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March 1, 1996

Mr. Kevin Garrahan
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National Center for Environmental Assessment
USEPA
401 M Street S.W.
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RE: RESULTS OF ADDITIONAL MAINE ANGLER SURVEY ANALYSES

Dear Mr. Garrahan:

This letter summarizes the results of analyses conducted on the 1990 Maine Angler Survey data in response to questions raised during our meeting in Portland last fall.

Information on the Top Ten Percent Consumers of Fish in the Maine Angler Survey

At our meeting, you and your colleagues raised several questions related to whether the anglers with the highest consumption rates had characteristics identifying them as a cohesive subpopulation. To address these questions, we compared angling behavior, demographic characteristics, and advisory awareness for the top ten percent consumers (hereafter referred to as the high consumers) to the remaining 90 percent (hereafter referred to as the remaining consumers). This comparison was performed for both the *all waters* and *rivers/streams* fish consumption rates. We also examined the ratings of site characteristics important to fishing location choice for the high consumers and compared them to the ratings of remaining anglers.

Tables 1 and 2 compare angling behavior between high consumers of fish from all waters and from rivers/streams, respectively. Although the high consumers in both cases generally took more fishing trips, distances traveled to preferred fishing locations were similar (i.e., approximately 30 miles on average) between consumer groups. The high consumers from all waters tended to be much more avid ice anglers than any of the other consumer groups.

Tables 3 and 4 summarize demographic characteristics for high consumers and remaining consumers for both all waters and rivers/streams, respectively. The information presented regarding employment status, educational attainment, ethnicity, and income level is focused on those characteristics that might be relevant to identifying a subpopulation dependent on freshwater fishing for food. No substantial differences were noted between high consumer and remaining consumer groups. While high

rivers/streams consumers were nearly three times as likely to be only seasonally employed, and there was a larger fraction of Native Americans among the high consumers, consumption rates for these groups were not clustered separately from other employment or ethnic groups within the high consumer group. Similarly, although there was a greater representation of households with incomes less than \$10,000 per year in the high consumer groups than in the remaining consumer groups, we observed no relationship between income and consumption rates within the groups.

Analysis of responses to questions about fish consumption advisories suggest that the high consumers are better informed than the remaining consumers, as shown in Tables 5 and 6 for all waters and rivers/streams, respectively. Awareness of advisories was greater among high consumers, and a larger fraction of high consumers fished from advisory locations than did remaining consumers, but a majority of all consumers modify their consumption behavior for fish from advisory waters. However, it must be remembered that of the approximately 37,000 miles of rivers, streams, and brooks in Maine, only 200 miles of mainstream, warmwater rivers had any history of pollution or advisories issued at the time of the survey. Not only was just a small portion of available bodies of water affected, but also, the availability of nearby alternative fishing locations makes it unlikely that the survey was biased by angling suppression. Figures 1 and 2 for high consumers from all waters and rivers/streams, respectively, present flow diagrams of awareness of, and behavioral responses to, advisories for these consumer groups. Figures 1 and 2 further support the results in Tables 5 and 6.

A review of the high consumers' responses concerning their preferred fishing locations did not reveal any clumping of preferred locations and revealed only infrequent mention of locations potentially covered under advisories applicable in 1990. For example, the 35 high anglers indicating preferred fishing locations reported 33 different first choices, and only one of these may have been covered by an advisory ("Kennebec River").

To further investigate high consumer's choice of fishing locations, we examined their ratings of important site characteristics. Figures 3 and 4 present the results for all waters and rivers/streams high consumers, respectively. While high consumers from both rivers/streams and all waters ranked the factors related to the productivity of the body of water as being important, they also highly ranked factors which suggest fishing is a pleasurable experience. For example, the highest rankings were given to factors such as presence of desirable fish species, beauty of the surrounding area, the type of waterbody, and the presence of few other anglers. These factors suggest that the high consumers select bodies of water based on recreational objectives. Conversely, factors that one might anecdotally associate with angling as a subsistence activity were consistently among the factors rated as not important. Examples of these factors include proximity to camp, proximity to home, ease of fishing from shore, and easy access from a road.

Overall, we found little evidence that the anglers with consumption rates at or above the 90th percentile are distinguishable from other consumers by factors other than consumption rates. These results suggest that the high consumers from the 1990 Maine Angler Survey do not constitute a cohesive, identifiable subpopulation. Furthermore, the high consumers tended to identify favorable recreational factors as more important influences upon their choice of angling location than were those factors related to reliable provision of food.

