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10. INTAKE OF FISH AND SHELLFISH

10.1. INTRODUCTION

Contaminated finfish and shellfish are potential sources of human exposure to toxic chemicals. Pollutants are carried in the surface waters but also may be stored and accumulated in the sediments as a result of complex physical and chemical processes. Finfish and shellfish are exposed to these pollutants and may become sources of contaminated food if the contaminants bioconcentrate in fish tissue or bioaccumulate through the food chain. Some chemicals (e.g., polychlorinated biphenyls and dioxins) are stored in fatty tissues, while others (e.g., mercury and arsenic) are typically found in the non-lipid components.

Accurately estimating exposure to toxic chemicals in fish requires information about the nature of the exposed population (i.e., general population, recreational fishermen, subsistence fishers) and their intake rates. For example, general population intake rates may be appropriate for assessing contaminants that are widely distributed in commercially caught fish. However, these data may not be suitable to estimate exposure to contaminants in a particular water source among recreational or subsistence fishers. Because the catch of recreational and subsistence fishermen is not "diluted" by fish from other water bodies, these individuals and their families represent the population that is most vulnerable to exposure by intake of contaminated fish from a specific location. Subsistence fishermen are those individuals who consume fresh caught fish as a major source of food. Their intake rates are generally higher than those of the general population. It should be noted that, depending on the study, the data presented in this chapter for Native American populations may or may not reflect subsistence fishing. Harper and Harris (2008), and Donatuto and Harper (2008) describe some difficulties associated with evaluating fish intake rates among Native American subsistence populations. For example, Donatuto and Harper (2008) suggest that contemporary Native American subsistence intake rates may be lower (i.e., suppressed) compared to heritage rates. Also, the intake rates among certain subsets of the Native American populations may be higher than the rate for the average Native American (Donatuto and Harper, 2008; Harper and Harris, 2008).

This chapter focuses on intake rates of fish. Note that in this section the term fish refers to both finfish and shellfish, unless otherwise noted. Intake rates for the general population, and recreational and Native American fishing populations are addressed, and data are presented for intake rates for both marine and freshwater fish, when available. The general population studies in this chapter use the term consumer-only intake when referring to the quantity of fish and shellfish consumed by individuals during the survey period. These data are generated by averaging intake across only the individuals in the survey who consumed fish and shellfish. Per capita intake rates are generated by averaging consumer-only intakes over the entire survey population (including those individuals that reported no intake). In general, per capita intake rates are appropriate for use in exposure assessments for which average dose estimates are of interest because they represent both individuals who ate the foods during the survey period and individuals who may eat fish at some time but did not consume it during the survey period. Per capita intake, therefore, represents an average across the entire population of interest but does so at the expense of underestimating consumption for the population of fish consumers. Similarly, the discussions regarding recreationally caught fish consumption use the terms "all respondents" and "consuming anglers." "All respondents" represents both survey individuals/anglers who ate recreationally caught fish during the survey period and those that did not but may eat recreationally caught fish during other periods. "Consuming anglers" refers only to the individuals who ate fish during the survey period.

The determination to use consumer-only or per capita estimates of fish consumption in exposure assessments depends on the purpose of the assessment and on the source of the data. Both approaches can be a source of valuable insights on analyses of exposure and risk related to consumption of fish. This is because in the overall population, fish is not a frequently consumed item, and quantities may be relatively small, while in some populations, fish is consumed frequently and in large quantities. Nationwide surveys of food intake such as the Continuing Survey of Food Intake by Individuals (CSFII) or the National Health and Nutrition Examination Survey (NHANES) provide objective measures of food consumption that by design include overall, population-based estimates of fish consumption. The data from the CSFII or NHANES can be analyzed in terms of overall per capita consumption or consumers only. Although the CSFII and NHANES data are collected over short time periods, the large scale nature and design of such studies offer substantial advantages. In exposure analysis and risk assessment applications where fish intake is a concern, usually consumer-only data are of greater interest because of the relative infrequency of

fish consumption. Both approaches are a source of valuable insights and help to provide context for the results from specialized surveys that typically focus on fish consumption. Specialized surveys are done for a variety of reasons using different methodologies that typically focus on relatively small, high-fish consuming groups. It may be important to know how results based on small, high consuming groups compare to overall estimates of consumption based on per capita data and consumer-only data. The data presented in this chapter come from a variety of sources and were collected using various methodologies. Some data come from creel surveys where fishermen are usually asked, among other things, how much they have caught and the number of family members with which they will share their catch. These data will not represent usual behavior because one cannot assume that the angler will have the same luck over time. In all likelihood, there will be variation in the amounts caught and consumed by anglers that should be considered. Other data come from mail surveys or personal or phone interviews where participants are asked to recall how much fish each family member eats over a certain period of time. In some cases, data are recorded by survey participants in a food diary. Some surveys may ask about frequency of consumption, but not the amount. Frequency of consumption data can be combined with information on amount consumed per eating occasion to estimate consumption. The recall period determines if the survey characterizes long-term (i.e., usual intake) or short-term consumption. Exposure assessors are generally interested in estimates of long-term behaviors, but longer recall periods are associated with generally higher reporting error that should be considered. If the data come from a survey where long-term or usual intake is characterized (i.e., how often does someone eat fish in a year?), then consumer-only estimates may capture day-to-day variability in consumption. On the other hand, if the survey instrument used to collect the data characterizes short-term consumption (e.g., how much was eaten in a week, how much was consumed on a particular day), then a per capita estimate may account for the fact that individuals who are not consumers during the survey period may consume fish at some point over a longer time period. Using consumer-only data from short-term surveys may tend to overestimate consumption over the long term, especially at the high end, because it would not include days where respondents do not consume fish. Overestimates of consumption could, however, be considered conservative with regard to intake of contaminants and, thus, provide the basis for measures protective of human health.

The U.S. Environmental Protection Agency (EPA) has prepared a review of and an evaluation of five different survey methods used for obtaining fish consumption data. They are

- Recall-Telephone Survey,
- Recall-Mail Survey,
- Recall-Personal Interview,
- Diary, and
- Creel Census.

Refer to U.S. EPA (1998) *Guidance for Conducting Fish and Wildlife Consumption Surveys* for more detail on these survey methods and their advantages and limitations. The type of survey used, its design, and any weighting factors used in estimating consumption should be considered when interpreting survey data for exposure assessment purposes. For surveys used in this handbook, respondents are typically adults who have reported on fish intake for themselves and for children living in their households.

Generally, surveys are either "creel" studies in which fishermen are interviewed while fishing, or broader population surveys using either mailed questionnaires or phone interviews. Both types of data can be useful for exposure assessment purposes, but somewhat different applications and interpretations are needed. In fact, results from creel studies have often been misinterpreted, due to inadequate knowledge of survey principles. Below, some basic facts about survey design are presented, followed by an analysis of the differences between creel and population-based studies.

Typical surveys seek to draw inferences about a larger population from a smaller sample of that population. This larger population, from which the survey sample is taken and to which the results of the survey are generalized, is denoted the target population of the survey. In order to generalize from the sample to the target population, the probability of being sampled must be known for each member of the target population. This probability is reflected in weights assigned to survey respondents, with weights being inversely proportional to sampling probability. When all members of the target population have the same probability of being sampled, all weights can be set to one and essentially ignored. For example, in a mail or phone study of licensed anglers, the target population is generally all licensed anglers in a particular area, and in the studies presented, the sampling probability is essentially equal for all target population members.

In a creel study (i.e., a study in which fishermen are interviewed while fishing), the target population is anyone who fishes at the locations being studied. Generally, in a creel study, the probability of being sampled is not the same for all members of the target population. For instance, if the survey is conducted for 1 day at a site, then it will include all persons who fish there daily, but only about 1/7 of the people who fish there weekly, 1/30 of the people who fish there monthly, etc. In this example, the probability of being sampled (or inverse weight) is seen to be proportional to the frequency of fishing. However, if the survey involves interviewers revisiting the same site on multiple days, and persons are only interviewed once for the survey, then the probability of being in the survey is not proportional to frequency; in fact, it increases less than proportionally with frequency. At the extreme of surveying the same site every day over the survey period with no re-interviewing, all members of the target population would have the same probability of being sampled regardless of fishing frequency, implying that the survey weights should all equal one. On the other hand, if the survey protocol calls for individuals to be interviewed each time an interviewer encounters them (i.e., without regard to whether they were previously interviewed), then the inverse weights will again be proportional to fishing frequency, no matter how many times interviewers revisit the same site. Note that when individuals can be interviewed multiple times, the results of each interview are included as separate records in the database and the survey weights should be inversely proportional to the expected number of times that an individual's interviews are included in the database.

In the published analyses of most creel studies, there is no mention of sampling weights; by default, all weights are set to one, implying equal probability of sampling. However, because the sampling probabilities in a creel study, even with repeated interviewing at a site, are highly dependent on fishing frequency, the fish intake distributions reported for these surveys are not reflective of the corresponding target populations. Instead, those individuals with high fishing frequencies are given too big a weight, and the distribution is skewed to the right, i.e., it overestimates the target population distribution.

Price et al. (1994) explained this problem and set out to rectify it by adding weights to creel survey data; the authors used data from two creel studies (Puffer et al., 1982; Pierce et al., 1981) as examples. Price et al. (1994) used inverse fishing frequency as survey weights and produced revised estimates of median and 95th percentile intake for the above two studies. These revised estimates were dramatically lower than the original estimates. The approach of Price et al. (1994) is discussed in more detail in Section 10.4 where the Puffer et al. (1982) and Pierce et al. (1981) studies are summarized.

When the correct weights are applied to survey data, the resulting percentiles reflect, on average, the distribution in the target population; thus, for example, an estimated 90% of the target population will have intake levels below the 90th percentile of the survey fish intake distribution. There is another way, however, of characterizing distributions in addition to the standard percentile approach; this approach is reflected in statements of the form "50% of the income is received by, for example, the top 10% of the population, which consists of individuals making more than $100,000." Note that the 50th percentile (median) of the income distribution is well below $100,000. Here the $100,000 level can be thought of as, not the 50th percentile of the population income distribution, but as the 50th percentile of the "resource utilization distribution" (see Appendix 10A for technical discussion of this distribution). Other percentiles of the resource utilization distribution have similar interpretations; e.g., the 90th percentile of the resource utilization distribution (for income) would be that level of income such that 90% of total income is received by individuals with incomes below this level and 10% by individuals with income above this level. This alternative approach to characterizing distributions is of particular interest when a relatively small fraction of individuals consumes a relatively large fraction of a resource, which is the case with regards to recreational fish consumption. In the studies of recreational anglers, this alternative approach, based on resource utilization, will be presented, where possible, in addition to the primary approach of presenting the standard percentiles of the fish intake distribution.

The recommendations for fish and shellfish ingestion rates are provided in the next section, along with summaries of the confidence ratings for these recommendations. The recommended values for the general population and for other subsets of the population are based on the key studies identified by U.S. EPA for this factor. Following the recommendations, the studies on fish ingestion among the general population (see Section 10.3), marine recreational angler populations (see Section 10.4), freshwater recreational populations (see Section 10.5), and Native American populations (see Section 10.6) are summarized. Information is provided on the key studies that form the basis for the fish and shellfish intake rate recommendations. Relevant data on ingestion of fish and shellfish are also provided. These studies are presented to provide

the reader with added perspective on the current state-of-knowledge pertaining to ingestion of fish and shellfish among children and adults. Information on other population studies (see Section 10.7), serving size (see Section 10.8), and other factors to consider (see Section 10.9) are also presented.

10.2. RECOMMENDATIONS

Considerable variation exists in the mean and upper percentile fish consumption rates obtained from the studies presented in this chapter. This can be attributed largely to the type of water body (i.e., marine, estuarine, freshwater) and the characteristics of the survey population (i.e., general population, recreational, Native American), but other factors such as study design, method of data collection, and geographic location also play a role. Based on these study variations, fish consumption studies were classified into the following categories:

- General Population (finfish, shellfish, and total fish and shellfish combined);
- Recreational Marine Intake;
- Recreational Freshwater Intake; and
- Native American Populations

For exposure assessment purposes, the selection of intake rates for the appropriate category (or categories) will depend on the exposure scenario being evaluated.

10.2.1. Recommendations—General Population

Fish consumption rates are recommended for the general population, based on the key study presented in Section 10.3.1. The key study for estimating mean fish intake among the general population is the U.S. EPA analysis of data from the Centers for Disease Control and Prevention (CDC) NHANES 2003–2006.

Table 10-1 presents a summary of the recommended values for per capita and consumer-only intake of finfish, shellfish, and total finfish and shellfish combined. Table 10-2 provides confidence ratings for the fish intake recommendations for the general population. The U.S. EPA analysis of 2003–2006 NHANES data was conducted using childhood age groups that differed slightly from U.S. EPA's *Guidance on Selecting Age Groups for Monitoring and Assessing Childhood Exposures to Environmental Contaminants* (U.S. EPA, 2005). However, for the purposes of the recommendations presented here, data were placed in the standardized age categories closest to those used in the analysis.

Note that the fish intake values presented in Table 10-1 are reported as uncooked fish weights. Recipe files were used to convert, for each fish-containing food, the as-eaten fish weight consumed into an uncooked equivalent weight of fish. This is important because the concentrations of the contaminants in fish are generally measured in the uncooked samples. Assuming that cooking results in some reductions in weight (e.g., loss of moisture), and the mass of the contaminant in the fish tissue remains constant, then the contaminant concentration in the cooked fish tissue will increase.

In terms of calculating the dose (i.e., concentration times weight), actual consumption may be overestimated when intake is expressed on an uncooked basis, but the actual concentration may be underestimated when it is based on the uncooked sample. The net effect on the dose would depend on the magnitude of the opposing effects on these two exposure factors. On the other hand, if the "as-prepared" (i.e., as-consumed) intake rate and the uncooked concentration are used in the dose equation, dose may be underestimated because the concentration in the cooked fish is likely to be higher, if the mass of the contaminant remains constant after cooking. Reported weights are also more likely to reflect uncooked weight, and interpretation of advisories are likely to be in terms of uncooked weights. Although it is generally more conservative and appropriate to use uncooked fish intake rates, one should also be sure to use like measures. That is to say, avoid using raw fish concentrations and cooked weights to estimate the dose. For more information on cooking losses and conversions necessary to account for such losses, refer to Chapter 13 of this handbook.

If concentration data can be adjusted to account for changes after cooking, then the "as-prepared" (i.e., as-consumed) intake rates are appropriate. However, data on the effects of cooking on contaminant concentrations are limited, and assessors generally make the conservative assumption that cooking has no effect on the contaminant mass. The key study on fish ingestion provides intake data based on uncooked fish weights. However, relevant data on both "as-prepared" (i.e., as-consumed) and uncooked general population fish intake are also presented in this handbook. The assessor should choose the intake data that best matches the concentration data that are being used.

The NHANES data on which the general population recommendations are based, are short-term survey data and could not be used to

estimate the distribution over the long term. Also, it is important to note that a limitation associated with these data is that the total amount of fish reported by respondents included fish from all sources (e.g., fresh, frozen, canned, domestic, international origin). The analysis of NHANES survey data used to develop the recommended intake rates in this handbook did not consider the source of the fish consumed. This type of information may be relevant for some assessments.

Recommended values should be selected that are relevant to the assessment, choosing the appropriate age groups and type of fish (i.e., finfish, shellfish, or total finfish, and shellfish). In some cases, a different study or studies may be particularly relevant to the needs of an assessment, in which case, results from that specific study or studies may be used instead of the recommended values provided here. For example, it may be advantageous to use estimates that target a particular region or geographical area, if relevant data are available. In addition, seasonal, sex, and fish species variations should be considered when appropriate, if data are available. Also, relevant data on general population fish intake in this chapter may be used if appropriate to the scenarios being assessed. For example, older data from the U.S. EPA's analysis of data from the 1994–1996 and 1998 CSFII provide intake rates for freshwater/estuarine fish and shellfish, marine fish and shellfish, and total fish and shellfish that are not available from the more recent NHANES analysis.

10.2.2. Recommendations—Recreational Marine Anglers

Table 10-3 presents the recommended values for recreational marine anglers. These values are based on the surveys of the National Marine Fisheries Service (NMFS, 1993). The values from NMFS (1993) are assumed to represent intake of marine fish among adult recreational fishers. Values represent both individuals who ate recreational fish during the survey period and those that did not, but may eat recreationally caught fish during other periods. Age-specific values were not available from this source. However, recommendations for children were estimated based on the ratios of marine fish intake for general population children to that of adults using data from U.S. EPA's analysis of CSFII data from 1994–1996 and 1998 (U.S. EPA, 2002) (see Section 10.3.2.6), multiplied by the adult recreational marine fish intake rates for the Atlantic, Gulf, and Pacific regions, using data from NMFS (1993) (see Section 10.4.1.1). The ratios of each age group to adults >18 years were calculated separately for the means and 95th percentiles. Much of the other relevant data on recreational marine fish intake in this chapter are limited to certain geographic areas and cannot be generalized to the U.S. population as a whole. However, assessors may use the data from the relevant studies provided in this chapter if appropriate to the scenarios being assessed. Table 10-4 presents the confidence ratings for recommended recreational marine fish intake rates.

10.2.3. Recommendations—Recreational Freshwater Anglers

Recommended values are not provided for recreational freshwater fish intake because the available data are limited to certain geographic areas and cannot be readily generalized to the U.S. population of freshwater recreational anglers as a whole (see Figure 10-1). For example, factors associated with water body, climate, fishing regulations, availability of alternate fishable water bodies, and water body productivity may affect recreational fish intake rates. However, data from several relevant recreational freshwater studies are provided in this chapter. Table 10-5 summarizes data from these studies. Assessors may use these data, if appropriate to the scenarios and locations being assessed. Although recommendations are not provided, some general observations can be made. Most of the studies in Table 10-5 represent state-wide surveys of recreational anglers. These include Alabama, Connecticut, Indiana, Maine, Michigan, Minnesota, North Dakota, and Wisconsin. Consumption data from these states would include freshwater fish from rivers, lakes, and ponds. The average range of consumption for all respondents from these states varies from 5 g/day to 51 g/day. Another two studies represent consumption of fish from specific rivers. These included Savannah River in Georgia and The Clinch River in Tennessee. The consumption rates for all respondents from these two rivers ranged from 20 g/day to 70 g/day. One of the studies in Table 10-5 represents the consumption of fish from three lakes in Washington, and another represents consumption of fish from Lake Ontario. The average consumption rate for all responding adults was 10 g/day for the three Washington lakes. It can also be noted that a large percentage of recreational anglers consumed fish and shellfish during the survey period. Thus, values for all respondents and consuming anglers are fairly similar. For Lake Ontario, the average consumption rate for adults was 5 g/day.

10.2.4. Recommendations—Native American Populations

Recommended values are also not provided for Native American fish intake because the available data are limited to certain geographic areas and/or tribes and cannot be readily generalized to Native American tribes as a whole. However, data from several Native American studies are provided in this chapter and are summarized in Table 10-6. Assessors may use these data, if appropriate to the scenarios and populations being assessed. These studies were performed at various study locations among various tribes.

Table 10-1. Recommended Per Capita and Consumer-Only Values for Fish Intake (g/kg-day), Uncooked Fish Weight, by Age

	Per Capita				Consumers Only			
Age	*N*	% Consuming	Mean	95th percentile	*N*	Mean	95th percentile	Source
Finfish[a]								
All	16,783	23	0.16	1.1	3,204	0.73	2.2	U.S. EPA Analysis of NHANES 2003–2006 data
Birth to 1 year	865	2.6	0.03	0.0[b]	22	1.3	2.9[b]	
1 to <2 years	1,052	14	0.22	1.2[b]	143	1.6	4.9[b]	
2 to <3 years	1,052	14	0.22	1.2[b]	143	1.6	4.9[b]	
3 to <6 years	978	15	0.19	1.4	156	1.3	3.6[b]	
6 to <11 years	2,256	15	0.16	1.1	333	1.1	2.9[b]	
11 to <16 years	3,450	15	0.10	0.7	501	0.66	1.7	
16 to <21 years	3,450	15	0.10	0.7	501	0.66	1.7	
21 to <50 years	4,289	23	0.15	1.0	961	0.65	2.1	
Females 13 to 49 years	4,103	22	0.14	0.9	793	0.62	1.8	
50+ years	3,893	29	0.20	1.2	1,088	0.68	2.0	
Shellfish[a]								
All	16,783	11	0.06	0.4	1,563	0.57	1.9	U.S. EPA Analysis of NHANES 2003–2006 data
Birth to 1 year	865	0.66	0.00	0.0[b]	11	0.42	2.3[b]	
1 to <2 years	1,052	4.4	0.04	0.0[b]	53	0.94	3.5[b]	
2 to <3 years	1,052	4.4	0.04	0.0[b]	53	0.94	3.5[b]	
3 to <6 years	978	4.6	0.05	0.0	56	1.0	2.9[b]	
6 to <11 years	2,256	7.0	0.05	0.2	158	0.72	2.0[b]	
11 to <16 years	3,450	5.1	0.03	0.0	245	0.61	1.9	
16 to <21 years	3,450	5.1	0.03	0.0	245	0.61	1.9	
21 to <50 years	4,289	13	0.08	0.5	605	0.63	2.2	
Females 13 to 49 years	4,103	11	0.06	0.3	474	0.53	1.8	
50+ years	3,893	13	0.05	0.4	435	0.41	1.2	
Total Finfish and Shellfish[a]								
All	16,783	29	0.22	1.3	4,206	0.78	2.4	U.S. EPA Analysis of NHANES 2003–2006 data
Birth to 1 year	865	3.1	0.04	0.0[b]	30	1.2	2.9[b]	
1 to <2 years	1,052	17	0.26	1.6[b]	183	1.5	5.9[b]	
2 to <3 years	1,052	17	0.26	1.6[b]	183	1.5	5.9[b]	
3 to <6 years	978	18	0.24	1.6	196	1.3	3.6[b]	
6 to <11 years	2,256	22	0.21	1.4	461	0.99	2.7[b]	
11 to <16 years	3,450	18	0.13	1.0	685	0.69	1.8	
16 to <21 years	3,450	18	0.13	1.0	685	0.69	1.8	
21 to <50 years	4,289	31	0.23	1.3	1,332	0.76	2.5	
Females 13 to 49 years	4,103	28	0.19	1.2	1,109	0.68	1.9	
50+ years	3,893	36	0.25	1.4	1,319	0.71	2.1	

[a] Analysis was conducted using slightly different childhood age groups than those recommended in *Guidance on Selecting Age Groups for Monitoring and Assessing Childhood Exposures to Environmental Contaminants* (U.S. EPA, 2005). Data were placed in the standardized age categories closest to those used in the analysis.

[b] Estimates are less statistically reliable based on guidance published in the *Joint Policy on Variance Estimation and Statistical Reporting Standards on NHANES III and CSFII Reports: NHIS/NCHS Analytical Working Group Recommendations* (NCHS, 1993).

Table 10-2. Confidence in Recommendations for General Population Fish Intake

General Assessment Factors	Rationale	Rating
Soundness		High
Adequacy of Approach	The survey methodology and the analysis of the survey data were adequate. Primary data were collected and used in a secondary analysis of the data. The sample size was large.	
Minimal (or Defined) Bias	The response rate was adequate. The survey data were based on recent recall. Data were collected over a short duration (i.e., 2 days).	
Applicability and Utility		High
Exposure Factor of Interest	The key study focused on the exposure factor of interest.	
Representativeness	The survey was conducted nationwide and was representative of the general U.S. population.	
Currency	Data were derived from 2003–2006 NHANES.	
Data Collection Period	Data were collected for 2 non-consecutive days.	
Clarity and Completeness		High
Accessibility	The primary data are accessible through CDC.	
Reproducibility	The methodology was clearly presented; enough information was available to allow for reproduction of the results.	
Quality Assurance	Quality assurance of NHANES data was good; quality control of secondary analysis was good.	
Variability and Uncertainty		Medium to high for averages; low for long-term upper percentiles
Variability in Population	Full distributions were provided by the key study.	
Uncertainty	The survey was not designed to capture long-term intake and was based on recall.	
Evaluation and Review		Medium
Peer Review	The National Center for Health Statistics (NCHS) NHANES survey received a high level of peer review. The U.S. EPA analysis of these data has not been peer reviewed outside the Agency, but the methodology used has been peer reviewed in analysis of previous data.	
Number and Agreement of Studies	The number of studies is one.	
Overall Rating		**Medium to High** (mean) **Medium** (long-term upper percentiles)

Table 10-3. Recommended Values for Recreational Marine Fish Intake

Age Group	Intake Rate[a]	
	Mean g/day[b]	95th Percentile g/day[b]
Atlantic		
3 to <6 years	2.5	8.8
6 to <11 years	2.5	8.6
11 to <16 years	3.4	13
16 to <18 years	2.8	6.6
>18 years	5.6	18
Gulf		
3 to <6 years	3.2	13
6 to <11 years	3.3	12
11 to <16 years	4.4	18
16 to <18 years	3.5	9.5
>18 years	7.2	26
Pacific		
3 to <6 years	0.9	3.3
6 to <11 years	0.9	3.2
11 to <16 years	1.2	4.8
16 to <18 years	1.0	2.5
>18 years	2.0	6.8

[a] Represents intake for the recreational fishing population only. Data from U.S. EPA analysis of NMFS (1993) assumed to represent adults >18 years. Values represent both survey anglers who ate recreational fish during the survey period and those that did not, but may eat recreationally caught fish during other periods.

[b] Recommendations for children were estimated based on the ratios of marine fish intake for general population children to that of adults using data from U.S. EPA's analysis of CSFII data (see Table 10-31), multiplied by the adult recreational marine fish intake rates for the Atlantic, Gulf, and Pacific regions, using data from NMFS (1993) (see Table 10-50).The ratios of each age group to adults >18 years were calculated separately for the means and 95th percentiles.

Table 10-4. Confidence in Recommendations for Recreational Marine Fish Intake

General Assessment Factors	Rationale	Rating
Soundness		Medium
Adequacy of Approach	The survey methodology and the analysis of the survey data were adequate. Primary data were collected and used in a secondary analysis of the data. The sample size was large.	
Minimal (or Defined) Bias	The response rate was adequate. The survey data were based on recent recall.	
Applicability and Utility		Low to Medium
Exposure Factor of Interest	The key study was not designed to estimate individual consumption of fish. U.S. EPA obtained the raw data and estimated intake distributions by employing assumptions derived from other data sources.	
Representativeness	The survey was conducted in coastal states in the Atlantic, Pacific, and Gulf regions and was representative of fishing populations in these regions of the United States.	
Currency	The data are from a survey conducted in 1993.	
Data Collection Period	Data were collected in telephone interviews and direct interviews of fishermen in the field over a short time frame.	
Clarity and Completeness		Medium
Accessibility	The primary data are from NMFS.	
Reproducibility	The methodology was clearly presented; enough information was available to allow for reproduction of the results.	
Quality Assurance	Quality assurance of the primary data was not described. Quality assurance of the secondary analysis was good.	
Variability and Uncertainty		Low
Variability in Population	Mean and 95th percentile values were provided.	
Uncertainty	The survey was specifically designed to estimate individual intake rates. U.S. EPA estimated intake based on an analysis of the raw data, using assumptions about the number of individuals consuming fish meals from the fish caught. Estimates for children are based on additional assumptions regarding the proportion of intake relative to the amount eaten by adults.	
Evaluation and Review		Medium
Peer Review	Data from NMFS (1993) were reviewed by NMFS and U.S. EPA. U.S. EPA's analysis was not peer reviewed outside of EPA.	
Number and Agreement of Studies	The number of studies is one.	
Overall Rating		**Low to Medium** (adults) **Low** (children)

Table 10-5. Summary of Relevant Studies on Freshwater Recreational Fish Intake

Location	Population Group	Mean	95th Percentile	Source
		g/day	g/day	
Alabama	All Respondents (Adults)	44[a]	-	ADEM (1994)
	Consuming Anglers	53[b]	-	
Connecticut	All Respondents	51[c]	-	Balcom et al. (1999)
	Consuming Anglers	53[c,d]	-	
Georgia (Savannah River)	All Respondents (Adult Whites)	38[e]	-	Burger et al. (1999)
	All Respondents (Adult Blacks)	70[e]	-	
Indiana	All Respondents	16	61	Williams et al. (1999)
	Consuming Anglers	20	61	
Maine	All Respondents	5.0	21	ChemRisk (1992);
	Consuming Anglers	6.4	26	Ebert et al. (1993)
Michigan	Consuming Anglers			West et al. (1993; 1989)
	1 to 5 years	5.6	-	
	6 to 10 years	7.9	-	
	11 to 20 years	7.3	-	
	21 to 80 years	16[f]	-	
	All ages	14	39	
Minnesota	All Respondents			Benson et al. (2001)
	0 to 14 years	1.2 (50th percentile)	14	
	>14 years (male)	4.5 (50th percentile)	40	
	15 to 44 (female)	2.1 (50th percentile)	25	
	>44 (female)	3.6 (50th percentile)	37	
	Consuming Anglers	14	37	
New York (Lake Ontario)	All Respondents (Adults)	4.9[f]	18	Connelly et al. (1996)
	Consuming Anglers	5.8[g]	-	
North Dakota	All Respondents			Benson et al. (2001)
	0 to 14 years	1.7 (50th percentile)	22	
	>14 years (male)	2.3 (50th percentile)	25	
	15 to 44 (female)	4.3 (50th percentile)	30	
	>44 (female)	4.2 (50th percentile)	33	
	Consuming Anglers	12	43	
Tennessee (Clinch River)	All Respondents	20[e,h]	-	Rouse Campbell et al. (2002)
	Consuming Anglers	38[e,h]	-	
Washington	All Respondents (Adults)	10	42	Mayfield et al. (2007)
	Children of Respondents	7	29	
	Consuming Anglers (Adults)	15[i]	-	
Wisconsin	All Respondents (Adults)	11	37	Fiore et al. (1989)
	Consuming Anglers	12	37	
Summary (mean ranges)	Statewide Surveys[j]	5–51 g/day		
	Rivers[k]	20–70 g/day		
	Lakes[l]	5–10 g/day		

Table 10-5. Summary of Relevant Studies on Freshwater Recreational Fish Intake (continued)

[a]	Based on the average of two methods.
[b]	Value represents anglers who consumed recreationally caught fish during the survey period, calculated by dividing all respondents by the percent consuming of 83%.
[c]	Values included consumption of both freshwater and saltwater fish.
[d]	Value calculated by dividing all respondents by the percent consuming of 97%.
[e]	Calculated as amount eaten per year divided by 365 days per year.
[f]	Based on average of multiple adult age groups.
[g]	Value calculated by dividing all respondents by the percent consuming of 84%.
[h]	Values included consumption of both self-caught and store-bought fish.
[i]	Value calculated by dividing all respondents by the percent consuming of 66%.
[j]	Represents the range from the following states: Alabama, Connecticut, Indiana, Maine, Michigan, Minnesota, North Dakota, and Wisconsin.
[k]	Represents the range from the following rivers: Savannah River in GA and The Clinch River in TN.
[l]	Represents the range from three lakes in Washington and Lake Ontario.
-	Estimate not available.
Note	All respondents represent both survey anglers who ate recreational fish during the survey period and those that did not, but may eat recreationally caught fish during other periods.

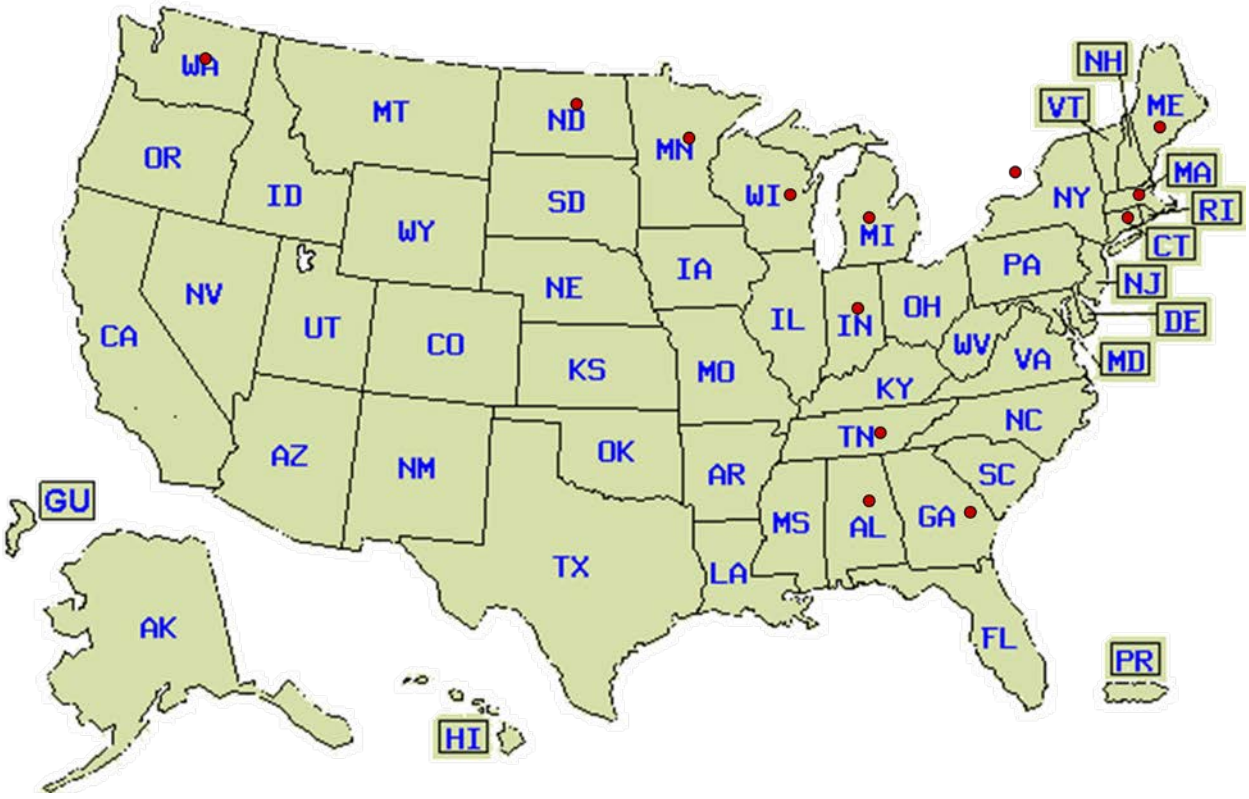

Figure 10-1. Locations of Freshwater Fish Consumption Surveys in the United States.

