changed over time, based on two measures. The majority believed the health advisory provides them with enough information and that it is not exaggerated.

Conclusions and Recommendations

Changes Since 1988

Angler awareness of the advisory increased (80% in 1988, 85% in 1991), particularly among young, low income, and less-educated anglers. More anglers used the Fishing Regulations Guide as a source of information about the health advisory. More anglers in 1991 vs. 1988 either ate less fish due to the advisory, or increased their fish consumption because of the advisory information. Increases in percent of anglers who reduced fish consumption were most evident for the youngest, lowest income, and female respondents. Fewer anglers in 1991 claimed they had made changes in fish cleaning or cooking procedures or in locations fished in response to the health advisory.

Recommendations for Risk Management

Risk managers should consider which target audiences require refinements in advisory communication strategies. Our results suggest women of childbearing age, young anglers, low income anglers, and anglers with low

education levels are most in need of changes in communication programs. Communication mechanisms should be evaluated for potential improvement, focusing on (1) mass media information changes to improve knowledge among anglers who do not use the Regulations Guide for information, (2) posted warnings to reach potential high-risk anglers such as nonwhite, and low income anglers, and anglers in households with children, and (3) personal contact methods that, in this study, were linked to higher levels of knowledge about the health advisory.

Recommendations for Research

New risk management strategies (e.g., those implemented in response to suggestions above) should be evaluated to assess what effects new strategies have on angler knowledge, beliefs, attitudes, and behaviors related to health advisories. Measurement of all variables in the conceptual model describing angler response to health advisories was not possible in this study. Future research should focus on determining the influence of normative and control-oriented beliefs, normative attitudes, and behavioral intentions on fish consumption behaviors and other behaviors related to health advisories. Coupled with this study, such future research could lead to a comprehensive, empirically-supported model of angler response to health advisories on which future risk management strategies could be based.

# INTRODUCTION

Fish consumption health advisories have been issued by state health, environmental quality, and fishery management agencies since the mid-1970's in response to concern over potential negative human health consequences of consuming sport-caught fish affected by chemical contaminants. Fish in the Great Lakes, for example, have been found to contain elevated levels of several contaminants, including mercury, PCBs, mirex, and chlordane (Rathke and McRae 1989). In a study sponsored by New York Sea Grant Institute, Zeitlin (1989) reported 26 of 30 coastal U.S. states issued contaminant-related health advisories in 1987. Nationwide, 37 states issued advisories in 1989 (Cunningham et al. 1990).

Issuing health advisories containing recommendations about limiting sport-caught fish consumption is the primary management strategy being implemented by state fishery and health agencies to address the contaminant problem, other than long-term remediation and control activities. In only a few sites nationwide is fishing or possessing fish banned. The purposes of this study were to (1) assess New York licensed angler awareness and knowledge about advisories and contaminants in fish, and fishing and fish-consuming behavior, and (2) identify changes in these factors that have occurred since the explanatory information in the advisory was expanded.

## New York Health Advisory Background

New York has responded to chemical contaminants in sport-caught fish since 1976, first through a ban on fish possession, later through the use of health advisories. The health advisory process used by the New York State Department of Environmental Conservation (NYSDEC) was formalized in 1986 (NYSDEC 1986), although the New York State Department of Health (NYSDOH) has

not produced a formal document outlining its role in the health advisory process (Knuth 1989).

The 1990-1991 New York health advisory listed 41 waters in which fish are affected by contaminants. These waters had specific recommendations, by species and size of fish, to limit consumption to no more than one fish meal per month or to avoid consumption completely. In addition, women of childbearing age and children under age 15 were advised not to eat fish with elevated contaminant levels (i.e., any fish from the waters listed). The health advisory also included a recommendation to all anglers to eat no more than one (1/2 pound) meal per week of fish from New York waters (Appendix A).

Issuing advisories is a management strategy that is largely voluntary on the part of fish consumers, rather than restrictive (as are bans). Advisories allow individuals to make an informed decision about their potential exposure to contaminants in sport-fish. The extent to which an angler or fish consumer is truly informed will depend in part on the information available to him/her, including content, quality, amount, and method of presentation. Other factors affecting angler understanding of and behavior resulting from advisories are whether the individual actually reads the information available, whether it makes sense to the person, whether knowledge influences attitudes and actions, what other information about contaminants an individual has available, and what consequences would accrue to the individual from following the advisory (Knuth 1990). The advisory management strategy presumes that anglers and fish consumers are aware of the recommendations, understand them, and have enough knowledge to make an informed decision to abide by, modify, or reject the recommendations contained in the health advisories (Knuth 1990).

The process of developing and issuing health advisories is complex, including the following components: initial fish tissue monitoring; data interpretation; deciding what recommendations to make; communicating those recommendations to target audiences; and evaluating the success of the advisory relative to specific management objectives. Previous evaluations have focused largely on whether anglers are aware of health advisories, and have assessed whether anglers have changed their fishing or fish consumption habits as a result of the advisories (Wendt 1986, Diana 1989, Fiore et al. 1989, Connelly et al. 1990, Springer 1990). Diana (1989), Connelly et al. (1990), and Springer (1990) began to assess the types of information that would lead to improved advisories from the perspective of anglers, focusing on New York as the study site.

Diana (1989) implemented a detailed mail survey with a sample of licensed anglers from one New York county bordering Lake Ontario. Her results are therefore less generalizable than a statewide study, but demonstrated a majority of anglers were aware of the health advisory. Beyond minimum awareness, however, few anglers were strictly following the advice contained in the advisory. Her study demonstrated lack of angler knowledge regarding specific contaminant-related topics.

Springer (1990) used several methods (i.e., mail surveys, personal interviews, group interviews) to compare advisory awareness, attitudes toward risk, and fishing and fish consumption behaviors of three target audiences and two communicator groups. The target audiences included angling association opinion leaders, migrant farmworkers, and low income individuals. The communicator groups included fishery and health professionals. Except for migrant farmworkers, a majority of each group was aware of the advisory, but

fish consumption rates, fish preparation behaviors, and attitudes toward the advisory all indicated the advisory was not having the intended effect of limiting fish consumption for particular individuals and groups.

Connelly et al. (1990) conducted a New York statewide licensed angler mail survey, part of which focused on health advisories, angler behavioral change, and need expressed by anglers for more contaminant-related information. A majority of licensed anglers were aware of the advisory, but most also desired more information about certain topics (e.g., comparative risks, specific health effects associated with contaminants).

Since completion of those studies, the New York State health advisory published in the "Fishing Regulations Guide" has been expanded. Prior to the 1990-1991 fishing season, the health advisory in the Guide consisted of two pages listing waters and species to be avoided by various groups of fish consumers, but included minimal attention to potential health effects, contaminants of concern, and specific advice about how to reduce exposure to contaminants other than limiting fish intake (Appendix B). The 1990-1991 advisory was expanded to include a brief explanation of the trimming procedures that help reduce some contaminants, a discussion of the chemicals that have been found in fish, a review of state vs. federal roles in the advisory process, more detailed explanation of the meaning of the advisory, and five specific behavioral modifications anglers can make to reduce exposure to contaminants (i.e., (1) choose fish from waters not listed in the advisory; (2) fillet the fish to reduce contaminant content; (3) choose smaller fish; (4) avoid tomalley in shellfish; and (5) broil, poach, boil, or bake fish).

The objectives the NYSDOH and NYSDEC hope to achieve through the advisory include the following, judged "very or extremely important" (Knuth

and Connelly 1991): (1) allow people to make their own, informed decision about eating fish; (2) reduce health risks to special at-risk groups of people; (3) reduce health risks to licensed sport anglers; (4) help people select less-contaminated species of fish to eat; (5) help people select risk-reducing fish cleaning and cooking methods; (6) reduce risks to people who rely on fish as a subsistence food resource; and (7) reduce health risks to unlicensed anglers.

This study used baseline data available regarding angler knowledge, behavior, and attitudes toward the advisory (primarily Connelly et al. 1990) to assess changes that have occurred among anglers following the availability of the expanded advisory, to assess the overall effects of the 1990-1991 health advisory on these factors. The study also serves as a means for evaluating the attainment of several of the important agency objectives noted above.

Theoretical Foundations

Issuing and disseminating health advisories is a component of chemical risk management known as risk communication. Risk communication is an interactive process of information exchange among individuals, groups, and institutions that involves multiple messages about the nature of risks (National Research Council 1989). Risk communication experts advocate a receiver-centered approach to risk communication (e.g., Earle and Cvetkovich 1984, Smith and Enger 1988). Such approaches demand focused studies and evaluations of how people respond to various types of information, what their needs are regarding information and education, and what their values are toward the resource.

Communicators of fish consumption risks must understand their target audiences to avoid being patronizing and too simplistic, but rather thoughtful and informing (Gillett 1990). Designers of information programs often assume mistakenly that information needs of their target audiences are similar to their own (Earle and Cvetkovich 1984). Springer (1990) found differences in perceptions between target audiences and risk communicators regarding what information was important to include in a health advisory.

We used the Theory of Planned Behavior (Ajzen 1989) and empirical results from prior health advisory research to develop a model for assessing receiver-centered health advisory communication (Fig. 1). The Theory of Planned Behavior is a modification of the Theory of Reasoned Action developed by Ajzen and Fishbein (1980). Both theories are based on the notion that people systematically use the information available to them to shape their beliefs and attitudes about certain actions before deciding to take those actions. According to the Theory of Planned Behavior, a person's actions (behavior) are a result of the intention to perform the behavior, which is a result of three determinants: the individual's attitude toward the behavior, the subjective norm (referring to the importance to an individual of doing what significant others feel the individual should do), and the individual's perceived control over the behavior and its consequences. Each of these determinants is the result of other determinants related to individual beliefs and perceptions.

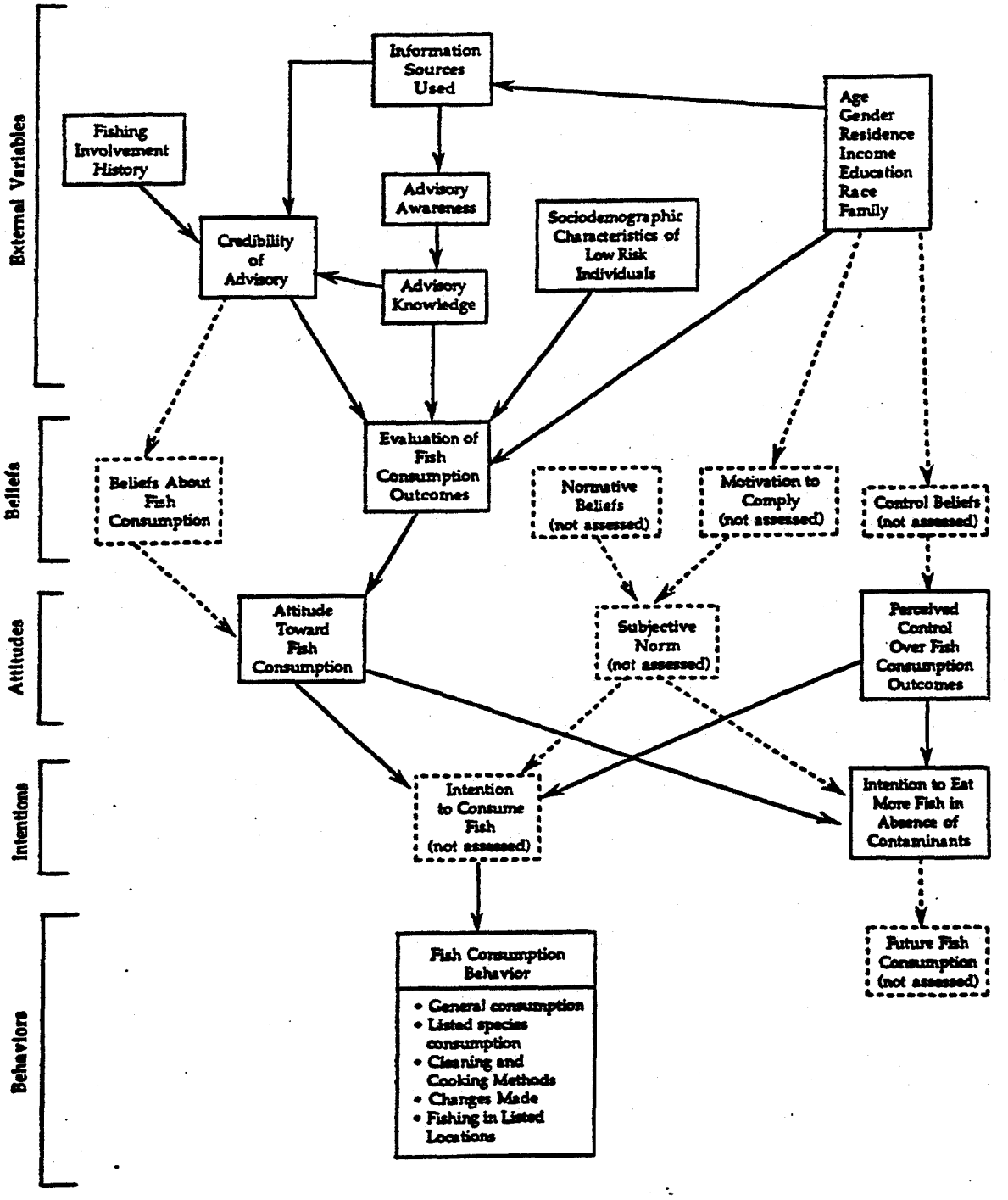


Figure 1. Conceptual diagram of social-psychological process determining response to health advisories, derived from the Theory of Planned Behavior (Ajzen 1989).

The model of social-psychological processes determining response to health advisories that we developed includes five major components: external variables, beliefs, attitudes, intentions, and behaviors (Fig. 1). Each of these components was operationalized in this study, although some more completely than others. External variables included sociodemographic and family status characteristics, advisory information sources, advisory awareness, advisory knowledge, perceived credibility of the advisory, and fishing involvement history. We operationalized beliefs about fish consumption outcomes, but did not measure beliefs about general fish consumption, normative factors, or control. Attitudes we examined included those toward fish consumption and control over fish consumption outcomes, but we did not measure subjective norms. We were not able to measure intention to eat fish and the resulting fish consumption action. Instead, we measured actual fish consumption behavior directly through several methods, and focused on intention to eat fish in a future scenario in which contaminants were not a problem, laying the groundwork for a future study to assess the relationship of that behavioral intention with actual future fish consumption.

Objectives

Our objectives for this study were to:

1. determine the level of awareness and understanding of New York State's (1990-1991) health advisory among New York licensed anglers;
2. describe fishing behaviors (e.g., species, waterways) and fish-consuming behaviors (e.g., species, preparation techniques used) of licensed anglers;

3. compare awareness, understanding, and behaviors among 1990-1991 anglers with results from anglers participating in a 1988 statewide angler survey; and
4. evaluate probable impacts of the 1990-1991 New York advisory and make recommendations for improving risk communication efforts in sport fisheries.

## METHODS

A systematic sample of 2,000 licenses was selected for the license year beginning October 1, 1990 and ending September 30, 1991. All licenses that permitted either resident or nonresident fishing in New York State formed the population from which the sample was drawn.

A mail questionnaire was developed, which contained some questions similar to those asked in the most recent statewide angler survey (Connelly et al. 1990). These questions on fish preparation and cooking methods, awareness of health advisories, changes made as a result of the health advisories, and general attitude questions allowed comparison between the results of the current study and the statewide angler survey to identify effects of the updated advisory and general changes over time. Additional questions were also included in the questionnaire to measure catch and consumption of fish, knowledge of specific health advisory information, attitudes toward health advisories, believable sources of health advisory information, and health advisory information desired by licensed anglers. (See Appendix C for exact content and wording of the questionnaire.)

The mail survey was implemented in January, 1992. Up to three follow-up mailings were sent to nonrespondents over the course of the following month.

Returned questionnaires were coded and entered onto the computer using the SPSS Data Entry II software package.

A nonresponse follow-up survey via telephone was conducted in March 1992 with 100 mail survey nonrespondents to provide an estimate of the degree to which nonrespondents differed from respondents. Nonrespondents who were contacted by telephone were considered to be representative of all nonrespondents.

Analysis was conducted using the SPSSX computer program (SPSS Inc. 1986). Chi-square, t-tests, and Scheffe's test were used to test for statistically significant differences at the $P \leq .05$ level.

Using respondents' reported fishing locations, catch, and consumption, two typologies of sport-fish consumption based on respondent's adherence to health advisory recommendations were created. The first typology grouped people based on overall sport-fish consumption. Those who ate no sport-caught fish in 1991 were placed in group 1. Those who ate up to 52 sport-caught fish meals in 1991 (i.e. within the advisory limit of one meal per week) were placed in group 2. Those who ate more than 52 sport-caught fish meals in 1991 (i.e. above the limit recommended in the health advisory) were placed in group 3. A few respondents were unsure of the number of fish meals of a certain species they consumed. These respondents were placed in group 3 only if the number of known fish meals exceeded 52. Thus we are certain that respondents in group 3 said they consumed more than the recommended maximum number of fish meals from any New York State waters.

The second typology we developed contained six groups based on fishing location, catch, and consumption of contaminated species. The definition of each group is outlined below:

1. "Did not fish listed waters". The respondent did not fish any waters with a specific advisory (but could have fished other New York State waters covered under the general 52-meal-per week maximum recommendation).

2. "Fished listed waters, did not catch". The respondent fished waters with specific advisories, but did not catch any of the species listed specifically on the advisory.

3. "Fished listed waters, did not eat". The respondent fished waters with specific advisories, caught species listed specifically, but did not eat any of the listed species.

4. "Ate, but within limits". The respondent fished waters with specific advisories, caught species listed specifically, and ate fish of the listed species but kept consumption within the levels recommended in the advisory.

5. "Ate, up to 3 times over limit". The respondent fished waters with specific advisories, caught species listed specifically, and ate listed species up to three times above the levels recommended in the advisory. For species with an "eat none" advisory recommendation, we placed anglers eating one to three meals of these species into category 5.

6. "Ate, > 3 times over the limit". The respondent fished waters with specific advisories, caught species listed specifically, and ate listed species over three times above the levels recommended in the advisory. For species with an "eat none" advisory recommendation, we placed anglers eating 4 or more meals of these species into category 6.

A respondent was placed in the highest group possible. If consumption of listed species was not clear (i.e. the respondent could not remember the number of meals, but knew they ate some), they may have been placed in a group lower than their actual fish consumption. We are therefore assured that members of groups 5 and 6 clearly exceeded the advisory limits for consumption of contaminated species. The advisory also recommended that women of childbearing age (defined in this study as age 15-45) not consume any fish from listed waters. Thus if a woman of childbearing age ate any fish from a listed water she was automatically placed in at least group 5.

## RESULTS AND DISCUSSION

### Survey Response

Of the 2,000 questionnaires mailed, 51 were undeliverable and 1,030 completed questionnaires were returned. This resulted in an adjusted response rate of 52.8%.

### Adjustments for Nonresponse Bias

Results of nonresponse bias comparisons confirm the conclusions of previous research that nonrespondents fish much less than respondents and are less likely to be aware of health advisories (Brown and Wilkins 1978, Connelly et al. 1990). We also found that nonrespondents ate fewer sport-caught fish meals, were more likely to feel that the advisory provided them with enough information, and were less likely to know if health risks from fish consumption are relatively minor compared with respondents. Respondents tended to be somewhat older, more likely male, and more likely to say they would eat more sport-caught fish if chemical contaminants did not exist compared with nonrespondents. Respondents and nonrespondents did not differ in their level of knowledge concerning health advisory recommendations or effects of

contaminants on fish, nor in their changes made in response to the health advisory (i.e. eating less fish or taking fewer fishing trips). (Detailed comparisons can be found in Appendix D.)

We made adjustments for nonresponse bias to population level estimates for the following variables: overall sportfish consumption, awareness of health advisory, and fish consumption suppression (detailed in Appendix D). These results are presented later in the sections of the report where each variable is discussed in detail.

## Awareness and Understanding of 1990-91 Advisory

### Awareness

An estimated 85% of anglers (adjusted for nonresponse bias) who purchased a license in New York in 1990-1991 were aware of the health advisory. Almost half of them said they were aware of specific species or waterbodies listed in the advisory, while the remainder were only generally or vaguely aware of the advisory. Middle-age respondents were more likely to be aware of specifics than younger or older respondents (Table 1). Women were more likely than men to be unaware or only generally aware of the health advisory. This is an important finding because women, especially those of childbearing age, have higher potential risks if they eat contaminated fish, due to the possibility of transferring contaminants and their effects to offspring. Fishery and health managers may be concerned if a higher-risk group (e.g., women of childbearing age) are among those least aware of the advisory. Another finding of potential concern is that non-whites are more likely to be unaware of the health advisory than whites. Ethical concerns have been raised about health advisories as a public policy tool if they are

Table 1. Heard about health advisories—overall and by socio-demographic characteristics.

| | Heard About Health Advisories | | |
|---|---|---|---|
| | No | Yes, Only Generally | Yes, Aware of Specifics |
| | Percent | | |
| Overall | 10.2 | 46.3 | 43.5 |
| Age* | | | |
| 16-29 | 14.4 | 55.1 | 30.5 |
| 30-39 | 9.7 | 48.0 | 42.3 |
| 40-49 | 8.9 | 43.5 | 47.6 |
| 50-64 | 10.1 | 39.1 | 50.8 |
| 65+ | 7.0 | 50.9 | 42.1 |
| Income | | | |
| ≤ $20,000 | 11.7 | 48.5 | 39.8 |
| $21,000-$32,000 | 11.3 | 46.9 | 41.8 |
| $33,000-$49,000 | 6.8 | 50.0 | 43.2 |
| ≥ $50,000 | 9.2 | 43.1 | 47.7 |
| Education | | | |
| Grades 1-11 | 9.8 | 47.6 | 42.6 |
| Grad. High School | 10.6 | 49.8 | 39.6 |
| Some College | 10.7 | 46.2 | 43.1 |
| Grad. College | 9.4 | 41.4 | 49.2 |
| Some Post Grad. | 9.1 | 44.7 | 46.2 |
| Sex* | | | |
| Male | 9.1 | 44.8 | 46.1 |
| Female | 16.8 | 54.0 | 29.2 |
| Residence | | | |
| Rural (< 5,000 people) | 10.1 | 48.9 | 41.0 |
| Small City (5,000-24,999 people) | 11.2 | 48.5 | 40.3 |
| City (25,000-99,999 people) | 9.4 | 41.3 | 49.3 |
| Large City (≥ 100,000 people) | 10.3 | 37.4 | 52.3 |
| Race* | | | |
| White | 9.7 | 47.3 | 43.0 |
| Other | 20.0 | 28.6 | 51.4 |
| Household | | | |
| With Children Under 15 | 10.4 | 45.2 | 44.4 |
| Without Children Under 15 | 9.4 | 47.0 | 43.6 |
| With Woman of Childbearing Age | 9.9 | 47.1 | 43.0 |
| Without Woman of Childbearing Age | 10.6 | 44.7 | 44.7 |

*Statistically significant difference at $P \leq .05$ using Chi-square test.

not protective of those groups at potentially higher risk but with less political clout (West et al. 1990).

Sources of Information

For those respondents who were aware of health advisory information, the 1990-1991 Fishing Regulations Guide and newspaper articles were the sources of information cited most frequently (69% and 67%, respectively). The Guide was cited more frequently by those in higher income groups, whereas newspapers were cited more frequently by older respondents and those who had at least graduated from high school (Table 2). Although friends were cited less frequently as a source of information (46%), younger people, households with women of childbearing age and households with children under 15 were more likely to list them. Posted warnings were cited very infrequently (8%), but non-whites were three times as likely to list them as a source of information (Table 2). Posted warnings also were listed more often as sources of information by respondents in the lowest income group and in households with children under 15. Although posted warnings may be effective at limiting consumption from the posted fishing site, they generally do not provide information on alternative sites, nor as detailed information about the effects of fish contaminants on human health as can be found in other sources such as the Fishing Regulations Guide. Since posted warnings are an important source for certain (potentially high-risk) groups, communicators should consider whether posted warnings are providing the groups who rely on them enough information.

The vast majority of respondents (86%) said they used more than one source of information, with the average number of sources used being 3.3. The number of sources used does not differ by socio-demographic characteristics.