Further Information on Effects of Fish Consumption Advisories

The effect of fish consumption advisories on consumption rates was also raised at our meeting. As mentioned earlier in this discussion, only 200 of 37,000 possible miles of Maine rivers, streams, and brooks have a history of industrial pollution that have led to advisories. Out of a total of 748 fishing locations identified by respondents, only 27 were at potentially impacted waters. In addition, no individual angler identified only potentially impacted locations as his or her top five preferred fishing locations.

Figure 5 presents a flow diagram analogous to Figures 1 and 2 that charts the awareness of 1990 Maine Angler Survey respondents to the presence of fish consumption advisories as well as the respondents' behavioral responses to these advisories. Of the 35 percent who were aware of advisories, 27 percent fished at an advisory location. Seventy-four percent of those who fished advisory waters modified their behavior with respect to consuming fish from these locations as a result of the advisory. Only 18 percent of those aware of advisories would have fished additional waters in absence of advisories. Together, these responses suggest that advisories are largely effective in Maine among those who are aware of them. However, the presence of advisories does not substantially limit fishing effort, due to the very limited stretches of advisory waters compared to fishable waters and the observation that no anglers preferred only advisory locations as preferred fishing spots.

Potential for Nonresponse and Complexity-Related Biases

As we discussed during our meeting, the 1990 Maine Angler Survey did not have a component to follow-up with nonrespondents. Our survey enjoyed a high (64 percent) response rate and thus the potential for nonresponse bias is less of a concern than for surveys with lower response rates. It is our belief that if nonresponse follow-up had been conducted, then our final consumption rate estimates would have been adjusted downward if at all. Research has demonstrated that response rates tend to be positively correlated with the salience of an issue to respondents (Haberlein and Baumgartner, 1978). Other recreational surveys indicate that nonrespondents have lower participation rates than respondents (e.g., Brown and Wilkins, 1978; Connelly et al., 1990, 1992; West et al., 1989, West, P.C., 1991; Tarrant and Manfredo, 1993). This evidence suggests that if nonrespondents to the 1990 Maine Angler Survey were different than respondents, then it would have been due to their lesser interest and/or participation in angling and fish consumption.

Having conducted an in-depth consideration of these issues, we are convinced that the anglers who responded to the 1990 Maine Angler Survey are representative of Maine anglers in general. Prior to our 1990 survey, two other mail surveys of Maine anglers were conducted in a largely similar manner. Table 2 of the July 1992 survey report compares respondent characteristics among these three surveys. Each survey was based on random samples and, as illustrated by Table 2, each shared similar respondent characteristics. As described in the July 1992 report, a survey pretest was conducted to assess survey difficulty and complexity among potential respondents, and the final survey instrument was refined following the pretest effort. Based on these facts, we believe that the respondents to the 1990 Maine Angler Survey were representative of Maine anglers characterized in previous angler surveys, despite the added length and complexity of the 1990 survey as compared to the previous angler surveys.

Paul White raised the question of whether the format of detailed questions about numbers and length of fish caught and consumed (e.g., Questions 11, 24, 29, and 31) might have proved too difficult or

challenging for respondents and, as a result, whether anglers might begin but not complete answering these questions. Were this to occur, then fish consumption rates might be underestimated using our analysis procedure. Based on the results of the survey pretest and the results presented in Table 4 of the July 1992 report, we do not believe that this form of complexity-related underreporting or associated bias is present in survey results. The species listing order in Table 4 corresponds to the species order in the relevant survey questions. Were there a systematic effect due to respondents only partially completing the questions, then the consumed quantities by species in Table 4 might show a decreasing trend moving down the species list. No such trend is noted. Furthermore, the species identified and the relative numbers consumed across species and fishing modes correspond to expectations for Maine anglers (e.g., smelt, white perch, and brook trout being the most-consumed species from ice fishing, lakes/ponds, and rivers/streams, respectively).

Use of Average Fish Length to Calculate Consumable Mass

Paul White also raised the question of whether our use of *average* fish length data might cause us to underestimate consumable mass due to the nonlinearity in length-weight relationships for fish species. Although we cannot know whether an underestimate of this nature could have occurred, we can investigate its potential for having a significant affect on consumption estimates.

For such an underestimate to occur, the sizes of consumed fish would have to vary about the reported average, and thus consumption of more than one fish per species would have to have been reported. The majority of anglers reported consumption of 10 fish or less of any particular species. For such an underestimate to be significant, variance in fish size would have to be relatively large. In general, for the species included in the survey, an increase of length on the order of 25 percent is required to generate an increase in mass of 100 percent. Considering that, to maintain the same average, an increase in length evaluated for some fish would be compensated partially by the decreases in length for remaining fish, then the effective increase in mass would be more on the order of 40 percent if actual consumed fish lengths varied over a range of 50 percent of the reported length. We would be pleased to share the details of this analysis with Paul White if requested.