Table 10-6. Summary of Relevant Studies on Native American Fish Intake

Location/Tribe	Population Group	Mean [a]	95th Percentile[a]	Source
94 Alaska Communities	All Respondents			Wolfe and Walker (1987)
	Lowest of 94	16 g/day	-	
	Median of 94	81 g/day	-	
	Highest of 94	770 g/day	-	
Chippewa Indians (Wisconsin)	All Respondents			Peterson et al. (1994)
	Adults	39 g/day[b]	-	
4 Columbia River Tribes (Oregon)	All Respondents			CRITFC (1994)
	Adults	59 g/day	170 g/day	
	Children ≤5 years	11 g/day (50th percentile)	98 g/day	
	Consumers			
	Adults	63 g/day[c]	183[c]	
Florida	All Respondents	0.8 g/kg-day	4.5 g/kg-day	Westat (2006)
	Consumers[d]	1.5 g/kg-day	5.7 g/kg-day	
Minnesota	All Respondents	2.8 g/kg-day	-	Westat (2006)
	Consumers[d]	2.8 g/kg-day	-	
Mohawk Tribe (New York and Canada)	All Respondents			Fitzgerald et al. (1995)
	Women	13 g/day[e]	-	
	Consuming Women	16 g/day[e]	-	
Mohawk Tribe (New York and Canada)	All Respondents[f]			Forti et al. (1995)
	Adults	25 g/day	131 g/day	
	Children 2 years[f]	10 g/day	54 g/day	
	Consumers			
	Adults[f]	29 g/day	135 g/day	
	Children 2 years[f]	13 g/day	58 g/day	
North Dakota	All Respondents	0.4 g/kg-day	0.9[g]	Westat (2006)
	Consumers[b]	0.4 g/kg-day	0.8 [g]	
Tulalip Tribe (Washington)	All Respondents			Toy et al. (1996)
	Adult	0.9 g/kg-day	2.9 g/kg-day	
	Children birth ≤5 years	0.2 g/kg-day	0.7 g/kg-day[g]	
Squaxin Island Tribe (Washington)	All Respondents			
	Adults	0.9 g/kg-day	3.0 g/kg-day	
	Children	0.8 g/kg-day	2.1 g/kg-day[g]	
Tulalip Tribe (Washington)	Consumers			Polissar et al. (2006)
	Adults	1.0 g/kg-day	2.6 g/kg-day	
	Children birth ≤5 years	0.4 g/kg-day	0.8 g/kg-day[g]	
Squaxin Island Tribe (Washington)	Consumers			
	Adults	1.0 g/kg-day	3.4 g/kg-day	
	Children birth ≤5 years	2.9 g/kg-day	7.7 g/kg-day	
Suquamish Tribe (Washington)	All Respondents			Duncan (2000)
	Adults	2.7 g/kg-day	10 g/kg-day	
	Children <6 years	1.5 g/kg-day	7.3 g/kg-day	
	Consumers			
	Adults	2.7 g/kg-day	10 g/kg-day	
	Children <6 years	1.5 g/kg-day	7.3 g/kg-day	

Table 10-6. Summary of Relevant Studies on Native American Fish Intake (continued)

[a] Results are reported in g/day or g/kg-day, depending on which was provided in the source material.
[b] All respondents consumed fish caught in Northern Wisconsin lakes.
[c] Value calculated by dividing all respondents by the percent consuming of 93%.
[d] Based on uncooked fish weight.
[e] Value represents consumption by Mohawk women >1 year before pregnancy. Value estimated by multiplying number of fish meals/year by the 90th percentile meal size of 209 g/meal for general population females 20–39 years old from Smiciklas-Wright et al. (2002).
[f] Based on 90th percentile general population meal size, based on Pao et al. (1982).
[g] Value represents the 90th percentile.
- Estimate not available.

10.3. GENERAL POPULATION STUDIES

10.3.1. Key General Population Study

10.3.1.1. *U.S. EPA Analysis of Consumption Data From 2003–2006 NHANES*

The key source of recent information on consumption rates of fish and shellfish is the U.S. CDC's NCHS' NHANES. Data from NHANES 2003–2006 have been used by the U.S. EPA, Office of Pesticide Programs (OPP) to generate per capita and consumer-only intake rates for finfish, shellfish, and total fish and shellfish combined.

NHANES is designed to assess the health and nutritional status of adults and children in the United States. In 1999, the survey became a continuous program that interviews a nationally representative sample of approximately 7,000 persons each year and examines a nationally representative sample of about 5,000 persons each year, located in counties across the country, 15 of which are visited each year. Data are released on a 2-year basis, thus, for example, the 2003 data are combined with the 2004 data to produce NHANES 2003–2004.

The dietary interview component of NHANES is called *What We Eat in America* and is conducted by the U.S. Department of Agriculture (USDA) and the U.S. Department of Health and Human Services (DHHS). DHHS' NCHS is responsible for the sample design and data collection, and USDA's Food Surveys Research Group is responsible for the dietary data collection methodology, maintenance of the databases used to code and process the data, and data review and processing. Beginning in 2003, 2 non-consecutive days of 24-hour intake data were collected. The first day is collected in-person, and the second day is collected by telephone 3 to 10 days later. These data are collected using USDA's dietary data collection instrument, the Automated Multiple Pass Method. This method provides an efficient and accurate means of collecting intakes for large-scale national surveys. It is fully computerized and uses a five-step interview. Details can be found at USDA's Agriculture Research Service (http://www.ars.usda.gov/ba/bhnrc/fsrg).

For NHANES 2003–2004, there were 12,761 persons selected; of these, 9,643 were considered respondents to the mobile examination center (MEC) for examination and data collection. However, only 9,034 of the MEC respondents provided complete dietary intakes for Day 1. Furthermore, of those providing the Day 1 data, only 8,354 provided complete dietary intakes for Day 2. For NHANES 2005–2006, there were 12,862 persons selected; of these, 9,950 were considered respondents to the MEC examination and data collection. However, only 9,349 of the MEC respondents provided complete dietary intakes for Day 1. Furthermore, of those providing the Day 1 data, only 8,429 provided complete dietary intakes for Day 2.

The 2003–2006 NHANES surveys are stratified, multistage probability samples of the civilian non-institutionalized U.S. population. The sampling frame was organized using 2000 U.S. population census estimates. NHANES oversamples low-income persons, adolescents 12–19 years, persons 60 years and older, African Americans, and Mexican Americans. Several sets of sampling weights are available for use with the intake data. By using appropriate weights, data for all 4 years of the surveys can be combined. Additional information on NHANES can be obtained at http://www.cdc.gov/nchs/nhanes.htm.

In 2010, U.S. EPA's OPP used NHANES 2003–2006 data to update the Food Commodity Intake Database (FCID) that was developed in earlier analyses of data from the U.S. Department of Agriculture's (USDA's) CSFII (U.S. EPA, 2002; USDA, 2000). NHANES data on the foods people reported eating were converted to the quantities of agricultural commodities eaten. "Agricultural commodity" is a term used by U.S. EPA to mean plant (or animal) parts consumed by humans as food; when such items are raw or unprocessed, they are referred to as "raw agricultural commodities." For example, clam chowder may contain the commodities clams, vegetables, and spices. FCID contains approximately 553 unique commodity names and eight-digit codes. The FCID commodity names and codes were selected and defined by U.S. EPA and were based on the U.S. EPA Food Commodity Vocabulary (http://www.epa.gov/pesticides/foodfeed/).

Intake rates were generated for finfish, shellfish, and finfish and shellfish combined. These intake rates represent intake of all forms of the food (e.g., both self-caught and commercially caught) for individuals who provided data for 2 days of the survey. Individuals who did not provide information on body weight or for whom identifying information was unavailable were excluded from the analysis. Two-day average intake rates were calculated for all individuals in the database for each of the food items/groups. Note that if the person reported consuming fish on only one day of the survey, their 2-day average would be half the amount reported for the one day of consumption. These average daily intake rates were divided by each individual's reported body weight to generate intake rates in units of grams per kilogram of body weight per day (g/kg-

day). The data were weighted according to the 4-year, 2-day sample weights provided in NHANES 2003–2006 to adjust the data for the sample population to reflect the national population.

Summary statistics were generated on a consumer-only and on a per capita basis. Summary statistics, including number of observations, percentage of the population consuming fish, mean intake rate, and standard error of the mean intake rate were calculated for finfish, shellfish, and finfish and shellfish combined, for both the entire population and consumers only (see Table 10-7 to Table 10-12). Data were provided for the following age groups: birth to <1 year, 1 to 2 years, 3 to 5 years, 6 to 12 years, 13 to 19 years, 20 to 49 years, and ≥50 years. Because these data were developed for use in U.S. EPA's pesticide registration program, the childhood age groups used are slightly different than those recommended in U.S. EPA's *Guidance on Selecting Age Groups for Monitoring and Assessing Childhood Exposures to Environmental Contaminants* (U.S. EPA, 2005).

The results are presented in units of g/kg-day (same as the CSFII data). Thus, use of these data in calculating potential dose does not require the body-weight factor to be included in the denominator of the average daily dose equation. It should be noted that converting these intake rates into units of g/day by multiplying by a single average body weight is inappropriate because individual intake rates were indexed to the reported body weights of the survey respondents. Also, it should be noted that the distribution of average daily intake rates generated using short-term data (e.g., 2-day) does not necessarily reflect the long-term distribution of average daily intake rates. The distributions generated from short-term and long-term data will differ to the extent that each individual's intake varies from day to day; the distributions will be similar to the extent that individuals' intakes are constant from day to day. Because of the increased variability of the short-term distribution, the short-term upper percentiles shown here may overestimate the corresponding percentiles of the long-term distribution.

The advantages of using the U.S. EPA's analysis of NHANES data are that it provides distributions of intake rates for various age groups of children and adults, normalized by body weight. The data set was designed to be representative of the U.S. population, and includes 4 years of intake data combined. Another advantage is the currency of the data. The NHANES data are from 2003–2006. However, short-term consumption data may not accurately reflect long-term eating patterns and may under-represent infrequent consumers of a given fish species. This is particularly true for the tails (extremes) of the distribution of food intake. Because these are 2-day averages, consumption estimates at the upper end of the intake distribution may be underestimated if these consumption values are used to assess acute (i.e., short-term) exposures. Also, the analysis was conducted using slightly different childhood age groups than those recommended in U.S. EPA's *Guidance on Selecting Age Groups for Monitoring and Assessing Childhood Exposures to Environmental Contaminants* (U.S. EPA, 2005). However, given the similarities in the age groups used, the data should provide suitable intake estimates for the age groups of interest.

10.3.2. Relevant General Population Studies

10.3.2.1. *SRI (1980)—Seafood Consumption Study*

SRI (1980) utilized data that were originally collected in a study funded by the Tuna Research Foundation (TRF) to estimate fish intake rates. The TRF study of fish consumption was performed by the National Purchase Diary during the period of September, 1973 to August, 1974. The data tapes from this survey were obtained by the NMFS, which later, along with the Food and Drug Administration, USDA and TRF, conducted an intensive effort to identify and correct errors in the database. SRI (1980) summarized the TRF survey methodology and used the corrected tape to generate fish intake distributions for various population groups.

The TRF survey sample included 9,590 families, of which 7,662 (25,162 individuals) completed the questionnaire, a response rate of 80%. The survey was weighted to represent the U.S. population.

The population of fish consumers represented 94% of the U.S. population. For this population of "fish consumers," SRI (1980) calculated means and percentiles of fish consumption by demographic variables (age, sex, race, census region, and community type) and overall (see Table 10-13). The overall mean fish intake rate among fish consumers was calculated at 14.3 g/day and the 95th percentile at 41.7 g/day.

Table 10-14 presents the distribution of fish consumption for females and males, by age; this table give the percentages of females/males in a given age bracket with intake rates within various ranges. Table 10-15 presents mean total fish consumption by fish species.

The TRF survey data were also utilized by Rupp et al. (1980) to generate fish intake distributions for three age groups (1 to 11, 12 to 18, and 18 to 98 years) within each of the 9 census regions and for

the entire United States. Separate distributions were derived for freshwater finfish, saltwater finfish, and shellfish. Ruffle et al. (1994) used the percentiles data of Rupp et al. (1980) to estimate the best-fitting lognormal parameters for each distribution. Table 10-16 presents the optimal lognormal parameters, the mean (μ) and standard deviation (σ). These parameters can be used to determine percentiles of the corresponding distribution of average daily fish consumption rates through the relation $(p) = \exp[\mu + z(p)\sigma]$ where DCR(p) is the p^{th} percentile of the distribution of average daily fish consumption rates and $z(p)$ is the z-score associated with the p^{th} percentile (e.g., $z(50) = 0$). The mean average daily fish consumption rate is given by $\exp[\mu + 0.5\sigma^2]$.

The advantages of the TRF data survey are that it was a large, nationally representative survey with a high response rate (80%) and was conducted over an entire year. In addition, consumption was recorded in a daily diary over a 1-month period; this format should be more reliable than one based on 1-month recall. The upper percentiles presented are derived from 1 month of data and are likely to overestimate the corresponding upper percentiles of the long-term (i.e., 1 year or more) average daily fish intake distribution. Similarly, the standard deviation of the fitted lognormal distribution probably overestimates the standard deviation of the long-term distribution. However, the period of this survey (1 month) is considerably longer than those of many other consumption studies, including the USDA National Food Consumption Surveys, CSFII, and NHANES, which report consumption over a 2-day to 1-week period. Another obvious limitation of this database is that it is now over 30 years out of date. Ruffle et al. (1994) considered this shortcoming and suggested that one may wish to shift the distribution upward to account for the recent increase in fish consumption, though CSFII has shown little change in g/day fish consumption from 1978 to 1996. Adding $\ln(1 + x/100)$ to the log mean μ will shift the distribution upward by x% (e.g., adding $0.22 = \ln(1.25)$ increases the distribution by 25%). Although the TRF survey distinguished between recreationally and commercially caught fish, SRI (1980), Rupp et al. (1980), and Ruffle et al. (1994) [which was based on Rupp et al. (1980)] did not present analyses by this variable.

10.3.2.2. *Pao et al. (1982)—Foods Commonly Eaten by Individuals: Amount per Day and per Eating Occasion*

The USDA 1977–1978 Nationwide Food Consumption Survey (NFCS) consisted of a household and individual component. For the individual component, all members of surveyed households were asked to provide three consecutive days of dietary data. For the first day's data, participants supplied dietary recall information to an in-home interviewer. Second and 3rd day dietary intakes were recorded by participants. A total of 15,000 households were included in the 1977–1978 NFCS, and about 38,000 individuals completed the 3-day diet records. Fish intake was estimated based on consumption of fish products identified in the NFCS database according to NFCS-defined food codes. These products included fresh, breaded, floured, canned, raw, and dried fish, but not fish mixtures or frozen plate meals.

Pao et al. (1982) used the data from this survey set to calculate per capita fish intake rates. However, because these data are now almost 30 years out of date, this analysis is not considered key with respect to assessing per capita intake (the average quantity of fish consumed per fish meal should be less subject to change over time than is per capita intake). In addition, fish mixtures and frozen plate meals were not included in the calculation of fish intake. The per capita fish intake rate reported by Pao et al. (1982) was 11.8 g/day. The 1977–1978 NFCS was a large and well-designed survey, and the data are representative of the U.S. population.

10.3.2.3. *USDA (1993)—Food and Nutrient Intakes by Individuals in the United States, 1 Day, 1987–1988: Nationwide Food Consumption Survey 1987–1988*

The USDA 1987–1988 (NFCS) also consisted of a household and individual component. For the individual component, each member of a surveyed household was interviewed (in person) and asked to recall all foods eaten the previous day; the information from this interview made up the "1-day data" for the survey. In addition, members were instructed to fill out a detailed dietary record for the day of the interview and the following day. The data for this entire 3-day period made up the "3-day diet records." A statistical sampling design was used to ensure that all seasons, geographic regions of the United States, and demographic and socioeconomic groups were represented. Sampling weights were used to match the population distribution of

13 demographic characteristics related to food intake (USDA, 1992).

Total fish intake was estimated based on consumption of fish products identified in the NFCS database according to NFCS-defined food codes. These products included fresh, breaded, floured, canned, raw, and dried fish but not fish mixtures or frozen plate meals.

A total of 4,500 households participated in the 1987–1988 survey; the household response rate was 38%. One-day data were obtained for 10,172 (81%) of the 12,522 individuals in participating households; 8,468 (68%) individuals completed 3-day diet records.

USDA (1992) used the 1-day data to derive per capita fish intake rate and intake rates for consumers of total fish. Table 10-17 shows these rates, calculated by sex and age group. Intake rates for consumers only were calculated by dividing the per capita intake rates by the fractions of the population consuming fish in 1 day.

An advantage of analyses based on the 1987-1988 USDA NFCS is that the data set is a large, geographically and seasonally balanced survey of a representative sample of the U.S. population. The survey response rate, however, was low, and an expert panel concluded that it was not possible to establish the presence or absence of non-response bias (USDA, 1992). In addition, the data from this survey have been superseded by more recent surveys.

10.3.2.4. *U.S. EPA (1996)—Descriptive Statistics From a Detailed Analysis of the National Human Activity Pattern Survey (NHAPS) Responses*

The U.S. EPA collected information for the general population on the duration and frequency of time spent in selected activities and time spent in selected microenvironments via 24-hour diaries (U.S. EPA, 1996). Over 9,000 individuals from 48 contiguous states participated in NHAPS. Approximately 4,700 participants also provided information on seafood consumption. The survey was conducted between October 1992 and September 1994. Data were collected on (1) the number of people that ate seafood in the last month, (2) the number of servings of seafood consumed, and (3) whether the seafood consumed was caught or purchased (U.S. EPA, 1996). The participant responses were weighted according to selected demographics such as age, sex, and race to ensure that results were representative of the U.S. population. Of those 4,700 respondents, 2,980 (59.6%) ate seafood (including shellfish, eels, or squid) in the last month (see Table 10-18). The number of servings per month was categorized in ranges of 1–2, 3–5, 6–10, 11–19, and 20+ servings per month (see Table 10-19). The highest percentage (35%) of the respondent population had an intake of 3–5 servings per month. Most (92%) of the respondents purchased the seafood they ate (see Table 10-20).

Intake data were not provided in the survey. However, intake of fish can be estimated using the information on the number of servings of fish eaten from this study and serving size data from other studies. Smiciklas-Wright et al. (2002) estimated that the mean value for fish serving size for all age groups combined is 114 g/serving based on the 1994–1996 CSFII survey (see Section 10.8). The CSFII serving size data are based on all finfish, except canned, dried, and raw, whether reported separately or as part of a sandwich or other mixed food. Using this mean value for serving size and assuming that the average individual eats 3–5 servings per month, the amount of seafood eaten per month would range from 340 to 570 g/month or 11.3 to 19.0 g/day for the highest percentage of the population. These values are within the range of per capita mean intake values for total fish (16.9 g/day, uncooked equivalent weight) calculated by U.S. EPA (2002) analysis of the USDA CSFII data. It should be noted that an all inclusive description for seafood was not presented in U.S. EPA (1996). It is not known if they included processed or canned seafood and seafood mixtures in the seafood category.

The advantages of NHAPS are that the data were collected for a large number of individuals and are representative of the U.S. general population. However, evaluation of seafood intake was not the primary purpose of the study, and the data do not reflect the actual amount of seafood that was eaten. However, using the assumption described above, the estimated seafood intake from this study is comparable to that observed in the U.S. EPA CSFII analysis.

10.3.2.5. *Stern et al. (1996)—Estimation of Fish Consumption and Methylmercury Intake in the New Jersey Population*

Stern et al. (1996) reported on a 7-day fish consumption recall survey that was conducted in 1993 as part of the New Jersey Household Fish Consumption Study. Households were contacted by telephone using the random-digit dialing technique, and the survey completion rate was 72% of households contacted. Respondents included 1 adult (i.e., $\geq$18 years) resident per household, for a total of

1,000 residents. The sample was "stratified to provide equal numbers of men and women and proportional representation by county" (Stern et al., 1996). Survey respondents provided data on consumption of all seafood consumed within the previous 7 days, including the number of fish meals, fish type, amount eaten at each meal, frequency of consumption, and whether the consumption patterns during the recall period were typical of their intake throughout the year.

Stern et al. (1996) reported that "of the 1,000 respondents, 933 reported that they normally consume fish at least a few times per year and 686 reported that they consumed fish during the recall period" (Stern et al., 1996). Table 10-21 presents the distribution of the number of meals for the 7-day recall period. The average portion size was 168 grams. Approximately "4–5% of all fish meals consisted of fish obtained non-commercially, and only about 13% of these consisted of freshwater fish" (Stern et al., 1996). Tuna was consumed most frequently, followed by shrimp and flounder/fluke (see Table 10-22).

Table 10-23 provides the average daily consumption rates (g/day) for all fish for all adults and for women of childbearing age (i.e., 18–40 years). The mean fish intake rate for all adult consumers was 50 g/day, and the 90th percentile was 107 g/day. For women of childbearing age, the mean fish intake rate was 41 g/day, and the 90th percentile was 88 g/day. Table 10-24 provides information on the frequency of fish consumption.

The advantages of this study are that it is based on a 7-day recall period and that data were collected for the frequency of eating fish. However, the data are based on fish consumers in New Jersey and may not be representative of the general population of the United States.

10.3.2.6. *U.S. EPA (2002)—Estimated Per Capita Fish Consumption in the United States*

U.S. EPA's Office of Water used data from the 1994–1996 CSFII and its 1998 Children's Supplement (referred to collectively as CSFII 1994–1996, 1998) to generate fish intake estimates (U.S. EPA, 2002). Participants in the CSFII 1994–1996, 1998 provided 2 non-consecutive days of dietary data. The Day 2 interview occurred 3 to 10 days after the Day 1 interview but not on the same day of the week. Data collection for the CSFII started in April of the given year and was completed in March of the following year. Respondents estimated the weight of each food that they consumed. Information on the consumption of food was classified using 11,345 different food codes and stored in a database in units of grams consumed per day. A total of 831 of these food codes related to fish or shellfish; survey respondents reported consumption across 665 of these codes. The fish component (by weight) of the various foods was calculated using data from the recipe file for release seven of USDA's Nutrient Data Base for Individual Food Intake Surveys.

The amount of fish consumed by each individual was then calculated by summing, over all fish containing foods, the product of the weight of food consumed and the fish component (i.e., the percentage fish by weight) of the food. The recipe file also contains cooking loss factors associated with each food. These were used to convert, for each fish-containing food, the as-eaten fish weight consumed into an uncooked equivalent weight of fish. Analyses of fish intake were performed on both an "as-prepared" (i.e., as-consumed) and uncooked basis.

Each fish-related food code was assigned, by U.S. EPA, to a habitat category. The habitat categories included freshwater/estuarine, or marine. Food codes were also designated as finfish or shellfish. Average daily individual consumption (g/day) was calculated, for a given fish type-by-habitat category (e.g., marine finfish), by summing the amount of fish consumed by the individual across the 2 reporting days for all fish-related food codes in the given fish-by-habitat category and then dividing by 2. Individual daily fish consumption (g/day) was calculated similarly except that total fish consumption was divided by the specific number of survey days the individual reported consuming fish; this was calculated for fish consumers only (i.e., those consuming fish on at least 1 of the 2 survey days). The reported body weight of the individual was used to convert consumption in g/day to consumption in g/kg-day.

There were a total of 20,607 respondents in the combined data set that had 2-day dietary intake data. Survey weights were assigned to this data set to make it representative of the U.S. population with respect to various demographic characteristics related to food intake. Survey weights were also adjusted for non-response.

U.S. EPA (2002) reported means, medians, and estimates of the 90th, 95th, and 99th percentiles of fish intake. The 90% interval estimates are non-parametric estimates from bootstrap techniques. The bootstrap estimates result from the percentile method, which calculates the lower and upper bounds for the interval estimate by the 100α percentile and 100 (1–α) percentile estimates from the

non-parametric distribution of the given point estimate (U.S. EPA, 2002).

Analyses of fish intake were performed on an as-prepared as well as on an uncooked equivalent basis and on a g/day and mg/kg-day basis. Table 10-25 gives the mean and various percentiles of the distribution of per capita finfish and shellfish intake rates (g/day), as prepared, by habitat and fish type, for the general population. Table 10-26 provides a list of the fish species categorized within each habitat. Table 10-26 also shows per capita consumption estimates by species. Table 10-27 displays the mean and various percentiles of the distribution of per capita finfish and shellfish intake rates (g/day) by habitat and fish type, on an uncooked equivalent basis. Table 10-28 shows per capita consumption estimates by species on an uncooked equivalent basis.

Table 10-29 through Table 10-36 present data for daily average fish consumption. These data are presented by selected age groupings (14 and under, 15–44, 45 and older, all ages, children ages 3 to 17, and ages 18 and older) and sex. It should be noted the analysis predated the age groups recommended by U.S. EPA *Guidelines on Selecting Age Groups for Monitoring and Assessing Childhood Exposure to Environmental Contaminants* (U.S. EPA, 2005). Table 10-29 through Table 10-32 present fish intake data (g/day and mg/kg-day; as prepared and uncooked) on a per capita basis, and Table 10-33 through Table 10-36 provide data for consumers only.

The advantages of this study are its large size and its representativeness. The survey was also designed and conducted to support unbiased estimation of food consumption across the population. In addition, through use of the USDA recipe files, the analysis identified all fish-related food codes and estimated the percent fish content of each of these codes. By contrast, some analyses of the USDA NFCSs, which reported per capita fish intake rates [e.g., Pao et al. (1982); USDA (1993)], excluded certain fish-containing foods (e.g., fish mixtures, frozen plate meals) in their calculations.

10.3.2.7. *Westat (2006)—Fish Consumption in Connecticut, Florida, Minnesota, and North Dakota*

Westat (2006) analyzed the raw data from three fish consumption studies to derive fish consumption rates for various age, sex, and ethnic groups, and according to the source of fish consumed (i.e., bought or caught) and habitat (i.e., freshwater, estuarine, or marine). The studies represented data from four states: Connecticut, Florida, Minnesota, and North Dakota.

The Connecticut data were collected in 1996/1997 by the University of Connecticut to obtain estimates of fish consumption for the general population, sport fishing households, commercial fishing households, minority and limited income households, women of child-bearing years, and children. Data were obtained from 810 households, representing 2,080 individuals, using a combination of a mail questionnaire that included a 10-day diary, and personal interviews. The response rate for this survey was low (i.e., 6% for the general population and 10% for anglers) but was considered to be adequate by the study authors (Balcom et al., 1999).

The Florida data were collected by telephone and in-person interviews by the University of Florida and represented a random sample of 8,000 households (telephone interviews) and 500 food stamp recipients (in-person interviews). The purpose of the survey was to obtain information on the quantity of fish and shellfish eaten, as well as the cooking method used. Additional information of the Florida survey can be found in Degner et al. (1994).

The Minnesota and North Dakota data were collected by the University of North Dakota in 2000 and represented 1,572 households and 4,273 individuals. Data on purchased and caught fish were collected for the general population, anglers, new mothers, and Native American tribes. The survey also collected information on the species of fish eaten. Additional information on this study can be found in Benson et al. (2001).

The primary difference in survey procedures among the three studies was the manner in which the fish consumption data were collected. In Connecticut, the survey requested information on how often each type of seafood was eaten, without a recall period specified. In Minnesota and North Dakota, the survey requested information on the rate of fish or shellfish consumption during the previous 12 months. In Florida, the survey requested information on fish consumption during the last 7 days prior to the telephone interview. In addition, for the Florida survey, information on away-from-home fish consumption was collected from a randomly selected adult from each participating household. Because this information was not collected from all household members, the study may tend to underestimate away-from-home consumption. The study notes that estimates of fish consumption using a shorter recall period will decrease the proportion of respondents that report eating fish or shellfish. This trend was observed in the Florida study (in which approximately half of respondents reported eating

fish/shellfish), compared with Connecticut, Minnesota, and North Dakota (in which approximately 90% of respondents reported eating fish or shellfish).

Table 10-37 through Table 10-46 present key findings of the Westat (2006) consumption study. The tables show the fish and shellfish consumption rates for various groups classified by demographic characteristics and by the source of the fish and shellfish consumed (i.e., freshwater versus marine, and bought versus self-caught). Consumption rates are presented in grams per kilogram of body weight per day for the entire population (i.e., consumption per capita) and for just those that reported consuming fish and shellfish (consumption for consumers only).

An advantage of this study is that it focused on individuals within the general population that may consume more fish and shellfish and, thus, may be at higher risk from exposure to contaminants in fish than other members of the population. Also, it provides distributions of fish consumption for different age cohorts, ethnic groups, socioeconomic status, types of fish (i.e., freshwater, marine, estuarine), and sources of fish (i.e., store-bought versus self-caught). However, the data were collected in four states and may not be representative of the U.S. population as a whole.

10.3.2.8. *Moya et al. (2008)—Estimates of Fish Consumption Rates for Consumers of Bought and Self-Caught Fish in Connecticut, Florida, Minnesota, and North Dakota*

Moya et al. (2008) summarized the analysis conducted by Westat (2006) described in Section 10.3.2.7. Moya et al. (2008) utilized the data to generate intake rates for 3 age groups of children (i.e., 1 to <6 years, 6 to <11 years, and 11 to <16 years) and 3 age groups of adults (16 to <30 years, 30 to <50 years, and >50 years), which are also listed by sex. These data represented the general population and angler population in the four states. Recreational fish intake rates were not provided for children, and data were not provided for children according to the source of intake (i.e., bought or caught) or habitat (i.e., freshwater, estuarine, or marine). Table 10-47 presents the intake rates for the general population who consumed fish and shellfish in g/kg-day, as-consumed. Table 10-47 also provides information on the fish intake among the sample populations from the four states, based on the source of the fish (i.e., caught or bought) and provides estimated fish intake rates among the general populations and angler populations from Connecticut, Minnesota, and North Dakota.

This analysis is based on the data from Westat (2006). Therefore, the advantages and limitations are the same as those of the Westat (2006) study. Also, while data were provided for individuals who ate self-caught fish, it is not possible from this analysis to determine the proportion of self-caught fish represented by marine or freshwater habitats.

10.3.2.9. *Mahaffey et al. (2009)—Adult Women's Blood Mercury Concentrations Vary Regionally in the United States: Association With Patterns of Fish Consumption (NHANES 1999–2004)*

Mahaffey et al. (2009) used NHANES 1999–2004 data to evaluate relationships between fish intake and blood mercury levels. Mercury intake via fish ingestion was evaluated for four coastal populations (i.e., Atlantic, Pacific, Gulf of Mexico, and Great Lakes), and four non-coastal populations defined by U.S. census regions (i.e., Northeast, South, Midwest, and West) (Mahaffey et al., 2009). Serving size data, based on 24-hour dietary recall, were used with 30-day food frequency data to estimate mercury intake from consumption of fish over a 30-day period. The frequency data used in the study indicated that people living on the Atlantic coast consumed fish most frequently (averaging 6 meals/month), followed closely by those of the Gulf and Pacific coasts. People living in non-coastal areas or on the coasts of the Great Lakes consumed fish least often (averaging $\leq$4 meals/month). Figure 10-2 illustrates these regional differences.

The advantage of this study is that it is based on relatively recent NHANES data (i.e., 1999–2004), it uses data from the 30-day food frequency questionnaire, and it provides regional data that are not available elsewhere. However, because the study focused on mercury exposure, it did not provide non-chemical specific fish intake data (in g/day or g/kg-day) that can be used to support risk assessments for other chemicals (i.e., only frequency data were provided). It does, however, provide useful information on the relative differences in frequency of fish intake for regional populations.