Table 2. Sources of health advisory information—overall and by socio-demographic characteristics.

| | Source of Health Advisory Information | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1990-1991 Fishing Regs. Guide | Previous Years Fishing Regs. Guides | Newspaper | TV or Radio | Magazines | Friends | NYSDEC Personnel | Posted Warnings | Guides/Charter Operators |
| | Percent | | | | | | | | |
| Overall | 69.2 | 36.3 | 67.2 | 38.6 | 35.4 | 46.3 | 12.1 | 8.0 | 7.3 |
| Age | | | | | | | | | |
| 16-29 | 62.2 | 35.7 | 62.2* | 42.0 | 35.7 | 64.3* | 11.9* | 9.8 | 6.3 |
| 30-39 | 69.5 | 35.0 | 62.3 | 33.6 | 34.1 | 52.0 | 6.3 | 5.4 | 6.3 |
| 40-49 | 60.0 | 40.0 | 68.4 | 40.0 | 38.0 | 43.6 | 13.6 | 8.8 | 8.8 |
| 50-64 | 62.6 | 35.8 | 72.1 | 38.9 | 36.8 | 33.2 | 17.9 | 8.9 | 7.9 |
| 65+ | 54.4 | 31.6 | 80.7 | 42.1 | 26.3 | 31.6 | 10.5 | 5.3 | 5.3 |
| Income | | | | | | | | | |
| ≤ $20,000 | 56.5* | 33.9 | 63.5 | 41.7 | 34.8 | 45.2 | 16.5 | 14.8* | 5.2 |
| $21,000-$32,000 | 60.4 | 37.1 | 67.3 | 39.6 | 34.6 | 51.6 | 11.3 | 6.3 | 6.9 |
| $33,000-$49,000 | 71.3 | 35.9 | 65.7 | 40.3 | 37.0 | 43.6 | 11.0 | 8.3 | 5.5 |
| ≥ $50,000 | 64.6 | 38.6 | 68.7 | 33.2 | 36.4 | 44.9 | 11.1 | 7.0 | 9.2 |
| Education | | | | | | | | | |
| Grades 1-11 | 54.2 | 33.9 | 54.2* | 40.7 | 32.2 | 40.7 | 6.8 | 8.5 | 0.0 |
| Grad. High School | 62.0 | 35.4 | 70.1 | 43.5 | 34.7 | 46.1 | 12.9 | 8.9 | 9.2 |
| Some College | 62.6 | 33.2 | 71.3 | 35.0 | 37.1 | 51.7 | 12.6 | 9.4 | 7.0 |
| Grad. College | 65.3 | 38.1 | 62.7 | 35.6 | 32.2 | 40.7 | 13.6 | 5.1 | 7.6 |
| Some Post Grad. | 66.7 | 45.8 | 63.3 | 36.7 | 35.8 | 40.0 | 11.7 | 5.8 | 7.5 |
| Sex | | | | | | | | | |
| Male | 64.2 | 38.6* | 66.3 | 36.2* | 37.3* | 45.9 | 12.7 | 8.0 | 7.6 |
| Female | 55.2 | 21.6 | 73.3 | 52.6 | 24.1 | 48.3 | 8.6 | 7.8 | 5.2 |

Table 2. (cont.)

| | Source of Health Advisory Information | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1990-1991 Fishing Regs. Guide | Previous Years Fishing Regs. Guides | Newspaper | TV or Radio | Magazines | Friends | NYSDEC Personnel | Posted Warnings | Guides/Charter Operators |
| | Percent | | | | | | | | |
| **Residence** | | | | | | | | | |
| Rural (<5,000 people) | 62.7 | 35.9 | 65.9 | 37.6 | 37.3 | 46.3 | 13.6 | 8.1 | 7.6 |
| Small City (5,000-24,999 people) | 62.3 | 35.0 | 71.0 | 42.6 | 36.1 | 46.4 | 9.3 | 9.3 | 6.0 |
| City (25,000-99,999 people) | 60.5 | 34.7 | 61.9 | 36.1 | 32.0 | 46.9 | 12.9 | 7.5 | 6.8 |
| Large City (≥ 100,000 people) | 70.4 | 43.9 | 73.5 | 39.8 | 31.6 | 43.9 | 10.2 | 5.1 | 8.2 |
| **Race** | | | | | | | | | |
| White | 62.2 | 35.8 | 68.2 | 38.4 | 35.8 | 46.4 | 11.9 | 7.4* | 7.6 |
| Other | 79.3 | 48.3 | 55.2 | 37.9 | 20.7 | 34.5 | 17.2 | 24.1 | 0.0 |
| **Household** | | | | | | | | | |
| With Children Under 15 | 63.7 | 36.9 | 67.3 | 40.2 | 39.0 | 51.2* | 13.4 | 11.0* | 6.5 |
| Without Children Under 15 | 63.1 | 35.5 | 68.3 | 36.9 | 33.5 | 43.7 | 11.2 | 5.6 | 8.2 |
| With Woman of Childbearing Age | 64.3 | 35.0 | 65.4 | 38.9 | 36.4 | 50.3* | 11.0 | 9.0 | 7.5 |
| Without Woman of Childbearing Age | 60.8 | 38.6 | 70.2 | 37.7 | 34.0 | 39.5 | 14.0 | 6.4 | 7.0 |

*Statistically significant difference at P≤.05 using Chi-square test.

For respondents who did not use the Fishing Regulations Guide as a source of information, newspapers, friends, and TV or radio were listed by a majority as sources of information (78%, 53%, and 51% respectively).

Since respondents generally use more than one source of information it is difficult to attribute increased knowledge or changes in behavior to a specific source. However, some indication of the effectiveness of key sources is needed. Thus, respondents were grouped based on whether or not they used the Fishing Regulations Guide or NYSDEC or NYSDOH personnel (i.e., "experts"). Fifty-six percent of respondents listed either the 1990-91 Guide or previous Guides but no experts as sources of information (other sources could also have been used). Fourteen percent used experts as at least one of their information sources. Of those who used an expert, the majority (83%) also used the Fishing Regulations Guide. Few respondents used an expert and no Guide, so this group could not be analyzed separately. (Comparisons using small sample techniques indicated that the group was similar to those who used experts and the Guide.) The remaining respondents (30%) used neither the Guide nor experts as sources of information. Socio-demographic comparisons showed that men were more likely to use the Guide and/or experts, while women relied more heavily on other information sources (Table 3). Those who used neither the Guide nor experts were much more likely to be only vaguely aware of the advisory than those who used the Guide and/or experts (Table 4). Anglers using experts as an information source were most likely to say they were aware of specific aspects of the health advisory.

Health Advisory Knowledge

Respondents' knowledge of health advisory information was assessed using 20 questions which measured knowledge in each of the following 6 areas:

Table 3. Source of health advisory information groupings—overall and by socio-demographic characteristics.

| | Sources of Information | | |
|---|---|---|---|
| | Fishing Regs. Guides/ No Experts | Experts and Others | No Fishing Regs. Guides or Experts |
| | Percent | | |
| Overall | 56.4 | 13.6 | 30.0 |
| Age | | | |
| 16-29 | 55.2 | 13.3 | 31.5 |
| 30-39 | 65.9 | 7.6 | 26.5 |
| 40-49 | 54.0 | 14.8 | 31.2 |
| 50-64 | 52.2 | 18.9 | 28.9 |
| 65+ | 49.1 | 15.8 | 35.1 |
| Income | | | |
| ≤$20,000 | 48.7 | 18.3 | 33.0 |
| $21,000-$32,000 | 53.5 | 13.2 | 33.3 |
| $33,000-$49,000 | 64.6 | 12.7 | 22.7 |
| ≥$50,000 | 58.9 | 12.0 | 29.1 |
| Education | | | |
| Grades 1-11 | 50.8 | 8.5 | 40.7 |
| Grad. High School | 54.6 | 14.4 | 31.0 |
| Some College | 58.0 | 13.3 | 28.7 |
| Grad. College | 52.5 | 16.1 | 31.4 |
| Some Post Grad. | 62.5 | 13.3 | 24.2 |
| Sex* | | | |
| Male | 57.4 | 14.3 | 28.3 |
| Female | 50.8 | 9.5 | 39.7 |
| Residence | | | |
| Rural (<5,000 people) | 54.4 | 15.2 | 30.4 |
| Small City (5,000-24,999 people) | 57.9 | 12.0 | 30.1 |
| City (25,000-99,999 people) | 55.8 | 12.9 | 31.3 |
| Large City (≥100,000 people) | 65.3 | 11.2 | 23.5 |
| Race | | | |
| White | 56.0 | 13.4 | 30.6 |
| Other | 62.1 | 20.7 | 17.2 |
| Household | | | |
| With Children Under 15 | 57.1 | 14.0 | 28.9 |
| Without Children Under 15 | 56.9 | 13.4 | 29.7 |
| With Woman of Childbearing Age | 58.4 | 12.3 | 29.3 |
| Without Woman of Childbearing Age | 53.5 | 15.8 | 30.7 |

*Statistically significant difference at P≤.05 using Chi-square test.

Table 4. Degree of health advisory awareness by source of health advisory information groupings.

| Degree of Health Advisory Awareness* | Sources of Information: Fishing Regs. Guides/ No Experts | Experts and Others | No Fishing Regs. Guides or Experts |
|---|---|---|---|
| | Percent | | |
| Generally or Vaguely Aware | 49.3 | 23.1 | 68.5 |
| Aware of Specifics | 50.7 | 76.9 | 31.5 |

*Statistically significant difference between generally aware and aware of specifics at $P \leq .05$ using Chi-square test.

effects of contaminants on fish, negative health effects of fish consumption, positive health effects of fish consumption, advisory recommendations, advisory process, and risk-reducing behaviors. Responses were recoded as either correct, incorrect, or not sure. Table 5 lists the responses to each question under the general knowledge heading and categorizes the responses according to whether the respondent was aware of the health advisory and if they were aware, by the sources of information groupings presented previously (i.e., use of Guide, experts, other sources).

Although Table 5 is lengthy, it provides specific information about health advisory knowledge and how it is acquired. This information should be helpful to those writing and disseminating health advisories. For example, knowledge regarding the effects of contaminants on fish was greater overall for knowledge related to fatty and older fish, but incorrect related to taste and behavior of fish. If anglers judge the relative safety of eating fish based on such cues as fish taste and behavior (as suggested by Belton et al. 1986 and Cable et al. 1987), then communicators may need to focus on these

Table 5. Health advisory knowledge questions by awareness of health advisory and by source of health advisory information groupings.

| KNOWLEDGE QUESTIONS | Correct | Not Sure | Incorrect |
|---|---|---|---|
| | Percent | | |
| **Effects of Contaminants on Fish** | | | |
| *Many chemical contaminants are found in greater amounts in fatty fish than in lean fish*[a] | | | |
| Aware of health advisory | 63.7 | 34.0 | 2.3 |
| Fishing Regs. Guide/No Experts | 67.0 | 30.9 | 2.1* |
| Experts and Others | 76.7 | 21.6 | 1.7 |
| No Fishing Regs. Guide or Experts | 51.2 | 46.0 | 2.8 |
| *Older fish generally have more contaminants in them than younger fish*[a] | | | |
| Aware of health advisory | 57.9 | 37.5 | 4.6 |
| Fishing Regs. Guide/No Experts | 61.7 | 34.7 | 3.6* |
| Experts and Others | 67.5 | 28.1 | 4.4 |
| No Fishing Regs. Guide or Experts | 45.8 | 47.4 | 6.8 |
| *Fish contaminated with chemicals will taste odd*[a] | | | |
| Aware of health advisory | 44.1 | 48.2 | 7.7 |
| Fishing Regs. Guide/No Experts | 47.3 | 45.1 | 7.6 |
| Experts and Others | 44.8 | 46.6 | 8.6 |
| No Fishing Regs. Guide or Experts | 35.9 | 55.9 | 8.2 |
| *Fish contaminated with chemicals don't behave normally*[a] | | | |
| Aware of health advisory | 41.1 | 52.9 | 6.0 |
| Fishing Regs. Guide/No Experts | 45.1 | 49.2 | 5.7* |
| Experts and Others | 38.9 | 55.8 | 5.3 |
| No Fishing Regs. Guide or Experts | 33.2 | 60.2 | 6.6 |
| **Negative Health Effects of Fish Consumption** | | | |
| *Eating contaminated fish over many years increases my health risks* | | | |
| Not aware of health advisory | 77.1 | 19.8 | 3.1 |
| Aware of health advisory | 84.7 | 13.9 | 1.4 |
| Fishing Regs. Guide/No Experts | 86.4 | 11.9 | 1.7 |
| Experts and Others | 85.0 | 13.3 | 1.7 |
| No Fishing Regs. Guide or Experts | 80.6 | 18.2 | 1.2 |
| *Eating contaminated fish can result in accumulation of chemicals in my body* | | | |
| Not aware of health advisory | 62.5 | 35.4 | 2.1* |
| Aware of health advisory | 74.9 | 22.8 | 2.3 |
| Fishing Regs. Guide/No Experts | 77.6 | 20.9 | 1.5* |
| Experts and Others | 75.2 | 19.5 | 5.3 |
| No Fishing Regs. Guide or Experts | 68.7 | 28.5 | 2.8 |

Table 5. (cont.)

| KNOWLEDGE QUESTIONS | Correct | Not Sure | Incorrect |
|---|---|---|---|
| | Percent | | |
| *Chemicals from fish can have a greater impact on developing organs in children or unborn babies than on organs in adults* | | | |
| Not aware of health advisory | 61.5 | 37.5 | 1.0 |
| Aware of health advisory | 71.1 | 27.5 | 1.4 |
| Fishing Regs. Guide/No Experts | 75.9 | 23.1 | 1.0* |
| Experts and Others | 75.2 | 24.8 | 0.0 |
| No Fishing Regs. Guide or Experts | 59.7 | 37.5 | 2.8 |
| *Potential negative health effects from eating contaminated fish include nervous system disorders and cancer*[a] | | | |
| Aware of health advisory | 46.9 | 51.0 | 2.1 |
| Fishing Regs. Guide/No Experts | 50.2 | 47.7 | 2.1* |
| Experts and Others | 57.4 | 40.0 | 2.6 |
| No Fishing Regs. Guide or Experts | 35.4 | 62.2 | 2.4 |
| *Negative health effects from eating contaminated fish are mainly short term*[a] | | | |
| Aware of health advisory | 44.5 | 51.7 | 3.8 |
| Fishing Regs. Guide/No Experts | 47.2 | 50.5 | 2.3* |
| Experts and Others | 48.7 | 44.3 | 7.0 |
| No Fishing Regs. Guide or Experts | 35.9 | 58.0 | 6.1 |
| Positive Health Effects of Fish Consumption | | | |
| *Increasing fish consumption reduces dietary fat and helps to control weight* | | | |
| Not aware of health advisory | 68.7 | 25.0 | 6.3 |
| Aware of health advisory | 62.9 | 27.9 | 9.2 |
| Fishing Regs. Guide/No Experts | 60.8 | 29.6 | 9.6* |
| Experts and Others | 64.6 | 21.2 | 14.2 |
| No Fishing Regs. Guide or Experts | 66.8 | 27.3 | 5.9 |
| *Eating fish oils decreases the risk of coronary heart disease* | | | |
| Not aware of health advisory | 34.7 | 53.7 | 11.6 |
| Aware of health advisory | 32.1 | 52.3 | 15.6 |
| Fishing Regs. Guide/No Experts | 30.9 | 53.7 | 15.4 |
| Experts and Others | 37.2 | 43.3 | 19.5 |
| No Fishing Regs. Guide or Experts | 32.0 | 53.8 | 14.2 |

Table 5. (cont.)

| KNOWLEDGE QUESTIONS | Correct | Not Sure | Incorrect |
|---|---|---|---|
| | | Percent | |
| **Advisory Recommendations** | | | |
| *Maximum number of fish meals eaten from any New York State water* | | | |
| Not aware of health advisory | 17.7 | 47.9 | 34.4* |
| Aware of health advisory | 27.7 | 23.7 | 48.6 |
| Fishing Regs. Guide/No Experts | 27.0 | 20.4 | 52.6* |
| Experts and Others | 36.3 | 18.6 | 45.1 |
| No Fishing Regs. Guide or Experts | 25.4 | 33.3 | 41.3 |
| *Maximum number of fish meals women of childbearing age and children under 15 should eat if fish have elevated contaminant levels* | | | |
| Not aware of health advisory | 32.0 | 51.5 | 16.5* |
| Aware of health advisory | 52.0 | 27.1 | 20.9 |
| Fishing Regs. Guide/No Experts | 53.4 | 23.8 | 22.8* |
| Experts and Others | 65.8 | 17.5 | 16.7 |
| No Fishing Regs. Guide or Experts | 41.8 | 37.3 | 20.9 |
| **Advisory Process** | | | |
| *Who should be contacted if someone wanted to know more about health effects from exposure to chemical contaminants* | | | |
| Not aware of health advisory | 46.8 | 9.4 | 43.8 |
| Aware of health advisory | 45.9 | 5.9 | 48.2 |
| Fishing Regs. Guide/No Experts | 46.7 | 5.5 | 47.8* |
| Experts and Others | 41.1 | 1.8 | 57.1 |
| No Fishing Regs. Guide or Experts | 44.5 | 9.0 | 46.5 |
| *Who should be contacted if someone wanted to know more about contaminant levels in fish* | | | |
| Not aware of health advisory | 14.6 | 10.4 | 75.0 |
| Aware of health advisory | 14.8 | 7.3 | 77.9 |
| Fishing Regs. Guide/No Experts | 14.8 | 5.7 | 79.5* |
| Experts and Others | 15.2 | 4.5 | 80.3 |
| No Fishing Regs. Guide or Experts | 15.4 | 11.7 | 72.9 |
| *Method used to measure contaminant levels in fish (i.e., fillet with skin on)*[a] | | | |
| Aware of health advisory | 4.4 | 58.6 | 37.0 |
| Fishing Regs. Guide/No Experts | 3.4 | 58.8 | 37.8* |
| Experts and Others | 11.4 | 45.6 | 43.0 |
| No Fishing Regs. Guide or Experts | 2.8 | 65.5 | 31.7 |

Table 5. (cont.)

| KNOWLEDGE QUESTIONS | Correct | Not Sure | Incorrect |
|---|---|---|---|
| | | Percent | |
| Risk Reducing Behaviors | | | |
| *For people aware of health advisories:* | | | |
| *To reduce the levels of chemical contaminants in fish you should:* | | | |
| *Remove the belly fat*[a] | 74.4 | 24.3 | 1.3 |
| Fishing Regs. Guide/No Experts | 77.8 | 20.7 | 1.5* |
| Experts and Others | 81.4 | 17.7 | 0.9 |
| No Fishing Regs. Guide or Experts | 63.8 | 35.0 | 1.2 |
| *Remove the skin*[a] | 71.0 | 26.8 | 2.2 |
| Fishing Regs. Guide/No Experts | 74.9 | 23.2 | 1.9* |
| Experts and Others | 76.3 | 23.7 | 0.0 |
| No Fishing Regs. Guide or Experts | 61.0 | 35.4 | 3.6 |
| *Broil the fish on a rack*[a] | 41.5 | 50.8 | 7.7 |
| Fishing Regs. Guide/No Experts | 44.5 | 46.8 | 8.7* |
| Experts and Others | 53.7 | 41.7 | 4.6 |
| No Fishing Regs. Guide or Experts | 29.7 | 62.2 | 8.1 |
| *Pan fry the fish*[a] | 33.9 | 57.3 | 8.8 |
| Fishing Regs. Guide/No Experts | 36.7 | 56.0 | 7.3* |
| Experts and Others | 37.1 | 50.5 | 12.4 |
| No Fishing Regs. Guide or Experts | 26.6 | 62.9 | 10.5 |

*Statistically significant difference between groups at $P \leq .05$ using Chi-square test.

[a]Only respondents who were aware of the health advisories were asked to answer these questions.

knowledge areas. Relatively weak knowledge areas related to the negative effects of fish consumption included knowledge about what the potential health effects are, and the time-frame over which effects may last. Knowledge of the advisory recommendation to limit fish consumption from New York waters to 1 meal per week was very low. Few respondents were knowledgeable about who to contact regarding more information about contaminants in fish, and how contaminant levels were measured. Fish cleaning procedures were known better overall than fish cooking procedures.

For readers less interested in the specific knowledge items, and to facilitate comparisons with other variables, the knowledge questions were combined into an overall knowledge scale and 6 subscales using the categories listed above for respondents aware of the health advisory. The reliability of the overall scale was good (i.e., alpha=0.67), but the reliability of the subscales with the fewest items was low. Thus, future users of the scale should develop additional items for at least some of the subscales to more fully measure the subconcepts and improve overall reliability of the scale.

The combination of information sources used appeared to affect most of the areas of knowledge. For most knowledge items exhibiting significant differences based on information sources used, respondents who used either the Guide or experts were more likely to answer the knowledge item correctly than those who used sources other than the Guide and experts (Table 5). In many cases, respondents using experts as an information source were more likely to be correct than respondents using the Guide and any other source of information except experts. This trend was particularly evident on questions dealing with which fish are most contaminated (e.g., fattier, older), what negative health effects are associated with eating contaminated fish, the

maximum fish consumption recommended for women of childbearing age and children, and risk-reducing fish preparation behaviors. The Guide, therefore, appears to be an effective mechanism for educating people about advisories when compared to other information sources such as mass media (e.g., newspapers), but not as effective as personal contact with an advisory expert. Notably, this trend broke down on a knowledge item related to the positive health effects of fish consumption, for which respondents using neither the Guide nor experts were more likely to be correct. Relatively few respondents (even those using the Guide or experts) could name correctly the maximum number of fish meals per year (52) the advisory recommends eating from any New York State water. Overall, knowledge items associated with the health advisory process were most frequently answered incorrectly or as unsure (Table 5).

About one-quarter of respondents who were aware of the health advisory answered correctly all of the knowledge questions in the following areas: negative health effects of fish consumption, positive health effects of fish consumption, risk-reducing behaviors, and effects of contaminants on fish (Table 6). Few respondents could identify the correct advisory recommendations as illustrated by a mean scale score of 0.05, measured on a scale where 1=correct, 0=don't know, and -1=incorrect. Respondents were more likely to choose an incorrect answer for the advisory process questions, resulting in an overall negative mean score for that area. The overall knowledge scale score was 0.34. No single individual answered all 20 knowledge questions correctly.

Differences in knowledge were associated with various socio-demographic characteristics (Table 7). Most notable were the lower knowledge scores of

Table 6. For people who were aware of health advisory, knowledge area scores.

| Knowledge Area | Percent with Correct Answers for all Questions in Area | Number of Questions | Mean Scale Score[a] |
|---|---|---|---|
| Negative health effects of fish consumption | 28.9 | 5 | 0.63 |
| Positive health effects of fish consumption | 26.1 | 2 | 0.35 |
| Risk-reducing behaviors | 26.8 | 4 | 0.50 |
| Effects of contaminants on fish | 23.8 | 4 | 0.46 |
| Advisory recommendations | 16.3 | 2 | 0.05 |
| Advisory process | 0.5 | 3 | -0.33 |
| Overall[b] | 0.0 | 20 | 0.34 |

[a]Correct answers were coded as 1, don't know as 0, and incorrect answers as -1. The mean scale score is the respondent's average score for questions in an area. If a majority of questions were answered then an average score was calculated, otherwise the case was missing.

[b]Reliability of overall scale, alpha=0.67.