It is also possible that respondents provided lengths in the form of modes rather than averages, i.e., the reported "average" lengths are actually the most commonly eaten length rather than a true average of lengths. If this were the case, then the number of fish consumed that were of different lengths than the reported "average" would be relatively small.

Potential for Suppression of Freshwater Angling and Consumption Due to Marine Alternative

Paul White also raised the question of whether freshwater fish consumption rates were low in Maine due to the presence of the marine angling and consumption alternative. Because the 1990 Maine Angler Survey did not ask questions regarding marine angling practices, this question is difficult to answer directly. However, freshwater angling is extremely popular in Maine. In 1990, Maine issued freshwater fishing licenses to 203,160 residents. Assuming that 75 percent of those resident licensees are male (per 1990 Maine Angler Survey results), then approximately half of Maine's 297,387 males over 18 (1990 data) are licensed anglers. Furthermore, because there are bountiful suitable locations statewide, consumption of freshwater fish would likely be limited only by angler skill, angler avidity, and presence of desirable species.

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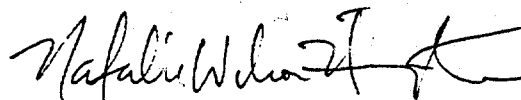
Certainly, marine fish species are widely available in markets across the state, but no data are available on consumption rates for self-caught fish. It is also not the case that marine fish are readily caught at shore-based locations in Maine's major population centers. While the Maine Department of Marine Resources does not have data for participation rates in marine angling, anecdotally it is believed that in the more densely populated southern part of the state, marine anglers are attracted to charter boat fishing, while most areas north of Rockland are popular dock-fishing sites (personal communication, Lt. LaHaye, Maine Department of Marine Resources).

We sincerely trust that these additional analyses and our discussion of the points you and your colleagues raised concerning the Maine Angler Survey have addressed your questions. Please contact us if additional clarification is needed.

Sincerely,



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Table 1

Comparison of Angling Behavior Between Consumer Groups: All Waters

	Consumed Fish at <90th Percentile Rate	Consumed Fish at ≥90th Percentile Rate
Number in Group	940	113
Median Number of Ice Fishing Trips	0	10
Median Number of Rivers/Streams Fishing Trips	2	7
Median Number of Ponds/Lakes Fishing Trips	6	15
Median of Average Days Spent Fishing at Preferred Locations	5	7
Median of Average Distance Traveled to Preferred Fishing Locations (miles)	30	30

Table 2

Comparison of Angling Behavior Between Consumer Groups: Rivers/Streams

	Consumed Fish at <90th Percentile Rate	Consumed Fish at ≥90th Percentile Rate
Number in Group	418	46
Median Number of Ice Fishing Trips	1	0
Median Number of Rivers/Streams Fishing Trips	6	12
Median Number of Ponds/Lakes Fishing Trips	10	22
Median of Average Days Spent Fishing at Preferred Locations	5	8
Median of Average Distance Traveled to Preferred Fishing Locations (miles)	29	27

Table 3
Demographic Comparison Between Consumer Groups: All Waters

	Consumed Fish at <90th Percentile Rate	Consumed Fish at ≥90th Percentile Rate
Number in Group	940	113
Percent Male	78	83
Median Age	41	38
Modal ^a Employment Status	Employed Full-Time (62%)	Employed Full-Time (60%)
Percent Seasonally Employed	4	6
Percent Unemployed	3	3
Percent Retired	15	15
Modal ^b Educational Attainment	High School Graduate (32%)	High School Graduate (39%)
Percent White	89	86
Percent Native American	9	13
Percent with Household Income Less than \$10,000 per year	8	15
Median Annual Household Income	\$30,000-\$39,999	\$20,000-\$29,999

a. Of eight possible response categories for this variable, the modal group is the group with the largest representation among the response categories. The percentage refers to the relative size of this group.

b. Of nine possible response categories for this variable, the modal group is the group with the largest representation among the response categories. The percentage refers to the relative size of this group.