10.4. MARINE RECREATIONAL STUDIES

10.4.1. Key Marine Recreational Study

10.4.1.1. *National Marine Fisheries Service (1993, 1986a, b, c)*

The NMFS conducts systematic surveys, on a continuing basis, of marine recreational fishing.

These surveys are designed to estimate the size of the recreational marine finfish catch by location, species, and fishing mode. In addition, the surveys provide estimates for the total number of participants in marine recreational finfishing and the total number of fishing trips.

The NMFS surveys involve two components: telephone surveys and direct interviewing of fishermen in the field. The telephone survey randomly samples residents of coastal regions, defined generally as counties within 25 miles of the nearest seacoast, and inquires about participation in marine recreational fishing in the resident's home state in the past year, and more specifically, in the past 2 months. This component of the survey is used to estimate, for each coastal state, the total number of coastal region residents who participate in marine recreational fishing (for finfish) within the state, as well as the total number of (within state) fishing trips these residents take. To estimate the total number of participants and fishing trips in the state, by coastal residents and others, a ratio approach, based on the field interview data, was used. Thus, if the field survey data found that there was a 4:1 ratio of fishing trips taken by coastal residents as compared to trips taken by non-coastal and out-of-state residents, then an additional 25% would be added to the number of trips taken by coastal residents to generate an estimate of the total number of within-state trips.

The surveys are not designed to estimate individual consumption of fish from marine recreational sources, primarily because they do not attempt to estimate the number of individuals consuming the recreational catch. Intake rates for marine recreational anglers can be estimated, however, by employing assumptions derived from other data sources about the number of consumers.

The field intercept survey is essentially a creel type survey. The survey utilizes a national site register that details marine fishing locations in each state. Sites for field interviews are chosen in proportion to fishing frequency at the site. Anglers fishing on shore, private boat, and charter/party boat modes who had completed their fishing were interviewed. The field survey included questions about frequency of fishing, area of fishing, age, and place of residence. The fish catch was classified by the interviewer as either type A, type B1, or type B2 catch. The type A catch denoted fish that were taken whole from the fishing site and were available for inspection. The type B1 and B2 catch were not available for inspection; the former consisted of fish used as bait, filleted, or discarded dead, while the latter was fish released alive. The type A catch was identified by species and weighed, with the weight reflecting total fish weight, including inedible parts. The type B1 catch was not weighed, but weights were estimated using the average weight derived from the type A catch for the given species, state, fishing mode, and season of the year. For both the type A and B1 catch, the intended disposition of the catch (e.g., plan to eat, plan to throw away, etc.) was ascertained.

U.S. EPA obtained the raw data tapes from NMFS in order to generate intake distributions and other specialized analyses. Fish intake distributions were generated using the field survey tapes. Weights proportional to the inverse of the angler's reported fishing frequency were employed to correct for the unequal probabilities of sampling; this was the same approach used by NMFS in deriving their estimates. Note that in the field survey, anglers were interviewed regardless of past interviewing experience; thus, the use of inverse fishing frequency as weights was justified (see Section 10.1).

For each angler interviewed in the field survey, the yearly amount of fish caught that was intended to be eaten by the angler and his/her family or friends was estimated by U.S. EPA as follows:

$$Y = [(\text{wt of A catch}) \times I_A + (\text{wt of B1 catch}) \times I_B] \times [\text{Fishing frequency}] \quad \text{(Eqn. 10-1)}$$

where I_A (I_B) are indicator variables equal to one if the type *A* (*B1*) catch was intended to be eaten, and equal to 0 otherwise. To convert *Y* to a daily fish intake rate by the angler, it was necessary to convert amount of fish caught to edible amount of fish, divide by the number of intended consumers, and convert from yearly to daily rate.

Although theoretically possible, U.S. EPA chose not to use species-specific edible fractions to convert overall weight to edible fish weight because edible fraction estimates were not readily available for many marine species. Instead, an average value of 0.5 was employed. For the number of intended consumers, U.S. EPA used an average value of 2.5, which was an average derived from the results of several studies of recreational fish consumption (ChemRisk, 1992; West et al., 1989; Puffer et al., 1982). Thus, the average daily intake rate (ADI) for each angler was calculated as

$$ADI = Y \times (0.5)/[2.5 \times 365] \quad \text{(Eqn. 10-2)}$$

Note that *ADI* will be 0 for those anglers who either did not intend to eat their catch or who did not catch any fish. The distribution of ADI among anglers was calculated by region and coastal status (i.e., coastal versus non-coastal counties).

The results presented in Table 10-48 and Table 10-49 are based on the results of the 1993 survey. Sample sizes were 200,000 for the telephone survey and 120,000 for the field surveys. All coastal states in the continental United States were included in the survey except Texas and Washington.

Table 10-48 presents the estimated number of coastal, non-coastal, and out-of-state fishing participants by state and region of fishing. Florida had the greatest number of both Atlantic and Gulf participants. The total number of coastal residents who participated in marine finfishing in their home state was eight million; an additional 750,000 non-coastal residents participated in marine finfishing in their home state.

Table 10-49 presents the estimated total weight of the type A and B1 catch by region and time of year. For each region, the greatest catches were during the 6-month period from May through October. This period accounted for about 90% of the North and Mid-Atlantic catch, about 80% of the Northern California and Oregon catch, about 70% of the Southern Atlantic and Southern California catch, and 62% of the Gulf catch. Note that in the North and Mid-Atlantic regions, field surveys were not done in January and February due to very low fishing activity. For all regions, over half the catch occurred within 3 miles of the shore or in inland waterways.

Table 10-50 presents the mean and 95th percentile of average daily intake (ADI) of recreationally caught marine finfish among anglers by region. The mean ADI values among all anglers were 5.6, 7.2, and 2.0 g/day for the Atlantic, Gulf, and Pacific regions, respectively. Table 10-51 gives the distribution of catch, by species, for the Atlantic, Gulf, and Pacific regions.

The NMFS surveys provide a large, geographically representative sample of marine angler activity in the United States. The major limitation of this database in terms of estimating fish intake is the lack of information regarding the intended number of consumers of each angler's catch. In this analysis, it was assumed that every angler's catch was consumed by the same number (2.5) of people; this number was derived from averaging the results of other studies. This assumption introduces a relatively low level of uncertainty in the estimated mean intake rates among anglers, but a somewhat higher level of uncertainty in the estimated intake distributions.

Under the above assumption, the distributions shown here pertain not only to the population of anglers, but also to the entire population of recreational fish consumers, which is 2.5 times the number of anglers. If the number of consumers was changed, to, for instance, 2.0, then the distribution would be increased by a factor of 1.25 (2.5/2.0), but the estimated population of recreational fish consumers to which the distribution would apply, would decrease by a factor of 0.8 (2.0/2.5).

Another uncertainty involves the use of 0.5 as an (average) edible fraction. This figure is assumed to be somewhat conservative (i.e., the true average edible fraction is probably lower); thus, the intake rates calculated here may be biased upward somewhat.

The recreational fish intake distributions given refer only to marine finfish. In addition, the intake rates calculated are based only on the catch of anglers in their home state. Marine fishing performed out-of-state would not be included in these distributions. Therefore, these distributions give an estimate of consumption of locally caught marine fish. These data are approximately 2 decades old and may not be entirely representative of current intake rates. Also, data were not available for children.

10.4.2. Relevant Marine Recreational Studies

10.4.2.1. *Pierce et al. (1981)—Commencement Bay Seafood Consumption Study*

Pierce et al. (1981) performed a local creel survey to examine seafood consumption patterns and demographics of sport fishermen in Commencement Bay, WA. The objectives of this survey included determining (1) the seafood consumption habits and demographics of non-commercial anglers catching seafood; (2) the extent to which resident fish were used as food; and (3) the method of preparation of the fish to be consumed. Salmon were excluded from the survey because it was believed that they had little potential for contamination. The first half of this survey was conducted from early July to mid-September, 1980 and the second half from mid-September through most of November. During the summer months, interviewers visited each of four sub-areas of Commencement Bay on five mornings and five evenings; in the fall, the areas were sampled on four complete survey days. Interviews were conducted only with persons who had caught fish. The anglers were interviewed only once during the survey period. Data were recorded for species, wet weight, size of the living group (family), place of residence, fishing frequency, planned uses of the fish, age, sex, and race (Pierce et al., 1981). The analysis

of Pierce et al. (1981) did not employ explicit sampling weights (i.e., all weights were set to one).

There were 304 interviews in the summer and 204 in the fall. About 60% of anglers were White, 20% Black, and 19% Asian, and the rest were Hispanic or Native American. Table 10-52 gives the distribution of fishing frequency calculated by Pierce et al. (1981); for both the summer and fall, more than half of the fishermen caught and consumed fish weekly. The dominant (by weight) species caught were Pacific hake and walleye pollock. Pierce et al. (1981) did not present a distribution of fish intake or a mean fish intake rate.

Price et al. (1994) obtained the raw data from this survey and performed a re-analysis using sampling weights proportional to inverse fishing frequency. The rationale for these weights is explained in Section 10.1 and in the discussion of the Puffer et al. (1982) study (see Section 10.4.2.2). In the re-analysis, Price et al. (1994) calculated a median intake rate of 1.0 g/day and a 90th percentile rate of 13 g/day. The distribution of fishing frequency generated by Pierce et al. (1981) is shown in Table 10-52. Note that when equal weights were used, Price et al. (1994) found a median rate of 19 g/day (Table 10-53).

The same limitations apply to interpreting the results presented here to those presented in the discussion of Puffer et al. (1982) (see Section 10.4.2.2). As with the Puffer et al. (1982) data described in the following section, these values (1.0 g/day and 19 g/day) are both probably underestimates because the sampling probabilities are less than proportional to fishing frequency; thus, the true target population median is probably somewhat above 1.0 g/day, and the true 50th percentile of the resource utilization distribution is probably somewhat higher than 19 g/day. The data from this survey provide an indication of consumption patterns for the time period around 1980 in the Commencement Bay area. However, the data may not reflect current consumption patterns because fishing advisories were instituted due to local contamination. Another limitation of these data is that fish consumption rates were estimated indirectly from a series of assumptions.

10.4.2.2. *Puffer et al. (1982)—Intake Rates of Potentially Hazardous Marine Fish Caught in the Metropolitan Los Angeles Area*

Puffer et al. (1982) conducted a creel survey with sport fishermen in the Los Angeles area in 1980. The survey was conducted at 12 sites in the harbor and coastal areas to evaluate intake rates of potentially hazardous marine fish and shellfish by local, non-professional fishermen. It was conducted for the full 1980 calendar year, although inclement weather in January, February, and March limited the interview days. Each site was surveyed an average of three times per month, on different days, and at a different time of the day. The survey questionnaire was designed to collect information on demographic characteristics, fishing patterns, species, number of fish caught, and fish consumption patterns. Scales were used to obtain fish weights. Interviews were conducted only with anglers who had caught fish, and the anglers were interviewed only once during the entire survey period.

Puffer et al. (1982) estimated daily consumption rates (g/day) for each angler using the following equation:

$$K \times N \times W \times F)/[E \times 365] \qquad \text{(Eqn. 10-3)}$$

where:

K = edible fraction of fish (0.25 to 0.5 depending on species),
N = number of fish in catch,
W = average weight of (grams) fish in catch,
F = frequency of fishing/year, and
E = number of fish eaters in family/living group.

No explicit survey weights were used in analyzing this survey; thus, each respondent's data were given equal weight.

A total of 1,059 anglers were interviewed for the survey. Table 10-54 shows the ethnic and age distribution of respondents; 88% of respondents were male. The median intake rate was higher for Asian/Samoan anglers (median 70.6 g/day) than for other ethnic groups and higher for those ages over 65 years (median 113.0 g/day) than for other age groups. Puffer et al. (1982) found similar median intake rates for seasons: 36.3 g/day for November through March and 37.7 g/day for April through October. Puffer et al. (1982) also evaluated fish preparation methods; Appendix 10B presents these data. Table 10-55 presents the cumulative distribution of recreational fish (finfish and shellfish) consumption by survey respondents; this distribution was calculated only for those fishermen who indicated they eat the fish they catch. The median fish consumption rate was 37 g/day, and the

90th percentile rate was 225 g/day (Puffer et al., 1982). Table 10-56 presents a description of catch patterns for primary fish species kept.

As mentioned in the introduction to this chapter, intake distributions derived from analyses of creel surveys that did not employ weights reflective of sampling probabilities will overestimate the target population intake distribution and will, in fact, be more reflective of the "resource utilization distribution." Therefore, the reported median level of 37.3 g/day does not reflect the fact that 50% of the target population has intake above this level; instead, 50% of recreational fish consumption is by individuals consuming at or above 37 g/day. In order to generate an intake distribution reflective of that in the target population, weights inversely proportional to sampling probability need to be employed. Price et al. (1994) made this attempt with the Puffer et al. (1982) survey data, using inverse fishing frequencies as the sampling weights. Price et al. (1994) was unable to get the raw data for this survey, but through the use of frequency tables and the average level of fish consumption per fishing trip provided in Puffer et al. (1982), generated an approximate revised intake distribution. This distribution was dramatically lower than that obtained by Puffer et al. (1982); the median was estimated at 2.9 g/day [compared with 37 from Puffer et al. (1982)] and the 90th percentile at 35 g/day [compared to 225 g/day from Puffer et al. (1982)].

There are several limitations to the interpretation of the percentiles presented by both Puffer et al. (1982) and Price et al. (1994). As described in Appendix 10A, the interpretation of percentiles reported from creel surveys in terms of percentiles of the "resource utilization distribution" is approximate and depends on several assumptions. One of these assumptions is that sampling probability is proportional to inverse fishing frequency. In this survey, where interviewers revisited sites numerous times and anglers were not interviewed more than once, this assumption is not valid, though it is likely that the sampling probability is still highly dependent on fishing frequency, so that the assumption does hold in an approximate sense. The validity of this assumption also impacts the interpretation of percentiles reported by Price et al. (1994) because inverse frequency was used as sampling weights. It is likely that the value (2.9 g/day) of Price et al. (1994) underestimates somewhat the median intake in the target population but is much closer to the actual value than the Puffer et al. (1982) estimate of 37.3 g/day. Similar statements would apply about the 90th percentile. Similarly, the 37.3-g/day median value, if interpreted as the 50th percentile of the "resource utilization distribution," is also somewhat of an underestimate.

The fish intake distribution generated by Puffer et al. (1982) [and by Price et al. (1994)] was based only on fishermen who caught fish and ate the fish they caught. If all anglers were included, intake estimates would be somewhat lower. In contrast, the survey assumed that the number of fish caught at the time of the interview was all that would be caught that day. If it were possible to interview fishermen at the conclusion of their fishing day, intake estimates could be potentially higher. An additional factor potentially affecting intake rates is that fishing quarantines were imposed in early spring due to heavy sewage overflow (Puffer et al., 1982). These data are also over 20 years old and may not reflect current behaviors.

10.4.2.3. *Burger and Gochfeld (1991)—Fishing a Superfund Site: Dissonance and Risk Perception of Environmental Hazards by Fishermen in Puerto Rico*

Burger and Gochfeld (1991) examined fishing behavior, consumption patterns, and risk perceptions of fishermen and crabbers engaged in recreational and subsistence fishing in the Humacao Lagoons located in eastern Puerto Rico. For a 20-day period in February and March 1988, all persons encountered fishing and crabbing at the Humacao lagoons and at control sites were interviewed on fishing patterns, consumption patterns, cooking patterns, fishing and crabbing techniques, and consumption warnings. The control interviews were conducted at sites that were ecologically similar to the Humacao lagoons and contained the same species of fish and crabs. A total of 45 groups of people (3 to 4 people per group) fishing at the Humacao Lagoons and 17 control groups (3 to 4 people per group) were interviewed.

Most people fished in the late afternoon or evenings, and on weekends. Eighty percent of the fishing groups from the lagoons were male. The breakdown according to age is as follows: 27% were younger than 20 years, 49% were 21–40 years old, 24% were 41–60 years old, and 2% were over 60. The age groups for fishing were generally lower than the groups for crabbing. Caught fish were primarily tilapia and some tarpon. All crabs caught were blue crabs.

On average, people at Humacao ate about 7 fish ($N = 25$) or 13 crabs ($N = 20$) each week, while people fishing at the control site ate about 2 fish ($N = 9$) and 14 crabs ($N = 9$) a week (see Table 10-57). All of the crabbers (100%) and 96% of the

fisherman at the lagoons had heard of a contamination problem.

All the interviewees that knew of a contamination problem knew that the contaminant was mercury. Most fisherman and crabbers believed that the water was clean and the catch was safe (fisherman—96% and crabbers—100%), and all fisherman and crabbers ate their catch. Seventy-two percent of the fisherman and crabbers from the lagoons lived within 3 km, 18% lived 17–30 km away, and 1 group came from 66 km away. Because many of the people interviewed had cars, researchers concluded that they were not impoverished and did not need the fish as a protein substitute.

Burger and Gochfeld (1991) noted that fisherman and crabbers did not know of anyone who had gotten sick from eating catches from the lagoons, and the potential of chronic health effects did not enter into their consideration. The study concluded that fisherman and crabbers experienced an incompatibility between their own experiences, and the risk driven by media reports of pollution and the lack of governmental prohibition of fishing.

One limitation of the study is that consumption rates were based on groups not individuals. In addition, rates were given in terms of fish per week and not mass consumed per time or body weight.

10.4.2.4. *Burger et al. (1992)—Exposure Assessment for Heavy Metal Ingestion From Sport Fish in Puerto Rico: Estimating Risk for Local Fishermen*

Burger et al. (1992) conducted another study in conjunction with the Burger and Gochfeld (1991) study. The study interviewed 45 groups of fishermen at Humacao and 14 groups at Boqueron in Puerto Rico. The respondents were 80% male, 50% were 21 to 40 years old, most fished with pole or cast, and most fished for 1.5 hours. In Humacao, 96% claimed that they ate the entire fish besides the head. The fish were either fried or boiled in stews or soups.

In February and March, 64% of the group caught only tilapia, but respondents stated that in June they caught mostly robalo and tarpon. Generally, the fisherman stated that they ate 2.1 fish (maximum of 11 fish) from Boqueron and 6.8 fish (maximum of 23) from Humacao per week. The study reported that adults ate 374 grams of fish per day, while children ate 127 grams per day. In order to calculate the daily mass intake of fish, the study assumed that an adult ate 4.4 robalos, each weighing 595 grams over a 7-day period, and a child ate 1.5 robalos, each weighing 595 grams over a 7-day period. The study used a maximum consumption value of 200 g/day for fishermen to create various hazard indices.

One limitation of this study is that the consumption rates were based on groups not individuals. In addition, consumption rates were calculated using the average fish weight and the number of meals per week reported by the respondents.

10.4.2.5. *Moya and Phillips (2001)—Analysis of Consumption of Home-Produced Foods*

The 1987–1988 NFCS was also utilized to estimate consumption of home-produced (i.e., self-caught) fish (as well as home-produced fruits, vegetables, meats, and dairy products) in the general U.S. population. The methodology for estimating home-produced intake rates was rather complex and involved combining the household and individual components of the NFCS; the methodology, as well as the estimated intake rates, are described in detail in Chapter 13. Some of the data on fish consumption from households who consumed self-caught fish are also provided in Moya and Phillips (2001). A total of 2.1% of the total survey population reported self-caught fish consumption during the survey week. Among consumers, the mean intake rate was 2.07 g/kg-day, and the 95^{th} percentile was 7.83 g/kg-day; the mean per capita intake rate was 0.04 g/kg-day. Note that intake rates for home-produced foods were indexed to the weight of the survey respondent and reported in g/kg-day.

The NFCS household component contains the question "Does anyone in your household fish?" For the population answering yes to this question (21% of households), the NFCS data show that 9% consumed home-produced fish in the week of the survey; the mean intake rate for fish consumers from fishing households was 2.2 g/kg-day (all ages combined, see Table 13-20) for the fishing population. Note that 92% of individuals reporting home-produced fish consumption for the week of the survey indicated that a household member fishes; the overall mean intake rate among home-produced fish consumers, regardless of fishing status, was the above reported 2.07 g/kg-day). The mean per capita intake rate among all those living in fishing household is then calculated as 0.2 g/kg-day (2.2 × 0.09). Using the estimated average weight of survey participants of 59 kg, this translates into an average national per capita self-caught fish consumption rate of 11.8 g/day among the population of individuals who fish. However, this intake rate represents intake of both freshwater and saltwater fish combined. According to the data in Chapter 13 (see Table 13-68),

home-produced fish consumption accounted for 32.5% of total fish consumption among households who fish.

As discussed in Chapter 13 of this handbook, intake rates for home-produced foods, including fish, are based on the results of the household survey, and as such, reflect the weight of fish taken into the household. In most of the recreational fish surveys discussed later in this section, the weight of the fish catch (which generally corresponds to the weight taken into the household) is multiplied by an edible fraction to convert to an uncooked equivalent of the amount consumed. This fraction may be species specific, but some studies used an average value; these average values ranged from 0.3 to 0.5. Using a factor of 0.5 would convert the above 11.8 g/day rate to 5.9 g/day.

The advantage of this study is that it provides a national perspective on the consumption of self-caught fish. A limitation of this study is that these values include both freshwater and saltwater fish. The proportion of freshwater to saltwater is unknown and will vary depending on geographical location. Intake data cannot be presented for various age groups due to sample size limitations. The unweighted number of households, who responded positively to the survey question "do you fish"? was also low (i.e., 220 households).

10.4.2.6. *KCA Research Division (1994)—Fish Consumption of Delaware Recreational Fishermen and Their Households*

In support of the Delaware Estuary Program, the State of Delaware's Department of Natural Resources and Environmental Control conducted a survey of marine recreational fishermen along the coastal areas of Delaware between July 1992 and June 1993 (KCA Research Division, 1994). There were two components of the study: (1) a field survey of fishermen as they returned from their fishing trips, and (2) a telephone follow-up call.

The purpose of the first component was to obtain information on their fishing trips and on their household composition. This information included the method and location of fishing, number of fish caught and kept by species, and weight of each fish kept. Household information included race, age, sex, and number of persons in the household. Information was also recorded as to the location of the angler intercept (i.e., where the angler was interviewed) and the location of the household.

The purpose of the second component was to obtain information on the amount of fish caught and kept from the fishing trip and then eaten by the household. The methods used for preparing and cooking the fish were also documented.

The field portion of the study was designed to interview 2,000 anglers. Data were obtained from 1,901 anglers, representing 6,204 household members (KCA Research Division, 1994). While the primary goal of the study was to collect data on marine recreational fishing practices, the survey included some freshwater fishing and crabbing sites. Follow-up phone interviews typically occurred 2 weeks after the field interview and were used to gather information about consumption. Interviewers aided respondents in their estimation of fish intake by describing the weight of ordinary products, for the purpose of comparison to the quantity of fish eaten. Information on the number of fishing trips a respondent had taken during the month was used to estimate average annual consumption rates.

For all respondents, the average consumption was 17.5 g/day. Males were found to have consumed more fish than women, and Caucasians consumed more fish per day than the other races surveyed (see Table 10-58). More than half of the study respondents reported that they skinned the fish that they ate (i.e., 450 out of 807 who reported whether they skinned their catch); the majority ate filleted fish (i.e., 617 out of 794 who reported the preparation method used), and over half fried their fish (i.e., 506 out of 875 who reported the cooking method). Information on consumption relative to preparation method indicated a higher consumption level for skinned fish (0.627 oz/day) than for un-skinned fish (0.517 oz/day). Although most respondents fried their catch (0.553 oz/day), baking and broiling were also common (0.484 and 0.541 oz/day, respectively).

One limitation of this study is that information on fish consumption is based on anglers' recall of amount of fish eaten. While this study provides information on fish consumption of various ethnic groups, another limitation of this study is that the sample size for ethnic groups was very small. Also, the study was limited to one geographic area and may not be representative of the U.S. population.

10.4.2.7. *Santa Monica Bay Restoration Project (SMBRP) (1995)—Seafood Consumption Habits of Recreational Anglers in Santa Monica Bay, Los Angeles, CA*

The Santa Monica Bay Restoration Project (SMBRP) conducted a study on the seafood consumption habits of recreational anglers in Santa Monica Bay, CA. The study was conducted between September 1991 and August 1992. Surveys were conducted at 11 piers and jetties, three private boat

launches and hoists, 11 beach and intertidal sites, and five party boat landings. Information requested in the survey included fishing history, types of fish eaten, consumption habits, methods of preparing fish, and demographics. Consumption rates were calculated based on the anglers' estimates of meal size relative to a model fish fillet that represented a 150-gram meal. Interviewers identified 67 species of fish, 2 species of crustaceans, 2 species of mollusks, and 1 species of echinoderms that had been caught from the study area by recreational anglers during the study period. The most abundant species caught were chub mackerel, barred sand bass, kelp bass, white croaker, Pacific barracuda, and Pacific bonito.

A total of 2,376 anglers were censused during 113 separate surveys. Of those anglers, 1,243 were successfully interviewed, and 554 provided sufficient information for calculation of consumption rates. The socio-demographics of the sample population were as follows: most anglers were male (93%), 21 to 40 years old (54%), White (43%), and had an annual household income of $25,000 to $50,000 (39%).

The results of the survey showed that the mean consumption rate was 50 g/day, while the 90th percentile was over two times higher at 107 g/day (see Table 10-59). Of the identified ethnic groups, Asians had the highest mean consumption rate (51 g/day) and the highest 90th percentile value for consumption rate (116 g/day). Anglers with annual household incomes greater than $50,000 had the highest mean consumption rate (59 g/day) and the highest 90th percentile consumption rate (129 g/day). Species of fish that were consumed in larger amounts than other species included barred sand bass, Pacific barracuda, kelp bass, rockfish species, Pacific bonito, and California halibut.

About 77% of all anglers were aware of health warnings about consumption of fish from Santa Monica Bay. Of these anglers, 50% had altered their seafood consumption habits as a result of the warnings (46% stopped consuming some species, 25% ate less of all species, 19% stopped consuming all fish, and 10% ate less of some species). Most anglers in the ethnic groups surveyed were aware of the health-risk warnings, but Asian and White anglers were more likely to alter their consumption behavior based on these warnings.

One limitation of this study is the low numbers of anglers younger than 21 years of age. In this study, if several anglers from the same household were fishing, only the head of the household was interviewed. Hence, young individuals were frequently not interviewed and, therefore, are under-represented in this study.

It should also be noted that this study was not adjusted for avidity bias, but the California Office of Environmental Health Hazard Assessment has adjusted the distribution of fish consumption for avidity bias and other factors in the Air Toxics Hot Spots Program Risk Assessment Guidelines Part IV: Exposure Assessment and Stochastic Analysis Technical Support (see http://www.oehha.ca.gov/air/hot_spots/finalStoc.html).

10.4.2.8. *Florida State Department of Health and Rehabilitative Services (1995)—Health Study to Assess the Human Health Effects of Mercury Exposure to Fish Consumed From the Everglades*

A health study was conducted in two phases in the Everglades, Florida for the U.S. Department of Health and Human Services (Florida State Department of Health and Rehabilitative Services, 1995). The objectives of the first phase were to (a) describe the human populations at risk for mercury exposure through their consumption of fish and other contaminated animals from the Everglades and (b) evaluate the extent of mercury exposure in those persons consuming contaminated food and their compliance with the voluntary health advisory. The second phase of the study involved neurologic testing of all study participants who had total mercury levels in hair greater than 7.5 µg/g.

Study participants were identified by using special targeted screenings, mailings to residents, postings and multi-media advertisements of the study throughout the Everglades region, and direct discussions with people fishing along the canals and waterways in the contaminated areas. The contaminated areas were identified by the interviewers and long-term Everglade residents. Of a total of 1,794 individuals sampled, 405 individuals were eligible to participate in the study because they had consumed fish or wildlife from the Everglades at least once per month in the last 3 months of the study period. The majority of the eligible participants (>93%) were either subsistence fishermen, Everglade residents, or both. Subsistence fishermen were defined in the survey as "people who rely on fish and the wildlife of the Everglades as a source of dietary protein for themselves and their families." Of the total eligible participants, 55 individuals refused to participate in the survey. Useable data were obtained from 330 respondents ranging in age from 10–81 years of age (mean age 39 years ± 18.8) (Florida State Department of Health and Rehabilitative Services, 1995). Respondents were administered a three-page questionnaire from which demographic

information, fishing and eating habits, and other variables were obtained (Florida State Department of Health and Rehabilitative Services, 1995).

Table 10-60 shows the ranges, means, and standard deviations of selected characteristics by various groups of the survey population. Sixty-two percent of the respondents were male with a slight preponderance of Black individuals (43% White, 46% Black non-Hispanic, and 11% Hispanic). Most of the respondents reported earning an annual income of $15,000 or less per family before taxes (Florida State Department of Health and Rehabilitative Services, 1995). The mean number of years fished along the canals by the respondents was 15.8 years with a standard deviation of 15.8. The mean number of times per week fish consumers reported eating fish over the last 6 months and last month of the survey period were 1.8 and 1.5 per week with standard deviations of 2.5 and 1.4, respectively. Table 10-60 also indicates that 71% of the respondents reported knowing about the mercury health advisories. Of those who were aware, 26% reported that they had lowered their consumption of fish caught in the Everglades, while the rest (74%) reported no change in consumption patterns (Florida State Department of Health and Rehabilitative Services, 1995).

A limitation of this study is that fish intake rates (g/day) were not reported. Another limitation is that the survey was site limited and, therefore, not representative of the U.S. population. An advantage of this study is that it is one of the few studies targeting populations expected to have higher consumption rates.

10.4.2.9. *Alcoa (1998)—Draft Report for the Finfish/Shellfish Consumption Study—Alcoa (Point Comfort)/Lavaca Bay Superfund Site*

The Texas Saltwater Angler Survey was conducted in 1996/1997 to evaluate the quantity and species of finfish and shellfish consumed by individuals who fish at Lavaca Bay (Alcoa, 1998). The target population for this study was residents of three Texas counties: Calhoun, Victoria, and Jackson (over 70% of the anglers who fish Lavaca Bay are from these three counties). The random sample design specified that the population percentages for the counties should be as follows: 50% from Calhoun, 30% from Victoria, and 20% from Jackson.

Each individual in the sample population was sent an introductory note describing the study and then was contacted by telephone. People who agreed to participate and had taken fewer than six fishing trips to Lavaca Bay were interviewed by telephone. Persons who agreed to participate and had taken more than five fishing trips to Lavaca Bay were sent a mail survey with the same questions. A total of 1,979 anglers participated in this survey, representing a response rate greater than 68%. Data were collected from the households for men, women, and children.

The information collected as part of the survey included recreational fishing trip information for November 1996 (i.e., fishing site, site facilities, distance traveled, number and species caught), self-caught fish consumption (by the respondent, spouse and child, if applicable), opinions on different types of fishing experiences, and socio-demographics. Portion size for shellfish was determined by utilizing the number of shrimp, crabs, oysters, etc. that an individual consumed during a meal and the assumed tissue weight of the particular species of shellfish.

Table 10-61 presents the results of the study. Adult men consumed 25 grams of self-caught finfish per day while women consumed an average of 18 grams daily. Women of childbearing age consumed 19 grams per day, on average. Small children were found to consume 11 g/day, and youths consumed 16 g/day, on average. Less shellfish was consumed by all individuals than finfish. Men consumed an average of 2 g/day, women and youths an average of 1 g/day, and small children consumed less than 1 g/day of shellfish.

The study results also showed the number of average meals and portion sizes for the respondents, (see Table 10-62). On average, members of each cohort consumed slightly more than 3 meals per month of finfish, although small children and youths consumed slightly less than 3 meals per month of finfish and less than 1 meal per month of shellfish. For finfish, adult men consumed an average, per meal, portion size of 8 ounces, while women and youths consumed 7 ounces, and small children consumed less than 5 ounces per meal. The average number of shellfish meals consumed per month for all cohorts was less than one. Adult men consumed an average shellfish portion size of 4 ounces, women and youth 3 ounces, and small children consumed 2 ounces per meal.

The study also discussed the species composition of self-caught fish consumed by source. Four different sources of fish were included: fish consumed from the closure area, fish consumed from Lavaca Bay, fish consumed from all waters, and all self-caught finfish and shellfish consumed, including preserved (i.e., frozen or smoked) fish where the location of the catch is not known. Red drum comprised the bulk of total finfish grams consumed

from any area, while black drum represented the smallest amount of finfish grams consumed. Overall, almost 40% of all self-caught finfish consumed were red drum, followed by speckled sea trout, flounder, all other finfish (all species were not specifically examined in this study), and black drum. Out of all self-caught shellfish, oysters accounted for 37%, blue crabs for 35%, and shrimp for 29% of the total.

The study authors noted that because the survey relied on the anglers' recall of meal frequency and portion, fish consumption may have been overestimated. There was evidence of overestimation when the data were validated, and approximately 10% of anglers reported consuming more fish than what they caught and kept. Also, the study was conducted at one geographic location and may not be representative of the U.S. population.