Table 7. For people aware of the health advisory, mean knowledge area scores by socio-demographic characteristics.

| | Negative Health Effects of Fish Consumption | Positive Health Effects of Fish Consumption | Risk-reducing Behaviors | Effects of Contaminants on Fish | Advisory Recommendations | Advisory Process | Overall Knowledge |
|---|---|---|---|---|---|---|---|
| | Mean | | | | | | |
| **Age** | | | | | | | |
| 16-29 | .59 | .25 | .36[a] | .34[a] | -.04 | -.26 | .27[a] |
| 30-39 | .68[b] | .38 | .46 | .48[b] | .05 | -.33 | .35[b] |
| 40-49 | .65 | .40 | .56[b] | .49[b] | .04 | -.34 | .37[b] |
| 50-64 | .60 | .33 | .56[b] | .51[b] | .11 | -.35 | .36[b] |
| 65+ | .51[a] | .36 | .59[b] | .47 | .20 | -.36 | .34 |
| **Income** | | | | | | | |
| ≤ $20,000 | .49[a] | .31 | .35[a] | .27[a] | .05 | -.38 | .23[a] |
| $21,000-$32,000 | .61 | .29 | .49[b] | .40[a] | .08 | -.28 | .32[b,c] |
| $33,000-$49,000 | .66[b] | .36 | .55[b] | .53[b] | .05 | -.33 | .38[b] |
| ≥ $50,000 | .68[b] | .38 | .56[b] | .56[b] | .07 | -.33 | .39[b,d] |
| **Education** | | | | | | | |
| Grades 1-11 | .55 | .29[a] | .42 | .25[a] | .08 | -.40 | .24[a] |
| Grad. High School | .54 | .27 | .45[a] | .39[c] | -.03 | -.36 | .27[a] |
| Some College | .65 | .36 | .51 | .47[b,e] | .12 | -.29 | .36[b,c] |
| Grad. College | .71 | .48[b] | .54 | .56[b,d] | .04 | -.36 | .40[b] |
| Some Post Grad. | .72 | .43 | .62[b] | .62[b,d,f] | .10 | -.30 | .45[b,d] |
| **Sex** | | | | | | | |
| Male | .63 | .34 | .51 | .48 | .05 | -.32 | .35 |
| Female | .61 | .42 | .44 | .40 | .07 | -.37 | .31 |

Table 7. (cont.)

| | Negative Health Effects of Fish Consumption | Positive Health Effects of Fish Consumption | Risk-reducing Behaviors | Effects of Contaminants on Fish | Advisory Recommendations | Advisory Process | Overall Knowledge |
|---|---|---|---|---|---|---|---|
| | | | | Mean | | | |
| **Residence** | | | | | | | |
| Rural (5,000 people) | .59[a] | .33 | .48 | .44[a] | .08 | -.34 | .32[a] |
| Small City (5,000-24,999 people) | .66 | .34 | .53 | .47 | .00 | -.32 | .35 |
| City (25,000-99,999 people) | .64 | .35 | .50 | .48 | .00 | -.35 | .34 |
| Large City (≥ 100,000 people) | .72[b] | .47 | .55 | .58[b] | .09 | -.28 | .42[b] |
| **Race** | | | | | | | |
| White | .63 | .35 | .51 | .47[b] | .06 | -.33 | .35 |
| Other | .60 | .30 | .41 | .26[a] | .00 | -.41 | .26 |
| **Household** | | | | | | | |
| With Children Under 15 | .65 | .36 | .52 | .46 | .04 | -.33 | .35 |
| Without Children Under 15 | .61 | .35 | .50 | .48 | .06 | -.33 | .34 |
| With Woman of Child-bearing Age | .65[b] | .35 | .50 | .47 | .04 | -.32 | .35 |
| Without Woman of Child-bearing Age | .59[a] | .36 | .51 | .46 | .07 | -.33 | .33 |

[a,b]Group a has a statistically significantly lower knowledge score than group b at P=.05 using Scheffe's test and t-test where appropriate.

[c,d]Group c has a statistically significantly lower knowledge score than group d at P=.05 using Scheffe's test and t-test where appropriate.

[e,f]Group e has a statistically significantly lower knowledge score than group f at P=.05 using Scheffe's test and t-test where appropriate.

the youngest respondents, those with the lowest income, those living in rural areas, and those with a high school or lower education level. Whites appeared somewhat more knowledgeable than non-whites, but the only significant difference was in the area of effects of contaminants on fish. Respondents living in households with women of childbearing age knew more about the negative health effects of fish consumption than those living in other households. This is important because many of the negative health effects can have a greater impact on unborn children.

We expected that those aware of the health advisory would be more knowledgeable about the recommendations than those not aware, but in fact no significant differences between mean knowledge scores existed for the three sets of knowledge questions we could compare (Table 8). [Those unaware of health advisories were not asked to complete sections of the questionnaire dealing with negative health effects of fish consumption, risk-reducing behaviors, and effects of contaminants on fish.] Further examination of the individual knowledge questions showed that those not aware of the advisory were more likely to choose "don't know", whereas those aware of the advisory chose either the correct or an incorrect answer (bringing their average close to zero [don't know]). A higher percentage of respondents who were not aware of the health advisory answered correctly all of the questions about the positive health effects of fish consumption. This difference may be attributed to the more prevalent coverage of the benefits of fish consumption by the mass news media.

Respondents who used the fishing regulations guide and/or experts as sources of information were more knowledgeable overall (Table 9). Those who

Table 8. Knowledge area scores by awareness of health advisory.

| Knowledge Areas | Aware of Health Advisory: Percent with Correct Answers for all Questions in Area | Aware of Health Advisory: Mean Scale Score | Not Aware of Health Advisory: Percent with Correct Answers for all Questions in Area | Not Aware of Health Advisory: Mean Scale Score |
|---|---|---|---|---|
| Negative Health Effects of Fish Consumption | 28.9 | 0.63 | NA | NA |
| Positive Health Effects of Fish Consumption | 26.1 | 0.35 | 31.6 | 0.43 |
| Risk-reducing Behaviors | 26.8 | 0.50 | NA | NA |
| Effects of Contaminants on Fish | 23.8 | 0.46 | NA | NA |
| Advisory Recommendations | 16.3 | 0.05 | 9.4 | 0.00 |
| Advisory Process | 0.5 | -0.33 | 9.4 | -0.29 |

Table 9. Knowledge area scores by source of health advisory information groupings.

| Knowledge Areas | Sources of Information: Fishing Regs. Guides/ No Experts — Percent With Correct Answers in Area | Fishing Regs. Guides/ No Experts — Mean Scale Score | Experts and Others — Percent with Correct Answers in Area | Experts and Others — Mean Scale Score | No Fishing Regs. Guides or Experts — Percent with Correct Answers in Area | No Fishing Regs. Guides or Experts — Mean Scale Score |
|---|---|---|---|---|---|---|
| Negative Health Effects of Fish Consumption | 32.2 | .66 | 32.7 | .65 | 20.6 | .54* |
| Positive Health Effects of Fish Consumption | 24.6 | .33 | 28.3 | .34 | 27.7 | .39 |
| Risk-reducing Behaviors | 29.5 | .54 | 33.0 | .58 | 18.7 | .39* |
| Effects of Contaminants on Fish | 27.1 | .50 | 27.6 | .52 | 14.9 | .35* |
| Advisory Recommendations | 16.9 | .03 | 22.1 | .20* | 12.0 | .03 |
| Advisory Process | 0.6 | -.33 | 0.9 | -.38 | 0.0 | -.30 |
| Overall | 0.0 | .36 | 0.0 | .38 | 0.0 | .28* |

*Mean is significantly different from other sources at P=.05 using Scheffe's test.

used experts as an information source were most likely to know the advisory recommendations.

One goal of this study was to measure the effect of the revised/expanded 1990-1991 health advisory on angler knowledge and behavior. To measure the effect on knowledge, respondents who used the previous Guides but not the 1990-1991 Guide as sources of information were compared with those who used the 1990-1991 Guide. No significant difference in overall knowledge was found between the two groups, but they did differ on several individual knowledge questions (Table 10). Respondents who were familiar with the 1990-1991 Guide were more likely to know that the "potential negative health effects from eating contaminated fish include nervous system disorders and cancer" and "chemicals from fish can have a greater impact on developing organs in

Table 10. Two knowledge questions by use of previous versus current fishing regulations guide.

| | Used Earlier Guide, but not 1990-91 Guide | Used 1990-91 Guide |
|---|---|---|
| | Percent | |
| *Potential negative health effects from eating contaminated fish include nervous system disorders and cancer* | | |
| Correct | 36.6 | 52.8 |
| Not Sure | 58.5 | 45.5 |
| Incorrect | 4.9 | 1.7 |
| *Chemicals from fish can have a greater impact on developing organs in children or unborn babies than on organs in adults* | | |
| Correct | 58.5 | 77.3* |
| Not Sure | 36.6 | 22.1 |
| Incorrect | 4.9 | 0.6 |

*Statistically significant difference between groups at $P \leq .05$ using Chi-square test.

children or unborn babies". These are knowledge areas emphasized more strongly in the 1990-1991 Guide than they had been in the past.

## 1991 Fishing Behaviors and Fish-Consuming Behaviors

### Fishing History and Fishing Activity

Most respondents (95%) have fished on a regular basis starting at an early age (mean=14 yrs. old). Over 90% of respondents to the mail questionnaire fished in New York State in 1991. Those fishing averaged 27 days on the water. The median number of days fishing was 15, suggesting a few people fish quite frequently.

### Fish Consumption

Overall mean consumption was 11 sport-caught meals in 1991 (adjusted for nonresponse bias). The highest reported fish consumption was 757 sport-caught meals per year. Anglers were divided into the two typologies of fish consumption described in the Methods section. Using the general advisory consumption typology, about one-quarter of respondents did not consume sport-caught fish, two-thirds consumed within the limit, and 8% of respondents exceeded the recommended number of fish meals per year (52 meals). Using the specific waters consumption typology, slightly over half of the respondents (56%) did not fish waters with advisories in 1991. About one-quarter fished waters with advisories, but did not eat listed species (i.e., those species listed specifically in the advisory for which limited or no consumption is advised). The remaining respondents ate at least some listed fish. Four percent ate listed fish but within the limits recommended in the advisory, and 7% ate up to 3 times over the recommended limit. The remaining 7% of respondents ate more than 3 times the recommended limit. The range of fish consumption for this group was from 4 to 185 fish meals of listed species in 1991.

Comparison of the two typologies yielded a significant finding: people who consumed above the general advisory recommendation of 52 fish meals per year maximum consumption were generally not eating listed species (Table 11). The reciprocal was also true, that the majority who ate listed species above the recommended limits were not eating more than 52 sport-caught fish meals per year. In other words, the majority of anglers who consumed listed species above the recommended limit stayed within the overall recommended limit of 52 meals per year of sport-caught fish (Table 11). Thus it is important to examine the characteristics, attitudes, and behaviors of high consumers using both typologies before drawing conclusions about an assumed homogeneous group of "high" fish consumers.

Fish consumption in relation to the advisory recommendations can be summarized as follows: 76% of anglers statewide did not eat listed species and followed the 1 meal per week maximum consumption recommendation; 4% statewide ate listed species within advisory guidelines and followed the 1 meal per week recommendation; 20% statewide exceeded the advisory recommendations in some way—15% ate listed species above the recommended levels, and 5% ate only unlisted species but more frequently than 1 meal per week.

Respondents who ate above the recommended limit for listed species were middle-aged (30-64; few were in the youngest or oldest age groups), and had at least a high school education, but few had post-graduate education (Table 12). Like other groups the majority was male, white, and came from a rural area. Respondents who did not follow the general advisory guideline (52 meals maximum) were more likely to be males from rural areas and lower income groups than those who followed the guidelines, but were not less likely to be aware

Table 11. Number and percent of respondents in each general advisory consumption group and specific waters consumption group.

| Specific Waters Consumption Groups | General Advisory Consumption Groups: Did Not Eat Sport-caught Fish in '91 (n) | Ate Within Limit (≤52 Meals) (n) | Ate Over Limit (>52 Meals) (n) | Total Percent |
|---|---|---|---|---|
| Did not fish listed waters | 134 | 325 | 30 | 56.0 |
| Fished listed waters, did not catch | 26 | 88 | 6 | 13.9 |
| Fished listed waters, did not eat | 47 | 50 | 8 | 11.5 |
| Ate, but within limits | 0 | 34 | 7 | 4.5 |
| Ate 1-3 times over the limit | 0 | 56 | 7 | 6.9 |
| Ate >3 times over the limit | 0 | 51 | 15 | 7.2 |
| Total (percent) | 23.5 | 68.3 | 8.2 | 100.0 |

Table 12. Specific waters and general advisory consumption groups by socio-demographic characteristics.

| | Specific Waters Consumption Groups | | | | | | General Advisory Consumption Groups | | |
|---|---|---|---|---|---|---|---|---|---|
| | Did Not Fish Listed Waters | Fished Listed Waters, Did Not Catch | Fished Listed Waters, Did Not Eat | Ate But Within Limits | Ate 1-3 Times Over The Limit | Ate >3 Times Over The Limit | Did Not Eat Sport-caught Fish in '91 | Ate Within Limit (≤52 Meals) | Ate Over Limit (>52 Meals) |
| | Percent | | | | | | | | |
| **Age** | | | | | | | | | |
| 16-29 | 58.1 | 15.0 | 15.6 | 3.1 | 4.4 | 3.8* | 25.8 | 63.9 | 10.3 |
| 30-39 | 57.4 | 13.5 | 11.5 | 4.5 | 4.1 | 9.0 | 25.3 | 67.1 | 7.6 |
| 40-49 | 55.8 | 12.5 | 11.7 | 5.5 | 9.0 | 5.5 | 21.9 | 71.8 | 6.3 |
| 50-64 | 48.6 | 15.2 | 10.2 | 4.1 | 10.2 | 11.7 | 23.6 | 67.0 | 9.4 |
| 65+ | 68.6 | 13.7 | 3.9 | 5.9 | 5.9 | 2.0 | 16.7 | 72.9 | 10.4 |
| **Income** | | | | | | | | | |
| ≤$20,000 | 62.5 | 11.5 | 9.9 | 4.6 | 4.6 | 6.9 | 22.1 | 64.2 | 13.7* |
| $21,000-$32,000 | 62.2 | 10.3 | 10.9 | 3.4 | 6.9 | 6.3 | 17.8 | 70.4 | 11.8 |
| $33,000-$49,000 | 51.1 | 16.7 | 13.4 | 4.3 | 8.6 | 5.9 | 25.3 | 67.0 | 7.7 |
| ≤$50,000 | 53.4 | 13.6 | 10.2 | 5.2 | 8.0 | 9.6 | 24.8 | 70.5 | 4.7 |
| **Education** | | | | | | | | | |
| Grades 1-11 | 68.2 | 14.3 | 6.3 | 3.2 | 4.8 | 3.2* | 21.0 | 64.5 | 14.5 |
| Grad. High School | 60.3 | 8.8 | 12.5 | 2.4 | 8.5 | 7.5 | 21.5 | 70.4 | 8.1 |
| Some College | 45.5 | 18.9 | 13.5 | 6.4 | 7.1 | 8.8 | 22.0 | 68.5 | 9.5 |
| Grad. College | 52.1 | 14.3 | 10.9 | 5.9 | 7.6 | 9.2 | 28.7 | 66.1 | 5.2 |
| Some Post Grad. | 65.6 | 13.6 | 8.0 | 4.8 | 4.0 | 4.0 | 26.8 | 68.3 | 4.9 |
| **Sex** | | | | | | | | | |
| Male | 54.2 | 13.7 | 11.9 | 4.9 | 7.2 | 8.1 | 23.3 | 67.6 | 9.1* |
| Female | 65.3 | 15.0 | 9.4 | 2.4 | 5.5 | 2.4 | 25.6 | 71.9 | 2.5 |

Table 12. (cont.)

| | Specific Waters Consumption Groups | | | | | | General Advisory Consumption Groups | | |
|---|---|---|---|---|---|---|---|---|---|
| | Did Not Fish Listed Waters | Fished Listed Waters, Did Not Catch | Fished Listed Waters, Did Not Eat | Ate But Within Limits | Ate 1-3 Times Over The Limit | Ate >3 Times Over The Limit | Did Not Eat Sport-caught Fish in '91 | Ate Within Limit (≤52 Meals) | Ate Over Limit (>52 Meals) |
| | Percent | | | | | | | | |
| **Residence** | | | | | | | | | |
| Rural (<5,000 people) | 55.6 | 13.7 | 10.6 | 4.0 | 7.5 | 8.6 | 19.4 | 69.9 | 10.7* |
| Small City (5,000-24,999 people) | 57.8 | 13.2 | 11.7 | 3.6 | 7.6 | 6.1 | 26.6 | 65.4 | 8.0 |
| City (25,000-99,999 people) | 54.1 | 14.0 | 14.0 | 8.9 | 4.5 | 4.5 | 28.4 | 69.0 | 2.6 |
| Large City (≥100,000 people) | 55.3 | 16.3 | 12.2 | 2.0 | 7.1 | 7.1 | 30.1 | 64.5 | 5.4 |
| **Race** | | | | | | | | | |
| White | 56.2 | 13.6 | 11.6 | 4.8 | 6.7 | 7.1 | 23.9 | 67.8 | 8.3 |
| Other | 46.4 | 14.3 | 10.7 | 0.0 | 17.9 | 10.7 | 13.8 | 75.9 | 10.3 |
| **Household** | | | | | | | | | |
| With Children Under 15 | 57.9 | 11.1 | 12.8 | 5.4 | 5.4 | 7.4 | 21.3 | 69.2 | 9.5 |
| Without Children Under 15 | 53.5 | 15.9 | 10.5 | 4.2 | 8.4 | 7.5 | 25.6 | 66.9 | 7.5 |
| With Woman of Childbearing Age | 56.1 | 12.5 | 12.7 | 4.8 | 6.2 | 7.7 | 23.7 | 69.1 | 7.2 |
| Without Woman of Childbearing Age | 55.6 | 16.1 | 9.8 | 4.0 | 8.0 | 6.6 | 23.6 | 66.5 | 9.9 |

*Statistically significant difference between groups at P≤.05 using Chi-square test.

of health advisories. In fact, respondents eating more than 52 sport-caught fish meals a year were just as likely as those eating 52 meals or less to know the recommended amount of fish that should be consumed in one year (less than 1/3 of each group knew the correct answer). It appears some of these respondents have chosen not to abide by the advisory recommendation, whereas others may be unaware of the recommendation.

As expected, those who did not fish listed waters were the most likely to be unaware of the health advisories (Table 13). Those who fished listed waters but did not consume contaminated fish were most likely to say they were aware of the specifics of the advisory. With one exception, however, the knowledge scores of those fishing listed waters but not eating fish did not differ from those who consumed contaminated fish over the recommended limit. Those who ate more than 3 times the recommended limit knew significantly less about the negative health effects of fish consumption than those keeping their consumption within the recommended limit.

No differences were found between the various fish consumption groups in use of the major information source groupings (i.e., Guides, Experts, others), but the consumption groups did differ in use of specific information sources. Respondents who ate more than the recommended limit of listed species were more likely to list charter operators and less likely to list newspapers as information sources than those who kept their consumption within the limits. Those who consumed more than 52 meals per year were more likely to list charter operators, NYSDEC personnel, and the previous years' Fishing Guides than those who kept their consumption within the limits. Interestingly, those who consumed over the general limit (>52 meals) listed more sources of information on average (4.1) than those whose consumption was within the limit

Table 13. Specific waters consumption groups by awareness of health advisory.

| Specific Waters Consumption Groups* | Aware of Health Advisory: No | Yes, Generally | Yes, Aware of Specifics |
|---|---|---|---|
| | Percent | | |
| Did Not Fish Listed Waters | 74.4 | 47.6 | 58.6 |
| Fished Listed Waters, Did Not Catch | 6.4 | 16.8 | 12.6 |
| Fished Listed Waters, Did Not Eat | 5.1 | 15.4 | 10.1 |
| Ate, But Within Limits | 2.6 | 4.8 | 5.1 |
| Ate, 1-3 Times Over the Limit | 5.1 | 7.7 | 6.8 |
| Ate, >3 Times Over the Limit | 6.4 | 7.7 | 6.8 |

*Statistically significant difference between groups at $P \leq .05$ using Chi-square test.

(3.3). As noted earlier, some of these respondents appear to be making a choice to consume fish above the recommended general limit, based on a broad consideration of information.

The advisory includes a section on techniques that can be used to reduce exposure to contaminants. The section is directed toward all fish consumers, but particularly those consumers eating listed species, who could benefit from use of these risk-reducing methods. Respondents were asked what techniques they used when cleaning and cooking sport-caught fish. Cleaning practices (e.g., trim dorsal fat, trim belly meat) seemed to be the risk-reducing techniques most widely adopted. For all risk-reducing cleaning practices, the majority (and generally over three-quarters) of anglers eating listed species always or usually used risk-reducing cleaning techniques (Table 14). Use of

Table 14. Fish preparation methods used—overall and by amount of contaminated fish consumed.

| Fish Preparation Methods | Overall | Ate NY Sport-caught Fish in '91 | Ate At Least 1 Listed Fish | Ate >3 Times Limit of Listed Species* |
|---|---|---|---|---|
| | Percent | | | |
| **Risk-reducing** | | | | |
| *Trim fat along back* | | | | |
| Always/Usually | 38.7 | 43.9* | 59.7** | 64.5 |
| Sometimes | 14.4 | 15.7 | 13.2 | 11.3 |
| Rarely | 8.7 | 8.6 | 5.7 | 4.8 |
| Never | 38.2 | 31.8 | 21.4 | 19.4 |
| *Trim belly meat* | | | | |
| Always/Usually | 49.6 | 54.8* | 73.0** | 76.3 |
| Sometimes | 15.1 | 16.5 | 4.3 | 6.3 |
| Rarely | 7.4 | 7.4 | 8.0 | 6.3 |
| Never | 27.9 | 21.3 | 14.7 | 11.1 |
| *Puncture or remove skin* | | | | |
| Always/Usually | 59.4 | 65.7* | 79.8** | 84.1 |
| Sometimes | 19.6 | 21.2 | 14.1 | 11.1 |
| Rarely | 5.2 | 4.2 | 1.8 | 1.6 |
| Never | 15.8 | 8.9 | 4.3 | 3.2 |
| *Fillet fish* | | | | |
| Always/Usually | 65.4 | 70.5* | 80.1** | 83.1 |
| Sometimes | 20.2 | 21.4 | 15.7 | 9.2 |
| Rarely | 4.6 | 4.2 | 2.4 | 4.6 |
| Never | 9.8 | 3.9 | 1.8 | 3.1 |
| *Bake, BBQ, or Poach* | | | | |
| Always/Usually | 24.0 | 24.2* | 34.5** | 43.1 |
| Sometimes | 36.8 | 40.3 | 40.1 | 36.9 |
| Rarely | 14.6 | 16.6 | 11.5 | 9.2 |
| Never | 24.6 | 18.9 | 13.9 | 10.8 |
| **Not Risk-reducing** | | | | |
| *Eat whole fish* | | | | |
| Always/Usually | 16.3 | 16.6* | 7.6** | 3.3 |
| Sometimes | 19.9 | 21.5 | 18.4 | 20.0 |
| Rarely | 14.1 | 15.6 | 23.4 | 26.7 |
| Never | 49.7 | 46.3 | 50.6 | 50.0 |

Table 14. (cont.)

| | Overall | Ate NY Sport-caught Fish in '91 | Ate At Least 1 Listed Fish | Ate >3 Times Limit of Listed Species[a] |
|---|---|---|---|---|
| | | | Percent | |
| *Pan Fry* | | | | |
| Always/Usually | 51.4 | 53.3* | 42.6** | 41.9 ← |
| Sometimes | 30.5 | 34.2 | 37.0 | 33.9 |
| Rarely | 6.1 | 6.3 | 13.0 | 19.4 |
| Never | 12.0 | 6.2 | 7.4 | 4.8 |
| *Deep Fry* | | | | |
| Always/Usually | 12.7 | 13.9* | 13.4** | 8.2 |
| Sometimes | 28.1 | 31.6 | 29.9 | 24.6 |
| Rarely | 17.7 | 20.5 | 27.4 | 39.3 |
| Never | 41.5 | 34.0 | 29.3 | 27.9 |
| *Make Fish Soup* | | | | |
| Always/Usually | 1.7 | 1.7* | 0.0** | 0.0 |
| Sometimes | 12.7 | 14.4 | 19.3 | 25.8 |
| Rarely | 20.2 | 22.6 | 25.5 | 25.8 |
| Never | 65.4 | 61.3 | 55.2 | 48.4 |
| *Reuse Fish Oil* | | | | |
| Always/Usually | 3.6 | 4.1 | 2.5** | 1.6 |
| Sometimes | 3.7 | 3.9 | 3.1 | 1.6 |
| Rarely | 5.4 | 6.6 | 10.6 | 11.3 |
| Never | 87.3 | 85.4 | 83.8 | 85.5 ← |
| Other Methods | | | | |
| *Freeze or Can for Later Use* | | | | |
| Always/Usually | 30.9 | 34.4* | 45.4** | 65.1 |
| Sometimes | 38.7 | 42.4 | 39.9 | 23.8 |
| Rarely | 5.3 | 4.9 | 1.8 | 3.2 |
| Never | 25.1 | 18.3 | 12.9 | 7.9 |

[a]Statistical differences were not calculated for this group.

*Statistically significant difference between those who ate and those who did not eat fish at $P \leq .05$ using Chi-square test.

**Statistically significant difference between those who ate listed species and those who did not at $P \leq .05$ using Chi-square test.

cooking methods was more variable, with approximately 40% of anglers eating listed species always or usually using bake, barbecue, or poach methods (risk-reducing) and pan frying (considered not risk-reducing). Anglers who ate listed species were more likely to make fish soup or deep fry their fish (not risk-reducing methods) than those who did not eat listed species. Consumption of sport-caught fish, including listed species, may occur over a span of time, not just at the time the fish is caught. Over 80% of anglers who ate listed species at least sometimes freeze or can their fish for later use. This behavior may support the use of certain risk assessment models that assume fish consumption is distributed throughout the calendar year.

Fish Consumption Suppression

Several measures of fish consumption suppression resulting from the advisories were obtained. We asked anglers if they would eat more fish if health risks from chemical contaminants did not exist (Table 15). Statewide, 47% of anglers would eat more fish if health risks did not exist. This number is lower than what is reported in Table 15 because it has been adjusted for nonresponse bias (i.e. nonrespondents were less likely to say they would eat more fish if health risks did not exist). Respondents who ate more than 52 meals of sport-caught fish per year were most likely to say they would eat even more fish if health risks did not exist. Although the difference was not significant, those who used experts as an information source were more likely to agree that they would eat more fish than those who did not use experts for information.