Table 4

Demographic Comparison Between Consumer Groups: Rivers/Streams

	Consumed Fish at <90th Percentile Rate	Consumed Fish at ≥90th Percentile Rate
Number in Group	418	46
Percent Male	86	76
Median Age	38	37
Modal ^a Employment Status	Employed Full-Time (69%)	Employed Full-Time (63%)
Percent Seasonally Employed	4	11
Percent Unemployed	2	2
Percent Retired	11	13
Modal ^b Educational Attainment	High School Graduate (32%)	High School Graduate (35%)
Percent White	89	85
Percent Native American	9	15
Percent with Household Income Less than \$10,000 per year	6	17
Median Annual Household Income	\$20,000-\$29,999	\$20,000-\$29,999

a. Of eight possible response categories for this variable, the modal group is the group with the largest representation among the response categories. The percentage refers to the relative size of this group.

b. Of nine possible response categories for this variable, the modal group is the group with the largest representation among the response categories. The percentage refers to the relative size of this group.

Table 5

Knowledge About and Reactions to Fish Consumption
Advisories Between Consumer Groups: All Waters

	Consumed Fish Rate <90th Percentile	Consumed Fish Rate ≥90th Percentile
Number in Group	940	113
Percent Aware of Advisories	38	46
Percent of Those Aware Who Fished at an Advisory Location	27	40
Percent of Those Aware for Whom Advisories Affect Whether they Eat Fish from Advisory Locations	82	81
Percent of Those Aware Who Would Fish Additional Waters in Absence of Advisories	20	30