10.4.2.10. *Burger et al. (1998)—Fishing, Consumption, and Risk Perception in Fisherfolk Along an East Coast Estuary*

Burger et al. (1998) examined fishing behavior, consumption patterns, and risk perceptions of 515 people that were fishing and crabbing in Barnegat Bay, NJ. This research also tested the null hypotheses that there are no sex differences in fishing behavior and consumption patterns and no sex differences in the perception of fish and crab safety.

The researchers interviewed 515 people who were fishing or crabbing on Barnegat Bay and Great Bay. Interviews were conducted from June 22 until September 27, 1996. Fifteen percent of the fishermen approached refused to be interviewed, usually because they did not have the time to participate. The questionnaire that researchers used to conduct the interviews contained questions about fishing behavior, consumption patterns, cooking patterns, warnings, and safety associated with the seafood, environmental problems, and changes in the Bay, and personal demographics.

Eighty-four percent of those who were interviewed were men, 95% were White, and the rest were evenly divided between African American, Hispanic, and Asian. The age of interviewees ranged from 13 to 92 years. The subjects fished an average of seven times per month and crabbed three times per month (see Table 10-63). Bluefish (*Pomatomus saltatrix*), fluke or summer flounder (*Paralichthys dentatus*), and weakfish (*Cynoscion regalis*) were the most frequently caught fish. The researchers found that the average consumption rate for people fishing along the Barnegat Bay was 5 fish meals per month (eating just under 10 ounces per meal) for an approximate total of 1,450 grams of fish per month (48.3 g/day). Most of the subjects (80%) ate the fish they caught.

The study found that there were significant differences in fishing behavior and consumption as a function of sex. Women had more children with them when fishing, and more women fished on foot along the Bay. The consumption by women included a significantly lower proportion of self-caught fish than men. Men ate significantly larger portions of fish per meal than did women, and men ate the whole fish more often. The study results showed that there were no sex differences with regard to the average number of fish caught or in fish size. Nearly 90% of the subjects believed the fish and crabs from Barnegat Bay were safe to eat, although approximately 40% of the subjects had heard warnings about their safety. The subjects generally did not have a clear understanding of the relationships between contaminants and fish size or trophic level. The researchers suggested that reducing the risk from contaminants does not necessarily involve a decrease in consumption rates but rather a change in the fish species and sizes consumed.

While the study provides some useful information on sex difference in fishing behavior and consumption, the study is limited in that the majority of the people surveyed were White males. There were low numbers for women and ethnic groups.

10.4.2.11. *Chiang (1998)—A Seafood Consumption Survey of the Laotian Community of West Contra Costa County, CA*

A survey of members of the Laotian community of West Contra Costa, CA, was conducted to obtain data on the fishing and fish consumption activities of this community. A questionnaire was developed and translated by the survey staff into the many ethnic languages spoken by the members of the Laotian community. The survey questions covered the following topics: demographics, fishing and fish consumption habits back home, current fishing and fish consumption habits, fish preparation methods, fish species commonly caught, fishing locations, and awareness of the health advisory for this area. A total of 229 people were surveyed.

Most respondents reported eating fish a few times per month, and the most common portion size was about 3 ounces. The mean amount of fish eaten per day was reported as 18.3 g/day, with a maximum of 182.3 g/day (see Table 10-64). "Fish consumers" were considered to be people who ate fish at least once a month, and this group made up 86.9% of the people surveyed. The mean fish consumption rate for this group ("fish consumers") averaged 21.4 g/day.

Catfish was most often mentioned when respondents were asked to name the fish they caught, but striped bass was the species reported caught most often by respondents. Soups/stews were reported as the most common preparation method of fish (86.4%) followed by frying (78.4%), and baking (63.6%).

Of all survey respondents, 48.5% reported having heard of the health advisory about eating fish and shellfish from San Francisco Bay. Of those that had heard the advisory, 59.5% reported recalling its contents, and 60.3% said that it had influenced their fishing and fish consumption patterns.

Some sectors of the Laotian community were not included in the survey such as the Lue, Hmong, and Lahu groups. However, it was noted that the groups excluded from the survey do not differ greatly from the sample population in terms of seafood consumption and fishing practices. The study authors also indicated that participants may have under-reported fishing and fish consumption practices due to recent publicity about contamination of the Bay, fear of losing disability benefits, and fear that the survey was linked to law enforcement actions about fishing from the Bay. Another limitation of the study involved the use of a 3-ounce fish fillet model to estimate portion size of fish consumed. The use of this small model may have biased respondents to choose a smaller portion size than what they actually eat. In addition, the study authors noted that the fillet model may not have been appropriate for estimating fish portions eaten by those respondents who eat "family style" meals.

10.4.2.12. *San Francisco Estuary Institute (SFEI) (2000)—Technical Report: San Francisco Bay Seafood Consumption Report*

A comprehensive study of 1,331 anglers was conducted by the California Department of Health Services between July 1998 and June 1999 at various recreational fishing locations in the San Francisco Bay area . The catching and consumption of 13 finned fish species and 3 shellfish species were investigated to determine the number of meals eaten from recreational and other sources such as restaurants and grocery stores. The method of fish preparation, including the parts of the fish eaten, was also documented. Information was gathered on the amount of fish consumed per meal, as well as respondents' ethnicity, age, income level, education, and the mode of fishing (e.g., pier, boat, and beach). Questions were also asked to ascertain the anglers' knowledge and response to local fish advisories. Respondents were asked to recall their fishing/consumption experiences within the previous 4 weeks. Anglers were not asked about the consumption habits of other members of their families.

About 15% of the anglers reported that they do not eat San Francisco Bay fish (whether self-caught or commercial). Of those who did consume Bay fish, 80% consumed about 1 fish meal per month or less; 10% ate about 2 fish meals per month; and 10% ate more than 2 fish meals per month, which is above the advisory level for fish. (The advisory level was 16 grams per day, or about two 8-ounce meals per 4 weeks.) Two-thirds of those consuming fish at levels above the advisory limit consumed more than twice the advisory limit. Difference in income, education, or fishing mode did not markedly change anglers' likelihood of eating in excess of the advisory limit. African Americans and Filipino anglers reported higher consumption levels than Caucasians (see Table 10-65). The overall mean consumption rate was 23 g/day.

More than 50% of the finfish caught by anglers were striped bass, and about 25% were halibut. Approximately 15% of the anglers caught each of the following fish: jacksmelt, sturgeon, and white croaker. All other species were caught by less than 10% of the anglers. For white croaker fish consumption: (1) lower income anglers consumed statistically more fish than mid- and upper-level income anglers, (2) anglers who did not have a high school education consumed more than those anglers with higher education levels, and (3) anglers of Asian descent consumed significantly more than anglers of other ethnic backgrounds. Asian anglers were more likely to eat fish skin, cooking juices, and raw fish than other anglers. These portions of the fish are believed to be more likely to contain higher levels of contamination. Likewise, skin consumption was higher for lower income and shore-based anglers. Anglers who had eaten Bay fish in the previous 4 weeks indicated, in general, that they were likely to have eaten 1 fish meal from another source in the same time period.

More than 60% of the anglers interviewed reported having knowledge of the health advisories. Of that 60%, only about one-third reported changing their fish-consumption behavior.

A limitation of this study is that the sample size for ethnic groups was very small. Data are also specific to the San Francisco Bay area and may not be representative of anglers in other locations.

10.4.2.13. *Burger (2002a)—Consumption Patterns and Why People Eat Fish*

Burger (2002a) evaluated fishing behavior and consumption patterns among 267 anglers who were interviewed at locations around Newark Bay and the New York-New Jersey Harbor estuary in 1999. Among the 267 study respondents, 13% were Asian, 21% were Hispanic, 23% were Black, and 43% were White. Survey participants provided demographic information as well as information on their fish and crab consumption, knowledge of fishing advisories, and reasons for angling. Individual monthly fish consumption was estimated by multiplying the reported number of fish meals eaten per month by an average portion size, based on comparisons to a three-dimensional model of an 8-ounce fish fillet. Individual monthly crab consumption was estimated by multiplying the reported number of crabs eaten per month by the edible portion of crab, which was assumed to weigh 70 grams. Yearly fish and crab consumption was estimated by multiplying the monthly consumption rates by the number of months in a year over which the survey respondents reported eating self-caught fish or crabs. Intake rates were provided separately for those who fished only (44%), for those who crabbed only (44%), and for respondents who reported both fishing and crabbing (12%) (Burger, 2002a). Burger (2002a) also reported that more than 30% of the respondents reported that they did not eat the fish or crabs that they caught. Table 10-66 provides the average daily intake rates of fish and crab. U.S. EPA calculated these average daily intake rates by dividing the yearly intake rates provided by Burger (2002a) by 365 days/year.

Burger (2002a) also evaluated potential differences in consumption based on age, income, and race/ethnicity. Consumption was found to be negatively correlated with mean income and positively correlated with age for fish, but not crabs. An evaluation of differences based on ethnicity indicated that Whites were the least likely to eat their catch than other groups; 49% of Whites, 40% of Hispanics, 24% of Asians, and 22% of Blacks reported that they did not eat the fish or crabs that they caught. Among all ethnicities most people indicated that they fished (63%) or crabbed (68%) for recreational purposes, and very few (4%) reported that they angled to obtain food.

The advantages of this study are that it provides information for both fish and crab intake, and that it provides data on intake over a longer period of time than many of the other studies summarized in this chapter. However, the data are for individuals living in the Newark Bay area and may not be representative of the U.S. population as a whole. Also, there may be uncertainties in long-term intake estimates that are based on recall.

10.4.2.14. *Mayfield et al. (2007)—Survey of Fish Consumption Patterns of King County (Washington) Recreational Anglers*

Mayfield et al. (2007) conducted a series of fish consumption surveys among recreational anglers at marine and freshwater sites in King County, WA. The marine surveys were conducted between 1997 and 2002 at public parks and boat launches throughout Elliot Bay and the Duwamish River, and at North King County marine locations. The numbers of individuals interviewed at these three locations were 807, 152, and 228, respectively. The majority of participants were male, 15 years and older, and were either Caucasian or Asian and Pacific Islander. Data were collected on fishing location preferences, fishing frequency, consumption amounts, species preferences, cooking methods, and whether family members would also consume the catch. Respondent demographic data were also collected. Consumption rates were estimated using information on fishing frequency, weight of the catch, a cleaning factor, and the number of individuals consuming the catch. Mean recreational marine fish and shellfish consumption rates were 53 g/day and 25 g/day, respectively (see Table 10-67). Mayfield et al. (2007) also reported differences in intake according to ethnicity. Mean marine fish intake rates were 73, 60, 50, 43, and 35 g/day for Native American, Caucasian, Asian and Pacific Islander, African American, and Hispanic/Latino respondents, respectively.

The advantages of this study are that it provides additional perspective on recreational marine fish intake. However, the data are limited to a specific area of the United States and may not be representative of anglers in other locations.

10.5. FRESHWATER RECREATIONAL STUDIES

10.5.1. Fiore et al. (1989)—Sport Fish Consumption and Body Burden Levels of Chlorinated Hydrocarbons: A Study of Wisconsin Anglers

This survey, reported by Fiore et al. (1989), was conducted to assess socio-demographic factors and sport-fishing habits of anglers, to evaluate anglers' comprehension of and compliance with the Wisconsin Fish Consumption Advisory, to measure body burden levels of polychlorinated biphenyls (PCBs) and Dichlorodiphenyldichloroethylene

(DDE) through analysis of blood serum samples, and to examine the relationship between body burden levels and consumption of sport-caught fish. The survey targeted all Wisconsin residents who had purchased fishing or sporting licenses in 1984 in any of 10 pre-selected study counties. These counties were chosen in part based on their proximity to water bodies identified in Wisconsin fish advisories. A total of 1,600 anglers were sent survey questionnaires during the summer of 1985.

The survey questionnaire included questions about fishing history, locations fished, species targeted, kilograms caught for consumption, overall fish consumption (including commercially caught), and knowledge of fish advisories. The recall period was 1 year.

A total of 801 surveys were returned (50% response rate). Of these, 601 (75%) were from males and 200 from females; the mean age was 37 years. Fiore et al. (1989) reported that the mean number of fish meals for 1984 for all respondents was 18 for sport-caught meals and 24 for non-sport-caught meals. Fiore et al. (1989) assumed that each fish meal consisted of 8 ounces (227 grams) of fish to generate means and percentiles of fish intake. The reported mean and 95th percentile intake rate of sport-caught fish for all respondents were 11.2 g/day and 37.3 g/day, respectively. Among consumers, who comprised 91% of all respondents, the mean sport-caught fish intake rate was 12.3 g/day, and the 95th percentile was 37.3 g/day. The mean daily fish intake from all sources (both sport-caught and commercial) was 26.1 g/day, with a 95th percentile of 63.4 g/day. The 95th percentile of 37.3 g/day of sport caught fish represents 60 fish meals per year; the 95th percentile of 63.4 g/day of total fish intake represents 102 fish meals per year.

U.S. EPA obtained the raw data from this study and calculated the distribution of the number of sport-caught fish meals and the distribution of fish intake rates using the same meal size (227 g/meal) used by Fiore et al. (1989). This meal size is higher than the mean meal size of 114 g/meal, but similar to the 90th percentile meal size for general population adults (age 20–39 years) reported in a study by Smiciklas-Wright et al. (2002). However, because data for the general population may underestimate meal size for anglers, use of an upper percentile general population value may reflect higher intake among anglers. This is supported by data from other studies in the literature that have shown that the average meal size for sport fishing populations is higher than those of the general population. For example, Balcom et al. (1999) reported an average meal size for sport-caught fish for the angler population of 7.3 ounces (i.e., 207 grams), while the average meal size for the general population was 5 ounces (142 grams). Other studies reported similar meal sizes for sport-caught fish. West et al. (1989) stated that the meal size most often reported in their survey was 8 ounces (i.e., 227 grams), and Connelly et al. (1996) estimated an average meal size of 216 grams. Another study reported an average meal size of 376 grams (Burger et al., 1999). Therefore, the meal size used by Fiore et al. (1989) was deemed reasonable to represent a mean value for the population of sport anglers. Table 10-68 presents distributions of fish consumption using a meal size of 227 grams.

This study is limited in its ability to accurately estimate intake rates because of the absence of data on weight of fish consumed. Another limitation of this study is that the results are based on 1-year recall, which may tend to over-estimate the number of fishing trips (Ebert et al., 1993). In addition, the response rate was rather low (50%).

10.5.2. West et al. (1989)—Michigan Sport Anglers Fish Consumption Survey

The Michigan Sport Anglers Fish Consumption Survey (West et al., 1989) surveyed a stratified random sample of Michigan residents with fishing licenses. The sample was divided into 18 cohorts, with one cohort receiving a mail questionnaire each week between January and May 1989. The survey included both a short-term recall component, and a usual frequency component. For the short-term recall component, respondents were asked to identify all household members and list all fish meals consumed by each household member during the past 7 days. Information on the source of the fish for each meal was also requested (self-caught, gift, market, or restaurant). Respondents were asked to categorize serving size by comparison with pictures of 8-ounce fish portions; serving sizes could be designated as either “about the same size,” “less,” or “more” than the size pictured. Data on fish species, locations of self-caught fish, and methods of preparation and cooking were also obtained.

The usual frequency component of the survey asked about the frequency of fish meals during each of the four seasons and requested respondents give the overall percentage of household fish meals that came from recreational sources. A sample of 2,600 individuals was selected from state records to receive survey questionnaires. A total of 2,334 survey questionnaires were deliverable, and 1,104 were completed and returned, giving a response rate of 47.3%.

In the analysis of the survey data by West et al. (1989), the authors did not attempt to generate the distribution of recreationally caught fish intake in the survey population. U.S. EPA obtained the raw data of this survey for the purpose of generating fish intake distributions and other specialized analyses.

As described elsewhere in this handbook, percentiles of the distribution of average daily intake reflective of long-term consumption patterns cannot, in general, be estimated using short-term (e.g., 1 week) data. Such data can be used to adequately estimate mean average daily intake rates (reflective of short- or long-term consumption); in addition, short-term data can serve to validate estimates of usual intake based on longer recall.

U.S. EPA first analyzed the short-term data with the intent of estimating mean fish intake rates. In order to compare these results with those based on usual intake, only respondents with information on both short-term and usual intake were included in this analysis. For the analysis of the short-term data, U.S. EPA modified the serving size weights used by West et al. (1989), which were 5, 8, and 10-ounces, respectively, for portions that were less, about the same, and more than the 8-ounce picture. U.S. EPA examined the percentiles of the distribution of fish meal sizes reported in Pao et al. (1982) derived from the 1977–1978 USDA National Food Consumption Survey and observed that a lognormal distribution provided a good visual fit to the percentile data. Using this lognormal distribution, the mean values for serving sizes greater than 8 ounces and for serving sizes at least 10% greater than 8 ounces were determined. In both cases, a serving size of 12 ounces was consistent with the Pao et al. (1982) distribution. The weights used in the U.S. EPA analysis then were 5, 8, and 12 ounces for fish meals described as less, about the same, and more than the 8-ounces picture, respectively. The mean serving size from Pao et al. (1982) was about 5 ounces, well below the value of 8 ounces most commonly reported by respondents in the West et al. (1989) survey.

Table 10-69 displays the mean number of total and recreational fish meals for each household member based on the 7-day recall data. Also shown are mean fish intake rates derived by applying the weights described above to each fish meal. Intake was calculated on both g/day and g/kg body weight-day bases. This analysis was restricted to individuals who eat fish and who reside in households reporting some recreational fish consumption during the previous year. About 75% of survey respondents (i.e., licensed anglers) and about 84% of respondents who fished in the prior year reported some household recreational fish consumption.

The U.S. EPA analysis next attempted to use the short-term data to validate the usual intake data. West et al. (1989) asked the main respondent in each household to provide estimates of their usual frequency of fishing and eating fish, by season, during the previous year. The survey provides a series of frequency categories for each season, and the respondent was asked to check the appropriate range. The ranges used for all questions were almost daily, 2–4 times a week, once a week, 2–3 times a month, once a month, less often, none, and don't know. For quantitative analysis of the data, it is necessary to convert this categorical information into numerical frequency values. As some of the ranges are relatively broad, the choice of conversion values can have some effect on intake estimates. In order to obtain optimal values, the usual fish eating frequency reported by respondents for the season during which the questionnaire was completed was compared to the number of fish meals reportedly consumed by respondents over the 7-day short-term recall period.

The results of these comparisons are displayed in Table 10-70; it shows that, on average, there is general agreement between estimates made using 1-year recall and estimates based on 7-day recall. The average number of meals (1.96/week) was at the bottom of the range for the most frequent consumption group with data (2–4 meals/week). In contrast, for the lower usual frequency categories, the average number of meals was at the top, or exceeded the top of category range. This suggests some tendency for relatively infrequent fish eaters to underestimate their usual frequency of fish consumption. The last column of the table shows the estimated fish eating frequency per week that was selected for use in making quantitative estimates of usual fish intake. These values were guided by the values in the second column, except that frequency values that were inconsistent with the ranges provided to respondents in the survey were avoided.

Using the four seasonal fish-eating frequencies provided by respondents and the above conversions for reported intake frequency, U.S. EPA estimated the average number of fish meals per week for each respondent. This estimate, as well as the analysis above, pertains to the total number of fish meals eaten (in Michigan) regardless of the source of the fish. Respondents were not asked to provide a seasonal breakdown for eating frequency of recreationally caught fish; rather, they provided an overall estimate for the past year of the percent of fish they ate that was obtained from different sources. U.S. EPA estimated the annual frequency of recreationally caught fish meals by multiplying the estimated total number of fish meals by the reported

percent of fish meals obtained from recreational sources; recreational sources were defined as either self-caught or a gift from family or friends.

The usual intake component of the survey did not include questions about the usual portion size for fish meals. In order to estimate usual fish intake, a portion size of 8 ounces was applied (the majority of respondents reported this meal size in the 7-day recall data). Individual body-weight data were used to estimate intake on a g/kg-day basis. Table 10-71 displays the fish intake distribution estimated by U.S. EPA.

The distribution shown in Table 10-71 is based on respondents who consumed recreational caught fish. As mentioned above, these represent 75% of all respondents and 84% of respondents who reported having fished in the prior year. Among this latter population, the mean recreational fish intake rate is 14.4 × 0.84 = 12.1 g/day; the value of 38.7 g/day (95^{th} percentile among consumers) corresponds to the 95.8^{th} percentile of the fish intake distribution in this (fishing) population.

The advantages of this data set and analysis are that the survey was relatively large and contained both short-term and usual intake data. The presence of short-term data allowed validation of the usual intake data, which were based on long-term recall; thus, some of the problems associated with surveys relying on long-term recall are mitigated here.

The response rate of this survey, 47%, was relatively low. In addition, the usual fish intake distribution generated here employed a constant fish meal size, 8 ounces. Although use of this value as an average meal size was validated by the short-term recall results, the use of a constant meal size, even if correct on average, may seriously reduce the variation in the estimated fish intake distribution.

This study was conducted in the winter and spring months of 1988. This period does not include the summer months, when peak fishing activity can be anticipated, leading to the possibility that intake results based on the 7-day recall data may understate individuals' usual (annual average) fish consumption. A second survey by West et al. (1993) gathered diary data on fish intake for respondents spaced over a full year. However, this later survey did not include questions about usual fish intake and has not been re-analyzed here. The mean recreational fish intake rates derived from the short-term and usual components were quite similar, however, 14.0 versus 14.4 g/day.

10.5.3. ChemRisk (1992)—Consumption of Freshwater Fish by Maine Anglers

ChemRisk conducted a study to characterize the rates of freshwater fish consumption among Maine residents (Ebert et al., 1993; ChemRisk, 1992). Because the only dietary source of local freshwater fish is recreational fish, the anglers in Maine were chosen as the survey population. The survey was designed to gather information on the consumption of fish caught by anglers from flowing (rivers and streams) and standing (lakes and ponds) water bodies. Respondents were asked to recall the frequency of fishing trips during the 1989–1990 ice-fishing season, and the 1990 open water season, the number of fish species caught during both seasons, and to estimate the number of fish consumed from 15 fish species. The respondents were also asked to describe the number, species, and average length of each sport-caught fish consumed that had been gifts from other members of their households or other households. The weight of fish consumed by anglers was calculated by first multiplying the estimated weight of the fish by the edible fraction and then dividing this product by the number of intended consumers. Species-specific regression equations were utilized to estimate weight from the reported fish length. The edible fractions used were 0.4 for salmon, 0.78 for Atlantic smelt, and 0.3 for all other species (Ebert et al., 1993).

A total of 2,500 prospective survey participants were randomly selected from a list of anglers licensed in Maine. The surveys were mailed in during October 1990. Because this was before the end of the open fishing season, respondents were also asked to predict how many more open water fishing trips they would undertake in 1990.

ChemRisk (1992) and Ebert et al. (1993) calculated distributions of freshwater fish intake for two populations, "all anglers" and "consuming anglers." All anglers were defined as licensed anglers who fished during either the 1989–1990 ice-fishing season or the 1990 open-water season (consumers and non-consumers) and licensed anglers who did not fish but consumed freshwater fish caught in Maine during these seasons. "Consuming anglers" were defined as those anglers who consumed freshwater fish obtained from Maine sources during the 1989-1990 ice fishing or 1990 open water fishing season. In addition, the distribution of fish intake from rivers and streams was also calculated for two populations, those fishing on rivers and streams ("river anglers"), and those consuming fish from rivers and streams ("consuming river anglers").

A total of 1,612 surveys were returned, giving a response rate of 64%; 1,369 (85%) of the 1,612 respondents were included in the "all angler" population, and 1,053 (65%) were included in the "consuming angler" population. Table 10-72 presents freshwater fish intake distributions. The mean and 95th percentile were 5.0 g/day and 21.0 g/day, respectively, for "all anglers," and 6.4 g/day and 26.0 g/day, respectively, for "consuming anglers." Table 10-72 also presents intake distributions for fish caught from rivers and streams. Among "river anglers," the mean and 95th percentile were 1.9 g/day and 6.2 g/day, respectively, while among "consuming river anglers," the mean and the 95th percentile were 3.7 g/day and 12.0 g/day, respectively. Table 10-73 presents fish intake distributions by ethnic group for consuming anglers. The highest mean intake rates reported are for Native Americans (10 g/day) and French Canadians (7.4 g/day). Because there was a low number of respondents for Hispanics, Asian/Pacific Islanders, and African Americans, intake rates within these groups were not calculated (ChemRisk, 1992).

Table 10-74 presents the consumption, by species, of freshwater fish caught. The largest species consumption was salmon from ice fishing (~292,000 grams); white perch (380,000 grams) for lakes and ponds; and Brook trout (420,000 grams) for rivers and streams (ChemRisk, 1992).

U.S. EPA obtained the raw data tapes from the marine anglers survey and performed some specialized analyses. One analysis involved examining the percentiles of the "resource utilization distribution" (this distribution was defined in Section 10.1). The 50th, or more generally, the p^{th} percentile of the resource utilization distribution, is defined as the consumption level such that p percent of the resource is consumed by individuals with consumptions below this level and 100–p percent by individuals with consumptions above this level. U.S. EPA found that 90% of recreational fish consumption was by individuals with intake rates above 3.1 g/day, and 50% was by individuals with intakes above 20 g/day. Those above 3.1 g/day make up about 30% of the "all angler" population, and those above 20 g/day make up about 5% of this population; thus, the top 5% of the angler population consumed 50% of the recreational fish catch.

U.S. EPA also performed an analysis of fish consumption among anglers and their families. This analysis was possible because the survey included questions on the number, sex, and age of each individual in the household and whether the individual consumed recreationally caught fish. The total population of licensed anglers in this survey and their household members was 4,872; the average household size for the 1,612 anglers in the survey was thus 3.0 persons. Fifty-six percent of the population was male, and 30% was 18 or under.

A total of 55% of this population was reported to consume freshwater recreationally caught fish in the year of the survey. The sex and ethnic distribution of the consumers was similar to that of the overall population. The distribution of fish intake among the overall household population, or among consumers in the household, can be calculated under the assumption that recreationally caught fish was shared equally among all members of the household reporting consumption of such fish (note this assumption was used above to calculate intake rates for anglers). With this assumption, the mean intake rate among consumers was 5.9 g/day, with a median of 1.8 g/day, and a 95th percentile of 23.1 g/day; for the overall population, the mean was 3.2 g/day and the 95th percentile was 14.1 g/day.

The results of this survey can be put into the context of the overall Maine population. The 1,612 anglers surveyed represent about 0.7% of the estimated 225,000 licensed anglers in Maine. It is reasonable to assume that licensed anglers and their families will have the highest exposure to recreationally caught freshwater fish. Thus, to estimate the number of persons in Maine with recreationally caught freshwater fish intake above, for instance, 6.5 g/day (the 80th percentile among household consumers in this survey), one can assume that virtually all persons came from the population of licensed anglers and their families. The number of persons above 6.5 g/day in the household survey population is calculated by taking 20% (i.e., 100–80%) of the consuming population in the survey; this number then is $0.2 \times (0.55 \times 4{,}872) = 536$. Dividing this number by the sampling fraction of 0.007 (0.7%), gives about 77,000 persons above 6.5 g/day of recreational freshwater fish consumption statewide. The 1990 census showed the population of Maine to be 1.2 million people; thus, the 77,000 persons above 6.5 g/day represent about 6% of the state's population.

ChemRisk (1992) reported that the fish consumption estimates were based upon the following assumptions: a 40% estimate as the edible portion of landlocked and Atlantic salmon; inclusion of the intended number of future fishing trips and an assumption that the average success and consumption rates for the individual angler during the trips already taken would continue through future trips. The data collected for this study were based on recall and self-reporting, which may have resulted in a biased estimate. The social desirability of the sport and

frequency of fishing are also bias-contributing factors; successful anglers are among the highest consumers of freshwater fish (ChemRisk, 1992). Additionally, fish advisories are in place in these areas and may affect the rate of fish consumption among anglers. The survey results showed that in 1990, 23% of all anglers consumed no freshwater fish, and 55% of the river anglers ate no freshwater fish. An advantage of this study is that the sample size is rather large.

10.5.4. Connelly et al. (1992)—Effects of Health Advisory and Advisory Changes on Fishing Habits and Fish Consumption in New York Sport Fisheries

Connelly et al. (1992) conducted a study to assess the awareness and knowledge of New York anglers about fishing advisories and contaminants found in fish and their fishing and fish consuming behaviors. The survey sample consisted of 2,000 anglers with New York State fishing licenses for the year beginning October 1, 1990, through September 30, 1991. A questionnaire was mailed to the survey sample in January 1992. The questionnaire was designed to measure catch and consumption of fish, as well as methods of fish preparation and knowledge of and attitudes towards health advisories (Connelly et al., 1992). The survey-adjusted response rate was 52.8% (1,030 questionnaires were completed, and 51 were not deliverable).

The average and median number of fishing days per year were 27 and 15 days, respectively (Connelly et al., 1992). The mean number of sport-caught fish meals was 11 meals/year. The maximum number of meals consumed was 757 meals/year. About 25% of anglers reported that they did not consume sport-caught fish.

Connelly et al. (1992) found that 80% of anglers statewide did not eat listed species or ate them within advisory limits and followed the 1 sport-caught fish meal per week recommended maximum. The other 20% of anglers exceeded the advisory recommendations in some way; 15% ate listed species above the limit, and 5% ate more than one sport-caught meal per week.

Connelly et al. (1992) found that respondents eating more than 1 sport-caught meal per week were just as likely as those eating less than one meal per week to know the recommended level of sport-caught fish consumption, although less than 1/3 in each group knew the level. An estimated 85% of anglers were aware of the health advisory. Over 50% of respondents said that they made changes in their fishing or fish consumption behaviors in response to health advisories.

The advisory included a section on methods that can be used to reduce contaminant exposure. Respondents were asked what methods they used for fish cleaning and cooking.

A limitation of this study with respect to estimating fish intake rates is that only the number of sport-caught meals was ascertained, not the weight of fish consumed. The fish meal data can be converted to a mean intake rate (g/day) by assuming a meal size of 227 g/meal (i.e., 8 ounces). This value corresponds to the adult general population 90^{th} percentile meal size derived from Smiciklas-Wright et al. (2002). The resulting mean intake rate among the angler population would be 6.8 g/day. However, about 25% of this population reported no sport-caught fish consumption. Therefore, the mean consumption rate among consuming anglers would be 27.4 g/day (i.e., 6.8 g/day divided by 0.25).

The major focus of this study was not on consumption, per se, but on the knowledge of and impact of fish health advisories; Connelly et al. (1992) provides important information on these issues.

10.5.5. Hudson River Sloop Clearwater, Inc. (1993)—Hudson River Angler Survey

Hudson River Sloop Clearwater, Inc. (1993) conducted a survey of adherence to fish consumption health advisories among Hudson River anglers. All fishing has been banned on the upper Hudson River where high levels of PCB contamination are well documented; while voluntary recreational fish consumption advisories have been issued for areas south of the Troy Dam (Hudson River Sloop Clearwater, 1993).

The survey consisted of direct interviews with 336 shore-based anglers between the months of June and November 1991, and April and July 1992. Table 10-75 presents socio-demographic characteristics of the respondents. The survey sites were selected based on observations of use by anglers, and legal accessibility. The selected sites included upper-, mid-, and lower- Hudson River sites located in both rural and urban settings. The interviews were conducted on weekends and weekdays during morning, midday, and evening periods. The anglers were asked specific questions concerning: fishing and fish consumption habits; perceptions of presence of contaminants in fish; perceptions of risks associated with consumption of recreationally caught fish; and awareness of, attitude toward, and response to fish consumption advisories or fishing bans.

Approximately 92% of the survey respondents were male. The following statistics were provided by Hudson River Sloop Clearwater, Inc. (1993). The most common reason given for fishing was for recreation or enjoyment. Over 58% of those surveyed indicated that they eat their catch. Of those anglers who eat their catch, 48% reported being aware of advisories. Approximately 24% of those who said they currently do not eat their catch have done so in the past. Anglers were more likely to eat their catch from the lower Hudson areas where health advisories, rather than fishing bans, have been issued. Approximately 94% of Hispanic Americans were likely to eat their catch, while 77% of African Americans and 47% of Caucasian Americans intended to eat their catch. Of those who eat their catch, 87% were likely to share their meal with others (including women of childbearing age, and children under the age of 15).

For subsistence anglers, more low-income than upper-income anglers eat their catch (Hudson River Sloop Clearwater, 1993). Approximately 10% of the respondents stated that food was their primary reason for fishing; this group is more likely to be in the lowest per capita income group (Hudson River Sloop Clearwater, 1993).

The average frequency of fish consumption reported was just under 1 (0.9) meal over the previous week, and 3 meals over the previous month. Approximately 35% of all anglers who eat their catch exceeded the amounts recommended by the New York State health advisories. Less than half (48%) of all the anglers interviewed were aware of the State health advisories or fishing bans. Only 42% of those anglers aware of the advisories have changed their fishing habits as a result.

The advantages of this study include in-person interviews with 95% of all anglers approached; field-tested questions designed to minimize interviewer bias; and candid responses concerning consumption of fish from contaminated waters. The limitations of this study are that specific intake amounts are not indicated, and that only shore-based anglers were interviewed.