We compared the mean number of sport-caught fish meals eaten based on advisory awareness, whether or not behavioral changes were made, and whether or not a respondent claimed he/she would eat more fish if advisories did not

Table 15. Respondent's desire to eat more fish if health risks from chemical contaminants did not exist—overall, by general advisory consumption group, by source of information, and by household characteristics.

| | I Would Eat More Fish If Health Risks Didn't Exist | | | |
|---|---|---|---|---|
| | Agree | Neutral | Disagree | Don't Know |
| | Percent | | | |
| Overall | 63.1 | 15.4 | 15.2 | 6.3 |
| General Advisory Consumption Groups | | | | |
| Did Not Eat Sport-caught Fish in '91 | 53.4 | 14.3 | 24.9 | 7.4* |
| Ate Within Limits (≤ 52 meals) | 65.6 | 16.5 | 12.7 | 5.2 |
| Ate Over Limit (> 52 meals) | 77.9 | 11.8 | 8.8 | 1.5 |
| Sources of Information | | | | |
| Fishing Regs. Guides/No Experts | 62.2 | 16.9 | 16.7 | 4.2 |
| Experts and Others | 75.2 | 11.0 | 9.2 | 4.6 |
| No Fishing Regs. Guides or Experts | 59.8 | 17.5 | 15.4 | 7.3 |
| Household Characteristics | | | | |
| With Children Under 15 | 66.7 | 15.4 | 13.3 | 4.6 |
| Without Children Under 15 | 60.3 | 15.9 | 16.5 | 7.3 |
| With Woman of Childbearing Age | 64.5 | 15.3 | 14.8 | 5.4 |
| Without Woman of Childbearing Age | 61.1 | 15.7 | 15.7 | 7.5 |

*Statistically significant difference between consumption groups at $P \leq .05$ using Chi-square test.

exist (Table 16). Those who were most aware of the advisory consumed the greatest amount of fish, similar to the findings of West et al. (1989). Anglers who were aware of the advisory and changed their behavior to eat less fish reported eating fewer fish meals than anglers who either made no changes or made other changes that did not include eating less fish, although the only significant difference was between anglers who made no behavioral changes and those who did make some. Anglers who claimed they would eat more fish if advisories did not exist exhibited a mean fish consumption rate almost three times higher than those who said they would not eat more fish if advisories did not exist.

Table 16. Mean fish consumption (number of sport-caught fish meals) based on advisory awareness, behavioral change, and behavioral intention.

| Advisory Awareness | Mean # sport-caught fish meals |
|---|---|
| Aware of specific advisory information | 27.4[a] |
| Generally aware of advisory | 16.6[a,b] |
| Unaware of advisory | 6.9[b] |
| **Behavioral Change** | |
| Made behavioral change, but did not change to eat less fish | 35.8[a] |
| Made behavioral change, including eating less fish | 24.2[a] |
| Made no changes in behavior | 12.3[b] |
| **Behavioral Intention** | |
| Anglers who would eat more fish if advisories did not exist | 23.0[a] |
| Anglers who would not eat more fish if advisories did not exist | 8.9[b] |

[a,b]Means with different superscripts are significantly different at $P \leq .05$ using Scheffe's test and t-test where appropriate.

Active fish eaters appear to be most aware of the advisory, most involved in changing their own behavior, but also most interested in increasing current fish consumption at a future time when advisories are no longer needed. As West et al. (1989) suggested, apparent fish consumption suppression has implications for risk assessments and regulatory policy, forcing regulators to consider whether actual fish consumption or desired fish consumption should be used as a basis for decision making.

Changes Made in Response to the Advisories

Over 50% of respondents said they made changes in their fishing behaviors or fish consumption in response to the health advisories. Eating less sport-caught fish was the most common change, made by 70% of New York licensed anglers. (Recall that no difference was found for this variable between respondents and nonrespondents, thus no weighting of the percentage for nonresponse bias was used.) Use of cleaning methods was the next most common change (Table 17). About one-fourth of respondents checked other items such as changed fishing location, changed species eaten, and changed size of fish eaten. Seventeen percent of respondents said they no longer ate sport-caught fish, whereas 23% said they ate more. Fish consumption suppression appears to be occurring as people eat less fish, cease eating sport-caught fish, or change species, sizes, and locations that were their first preferences. The advisory may be stimulating fish consumption in some anglers (23%), by allowing them to choose relatively safe locations or species.

Of those aware of the health advisory, women and those living in large cities were less likely than other groups to make any change in their fishing and fish-eating behaviors in response to advisories (Table 18). Specific

Table 17. Percent of respondents making various changes in response to the health advisories.

| Of Those Who Made Changes, the Following Changes Were Made: | Percent |
|---|---|
| Eat Less Sport-caught Fish | 69.6 |
| Changed Cleaning Methods | 44.7 |
| Changed Fishing Locations | 27.2 |
| Changed Species Eaten | 27.2 |
| Changed Size of Fish Eaten | 24.9 |
| Changed Cooking Methods | 21.0 |
| Take Fewer Fishing Trips | 17.9 |
| No Longer Eat Sport-caught Fish | 17.0 |
| Eat More Sport-caught Fish | 22.7 |
| Take More Fishing Trips Because I Can Choose Waters With Less Serious Contaminant Problems | 3.9 |

Table 18. For those who knew of the health advisories, whether or not they made changes in their fishing habits or the way they ate fish and if so, selected types of changes made, overall and by socio-demographic characteristics.

| | Made Changes | Of Those Who Made Changes, the Following Changes Were Made: | | | | | |
|---|---|---|---|---|---|---|---|
| | | Eat Less Fish | Changed Clean/prep. Practices | Changed Fishing Location | Changed Species Eaten | Take Fewer Fishing Trips | Don't Eat Sport-caught Fish |
| | Percent | | | | | | |
| Overall | 53.5 | 69.6 | 44.7 | 27.2 | 27.2 | 17.9 | 17.0 |
| Age | | | | | | | |
| 16-29 | 52.1 | 73.3 | 37.8 | 40.0 | 17.8 | 20.0 | 13.0 |
| 30-39 | 56.6 | 73.7 | 38.2 | 27.6 | 32.9 | 14.5 | 19.8 |
| 40-49 | 53.3 | 68.0 | 48.0 | 24.0 | 24.0 | 21.3 | 14.7 |
| 50-64 | 49.7 | 68.1 | 55.3 | 21.3 | 36.2 | 21.3 | 20.8 |
| 65+ | 58.0 | 50.0 | 50.0 | 21.4 | 14.3 | 0.0 | 14.3 |
| Income | | | | | | | |
| ≤ $20,000 | 59.0 | 78.4 | 29.7 | 32.4 | 27.0 | 29.7 | 18.4 |
| $21,000-$32,000 | 54.1 | 71.1 | 48.9 | 35.6 | 31.1 | 11.1 | 13.3 |
| $33,000-$49,000 | 54.6 | 75.5 | 49.1 | 26.4 | 35.8 | 13.2 | 10.9 |
| ≥ $50,000 | 49.8 | 65.0 | 48.0 | 19.0 | 23.0 | 19.0 | 22.3 |
| Education | | | | | | | |
| Grades 1-11 | 59.3 | 58.3 | 58.3 | 33.3 | 8.3 | 8.3 | 16.7 |
| Grad. High School | 52.5 | 68.6 | 35.7 | 28.6 | 28.6 | 18.6 | 20.5 |
| Some College | 58.7 | 77.9 | 43.2 | 29.5 | 31.6 | 20.0 | 14.3 |
| Grad. College | 47.4 | 62.2 | 43.2 | 27.0 | 21.6 | 18.9 | 23.7 |
| Some Post Grad. | 44.5 | 63.2 | 63.2 | 21.1 | 23.7 | 13.2 | 7.9 |
| Sex | | | | | | | |
| Male | 54.9* | 69.4 | 45.3 | 27.2 | [illegible] | 18.1 | 16.5 |
| Female | 43.6 | 70.8 | 41.7 | 25.0 | 12.5 | 12.5 | 23.1 |

Table 18. (cont.)

| | Made Changes | Of Those Who Made Changes, the Following Changes Were Made: | | | | | |
|---|---|---|---|---|---|---|---|
| | | Eat Less Fish | Changed Clean/prep. Practices | Changed Fishing Location | Changed Species Eaten | Take Fewer Fishing Trips | Don't Eat Sport-caught Fish |
| | Percent | | | | | | |
| **Residence** | | | | | | | |
| Rural (<5,000 people) | 53.1* | 68.5 | 46.5 | 26.0 | 23.6 | 18.9 | 15.6 |
| Small City (5,000-24,999 people) | 52.0 | 77.4 | 43.4 | 20.8 | 26.4 | 17.0 | 14.5 |
| City (25,000-99,999 people) | 63.2 | 69.8 | 39.6 | 37.7 | 34.0 | 18.9 | 16.7 |
| Large City (≥ 100,000 people) | 44.1 | 58.3 | 50.0 | 25.0 | 33.3 | 12.5 | 29.6 |
| **Race** | | | | | | | |
| White | 52.9 | 69.1 | 45.7 | 26.3 | 27.2 | 17.3 | 17.2 |
| Other | 61.5 | 83.3 | 33.3 | 16.7 | 16.7 | 33.3 | 16.7 |
| **Household** | | | | | | | |
| With Children Under 15 | 57.4 | 70.7 | 43.1 | 31.9 | 31.0 | 22.4 | 16.7 |
| Without Children Under 15 | 50.6 | 68.5 | 46.9 | 22.3 | 24.6 | 13.8 | 18.0 |
| With Woman of Childbearing Age | 54.8 | 70.9 | 45.7 | 28.0 | 29.1 | 18.9 | 17.0 |
| Without Woman of Childbearing Age | 51.1 | 66.7 | 43.2 | 24.7 | 23.5 | 14.8 | 17.3 |

*Statistically significant difference at $P \leq .05$ using Chi-square test.

changes made did not differ statistically on the basis of socio-demographic characteristics.

Forty-six percent of respondents said they did not make changes in response to the health advisory. The most commonly cited reason was that the amount of fish eaten before learning about the advisory was less than the recommended limit (64%). Other reasons were cited much less frequently (Table 19). Respondents over 65, men, and people from households without women of childbearing age are among the lower-risk populations; these respondents were also more likely to believe that sport-caught fish do not pose a health risk for them (Table 20).

Information sources consulted by respondents were related to the changes they made in response to the health advisory. Those who consulted experts (and any other sources) were more likely to make changes than those who had not contacted experts (Table 21). This group was more likely to make each of the changes listed in the questionnaire, except for ceasing to eat sport-caught fish. Those who consulted the Fishing Regulations Guide but not experts were more likely not to make changes because the amount of fish they ate was less than the recommended limits. Those who used neither the Guide nor experts were twice as likely (compared to those who used these information sources) to check the following reasons for not making changes: they don't know how to fish for species with less chemicals, and they couldn't tell from the advisory what size of fish to eat, how to clean them, or how to cook them. Reliance on information sources other than experts and the Regulations Guide may limit the information available to anglers. Efforts to include this information in mass media information channels may be warranted from those who seek to disseminate health advisory information.

Table 19. Percent of respondents checking various reasons for not making changes as a result of the health advisories.

| Reasons for Not Making Changes as a Result of Health Advisories | Percent Checking Reason |
|---|---|
| The amount of fish eaten before learning about the advisories was less than recommended limits | 64.4 |
| Never ate New York sport-caught fish even before learning about the advisories | 17.4 |
| Don't believe sport-caught fish pose a health risk for me | 16.8 |
| Couldn't tell from advisories how to cook fish in a way that reduces chemicals in them | 8.9 |
| Couldn't tell from advisories which species have less chemicals in them | 8.5 |
| Couldn't tell from advisories how to clean fish in a way that reduces chemicals in them | 8.1 |
| Couldn't tell from advisories what sizes of fish have less chemicals in them | 8.1 |
| Couldn't tell from advisories which locations would have cleaner fish in them | 8.1 |
| Don't know how to fish for species that have less chemicals in them | 4.9 |

Table 20. For those who knew of the health advisories, whether or not they made changes and if not, selected reasons for not making changes—overall and by socio-demographic characteristics.

| | Have Not Made Changes | For Those Who Did Not Make Changes, the Following Reasons Were Given: | | |
|---|---|---|---|---|
| | | Amount Eaten Was Less Than Recommended | Never Ate Sport-caught Fish | Don't Believe Fish Pose Risk |
| | Percent | | | |
| Overall | 46.5 | 69.4 | 17.4 | 16.8 |
| Age | | | | |
| 16-29 | 47.9 | 59.5 | 22.8 | 13.9* |
| 30-39 | 43.4 | 69.1 | 20.9 | 11.8 |
| 40-49 | 46.7 | 73.0 | 16.4 | 13.9 |
| 50-64 | 50.3 | 71.1 | 13.2 | 21.1 |
| 65+ | 42.0 | 77.3 | 9.1 | 45.5 |
| Income | | | | |
| ≤ $20,000 | 41.0 | 67.9 | 17.0 | 24.5 |
| $21,000-$32,000 | 45.9 | 74.1 | 14.1 | 9.4 |
| $33,000-$49,000 | 45.4 | 64.9 | 20.2 | 19.1 |
| ≥ $50,000 | 50.2 | 69.3 | 19.9 | 18.1 |
| Education | | | | |
| Grades 1-11 | 40.7 | 63.3 | 20.0 | 16.7 |
| Grad. High School | 47.5 | 74.0 | 12.3 | 17.1 |
| Some College | 41.3 | 70.5 | 17.8 | 16.4 |
| Grad. College | 52.6 | 66.7 | 17.5 | 22.2 |
| Some Post Grad. | 55.5 | 63.3 | 25.0 | 11.7 |
| Sex | | | | |
| Male | 45.1* | 68.5 | 18.0 | 18.8* |
| Female | 56.4 | 73.9 | 14.5 | 5.8 |

Table 20. (cont.)

| | Have Not Made Changes | For Those Who Did Not Make Changes, the Following Reasons Were Given: | | |
|---|---|---|---|---|
| | | Amount Eaten Was Less Than Recommended | Never Ate Sport-caught Fish | Don't Believe Fish Pose Risk |
| | Percent | | | |
| **Residence** | | | | |
| Rural (< 5,000 people) | 46.9* | 70.9 | 13.2* | 18.5 |
| Small City (5,000-24,999 people) | 48.0 | 69.5 | 17.9 | 16.8 |
| City (25,000-99,999 people) | 36.8 | 73.8 | 18.5 | 13.8 |
| Large City (≥ 100,000 people) | 55.9 | 59.3 | 30.5 | 13.6 |
| **Race** | | | | |
| White | 47.1 | 69.6 | 17.2 | 16.9 |
| Other | 38.5 | 53.8 | 30.8 | 15.4 |
| **Household** | | | | |
| With Children Under 15 | 42.6 | 67.5 | 15.6 | 15.6 |
| Without Children Under 15 | 49.4 | 70.3 | 19.0 | 16.8 |
| With Woman of Childbearing Age | 45.2 | 67.1 | 17.5 | 12.0* |
| Without Woman of Childbearing Age | 48.9 | 70.8 | 17.3 | 24.3 |

*Statistically significant difference at $P \leq .05$ using Chi-square test.

Table 21. Source of health advisory information groupings by changes made or reasons for not making changes in response to the health advisories.

| Changes Made in Response to Advisory | Sources of Information: Fishing Regs. Guides/ No Experts | Experts and Others | No Fishing Regs. Guides or Experts |
|---|---|---|---|
| | Percent | | |
| No Changes Made | 48.7 | 29.4 | 54.6* |
| Yes, Changes Made | 51.3 | 70.6 | 45.4 |
| **Reasons for Not Making Changes** | Percent Checking Reason/Change | | |
| Amount Eaten Was Less Than Recommended | 73.8 | 67.5 | 61.3** |
| Never Ate Sport-caught Fish | 16.5 | 15.0 | 19.7 |
| Don't Believe Fish Pose Risk | 16.1 | 17.5 | 17.5 |
| **Changes Made** | | | |
| Eat Less Fish | 66.9 | 86.0 | 62.1** |
| Changed Clean/Prep. Practices | 46.6 | 54.0 | 32.8 |
| Changed Cooking Methods | 17.6 | 34.0 | 19.0** |
| Changed Fishing Location | 25.0 | 34.0 | 27.6 |
| Changed Species Eaten | 25.0 | 50.0 | 13.8** |
| Changed Size of Fish Eaten | 23.6 | 38.0 | 15.5** |
| Take Fewer Fishing Trips | 15.5 | 26.0 | 17.2 |
| Don't Eat Sport-caught Fish | 18.4 | 10.0 | 16.9 |

*Statistically significant difference between those who made changes and those who did not at $P \leq .05$ using Chi-square test.

**Statistically significant difference between those who checked reason and those who did not at $P \leq .05$ using Chi-square test.

To confirm the changes claimed by respondents, we compared their use of fish preparation methods with the changes they said they had made. Those who said they changed fish cleaning and cooking methods were more likely to use risk-reducing methods of cooking and cleaning fish (Tables 22 and 23). Those who made changes and those who did not did not differ in the frequency of non-risk-reducing techniques such as eating whole fish, frying fish, or making fish soup, however. Overall, except for pan-frying, non-risk-reducing techniques were among the least frequently used by all respondents. Those who could not tell from the advisory how to clean or cook fish were more likely to eat whole fish and to pan fry fish than those who could tell. Those who fished listed waters and those who did not did not differ in likelihood of changing their fishing location in response to the advisory.

We identified the changes made by fish consumers in response to the advisory. The most frequent change for any fish consumption group (except those who did not eat fish in 1991) was to reduce fish consumption (Table 24). Over 40% of those who did not eat fish in 1991 had made changes in response to the advisory, primarily reducing or ceasing fish consumption. Those eating more than 52 meals of sport-caught fish per year were more likely to have made changes than less frequent fish consumers. The high consumers were more likely to change cleaning and cooking methods, fishing location, and species and size of fish eaten. This may partially explain the lack of overlap between high fish consumers under the general advisory and high consumers of listed species. Although they may not have known the advisory recommendation regarding the one meal per week maximum consumption (see knowledge section), the advisory had influenced these anglers regarding other fish-consuming behaviors.

Table 22. Whether changes in fish cleaning methods were made or not made by usual use of fish cleaning methods.

| Fish Preparation Methods[a] | Couldn't Tell From Advisory How to Clean Fish | | Changed Cleaning Methods | |
|---|---|---|---|---|
| | Yes | No | Yes | No |
| | Mean | | | |
| **Risk-reducing** | | | | |
| Trim Fat Along Back | 2.5 | 2.6 | 3.6 | 2.7* |
| Trim Belly Meat | 2.8 | 3.0 | 4.0 | 3.1* |
| Puncture or Remove Skin | 4.0 | 3.6 | 4.2 | 3.5* |
| Fillet Fish | 3.9 | 3.7 | 4.2 | 3.8 |
| **Not Risk-reducing** | | | | |
| Eat Whole Fish | 2.5 | 2.0* | 2.0 | 2.1 |

[a]Measured on a scale where 1=never to 5=always.

*Statistically significant difference at $P \leq .05$ using t-test.

Table 23. Whether changes in fish cooking methods were made or not made by usual use of fish cooking methods.

| Fish Preparation Methods[a] | Couldn't Tell From Advisory How to Cook Fish | | Changed Cooking Methods | |
|---|---|---|---|---|
| | Yes | No | Yes | No |
| | Mean | | | |
| **Risk-reducing** | | | | |
| Bake, BBQ, or poach | 2.6 | 2.6 | 3.2 | 2.7* |
| **Not Risk-reducing** | | | | |
| Pan Fry | 3.7 | 3.3* | 3.3 | 3.4 |
| Deep Fry | 2.1 | 2.1 | 2.1 | 2.3 |
| Make Fish Soup | 1.5 | 1.5 | 1.8 | 1.6 |
| Reuse Fish Oil | 1.3 | 1.2 | 1.2 | 1.3 |

[a]Measured on a scale where 1=never to 5=always.

*Statistically significant difference at $P \leq 0.5$ using t-test.

Table 24. Whether changes were made, selected changes, and selected reasons for not making changes by specific waters consumption groups and general advisory consumption groups.

| | | Changes Made: | | | Reasons Why Changes Were Not Made: | | |
|---|---|---|---|---|---|---|---|
| | Made Changes | Eat Less Fish | Changed Clean/Prep. Practices | Don't Eat Sport-caught Fish | Amount Eaten Was Less Than Recommended | Never Ate Sport-caught Fish | Don't Believe Fish Pose Risk |
| Specific Waters Consumption Groups | Percent | Percent Checking Change or Reason | | | | | |
| Did Not Fish Listed Waters | 47.2* | 70.8 | 41.5 | 17.4 | 68.0 | 17.4 | 15.8* |
| Fished Listed Waters, Did Not Catch | 55.4 | 57.9 | 42.1 | 17.9 | 69.6 | 17.9 | 12.5 |
| Fished Listed Waters, Did Not Eat | 63.8 | 70.6 | 38.2 | 28.6 | 64.4 | 28.9 | 8.9 |
| Ate, But Within Limits | 70.3 | 71.4 | 57.1 | 0.0 | 69.2 | 7.7 | 38.5 |
| Ate, 1-3 Times Over the Limit | 61.8 | 82.6 | 52.2 | 8.7 | 84.0 | 4.0 | 40.0 |
| Ate >3 Times Over the Limit | 68.0 | 73.9 | 65.2 | 4.3 | 80.0 | 5.0 | 25.0 |
| General Advisory Consumption Groups | | | | | | | |
| Did Not Eat Sport-caught Fish in '91 | 40.4* | 46.5* | 23.3* | 58.3* | 45.9* | 49.5* | 6.4* |
| Ate Within Limits (≤ 52 meals) | 56.9 | 73.6 | 48.5 | 6.7 | 80.3 | 3.9 | 19.3 |
| Ate Over Limit (> 52 meals) | 76.6 | 83.3 | 63.3 | 0.0 | 57.1 | 4.8 | 42.9 |

*Statistically significant difference at P≤.05 using Chi-square test.

Those who fished listed waters were more likely to have made changes, primarily eating less fish and changing cleaning and cooking practices (Table 24). For both consumption typologies, those who were high consumers and did not make changes were more likely to believe that sport-caught fish do not pose a health risk for them. High consumers of listed species were somewhat more likely than other consumers to believe the amount of fish they ate was less than the levels recommended in the health advisory, but the difference between the consumption groups was not significant statistically.

Changes made in consumption differed by species. Types of fish included most often in the advisories (i.e., bottom feeders and fatty game fish) were the fish most likely to be consumed in decreasing quantities by anglers (Table 25). Panfish and non-fatty game fish were most likely to have experienced no change in fish consumption in response to the advisory, although every species had experienced some reduction. High consumers of listed species as a group did not change (or reduced very slightly) their consumption of 4 fatty game species, whereas anglers who fished listed waters but did not eat listed species they caught had decreased or stopped consuming these 4 species (Table 26). Some anglers appeared to be changing their fishing behavior to reduce risks. No other species had significantly different means for the specific waters consumption groups.