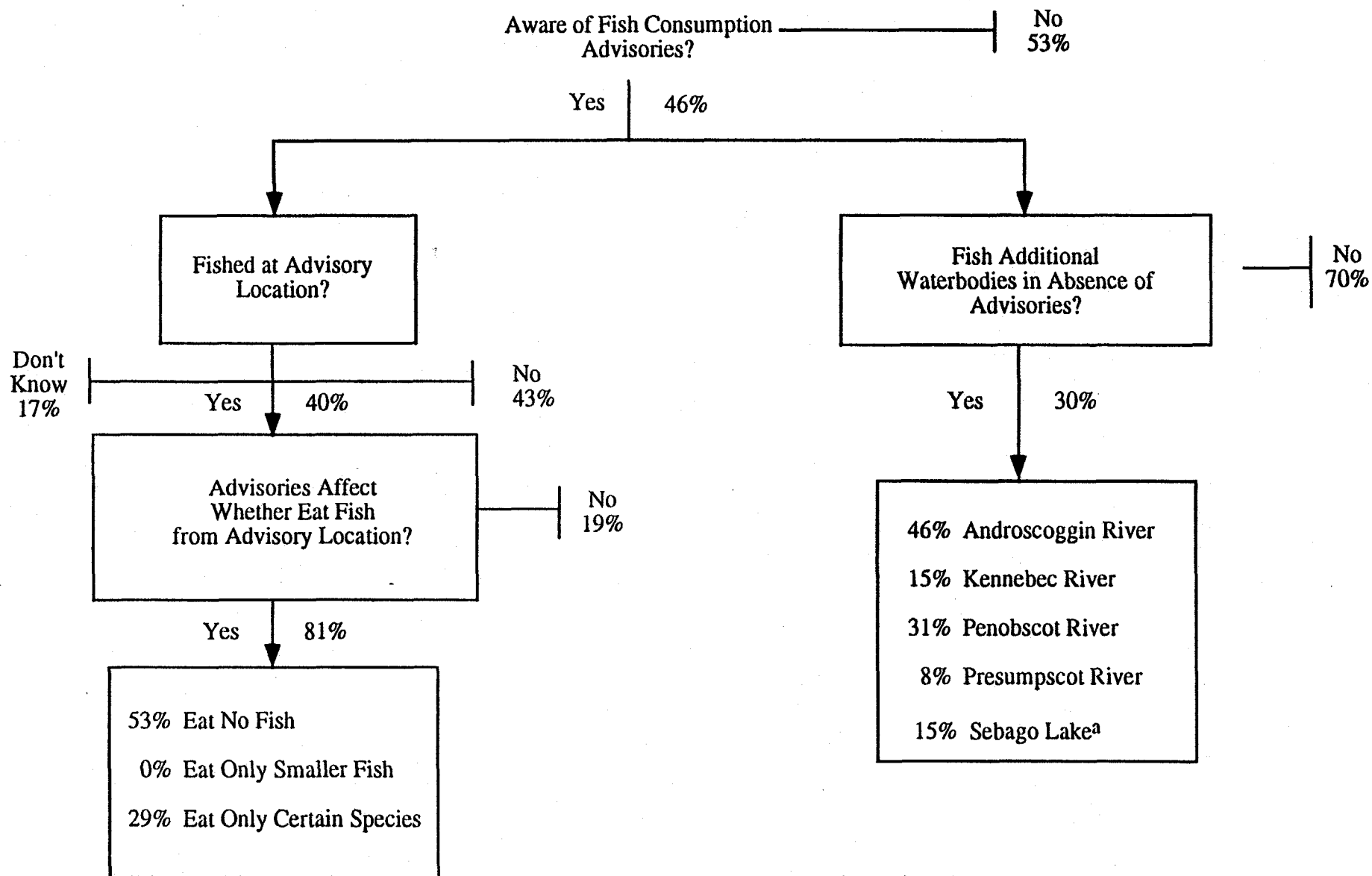
Table 6

**Knowledge About and Reactions to Fish Consumption
Advisories Between Consumer Groups: Rivers/Streams**

	Consumed Fish Rate <90th Percentile	Consumed Fish Rate ≥90th Percentile
Number in Group	418	46
Percent Aware of Advisories	42	52
Percent of Those Aware Who Fished at an Advisory Location	30	50