10.5.6. West et al. (1993)—Michigan Sport Anglers Fish Consumption Study, 1991–1992

West et al. (1993) conducted a survey financed by the Michigan Great Lakes Protection Fund, as a follow-up to the earlier 1989 Michigan survey described previously. The major purpose of 1991–1992 survey was to provide short-term recall data of recreational fish consumption over a full year period; the 1989 survey, in contrast, was conducted over only a half year period (West et al., 1993).

This survey was similar in design to the 1989 Michigan survey. A sample of 7,000 persons with Michigan fishing licenses was drawn, and surveys were mailed in 2-week cohorts over the period January 1991 to January 1992. Respondents were asked to report detailed fish consumption patterns during the preceding 7 days, as well as demographic information; they were also asked if they currently eat fish. Enclosed with the survey were pictures of about a half pound of fish. Respondents were asked to indicate whether reported consumption at each meal was more, less, or about the same as the picture. Based on responses to this question, respondents were assumed to have consumed ten, 5- or 8-ounce portions of fish, respectively.

A total of 2,681 surveys were returned. West et al. (1993) calculated a response rate for the survey of 46.8%; this was derived by removing from the sample those respondents who could not be located or who did not reside in Michigan for at least 6 months.

Of these 2,681 respondents, 2,475 (93%) reported that they currently eat fish; all subsequent analyses were restricted to the current fish eaters. The mean fish consumption rates were found to be 16.7 g/day for sport fish and 26.5 g/day for total fish (West et al., 1993). Table 10-76 shows mean sport-fish consumption rates by demographic categories. Rates were higher among minorities, people with low income, and people residing in smaller communities. Consumption rates in g/day were also higher in males than in females; however, this difference would likely disappear if rates were computed on a g/kg-day basis.

West et al. (1993) estimated the 80^{th} percentile of the survey fish consumption distribution. More extensive percentile calculations were performed by U.S. EPA (1995) using the raw data from the West et al. (1993) survey. However, because this survey only measured fish consumption over a short (1 week) interval, the resulting distribution will not be indicative of the long-term fish consumption distribution, and the upper percentiles reported from the U.S. EPA analysis will likely considerably overestimate the corresponding long-term percentiles. The overall 95^{th} percentile calculated by U.S. EPA (1995) was 77.9; this is about double the 95^{th} percentile estimated using yearlong consumption data from the 1989 Michigan survey.

The limitations of this survey are the relatively low response rate and the fact that only three categories were used to assign fish portion size. The main study strengths were its relatively large size and its reliance on short-term recall.

10.5.7. Alabama Dept. of Environmental Management (ADEM) (1994)—Estimation of Daily Per Capita Freshwater Fish Consumption of Alabama Anglers

The Alabama Department of Environmental Management (1994) conducted a fish consumption survey of sport-fishing Alabama anglers during the time period from August 1992 to August 1993. The target population included all anglers who were Alabama residents. The survey design consisted of personal interviews given to sport fishermen at the end of their fishing trips at 23 sampling sites. Each sampling site was surveyed once during each season (summer, fall, winter, and spring). The survey was conducted for 2 consecutive days, either a Friday and Saturday or a Sunday and Monday. This approach minimized single-day-type bias and maximized surveying the largest number of anglers because a large amount of fishing occurs on weekends. Anglers were asked about consumption of fish caught at the sampling site as well as consumption of fish caught from other lakes and rivers in Alabama.

A total of 1,586 anglers were interviewed during the entire study period, of which, 83% reported eating fish they caught from the sampling sites (1,313 anglers). The number of anglers interviewed during each season was as follows: 488 during the summer, 363 during the fall, 224 during the winter, and 511 during the spring. Fish consumption rates were estimated using two methods: the 4-ounce Serving Method and the Harvest Method. The 4-ounce Serving Method estimated consumption based on a typical 4-ounce serving size. The Harvest Method used the actual harvest of fish and dressing method reported. All of the 1,313 anglers were used in the mean estimates of daily consumption based on the 4-ounce Serving Method, while only 563 anglers were utilized in the calculations of mean estimates of daily consumption, based on the Harvest Method.

Table 10-77 shows the results of the survey. Adults consumed an annual average of 32.6 g/day using the Harvest Method, calculated from study sites, and an annual average of 43.1 g/day using the Harvest Method, calculated from study sites plus other Alabama lakes and rivers. The survey also showed that adults consumed an annual average of 30.3 g/day using the 4-ounce Serving Method, calculated from study sites, and an annual average of 45.8 g/day using the 4-ounce Serving Method, calculated from study sites plus other Alabama lakes and rivers. When the entire sample was pooled, and a mean was taken over all respondents for the 4-ounce Serving Method, the average annual consumption was 44.8 g/day.

The study also examined fish consumption in conjunction with socio-demographic factors. It was noted that fish consumption tended to increase with age. Anglers below the age of 20 years were not well represented in this study. However, based on estimates of consumption rates using the 4-ounce Serving Method, the study found that anglers between 20 and 30 years of age consumed an average of 16 g/day, anglers between 30 and 50 years old consumed 39 g/day, and anglers over 50 years old consumed 76 g/day. Trends also emerged when ethnic groups and income levels were examined together. Using the 4-ounce Serving Method, estimates of fish consumption for Blacks dropped from 60 g/day for poverty-level families to 15 g/day for upper-income families. For Whites, fish consumption rates dropped slightly from 41 g/day for poverty-level families to 35 g/day for upper-income families. Similar trends were observed with the Harvest Method estimates. Averaging the results from the two estimation methods, there was a tendency for upper-income White anglers to eat roughly 30% less fish than poverty-level White anglers, while upper-income Black anglers ate about 80% less fish as poverty-level Black anglers. The analysis of seasonal intake showed that the highest consumption rates were consistently found to occur in the summer (see Table 10-77). It was also found the lowest fish consumption rate occurred in the spring.

The advantages of this study are that it compares estimates of intake using two different methods and provides some perspective on seasonal differences in intake. Data are not provided for children, and the number of observations for some race/ethnic groups is very small.

10.5.8. Connelly et al. (1996)—Sportfish Consumption Patterns of Lake Ontario Anglers and the Relationship to Health Advisories, 1992

The objectives of the Connelly et al. (1996) study were to provide accurate estimates of fish consumption (overall and sport caught) among Lake Ontario anglers and to evaluate the effect of Lake Ontario health advisory recommendations (Connelly et al., 1996). To target Lake Ontario anglers, a sample of 2,500 names was randomly drawn from 1990–1991 New York fishing license records for licenses purchased in six counties bordering Lake Ontario. Participation in the study was solicited by mail with potential participants encouraged to enroll in the study even if they fished infrequently or consumed

little or no sport-caught fish. The survey design involved three survey techniques including a mail questionnaire asking for 12-month recall of 1991 fishing trips and fish consumption, self-recording information in a diary for 1992 fishing trips and fish consumption, periodic telephone interviews to gather information recorded in the diary, and a final telephone interview to determine awareness of health advisories (Connelly et al., 1996).

Participants were instructed to record in the diary the species of fish eaten, meal size, method by which fish was acquired (sport-caught or other), fish preparation and cooking techniques used, and the number of household members eating the meal. Fish meals were defined as finfish only. Meal size was estimated by participants by comparing their meal size to pictures of 8-ounce fish steaks and fillets on dinner plates. An 8-ounce size was assumed unless participants noted their meal size was smaller than 8 ounces, in which case, a 4-ounce size was assumed, or they noted it was larger than 8 ounces, in which case, a 12-ounce size was assumed. Participants were also asked to record information on fishing trips to Lake Ontario and species and length of any fish caught.

From the initial sample of 2,500 license buyers, 1,993 (80%) were reachable by phone or mail, and 1,410 of these were eligible for the study, in that they intended to fish Lake Ontario in 1992. A total of 1,202 of these 1,410, or 85%, agreed to participate in the study. Of the 1,202 participants, 853 either returned the diary or provided diary information by telephone. Due to changes in health advisories for Lake Ontario, which resulted in less Lake Ontario fishing in 1992, only 43%, or 366 of these 853 persons indicated that they fished Lake Ontario during 1992. The study analyses summarized below concerning fish consumption and Lake Ontario fishing participation are based on these 366 persons.

Anglers who fished Lake Ontario reported an average of 30.3 (standard error = 2.3) fish meals per person from all sources in 1992; of these meals, 28% were sport caught (Connelly et al., 1996). Less than 1% ate no fish for the year, and 16% ate no sport-caught fish. The mean fish intake rate from all sources was 17.9 g/day, and from sport-caught sources was 4.9 g/day. Table 10-78 gives the distribution of fish intake rates from all sources and from sport-caught fish. The median rates were 14.1 g/day for all sources and 2.2 g/day for sport caught; the 95th percentiles were 42.3 g/day and 17.9 g/day for all sources and sport caught, respectively. As seen in Table 10-79, statistically significant differences in intake rates were seen across age and residence groups, with residents of large cities and younger people having lower intake rates, on average.

The main advantage of this study is the diary format. This format provides more accurate information on fishing participation and fish consumption, than studies based on 1-year recall (Ebert et al., 1993). However, a considerable portion of diary respondents participated in the study for only a portion of the year, and some errors may have been generated in extrapolating these respondents' results to the entire year (Connelly et al., 1996). In addition, the response rate for this study was relatively low—853 of 1,410 eligible respondents, or 60%—which may have engendered some non-response bias.

The presence of health advisories should be taken into account when evaluating the intake rates observed in this study. Nearly all respondents (>95%) were aware of the Lake Ontario health advisory. This advisory counseled to eat none of nine fish species from Lake Ontario and to eat no more than one meal per month of another four species. In addition, New York State issues a general advisory to eat no more than 52 sport-caught fish meals per year. Among participants who fished Lake Ontario in 1992, 32% said they would eat more fish if health advisories did not exist. A significant fraction of respondents did not totally adhere to the fish advisory; however, 36% of respondents, and 72% of respondents reporting Lake Ontario fish consumption, ate at least one species of fish over the advisory limit. Interestingly, 90% of those violating the advisory reported that they believed they were eating within advisory limits.

10.5.9. Balcom et al. (1999)—Quantification of Seafood Consumption Rates for Connecticut

Balcom et al. (1999) conducted a seafood consumption study in Connecticut, utilizing a food frequency questionnaire along with portion size models. Follow-up telephone calls were made to encourage participation 7–10 days after mailing the questionnaires to improve response rates. Information requested in the survey included frequency of fish consumption, types of fish/seafood eaten, portion size, parts eaten, and the source of the fish/seafood eaten. A diary was also given to the sample populations to record fish and seafood consumption over a 10-day period, and to document where the fish/seafood was obtained and how it was prepared.

The sample population size for this study was 2,354 individuals (1,048 households). The study authors divided this overall population into various population groups including the general population (460 individuals/216 households), commercial

fishing population (178 individuals/73 households), sport fishing and cultural/subsistence fishing population (514 individuals/348 households), minority population (860 individuals/245 households), Southeast Asian (329 individuals/89 households), non-Southeast Asian (531 individuals/156 households), limited income population (937 individuals/276 households), women of childbearing age population (493 individuals/420 households), and children population (559 individuals/305 households).

It is important to note that the nine population groups used in this study are not mutually exclusive. Many individuals were included in more than one population. For this reason, the authors did not attempt to make any statistical comparisons between the population groups.

The survey showed that over 33% of the respondents ate 1–2 meals of fish or seafood per week, including 39% of the general population, 35% of the sport fishing population, 38% of the commercial and minority populations, and 39% of the limited income population. A total of 36% of the Southeast Asian population consumed 2–3 meals per week with 2.1% consuming 5 or more meals per week, while 43% of non-Southeast Asians consumed 1–2 meals of seafood per week. The general population consumed, on average, 4.2 ounces of fish per meal of purchased fish and 5.0 ounces per meal of caught fish. Individuals in the sport fishing population showed a marked difference, consuming 4.7 ounces per meal of bought fish and 7.3 ounces per meal of caught fish. Southeast Asians consumed smaller portions of fish per meal, and children consumed the smallest portions of fish per meal.

On average, the general population consumed 27.7 g/day of fish and seafood while the sport fishing population consumed 51.1 g/day (see Table 10-80). The consumption of sport fish among consuming anglers can be estimated by dividing the consumption for all respondents by the percentage of consuming anglers reported by Balcom et al. (1999) of 97% to yield 52.7 g/day. The commercial fishing population had an average consumption rate of 47.4 g/day, while the limited income population's rate was 43.1 g/day. The overall minority population consumption rate was 50.3 g/day, with Southeast Asians consuming an average of 59.2 g/day (the highest overall rate) and non-Southeast Asians consuming an average of 45.0 g/day. Child-bearing age women consumed an average of 45.0 g/day, and children consumed an average of 18.3 g/day.

The study also examined fish preparations and cooking practices for each population group. It was found that the sport fishing population was most likely to perform risk-reducing preparation methods compared to the other populations, while the minority population was least likely to use the same risk-reducing methods. Cooking information by specie was only available for the Southeast Asian population, but the most common cooking methods were boiling, poaching-boiling-steaming, sauté/stir fry, and deep frying.

The authors noted that there were some limitations to this study. First, there was some association among household members in terms of the tendency to eat fish and seafood, but there was no dependence between households. Second, the study had a very low percent return rate for the general population mail survey, and it is questionable whether or not the responses accurately reflect the total population's behavior. In addition, the proportion of intake that can be attributed to freshwater fish is not known.

10.5.10. Burger et al. (1999)—Factors in Exposure Assessment: Ethnic and Socioeconomic Differences in Fishing and Consumption of Fish Caught Along the Savannah River

Burger et al. (1999) examined the differences in fishing rates and fish consumption of people fishing along the Savannah River as a function of age, education, ethnicity, employment history, and income. A total of 258 people who were fishing on the Savannah River were interviewed. The interviews were conducted both on land and by boat from April to November 1997. Anglers were asked about fishing behavior, consumption patterns, cooking patterns, knowledge of warnings and safety of fish, and personal demographics. The authors used multiple regression procedures to examine the relative contribution of ethnicity, income, age, and education to parameters such as years fished, serving size, meals/month, and total ounces of fish consumed per year.

Eighty-nine percent of people interviewed were men, 70% were White, 28% were African American, and 2% were of other ethnicity not specified in the study. The age of the interviewees ranged from 16 to 82 years (mean = 43 ± 1 years). The study authors reported that the average fish intake for all survey respondents was 1.46 kg of fish per month (48.7 g/day). Although most of the respondents were men, they indicated that their wives and children consumed fish as often as they did, and children began to eat fish at 3 to 5 years of age.

There were significant differences in fishing behavior and consumption as a function of ethnicity (see Table 10-81). African Americans fished more

often, consumed fish more frequently, and ate larger portions of fish than did Whites. Given the higher level of consumption by African Americans compared to consumption by Whites, the study authors suggested that the potential for exposure is higher for African Americans than for Whites, although the risks depend on the levels of contaminants in the fish. Income and education also contributed to variations in fishing and consumption behavior. Anglers with low incomes (less than or equal to $20,000) ate fish more often that those with higher incomes. Anglers who had not graduated from high school consumed fish more frequently, ate more fish per month and per year, and deep fried fish more often than anglers with more education. At all levels of education, African Americans consumed more fish than Whites.

The authors acknowledged that there may have been sampling bias in the study because they only interviewed people who were fishing on the river and were, therefore, limited to those people they found. To reduce the bias, the authors conducted the survey at all times of the day, on all days of the week, and along different sections of the river. Another limitation noted by the study authors is that the survey asked questions about consumption of fish from two general sources: self-caught and bought. The study authors indicated that it would have been useful to distinguish between fish obtained directly from the wild by the anglers, their friends or family, and store-bought or restaurant fish.

10.5.11. Williams et al. (1999)—Consumption of Indiana Sport-Caught Fish: Mail Survey of Resident License Holders

In 1997, sport-caught fish consumption among licensed Indiana anglers was assessed using a mail survey (Williams et al., 1999). Anglers were asked about their consumption patterns during a 3-month recall, their fishing rates, species of fish consumed, awareness of advisory warnings, and associated behaviors.

Average meal size among respondents was 9.3 ounces per meal. Consumers indicated that, on average, they ate between 1 and 2 meals per month. The survey population was divided into active consumers (those who actively engage in consuming sport fish meals) and potential consumers (those who eat fish during other times of the year). The average consumption rate for active consumers was reported as 19.8 g/day. For both active and potential consumers, the rate was 16.4 g/day (see Table 10-82).

The statewide mail survey of licensed Indiana anglers did not specifically address lower-income and minority anglers. The respondents to the mail survey were predominately White (94.5%). The recall period for this survey extended from the summer through the end of fall and early winter. No information was collected on consumption during spring or winter. Another limitation of the study was that only sport-caught fish consumption was measured among anglers.

10.5.12. Burger (2000)—Gender Differences in Meal Patterns: Role of Self-Caught Fish and Wild Game in Meat and Fish Diets

Burger (2000) used the hypothesis that there are sex differences in consumption patterns of self-caught fish and wild game in a meat and fish diet. A total of 457 people were randomly selected and interviewed while attending the Palmetto Sportsmen's Classic in Columbia, SC in March 1998. The mean age of the respondents was 40 years and ranged from 15 to 74. The questionnaire requested information on two different categories: socio-demographics and number of meals consumed that included several types of fish and wild game. The demographics section contained questions dealing with ethnicity, sex, age, location of residence, occupation, and income. The section on consumption of wild game and fish included specific questions about the number of meals eaten and the source (i.e., self-caught fish, store-bought fish, and restaurant fish).

The results of this study indicated that there were no sex differences in the percentage of people who ate commercial protein sources, but there were significant sex differences for the consumption of most wild-caught game and fish. A higher proportion of men (81.5%) ate wild-caught species than women (73.2%). There were also sex differences in mean monthly meals and mean serving sizes for wild-caught fish. Men ate more meals of wild-caught fish than woman, and men also ate larger portions than women. The mean number of wild-caught fish meals eaten per month was 2.24 for men and 1.52 for women. The mean serving size was 373 grams for men and 232 for women. The study authors also found that individuals who consumed a large number of fish meals per month consumed a higher percentage of wild-caught fish meals than individuals who consumed a small number of fish meals per month.

This study provides information on sex differences with regard to consumption of wild-caught fish. Information on the number of monthly meals and meal size is provided. However, the study did not distinguish between marine and

freshwater fish. In addition, all subjects interviewed were White.

10.5.13. Williams et al. (2000)—An Examination of Fish Consumption by Indiana Recreational Anglers: An Onsite Survey

An on-site survey of Indiana anglers was conducted in the summer of 1998 (Williams et al., 2000). A total of 946 surveys were completed. Minority anglers accounted for 31.8% of those surveyed, with African American anglers accounting for the majority of this group (25.1% of all respondents). Respondents reporting household incomes below $25,000 comprised 30.9% of the respondents. Anglers were asked to report their Indiana sport-caught fish consumption frequency for a 3-month recall period. Using the meal frequency and portion size reported by the anglers, the amount of fish consumed was calculated into a daily amount called grams per day consumption. Consumption rates were weighted to correct for participation bias.

Consumption was reported as 27.2 g/day among minority consumers and 20.0 g/day among White consumers (see Table 10-83). Of the anglers surveyed, 75.4% of White active consumers reported being aware of the fish consumption advisory, while 70.0% of the minority consumers reported awareness. The study authors also examined angler consumption rate based on the level of awareness of Indiana fish consumption advisories reported by the anglers. The consumption rate for those consumers who were very aware of the advisory was 35.2 g/day. For those with a general awareness of the advisory, the consumption rate was 14.1 g/day, and for those who were not aware of the advisory, the consumption rate was 21.3 g/day. In terms of income, the study authors found that there was a significant difference in grams of Indiana sport-caught fish consumed per day. Anglers reporting a household income below $25,000 had an average consumption rate of 18.9 g/day. Anglers with incomes between $25,000 and $34,999 averaged 18.8 g/day, and anglers with incomes between $35,000 and $49,999 averaged 15.2 g/day. The highest income—those reporting an income $50,000 or above—consumed an average of 48.9 g/day.

The advantages of this study are that it was designed to determine the consumption rates of Indiana anglers, particularly those in minority and low-income groups, during a portion of the year. However, information was not collected for the period of September through January, so calculation of year-round consumption was not possible.

10.5.14. Benson et al. (2001)—Fish Consumption Survey: Minnesota and North Dakota

Benson et al. (2001) conducted a fish consumption survey among Minnesota and North Dakota residents. The target population included the general population, licensed anglers, and members of Native American tribes. The survey focused on obtaining the most recent year's fish intake from all sources, including locally caught fish. Survey questionnaires were mailed to potential respondent households. Groups of interest were selected and allotted a portion of the total number of surveys to be distributed to each group as follows: a group categorized as the general population and anglers received 37.5% of the surveys, and new mothers and Native Americans each received 12.5% of the total surveys distributed. The survey distribution was split 60/40 between Minnesota and North Dakota. For the entire survey population, a total of 1,565 surveys were returned completed (out of 7,835 that were mailed out), resulting in a total of 4,273 respondents. A target of 100 completed telephone interviews of non-respondents was set in order to characterize the non-respondent population. However, this target was not met.

The Minnesota survey showed median total fish and sport fish consumption rates for the general population (2,312 respondents) of 12.3 and 2.8 g/day, respectively (see Table 10-84). The total number of Minnesota Bois Forte Tribe respondents was 232, and median total fish and sport fish consumption rates in g/day were 9.3 and 2.8, respectively. For Minnesota residents with fishing licenses (2,020 respondents), median total fish and sport fish consumption rates in g/day were 13.2 and 3.9, respectively. For Minnesota respondents without fishing licenses, median total fish and sport fish consumption rates in g/day were 7.5 and 0, respectively. Table 10-84 also shows median intake rates for purchased fish, upper percentile intake rates for total fish, sport fish and purchased fish for various age groups.

The North Dakota survey showed median total fish and sport fish consumption rates for the general population (1,406 respondents) of 12.6 and 3.0 g/day, respectively (see Table 10-84). The total number of North Dakota Spirit Lake Nation and Three Affiliated Tribes respondents was 105, and the median total fish and sport fish consumption rates in g/day were 1.4 and 0, respectively. For North Dakota residents with fishing licenses (1,101 respondents), median total fish and sport fish consumption rates in g/day were 14.0 and 4.5, respectively. For North Dakota respondents without fishing licenses, median total fish and sport fish consumption rates in g/day were

7.2 and 0, respectively. Table 10-84 also shows median intake rates for purchased fish, upper percentile intake rates for total fish, sport fish and purchased fish for various age groups.

Westat (2006) analyzed the raw data from Benson et al. (2001) to derive fish consumption rates for various age, sex, and ethnic groups, and according to the source of fish consumed (i.e., bought or caught) and habitat (i.e., freshwater, estuarine, or marine). Westat (2006) calculated consumption rates of freshwater fish for consuming anglers. For Minnesota and North Dakota, these values are identical to the consumption rates estimated by Westat (2006) for consuming anglers of all self-caught fish (i.e., freshwater and saltwater). From this observation, it can be concluded that all the consumption of self-caught fish comes from freshwater. The mean and 95th percentile consumption rate for consuming anglers of freshwater fish reported by Westat (2006) are 14 g/day and 37 g/day, respectively, for Minnesota and 12 g/day and 43 g/day, respectively, for North Dakota.

The authors noted that 80% of respondents in Minnesota and 72% of respondents in North Dakota lived in a household that included a licensed angler. They stated that this was a result of a direct intent to oversample the angling population in both states by sending 37.5% of surveys distributed to persons who purchased a fishing license in either Minnesota or North Dakota. The data were adjusted to incorporate overall licensed angler rates in both states (47.3% of households in Minnesota and 40.0% of households in North Dakota).

An advantage of this study is its large overall sample size. A limitation of the study is the low numbers of Native Americans surveyed; thus, the survey may not be representative of overall Native American populations in Minnesota. In addition, the study did not include Asian Immigrants, African Americans, African immigrants, or Latino populations, and was limited to two states. Therefore, the results may not be representative of the U.S. population as a whole.

10.5.15. Moya and Phillips (2001)—Analysis of Consumption of Home-Produced Foods

As discussed in Section 10.4.2.5, some data on fish consumption from households who fish are provided in Chapter 13 and in Moya and Phillips (2001). This information is based on an analysis of data from the household component of the USDA's 1987–1988 NFCS. This analysis shows a mean consumer-only fish consumption of 2.2 g/kg-day (all ages combined, see Table 13-20) for the fishing population. This value can be converted to a per capita value by multiplying by the number of consumers and dividing by the total number of positive responses to the survey question "do you fish?" Assuming an average body weight of 59 kg for the survey population results in an average national per capita self-caught fish consumption rate of 12 g/day among the population of individuals who fish. However, this mean intake rate represents intake of both freshwater and saltwater fish combined. Converting this number into the edible portion by multiplying by 0.5 as described in Section 10.4.2.5, the mean national per capita self-caught fish consumption rate is about 6 g/day.

The advantage of this study is that it provides a national perspective on the consumption of self-caught fish. A limitation of this study is that these values include both freshwater and saltwater fish. The proportion of freshwater to saltwater is unknown and will vary depending on geographical location. Intake data cannot be presented for various age groups due to sample size limitations. The unweighted number of households, who responded positively to the survey question "do you fish?" was also low (i.e., 220 households).

10.5.16. Rouse Campbell et al. (2002)—Fishing Along the Clinch River Arm of Watts Bar Reservoir Adjacent to the Oak Ridge Reservation, Tennessee: Behavior, Knowledge, and Risk Perception

Rouse Campbell et al. (2002) examined consumption habits of anglers fishing along the Clinch River arm of Watts Bar Reservoir, adjacent to the U.S. Department of Energy's Oak Ridge Reservation in East Tennessee. A total of 202 anglers were interviewed on 65 sampling days, which included 48 weekdays and 17 weekend days. Eighty-six percent of fishermen interviewed were fishing from the shore, while 14% were fishing from a boat. The questionnaire utilized in the study included questions on demographics, fishing behavior, perceptions, cooking patterns, consumption patterns, and consumption warnings. Interviews were conducted by two people who were local to the area in order to promote participation in the study.

Out of all anglers interviewed, approximately 35% did not eat fish. Of the 65% who ate fish, only 38% ate fish from the study area. This 38% (77 people) was considered useful to the study and, thus, were the main focus of the data analysis. These anglers averaged 2 meals of fish per month, with an average consumption rate of 37 grams per day or 13.7 kilograms per year (see Table 10-85). They

caught almost 90% of the fish they ate, had a mean age of 42 years, and a mean income of $28,800. The species of fish most often mentioned by anglers who caught and ate fish from the study area were crappie, striped bass, white bass, sauger, and catfish.

A limitation of this study is that the small size of the population does not allow for statistically significant analysis of the data.

10.5.17. Burger (2002b)—Daily Consumption of Wild Fish and Game: Exposure of High-End Recreationists

Burger (2002b) determined consumption patterns for a range of wild-caught fish and game in South Carolina. The population selected for dietary surveys were attendees at the Palmetto Sportsman's Classic in Columbia, South Carolina. Individual dietary surveys were conducted at the show in March, 1998, on 458 participants who were randomly selected from an attending population of approximately 60,000 people. Of the survey participants, 15% were Black, 85% were White, and 33% were women. The age composition was similar for black and white respondents; however, Black participants had significantly lower mean incomes than White participants.

The dietary survey took about 20 minutes to complete and was divided into three parts: a section on demographics; one on the number of meals consumed of different types of fish and meat for each of the past 12 months, and a section collecting information on serving size and cooking methods. The types of fish and meat inquired about included wild-caught fish, store-bought fish, restaurant fish, deer, wild-caught quail, restaurant quail, dove, duck, rabbit, squirrel, raccoon, wild turkey, beef, chicken, pork, and any wild game not listed in the questionnaire. Respondents were asked to provide information regarding serving/portion size and what percent of their meals they consumed as meat as opposed to stews. The average number of meals eaten as meat and stew were separately determined for each of the 12 months, then multiplied by the average serving size. Yearly consumption rates were then determined by summing across months for each type of fish or meat. Means and percentiles were computed using SAS.

Mean daily consumption of wild-caught fish ranged from 32.6 g/kg-day for respondents less than 32 years of age to 171.0 g/kg-day for Black respondents (see Table 10-86). The disparity in mean consumption was the greatest for ethnicity and income level, with black and low income respondents eating more than twice as much wild-caught fish as Whites or higher income respondents. Male fish consumption (mean of 55.2 g/kg-day) was higher than that of females (mean of 39.1 g/kg-day), while by age, fish consumption was highest among the 33−45 year olds (mean intake of 71.3 g/kg-day). The author suggested that although the high consumption of wild-caught fish for this age group may reflect a more active lifestyle, it may also reflect exposure of women of child-bearing age. As shown in Table 10-86, the differences between mean consumption rates and 99th percentile values were very large. For some population groups at the higher end of the distribution, fish consumption was ten times greater than that of the mean.

This study provides useful comparisons on wild-caught fish intake among populations with differing ethnicity, sex, age, and income level. Data on fish consumption at the higher end of the distribution were also provided. A limitation of the study includes the fact that the study was based on dietary recall which is less reliable over time and may have recall bias. In addition, although the methodology indicated that information was collected and/or calculated for serving/portion size, the percent of meals consumed as meat versus stews, and yearly consumption rates, no data were provided for these parameters in the study.

10.5.18. Mayfield et al. (2007)—Survey of Fish Consumption Patterns of King County (Washington) Recreational Anglers

Mayfield et al. (2007) conducted a series of fish consumption surveys among recreational anglers at marine and freshwater sites in King County, WA. The freshwater surveys were conducted between 2002 and 2003 at "freshwater locations around Lake Sammamish, Lake Washington, and Lake Union" (Mayfield et al., 2007). A total of 212 individuals were interviewed at these locations. The majority of participants were male, 18 years and older, and were either Caucasian or Asian and Pacific Islander. Data were collected on fishing location preferences, fishing frequency, consumption amounts, species preferences, cooking methods, and whether family members would also consume the catch. Respondent demographic data were also collected. Consumption rates were estimated using information on fish meal frequency and meal size. The mean recreational freshwater fish consumption rates were 10 g/day for all respondents and 7 g/day for the children of survey respondents (see Table 10-87). Mayfield et al. (2007) also reported differences in intake according to ethnicity. Mean freshwater fish intake rates were 40, 38, 20, 19, and 2 g/day for Native American, African

American, Asian and Pacific Islander, Caucasian, and Hispanic/Latino respondents, respectively.

The advantage of this study is that it provides additional perspective on recreational freshwater fish intake. However, the data are limited to a specific area of the United States and may not be representative of anglers in other locations.

10.6. NATIVE AMERICAN STUDIES

10.6.1. Wolfe and Walker (1987)—Subsistence Economies in Alaska: Productivity, Geography, and Development Impacts

Wolfe and Walker (1987) analyzed a data set from 98 communities for harvests of fish, land mammals, marine mammals, and other wild resources. The analysis was performed to evaluate the distribution and productivity of subsistence harvests in Alaska during the 1980s. Harvest levels were used as a measure of productivity. Wolfe and Walker (1987) defined harvest to represent a single year's production from a complete seasonal round. The harvest levels were derived primarily from a compilation of data from subsistence studies conducted between 1980 and 1985 by various researchers in the Alaska Department of Fish and Game, Division of Subsistence.

Of the 98 communities studied, four were large urban population centers, and 94 were small communities. The harvests for these latter 94 communities were documented through detailed retrospective interviews with harvesters from a sample of households (Wolfe and Walker, 1987). Harvesters were asked to estimate the quantities of a particular species that were harvested and used by members of that household during the previous 12-month period. Wolfe and Walker (1987) converted harvests to a common unit for comparison, pounds dressed weight per capita per year, by multiplying the harvests of households within each community by standard factors, converting total pounds to dressed weight, summing across households, and then dividing by the total number of household members in the household sample. Note average consumption by household member can be misleading because households include both children and adults whose intake rates may be very different. Dressed weight varied by species and community but, in general, was 70% to 75% of total fish weight; dressed weight for fish represents that portion brought into the kitchen for use (Wolfe and Walker, 1987).

Harvests for the four urban populations were developed from a statewide data set gathered by the Alaska Department of Fish and Game Divisions of Game and Sports Fish. Urban sport-fish harvest estimates were derived from a survey that was mailed to a randomly selected statewide sample of anglers (Wolfe and Walker, 1987). Sport-fish harvests were disaggregated by urban residency, and the data set was analyzed by converting the harvests into pounds and dividing by the 1983 urban population.

For the overall analysis, each of the 98 communities was treated as a single unit of analysis, and the entire group of communities was assumed to be a sample of all communities in Alaska (Wolfe and Walker, 1987). Each community was given equal weight, regardless of population size. Annual per capita harvests were calculated for each community. For the four urban centers, fish harvests ranged from 5 to 21 pounds per capita per year (6.2 g/day to 26.2 g/day).