1991 Angler Perceptions About Advisory and Attitudes Toward Fish Consumption

A majority of anglers who were aware of the health advisories, especially those using the Fishing Regulations Guide and/or experts, thought that the health advisories provided them with enough information to decide whether or not to eat certain fish (Table 27). Few anglers thought that the

Table 25. Percent who never ate fish by species, and of those who ate fish the change in the amount eaten because of the advisories.

| Fish Species Groups | Percent Who Never Ate Fish Before Learning About Advisory | Of Those Who Ate Fish, Change in Amount Eaten Because of Advisories | | | | |
|---|---|---|---|---|---|---|
| | | Mean[1] | Stopped Eating | Decreased Amount | No Change | Increased Amount |
| | | | Percent | | | |
| **Less-fatty Game and Panfish** | | | | | | |
| Smallmouth bass | 31.6 | 2.8[a] | 5.0 | 15.6 | 78.1 | 1.3 |
| Yellow perch | 36.9 | 2.8[a] | 4.9 | 11.0 | 81.1 | 3.0 |
| Walleye | 45.5 | 2.8[a] | 3.8 | 14.5 | 77.7 | 4.0 |
| Sunfish | 51.0 | 2.8[a] | 6.2 | 10.5 | 80.1 | 3.2 |
| Crappie | 56.3 | 2.8[a] | 5.8 | 12.2 | 79.3 | 2.7 |
| Rainbow trout | 27.8 | 2.7[a,b] | 5.4 | 17.8 | 74.3 | 2.5 |
| Largemouth bass | 32.2 | 2.7[a,b] | 5.5 | 16.2 | 76.2 | 2.1 |
| Brown trout | 33.9 | 2.7[a,b] | 6.6 | 19.1 | 73.1 | 1.2 |
| Pickerel or Pike | 54.3 | 2.7[a,b] | 6.1 | 19.3 | 72.9 | 1.7 |
| White perch | 63.5 | 2.7[a,b] | 9.1 | 13.5 | 76.3 | 1.1 |
| **More-fatty Fish and Bottom Feeders** | | | | | | |
| Lake trout | 43.7 | 2.6[b,c] | 10.6 | 23.9 | 64.1 | 1.4 |
| Brown bullhead | 55.5 | 2.6[b,c] | 11.1 | 16.4 | 71.9 | 0.6 |
| Muskellunge | 87.8 | 2.5[b,c] | 18.9 | 15.6 | 65.5 | 0.0 |
| Coho salmon | 58.3 | 2.4[b,c] | 16.8 | 31.0 | 50.6 | 1.6 |
| Channel catfish | 80.0 | 2.4[b,c] | 22.7 | 20.0 | 55.3 | 2.0 |
| Chinook salmon | 60.5 | 2.3[c] | 16.6 | 34.1 | 48.0 | 1.3 |
| American eel | 91.8 | 2.3[c] | 29.0 | 11.3 | 59.7 | 0.0 |
| White sucker | 93.1 | 2.3[c] | 25.5 | 13.7 | 60.8 | 0.0 |
| Carp | 93.9 | 2.3[c] | 31.1 | 11.1 | 57.8 | 0.0 |

[1]Measured on a scale where 1=stopped eating to 4=increased amount.

[a,b,c]Means with same letter are not significantly different using t-tests.

Table 26. Mean change in amount of species eaten by specific waters consumption groups for those species with statistically significant differences between consumption groups.

| Fish Species Eaten | Specific waters consumption groups: Did Not Fish Listed Waters | Fished Listed Waters, Did Not Catch | Fished Listed Waters, Did Not Eat | Ate, But Within Limits | Ate, 1-3 Times Over the Limit | Ate, >3 Times Over the Limit |
|---|---|---|---|---|---|---|
| | Mean Change in Amount of Species Eaten[a] | | | | | |
| Brown trout | 2.8[b] | 2.7 | 2.4[c] | 2.6 | 2.6 | 2.7 |
| Lake trout | 2.7[b] | 2.6[b] | 2.2[c] | 2.4 | 2.4 | 2.6 |
| Coho salmon | 2.5[b] | 2.4[b] | 1.8[c] | 2.4 | 2.4[b] | 2.7[b] |
| Chinook salmon | 2.4[b] | 2.3 | 1.9[c] | 2.4 | 2.4[b] | 2.6[b] |

[a]Measured on a scale where 1=stopped eating to 4=increased amount.
[b,c]Mean of group b is statistically larger than group c at P=.05 using Scheffe's test.

Table 27. For those aware of health advisories, opinions of the advisory—overall, by source of information groupings and by household characteristics.

| | Health Advisories Provide Enough Information | | | Health Advisories Are Not Needed Or Are Exaggerated | | |
|---|---|---|---|---|---|---|
| | Yes | No | Not Sure | Yes | No | Not Sure |
| | Percent | | | | | |
| Overall | 53.1 | 18.6 | 28.3 | 8.5 | 64.7 | 26.8 |
| Source of Information | | | | | | |
| Fishing Regs. Guides/No Experts | 60.8 | 14.6 | 24.6* | 8.6 | 67.6 | 23.8 |
| Experts and Others | 56.5 | 20.9 | 22.6 | 6.2 | 72.6 | 21.2 |
| No Fishing Regs. Guides or Experts | 39.2 | 23.7 | 37.1 | 9.0 | 59.0 | 32.0 |
| Household Characteristics | | | | | | |
| With Children Under 15 | 50.1 | 21.2 | 28.7 | 8.4 | 67.1 | 24.5 |
| Without Children Under 15 | 55.6 | 17.1 | 27.3 | 8.6 | 63.9 | 27.5 |
| With Woman of Childbearing Age | 50.8 | 20.2 | 29.0 | 7.0 | 68.4 | 24.6* |
| Without Woman of Childbearing Age | 57.2 | 16.3 | 26.5 | 11.1 | 59.0 | 29.9** |

*Statistically significant difference between sources of information at $P \leq .05$ using Chi-square test.
**Statistically significant differences between households with and without women of childbearing age at $P \leq .05$ using Chi-square test.

advisories were not needed or were exaggerated. This was especially true for households with women of childbearing age.

A plurality of anglers believed that the health risk from eating contaminated sport-caught fish is minor when compared with other risks they are exposed to, whereas over half of anglers consuming listed species believed the risks are minor (Table 28). Anglers consuming listed species were generally more likely to agree with the statement that the health benefits are greater than the health risks, except for the highest consumers of listed species, who tended to be neutral or disagree. Anglers who ate more than 52 sport-caught fish meals in 1991 were also more likely to think health benefits outweigh risks compared to lower-consumption groups.

Belief about health benefits was also related to source of information, with those not using the Fishing Regulations Guide or experts somewhat more likely to believe the benefits outweigh the risks. This corresponds with their higher knowledge score about positive benefits of fish consumption reported earlier.

A majority of anglers believed that the health risks outweigh the health benefits for children and for unborn children (Table 29). Those most likely to hold this belief were anglers who did not eat sport-caught fish, fished listed waters but did not eat listed species, and those who consulted experts, although a majority of the highest consumers of listed species also shared this belief. Households with children under 15 or with women of childbearing age, and anglers who used experts as an information source, were more likely to believe that the health risks outweigh the health benefits for unborn children.

Table 28. Opinions of comparative risks and health benefits—overall, by two consumption typologies, by source of information groupings, and by household characteristics.

| | Health Risks Are Minor Compared With Other Risks | | | | Health Benefits Are Greater Than Health Risks | | | |
|---|---|---|---|---|---|---|---|---|
| | Agree | Neutral | Disagree | Don't Know | Agree | Neutral | Disagree | Don't Know |
| | Percent | | | | | | | |
| Overall | 43.2 | 21.9 | 26.2 | 8.7 | 13.0 | 26.5 | 40.4 | 20.1 |
| Specific Waters Consumption Groups | | | | | | | | |
| Did Not Fish Listed Waters | 42.3 | 22.0 | 26.3 | 9.4* | 11.8 | 30.9 | 38.8 | 18.5* |
| Fished Listed Waters, Did Not Catch | 39.9 | 25.4 | 25.4 | 9.3 | 15.4 | 18.8 | 41.9 | 23.9 |
| Fished Listed Waters, Did Not Eat | 38.6 | 26.7 | 30.7 | 4.0 | 6.9 | 18.8 | 56.5 | 17.8 |
| Ate, But Within Limits | 63.1 | 21.1 | 15.8 | 0.0 | 23.7 | 21.1 | 31.5 | 23.7 |
| Ate, 1-3 Times Over the Limit | 55.0 | 15.0 | 25.0 | 5.0 | 26.7 | 28.3 | 31.7 | 13.3 |
| Ate, >3 Times Over the Limit | 59.3 | 11.9 | 22.0 | 6.8 | 13.6 | 30.5 | 39.0 | 16.9 |
| General Advisory Consumption Groups | | | | | | | | |
| Did Not Eat Sport-caught Fish in '91 | 41.6 | 20.0 | 30.0 | 8.4 | 8.4 | 17.4 | 55.3 | 18.9* |
| Ate Within Limits (≤ 52 meals) | 45.7 | 22.5 | 24.3 | 7.4 | 14.2 | 29.8 | 36.8 | 19.2 |
| Ate Over Limit (>52 meals) | 45.8 | 20.0 | 27.1 | 7.1 | 20.6 | 30.9 | 32.3 | 16.2 |
| Source of Information | | | | | | | | |
| Fishing Regs. Guides/No Experts | 45.4 | 20.8 | 27.9 | 5.9 | 9.7 | 28.8 | 44.2 | 17.3** |
| Experts and Others | 42.2 | 25.7 | 25.7 | 6.4 | 13.9 | 19.4 | 49.1 | 17.6 |
| No Fishing Regs. Guides or Experts | 39.6 | 23.0 | 25.5 | 11.9 | 16.2 | 27.2 | 33.6 | 23.0 |
| Household Characteristics | | | | | | | | |
| With Children Under 15 | 42.5 | 22.6 | 26.6 | 8.3 | 14.4 | 26.6 | 40.6 | 18.4 |
| Without Children Under 15 | 44.5 | 21.6 | 25.7 | 8.2 | 11.9 | 26.5 | 41.4 | 20.1 |
| With Woman of Childbearing Age | 42.8 | 23.1 | 26.0 | 8.1 | 11.9 | 27.3 | 41.3 | 19.5 |
| Without Woman of Childbearing Age | 44.1 | 19.8 | 26.7 | 9.4 | 15.0 | 25.2 | 39.0 | 20.8 |

*Statistically significant difference between consumption groups at P≤.05 using Chi-square test.

**Statistically significant difference between sources of information at P≤.05 using Chi-square test.

Table 29. Opinion of health benefits for children and unborn children compared with health risks—overall, by specific waters consumption group, by general advisory consumption group, by source of information, and by household characteristics.

| | Health Benefits For Children Are Greater Than Health Risks | | | | Health Benefits For Unborn Children Are Greater Than Health Risks | | | |
|---|---|---|---|---|---|---|---|---|
| | Agree | Neutral | Disagree | Don't Know | Agree | Neutral | Disagree | Don't Know |
| | Percent | | | | | | | |
| Overall | 8.7 | 17.7 | 51.3 | 22.3 | 8.4 | 11.0 | 55.4 | 25.2 |
| Specific Waters Consumption Groups | | | | | | | | |
| Did Not Fish Listed Waters | 8.8 | 19.5 | 50.9 | 20.8* | 9.9 | 11.7 | 53.3 | 25.1 |
| Fished Listed Waters, Did Not Catch | 7.6 | 14.4 | 51.7 | 26.3 | 8.5 | 10.2 | 51.6 | 29.7 |
| Fished Listed Waters, Did Not Eat | 8.9 | 5.9 | 67.4 | 17.8 | 5.9 | 6.9 | 67.4 | 19.8 |
| Ate, But Within Limits | 11.4 | 22.9 | 40.0 | 25.7 | 10.5 | 7.9 | 63.2 | 18.4 |
| Ate, 1-3 Times Over the Limit | 11.7 | 31.6 | 40.0 | 16.7 | 6.7 | 16.7 | 56.6 | 20.0 |
| Ate, >3 Times Over the Limit | 3.4 | 18.6 | 56.0 | 22.0 | 6.8 | 10.2 | 57.6 | 25.4 |
| General Advisory Consumption Groups | | | | | | | | |
| Did Not Eat Sport-caught Fish in '91 | 7.3 | 10.5 | 61.3 | 20.9* | 6.3 | 7.9 | 60.7 | 25.1 |
| Ate Within Limit (≤ 52 meals) | 8.2 | 21.1 | 49.9 | 20.8 | 8.7 | 12.7 | 55.0 | 23.6 |
| Ate Over Limit (> 52 meals) | 10.3 | 16.2 | 48.5 | 25.0 | 14.9 | 7.5 | 49.2 | 28.4 |
| Source of Information | | | | | | | | |
| Fishing Regs. Guides/No Experts | 6.9 | 19.0 | 56.4 | 17.7** | 7.3 | 11.5 | 62.4 | 18.8** |
| Experts and Others | 6.4 | 14.7 | 62.4 | 16.5 | 9.3 | 6.5 | 68.5 | 15.7 |
| No Fishing Regs. Guides or Experts | 11.1 | 16.7 | 44.0 | 28.2 | 9.4 | 11.1 | 44.9 | 34.6 |

Table 29. (cont.)

| | Health Benefits For Children Are Greater Than Health Risks | | | | Health Benefits for Unborn Children Are Greater Than Health Risks | | | |
|---|---|---|---|---|---|---|---|---|
| | Agree | Neutral | Disagree | Don't Know | Agree | Neutral | Disagree | Don't Know |
| | Percent | | | | | | | |
| **Household Characteristics** | | | | | | | | |
| With Children Under 15 | 10.3 | 17.1 | 53.4 | 19.2 | 8.4 | 11.9 | 60.2 | 19.5*** |
| Without Children Under 15 | 7.9 | 18.3 | 50.4 | 23.4 | 8.5 | 10.5 | 52.8 | 28.2 |
| With Woman of Childbearing Age | 8.0 | 17.2 | 53.6 | 21.2 | 6.2 | 11.8 | 61.4 | 20.6**** |
| Without Woman of Childbearing Age | 9.9 | 18.5 | 47.6 | 24.0 | 11.9 | 9.7 | 45.8 | 32.5 |

*Statistically significant difference between consumption groups at $P \leq .05$ using Chi-square test.
**Statistically significant difference between sources of information at $P \leq .05$ using Chi-square test.
***Statistically significant difference between households with and without children under 15 at $P \leq .05$ using Chi-square test.
****Statistically significant difference between households with and without women of childbearing age at $P \leq .05$ using Chi-square test.

Who should be concerned about the health risks from eating contaminated fish? A majority of respondents felt the general public should be very concerned, while slightly over 40% felt they were personally very concerned about their risk (Table 30). Those who consulted experts for information were most likely to be very concerned themselves and also feel the general public should be very concerned. As consumption of listed species increased, the percent of respondents feeling very concerned about the risk for themselves decreased, but listed fish consumption groups did not differ regarding the level of concern the general public should feel regarding health risks from fish consumption. High fish consumers based on the general advisory (> 52 meals/year) were significantly more likely to believe the general public should be very concerned, and tended to be more likely (but not significant statistically) to be very concerned themselves compared to consumers of listed species. High fish consumers appear to differ in their beliefs depending on which fish consumption typology is used to define "high."

Anglers varied widely in the amount of control they believed they had in determining whether they would experience health problems due to eating New York sport-caught fish. Approximately one-fifth thought they had complete control, whereas a slightly lower percent thought they had no control. The remainder centered around neutral, producing an overall neutral average (Table 31). There were no differences in the amount of control felt by various consumption groups or by sources of information consulted.

Approximately equal percentages of respondents agreed and disagreed with the statement that government agencies do not really know how much chemical contaminants are in fish (Table 31). Those who used Fishing Guides or Experts were more likely to disagree with the statement than those who used other

Table 30. Level of concern the general public should feel and anglers personally feel regarding health risks—overall, by specific waters consumption group, by general advisory consumption group, by source of information, and by household characteristics.

| | LEVEL OF CONCERN GENERAL PUBLIC SHOULD FEEL REGARDING HEALTH RISKS | | | | | LEVEL OF CONCERN YOU AND YOUR FAMILY SHOULD FEEL REGARDING HEALTH RISKS | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Very Concerned | Somewhat Concerned | Slightly Concerned | Not At All Concerned | Don't Know | Very Concerned | Somewhat Concerned | Slightly Concerned | Not At All Concerned | Don't Know |
| Overall | 55.7 | 30.3 | 9.5 | 1.1 | 3.4 | 42.5 | 27.2 | 18.7 | 10.1 | 1.5 |
| Specific Waters Consumption Groups | | | | | | | | | | |
| Did Not Fish Listed Waters | 56.3 | 29.8 | 10.1 | 1.0 | 2.8 | 42.0 | 27.5 | 18.8 | 10.9 | 0.8* |
| Fished Listed Waters, Did Not Catch | 50.1 | 37.7 | 5.7 | 0.8 | 5.7 | 41.0 | 32.7 | 15.6 | 8.2 | 2.5 |
| Fished Listed Waters, Did Not Eat | 61.6 | 32.7 | 3.8 | 0.0 | 1.9 | 54.4 | 29.1 | 9.7 | 4.9 | 1.9 |
| Ate, But Within Limits | 51.2 | 29.3 | 17.1 | 0.0 | 2.4 | 48.8 | 26.8 | 14.6 | 9.8 | 0.0 |
| Ate, 1-3 Times Over the Limit | 52.5 | 26.2 | 19.7 | 0.0 | 1.6 | 39.3 | 24.6 | 23.0 | 11.5 | 1.6 |
| Ate, >3 Times Over the Limit | 44.7 | 32.3 | 13.8 | 4.6 | 4.6 | 26.2 | 23.1 | 36.9 | 12.3 | 1.5 |
| General Advisory Consumption Groups | | | | | | | | | | |
| Did Not Eat Sport-caught Fish in '91 | 56.5 | 29.3 | 7.3 | 1.5 | 5.4* | 46.7 | 23.2 | 14.8 | 13.3 | 2.0 |
| Ate Within Limits (≤ 52 meals) | 52.8 | 33.1 | 11.6 | 0.5 | 2.0 | 40.4 | 29.8 | 19.9 | 8.9 | 1.0 |
| Ate Over Limit (> 52 meals) | 63.4 | 23.9 | 8.5 | 2.8 | 1.4 | 50.8 | 22.5 | 19.7 | 7.0 | 0.0 |
| Source of Information | | | | | | | | | | |
| Fishing Regs. Guides/No Experts | 53.5 | 33.8 | 10.4 | 1.0 | 1.3** | 37.6 | 31.2 | 20.5 | 9.9 | 0.8** |
| Experts and Others | 68.1 | 23.0 | 4.4 | 1.8 | 2.7 | 56.7 | 29.2 | 5.3 | 8.8 | 0.0 |
| No Fishing Regs. Guides/No Experts | 54.0 | 30.2 | 7.9 | 0.4 | 7.5 | 45.3 | 22.6 | 20.6 | 8.7 | 2.8 |

Table 30. (cont.)

| | LEVEL OF CONCERN GENERAL PUBLIC SHOULD FEEL REGARDING HEALTH RISKS | | | | | LEVEL OF CONCERN YOU AND YOUR FAMILY SHOULD FEEL REGARDING HEALTH RISKS | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Very Concerned | Somewhat Concerned | Slightly Concerned | Not At All Concerned | Don't Know | Very Concerned | Somewhat Concerned | Slightly Concerned | Not At All Concerned | Don't Know |
| Household Characteristics | | | | | | | | | | |
| With Children Under 15 | 58.7 | 29.2 | 9.0 | 0.8 | 2.3 | 45.6 | 27.2 | 16.7 | 10.0 | 0.5 |
| Without Children Under 15 | 53.5 | 31.6 | 10.1 | 1.1 | 3.7 | 39.8 | 27.3 | 20.7 | 10.3 | 1.9 |
| With Woman of Childbearing Age | 55.7 | 31.5 | 10.2 | 0.3 | 2.3*** | 43.4 | 28.7 | 16.8 | 9.9 | 1.2 |
| Without Woman of Childbearing Age | 55.8 | 28.7 | 8.3 | 2.3 | 4.9 | 41.2 | 24.7 | 21.9 | 10.4 | 1.8 |

*Statistically significant difference between consumption groups at $P \leq .05$ using Chi-square test.
**Statistically significant difference between sources of information at $P \leq .05$ using Chi-square test.
***Statistically significant difference between households with and without women of childbearing age at $P \leq .05$ using Chi-square test.

Table 31. Amount of control anglers feel in determining health risks and opinion about government agencies' knowledge concerning contaminants in fish—overall, by source of information, and by household characteristics.

| | Average Amount of Control In Determining If You Will Experience Health Risks Due To Consumption[a] | Don't Think Government Agencies Know How Much Contaminants Are in Fish | | | |
|---|---|---|---|---|---|
| | | Agree | Neutral | Disagree | Don't Know |
| | | Percent | | | |
| Overall | 4.2 | 35.8 | 16.8 | 38.1 | 9.3 |
| Source of Information | | | | | |
| Fishing Regs. Guides/No Experts | 4.4 | 30.5 | 18.6 | 43.4 | 7.5* |
| Experts and Others | 4.5 | 39.4 | 17.4 | 39.5 | 3.7 |
| No Fishing Regs. Guides or Experts | 4.0 | 40.9 | 13.6 | 35.3 | 10.2 |
| Household Characteristics | | | | | |
| With Children Under 15 | 4.2 | 36.5 | 15.0 | 41.3 | 7.2 |
| Without Children Under 15 | 4.2 | 35.5 | 18.2 | 36.1 | 10.2 |
| With Woman of Childbearing Age | 4.3 | 37.2 | 17.4 | 38.5 | 6.9** |
| Without Woman of Childbearing Age | 4.1 | 33.7 | 15.9 | 37.5 | 12.9 |

[a]Scale ranges from 1=almost no control to 4=neutral to 7=almost complete control.
*Statistically significant difference between sources of information at $P \leq .05$ using Chi-square test.
**Statistically significant difference between households with and without women of childbearing age at $P \leq .05$ using Chi-square test.

information sources, although the majority of those who used Guides or Experts either agreed or were neutral.

Respondents were asked if awareness of the health advisories had increased their interest in water pollution control and clean up efforts. The vast majority of respondents aware of the health advisories felt their interest had increased (Table 32). Over 90% of respondents who had consulted experts felt their interest in water pollution control had increased. Respondents in the highest general fish consumption category (> 52 meals/year) were more likely to have experienced an increased interest than lower fish consumers.

Information Still Desired by 1991 Anglers

The majority of anglers desired more information on all of the topics listed in the questionnaire (Table 33). Those topics most frequently noted were cooking and cleaning methods, how to choose fishing locations, and which species of fish to eat to reduce risks. Those with knowledge scores lower than average tended to be less sure of what additional information they desired, but the majority still desired information on all topics (Table 34). Those who consumed more than 52 sport-caught fish meals in 1991 were more likely to want more information on most topics than anglers who ate less or no fish meals (Table 35).

No significant differences in desires for additional information were found between users of various information sources, except for information on how agencies decide on health advisory recommendations. For that item, more respondents who listed experts or Fishing Guides as information sources desired this type of additional information (86% and 80% vs. 74%).

Table 32. For those aware of health advisories, the effect the advisories had on their interest in water pollution control and clean up efforts—overall, by general advisory consumption group, by source of information, and by household characteristics.

| | Advisories Increased Interest in Water Pollution Control and Clean Up Efforts | | |
|---|---|---|---|
| | Yes | No | Not Sure |
| | Percent | | |
| Overall | 83.8 | 9.7 | 6.5 |
| General Advisory Consumption Groups | | | |
| Did Not Eat Sport-caught Fish in '91 | 78.6 | 15.9 | 5.5* |
| Ate Within Limit (≤ 52 meals) | 85.0 | 8.6 | 6.4 |
| Ate Over Limit (> 52 meals) | 93.0 | 4.2 | 2.8 |
| Source of Information | | | |
| Fishing Regs. Guides/ No Experts | 82.8 | 11.5 | 5.7** |
| Experts and Others | 94.8 | 1.7 | 3.5 |
| No Fishing Regs. Guides or Experts | 82.0 | 10.4 | 7.6 |
| Household Characteristics | | | |
| With Children Under 15 | 82.2 | 10.9 | 6.9 |
| Without Children Under 15 | 84.9 | 9.4 | 5.7 |
| With Woman of Childbearing Age | 82.8 | 9.9 | 7.3 |
| Without Woman of Childbearing Age | 85.8 | 9.6 | 4.6 |

*Statistically significant difference between consumption groups at $P \leq .05$ using Chi-square test.