Percent of Those Aware for Whom Advisories Affect Whether they Eat Fish from Advisory Locations	78	100
Percent of Those Aware Who Would Fish Additional Waters in Absence of Advisories	22	32

Figure 1

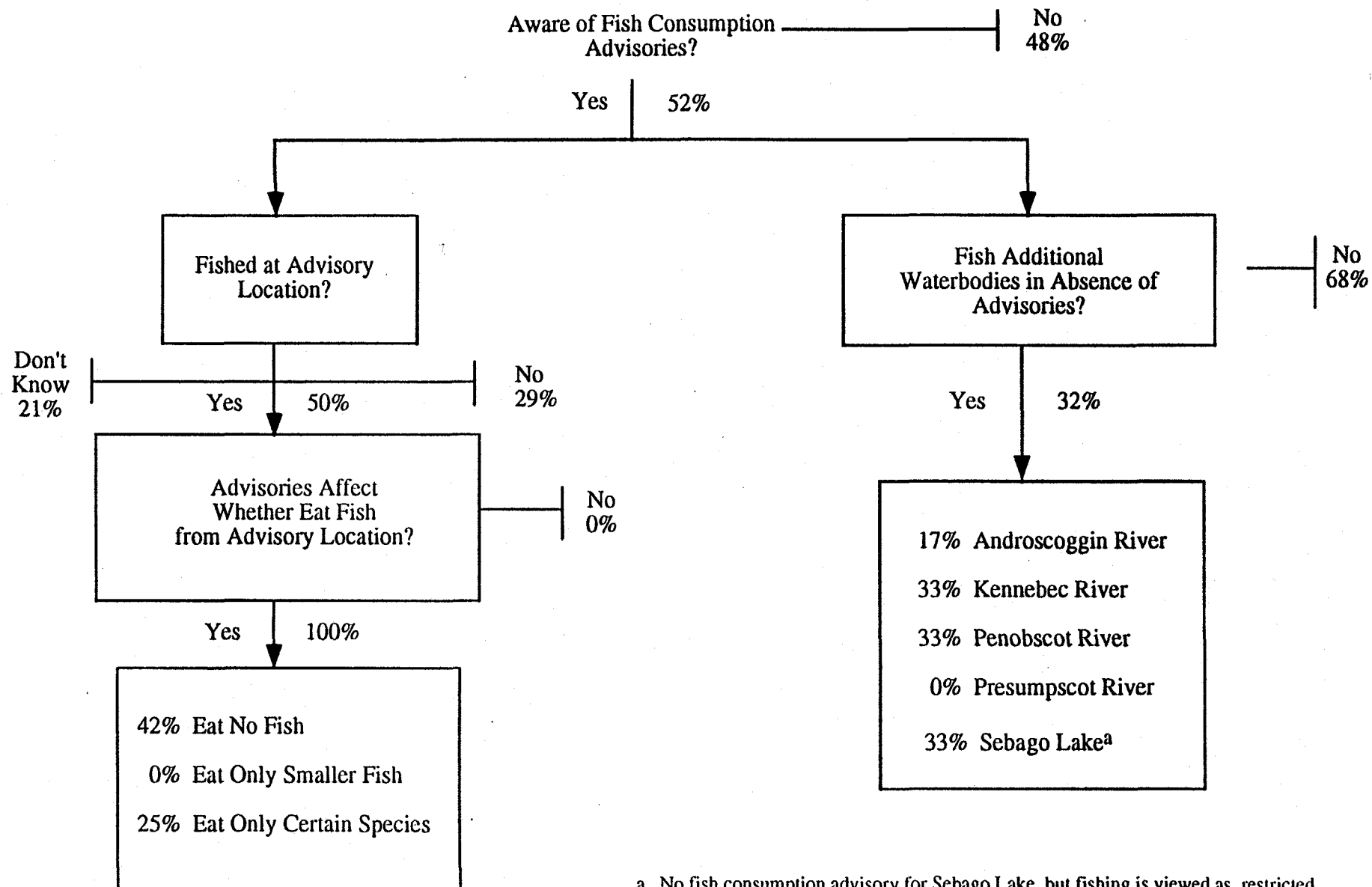
Awareness of and Behavior Responses to Fish Consumption Advisories High Consumers from All Waters