The range for the 94 small communities was 25 to 1,239 pounds per capita per year (31 g/day to 1,541 g/day). For these 94 communities, the median per capita fish harvest was 130 pounds per year (162 g/day). In most (68%) of the 98 communities analyzed, resource harvests for fish were greater than the harvests of the other wildlife categories (land mammal, marine mammal, and other) combined.

The communities in this study were not made up entirely of Alaska Natives. For roughly half the communities, Alaska Natives comprised 80% or more of the population, but for about 40% of the communities, they comprised less than 50% of the population. Wolfe and Walker (1987) performed a regression analysis, which showed that the per capita harvest of a community tended to increase as a function of the percentage of Alaska Natives in the community. Although this analysis was done for total harvest (i.e., fish, land mammal, marine mammal, and others), the same result should hold for fish harvest because it is highly correlated with total harvest.

A limitation of this report is that it presents per capita harvest rates as opposed to individual intake rates. Wolfe and Walker (1987) compared the per capita harvest rates reported to the results for the household component of the 1977–1978 USDA NFCS. The NFCS showed that about 222 pounds of meat, fish, and poultry were purchased and brought into the household kitchen for each person each year in the western region of the United States. This contrasts with a median total resource harvest of 260 lbs/year in the 94 communities studied. This comparison, and the fact that Wolfe and Walker (1987) state that “harvests represent that portion brought into the kitchen for use,” suggest that the same factors used to convert household consumption rates in the NFCS to individual intake rates can be used to convert per capita harvest rates to individual

intake rates. In Section 10.3, a factor of 0.5 was used to convert fish consumption from household to individual intake rates. Applying this factor, the median per capita individual fish intake in the 94 communities would be 81 g/day and the range 15.5 to 770 g/day.

A limitation of this study is that the data were based on 1-year recall from a mailed survey. An advantage of the study is that it is one of the few studies that present fish harvest patterns for subsistence populations.

10.6.2. Columbia River Inter-Tribal Fish Commission (CRITFC) (1994)—A Fish Consumption Survey of the Umatilla, Nez Perce, Yakama, and Warm Springs Tribes of the Columbia River Basin

The Columbia River Inter-Tribal Fish Commission (CRITFC) (1994) conducted a fish consumption survey among four Columbia River Basin Native American tribes during the fall and winter of 1991–1992. The target population included all adult tribal members who lived on or near the Yakama, Warm Springs, Umatilla, or Nez Perce reservations. The survey was based on a stratified random sampling design where respondents were selected from patient registration files at the Indian Health Service. Interviews were performed in person at a central location on the member's reservation.

The overall response rate was 69%, yielding a sample size of 513 tribal members, 18 years old and above. Of these, 58% were female, and 59% were under 40 years old. Each participating adult was asked if there were any children 5 years old or younger in his or her household. Those responding affirmatively were asked a set of survey questions about the fish consumption patterns of the youngest child in the household (CRITFC, 1994). Information for 204 children, 5 years old and younger, was provided by participating adult respondents. Consumption data were available for 194 of these children.

Participants were asked to describe and quantify all food and drink consumed during the previous day. They were then asked to identify the months in which they ate the most and the least fish, and the number of fish meals consumed per week during each of those periods and an average value for the whole year. The typical portion size (in ounces) was determined with the aid of food models provided by the questioner. The next set of questions identified specific species of fish and addressed the number of times per month each was eaten, as well as what parts (e.g., fillet, skin, head, eggs, bones, other) were eaten. Respondents were then asked to identify the frequency with which they used various preparation methods, expressed as a percentage. Respondents sharing a household with a child, aged 5 years or less, were asked to repeat the serving size, eating frequency, and species questions for the child's consumption behavior. All respondents were asked about the geographic origin of any fish they personally caught and consumed, and to identify the major sources of fish in their diet (e.g., self-caught, grocery store, tribe, etc.). Fish intake rates were calculated by multiplying the annual frequency of fish meals by the average serving size per fish meal.

The population sizes of the four tribes were highly unequal, ranging from 818 to 3,872 individuals (CRITFC, 1994). Nearly equal sample sizes were collected from each tribe. Weighting factors were applied to the pooled data (in proportion to tribal population size) so that the survey results would be representative of the overall population of the four tribes for adults only. Because the sample size for children was considered small, only an unweighted analysis was performed for this population. Based on a desired sample size of approximately 500 and an expected response rate of 70%, 744 individuals were selected at random from lists of eligible patients; the numbers from each tribe were approximately equal.

The results of the survey showed that adults consumed an average of 1.71 fish meals/week and had an average intake of 58.7 g/day (CRITFC, 1994). Table 10-88 shows the adult fish intake distribution; the median was between 29 and 32 g/day, and the 95th percentile about 170 g/day. A small percentage (7%) of respondents indicated that they were not fish consumers. Table 10-89 shows that mean intake was slightly higher in males than females (63 g/day versus 56 g/day) and was higher in the over 60 years age group (74.4 g/day) than in the 18–39 years (57.6 g/day) or 40–59 years (55.8 g/day) age groups. Intake also tended to be higher among those living on the reservation. The mean intake for nursing mothers—59.1 g/day—was similar to the overall mean intake. Intake rates were calculated for children for which both the number of fish meals per week and serving size information were available. Appendix 10B presents the weighted percentage of adults consuming specific fish parts.

A total of 49% of respondents of the total survey population reported that they caught fish from the Columbia River basin and its tributaries for personal use or for tribal ceremonies and distributions to other tribe members, and 88% reported that they obtained fish from either self-harvesting, family, or friends; at tribal ceremonies; or from tribal distributions. Of all

fish consumed, 41% came from self- or family harvesting, 11% from the harvest of friends, 35% from tribal ceremonies or distribution, 9% from stores, and 4% from other sources (CRITFC, 1994).

Of the 204 children, the total number of respondents used in the analysis varied from 167 to 202, depending on the topic (amount and species consumed, fish meals consumed/week, age consumption began, serving size, consumption of fish parts) of the analysis. The unweighted mean for the age when children begin eating fish was 13.1 months of age (N = 167). The unweighted mean number of fish meals consumed per week by children was 1.2 meals per week (N = 195), and the unweighted mean serving size of fish for children aged 5 years old and less was 95 grams (i.e., 3.36 ounces) (N = 201). The unweighted percent of fish consumed by children by species was 82.7% for salmon, followed by 46.5% (N = 202) for trout.

The analysis of seasonal intake showed that May and June tended to be high-consumption months and December and January, low consumption months. The mean adult intake rate for May and June was 108 g/day, while the mean intake rate for December and January was 30.7 g/day. Salmon was the species eaten by the highest number of respondents (92%) followed by trout (70%), lamprey (54%), and smelt (52%). Table 10-90 gives the fish intake distribution for children under 5 years of age. The mean intake rate was 19.6 g/day, and the 95th percentile was approximately 70 g/day. These mean intake rates include both consumers and non-consumers. These values are based on survey questions involving estimated behavior throughout the year, which survey participants answered in terms of meals per week or per month and typical serving size per meal. Table 10-91 presents consumption rates for children, who were reported to consume particular species of fish.

The authors noted that some non-response bias may have occurred in the survey because respondents were more likely to be female and live near the reservation than non-respondents. In addition, they hypothesized that non-consumers may have been more likely to be non-respondents than fish consumers because non-consumers may have thought their contribution to the survey would be meaningless. If such were the case, this study would overestimate the mean per capita intake rate. It was also noted that the timing of the survey, which was conducted during low fish consumption months, may have led to underestimation of actual fish consumption. The authors conjectured that an individual may have reported higher annual consumption if interviewed during a relatively high consumption month and lower annual consumption if interviewed during a relatively low consumption month. Finally, with respect to children's intake, it was observed that some of the respondents provided the same information for their children as for themselves; thereby, the reliability of some of these data is questioned (CRITFC, 1994). The combination of four different tribes' survey responses into a single pooled data set is somewhat problematic. The data presented are unweighted and, therefore, contain a bias toward the smaller tribes, who were oversampled compared to the larger tribes.

The limitations of this study, particularly with regard to the estimates of children's consumption, result in a high degree of uncertainty in the estimated rates of consumption. Although the authors have noted these limitations, this study does present information on fish consumption patterns and habits for a Native American population.

10.6.3. Peterson et al. (1994)—Fish Consumption Patterns and Blood Mercury Levels in Wisconsin Chippewa Indians

Peterson et al. (1994) investigated the extent of exposure to methylmercury by Chippewa Indians living on a Northern Wisconsin reservation who consume fish caught in Northern Wisconsin lakes. Chippewa have a reputation for high fish consumption (Peterson et al., 1994). The Chippewa Indians fish by the traditional method of spearfishing. Spearfishing (for walleye) occurs for about 2 weeks each spring after the ice breaks, and although only a small number of tribal members participate in it, the spearfishing harvest is distributed widely within the tribe by an informal distribution network of family and friends and through traditional tribal feasts (Peterson et al., 1994).

Potential survey participants, 465 adults, 18 years of age and older, were randomly selected from the tribal registries (Peterson et al., 1994). Participants were asked to complete a questionnaire describing their routine fish consumption and, more extensively, their fish consumption during the 2 previous months. The survey was carried out in May 1990. A follow-up survey was conducted for a random sample of 75 non-respondents (80% were reachable), and their demographic and fish consumption patterns were obtained. Peterson et al. (1994) reported that the non-respondents' socioeconomic information and fish consumption were similar to the respondents.

A total of 175 of the original random sample (38%) participated in the study. In addition, 152 non-randomly selected participants were surveyed and included in the data analysis; these participants were reported by Peterson et al. (1994) to

have fish consumption rates similar to those of the randomly selected participants. Results from the survey showed that fish consumption varied seasonally, with 50% of the respondents reporting April and May (spearfishing season) as the highest fish consumption months (Peterson et al., 1994). Table 10-92 shows the number of fish meals consumed per week during the last 2 months (recent consumption) before the survey was conducted and during the respondents' peak consumption months grouped by sex, age, education, and employment level. During peak consumption months, males consumed more fish (1.9 meals per week) than females (1.5 meals per week), respondents under 35 years of age consumed more fish (1.8 meals per week) than respondents 35 years of age and over (1.6 meals per week), and the unemployed consumed more fish (1.9 meals per week) than the employed (1.6 meals per week). During the highest fish consumption season (April and May), 50% of respondents reported eating 1 or less fish meals per week, and only 2% reported daily fish consumption. A total of 72% of respondents reported Walleye consumption in the previous 2 months. Peterson et al. (1994) also reported that the mean number of fish meals usually consumed per week by the respondents was 1.2.

The mean fish consumption rate reported (1.2 fish meals per week, or 62.4 meals per year) in this survey was compared with the rate reported in a previous survey of Wisconsin anglers (Fiore et al., 1989) of 42 fish meals per year. These results indicate that the Chippewa Indians do not consume much more fish than the general Wisconsin angler population (Peterson et al., 1994). The differences in the two values may be attributed to differences in study methodology (Peterson et al., 1994). Note that this number (1.2 fish meals per week) includes fish from all sources. Peterson et al. (1994) noted that subsistence fishing, defined as fishing as a major food source, appears rare among the Chippewa. Using a meal size of 227 g/meal, the rate reported here of 1.2 fish meals per week translates into a mean fish intake rate of 39 g/day in this population. This meal size is similar to an adult general population 90th percentile meal size derived from Smiciklas-Wright et al. (2002) (see Section 10.8.2).

The advantages of this study are that it targeted a specific Native American population and provides some perspective on peak consumption and species of fish consumed. However, the data are more than 2 decades old and may not be entirely representative of current intake patterns.

10.6.4. Fitzgerald et al. (1995)—Fish PCB Concentrations and Consumption Patterns Among Mohawk Women at Akwesasne

Akwesasne is a Native American community of 10,000 plus persons located along the St. Lawrence River (Fitzgerald et al., 1995). Fitzgerald et al. (1995) conducted a recall study from 1986 to 1992 to determine the fish consumption patterns among nursing Mohawk women residing near three industrial sites. The study sample consisted of 97 Mohawk women living on the Akwesasne Reservation and 154 nursing Caucasian controls living in Warren and Schoharie counties, which are primary rural like the Akwesasne. The Mohawk mothers were significantly younger (mean age: 24.9) than the controls (mean age: 26.4) and had significantly more years of education (mean: 13.1 for Mohawks versus 12.4 for controls). A total of 97 out of 119 Mohawk nursing women responded, a response rate of 78%; 154 out of 287 control nursing Caucasian women responded, a response rate of 54%. Statistical analysis focused upon socio-demographic, physical, reproductive, lifestyle, and dietary and consumption differences between the Mohawk and control women.

Potential participants were identified prior to, or shortly after, delivery. The interviews were conducted at home within 1 month postpartum and were structured to collect information for socio-demographics, vital statistics, use of medications, occupational and residential histories, behavioral patterns (cigarette smoking and alcohol consumption), drinking water source, diet, and fish preparation methods (Fitzgerald et al., 1995). The dietary data collected were based on recall for food intake during the index pregnancy, the year before the pregnancy, and more than 1 year before the pregnancy.

The dietary assessment involved the report by each participant on the consumption of various foods with emphasis on local species of fish and game (Fitzgerald et al., 1995). This method combined food frequency and dietary histories to estimate usual intake. Food frequency was evaluated with a checklist of foods for indicating the amount of consumption of a participant per week, month, or year. Information gathered for the dietary history included duration of consumption, changes in the diet, and food preparation method.

Table 10-93 presents the number of local fish meals per year for both the Mohawk and control participants. The highest percentage of participants reported consuming between 1 and 9 local fish meals

per year. Table 10-93 indicates that Mohawk respondents consumed statistically significantly more local fish than did control respondents during the two time periods prior to pregnancy; for the time period during pregnancy, there was no significant difference in fish consumption between the two groups. Table 10-94 presents the mean number of local fish meals consumed per year by time period for all respondents and for those ever consuming (consumers only). A total of 82 (85%) Mohawk mothers and 72 (47%) control mothers reported ever consuming local fish. The mean number of local fish meals consumed per year by Mohawk respondents declined over time, from 23.4 (over 1 year before pregnancy) to 9.2 (less than 1 year before pregnancy) to 3.9 (during pregnancy); a similar decline was seen among consuming Mohawks only. There was also a decreasing trend over time in consumption among controls, though it was much less pronounced.

Table 10-95 presents the mean number of fish meals consumed per year for all participants by time period and selected characteristics (age, education, cigarette smoking, and alcohol consumption). Pairwise contrasts indicated that control participants over 34 years of age had the highest fish consumption of local fish meals (22.1) (see Table 10-95). However, neither the overall nor pairwise differences by age among the Mohawk women over 34 years old were statistically significant, which may be due to the small sample size (N = 6) (Fitzgerald et al., 1995). The most common fish consumed by Mohawk mothers was yellow perch; for controls, the most common fish consumed was trout.

An advantage of this study is that it presents data for fish consumption patterns for Native Americans as compared to a demographically similar group of Caucasians. Although the data are based on nursing mothers as participants, the study also captures consumption patterns prior to pregnancy (up to 1 year before and more than 1 year before). Fitzgerald et al. (1995) noted that dietary recall for a period more than 1 year before pregnancy may be inaccurate, but these data were the best available measure of the more distant past. They also noted that the observed decrease in fish consumption among Mohawks from 1 year before pregnancy to the period of pregnancy is due to a secular trend of declining fish consumption over time in Mohawks. This decrease, which was more pronounced than that seen in controls, may be due to health advisories promulgated by tribal, as well as state, officials. The authors noted that this decreasing secular trend in Mohawks is consistent with a survey from 1979–1980 that found an overall mean of 40 fish meals per year among male and female Mohawk adults.

The data are presented as number of fish meals per year; the authors did not assign an average weight to fish meals. If assessors wanted to estimate the weight of fish consumed, some value of weight per fish meal would have to be assumed. Smiciklas-Wright et al. (2002) reported 209 grams as the 90th percentile weight of fish consumed per eating occasion for general population females 20–39 years old. Using this value, the rate reported of 27.6 fish meals per year for consumers only (over 1 year before pregnancy) translates into a mean fish intake rate of 15.8 g/day.

A limitation of this study is that information on meal size was not available. It is not known whether the 90th percentile meal size from the general population is representative of the population of Mohawk women.

10.6.5. Forti et al. (1995)—Health Risk Assessment for the Akwesasne Mohawk Population From Exposure to Chemical Contaminants in Fish and Wildlife

Forti et al. (1995) estimated the potential exposure of residents of the Mohawk Nation at Akwesasne to PCBs through the ingestion of locally caught fish and wildlife, and human milk. The study was part of a remedial investigation/feasibility study (RI/FS) for a National Priorities List site near Massena, NY and the St. Lawrence River. Forti et al. (1995) used data collected in 1979–1980 on the source (store bought or locally caught), species, and frequency of fish consumption among 1,092 adult Mohawk Native Americans. The information on frequency of fish consumption was combined with an assumed meal size of 227 grams to estimate intake among the adult population. This meal size represents the 90th percentile meal size for fish consumers in the U.S. population as reported by Pao et al. (1982). Children were assumed to eat fish at the same frequency as adults but were assumed to have a meal size of 93 grams.

Table 10-96 presents the mean and 95th percentile fish intake estimates for the Mohawk population, as reported by Forti et al. (1995). Mean intake of local fish was estimated to be 25 g/day for all adult fish consumers and 29 g/day for adult consumers only; 95th percentile rates for these groups were 131 and 135 g/day, respectively. Mean intake of local fish was estimated to be 10 g/day among all Mohawk children and 13 g/day among children consumers only; 95th percentile estimates for these groups were 54 and 58 g/day, respectively.

The advantage of this study is that it provides additional perspective on intake among Native

American populations, especially those in the St. Lawrence River area. However, the fish intake survey data used in this analysis were collected more than 3 decades ago and may not represent current intake patterns for this population. Also, the Forti et al. (1995) report provides limited details about the survey methodology and data used to estimate intake. It should also be noted that fish intake rates were estimated using a 90th percentile meal size. It is not known whether the 90th percentile meal size from the general population is representative of this population of Native Americans.

10.6.6. Toy et al. (1996)—A Fish Consumption Survey of the Tulalip and Squaxin Island Tribes of the Puget Sound Region

Toy et al. (1996) conducted a study to determine fish and shellfish consumption rates of the Tulalip and Squaxin Island tribes living in the Puget Sound region. These two Indian tribes were selected on the basis of judgment that they would be representative of the expected range of fishing and fish consumption activities of the 14 tribes in the region. Commercial fishing is a major source of income for members of both tribes; some members of the Squaxin Island tribe also participate in commercial shellfishing. Both tribes participate in subsistence fishing and shellfishing.

A survey was conducted to describe fish consumption for Puget Sound tribal members over the age of 18 years, and their dependents, aged 5 years and under, in terms of their consumption rate of anadromous, pelagic, bottom fish, and shellfish in grams per kilogram of body weight per day. The survey focused on the frequency of fish and shellfish consumption (number of fish meals eaten per day, per week, per month, or per year) over a 1-year period, and the portion size of each meal. Data were also collected on fish parts consumed, preparation methods, patterns of acquisition for all fish and shellfish consumption (including seasonal variations in consumption), and children's consumption rates. Interviews were conducted between February 25 and May 15, 1994. A total of 190 tribal members, aged 18 years old and older, and 69 children between birth and 5 years old, were surveyed on consumption of 52 species. The response rate was 77% for the Squaxin Island tribe and 76% for the Tulalip tribes.

The appropriate sample size was calculated based on the enrolled population of each tribe and a desired confidence interval of ±20% from the mean, with an additional 25% added to the total to allow for non-response or unusable data. The target population, derived from lists of enrolled tribal members provided by the tribes, consisted of enrolled tribal members aged 18 years and older and children aged 5 years and younger living in the same household as an enrolled member. Only members living on or within 50 miles of the reservation were considered for the survey. Each eligible enrolled tribal member was assigned a number, and computer-generated random numbers were used to identify the survey participants. Children were not sampled directly but through adult members of their household; if one adult had more than one eligible child in his or her household, one of the children was selected at random. This indirect sampling method was necessitated by the available tribal records but may have introduced sampling bias to the process of selecting children for the study. A total of 190 adult tribal members (ages 18 years old and older) and 69 children between birth and 5 years old (i.e., 0 to <6 years) were surveyed about their consumption of 52 fish species in six categories: anadromous, pelagic, bottom, shellfish, canned tuna, and miscellaneous.

Respondents described their consumption behavior for the past year in terms of frequency of fish meals eaten per week or per month, including seasonal variations in consumption rates. Portion sizes (in ounces) were estimated with the aid of model portions provided by the questioner. Data were also collected on fish parts consumed, preparation methods, patterns of acquisition for all fish and shellfish consumption, and children's consumption rates.

The adult mean and median consumption rates for all forms of fish combined were 0.89 and 0.55 g/kg-day for the Tulalip tribes, and 0.89 and 0.52 g/kg-day for the Squaxin Island tribe, respectively (see Table 10-97). As shown in Table 10-98, consumption per body weight varied by sex (males consumed more as indicated by mean and median consumption). The median rates for the Tulalip Tribes were 53 g/day for males and 34 g/day for females, while the rates were 66 g/day for males and 25 g/day for females for the Squaxin Island tribe (see Table 10-99). Among adults, consumption generally followed a curvilinear pattern, with greater median consumption in the age range of 35 to 64 years old, and lower consumption in the age range of 18 to 34 years old and 65 years old and over (see Table 10-100). No consistent pattern of consumption by income was found for either tribe (see Table 10-101).

The mean and median consumption rates for children 5 years and younger for both tribes combined, were 0.53 and 0.17 g/kg-day, respectively. These values were significantly lower than those of

adults, even when the consumption rate was adjusted for body weight (see Table 10-102). Squaxin Island children tended to consume more fish than Tulalip children (mean: 0.825 g/kg-day vs. 0.239 g/kg-day). The data were insufficient to allow re-analysis to fit the data to the standard U.S. EPA age categories used elsewhere in this handbook. A minority of consumers ate fish parts that are considered to have a higher concentration of toxins: skin, head, bones, eggs, and organs, and for the majority of consumers, fish were prepared (baking, boiling, broiling, roasting, and poaching) and eaten in a manner that tends to reduce intake of contaminants. Most anadromous fish and shellfish were obtained by harvesting in the Puget Sound area rather than by purchasing, though sources of harvesting varied between the tribes.

The advantage of this study is that the data can be used to improve how exposure assessments are conducted for populations that include high consumers of fish and shellfish and to identify cultural characteristics that may place tribal members at disproportionate risk to chemical contamination. One limitation associated with this study is that although data from the Tulalip and Squaxin Island tribes may be representative of consumption rates of these specific tribes, fish consumption rates, habits, and patterns can vary among tribes and other population groups. As a result, the consumption rates of these two tribes may not be useful as a surrogate for consumption rates of other Native American tribes. There might also be a possible bias due to the time the survey was conducted; many species in the survey are seasonal, and although the survey was designed to solicit annual consumption rates, respondents may have weighted their responses toward the interview period. For example, because of the timing of the survey, respondents may have overestimated their annual consumption of shellfish and underestimated their annual consumption of salmon. Furthermore, there were differences in consumption patterns between the two tribes included in this study; the study provided data for each tribe and for the pooled data from both tribes, but the latter may not be a statistically valid measure for tribes in the region.

10.6.7. Duncan (2000)—Fish Consumption Survey of the Suquamish Indian Tribe of the Port Madison Indian Reservation, Puget Sound Region

The Suquamish Tribal Council conducted a study of the Suquamish tribal members living on and near the Port Madison Indian Reservation in the Puget Sound region (Duncan, 2000). The study was funded by the Agency for Toxic Substances and Disease Registry (ATSDR) through a grant to the Washington State Department of Health. The purpose of the study was to determine seafood consumption rates, patterns, and habits of the members of the Suquamish Tribe. The second objective was to identify cultural practices and attributes that affect consumption rates, patterns, and habits of members of the Suquamish Tribe.

Adults, 16 years and older, were selected randomly from a Tribal enrollment roster. The study had a participation rate of 64.8%, which was calculated on the basis of 92 respondents out of a total of 142 potentially eligible adults on the list of those selected into the sample. Consumption data for children under 6 years of age were gathered through adult respondents who had children in this age group living in the household at the time of the survey. Data were collected for 31 children under 6 years old.

A survey questionnaire was administered by personal interview. The survey included four parts: (1) 24-hour dietary recall; (2) identification, portions, frequency of consumption, preparation, harvest location of fish; (3) shellfish consumption, preparation, harvest location; and (4) changes in consumption over time, cultural information, physical information, and socioeconomic information. A display booklet was used to assist respondents in providing consumption data and identifying harvest locations of seafood consumed. Physical models of finfish and shellfish were constructed to assist respondents in determining typical food portions. Finfish and shellfish were grouped into categories based on similarities in life history as well as practices of Tribal members who fish for subsistence, ceremonial, and commercial purposes.

Adult respondents reported a mean consumption rate of all finfish and all shellfish of 2.71 g/kg-day (see Table 10-103). Table 10-104, Table 10-105, and Table 10-106 provide consumption rates for adults by species, sex, and age, respectively. For children under 6 years of age, the mean consumption rate of all finfish and shellfish was 1.48 g/kg-day (see Table 10-107 and Table 10-108). The Suquamish Tribe's seafood consumption rates for adults and children under 6 years of age were higher than seafood consumption rates reported in studies conducted among the CRITFC, Tulalip Tribes, Squaxin Island Tribe, and the Asian Pacific Island population of King County (Duncan, 2000). This disparity illustrates the high degree of variability found between tribes even within a small geographic region (Puget Sound) and indicates that exposure and risk assessors should exercise care when imputing fish

consumption rates to a population of interest using data from tribal studies.

An important attribute of this survey is that it provides consumption rates by individual type of fish and shellfish. It is important to note that the report indicates that increased levels of development as well as pollutants from residential, industrial, and commercial uses have resulted in degraded habitats and harvesting restrictions. Despite degraded water quality and habitat, tribal members continue to rely on fish and shellfish as a significant part of their diet. A limitation of this study is that the sample size for children was fairly small (31 children).

10.6.8. Westat (2006)—Fish Consumption in Connecticut, Florida, Minnesota, and North Dakota

As discussed in Section 10.3.2.7, Westat (2006) analyzed the raw data from three fish consumption studies to derive fish consumption rates for various age, sex, and ethnic groups, and according to the source of fish consumed (i.e., bought or caught) and habitat (i.e., freshwater, estuarine, or marine). The studies represented data from four states: Connecticut, Florida, Minnesota, and North Dakota. Consumption rates for individuals of Native American heritage were available for the states of Florida, Minnesota, and North Dakota. Fish intake distributions for these populations are presented in Table 10-41 for all respondents and Table 10-42 for consuming individuals. The mean and 95th percentile for all Native American respondents were 0.8 g/kg-day and 4.5 g/kg-day for Florida, respectively. The mean fish intake rate for all Native American respondents for Minnesota was 2.8 g/kg-day. The mean and 90th percentile fish intake rate for all Native American respondents for North Dakota were 0.4 g/kg-day and 0.9 g/kg-day, respectively. The mean and 95th percentile intake rate for Native American consumers only for Florida were 1.5 g/kg-day and 5.7 g/kg-day, respectively. The mean fish intake rate for Native American consumers only for Minnesota was 2.8 g/kg-day. The mean and 90th percentile fish intake rate for Native American consumers only for North Dakota were 0.4 g/kg-day and 0.8 g/kg-day, respectively (Westat, 2006).

A limitation of this study is that sample sizes for these populations were small. Intake rates represent consumption of fish from all sources. Also, the study did not specifically target Native Americans, and it is not known whether the Native Americans included in the survey lived on reservations.

10.6.9. Polissar et al. (2006)—A Fish Consumption Survey of the Tulalip and Squaxin Island Tribes of the Puget Sound Region—Consumption Rates for Fish Consumers Only

Using fish consumption data from the Toy et al. (1996) survey of the Tulalip and Squaxin Island tribes of Puget Sound, Polissar et al. (2006) calculated consumption rates for various fish species groups, considering only the consumers of fish within each group. Weight-adjusted consumption rates were calculated by tribe, age, sex, and species groups. Species groups (anadromous, bottom, pelagic, and shellfish) were defined by life history and distribution in the water column. Data were available for 69 children, birth to <6 years of age; 18 of these children had no reported fish consumption and were excluded from the analysis. Thus, estimated fish consumption rates are based on data for 51 children; 15 from the Tulalip tribe and 36 from the Squaxin Island tribe. Both median and mean fish consumption rates for adults and children within each tribe were calculated in terms of grams per kilogram of body weight per day (g/kg-day). Anadromous fish and shellfish were the groups of fish most frequently consumed by both tribes and sexes. Consumption per body weight varied by sex (males consumed more) and age (those 35 to 64 years old consumed more than those younger and older). The consumption rates for groups of fish differed between the tribes. The distribution of consumption rates was skewed toward large values. In the Tulalip tribes, the estimated adult mean consumption rate for all forms of fish combined was 1.0 g/kg-day, and in the Squaxin Island tribe, the estimated mean rate was also 1.0 g/kg-day (see Table 10-109). Table 10-110 presents consumption rates for adults by species and sex. Table 10-111 and Table 10-112 show consumption rates for adults by species and age for the Squaxin Island and Tulalip tribes, respectively. The mean consumption rate for the Tulalip children was 0.45 g/kg-day, and 2.9 g/kg-day for the Squaxin Island children (see Table 10-113). Table 10-114 presents consumption rates for children by species and sex.

Because this study used the data originally generated by Toy et al. (1996), the advantages and limitations associated with the Toy et al. (1996) study, as described in Section 10.6.6, also apply to this study. However, an advantage of this study is that the consumption rates are based only on individuals who consumed fish within the selected categories.

10.7. OTHER POPULATION STUDIES

10.7.1. U.S. EPA (1999)—Asian and Pacific Islander Seafood Consumption Study in King County, WA

This study was conducted to obtain seafood consumption rates, species, and seafood parts consumed, and cooking methods used by the Asian and Pacific Islander (API) community. Participants were seafood consumers who were first or second generation members of the API ethnic group, 18 years of age or older, and lived in King County, WA. APIs represent one of the most diverse and rapidly growing immigrant populations in the United States. In 1997, APIs (166,000) accounted for 10% of King County's population, an increase from 8% in 1990. Between 1990 and 1997, the total population of King Country increased by 9%, while the population of APIs increased by 43% (U.S. EPA, 1999).

This study was conducted in three phases. Phase I focused on identifying target ethnic groups and developing appropriate questionnaires in the language required for each ethnic group. Phase II focused on characterizing seafood consumption patterns for 10 API ethnic groups (Cambodian, Chinese, Filipino, Hmong, Japanese, Korean, Laotian, Mien, Samoan, and Vietnamese) within the study area. Phase III focused on developing culturally appropriate health messages on risks related to seafood consumption and disseminating this information for the API community. The majority of the 202 respondents (89%) were first generation (i.e., born outside the United States). There were slightly more women (53%) than men (47%), and 35% lived under the 1997 Federal Poverty Level (FPL).

In general, it was found that API members consumed seafood at a very high rate. As shown in Table 10-115, the mean overall consumption rate for all seafood combined was 1.9 g/kg body weight-day (g/kg-day), with a median consumption rate of 1.4 g/kg-day. The predominant seafood consumed was shellfish (46% of all seafood). The API community consumed more shellfish (average consumption rate of 0.87 g/kg-day) than all finfish combined (an average consumption rate of 0.82 g/kg-day). Within the category of finfish, pelagic fish were consumed most by the API members, mean consumption rate of 0.38 g/kg-day (median: 0.22 g/kg-day), followed by anadromous fish with a mean consumption rate of 0.20 g/kg-day (median: 0.09 g/kg-day). The mean consumption for freshwater fish was 0.11 g/kg-day (median: 0.04 g/kg-day), and bottom fish was 0.13 g/kg-day (median: 0.05 g/kg-day). Individuals in the lowest income level (under the FPL) consumed more seafood than those in higher income levels (1–2, 2–3, and >3 times the FPL), but the difference was not statistically significant.

In an effort to capture the participants consuming large quantities of seafood, the survey participants were classified as higher (N = 44) or lower (N = 158) consumers of shellfish or finfish based on their consumption rates being $\geq 75^{th}$ (higher) or $\leq 75^{th}$ (lower) percentile. Table 10-116 shows that people in the >55-years-old-category had the greatest percentage for high consumers of finfish; they had approximately the same percentage as other age groups for shellfish. The Japanese had a greater percentage (52%) for higher finfish consumers, and Vietnamese (50%) were in the higher shellfish consumer category.

Table 10-117 presents seafood consumption rates by ethnicity. In general, members of the Vietnamese and Japanese communities had the highest overall consumption rate, averaging 2.6 g/kg-day (median 2.4 g/kg-day) and 2.2 g/kg-day (median 1.8 g/kg day), respectively.

Table 10-118 presents consumption rates by sex. The mean consumption rate for all seafood for women was 1.8 g/kg-day (median: 1.4 g/kg-day) and 1.7 g/kg-day (median: 1.3 g/kg-day) for men.