**Statistically significant difference between sources of information at $P \leq .05$ using Chi-square test.

Table 33. Additional types of information desired by respondents.

| Additional Information Desired | Yes | No | Not Sure |
|---|---|---|---|
| | Percent | | |
| Cooking Methods to Reduce Risk | 83.7 | 12.6 | 3.7 |
| Which Species of Fish to Eat | 82.4 | 13.7 | 3.9 |
| Cleaning Methods to Reduce Risk | 82.0 | 14.3 | 3.7 |
| How to Choose Fishing Locations | 81.1 | 14.5 | 4.4 |
| Potential Health Problems for Adults | 80.2 | 14.0 | 5.8 |
| Potential Health Benefits | 78.9 | 15.2 | 5.9 |
| Chemical Contaminants in Fish | 78.8 | 14.4 | 6.8 |
| How Agencies Decide on Recommendations | 77.9 | 14.9 | 7.2 |
| Potential Health Problems for Children | 77.2 | 15.9 | 6.9 |
| Which Size of Fish to Eat | 76.5 | 18.1 | 5.4 |
| How Risk Changes as More or Less Fish Is Eaten | 75.5 | 17.6 | 6.9 |
| Potential Health Problems for Unborn Children | 69.0 | 23.0 | 8.0 |
| Comparing Health Risks of Eating Fish With Eating Other Protein Sources | 67.3 | 23.6 | 9.1 |
| Comparing Health Risks of Eating Fish With Risks From Other Activities | 51.9 | 40.2 | 7.9 |

Table 34. Additional information desired for those with above (or equal to) average knowledge scores and for those with below average knowledge scores.

| Additional Information Desired | Overall Knowledge Score ≥ Mean | | | Overall Knowledge Score < Mean | | |
|---|---|---|---|---|---|---|
| | Yes | No | Not Sure | Yes | No | Not Sure |
| | Percent | | | | | |
| Cooking Methods to Reduce Risk | 83.5 | 15.0 | 1.5 | 84.2 | 10.0 | 5.8* |
| Which Species of Fish to Eat | 84.7 | 14.1 | 1.3 | 82.9 | 11.6 | 5.5* |
| Cleaning Methods to Reduce Risk | 81.0 | 17.8 | 1.3 | 83.1 | 10.8 | 6.1* |
| How to Choose Fishing Locations | 80.7 | 16.0 | 3.3 | 81.5 | 13.2 | 5.2 |
| Potential Health Problems for Adults | 81.4 | 14.6 | 4.0 | 80.1 | 13.7 | 6.3 |
| Potential Health Benefits | 78.9 | 15.8 | 5.3 | 79.6 | 13.8 | 6.6 |
| Chemical Contaminants in Fish | 79.9 | 14.6 | 5.5 | 81.2 | 12.5 | 6.4 |
| How Agencies Decide on Recommendations | 80.4 | 14.6 | 5.0 | 78.0 | 13.8 | 8.3 |
| Potential Health Problems for Children | 78.4 | 16.8 | 4.8 | 77.7 | 14.0 | 8.2 |
| Which Size of Fish to Eat | 76.9 | 21.1 | 2.0 | 75.6 | 16.1 | 8.3* |
| How Risk Changes as More or Less Fish is Eaten | 78.3 | 17.6 | 4.0 | 74.5 | 16.7 | 8.8* |
| Potential Health Problems for Unborn Children | 70.3 | 24.9 | 4.8 | 68.4 | 21.7 | 9.9* |
| Comparing Health Risks of Eating Fish With Eating Other Protein Sources | 71.4 | 21.3 | 7.3 | 62.5 | 26.4 | 11.0* |
| Comparing Health Risks of Eating Fish With Risks From Other Activities | 51.6 | 42.8 | 5.5 | 52.5 | 37.8 | 9.7 |

*Statistically significant difference between knowledge groups at $P \leq .05$ using Chi-square test.

Table 35. Percent desiring additional types of information by general advisory consumption groups.

| Additional Information Desired | General Advisory Consumption Groups | | |
|---|---|---|---|
| | Did Not Eat Sport-caught Fish in '91 | Ate Within Limits (< 52 meals) | Ate Over Limit (> 52 meals) |
| | Percent Saying Info. Desired | | |
| Cooking Methods to Reduce Risk | 76.6 | 85.6 | 88.2* |
| Which Species of Fish to Eat | 73.9 | 84.5 | 94.2* |
| Cleaning Methods to Reduce Risk | 73.1 | 83.8 | 86.8* |
| How to Choose Fishing Locations | 73.5 | 82.6 | 85.5* |
| Potential Health Problems for Adults | 72.0 | 83.0 | 84.1* |
| Potential Health Benefits | 73.0 | 79.2 | 88.4* |
| Chemical Contaminants in Fish | 73.0 | 82.3 | 79.4* |
| How Agencies Decide on Recommendations | 74.6 | 79.8 | 87.0* |
| Potential Health Problems for Children | 70.8 | 78.5 | 88.4* |
| Which Size of Fish to Eat | 67.9 | 77.6 | 86.8* |
| How Risk Changes as More or Less Fish is Eaten | 66.5 | 77.5 | 85.5* |
| Potential Health Problems for Unborn Children | 65.8 | 69.9 | 73.9 |
| Comparing Health Risks of Eating Fish With Eating Other Protein Sources | 62.7 | 69.3 | 68.1 |
| Comparing Health Risks of Eating Fish With Risks From Other Activities | 48.9 | 53.5 | 64.2 |

*Statistically significant difference between consumption groups at $P \leq .05$ using Chi-square test.

Reasons for making or not making changes as a result of the health advisory were reflected in desires for additional information. For example, those who could not tell from the advisory how to choose fishing locations were more likely to want additional information on how to choose fishing locations (Table 36). Conversely, those who had changed cleaning methods were less likely to want more information on how to clean fish.

Sources of Future Information

A plurality of respondents desiring more information would seek out the NYSDEC Bureau of Fisheries for that information (Table 37). Of all the sources listed in Table 37, the Bureau was rated as most believable. The NYS Department of Health was listed by about one-fourth of respondents as the source they would contact first, and was also rated high on the believability scale. Physicians and the NYSDEC Bureau of Environmental Protection also were viewed as believable, which may indicate physicians could be a useful mechanism for transferring health advisory information to potential fish consumers. Over 10% of respondents were not sure who to contact for more information. Newspaper reporters were rated as least believable, but were very often cited as information sources that had been used.

Comparisons with 1988 Statewide Angler Survey

We compared anglers who responded to the 1988 Statewide Angler Survey (Connelly et al. 1990) with those who responded to the current survey. Since no major changes had occurred in New York's freshwater fishery in the intervening years, it was not surprising that we found little change in angler fishing behavior from 1988 to 1991. About 90% of respondents in each year fished in New York, for an average of 25 to 27 days per year. In 1988, 27% fished Lake Ontario compared with 22% in 1991. Connelly et al. (1990)

Table 36. Specific types of additional information desired by specific reasons for making or not making changes as a result of the health advisory.

| Reasons for Making or Not Making Changes As A Result of Health Advisory | Additional Information Desired: Yes | No | Not Sure |
|---|---|---|---|
| | Percent | | |
| *Couldn't Tell From Advisory How to Choose Fishing Location** | How To Choose Fishing Location | | |
| Yes | 84.4 | 3.1 | 12.5 |
| No | 74.6 | 19.8 | 5.6 |
| | Which Species of Fish to Eat | | |
| *Changed Species of Fish Eaten* | | | |
| Yes | 89.5 | 7.5 | 3.0 |
| No | 84.3 | 14.6 | 1.1 |
| *Couldn't Tell From Advisory Which Species Have Less Chemicals* | | | |
| Yes | 91.9 | 5.4 | 2.7 |
| No | 77.9 | 17.7 | 4.4 |
| | Which Size of Fish to Eat | | |
| *Changed Size of Fish Eaten* | | | |
| Yes | 86.9 | 11.5 | 1.6 |
| No | 77.0 | 19.7 | 3.3 |
| *Couldn't Tell From Advisories What Size Fish Have Less Chemicals* | | | |
| Yes | 85.3 | 5.9 | 8.8 |
| No | 70.7 | 23.6 | 5.7 |
| | Cleaning Methods to Reduce Risk | | |
| *Changed Cleaning Methods** | | | |
| Yes | 77.3 | 22.7 | 0.0 |
| No | 81.8 | 12.9 | 5.3 |
| *Couldn't Tell From Advisories How To Clean Fish to Reduce Risk* | | | |
| Yes | 97.0 | 3.0 | 0.0 |
| No | 80.2 | 15.5 | 4.3 |

Table 36. (cont.)

| Reasons for Making or Not Making Changes As A Result of Health Advisory | Additional Information Desired: Yes | No | Not Sure |
|---|---|---|---|
| | Percent | | |
| | Cooking Methods to Reduce Risk | | |
| *Changed Cooking Methods* | | | |
| Yes | 86.0 | 12.0 | 2.0 |
| No | 82.3 | 14.1 | 3.6 |
| *Couldn't Tell From Advisories How to Cook Fish to Reduce Risk* | | | |
| Yes | 94.4 | 2.8 | 2.8 |
| No | 80.9 | 14.8 | 4.3 |

*Statistically significant difference between groups at $P \leq .05$ using Chi-square test.

Table 37. Believability of various sources of information and the source respondents would contact first for more information regarding health risks associated with sportfish consumption.

| Sources of Information | Believability Regarding Potential Health Risks Associated With Eating Sport-caught Fish | | | Source You Would Contact First For More Info. |
|---|---|---|---|---|
| | Extremely Believable | Not At All Believable | Mean Score[a] | |
| | Percent | | | Percent |
| NYSDEC, Bureau of Fisheries | 24.4 | 2.5 | 3.8 | 41.6 |
| Own Physician | 18.8 | 3.4 | 3.5 | 5.1 |
| NYS, Dept. of Health | 16.6 | 2.8 | 3.5 | 22.4 |
| NYSDEC, Bureau of Environmental Protection | 14.3 | 4.3 | 3.5 | 9.6 |
| Sportsmen's Associations or Clubs | 9.4 | 7.6 | 3.0 | 2.2 |
| U.S. Environmental Protection Agency | 8.8 | 6.0 | 3.2 | 3.6 |
| Environmental Interest Groups | 7.8 | 15.0 | 2.8 | 2.0 |
| Sea Grant Extension Specialists | 5.8 | 9.5 | 2.9 | 1.8 |
| Charter Boat Operators or Guides | 4.1 | 19.1 | 2.5 | 0.0 |
| Newspaper Reporters or Writers | 2.1 | 21.6 | 2.5 | 0.1 |
| Don't Know | | | | 11.6 |
| | | | | 100.0 |

[a]Scale ranges from 1=not at all believable to 5=extremely believable.

estimated that 34% of respondents had fished listed waters, but the list used to make this determination was not the complete list included in the advisory. (It was not possible to determine if 1988 respondents fished a few of the smaller waterbodies.) Thus, the percentage of respondents actually fishing advisory-listed waters in 1988 may be closer to the 44% who fished listed waters in 1991.

The only fish consumption comparison that was possible between the two studies showed little change. In 1988, Lake Ontario anglers ate an average of 6.9 meals of Lake Ontario fish, compared with 8.8 meals in 1991.

Awareness of the health advisory, however, increased from 80% to 85% from 1988 to 1991 (both numbers were adjusted for nonresponse bias to reflect the general licensed angler population). Some differences in awareness based on sociodemographic characteristics continued, with the youngest anglers and women tending to be less aware of the advisory compared to their counterparts (Table 38). Increases of 9% or more of respondents within certain categories being aware of the advisory in 1991 vs. 1988 were found for the youngest, the oldest, the lowest income, and the least educated.

The percentage listing the Fishing Regulations Guide as a health advisory information source rose from 61% in 1988 to 75% in 1991, whereas the percentage listing all other sources declined or remained the same (Table 38). The increased use of the Guide is important because it is one of the most comprehensive sources of specific advisory recommendations and the "official" information summary from NYSDOH and NYSDEC regarding health advisories. The percentage in each age group using the Guide has increased from 1988 to 1991, with the largest increase being in the older age groups in which use has increased by one-half to two-thirds.

Table 38. Heard about health advisories and sources of information—overall and by socio-demographic characteristics in 1988 and 1991.

| | Heard About Health Advisory | | Source of Health Advisory Information | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Fishing Regs. Guide | | Newspaper | | TV or Radio | | Magazines | | Friends | | Posted Warnings | | Guides/Charter Operators | |
| | 1988 | 1991 | 1988 | 1991 | 1988 | 1991 | 1988 | 1991 | 1988 | 1991 | 1988 | 1991 | 1988 | 1991 | 1988 | 1991 |
| | Percent | | | | | | | | | | | | | | | |
| Overall | 82.0 | 89.8 | 61.2 | 74.6 | 72.8 | 67.2 | 44.0 | 38.6 | 41.2 | 35.4 | 51.6 | 46.3 | 10.3 | 8.0 | 8.2 | 7.3 |
| Age | | | | | | | | | | | | | | | | |
| 16-29 | 76.5 | 85.6 | 65.3 | 72.0 | 64.5 | 62.2 | 43.8 | 42.0 | 39.3 | 35.7 | 57.6 | 64.3 | 11.7 | 9.8 | 8.8 | 6.3 |
| 30-39 | 82.7 | 90.3 | 66.6 | 70.0 | 70.4 | 62.3 | 41.6 | 33.6 | 42.9 | 34.1 | 56.6 | 52.0 | 11.3 | 5.4 | 8.7 | 6.3 |
| 40-49 | 85.0 | 91.1 | 62.6 | 75.2 | 72.8 | 68.4 | 43.4 | 40.0 | 41.4 | 38.0 | 49.9 | 43.6 | 9.4 | 8.8 | 7.3 | 8.8 |
| 50-64 | 84.3 | 89.9 | 55.0 | 79.5 | 79.7 | 72.1 | 46.9 | 38.9 | 42.2 | 36.8 | 46.9 | 33.2 | 10.3 | 8.9 | 8.5 | 7.9 |
| 65+ | 81.3 | 93.0 | 49.4 | 84.2 | 81.8 | 80.7 | 46.5 | 42.1 | 38.5 | 26.3 | 41.2 | 31.6 | 7.8 | 5.3 | 7.4 | 5.3 |
| Income | | | | | | | | | | | | | | | | |
| ≤ $20,000 | 78.6 | 88.3 | 58.6 | 71.3 | 70.3 | 63.5 | 51.0 | 41.7 | 37.3 | 34.8 | 51.8 | 45.2 | 11.1 | 14.8 | 6.1 | 5.2 |
| $21,000-$32,000 | 83.7 | 88.7 | 62.1 | 76.1 | 72.3 | 67.3 | 42.9 | 39.6 | 41.7 | 34.6 | 54.1 | 51.6 | 10.5 | 6.3 | 6.9 | 6.9 |
| $33,000-$49,000 | 84.6 | 83.2 | 65.6 | 73.5 | 72.6 | 65.7 | 42.5 | 40.3 | 41.6 | 37.0 | 49.9 | 43.6 | 9.6 | 8.3 | 8.7 | 5.5 |
| $≥ $50,000 | 83.0 | 90.8 | 63.4 | 76.3 | 75.3 | 68.7 | 38.7 | 33.2 | 44.4 | 36.4 | 50.1 | 44.9 | 9.8 | 7.0 | 11.5 | 9.2 |
| Education | | | | | | | | | | | | | | | | |
| Grades 1-11 | 76.3 | 90.2 | 50.0 | 67.8 | 72.4 | 54.2 | 56.4 | 40.7 | 34.5 | 32.2 | 57.6 | 40.7 | 12.3 | 8.5 | 6.4 | 0.0 |
| Grad. High School | 82.1 | 89.4 | 61.9 | 77.5 | 71.2 | 70.1 | 46.4 | 43.5 | 42.4 | 34.7 | 53.6 | 46.1 | 10.2 | 8.9 | 7.8 | 9.2 |
| Some College | 82.3 | 89.3 | 63.1 | 77.6 | 73.9 | 71.3 | 42.2 | 35.0 | 43.8 | 37.1 | 51.7 | 51.7 | 10.1 | 9.4 | 9.4 | 7.0 |
| Grad. College | 82.4 | 90.6 | 64.0 | 72.0 | 74.6 | 62.7 | 37.8 | 35.6 | 36.2 | 32.2 | 44.7 | 40.7 | 10.8 | 5.1 | 7.3 | 7.6 |
| Some Post Grad. | 85.7 | 90.9 | 64.6 | 68.3 | 73.0 | 63.3 | 38.3 | 36.7 | 42.7 | 35.8 | 47.0 | 40.0 | 8.9 | 5.8 | 8.9 | 7.5 |
| Sex | | | | | | | | | | | | | | | | |
| Male | 82.4 | 90.9 | 61.9 | 74.2 | 72.6 | 66.3 | 43.2 | 36.2 | 41.5 | 37.3 | 52.1 | 45.9 | 10.2 | 8.0 | 8.4 | 7.6 |
| Female | 79.9 | 83.2 | 57.5 | 77.6 | 74.5 | 73.3 | 49.2 | 52.6 | 39.5 | 24.1 | 48.7 | 48.3 | 10.9 | 7.8 | 7.1 | 5.2 |

In both the 1988 and 1991 surveys, respondents were asked if they had ever made changes in their fishing habits or in the way they ate fish in response to the health advisory. The format of the questions differed between years, however, with the 1991 version allowing respondents to indicate various reasons why they had not made changes. This change in format may account in part for the decrease in the percent who said they made changes (61% ±1.5% in 1988, 54% ±3.4% in 1991). Alternatively, since advisory awareness has been high over time, respondents in 1991 may have initiated changes several years ago that they have now adopted as normal behavior, and so may have forgotten that they made those changes in response to the advisory.

The most notable differences in changes made were related to fish consumption. Comparing the two years, more 1991 respondents indicated that they eat less fish or have ceased eating sport-caught fish due to the advisories (Table 39), and more 1991 anglers indicated they have increased their fish consumption due to the information included in advisories (9% in 1988, 23% in 1991). Declines in percentages making changes were noted for cleaning and cooking methods and fishing location. As noted above, it is possible that these kinds of behaviors, once initiated, are adopted as the norm and therefore not remembered as changes in response to the advisory. It is less likely that changes made in fish consumption, an ultimate goal for some anglers, would be as quickly forgotten as changes in cleaning or cooking methods.

Increases in the percentage of respondents who reduced their fish consumption, either eating less or avoiding fish, were most evident for the youngest, lowest income, and female respondents.

Table 39. For those who knew of the health advisories, whether or not they made changes in their fishing habits or the way they ate fish and if so, selected types of changes made, overall and by socio-demographic characteristics in 1988 and 1991.

| | Made Changes | | Of Those Who Made Changes, the Following Changes Were Made: | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Eat Less Fish | | Changed Clean/prep. Practices | | Changed Fishing Location | | Take Fewer Fishing Trips | | Don't Eat Sport-caught Fish | |
| | 1988 | 1991 | 1988 | 1991 | 1988 | 1991 | 1988 | 1991 | 1988 | 1991 | 1988 | 1991 |
| | Percent | | | | | | | | | | | |
| **Overall** | 61.3 | 53.5 | 51.2 | 69.6 | 46.1 | 44.7 | 31.3 | 27.2 | 17.0 | 17.9 | 10.8 | 17.0 |
| **Age** | | | | | | | | | | | | |
| 16-29 | 63.6 | 52.1 | 49.7 | 73.3 | 41.9 | 37.8 | 34.1 | 40.0 | 14.0 | 20.0 | 12.4 | 13.0 |
| 30-39 | 64.9 | 56.6 | 52.4 | 73.7 | 46.3 | 38.2 | 31.3 | 27.6 | 17.0 | 14.5 | 10.4 | 19.8 |
| 40-49 | 62.8 | 53.3 | 52.1 | 68.0 | 46.0 | 48.0 | 31.0 | 24.0 | 15.7 | 21.3 | 10.0 | 14.7 |
| 50-64 | 57.1 | 49.7 | 48.3 | 68.1 | 50.9 | 55.3 | 31.5 | 21.3 | 17.6 | 21.3 | 10.4 | 20.8 |
| 65+ | 52.1 | 58.0 | 53.0 | 50.0 | 45.8 | 50.0 | 26.7 | 21.4 | 23.9 | 0.0 | 10.8 | 14.3 |
| **Income** | | | | | | | | | | | | |
| ≤ $20,000 | 58.4 | 59.0 | 46.9 | 78.4 | 41.4 | 29.7 | 35.0 | 32.4 | 21.2 | 29.7 | 9.5 | 18.4 |
| $21,000-$32,000 | 60.4 | 54.1 | 50.9 | 71.1 | 46.8 | 48.9 | 33.1 | 35.6 | 15.0 | 11.1 | 11.2 | 13.3 |
| $33,000-$49,000 | 64.5 | 54.6 | 51.0 | 75.5 | 50.0 | 49.1 | 29.1 | 26.4 | 16.0 | 13.2 | 10.9 | 10.9 |
| ≥ $50,000 | 61.8 | 49.8 | 55.1 | 65.0 | 47.7 | 48.0 | 30.0 | 19.0 | 16.1 | 19.0 | 9.1 | 22.3 |
| **Education** | | | | | | | | | | | | |
| Grades 1-11 | 53.2 | 59.3 | 51.4 | 58.3 | 44.4 | 58.3 | 28.0 | 33.3 | 23.8 | 8.3 | 12.6 | 16.7 |
| Grad. High School | 60.4 | 52.5 | 51.7 | 68.6 | 46.6 | 35.7 | 30.5 | 28.6 | 14.8 | 18.6 | 10.7 | 20.5 |
| Some College | 63.9 | 58.7 | 50.6 | 77.9 | 47.8 | 43.2 | 31.5 | 29.5 | 17.7 | 20.0 | 8.7 | 14.3 |
| Grad. College | 59.7 | 47.4 | 50.6 | 62.2 | 44.2 | 43.2 | 32.6 | 27.0 | 16.5 | 18.9 | 11.0 | 23.7 |
| Some Post Grad. | 63.4 | 44.5 | 51.3 | 63.2 | 45.4 | 63.2 | 34.2 | 21.1 | 15.4 | 13.2 | 12.3 | 7.9 |
| **Sex** | | | | | | | | | | | | |
| Male | 61.2 | 54.9 | 51.8 | 69.4 | 45.9 | 45.3 | 31.7 | 27.4 | 16.7 | 18.1 | 11.3 | 16.5 |
| Female | 61.6 | 43.6 | 47.3 | 70.8 | 47.5 | 41.7 | 29.2 | 25.0 | 17.5 | 12.5 | 7.9 | 23.1 |

Use of specific risk-reducing fish preparation methods has not changed over time (Table 40). The majority of anglers use risk-reducing methods at least some of the time. Use of non risk-reducing methods also has not changed between 1988 and 1991.

Angler opinions about the health advisory have not changed over time, based on two measures. The majority believed the health advisory provides them with enough information and that it is not exaggerated (Table 41). In 1988, 84% of respondents believed that chemical contaminants in fish posed some danger to them, similar to 1991 in which 88% were at least slightly concerned that eating sport-caught fish was a potential health risk for themselves or their family.

As reported earlier, a variety of additional information was desired by anglers in 1991. Two of the 1991 questions were similar to those in 1988. In both cases the majority desired more information on the topics posed. In 1988, 78% of respondents desired more information about the risks of eating fish with chemical contaminants, compared with 75% in 1991 desiring more information about how health risks changes as more or less fish is eaten. In 1988, 75% of respondents desired more information about the risks of eating certain fish compared with other risks in life, compared with 52% in 1991 desiring that type of information.

## CONCLUSIONS AND RECOMMENDATIONS

### Effects of the 1990-91 Advisory

Based on public awareness and anglers' fish consumption, the 1990-1991 advisory could be judged a success. Eighty-five percent of anglers statewide were aware of the advisory, up from 80% in 1988. Increases in awareness since 1988 were noted for groups of special concern, including the youngest anglers,

Table 40. Fish preparation methods used in 1988 and 1991.

| Fish Preparation Methods | 1988 | 1991 |
|---|---|---|
| Risk-reducing | | |
| *Trim fat along back* | | |
| Always/Usually | 44.8 | 38.7 |
| Sometimes | 15.7 | 14.4 |
| Rarely | 10.8 | 8.7 |
| Never | 28.7 | 38.2 |
| *Trim belly meat* | | |
| Always/Usually | 51.1 | 49.6 |
| Sometimes | 15.8 | 15.1 |
| Rarely | 9.3 | 7.4 |
| Never | 23.8 | 27.9 |
| *Puncture or remove skin* | | |
| Always/Usually | 59.3 | 59.4 |
| Sometimes | 21.1 | 19.6 |
| Rarely | 5.8 | 5.2 |
| Never | 13.8 | 15.8 |
| *Fillet fish* | | |
| Always/Usually | 69.2 | 65.4 |
| Sometimes | 21.1 | 20.2 |
| Rarely | 3.8 | 4.6 |
| Never | 5.9 | 9.8 |
| *Bake, BBQ, or Poach* | | |
| Always/Usually | 23.8 | 24.0 |
| Sometimes | 40.3 | 36.8 |
| Rarely | 14.9 | 14.6 |
| Never | 21.0 | 24.6 |
| Not Risk-reducing | | |
| *Eat whole fish* | | |
| Always/Usually | 18.9 | 16.3 |
| Sometimes | 17.0 | 19.9 |
| Rarely | 14.4 | 14.1 |
| Never | 49.7 | 49.7 |

Table 40. (cont.)

| Fish Preparation Methods | 1988 | 1991 |
|---|---|---|
| *Make Fish Soup* | | |
| Always/Usually | 3.0 | 1.7 |
| Sometimes | 15.4 | 12.7 |
| Rarely | 19.6 | 20.2 |
| Never | 62.0 | 65.4 |
| *Reuse Fish Oil* | | |
| Always/Usually | 4.1 | 3.6 |
| Sometimes | 5.5 | 3.7 |
| Rarely | 5.6 | 5.4 |
| Never | 84.8 | 87.3 |

Table 41. Opinion of health advisories in 1988 and 1991.

| | Health Advisories Provide Enough Information | | | Health Advisories Are Not Needed Or Are Exaggerated | | |
|---|---|---|---|---|---|---|
| | Agree | Disagree | No Opinion | Agree | Disagree | No Opinion |
| Survey Year | | | | | | |
| 1988 | 69.5 | 20.7 | 9.8 | 11.5 | 66.6 | 21.9 |
| 1991[a] | 53.1 | 18.6 | 28.3 | 8.5 | 64.7 | 26.8 |

[a]Response categories in the 1991 questionnaire were "Yes," "No," and "Not Sure."

lowest income, and least educated. Use of the Fishing Regulations Guide had increased since 1988, with the Guide the most-used information source in 1991.