a. No fish consumption advisory for Sebago Lake, but fishing is viewed as restricted because no fishing is allowed in the protected watershed area.

Figure 2

Awareness of and Behavior Responses to Fish Consumption Advisories High Consumers from Rivers/Streams



a. No fish consumption advisory for Sebago Lake, but fishing is viewed as restricted because no fishing is allowed in the protected watershed area.

Figure 3

**Rating of Site Characteristics Important to Fishing Location
Choice Among High Consumers of All Waters Fish Consumers**

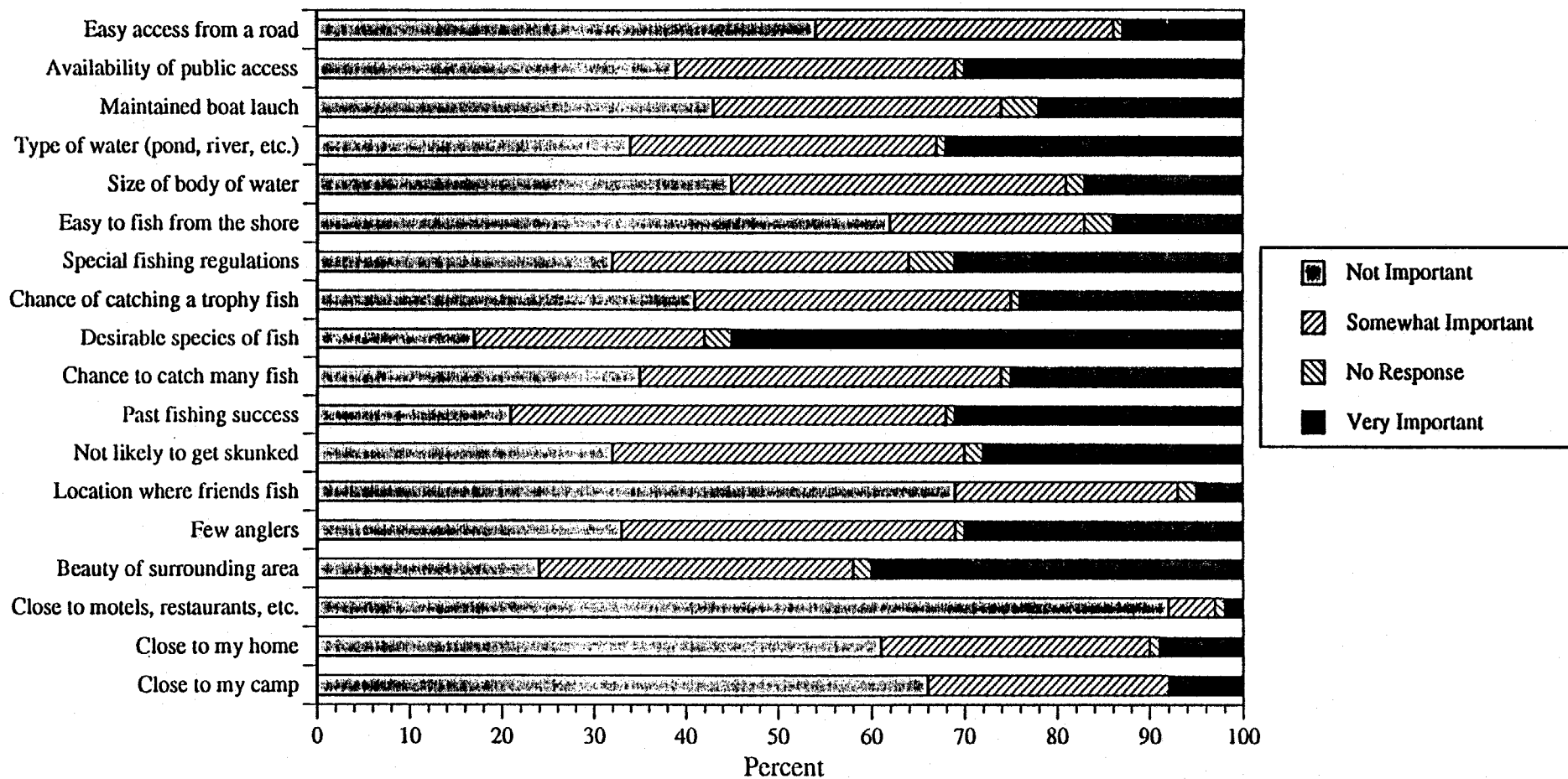
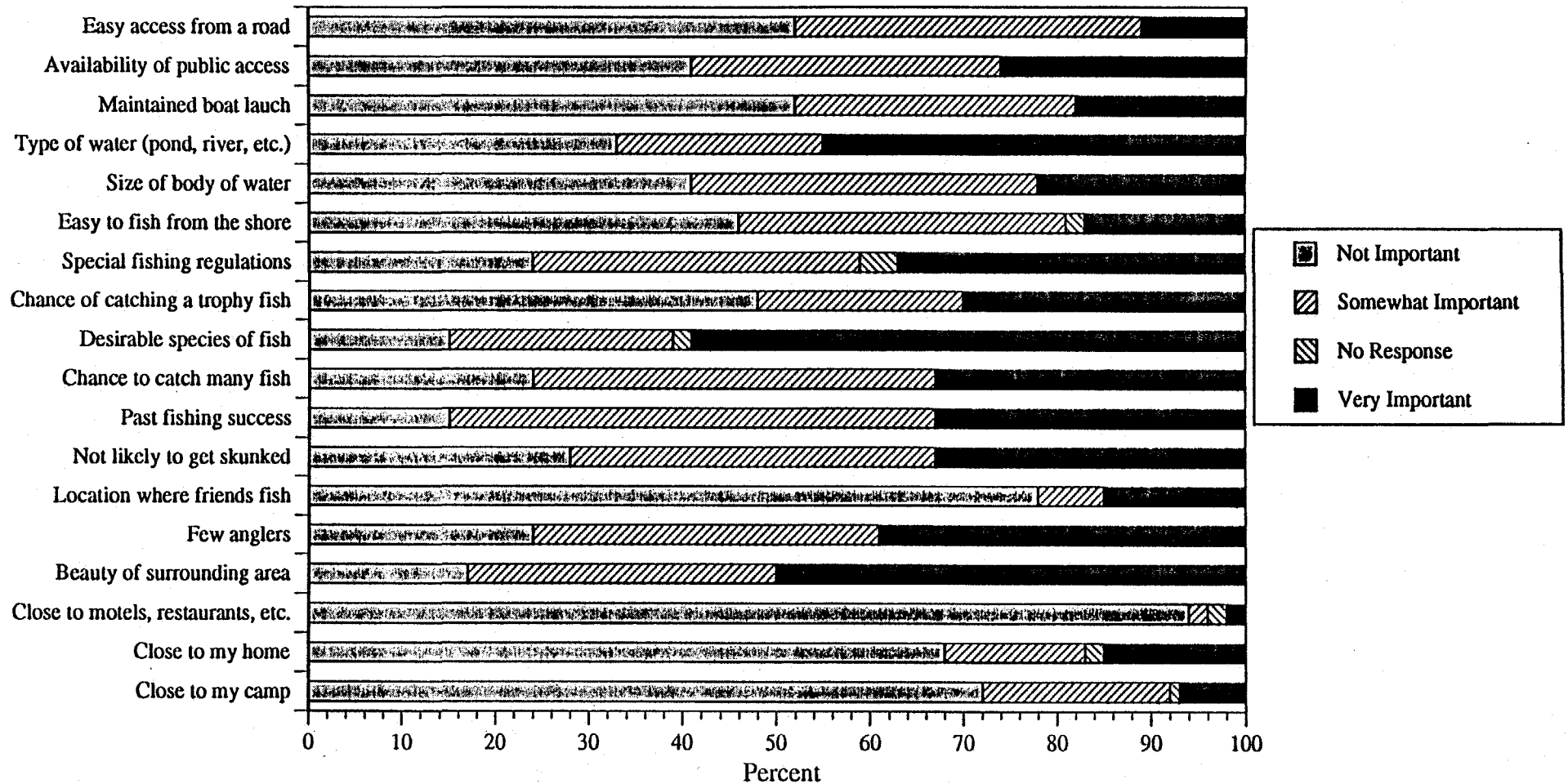