Salmon and tuna were the most frequently consumed finfish. More than 75% of the respondents consumed shrimp, crab, and squid. Table 10-119 presents these data. For all survey participants, the head, bones, eggs, and other organs were consumed 20% of the time. Fillet without skin was consumed 45% of the time, and fillet with skin, 55% of the time. Consumption patterns of shellfish parts varied depending on the type of shellfish.

Preparation methods were also surveyed in the API community. The survey covered two categories of preparation methods: (1) baked, broiled, roasted, or poached and (2) canned, fried, raw, smoked, or dried. The respondents most frequently prepared their finfish and shellfish using the baked, boiled, broiled, roasted, or poached method, averaging 65% and 78%, respectively.

The benefit of this research is that it can be used to improve API-specific risk assessments. API community members consume greater amounts of seafood than the general population, and these consumption patterns may pose a health risk if the consumed seafood is contaminated with toxic chemicals. Because the survey was based on recall, the authors selected 20 respondents for a follow-up re-interview. Its purpose was to assess the reliability of the responses. The results of the re-interview suggest that, based on the difference in means between the original and re-interview responses, the

estimated consumption rates from this study are reliable. One limitation associated with this study is that it is based on a relatively small number of respondents within each ethnic group. Caution should be used to avoid extrapolation of data to other ethnic groups that have potentially significant cultural differences. Further study of the consumption patterns and preparation methods for the Hmong, Laotian, Mien, and Vietnamese communities is also needed because of potential health risks from contaminated seafood.

10.7.2 Shilling et al. (2010)—Contaminated Fish Consumption in California's Central Valley Delta

Shilling et al. (2010) conducted a survey of 373 anglers and 137 community members between September 2005 and June 2008, in a region of the Sacramento-San Joaquin River Delta where subsistence fishing rates are high. This area was also chosen as an area where mercury concentrations in fish tissues were likely to be high. Anglers were selected for interviews as they were encountered in order to reduce bias, however, approximately 5% of the anglers approached did not speak English and were unable to be interviewed. Community members were chosen for interviews based on knowledge that an extended family member fished in this area. The interviews were conducted primarily in the early morning and late afternoon, and all days of the week were represented. Subjects were told at the beginning of the interview that the study was about fishing activity along the river, but not that it was related to fish contamination. Anglers and community members were grouped according to ethnicity, and fish consumption rates were calculated based on each individual's 30-day recall of how much and how often types of fish were eaten. Mean, median and 95th percentile fish consumption rates were calculated for study participants according to ethnicity, age, and sex. In addition, fish intake was determined for households containing women of child-bearing age, children, and for respondents whose awareness of warnings about fish contamination in the area ranged from no awareness to high awareness.

Regardless of ethnicity, the fish species that were primarily targeted by anglers in this study were striped bass, salmon, shad, and catfish, similar to those identified in creel survey data for this region from the California Department of Fish and Game. Consumption rates for locally caught and commercially obtained fish are shown in Table 10-120. Mean intake of locally caught fish among all ethnic groups ranged from 6.5 g/day for Native American anglers to 57.6 g/day for Southeast Asian/Lao anglers. For all anglers, the mean and median consumption rates of locally caught fish were 27.4 and 19.7 g/day, respectively. These values increased to 40.6 g/day (mean) and 26.1 g/day (median) when commercially obtained fish were included. The 95th percentile intake rates for all anglers were 126.6 g/day for local fish consumption and 147.3 g/day for total fish consumption. Fish consumption rates were not significantly different among age groups, but were higher for anglers from households with either children or women of child-bearing age.

No significant trend (p = 0.78) was observed across the 3-year study period for the consumption of locally caught fish. Peak consumption rates occurred during the fall, when striped bass and salmon return to the area to spawn and fishing activity is the highest. Fish consumption rates were significantly different for anglers and community members, with the exception of Southeast Asians. No significant difference was observed between the day of the week when surveying was conducted and ethnic group or fish consumption rates, or between anglers with higher or lower awareness of warnings about fish contamination in the area.

The advantages of this study are that the sample size was fairly large and that a number of ethnic groups were included. Limitations of the study include the fact that information on fish consumption was based on 30-day recall data and that the study was limited to one geographic area and may not be representative of the U.S. general population.

10.8. SERVING SIZE STUDIES

10.8.1. Pao et al. (1982)—Foods Commonly Eaten in the United States: Amount per Day and per Eating Occasion

Pao et al. (1982) used the 1977–1978 NFCS to examine the quantity of fish consumed per eating occasion. For each individual consuming fish in the 3-day survey period, the quantity of fish consumed per eating occasion was derived by dividing the total reported fish intake over the 3-day period by the number of occasions the individual reported eating fish. Table 10-121 displays the distributions, by age and sex, for the quantity of fish consumed per eating occasion (Pao et al., 1982). For the general population, the average quantity of fish consumed per fish meal was 117 grams, with a 95th percentile of 284 grams. Males in the age groups 19–34, 35–64, and 65–74 years had the highest average and 95th percentile quantities among the age-sex groups presented. It should be noted that the serving size

data from this analysis has been superseded by the analysis of the 1994–1996 USDA CSFII data conducted by Smiciklas-Wright et al. (2002).

10.8.2. Smiciklas-Wright et al. (2002)—Foods Commonly Eaten in the United States: Quantities Consumed per Eating Occasion and in a Day, 1994–1996

Using data gathered in the 1994–1996 USDA CSFII, Smiciklas-Wright et al. (2002) calculated distributions for the quantities of canned tuna and other finfish consumed per eating occasion by members of the U.S. population (i.e., serving sizes), over a 2-day period. The estimates of serving size are based on data obtained from 14,262 respondents, ages 2 years and above, who provided 2 days of dietary intake information. Only dietary intake data from users of the specified food were used in the analysis (i.e., consumer-only data).

Table 10-122 and Table 10-123 present serving size data for canned tuna and other finfish, respectively. These data are presented on an as-consumed basis (grams) and represent the quantity of fish consumed per eating occasion. These estimates may be useful for assessing acute exposures to contaminants in specific foods, or other assessments where the amount consumed per eating occasion is necessary. The average meal size for finfish (other than tuna) for adults 20 years and older was 114 g/meal (see Table 10-122). It should be noted that this value represents fish eaten in any form (e.g., as an ingredient in a meal) and not just fish eaten as a meal (e.g., fish fillet).

The advantages of using these data are that they were derived from the USDA CSFII and are representative of the U.S. population. The analysis conducted by Smiciklas-Wright et al. (2002) accounted for individual foods consumed as ingredients of mixed foods. Mixed foods were disaggregated via recipe files so that the individual ingredients could be grouped together with similar foods that were reported separately. Thus, weights of foods consumed as ingredients were combined with weights of foods reported separately to provide a more thorough representation of consumption. However, it should be noted that because the recipes for the mixed foods consumed by respondents were not provided by the respondents, standard recipes were used. As a result, the estimates of the quantity of some food types are based on assumptions about the types and quantities of ingredients consumed as part of mixed foods.

10.9. OTHER FACTORS TO CONSIDER FOR FISH CONSUMPTION

Other factors to consider when using the available survey data include location, climate, season, and ethnicity of the angler or consumer population, as well as the parts of fish consumed and the methods of preparation. Some contaminants (for example, persistent, bioaccumulative, and toxic contaminants such as dioxins and polychlorinated biphenyls) have the affinity to accumulate more in certain tissues, such as the fatty tissue, as well as in certain internal organs. The effects of cooking methods for various food products on the levels of dioxin-like compounds have been addressed by evaluating a number of studies in U.S. EPA (2003). These studies showed various results for contamination losses based on the methodology of the study and the method of food preparation. Refer to U.S. EPA (2003) for a detailed review of these studies.

In addition, some studies suggest that there is a significant decrease of contaminants in cooked fish when compared with raw fish (San Diego County, 1990). Several studies cited in this section have addressed fish preparation methods and parts of fish consumed. Table 10-124 provides summary results from these studies on fish preparation methods; Appendix 10B presents further details on preparation methods, as well as results from some studies on parts of fish consumed.

Users of the data presented in this chapter should ensure that consistent units are used for intake rate and concentration of contaminants in fish. The following sections provide information on converting between wet weight and dry weight, and between wet weight and lipid weight.

10.9.1. Conversion Between Wet and Dry Weight

The intake data presented in this chapter are reported in units of wet weight (i.e., as-consumed or uncooked weight of fish consumed per day or per eating occasion). However, data on the concentration of contaminants in fish may be reported in units of either wet or dry weight (e.g., milligram of contaminant per gram-dry-weight of fish). It is essential that exposure assessors be aware of this difference so that they may ensure consistency between the units used for intake rates and those used for concentration data (i.e., if the contaminant concentration is measured in dry weight of fish, then the dry-weight units should be used for fish intake values).

If necessary, wet-weight (e.g., as-consumed) intake rates may be converted to dry-weight intake rates using the moisture content percentages

presented in Table 10-125 and the following equation:

$$IR_{dw} = IR_{ww}\left[\frac{100 - W}{100}\right] \quad \text{(Eqn. 10-4)}$$

where:

IR_{dw} = dry-weight intake rate,
IR_{ww} = wet-weight intake rate, and
W = percent water content.

Alternately, dry-weight residue levels in fish may be converted to wet-weight residue levels for use with wet-weight (e.g., as-consumed) intake rates, as follows:

$$C_{ww} = C_{dw}\left[\frac{100 - W}{100}\right] \quad \text{(Eqn. 10-5)}$$

where:

C_{ww} = wet-weight concentration,
C_{dw} = dry-weight concentration, and
W = percent water content.

The moisture content data presented in Table 10-125 are for selected fish taken from USDA (2007). The moisture content is based on the percent of water present.

10.9.2. Conversion Between Wet-Weight and Lipid-Weight Intake Rates

In some cases, the residue levels of contaminants in fish are reported as the concentration of contaminant per gram of fat. This may be particularly true for lipophilic compounds. When using these residue levels, the assessor should ensure consistency in the exposure-assessment calculations by using consumption rates that are based on the amount of fat consumed for the fish product of interest.

The total fat content (percent) measured and/or calculated in various fish forms (i.e., raw, cooked, smoked, etc.) for selected fish species is presented in Table 10-125, based on data from USDA (2007). The total percent fat content is based on the sum of saturated, monounsaturated, and polyunsaturated fat.

If necessary, wet-weight (e.g., as-consumed) intake rates may be converted to lipid-weight intake rates using the fat content percentages presented in Table 10-125 and the following equation:

$$IR_{lw} = IR_{ww}\left[\frac{L}{100}\right] \quad \text{(Eqn. 10-6)}$$

where:

IR_{lw} = lipid-weight intake rate,
IR_{ww} = wet-weight intake rate, and
L = percent lipid (fat) content.

Alternately, wet-weight residue levels in fish may be estimated by multiplying the levels based on fat by the fraction of fat per product as follows:

$$C_{ww} = C_{lw}\left[\frac{L}{100}\right] \quad \text{(Eqn. 10-7)}$$

where:

C_{ww} = wet-weight concentration,
C_{lw} = lipid-weight concentration, and
L = percent lipid (fat) content.

The resulting residue levels may then be used in conjunction with wet-weight (e.g., as-consumed) consumption rates. The total fat content data presented in Table 10-125 are for selected fish taken from USDA (2007).

10.10. REFERENCES FOR CHAPTER 10

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Table 10-7. Per Capita Intake of Finfish (g/kg-day), Edible Portion, Uncooked Fish Weight

Population Group	N	% Consuming	Mean	SE	Lower 95% CL	Upper 95%CL	Percentiles										
							Min	1st	5th	10th	25th	50th	75th	90th	95th	99th	Max
Whole Population	16,783	23	0.16	0.01	0.14	0.18	0.0[b]	0.0	0.0	0.0	0.0	0.0	0.0	0.6	1.1	2.3	13.4[b]
Age Group (years)																	
0 to 1	865	2.6	0.03	0.01	0.01	0.06	0.0[b]	0.0[b]	0.0[b]	0.0	0.0	0.0	0.0	0.0	0.0[b]	1.5[b]	3.7[b]
1 to 2	1,052	14	0.22	0.05	0.12	0.32	0.0[b]	0.0[b]	0.0[b]	0.0	0.0	0.0	0.0	0.5	1.2[b]	4.3[b]	13.4[b]
3 to 5	978	15	0.19	0.03	0.13	0.25	0.0[b]	0.0[b]	0.0	0.0	0.0	0.0	0.0	0.7	1.4	2.7[b]	7.0[b]
6 to 12	2,256	15	0.16	0.04	0.08	0.24	0.0[b]	0.0[b]	0.0	0.0	0.0	0.0	0.0	0.5	1.1	2.6[b]	6.7[b]
13 to 19	3,450	15	0.10	0.01	0.08	0.11	0.0[b]	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.7	1.7	6.9[b]
20 to 49	4,289	23	0.15	0.01	0.13	0.17	0.0[b]	0.0	0.0	0.0	0.0	0.0	0.0	0.5	1.0	2.2	8.5[b]
Females 13 to 49	4,103	22	0.14	0.01	0.11	0.16	0.0[b]	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.9	1.8	8.5[b]
50+	3,893	29	0.20	0.02	0.16	0.23	0.0[b]	0.0	0.0	0.0	0.0	0.0	0.1	0.7	1.2	2.4	6.1[b]
Race																	
Mexican American	4,450	16	0.15	0.02	0.11	0.18	0.0[b]	0.0	0.0	0.0	0.0	0.0	0.0	0.5	1.1	2.6	8.5[b]
Non-Hispanic Black	4,265	24	0.18	0.02	0.15	0.22	0.0[b]	0.0	0.0	0.0	0.0	0.0	0.0	0.6	1.1	2.4	8.8[b]
Non-Hispanic White	6,757	22	0.15	0.01	0.13	0.17	0.0[b]	0.0	0.0	0.0	0.0	0.0	0.0	0.5	1.0	2.0	13.4[b]
Other Hispanic	562	22	0.18	0.03	0.11	0.24	0.0[b]	0.0[b]	0.0	0.0	0.0	0.0	0.0	0.5	1.0	2.7[b]	7.3[b]
Other [a]	749	33	0.31	0.05	0.20	0.42	0.0[b]	0.0[b]	0.0	0.0	0.0	0.0	0.2	1.1	2.0	4.0[b]	6.5[b]

[a] Other: Other Race - including Multiple Races.

[b] Estimates are less statistically reliable based on guidance published in the *Joint Policy on Variance Estimation and Statistical Reporting Standards on NHANES III and CSFII Reports: NHIS/NCHS Analytical Working Group Recommendations* (NCHS, 1993).

N = Sample size.
SE = Standard error.
CL = Confidence limit.
Min = Minimum value.
Max = Maximum value.
Source: U.S. EPA analysis of NHANES 2003–2006.

Table 10-8. Consumer-Only Intake of Finfish (g/kg-day), Edible Portion, Uncooked Fish Weight

Population Group	N	Mean	SE	Lower 95%CL	Upper 95% CL	Min	Percentiles									
							1st	5th	10th	25th	50th	75th	90th	95th	99th	Max
Whole Population	3,204	0.73	0.03	0.67	0.78	0.0[b]	0.0	0.0	0.0	0.2	0.5	1.0	1.6	2.2	4.0	13.4[b]
Age Group (years)																
0 to 1	22	1.31	0.31	0.68	1.94	0.1[b]	0.1[b]	0.2[b]	0.2[b]	0.4[b]	0.8[b]	2.0[b]	2.8[b]	2.9[b]	3.7[b]	3.7[b]
1 to 2	143	1.61	0.27	1.06	2.16	0.0[b]	0.0[b]	0.1[b]	0.2[b]	0.5[b]	0.8[b]	1.7[b]	3.6[b]	4.9[b]	13.4[b]	13.4[b]
3 to 5	156	1.28	0.13	1.01	1.55	0.0[b]	0.0[b]	0.0[b]	0.2[b]	0.5	1.0	1.7	2.7[b]	3.6[b]	5.6[b]	7.0[b]
6 to 12	333	1.05	0.12	0.81	1.29	0.0[b]	0.0[b]	0.0[b]	0.1[b]	0.3	0.7	1.4	2.1[b]	2.9[b]	6.5[b]	6.7[b]
13 to 19	501	0.66	0.03	0.59	0.73	0.0[b]	0.0[b]	0.0	0.0	0.2	0.5	0.9	1.4	1.7	2.6[b]	6.9[b]
20 to 49	961	0.65	0.02	0.60	0.70	0.0[b]	0.0[b]	0.0	0.0	0.2	0.4	0.9	1.5	2.1	3.9[b]	8.5[b]
Females 13 to 49	793	0.62	0.04	0.54	0.69	0.0[b]	0.0	0.0	0.0	0.1	0.4	0.9	1.4	1.8	2.9	8.5[b]
50+	1,088	0.68	0.04	0.61	0.76	0.0[b]	0.0[b]	0.0	0.0	0.2	0.5	0.9	1.5	2.0	3.2[b]	6.1[b]
Race						0.0[b]										
Mexican American	584	0.93	0.04	0.84	1.03	0.0[b]	0.0[b]	0.0	0.0	0.3	0.7	1.3	1.9	2.8	4.7[b]	8.5[b]
Non-Hispanic Black	906	0.77	0.05	0.66	0.88	0.0[b]	0.0	0.0	0.1	0.2	0.5	1.0	1.7	2.1	4.9	8.8[b]
Non-Hispanic White	1,405	0.67	0.03	0.62	0.72	0.0[b]	0.0[b]	0.0	0.0	0.2	0.5	0.9	1.5	1.9	3.2[b]	13.4[b]
Other Hispanic	101	0.82	0.10	0.61	1.03	0.0[b]	0.0[b]	0.0[b]	0.1[b]	0.3	0.5	1.0	2.0[b]	2.7[b]	4.9[b]	7.3[b]
Other [a]	208	0.96	0.14	0.68	1.23	0.0[b]	0.0[b]	0.0[b]	0.0	0.2	0.5	1.3	2.2	3.6[b]	5.3[b]	6.5[b]

[a] Other: Other Race - including Multiple Races.

[b] Estimates are less statistically reliable based on guidance published in the *Joint Policy on Variance Estimation and Statistical Reporting Standards on NHANES III and CSFII Reports: NHIS/NCHS Analytical Working Group Recommendations* (NCHS, 1993).

N = Sample size.
SE = Standard error.
CL = Confidence limit.
Min = Minimum value.
Max = Maximum value.

Source: U.S. EPA analysis of NHANES 2003–2006.

Table 10-9. Per Capita Intake of Shellfish (g/kg-day), Edible Portion, Uncooked Fish Weight

Population Group	N	% Consuming	Mean	SE	Lower 95% CL	Upper 95% CL	Percentiles Min	1st	5th	10th	25th	50th	75th	90th	95th	99th	Max
Whole Population	16,783	11	0.06	0.01	0.05	0.07	0.0[b]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.4	6.6[b]
Age Group (years)																	
0 to 1	865	0.66	0.00	0.00	0.00	0.01	0.0[b]	0.0[b]	0.0[b]	0.0	0.0	0.0	0.0	0.0	0.0[b]	0.0[b]	2.3[b]
1 to 2	1,052	4.4	0.04	0.01	0.02	0.06	0.0[b]	0.0[b]	0.0[b]	0.0	0.0	0.0	0.0	0.0	0.0[b]	1.0[b]	6.6[b]
3 to 5	978	4.6	0.05	0.01	0.02	0.08	0.0[b]	0.0[b]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4[b]	4.0[b]
6 to 12	2,256	7.0	0.05	0.01	0.02	0.08	0.0[b]	0.0[b]	0.0	0.0	0.0	0.0	0.0	0.0	0.2	1.4[b]	4.9[b]
13 to 19	3,450	5.1	0.03	0.01	0.02	0.04	0.0[b]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	4.5[b]
20 to 49	4,289	13	0.08	0.01	0.06	0.10	0.0[b]	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.5	1.9	5.4[b]
Females 13 to 49	4,103	11	0.06	0.01	0.04	0.07	0.0[b]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	1.3	5.3[b]
50+	3,893	13	0.05	0.01	0.04	0.07	0.0[b]	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.4	1.0	5.2[b]
Race																	
Mexican American	4,450	9.5	0.08	0.01	0.05	0.11	0.0[b]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	1.8	6.6[b]
Non-Hispanic Black	4,265	12	0.06	0.01	0.04	0.07	0.0[b]	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	1.1	4.9[b]
Non-Hispanic White	6,757	10	0.05	0.01	0.04	0.07	0.0[b]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	1.2	5.4[b]
Other Hispanic	562	15	0.09	0.02	0.05	0.14	0.0[b]	0.0[b]	0.0	0.0	0.0	0.0	0.0	0.4	0.7	2.1[b]	2.6[b]
Other[a]	749	20	0.13	0.02	0.10	0.17	0.0[b]	0.0[b]	0.0	0.0	0.0	0.0	0.0	0.4	0.9	2.6[b]	4.5[b]

[a] Other: Other Race - including Multiple Races.

[b] Estimates are less statistically reliable based on guidance published in the *Joint Policy on Variance Estimation and Statistical Reporting Standards on NHANES III and CSFII Reports: NHIS/NCHS Analytical Working Group Recommendations* (NCHS, 1993).

N = Sample size.
SE = Standard error.
CL = Confidence limit.
Min = Minimum value.
Max =Maximum value.
Source: U.S. EPA analysis of NHANES 2003–2006.

Table 10-10. Consumer-Only Intake of Shellfish (g/kg-day), Edible Portion, Uncooked Fish Weight

Population Group	N	Mean	SE	Lower 95%CL	Upper 95% CL	Min	Percentiles									
							1st	5th	10th	25th	50th	75th	90th	95th	99th	Max
Whole Population	1,563	0.57	0.03	0.50	0.63	0.0[b]	0.0[b]	0.0	0.0	0.1	0.3	0.7	1.3	1.9	3.0[b]	6.6[b]
Age Group (years)																
0 to 1	11	0.42	0.21	0.00	0.85	0.0[b]	0.0[b]	0.0[b]	0.0[b]	0.0[b]	0.2[b]	0.2[b]	1.3[b]	2.3[b]	2.3[b]	2.3[b]
1 to 2	53	0.94	0.18	0.56	1.31	0.0[b]	0.0[b]	0.0[b]	0.1[b]	0.2[b]	0.6[b]	1.0[b]	1.6[b]	3.5[b]	6.6[b]	6.6[b]
3 to 5	56	1.00	0.18	0.63	1.36	0.0[b]	0.0[b]	0.0[b]	0.1[b]	0.4[b]	0.7[b]	1.4[b]	2.9[b]	2.9[b]	4.0[b]	4.0[b]
6 to 12	158	0.72	0.12	0.47	0.97	0.0[b]	0.0[b]	0.1[b]	0.1[b]	0.2	0.5	1.1	1.7[b]	2.0[b]	4.5[b]	4.9[b]
13 to 19	245	0.61	0.06	0.49	0.74	0.0[b]	0.0[b]	0.0	0.0	0.1	0.4	0.9	1.5	1.9	2.7[b]	4.5[b]
20 to 49	605	0.63	0.06	0.52	0.75	0.0[b]	0.0[b]	0.0	0.0	0.1	0.4	0.8	1.8	2.2	4.3[b]	5.4[b]
Females 13 to 49	474	0.53	0.06	0.40	0.66	0.0[b]	0.0[b]	0.0	0.0	0.1	0.3	0.6	1.2	1.8	4.5[b]	5.3[b]
50+	435	0.41	0.02	0.36	0.46	0.0[b]	0.0[b]	0.0	0.0	0.1	0.3	0.5	0.9	1.2	1.8[b]	5.2[b]
Race																
Mexican American	331	0.83	0.10	0.62	1.04	0.0[b]	0.0[b]	0.0	0.1	0.2	0.5	1.1	1.9	2.8	4.3[b]	6.6[b]
Non-Hispanic Black	449	0.48	0.03	0.41	0.54	0.0[b]	0.0[b]	0.0	0.0	0.1	0.3	0.6	1.1	1.7	2.5[b]	4.9[b]
Non-Hispanic White	617	0.53	0.05	0.44	0.63	0.0[b]	0.0[b]	0.0	0.0	0.1	0.3	0.6	1.2	1.9	3.0[b]	5.4[b]
Other Hispanic	49	0.64	0.07	0.49	0.79	0.0[b]	0.0[b]	0.0[b]	0.1[b]	0.3[b]	0.4	0.9[b]	1.3[b]	2.1[b]	2.6[b]	2.6[b]
Other [a]	117	0.67	0.06	0.55	0.80	0.0[b]	0.0[b]	0.1[b]	0.1[b]	0.2	0.4	0.9	1.4[b]	2.6[b]	2.6[b]	4.5[b]

[a] Other: Other Race - including Multiple Races.

[b] Estimates are less statistically reliable based on guidance published in the *Joint Policy on Variance Estimation and Statistical Reporting Standards on NHANES III and CSFII Reports: NHIS/NCHS Analytical Working Group Recommendations* (NCHS, 1993).

N = Sample size.
SE = Standard error.
CL = Confidence limit.
Min = Minimum value.
Max = Maximum value.

Source: U.S. EPA analysis of NHANES 2003–2006.

Table 10-11. Per Capita Intake of Total Finfish and Shellfish Combined (g/kg-day), Edible Portion, Uncooked Fish Weight

Population Group	N	% Consuming	Mean	SE	Lower 95%CL	Upper 95% CL	Percentiles										
							Min	1st	5th	10th	25th	50th	75th	90th	95th	99th	Max
Whole Population	16,783	29	0.22	0.014	0.20	0.25	0.0[b]	0.0	0.0	0.0	0.0	0.0	0.1	0.8	1.3	2.7	13.4[b]
Age Group (years)																	
0 to 1	865	3.1	0.04	0.01	0.02	0.06	0.0[b]	0.0[b]	0.0[b]	0.0	0.0	0.0	0.0	0.0	0.0[b]	1.5[b]	5.1[b]
1 to 2	1,052	17	0.26	0.06	0.15	0.38	0.0[b]	0.0[b]	0.0[b]	0.0	0.0	0.0	0.0	0.7	1.6[b]	4.7[b]	13.4[b]
3 to 5	978	18	0.24	0.03	0.17	0.31	0.0[b]	0.0[b]	0.0	0.0	0.0	0.0	0.0	0.9	1.6	3.4[b]	7.0[b]
6 to 12	2,256	22	0.21	0.05	0.12	0.31	0.0[b]	0.0[b]	0.0	0.0	0.0	0.0	0.0	0.8	1.4	2.7[b]	6.7[b]
13 to 19	3,450	18	0.13	0.01	0.10	0.15	0.0[b]	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.0	1.7	6.9[b]
20 to 49	4,289	31	0.23	0.02	0.20	0.27	0.0[b]	0.0	0.0	0.0	0.0	0.0	0.1	0.8	1.3	2.7	8.6[b]
Females 13 to 49	4,103	28	0.19	0.02	0.16	0.22	0.0[b]	0.0	0.0	0.0	0.0	0.0	0.0	0.7	1.2	2.4	8.6[b]
50+	3,893	36	0.25	0.02	0.21	0.29	0.0[b]	0.0	0.0	0.0	0.0	0.0	0.3	0.9	1.4	2.6	6.1[b]
Race																	
Mexican American	4,450	22	0.23	0.03	0.17	0.28	0.0[b]	0.0	0.0	0.0	0.0	0.0	0.0	0.9	1.4	3.5	8.6[b]
Non-Hispanic Black	4,265	32	0.24	0.02	0.20	0.28	0.0[b]	0.0	0.0	0.0	0.0	0.0	0.2	0.8	1.3	2.7	8.9[b]
Non-Hispanic White	6,757	28	0.20	0.01	0.17	0.23	0.0[b]	0.0	0.0	0.0	0.0	0.0	0.1	0.7	1.2	2.4	13.4[b]
Other Hispanic	562	32	0.27	0.05	0.17	0.37	0.0[b]	0.0[b]	0.0	0.0	0.0	0.0	0.2	0.9	1.7	3.1[b]	7.3[b]
Other [a]	749	43	0.45	0.06	0.32	0.58	0.0[b]	0.0[b]	0.0	0.0	0.0	0.0	0.4	1.5	2.5	4.1[b]	6.5[b]

[a] Other: Other Race - including Multiple Races.

[b] Estimates are less statistically reliable based on guidance published in the *Joint Policy on Variance Estimation and Statistical Reporting Standards on NHANES III and CSFII Reports: NHIS/NCHS Analytical Working Group Recommendations* (NCHS, 1993).

N = Sample size.
SE = Standard error.
CL = Confidence limit.
Min = Minimum value.
Max = Maximum value.

Source: U.S. EPA analysis of NHANES 2003–2006.

Table 10-12. Consumer-Only Intake of Total Finfish and Shellfish Combined (g/kg-day), Edible Portion, Uncooked Fish Weight

Population Group	N	Mean	SE	Lower 95%CL	Upper 95% CL	Min	Percentiles									
							1st	5th	10th	25th	50th	75th	90th	95th	99th	Max
Whole Population	4,206	0.78	0.03	0.73	0.83	0.0[b]	0.0	0.0	0.1	0.2	0.5	1.1	1.8	2.4	4.2	13.4[b]
Age Group (years)						0.0[b]										
0 to 1	30	1.18	0.29	0.59	1.76	0.0[b]	0.0[b]	0.0[b]	0.1[b]	0.2[b]	0.7[b]	1.6[b]	2.8[b]	2.9[b]	5.1[b]	5.1[b]
1 to 2	183	1.54	0.25	1.04	2.04	0.0[b]	0.0[b]	0.1[b]	0.2[b]	0.4[b]	0.8	1.7[b]	3.5[b]	5.9[b]	13.4[b]	13.4[b]
3 to 5	196	1.31	0.14	1.04	1.59	0.0[b]	0.0[b]	0.1[b]	0.2[b]	0.5	1.0	1.7	2.9[b]	3.6[b]	6.2[b]	7.0[b]
6 to 12	461	0.99	0.08	0.82	1.15	0.0[b]	0.0[b]	0.1[b]	0.1	0.3	0.7	1.4	2.0	2.7[b]	5.2[b]	6.7[b]
13 to 19	685	0.69	0.03	0.63	0.76	0.0[b]	0.0	0.0	0.0	0.2	0.5	1.0	1.5	1.8	3.0	6.9[b]
20 to 49	1,332	0.76	0.04	0.68	0.83	0.0[b]	0.0[b]	0.0	0.0	0.2	0.5	1.0	1.8	2.5	4.2[b]	8.6[b]
Females 13 to 49	1,109	0.68	0.04	0.60	0.76	0.0[b]	0.0	0.0	0.0	0.2	0.4	0.9	1.5	1.9	4.0	8.6[b]
50+	1,319	0.71	0.03	0.64	0.77	0.0[b]	0.0[b]	0.0	0.1	0.2	0.5	1.0	1.6	2.1	3.3[b]	6.1[b]
Race						0.0[b]										
Mexican American	831	1.01	0.06	0.88	1.14	0.0[b]	0.0[b]	0.0	0.1	0.3	0.8	1.3	2.1	3.2	5.6[b]	8.6[b]
Non-Hispanic Black	1,212	0.76	0.04	0.67	0.85	0.0[b]	0.0	0.0	0.1	0.2	0.5	1.0	1.8	2.2	4.9	8.9[b]
Non-Hispanic White	1,753	0.73	0.03	0.67	0.78	0.0[b]	0.0[b]	0.0	0.0	0.2	0.5	1.0	1.6	2.1	3.4[b]	13.4[b]
Other Hispanic	136	0.86	0.11	0.63	1.09	0.0[b]	0.0[b]	0.0[b]	0.1[b]	0.3	0.5	1.2	2.0[b]	2.6[b]	5.2[b]	7.3[b]
Other [a]	274	1.03	0.13	0.77	1.29	0.0[b]	0.0[b]	0.0[b]	0.1	0.2	0.6	1.4	2.5	2.9[b]	6.1[b]	6.5[b]

[a] Other: Other Race - including Multiple Races.

[b] Estimates are less statistically reliable based on guidance published in the *Joint Policy on Variance Estimation and Statistical Reporting Standards on NHANES III and CSFII Reports: NHIS/NCHS Analytical Working Group Recommendations* (NCHS, 1993).

N = Sample size.
SE = Standard error.
CL = Confidence limit.
Min = Minimum value.
Max = Maximum value.

Source: U.S. EPA analysis of NHANES 2003–2006.