Eighty percent of respondents in this study were keeping fish consumption within the levels recommended in the advisory for both listed and general New York waters. Of the 20% of respondents who exceeded the recommendations in some way, 8% exceeded the general one meal per week recommendation. Of those eating more than 52 meals per week, most had made changes in their fish preparation methods, fishing locations, and species and sizes caught. Only 15% of respondents were exceeding the advisory recommendations by consuming species of highest concern.

The health advisory stimulated increased interest in water pollution clean-up and prevention activities for most respondents. Risk-reducing fish cleaning procedures have been adopted widely. The most prominent behavioral changes reported related to fish consumption—either decreases or increases in consumption based on health advisory information.

Can the advisory be improved further? Consider the specific objectives NYSDEC and NYSDOH hold for the health advisory (note we did not assess factors related to objectives for reducing risks to subsistence or unlicensed anglers):

(1) Reduce health risks to special at-risk groups of people. Female anglers and the youngest anglers remained least aware of the health advisory (note this study did not provide information about female partners of male anglers). Female anglers tended not to use the official information sources such as the Guide and experts. Female anglers were less likely to make changes in their fishing and fish-eating behavior in response to the advisory. Nonwhites tended to be less aware of the advisories than white anglers. Advisory-related knowledge was lowest for the youngest, lowest income, and least educated anglers.

(2) Reduce health risks to licensed sport anglers. Twenty percent of anglers were exceeding the advisory recommendations in some way, 15% related to overconsumption of listed species from specific waters of concern.

(3) Allow people to make their own, informed decision about eating fish. The Fishing Regulations Guide was not used by 21% of licensed anglers as a source of health advisory information. Younger anglers, women of childbearing age, and anglers in households with children relied much more on newspapers as an information source than on the Guide. Angler knowledge was weak regarding the negative health effects of fish

consumption, where to get more information about contaminants in fish, and the general advisory recommendation to limit consumption to one meal per week. The highest fish consumers (based on listed species consumption) knew less about the negative health effects from fish than did other fish consumers.

(4) Help people select less-contaminated species of fish to eat. As noted earlier, 15% of anglers ate listed species above the recommended levels. Most anglers desired more information about fishing locations and species with less relative risk.

(5) Help people select risk-reducing fish cleaning and cooking methods. Angler knowledge was weak regarding risk-reducing fish cooking procedures. Angler adoption of risk-reducing cooking behaviors was weak compared to adoption of fish cleaning methods. Most anglers desired more information about risk-reducing fish cleaning and cooking methods.

Determinants of Angler Responses to Health Advisories

Behavioral changes made in response to health advisories appeared to be linked to belief about the personal risk posed by fish consumption, sociodemographic characteristics, and sources of advisory information. Fish consumption was linked to sociodemographic characteristics, advisory awareness, advisory knowledge, information sources, beliefs, and attitudes about fish consumption. The strength and direction of these relationships in this study is being investigated further, and will be reported in a later document.

Of special interest to fishery and public health professionals may be the group of fish consumers eating greater quantities of listed species than recommended in the advisory. This group tended to be aware of the health advisory, as knowledgeable about the advisory as other fish consumers, and just as likely to believe health advisories provide enough information to allow anglers to make an informed decision. These high fish consumers, however, were more likely than other fish consumers to believe the health risks associated with fish consumption are minor compared to other risks, the health benefits are greater than the risks, more likely to have made changes in their fish preparation or fishing behavior, and more likely to exert personal control by using risk-reducing cleaning and cooking methods. Of the high fish consumers who did not change in response to the advisory, many felt eating fish did not pose a risk, but the majority (80%) believed the amount of fish they ate was within the recommended levels. These anglers demonstrated the same opinions as other fish consumers regarding the level of concern the general public should feel about health risks from fish consumption, but were less concerned about the risks for themselves and their families than other fish consumers. Weinstein (1989) reported that people tend to be optimistic about hazards judged to be controllable by personal action. Choosing how to catch, clean, cook, and eat sport-caught fish is largely under individual control. To address optimistic biases associated with personal risk, Weinstein (1984) suggested health communications should not only point out risky behaviors, but also stress the link between specific behaviors and susceptibility to the risk.

Recommendations for Risk Management

Risk managers should consider which target audiences are being reached adequately with existing communication strategies, and which audiences may require refinements in communication strategies. Due to low advisory awareness or knowledge, lack of response to advisories, or lack of use of official information sources, women of childbearing age, young anglers, low income anglers, and anglers with low education levels may be most in need of changes in communication programs.

Current advisory information-dissemination mechanisms should be evaluated for potential improvement. Because such a large percent of anglers use newspapers, risk managers should evaluate existing mechanisms for influencing newspaper coverage of advisory issues to determine if improvements are needed. For example, efforts could be targeted on mass media information changes to improve knowledge about risk-reducing cleaning and cooking methods among those anglers who use neither the Regulations Guide nor experts for advisory information. Posted warnings are used by nonwhite anglers, low income anglers, and anglers in households with children. Because these groups are considered among potential high-risk anglers, posted warnings should be evaluated to identify potential improvements in information content. Content of all advisory dissemination mechanisms should be reviewed to assess the extent to which they may contribute to optimistic biases about health risks associated with fish consumption. As noted earlier, Weinstein's (1984) recommendations coupled with this study suggest more attention should be devoted to drawing a link between specific behaviors (e.g., how much fish is eaten, what types of fish are eaten, how fish are cleaned or cooked) and associated increases or decreases in health risks.

Alternative information dissemination methods can be explored. Anglers judged NYSDEC Bureau of Fisheries and NYSDOH as the more frequently-used and more believable information sources. Coupled with evidence that anglers using the Guide (NYSDEC-NYSDOH collaboration) and experts (NYSDEC, NYSDOH personnel) were more knowledgeable or more likely to make behavioral changes, improved information dissemination could focus on making greater use of these two agencies, or at least using personal-contact methods as much as possible. Physicians, although not frequently used, were viewed as quite believable. Particularly for reaching potentially high-risk audiences, physicians and other health care providers may be an effective information source (Springer 1990).

Based on knowledge scores, advisory-related information for all anglers could be improved regarding risk-reducing cooking procedures and the general 1 meal per week maximum recommendation for fish consumption from New York waters.

Risk management assumptions may be better-informed as a result of this study. Thirty to 65% of anglers in various groups reported freezing or canning their sport-caught fish for later use, which may support or refute certain risk assessment assumptions about the time span over which fish consumption occurs.

Fish consumption suppression is evident in New York anglers, as 47% statewide indicated they would eat more sport-caught fish if problems with contaminants did not exist. Regulators and damage assessors should consider the merits of using current sport-caught fish consumption versus desired fish consumption as the basis for decisions.

Recommendations for Research

The Theory of Planned Behavior provided the basis for a conceptual model of angler responses to health advisories (Fig. 1). Further analysis of the data produced from this study is being conducted to assess the utility of the model. We could not operationalize all relevant variables in this study, however. Future research should focus on determining the influence of normative and control-oriented beliefs, normative attitudes, and behavioral intentions on fish consumption behaviors (and other behaviors related to health advisories).

Future research can build on this study by improving the operationalization of several factors. For example, the overall scale to assess advisory-related knowledge was quite reliable, but measurement of the specific knowledge areas (e.g., advisory recommendations, advisory process) could be improved by developing additional items for each scale. Beliefs about the health risks posed by fish consumption were not assessed for all anglers. Such an assessment would allow stronger conclusions regarding the effects of knowledge on beliefs, and beliefs on attitudes and behaviors.

Several changes in risk management strategies are suggested above. Future research could focus on assessing what effects these changes have on angler knowledge, beliefs, attitudes, and behaviors related to health advisories. This research would lead to further refinements and improvements in the New York State health advisory.

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# APPENDIX A:

## 1991 Advisory as It Appeared in the Fishing Regulations Guide

## HEALTH ADVISORY

The following recommendations are based on evaluation of contaminant levels in fish and wildlife. To minimize potential adverse health impacts, the NYS Department of Health (DOH) recommends:

- Eat no more than one meal (½ pound) per week of fish from the state's freshwaters, the Hudson River estuary, or the New York City Harbor area (the New York waters of the Hudson River to the Verrazano Narrows Bridge, the East River to the Throgs Neck Bridge, the Arthur Kill, Kill Van Kull, and the Harlem River), except as recommended below.
- Women of childbearing age, infants and children under the age of 15 should not eat fish with elevated contaminant levels. The fish species listed from the waters below have contaminant levels that exceed federal food standards and most fish taken from these waters contain elevated contaminant levels.
- Observe the following restrictions on eating fish from these waters and their tributaries to the first barrier impassable by fish.

| Water | Species | Recommended |
|---|---|---|
| ...mont Lake (Suffolk Co.) | Carp | • |
| ...alo River & Harbor (Erie Co.) | Carp | • |
| ...adice Lake (Ontario Co.) | Lake trout or brown trout over 21" | • |
| Canandaigua Lake (Ontario-Yates Co.) | Lake trout over 24" | □ |
| Cayuga Creek (Niagara Co.) | All species | • |
| East River (New York City) | American eel | • |
| Fourth Lake (Herkimer-Hamilton Counties) | Lake trout | • |
| Freeport Reservoir (Nassau Co.) | All species | □ |
| Gill Creek (Niagara Co.) | All species | • |
| Mouth to Hyde Park Lake Dam | | |
| *Grasse River (St. Lawrence Co.) | Smallmouth bass, brown bullhead, walleye | □ |
| Mouth to dam in Massena | | |
| Hall's Pond (Nassau Co.) | Carp, goldfish | • |
| Harlem River (New York City) | American eel | • |
| Hoosic River (Rensselaer Co.) | Brown trout, rainbow trout | □ |
| Hudson River: | | |
| Hudson Falls to Troy Dam | All species | No fishing |
| Troy Dam south to and including the lower NYC harbor | American eel, white perch, carp, goldfish, brown bullhead, largemouth bass, pumpkinseed, white catfish, striped bass, walleye | • |
| | Black crappie, rainbow smelt, Atlantic needlefish, northern pike, tiger muskellunge, bluefish | □ |
| | Blue crab: | Eat no more than 6 crabs per week |
| | hepatopancreas (mustard, liver or tomalley) | • |
| | cooking liquid | discard |
| Indian Lake (Lewis Co.) | All species | □ |
| Irondequoit Bay (Monroe Co.) | Carp | • |
| Keuka Lake (Yates-Steuben Cos.) | Lake trout over 25" | □ |
| Kinderhook Lake (Columbia Co.) | American eel | □ |
| *Lake Champlain: | | |
| Entire lake | Lake trout greater than 25", walleye greater than 19" | □ |
| Bay within Cumberland Head to Valcour Island | American eel, brown bullhead | □ |
| Lake Ontario, and Niagara River below the falls | American eel, channel catfish, lake trout, chinook salmon, coho salmon over 21", rainbow trout over 25", brown trout over 20", carp | • |
| | White perch, smaller coho salmon, rainbow and brown trout, white sucker | □ |
| Loft's Pond (Nassau Co.) | Carp, goldfish | □ |
| Long Pond (Lewis Co.) | Splake over 12" | • |
| Upper Massapequa Reservoir (Nassau Co.) | White perch | □ |
| Mohawk River below Lock 7 | White perch | • |
| | Smallmouth bass | □ |
| Nassau Lake (Rensselaer Co.) | All species | • |
| Niagara River above the falls | Carp | □ |
| Niagara River below the falls; also see Lake Ontario | Smallmouth bass | □ |
| Onondaga Lake (Onondaga Co.) | All species | • |
| Oswego River (Oswego Co.) from power dam in Oswego to upper dam at Fulton | Channel catfish | □ |
| St. James Pond (Suffolk Co.) | All species | □ |
| *St. Lawrence River Entire river | American eel, channel catfish, chinook salmon, carp, lake trout, coho salmon over 21", brown trout over 20", rainbow trout over 25" | • |
| | White perch, smaller coho salmon, rainbow and brown trout | □ |
| Bay at St. Lawrence-Franklin county line | All species | • |
| Salmon River (Oswego Co.) Mouth to Salmon Reservoir; also see Lake Ontario | Smallmouth bass | • |
| Saw Mill River (Westchester Co.) | American eel | □ |
| Schroon Lake (Warren Co.) | Lake trout | □ |
| Sheldrake River (Westchester Co.) | American eel | • |
| Smith Pond at Rockville Center (Nassau Co.) | All species | □ |
| Smith Pond at Roosevelt Park (Nassau Co.) | Carp, goldfish | □ |
| Spring Pond (Suffolk Co.) | All species | • |
| Stillwater Reservoir (Herkimer Co.) | Splake | □ |
| *Three Mile Creek (Oneida Co.) | White sucker | • |
| Valatie Kill (Rensselaer Co.) Between Co. Rt. 18 and Nassau Lake | All species | • |

• Eat none.
□ Eat no more than one meal per month.
* Changes from the 1989-90 Health Advisory

### Additional Advice

The health implications of eating deformed or cancerous fish are unknown. Any grossly diseased fish should probably be discarded. Levels of PCB, mirex and possibly other contaminants of concern (except mercury) can be reduced by removing the skin and fatty portions along the back, sides and belly of smallmouth bass, brown trout, lake trout, coho salmon, striped bass and bluefish. (This technique does not reduce mercury levels, however.) A guide to this method can be obtained from any DEC office. (Additional Advice continued on page 70)

**HEALTH ADVISORY—Additional Advice** continued from page 1

**Marine Waters**—The general advisory (*eat no more than one meal per week*) applies to bluefish and American eel, but not to other fish species taken from marine waters. American eels from the Hudson, Harlem, and East rivers and New York Harbor should not be eaten.

**Marine Striped Bass**—Eat no striped bass taken from the marine waters of Western Long Island, which includes that portion of the island west of a line between Wading River and the terminus of Route 46 near Mastic Beach. Eat no more than one meal (½ pound) per month of striped bass taken from Eastern Long Island marine waters. Women of childbearing age, infants and children under 15 should not eat striped bass taken from Long Island marine waters.

**Marine Crab and Lobsters**—It is recommended that the hepatopancreas (liver, mustard, or tomalley) of crabs and lobsters not be eaten because this organ has high contaminant levels.

## Chemicals in Sportfish or Game

**Summary**

The NYS Department of Health issues an advisory on eating sportfish and wildlife taken in New York State because some of these foods contain potentially harmful levels of chemical contaminants. The health advisory is divided into three section: (1) general advice on sportfish taken from waters in New York State; (2) advice on sportfish from specific water bodies; and (3) advice on wildlife. The advisory is developed and updated yearly and is directed to persons who may be likely to eat large quantities of sportfish or wildlife which might be contaminated.

**Background**

Fishing and hunting provide many benefits including food and recreation. Many people enjoy cooking and eating their own catch. However, some fish and wildlife contain elevated levels of potentially harmful chemicals. These chemicals or contaminants enter the environment through such means as past industrial discharges, leaking landfills and widespread use of pesticides. Fish and wildlife take in contaminants directly from the environment and from the food they eat. Some chemicals remain in them and then are ingested by people. DDT, PCBs, mirex, chlordane and mercury have been found in some species of fish taken in New York State at levels that exceed federal food standards. Long-term exposure to high levels of these chemicals has been linked to health effects such as cancer (in laboratory animals) or nervous system disorders (in humans).

The federal government establishes standards (tolerance levels or action levels) for chemical residues in or on raw agricultural products, including fish. A tolerance level is the maximum amount of a residue expected when a pesticide is used according to the label directions, provided that the level is not an unacceptable health risk. The federal government estimates of health risks assume that people eat about one-half pound of fish each month. Action levels are established for chemicals that do not have approved agriculture uses but may unavoidably contaminate food due to their environmental persistence. Fish and wildlife cannot be legally sold if they contain a contaminant at a greater level than its tolerance or action level.

In New York State, DEC routinely monitors contaminant levels in fish and wildlife. The contaminant levels are measured in a skin-on fillet



which has not been trimmed; the federal government uses this sample in determining whether or not the fish exceeds the tolerance level. When fish from a specific water body are found to contain high contaminant levels, DOH issues a sportfish consumption advisory for that species of fish. Under some circumstances, the state prohibits the sale or offering for sale of fish containing high contaminant levels. Advisories are also developed for contaminated wildlife. These actions are taken to minimize public exposure to contaminated food products.

**General Advisory**

The general health advisory for sportfish is that an individual eat no more than one meal (one-half pound) per week of fish from the state's freshwaters, the Hudson River estuary, or the New York City harbor area (the New York waters of the Hudson River to the Verrazano Narrows Bridge, the East River to the Throgs Neck Bridge, the Arthur Kill, Kill Van Kull and Harlem River). This general advisory is designed to protect against consumption of large amounts of fish which may come from contaminated waterways that are as yet untested or which may contain unidentified contaminants. The general advisory does not apply to fish taken from marine waters. Ocean fish, although less tested, are generally less contaminated than freshwater fish, and fish that live further out from shore are likely to be even less contaminated than those that live or migrate close to shore.

**Specific Freashwater Advisories**

The second part of the health advisory contains information and recommendations for specific bodies of water. Fish monitoring has identified over thirty water bodies that have fish with a contaminant level that exceeds an action level or tolerance level. DOH recommendations are based on the contaminant levels and suggests either limiting or avoiding eating a specific kind of fish from a particular body of water. In some cases, enough information is available to issue advisories based on the length of the fish. Older (larger) fish are often more contaminated than younger (smaller) fish.

The health advisory contains specific advice for infants, children under the age of fifteen and women of childbearing age. DOH recommends that they not eat fish from the specific water bodies listed in the advisory. The reason for this specific advice is that chemicals can have potentially greater impact on developing organs in young children or in the fetus. Waters which have specific advisories have at least one species of fish with an elevated contaminant level, which means that a contamination source is in or near the water.

**Other Advisories**

DOH has also issued special advisories for crabs , lobsters, snapping turtles, and waterfowl which have been found to be contaminated with PCBs. Cooking methods that minimize the amount of contaminants which would be eaten are recommended. Advisories for snapping turtles and waterfowl are provided in the Small Game Hunting Guide. Blue crab advisory is provided at the beginning of this booklet. Advisories on marine crabs and lobsters are provided on page 70.

**What Can I Do To Reduce My Exposure To Chemical Contaminants From Fish**

Fish is an important source of protein and is low in saturated fat.

Naturally occurring fish oils have been reported to lower plasma cholestrol and triglycerides, thereby decreasing the risk of coronary heart disease. Increasing fish consumption is useful in reducing dietary fat and controlling weight. By eating a diet which includes food from a variety of protein sources, an individual is more likely to have a diet which is adequate in all nutrients.

Although eating fish has some health benefits, fish with high contaminant levels should be avoided. When deciding whether or not to eat fish which may be contaminated, the benefits of eating those fish can be weighed against the risks. For young women, eating contaminated fish is a health concern not only for herself but also for any unborn or nursing child, since the chemicals may reach the fetus and can be passed on in breastmilk. For an older person with heart disease the risks, especially of long term health effects, may not be as great a concern when compared to the benefits of reducing the risks of heart disease.

Everyone can benefit from eating fish they catch and can minimize their contaminant intake by following these general recommendations:

- Choose uncontaminated species from water bodies which are not listed in the DOH advisory.
- Use a method of filleting the fish which will reduce the skin, fatty material and dark meat. These parts of the fish contain many of the contaminants. A pamphlet on this method is available from the DEC.
- Choose smaller fish, consistent with DEC regulations, within a species since they may have lower contaminant levels. Older (larger) fish within a species may be more contaminated because they have had more time to accumulate contaminants in their bodies.
- For shellfish, such as crab and lobster, do not eat the soft green substance found in the body section (tomalley, liver). This part of the shellfish has been found to contain high levels of chemical contaminants, including PCBs and heavy metals.
- Based on limited studies, cooking methods such as broiling, poaching, boiling and baking, which allow contaminants from the fatty portions of fish to drain out, are preferable. Pan frying is not recommended. The cooking liquids of fish from contaminated waters should be avoided since these liquids may retain contaminants.

**For more DOH information on health effects from exposure to chemical contaminants, contact:**
Environmental Health Information
1-800-458-1158 (toll-free number)
Leave your name, number and brief message. Your call will be returned as soon as possible.

**For more DEC information on contaminant levels, contact:**
Bureau of Environmental Protection
50 Wolf Road, Albany, New York 12233
(518) 457-6178

**For DEC more information on fishing, contact regional offices listed on page 64.**

# APPENDIX B:

## 1988 Advisory as It Appeared in the Fishing Regulations Guide

## Health Advisory

The following recommendations are based on evaluation of contaminant levels in fish and wildlife. To minimize potential adverse health impacts, the NYS Department of Health recommends:

- Eat no more than one meal (½ pound) per week of fish from any water in the state except as recommended below.
- Women of childbearing age, infants and children under the age of 15 should not eat fish with elevated contaminant levels—most fish taken from the waters listed below contain elevated contaminant levels.
- Observe the following restrictions on eating fish from specific waters and their tributaries to the first barrier impassable by fish.

| Water | Species | Recommended |
|---|---|---|
| Belmont Lake (Suffolk Co.) | Carp | • |
| *Buffalo River & Harbor (Erie Co.) | Carp | • |
| Canadice Lake (Ontario Co.) | Lake trout over 21" | • |
| | Brown trout over 21" | • |
| Canandaigua Lake (Ontario-Yates Co.) | Lake trout over 24" | □ |
| Cayuga Creek (Niagara Co.) | All species | • |
| East River (New York City) | American eel | • |
| Fourth Lake (Herkimer-Hamilton Counties) | Lake trout | • |
| Freeport Reservoir (Nassau Co.) | All species | □ |
| *Gill Creek (Niagara Co.) | All species | • |
| Halls Pond (Nassau Co.) | Carp, goldfish | • |
| Harlem River (New York City) | American eel | • |
| *Hoosic River (Rensselaer Co.) | Brown trout, rainbow trout | □ |
| Hudson River: | | |
| Hudson Falls to Troy Dam | All species | No fishing |
| Troy Dam south to and including the lower NYC harbor | American eel, white perch, carp, goldfish, brown bullhead, largemouth bass, pumpkinseed, white catfish, striped bass, walleye | • |
| | Black crappie, rainbow smelt, Atlantic needlefish, northern pike, tiger muskellunge, bluefish | □ |
| | Blue crab: | Eat no more than 6 crabs per week |
| | hepatopancreas (mustard, liver or tomalley) cooking liquid | • Discard |
| Indian Lake (Lewis Co.) | All species | □ |
| Irondequoit Bay (Monroe Co.) | Carp | • |
| Keuka Lake (Yates-Steuben Counties) | Lake trout over 25" | □ |
| Kinderhook Lake (Columbia) | American eel, white perch | □ |
| Lake Champlain: | | |
| *Bay within Cumberland Head to Valcour Island | American eel, brown bullhead | □ |
| Entire Lake | Lake trout | □ |
| Lake Ontario, St. Lawrence River and Niagara River below the falls | American eel, channel catfish, lake trout, chinook salmon, coho salmon over 21", rainbow trout over 25" brown trout over 20" | • |
| | Carp, white perch, smaller coho salmon, rainbow and brown trout | □ |
| Lefts Pond (Nassau Co.) | Carp, goldfish | □ |
| Long Pond (Lewis Co.) | Splake over 12" | • |
| Upper Massapequa Reservoir (Nassau Co.) | White perch | □ |
| Mohawk River (below Lock 7) | White perch | • |
| *Nassau Lake (Rensselaer Co.) | All species | • |
| Niagara River (entire) | Carp | □ |
| Niagara River (lower; also see Lake Ontario) | Smallmouth bass | □ |
| Onondaga Lake (Onondaga Co.) | All species | • |
| *Oswego River from power dam in Oswego to upper dam at Fulton (Oswego Co.) | Channel catfish | □ |
| Salmon River (Oswego Co.) Mouth to Salmon Reservoir | Smallmouth bass | • |
| St. James Pond (Suffolk Co.) | All species | □ |
| *St. Lawrence River | See Lake Ontario | |
| Saw Mill River (Westchester Co.) | American eel | □ |
| Schroon Lake (Warren Co.) | Lake trout | □ |
| Sheldrake River (Westchester Co.) | American eel | • |
| Smith Pond at Rockville Center (Nassau Co.) | All species | □ |
| Smith Pond at Roosevelt Park (Nassau Co.) | Carp, goldfish | □ |
| Spring Pond (Suffolk Co.) | All species | • |
| Stillwater Reservoir (Herkimer Co.) | Splake | □ |
| Valatie Kill (between Co. Rt. 18 and Nassau Lake) | All species | • |

• Eat none.
□ Eat no more than one meal per month.
* Changes from the 1987-88 Health Advisory

### ADDITIONAL ADVICE

The health implications of eating deformed or cancerous fish are unknown. Any grossly diseased fish should probably be discarded. Levels of PCB, mirex and possibly other contaminants can be reduced by removing the skin and fatty portions along the back, sides and belly of smallmouth bass, brown trout, lake trout, coho salmon, and striped bass. A guide to this method can be obtained from any DEC office.