Figure 4

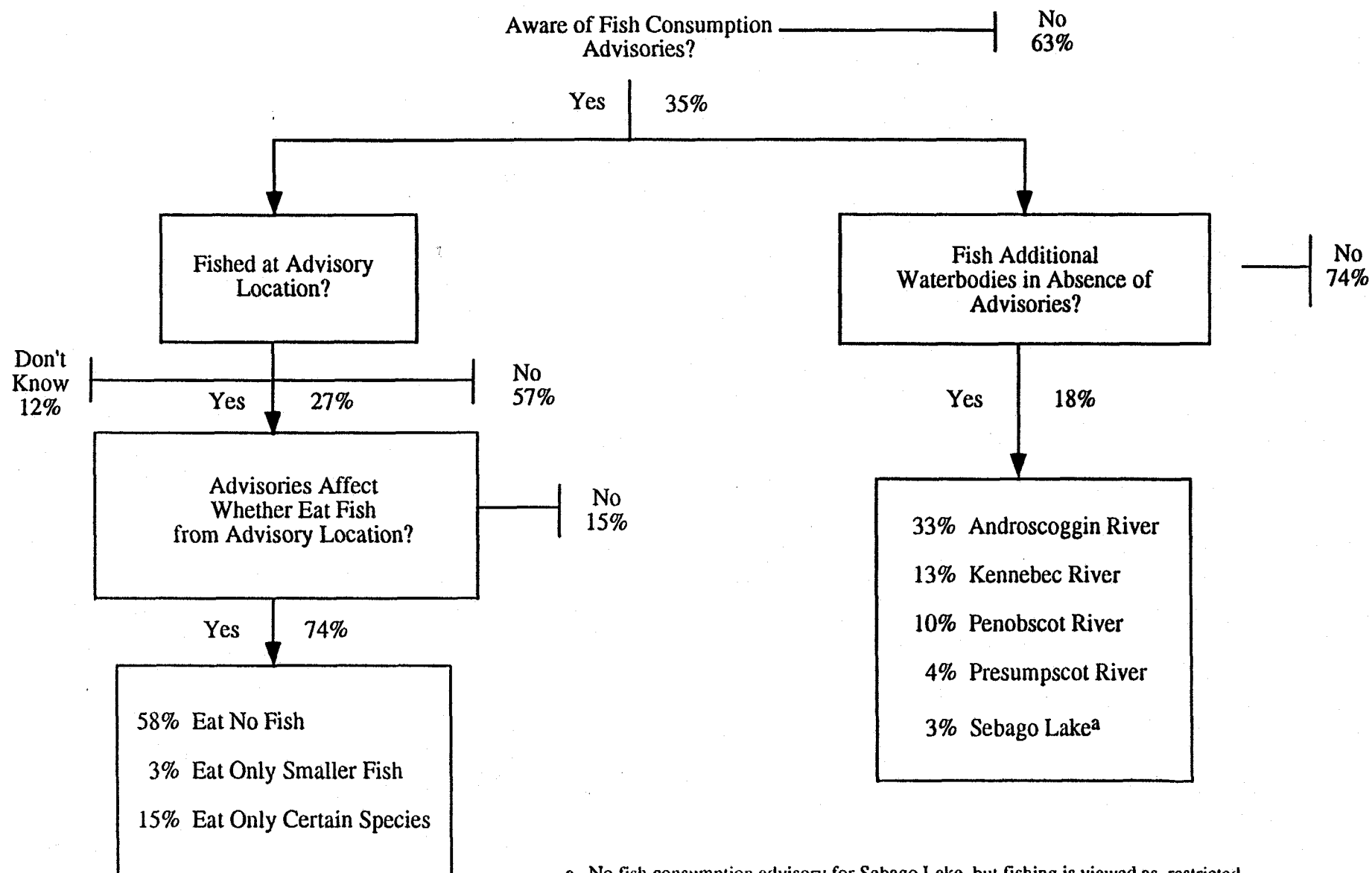
Rating of Site Characteristics Important to Fishing Location
Choice Among High Consumers of Rivers/Streams Fish Consumers



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Figure 5

Awareness of and Behavior Responses to Fish Consumption Advisories All Survey Respondents



a. No fish consumption advisory for Sebago Lake, but fishing is viewed as restricted because no fishing is allowed in the protected watershed area.