**Marine Waters**—Eat no striped bass taken from the marine waters of Western Long Island, which includes that portion of the island west of a line between Wading River and the terminus of Route 46 near Mastic Beach. Eat no more than one meal (½ pound) per month of striped bass taken from Eastern Long Island marine waters.

**Snapping turtles** retain contaminants in their fat, liver, eggs and to a lesser extent in the muscle. If you choose to consume snapping turtles, carefully trimming away all fat and discarding the fat, liver and eggs prior to cooking the meat or preparing soup, or other dishes, will reduce exposure. Women of childbearing age and children under the age of 15 should avoid ingesting snapping turtles or any soup or stew made with snapping turtle meat.

**Waterfowl**—It is recommended that you eat no mergansers and common goldeneye since they are the most heavily contaminated waterfowl species. Other waterfowl should be skinned and all fat removed before cooking; the stuffing should be discarded after cooking; and limit eating to two meals per month. Monitoring data indicate that wood ducks and Canada geese are less contaminated than other waterfowl species, with dabbler ducks and then diving ducks having increasingly higher contaminant levels.

# APPENDIX C:

## Mail Questionnaire

# CATCHING AND EATING FRESHWATER FISH IN NEW YORK

Human Dimensions Research Unit
Department of Natural Resources
New York State College of Agriculture and Life Sciences
A Statutory College of the State University
Cornell University, Ithaca, N. Y.

# CATCHING AND EATING

# FRESHWATER FISH IN NEW YORK

Research conducted by the
Human Dimensions Research Unit
in the Department of Natural Resources
New York State College of
Agriculture and Life Sciences
Cornell University

The purpose of this survey is to learn more about freshwater fishing in New York State. We're interested in the activities and opinions of anglers related to fishing and eating fish. Your answers will help improve the process of advising anglers about the safety of eating freshwater fish in New York State.

Please complete this questionnaire at your earliest convenience, seal it, and drop it in any mailbox (no envelope is needed); return postage has been provided. Your responses will remain confidential and will never be associated with your name.

**THANK YOU FOR YOUR ASSISTANCE!**

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1. **At what age did you first fish on a fairly regular basis (at least 5 days per year?)**

   Age when you first started fishing regularly: _____

   Check here _____ *if you have never fished at least 5 days in any year.*

2. **Did you do any freshwater fishing in New York State between January 1, and December 31, 1991?** *(Check one.)*

   _____ Yes ➡ How many days? *(Count any part of a day as a whole day.)*

   _____ days

   _____ No

3. **Please indicate which of the following methods you use to prepare and eat any sport-caught fish in your household. Circle the number for each item that best describes your actions.**

   1=Always; 2=Usually; 3=Sometimes; 4=Rarely; 5=Never

| | Always | | | | Never |
|---|---|---|---|---|---|
| a. Trim the strip of fat along the back of the fish | 1 | 2 | 3 | 4 | 5 |
| b. Trim belly meat | 1 | 2 | 3 | 4 | 5 |
| c. Puncture or remove the skin | 1 | 2 | 3 | 4 | 5 |
| d. Eat whole, gutted fish | 1 | 2 | 3 | 4 | 5 |
| e. Fillet the fish | 1 | 2 | 3 | 4 | 5 |
| f. Pan fry | 1 | 2 | 3 | 4 | 5 |
| g. Deep fry | 1 | 2 | 3 | 4 | 5 |
| h. Make fish soups or chowders | 1 | 2 | 3 | 4 | 5 |
| i. Bake, barbecue, or poach fish | 1 | 2 | 3 | 4 | 5 |
| j. Reuse oil or fat from cooking fish | 1 | 2 | 3 | 4 | 5 |
| k. Freeze or can the fish for use at a later time | 1 | 2 | 3 | 4 | 5 |

4. **Please indicate on the chart below the name and county location for each area that you fished in New York State between January 1 and December 31, 1991. For each location record the number of each species of fish you personally caught in the upper left corner of the box. Record the number of meals of fish you ate of each species from each location below the diagonal line in the lower right corner of each box.** (*If you can't remember the number, but know you caught or ate some put a "?" in the appropriate triangle.*) *If you did not fish in New York in 1991, skip to Question 5.*

| Name of Lake or Stream | County | American Eel | Bass | Bullhead | Brown Trout 20" or under | Brown Trout over 20" | Carp | Channel Catfish | Chinook Salmon | Coho Salmon 21" or under | Coho Salmon over 21" | Lake Trout 21" or under | Lake Trout over 21" | Rainbow Trout 25" or under | Rainbow Trout over 25" | Walleye | White Perch | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | | | | |
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**Sportfish in a number of New York waterways have been found to contain levels of chemical contaminants which may pose health risks to fish consumers. The New York Department of Environmental Conservation distributes health advisories written by the Department of Health which give advice about limiting consumption of fish from certain waters of the State.**

5. **Prior to this survey were you aware of these health advisories?** *(Check one.)*

   _____ YES, aware of specific species and/or water bodies
   _____ YES, generally or vaguely aware
   _____ NO *(SKIP TO QUESTION 11)*

6. **Which of the following information sources made you aware of the health advisories?** *(Please check all that apply.)*

   _____ Newspaper article or editorial
   _____ Magazine article
   _____ 1990-1991 Fishing, Small Game Hunting, and Trapping Regulations Guide
   _____ Previous years Fishing, Small Game Hunting, and Trapping Regulations Guides
   _____ Newsletters from fishing clubs
   _____ Cooperative Extension information
   _____ New York Sea Grant information
   _____ New York State Fisheries agency personnel (Department of Environmental Conservation)
   _____ New York State Department of Health personnel
   _____ Warnings posted on waters that I fish
   _____ Friends
   _____ Television or radio
   _____ Guides or charterboat operators

**7. Since you learned about the New York State health advisories, have you made any changes in either your fishing habits or in the way you eat the fish you catch?**

____ NO. I made no changes as a result of the advisories, because: *(Please check all that apply.)*

- _____ I never ate New York sport-caught fish even before I learned about the advisories.
- _____ The amount of fish I ate before I learned about the advisories was less than the recommended limits.
- _____ I don't believe sport-caught fish pose a health risk for me.
- _____ I couldn't tell from the advisories which locations would have cleaner fish in them.
- _____ I couldn't tell from the advisories which species of fish have less chemicals in them.
- _____ I don't know how to fish for the species of fish that have less chemicals in them.
- _____ I couldn't tell from the advisories what sizes of fish have less chemicals in them.
- _____ I couldn't tell from the advisories how to clean my fish in a way that reduces chemicals in them.
- _____ I couldn't tell from the advisories how to cook my fish in a way that reduces chemicals in them.

____ YES. What changes have you made? *(Please check all that apply.)*

- _____ I no longer eat any sport-caught fish.
- _____ I eat less sport-caught fish now than before the advisories.
- _____ I eat more sport-caught fish now because I can choose to keep fish from waters where there are less serious advisories.
- _____ I have changed the ways I clean fish before eating them.
- _____ I have changed the ways I cook fish before eating them.
- _____ I have changed fishing locations because of the advisories.
- _____ I take fewer fishing trips since learning about the advisories.
- _____ I take more fishing trips now because I can choose waters with less serious contaminant problems.
- _____ I have changed the species of fish I eat because of the advisories.
- _____ I have changed the sizes of fish I eat because of the advisories.

8. **For each type of fish, please circle the number that best describes the change you made in the amount of fish you eat <u>because of the advisories</u>. Circle 5 if you never ate a certain type of fish before or after learning about the advisories.**

| | Stopped Eating | Decreased Amount | No Change | Increased Amount | Never Ate |
|---|---|---|---|---|---|
| American eel | 1 | 2 | 3 | 4 | 5 |
| Brown bullhead | 1 | 2 | 3 | 4 | 5 |
| Brown trout | 1 | 2 | 3 | 4 | 5 |
| Carp | 1 | 2 | 3 | 4 | 5 |
| Channel catfish | 1 | 2 | 3 | 4 | 5 |
| Chinook salmon | 1 | 2 | 3 | 4 | 5 |
| Coho salmon | 1 | 2 | 3 | 4 | 5 |
| Crappie | 1 | 2 | 3 | 4 | 5 |
| Lake trout | 1 | 2 | 3 | 4 | 5 |
| Largemouth bass | 1 | 2 | 3 | 4 | 5 |
| Muskellunge | 1 | 2 | 3 | 4 | 5 |
| Pickerel or Pike | 1 | 2 | 3 | 4 | 5 |
| Rainbow trout | 1 | 2 | 3 | 4 | 5 |
| Smallmouth bass | 1 | 2 | 3 | 4 | 5 |
| Sunfish (e.g. bluegill, pumpkinseed) | 1 | 2 | 3 | 4 | 5 |
| Walleye | 1 | 2 | 3 | 4 | 5 |
| White perch | 1 | 2 | 3 | 4 | 5 |
| White sucker | 1 | 2 | 3 | 4 | 5 |
| Yellow perch | 1 | 2 | 3 | 4 | 5 |

**9. Please check YES, NO, or NOT SURE for each statement below:**

| | Yes | No | Not Sure |
|---|---|---|---|
| a. The health advisories provide me with enough information to decide whether or not to eat certain fish. | ____ | ____ | ____ |
| b. The advisories are not needed, or are exaggerated. | ____ | ____ | ____ |
| c. The New York State health advisories have increased my interest in water pollution control and cleanup efforts. | ____ | ____ | ____ |
| d. The negative health effects from eating contaminated fish are mainly short term. | ____ | ____ | ____ |
| e. The potential negative health effects from eating contaminated fish include nervous system disorders and cancer. | ____ | ____ | ____ |
| f. Older fish generally have more contaminants in them than younger fish. | ____ | ____ | ____ |
| g. Many chemical contaminants are found in greater amounts in fatty fish than in lean fish. | ____ | ____ | ____ |
| h. Fish contaminated with chemicals will taste odd. | ____ | ____ | ____ |
| i. Fish contaminated with chemicals don't behave normally. | ____ | ____ | ____ |
| j. To reduce the levels of chemical contaminants in fish you should: | | | |
| 1. remove the belly fat | ____ | ____ | ____ |
| 2. pan fry the fish | ____ | ____ | ____ |
| 3. broil the fish on a rack | ____ | ____ | ____ |
| 4. remove the skin | ____ | ____ | ____ |

**10. Which of the following methods do you think is used to measure contaminant levels in fish for the New York health advisories?** *(Check one.)*

____ measure whole fish, skin on
____ measure fillet from fish, skin on
____ measure fillet from fish, skin off
____ don't know

**11. What do you think the State recommends as the maximum number of meals of fish that a person should eat from any water in New York State?** *(Check one.)*

| | | |
|---|---|---|
| _____ None | _____ 1 per week | _____ 5-6 per week |
| _____ 1 or less per mo. | _____ 2 per week | _____ 1 per day |
| _____ 2-3 per mo. | _____ 3-4 per week | _____ Don't Know |

**12. What do you think the State recommends as the maximum number of meals of fish that women of childbearing age and children under 15 should eat if the fish have elevated contaminant levels?** *(Check one.)*

| | | |
|---|---|---|
| _____ None | _____ 1 per week | _____ 5-6 per week |
| _____ 1 or less per mo. | _____ 2 per week | _____ 1 per day |
| _____ 2-3 per mo. | _____ 3-4 per week | _____ Don't Know |

**13. For questions 13a and 13b, please use this list of government agencies to answer the questions:**

a. New York State Department of Health
b. County/City Department of Health
c. Department of Environmental Conservation, Bureau of Environmental Protection
d. Department of Environmental Conservation, Bureau of Fisheries
e. Don't Know

**13a. If someone wanted to know more about health effects from exposure to chemical contaminants, which government agency do you think the person should contact?**

_____ (Write one letter from the list above.)

**13b. If someone wanted more information about contaminant levels in fish, which government agency do you think the person should contact?**

_____ (Write one letter from the list above.)

**14. How much control do you believe you have in determining whether you will experience health problems due to eating New York sport-caught fish?** *(Circle the number that best reflects your opinion.)*

| Almost No Control | | Very Little Control | | Very Much Control | | Almost Complete Control |
|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |

**15. How concerned should the general public be about the potential health risks from New York sport-caught fish?** *(Circle one number.)*

| Very Concerned | Somewhat Concerned | Slightly Concerned | Not at All Concerned | Don't Know |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

**16. How concerned are you personally that eating New York sport-caught fish is a potential health risk to you or members of your immediate family?** *(Circle one number.)*

| Very Concerned | Somewhat Concerned | Slightly Concerned | Not at All Concerned | Don't Know |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

**17. Please check YES, NO, or NOT SURE for each statement below:**

| | Yes | No | Not Sure |
|---|---|---|---|
| a. Chemicals from fish can have a greater impact on developing organs in children or unborn babies than on organs in adults. | ____ | ____ | ____ |
| b. Eating fish oils decreases the risk of coronary heart disease. | ____ | ____ | ____ |
| c. Increasing fish consumption reduces dietary fat and helps to control weight. | ____ | ____ | ____ |
| d. Eating contaminated fish can result in accumulation of chemicals in my body. | ____ | ____ | ____ |
| e. Eating contaminated fish over many years increases my health risks. | ____ | ____ | ____ |

**18. Please indicate how strongly you agree or disagree with the following statements.** *(Circle one number for each item.)*

1=Strongly agree
2=Agree
3=Neutral
4=Disagree
5=Strongly disagree
6=Don't know

| | Strongly Agree | | | | Strongly Disagree | Don't Know |
|---|---|---|---|---|---|---|
| a. The health risk from eating contaminated sport-caught fish is minor when compared with other risks I'm exposed to. | 1 | 2 | 3 | 4 | 5 | 6 |
| b. I don't think government agencies really know how much chemical contaminants are in fish. | 1 | 2 | 3 | 4 | 5 | 6 |
| c. The health benefits of eating sport-caught fish are greater than the health risks. | 1 | 2 | 3 | 4 | 5 | 6 |
| d. The health benefits children get from eating sport-caught fish are greater than the health risks. | 1 | 2 | 3 | 4 | 5 | 6 |
| e. The health benefits unborn children get when their mothers eat sport-caught fish are greater than the health risks. | 1 | 2 | 3 | 4 | 5 | 6 |
| f. I would eat more sport-caught fish if health risks from chemical contaminants did not exist. | 1 | 2 | 3 | 4 | 5 | 6 |

**19a. Please rate how believable you think each of the following are as sources of information about the potential health risks from eating sport-caught fish.** *(Circle one number for each information source.)*

| | Not At All Believable | | Moderately Believable | | Extremely Believable |
|---|---|---|---|---|---|
| a. U.S. Environmental Protection Agency | 1 | 2 | 3 | 4 | 5 |
| b. NYS Department of Health | 1 | 2 | 3 | 4 | 5 |
| c. NYS Department of Environmental Conservation, Bureau of Fisheries | 1 | 2 | 3 | 4 | 5 |
| d. NYS Department of Environmental Conservation, Bureau of Environmental Protection | 1 | 2 | 3 | 4 | 5 |
| e. Sportsmen's associations or clubs | 1 | 2 | 3 | 4 | 5 |
| f. Charter boat operators or guides | 1 | 2 | 3 | 4 | 5 |
| g. Sea Grant Extension specialists | 1 | 2 | 3 | 4 | 5 |
| h. Environmental interest groups | 1 | 2 | 3 | 4 | 5 |
| i. Newspaper reporters or writers | 1 | 2 | 3 | 4 | 5 |
| j. Your own physician | 1 | 2 | 3 | 4 | 5 |

**19b. If you wanted to know more about the health risks from eating sport-caught fish, which one of the sources of information listed in 19a would you contact first?**

_____ Please write one letter from the list in Question 19a.
*(Check here _____ if you don't know)*

**20. Please check YES, NO, or NOT SURE for each statement below:**

| *I would like more information about:* | Yes | No | Not Sure |
|---|---|---|---|
| a. how potential health risks change as more or less fish is eaten. | ____ | ____ | ____ |
| b. the potential health problems that may occur in adults who eat contaminated fish. | ____ | ____ | ____ |
| c. the potential health problems that may occur in children who eat contaminated fish. | ____ | ____ | ____ |
| d. the potential health problems that may occur in children whose mothers eat contaminated fish before or during pregnancy. | ____ | ____ | ____ |
| e. comparing health risks from eating contaminated fish with health risks from eating other protein sources. | ____ | ____ | ____ |
| f. comparing health risks from eating contaminated fish with health risks from other activities such as smoking cigarettes or drinking alcohol. | ____ | ____ | ____ |
| g. how to clean fish to reduce the health risks posed by contaminants. | ____ | ____ | ____ |
| h. how to cook fish to reduce the health risks posed by contaminants. | ____ | ____ | ____ |
| i. the chemical contaminants in sport-caught fish that cause advisories to be issued. | ____ | ____ | ____ |
| j. the way in which health agencies and fishery management agencies decide how much fish to recommend eating in advisories. | ____ | ____ | ____ |
| k. how to choose fishing locations to reduce the health risks posed by contaminants. | ____ | ____ | ____ |
| l. which sizes of fish to eat to reduce the health risks posed by contaminants. | ____ | ____ | ____ |
| m. which species of fish to eat to reduce the health risks posed by contaminants. | ____ | ____ | ____ |
| n. the potential health benefits that may occur for people who eat sport-caught fish. | ____ | ____ | ____ |

## BACKGROUND INFORMATION

**21. In what year were you born?** 19___

**22. Are you male or female?** _____ Male _____ Female

**23. Besides yourself, how many people in the following age and sex categories live with you in your household?**

| Age | Number of Males | Number of Females |
|---|---|---|
| less than 6 years old | _____ | _____ |
| 6 to 14 years old | _____ | _____ |
| 15 to 18 years old | _____ | _____ |
| 19 to 45 years old | _____ | _____ |
| over 45 years old | _____ | _____ |

**24. Which of the following best describes the area where you currently live?** *(Check one.)*

_____ Rural, hamlet, or village (under 5,000 population)
_____ Small city of 5,000 to 24,999 population
_____ City of 25,000 to 99,999 population
_____ Large city of 100,000 population or over

**25. How many years of school did you complete, counting 12 years for high school graduation, and 1 year for each additional year of college, technical, or vocational training?**

_____ years

**26. Please circle your approximate 1991 TOTAL HOUSEHOLD INCOME before taxes, in thousands of dollars:**

5 6 7 8 9 10 11 12 13 14 15 16 17 18 19

20 22 24 26 28 30 32 34 36 38 40 45 50 55

60 65 70 75 80 More than 80

**27. What is your race?**

_____ White, not of Hispanic origin
_____ White, of Hispanic origin
_____ Black or African-American
_____ Asian or Pacific Islander
_____ Native American Indian
_____ Other

**Please use the space below for any additional comments you may wish to make.**

## Thank You For Your Time and Effort!

**To return this questionnaire, simply seal it (postage has been provided) and drop it in the nearest mailbox.**

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# APPENDIX D:

## Tests for Nonresponse Bias and Calculations for Nonresponse Adjustments

Table D-1. Tests for Nonresponse Bias.

| Questions | Respondents Percent | Respondents n | Nonrespondents Percent | Nonrespondents n |
|---|---|---|---|---|
| Fish in 1991? | | | | |
| No | 8.1 | 82 | 16.0 | 16 |
| Yes | 91.9 | 927 | 84.0 | 84 |
| | ($\chi^2$ = 7.0, df = 1, P = .05) | | | |
| Heard About Health Advisories? | | | | |
| No | 10.2 | 97 | 20.0 | 20 |
| Yes | 89.8 | 856 | 80.0 | 80 |
| | ($\chi^2$ = 8.8, df = 1, P = .05) | | | |
| Eat Less Fish Now Because of Advisory (Note: A different sequence of questions used on each survey.) | | | | |
| No | 75.5 | 552 | 67.5 | 54 |
| Yes | 24.5 | 179 | 32.5 | 26 |
| | NS | | | |
| Fewer Trips Due to Advisory (Note: A different sequence of questions used on each survey.) | | | | |
| No | 93.7 | 685 | 91.2 | 73 |
| Yes | 6.3 | 46 | 8.8 | 7 |
| | NS | | | |
| Health Advisory Provides Enough Information | | | | |
| No | 18.6 | 166 | 8.7 | 7 |
| Yes | 53.1 | 474 | 68.8 | 55 |
| Not Sure | 28.3 | 252 | 22.5 | 18 |
| | ($\chi^2$ = 8.2, df = 2, P = .05) | | | |
| Chemicals Are Found In Greater Amounts in Fatty Fish Than in Lean Fish | | | | |
| No | 2.6 | 23 | 2.5 | 2 |
| Yes | 63.4 | 569 | 66.2 | 53 |
| Not Sure | 34.0 | 306 | 31.3 | 25 |
| | NS | | | |
| Max. Meals Recommended By State | | | | |
| Correct | 26.2 | 259 | 26.0 | 26 |
| Incorrect | 46.6 | 460 | 46.0 | 46 |
| Don't Know | 27.2 | 268 | 28.0 | 28 |
| | NS | | | |
| Health Risks Minor Compared With Other Risks | | | | |
| Agree | 43.3 | 410 | 56.3 | 54 |
| Neutral | 21.9 | 207 | 2.0 | 2 |
| Disagree | 26.2 | 248 | 16.7 | 16 |
| Don't Know | 8.6 | 82 | 25.0 | 24 |
| | ($\chi^2$ = 46.3, df = 3, P = .05) | | | |
| Would Eat More Sport-Caught Fish If Health Risks Didn't Exist | | | | |
| Agree | 63.1 | 594 | 28.1 | 27 |
| Neutral | 15.4 | 145 | 32.3 | 31 |
| Disagree | 15.2 | 143 | 36.5 | 35 |
| Don't Know | 6.3 | 59 | 3.1 | 3 |
| | ($\chi^2$ = 56.8, df = 3, P = .05) | | | |

Table D-1. (cont.)

| Questions | Respondents Percent | Respondents n | Nonrespondents Percent | Nonrespondents n |
|---|---|---|---|---|
| Sex | | | | |
| Male | 85.5 | 876 | 76.0 | 76 |
| Female | 14.5 | 148 | 24.0 | 24 |
| | ($\chi^2$ = 6.4, df = 1, P = .05) | | | |
| | Mean | n | Mean | n |
| Average # Days Fish in 1991 (for those who fished) | 27.0 | 917 | 15.6 | 84 |
| | (t = 4.4, P = .05, df = 999) | | | |
| Average # Sport-Caught Fish Meals in 1991 | 20.4 | 716 | 7.6 | 99 |
| | (t = 5.0, P = .05, df = 813) | | | |
| Age | 42.7 | 1,023 | 39.1 | 98 |
| | (t = 3.3, P = .05, df = 1,119) | | | |

Calculations to Account for Nonresponse Bias

From the original sample of 2,000, 51 were undeliverable, 1,030 responded, and the rest (919) were nonrespondents. From the nonrespondents, 100 were interviewed by telephone. We assume that those interviewed by telephone are representative of all nonrespondents. Undeliverable surveys will be dropped from the analysis here because we know nothing specific about their fishing behavior and we assume that they are similar to the general angling public.

The following calculations were made to estimate the percentage of the survey population (respondents and nonrespondents) responding in each category.

| | n | x | Percent Aware of Health Advisory | = | n Aware of Health Advisory |
|---|---|---|---|---|---|
| Respondents | 1,030 | | 89.8 | | 925 |
| Nonrespondents | 919 | | 80.0 | | 735 |
| Total | 1,949 | | 85.2 | | 1 660 |

| | n | x | Percent Eat More If No Contaminants | = | n Eat More If No Contaminants |
|---|---|---|---|---|---|
| Respondents | 1,030 | | 63.1 | | 650 |
| Nonrespondents | 919 | | 28.1 | | 258 |
| Total | 1,949 | | 46.6 | | 908 |

| | n | x | Mean Number of Sport-Caught Fish Meals | = | Total Number of Sport-Caught Meals |
|---|---|---|---|---|---|
| Respondents | 1,030 (n=716 who answered question) | | 20.4 | | 14,606 |
| Nonrespondents | 919 | | 7.6 | | 6,984 |
| Total | 1,949 | | 11.1 | | 21,590 |