Table 10-13. Total Fish Consumption, Consumers Only, by Demographic Variables[a]

	Intake (g/person-day)	
Demographic Category	Mean	95th Percentile
Overall (all fish consumers)	14.3	41.7
Race		
Caucasian	14.2	41.2
Black	16.0	45.2
Asian	21.0	67.3
Other	13.2	29.4
Sex		
Female	13.2	38.4
Male	15.6	44.8
Age (years)		
0 to 9	6.2	16.5
10 to 19	10.1	26.8
20 to 29	14.5	38.3
30 to 39	15.8	42.9
40 to 49	17.4	48.1
50 to 59	20.9	53.4
60 to 69	21.7	55.4
≥70	13.3	39.8
Sex and Age (years)		
Female		
0 to 9	6.1	17.3
10 to 19	9.0	25.0
20 to 29	13.4	34.5
30 to 39	14.9	41.8
40 to 49	16.7	49.6
50 to 59	19.5	50.1
60 to 69	19.0	46.3
≥70	10.7	31.7
Male		
0 to 9	6.3	15.8
10 to 19	11.2	29.1
20 to 29	16.1	43.7
30 to 39	17.0	45.6
40 to 49	18.2	47.7
50 to 59	22.8	57.5
60 to 69	24.4	61.1
≥70	15.8	45.7
Census Region		
New England	16.3	46.5
Middle Atlantic	16.2	47.8
East North Central	12.9	36.9
West North Central	12.0	35.2
South Atlantic	15.2	44.1
East South Central	13.0	38.4
West South Central	14.4	43.6
Mountain	12.1	32.1
Pacific	14.2	39.6

Table 10-13. Total Fish Consumption, Consumers Only, by Demographic Variables[a] (continued)

Demographic Category	Intake (g/person-day)	
	Mean	95th Percentile
Community Type		
Rural, non-SMSA	13.0	38.3
Central city, 2M or more	19.0	55.6
Outside central city, 2M or more	15.9	47.3
Central city, 1M–2M	15.4	41.7
Outside central city, 1M–2M	14.5	41.5
Central city, 500K–1M	14.2	41.0
Outside central city, 500K–1M	14.0	39.7
Outside central city, 250K–500K	12.2	32.1
Central city, 250K–500K	14.1	40.5
Central city, 50K–250K	13.8	43.4
Outside central city, 50K–250K	11.3	31.7
Other urban	13.5	39.2

[a] The calculations in this table are based on respondents who consumed fish during the survey month. These respondents are estimated to represent 94% of the U.S. population.

SMSA = Standard metropolitan statistical area.

Source: SRI (1980).

Table 10-14. Percent Distribution of Total Fish Consumption for Females and Males by Age[a]

Age (years)	Consumption Category (g/day)										
	0.0–5.0	5.1–10.0	10.1–15.0	15.1–20.0	20.1–25.0	25.1–30.0	30.1–37.5	37.6–47.5	47.6–60.0	60.1–122.5	over 122.5
Females											
0 to 9	55.5	26.8	11.0	3.7	1.0	1.1	0.7	0.3	0.0	0.0	0.0
10 to 19	17.8	31.4	15.4	6.9	3.5	2.4	1.2	0.7	0.2	0.4	0.0
20 to 29	28.1	26.1	20.4	11.8	6.7	3.5	4.4	2.2	0.9	0.9	0.0
30 to 39	22.4	23.6	18.0	12.7	8.3	4.8	3.8	2.8	1.9	1.7	0.1
40 to 49	17.5	21.9	20.7	13.2	9.3	4.5	4.6	2.8	3.4	2.1	0.2
50 to 59	17.0	17.4	16.8	15.5	10.5	8.5	6.8	5.2	4.2	2.0	0.2
60 to 69	11.5	16.9	20.6	15.9	9.1	9.2	6.0	6.1	2.4	2.1	0.2
≥70	41.9	22.1	12.3	9.7	5.2	2.9	2.6	1.2	0.8	1.2	0.1
Overall	28.9	24.0	16.8	10.7	6.4	4.3	3.5	2.4	1.6	1.2	0.1
Males											
0 to 9	52.1	30.1	11.9	3.1	1.2	0.6	0.7	0.1	0.2	0.1	0.0
10 to 19	27.8	29.3	19.0	10.4	6.0	3.2	1.7	1.7	0.4	0.5	0.0
20 to 29	16.7	22.9	19.6	14.5	8.8	6.2	4.4	3.1	1.9	1.9	0.1
30 to 39	16.6	21.2	19.2	13.2	9.5	7.3	5.2	3.2	1.3	2.2	0.0
40 to 49	11.9	22.3	18.6	14.7	8.4	8.5	5.3	5.2	3.3	1.7	0.1
50 to 59	9.9	15.2	15.4	14.4	10.4	9.7	8.7	7.6	4.3	4.1	0.2
60 to 69	7.4	15.0	15.6	12.8	11.4	8.5	9.9	8.3	5.5	5.5	0.1
≥70	24.5	21.7	15.7	9.9	9.8	5.3	5.4	3.1	1.7	2.8	0.1
Overall	22.6	23.1	17.0	11.3	7.7	5.7	4.6	3.6	2.2	2.1	0.1

[a] The percentage of females in an age bracket whose average daily fish consumption is within the specified range. The calculations in this table are based upon the respondents who consumed fish during the month of the survey. These respondents are estimated to represent 94% of the U.S. population.

Source: SRI (1980).

Table 10-15. Mean Total Fish Consumption by Species[a]

Species	Mean Consumption (g/day)	Species	Mean Consumption (g/day)
Not reported	1.173	Mullet[b]	0.029
Abalone	0.014	Oysters[b]	0.291
Anchovies	0.010	Perch (Freshwater)[b]	0.062
Bass[b]	0.258	Perch (Marine)	0.773
Bluefish	0.070	Pike (Marine)[b]	0.154
Bluegills[b]	0.089	Pollock	0.266
Bonito[b]	0.035	Pompano	0.004
Buffalofish	0.022	Rockfish	0.027
Butterfish	0.010	Sablefish	0.002
Carp[b]	0.016	Salmon[b]	0.533
Catfish (Freshwater)[b]	0.292	Scallops[b]	0.127
Catfish (Marine)[b]	0.014	Scup[b]	0.014
Clams[b]	0.442	Sharks	0.001
Cod	0.407	Shrimp[b]	1.464
Crab, King	0.030	Smelt[b]	0.057
Crab, other than King[b]	0.254	Snapper	0.146
Crappie[b]	0.076	Snook[b]	0.005
Croaker[b]	0.028	Spot[b]	0.046
Dolphin[b]	0.012	Squid and Octopi	0.016
Drums	0.019	Sunfish	0.020
Flounders[b]	1.179	Swordfish	0.012
Groupers	0.026	Tilefish	0.003
Haddock	0.399	Trout (Freshwater)[b]	0.294
Hake	0.117	Trout (Marine)[b]	0.070
Halibut[b]	0.170	Tuna, light	3.491
Herring	0.224	Tuna, White Albacore	0.008
Kingfish	0.009	Whitefish[b]	0.141
Lobster (Northern)[b]	0.162	Other finfish[b]	0.403
Lobster (Spiny)	0.074	Other shellfish[b]	0.013
Mackerel, Jack	0.002		
Mackerel, other than Jack	0.172		

[a] The calculations in this table are based upon respondents who consumed fish during the month of the survey. These respondents are estimated to represent 94% of the U.S. population.

[b] Designated as freshwater or estuarine species.

Source: SRI (1980).

Table 10-16. Best Fits of Lognormal Distributions Using the Non-Linear Optimization Method

	Adults	Teenagers	Children
Shellfish			
μ	1.370	–0.183	0.854
σ	0.858	1.092	0.730
Finfish (freshwater)			
μ	0.334	0.578	–0.559
σ	1.183	0.822	1.141
Finfish (saltwater)	2.311	1.691	0.881
μ	0.72	0.830	0.970
σ			

The following equations may be used with the appropriate μ and σ values to obtain an average Daily Consumption Rate (DCR), in grams, and percentiles of the DCR distribution.

$DCR50 = \exp(\mu)$

$DCR90 = \exp[\mu + z(0.90) \times \sigma]$

$DCR99 = \exp[\mu + z(0.99) \times \sigma]$

$DCR_{avg} = \exp[\mu + 0.5 \times \sigma^2]$

Source: Ruffle et al. (1994).

Table 10-17. Mean Fish Intake in a Day, by Sex and Age[a]

Sex Age (years)	Per Capita Intake (g/day)	Percent of Population Consuming Fish in 1 Day	Mean Intake (g/day) for Consumers Only[b]
Males or Females			
5 and under	4	6.0	67
Males			
6 to 11	3	3.7	79
12 to 19	3	2.2	136
20 and over	15	10.9	138
Females			
6 to 11	7	7.1	99
12 to 19	9	9.0	100
20 and over	12	10.9	110
All individuals	11	9.4	117

[a] Based on USDA Nationwide Food Consumption Survey 1987–1988 data for 1 day.

[b] Intake for users only was calculated by dividing the per capita consumption rate by the fraction of the population consuming fish in 1 day.

Source: USDA (1992).

Table 10-18. Percent of Respondents That Responded Yes, No, or Don't Know to Eating Seafood in 1 Month (including shellfish, eels, or squid)

		Response					
		No		Yes		DK	
Population Group	Total *N*	*N*	%	*N*	%	*N*	%
Overall	4,663	1,811	38.8	2,780	59.6	72	1.5
Sex							
*	2	1	50.0	1	50.0	*	*
Male	2,163	821	38.0	1,311	60.6	31	1.4
Female	2,498	989	39.6	1,468	58.8	41	1.6
Age (years)							
*	84	25	29.8	42	50.0	17	20.2
1 to 4	263	160	60.8	102	38.8	1	0.4
5 to 11	348	177	50.9	166	47.7	5	1.4
12 to 17	326	179	54.9	137	42.0	10	3.1
18 to 64	2,972	997	33.5	1,946	65.5	29	1.0
>64	670	273	40.7	387	57.8	10	1.5
Race							
*	60	20	33.3	22	36.7	18	30.0
White	3,774	1,475	39.1	2,249	59.6	50	1.3
Black	463	156	33.7	304	65.7	3	0.6
Asian	77	21	27.3	56	72.7	*	*
Some Others	96	39	40.6	56	58.3	1	1.0
Hispanic	193	100	51.8	93	48.2	*	*
Hispanic							
*	46	10	21.7	412	43.0	28	41.3
No	4,243	1,625	31.2	1,366	67.7	21	1.2
Yes	348	165	35.4	236	62.3	9	*
DK	26	11	40.4	766	58.5	14	*
Employment							
*	958	518	54.1	412	43.0	28	2.9
Full Time	2,017	630	31.2	1,366	67.7	21	1.0
Part Time	379	134	35.4	236	62.3	9	2.4
Not Employed	1,309	529	40.4	766	58.5	14	1.1
Education							
*	1,021	550	53.9	434	42.5	37	3.6
<High School	399	196	49.1	198	49.6	45	1.3
High School Graduate	1,253	501	40.0	739	59.0	13	1.0
<College	895	304	34.0	584	65.3	7	0.8
College Graduate	650	159	24.5	484	74.5	7	1.1
Post-Graduate	445	101	22.7	341	76.6	3	0.7

Table 10-18. Percent of Respondents That Responded Yes, No, or Don't Know to Eating Seafood in 1 Month (including shellfish, eels, or squid) (continued)

		Response					
		No		Yes		DK	
Population Group	Total *N*	*N*	%	*N*	%	*N*	%
Census Region							
Northeast	1,048	370	35.3	655	62.5	23	2.2
Midwest	1,036	449	43.3	575	55.5	12	1.2
South	1,601	590	36.9	989	61.8	22	1.4
West	978	402	41.1	561	57.4	15	1.5
Day of Week							
Weekday	3,156	1,254	39.7	1,848	58.6	54	1.7
Weekend	1,507	557	37.0	932	61.8	18	1.2
Season							
Winter	1,264	462	36.6	780	61.7	22	1.7
Spring	1,181	469	39.7	691	58.5	21	1.8
Summer	1,275	506	39.7	745	58.4	24	1.9
Fall	943	374	39.7	564	59.8	5	0.5
Asthma							
No	4,287	1,674	39.0	2,563	59.8	50	1.2
Yes	341	131	38.4	207	60.7	3	0.9
DK	35	6	17.7	10	28.6	19	54.3
Angina							
No	4,500	1,750	38.9	2,698	60.0	52	1.2
Yes	125	56	44.8	68	54.4	1	0.8
DK	38	50	13.2	14	36.8	19	50.0
Bronchitis/Emphysema							
No	4,424	1,726	9.0	2,648	59.6	50	1.1
Yes	203	80	39.4	121	59.6	2	1.0
DK	36	5	13.9	11	30.6	20	55.6

* = Missing data.
DK = Don't know.
% = Row percentage.
N = Sample size.

Source: U.S. EPA (1996).

Table 10-19. Number of Respondents Reporting Consumption of a Specified Number of Servings of Seafood in 1 Month

Population Group	Total *N*	Number of Servings in a Month					
		1–2	3–5	6–10	11–19	20+	DK
Overall	2,780	918	990	519	191	98	64
Sex							
*	1,311	405	458	261	101	57	29
Male	1,468	512	532	258	90	41	35
Female	1	1	*	*	*	*	*
Age (years)							
*	42	13	16	5	4	1	3
1 to 4	102	55	29	12	2	*	4
5 to 11	166	72	57	21	6	4	6
12 to 17	137	68	54	9	2	1	3
18 to 64	1,946	603	679	408	145	79	32
>64	387	107	155	64	32	13	16
Race							
*	2,249	731	818	428	155	76	41
White	304	105	103	56	16	10	14
Black	56	15	17	11	5	5	3
Asian	56	22	18	6	5	3	2
Some Others	93	41	25	14	9	2	2
Hispanic	22	4	9	4	1	2	2
Hispanic							
*	2,566	844	922	480	175	88	57
No	182	68	52	34	15	8	5
Yes	15	5	8	2	*	*	*
DK	17	1	8	3	1	2	2
Employment							
*	399	190	140	40	11	5	13
Full Time	1,366	407	466	307	107	57	22
Part Time	236	70	95	46	14	8	3
Not Employed	766	249	285	124	57	26	25
Refused	13	2	4	2	2	2	1
Education							
*	434	205	149	47	12	7	14
<High School	198	88	62	20	6	10	12
High School Graduate	739	267	266	119	46	21	20
<College	584	161	219	122	48	26	8
College Graduate	484	115	183	121	43	17	5
Post-Graduate	341	82	111	90	36	17	5
Census Region							
Northeast	655	191	241	137	62	12	12
Midwest	575	199	221	102	17	22	14
South	989	336	339	175	70	41	28
West	561	192	189	105	42	23	10

Table 10-19. Number of Respondents Reporting Consumption of a Specified Number of Servings of Seafood in 1 Month (continued)

Population Group	Total *N*	Number of Servings in a Month					
		1–2	3–5	6–10	11–19	20+	DK
Day of Week							
Weekday	1,848	602	661	346	129	70	40
Weekend	932	316	329	173	62	28	24
Season							
Winter	780	262	284	131	60	28	15
Spring	691	240	244	123	45	25	14
Summer	745	220	249	160	59	31	26
Fall	564	196	213	105	27	14	9
Asthma							
No	2,563	846	917	475	180	88	57
Yes	207	69	71	42	11	9	5
DK	10	3	2	2	*	1	2
Angina							
No	2,698	896	960	509	183	95	55
Yes	68	19	27	8	7	1	6
DK	14	3	3	2	1	2	3
Bronchitis/Emphysema							
No	2,648	877	940	495	185	91	60
Yes	121	37	47	23	6	6	2
DK	11	4	3	1	*	1	2

* = Missing data.
DK = Don't know.
% = Row percentage.
N = Sample size.
Refused = Respondent refused to answer.

Source: U.S. EPA (1996).

Table 10-20. Number of Respondents Reporting Monthly Consumption of Seafood That Was Purchased or Caught by Someone They Knew

Population Group	Total *N*	*	Mostly Purchased	Mostly Caught	DK
Overall	2,780	3	2,584	154	39
Sex					
*	1,311	1	1,206	85	19
Male	1,468	2	1,377	69	20
Female	1	*	1	*	*
Age (years)					
*	42	*	39	3	*
1 to 4	102	*	94	8	*
5 to 11	166	*	153	9	4
12 to 17	137	*	129	6	2
18 to 64	1,946	3	1,810	106	27
>64	387	*	359	22	6
Race					
*	2,249	1	2,092	124	32
White	304	1	280	19	4
Black	56	*	50	4	2
Asian	56	*	55	*	1
Some Others	93	*	86	7	*
Hispanic	22	1	21	*	*
Hispanic					
*	2,566	2	2,387	140	37
No	182	*	169	13	*
Yes	15	*	12	1	2
DK	17	1	16	*	*
Employment					
*	399	*	368	25	6
Full Time	1,366	2	1,285	64	15
Part Time	236	1	217	15	3
Not Employed	766	*	701	50	15
Refused	13	*	13	*	*
Education					
*	434	*	401	26	7
<High School	198	*	174	20	4
High School Graduate	739	*	680	48	11
<College	584	2	547	28	7
College Graduate	484	*	460	19	5
Post-Graduate	341	1	322	13	5
Census Region					
Northeast	655	2	627	21	5
Midwest	575	*	547	20	8
South	989	1	897	73	18
West	561	*	513	40	8

Table 10-20. Number of Respondents Reporting Monthly Consumption of Seafood That Was Purchased or Caught by Someone They Knew (continued)

Population Group	Total *N*	*	Mostly Purchased	Mostly Caught	DK
Day of Week					
Weekday	1,848	2	1,724	100	22
Weekend	932	1	860	54	17
Season					
Winter	780	*	741	35	4
Spring	691	*	655	27	9
Summer	745	2	674	54	15
Fall	564	1	514	38	11
Asthma					
No	2,563	2	2,384	142	35
Yes	207	1	190	12	4
DK	10	*	10	*	*
Angina					37
No	2,698	3	2,507	151	2
Yes	68	*	63	3	*
DK	14	*	14	*	
Bronchitis/Emphysema					
No	2,648	3	2,457	149	39
Yes	121	*	116	5	*
DK	11	*	11	*	*

* = Missing data.
DK = Don't know.
N = Sample size.
Refused = Respondent refused to answer.

Source: U.S. EPA (1996).

Table 10-21. Distribution of Fish Meals Reported by NJ Consumers During the Recall Period

Meals	*N*	% of Total	Cumulative %
1	288	41.9	41.9
2	204	29.7	71.7
3	118	17.2	88.9
4	34	5.0	93.9
5	16	2.3	96.2
6	13	1.9	98.1
7	7	1.0	99.1
≥7	6	0.9	100.0
Total	686	99.9	--

N = Number of respondents.

Source: Stern et al. (1996).

Table 10-22. Selected Species Among All Reported Meals by NJ Consumers During the Recall Period

Species	% of total reported meals (*N* = 1,447)
Tuna[a]	19.2
Shrimp	13.5
Founder/fluke	11.9
Shellfish/clams, etc.[b]	8.2
Finfish (unidentified)	7.5
Salmon	5.3
Swordfish	1.5
Shark	0.3
Total	67.4

[a] Includes fresh and canned tuna, as fillets, sandwiches, and salads.
[b] Includes soups and stews.
N = Number of meals.

Source: Stern et al. (1996).

Table 10-23. Cumulative Probability Distribution of Average Daily Fish Consumption (g/day)

Percentile	All Adult Fish Consumers (≥18 years)	Fish Consuming Women (18 to 40 years)
Arithmetic mean	50.2	41.0
Geometric mean	36.6	30.8
Percentiles		
5th	9.1	7.0
10th	12.2	10.3
25th	24.3	20.3
40th	28.4	24.3
50th	32.4	28.0
60th	42.6	33.4
75th	62.1	48.6
90th	107.4	88.1
95th	137.7	106.8
99th	210.6	142.3

Source: Stern et al. (1996).

Table 10-24. Distribution of the Usual Frequency of Fish Consumption[a]

Usual Frequency	All Fish Consumers *N* = 933	% of Total	Consumers During Recall Period *N* = 686	% of Total
>2 times/week	63	6.8	59	8.6
1 to 2 times/week	365	39.1	335	48.8
2 times/month	173	18.5	136	19.8
1 time/month	206	22.0	121	17.6
Few times/year	126	13.5	35	5.1

[a] Based on survey respondents and household members.
N = Sample size.

Source: Stern et al. (1996).

Table 10-25. Per Capita Distribution of Fish Intake (g/day) by Habitat and Fish Type for the U.S. Population, as Prepared

Habitat	Statistic	Estimate (90% Interval)	
		Finfish	Shellfish
Fresh/Estuarine	Mean	2.6 (2.3–2.8)	2.0 (1.8–2.3)
	50th percentile	0.0 (0.0–0.0)	0.0 (0.0–0.0)
	90th percentile	0.0 (0.0–0.0)	0.0 (0.0–0.2)
	95th percentile	6.7 (5.3–9.3)	9.6 (7.9–10.6)
	99th percentile	67.2 (63.5–75.5)	59.3 (51.5–64.0)
Marine	Mean	6.6 (6.1–7.0)	1.7 (1.3–2.0)
	50th percentile	0.0 (0.0–0.0)	0.0 (0.0–0.0)
	90th percentile	26.3 (24.3–27.4)	0.0 (0.0–0.0)
	95th percentile	46.1 (43.1–47.5)	0.0 (0.0–0.0)
	99th percentile	94.7 (89.8–100.4)	67.9 (51.6–84.5)
All Fish	Mean	9.1 (8.6–9.7)	3.7 (3.2–4.2)
	50th percentile	0.0 (0.0–0.0)	0.0 (0.0–0.0)
	90th percentile	34.8 (31.4–36.6)	0.0 (0.0–0.0)
	95th percentile	59.8 (57.5–61.6)	22.6 (17.2–26.3)
	99th percentile	126.3 (120.6–130.1)	90.6 (82.9–95.7)

Note: Percentile confidence intervals estimated using the bootstrap method with 1,000 replications. Estimates are projected from a sample of 20,607 individuals to the U.S. population of 261,897,236 using 4-year combined survey weights.

Source: U.S. EPA (2002).

Table 10-26. Daily Average Per Capita Estimates of Fish Consumption: U.S. Population—Mean Consumption by Species Within Habitat, as Prepared

Habitat	Species	Estimated Mean g/Person/Day	Habitat	Species	Estimated Mean g/Person/Day	Habitat	Species	Estimated Mean g/Person/Day
Estuarine	Shrimp	1.63012	Marine (Cont)	Lobster	0.15725	All Species	Perch (Freshwater)	0.12882
	Flounder	0.45769		Scallop (Marine)	0.14813	(Cont)	Squid	0.12121
	Catfish (Estuarine)	0.34065		Squid	0.12121		Oyster	0.11615
	Flatfish (Estuarine)	0.27860		Ocean Perch	0.11135		Ocean Perch	0.11135
	Crab (Estuarine)	0.17971		Sea Bass	0.09766		Sea Bass	0.09766
	Perch (Estuarine)	0.12882		Mackerel	0.08780		Carp	0.09584
	Oyster	0.11615		Swordfish	0.07790		Herring	0.09409
	Herring	0.09409		Sardine	0.07642		Croaker	0.08798
	Croaker	0.08798		Pompano	0.07134		Mackerel	0.08780
	Trout, mixed sp.	0.08582		Flatfish (Marine)	0.05216		Trout (Estuarine)	0.08582
	Salmon (Estuarine)	0.05059		Mussels	0.05177		Trout (Freshwater)	0.08582
	Rockfish	0.03437		Octopus	0.04978		Swordfish	0.07790
	Anchovy	0.02976		Halibut	0.02649		Sardine	0.07642
	Clam (Estuarine)	0.02692		Snapper	0.02405		Pompano	0.07134
	Mullet	0.02483		Whitefish (Marine)	0.00988		Flatfish (Marine)	0.05216
	Smelts (Estuarine)	0.00415		Smelts (Marine)	0.00415		Mussels	0.05177
	Eel	0.00255		Shark	0.00335		Salmon (Estuarine)	0.05059
	Scallop (Estuarine)	0.00100		Snails (Marine)	0.00198		Octopus	0.04978
	Smelts, Rainbow	0.00037		Conch	0.00155		Rockfish	0.03437
	Sturgeon (Estuarine)	0.00013		Roe	0.00081		Anchovy	0.02976
			Unknown				Pike	0.02958
Freshwater	Catfish (Freshwater)	0.34065		Fish	0.23047		Clam (Estuarine)	0.02692
	Trout	0.15832		Seafood	0.00203		Halibut	0.02649
	Perch (Freshwater)	0.12882	All Species				Mullet	0.02483
	Carp	0.09584		Tuna	2.62988		Snapper	0.02405
	Trout, mixed sp.	0.08582		Shrimp	1.63012		Whitefish (Freshwater)	0.00988
	Pike	0.02958		Cod	1.12504		Whitefish (Marine)	0.00988
	Whitefish (Freshwater)	0.00988		Salmon (Marine)	1.01842		Crayfish	0.00575
	Crayfish	0.00575		Clam (Marine)	1.00458		Smelts (Estuarine)	0.00415
	Snails (Freshwater)	0.00198		Flounder	0.45769		Smelts (Marine)	0.00415
	Cisco	0.00160		Catfish (Estuarine)	0.34065		Shark	0.00335
	Salmon (Freshwater)	0.00053		Catfish (Freshwater)	0.34065		Eel	0.00255
	Smelts, Rainbow	0.00037		Flatfish (Estuarine)	0.27860		Seafood	0.00203
	Sturgeon (Freshwater)	0.00013		Pollock	0.27685		Snails (Freshwater)	0.00198
				Porgy	0.27346		Snails (Marine)	0.00198
Marine	Tuna	2.62988		Haddock	0.25358		Cisco	0.00160
	Cod	1.12504		Fish	0.23047		Conch	0.00155
	Salmon (Marine)	1.01842		Crab (Marine)	0.20404		Scallop (Estuarine)	0.00100
	Clam (Marine)	1.00458		Whiting	0.20120		Roe	0.00081
	Pollock	0.27685		Crab (Estuarine)	0.17971		Salmon (Freshwater)	0.00053
	Porgy	0.27346		Trout	0.15832		Smelts, Rainbow (Estuarine)	0.00037
	Haddock	0.25358		Lobster	0.15725		Smelts, Rainbow	0.00037
	Crab (Marine)	0.20404		Scallop (Marine)	0.14813		Sturgeon (Estuarine)	0.00013
	Whiting	0.20120		Perch (Estuarine)	0.12882		Sturgeon (Freshwater)	0.00013

Notes: Estimates are projected from a sample of 20,607 individuals to the U.S. population of 261,897,236 using 4-year combined survey weights. Source of individual consumption data: USDA Combined 1994–1996, 1998 CSFII. The fish component of foods containing fish was calculated using data from the recipe file of the USDA's Nutrient Data Base for Individual Food Intake Surveys.

Source: U.S. EPA (2002).

Table 10-27. Per Capita Distribution of Fish Intake (g/day) by Habitat and Fish Type for the U.S. Population, Uncooked Fish Weight

		Estimate (90% Interval)	
Habitat	Statistic	Finfish	Shellfish
Fresh/Estuarine	Mean	3.6 (3.2–4.0)	2.7 (2.4–3.1)
	50th percentile	0.0 (0.0–0.0)	0.0 (0.0–0.0)
	90th percentile	0.0 (0.00–0.7)	0.0 (0.0–0.0)
	95th percentile	14.1 (10.0–16.8)	12.8 (10.5–13.8)
	99th percentile	95.3 (80.7–100.8)	77.0 (69.7–84.1)
Marine	Mean	9.0 (8.4–9.6)	1.6 (1.2–2.0)
	50th percentile	0.0 (0.0–0.0)	0.0 (0.0–0.0)
	90th percentile	37.5 (35.7–37.6)	0.0 (0.0–0.0)
	95th percentile	62.9 (61.3–65.5)	0.0 (0.0–0.0)
	99th percentile	128.4 (119.3–135.8)	54.8 (33.1–80.6)
All Fish	Mean	12.6 (11.9–13.3)	4.3 (3.7–4.9)
	50th percentile	0.0 (0.0–0.0)	0.0 (0.0–0.0)
	90th percentile	48.7 (45.3–50.4)	0.0 (0.0–0.0)
	95th percentile	81.8 (79.5–85.0)	23.2 (18.3–28.3)
	99th percentile	173.6 (168.0–183.4)	110.5 (93.1–112.9)

Note: Percentile confidence intervals estimated using the bootstrap method with 1,000 replications. Estimates are projected from a sample of 20,607 individuals to the U.S. population of 261,897,236 using 4-year combined survey weights.

Source: U.S. EPA (2002).

Table 10-28. Daily Average Per Capita Estimates of Fish Consumption U.S. Population—Mean Consumption by Species Within Habitat, Uncooked Fish Weight

Habitat	Species	Estimated Mean g/Person/Day	Habitat	Species	Estimated Mean g/Person/Day	Habitat	Species	Estimated Mean g/Person/Day
Estuarine	Shrimp	2.20926	Marine (Cont.)	Lobster	0.21290	All	Perch (Freshwater)	0.18148
	Flounder	0.58273		Scallop (Marine)	0.18951	Species	Squid	0.15438
	Catfish (Estuarine)	0.48928		Squid	0.15438	(Cont.)	Ocean Perch	0.14074
	Flatfish (Estuarine)	0.33365		Ocean Perch	0.14074		Oyster	0.13963
	Crab (Estuarine)	0.25382		Sea Bass	0.12907		Croaker	0.13730
	Perch (Estuarine)	0.18148		Mackerel	0.11468		Carp	0.13406
	Oyster	0.13963		Sardine	0.10565		Herring	0.13298
	Croaker	0.13730		Swordfish	0.10193		Sea Bass	0.12907
	Herring	0.13298		Pompano	0.09905		Trout (Estuarine)	0.11908
	Trout, mixed sp.	0.11908		Mussels	0.07432		Trout (Freshwater)	0.11908
	Salmon (Estuarine)	0.06898		Octopus	0.06430		Mackerel	0.11468
	Rockfish	0.04448		Flatfish (Marine)	0.06247		Sardine	0.10565
	Anchovy	0.04334		Halibut	0.03226		Swordfish	0.10193
	Mullet	0.03617		Snapper	0.02739		Pompano	0.09905
	Clam (Estuarine)	0.01799		Whitefish (Marine)	0.00995		Mussels	0.07432
	Smelts (Estuarine)	0.00611		Smelts (Marine)	0.00611		Salmon (Estuarine)	0.06898
	Eel	0.00324		Shark	0.00424		Octopus	0.06430
	Scallop (Estuarine)	0.00128		Snails (Marine)	0.00249		Flatfish (Marine)	0.06247
	Smelts, Rainbow	0.00052		Conch	0.00207		Rockfish	0.04448
	Sturgeon (Estuarine)	0.00013		Roe	0.00102		Anchovy	0.04334
			Unknown				Mullet	0.03617
Freshwater	Catfish (Freshwater)	0.48928		Fish	0.60608		Pike	0.03260
	Trout	0.19917		Seafood	0.00326		Halibut	0.03226
	Perch (Freshwater)	0.18148	All Species				Snapper	0.02739
	Carp	0.13406		Tuna	3.61778		Clam (Estuarine)	0.01799
	Trout, mixed sp.	0.11908		Shrimp	2.20926		Whitefish (Freshwater)	0.00995
	Pike	0.03260		Cod	1.47734		Whitefish (Marine)	0.00995
	Whitefish (Freshwater)	0.00995		Salmon (Marine)	1.38873		Crayfish	0.00746
	Crayfish	0.00746		Clam (Marine)	0.67135		Smelts (Estuarine)	0.00611
	Snails (Freshwater)	0.00249		Flounder	0.60608		Smelts (Marine)	0.00611
	Cisco	0.00234		Catfish (Estuarine)	0.58273		Shark	0.00424
	Salmon (Freshwater)	0.00073		Catfish (Freshwater)	0.48928		Seafood	0.00326
	Smelts, Rainbow	0.00052		Porgy	0.48928		Eel	0.00324
	Sturgeon (Freshwater)	0.00013		Flatfish (Estuarine)	0.40148		Snails (Freshwater)	0.00249
				Pollock	0.33365		Snails (Marine)	0.00249
Marine	Tuna	3.61778		Haddock	0.32878		Cisco	0.00234
	Cod	1.47734		Fish	0.32461		Conch	0.00207
	Salmon (Marine)	1.38873		Crab (Marine)	0.28818		Scallop (Estuarine)	0.00128
	Clam (Marine)	0.67135		Whiting	0.25725		Roe	0.00102
	Porgy	0.40148		Crab (Estuarine)	0.25382		Salmon (Freshwater)	0.00073
	Pollock	0.32878		Trout	0.21290		Smelts, Rainbow (Estuarine)	0.00052
	Haddock	0.32461		Lobster	0.19917		Smelts, Rainbow	0.00052
	Crab (Marine)	0.28818		Scallop (Marine)	0.18951		Sturgeon (Estuarine)	0.00013
	Whiting	0.25725		Perch (Estuarine)	0.18148		Sturgeon (Freshwater)	0.00013

Notes: Estimates are projected from a sample of 20,607 individuals to the U.S. population of 261,897,236 using 4-year combined survey weights. Source of individual consumption data: USDA Combined 1994–1996, 1998 CSFII. Amount of consumed fish recorded by survey respondents was converted to uncooked fish quantities using data from the recipe file of USDA's Nutrient Data Base for Individual Food Intake Survey. Fish component of foods containing fish was calculated using data from the recipe file of the USDA's Nutrient Data Base for Individual Food Intake Surveys.

Source: U.S. EPA (2002).

Table 10-29. Per Capita Distributions of Fish (finfish and shellfish) Intake (g/day), as Prepared[a]

Age (years)	*N*	Mean (90% CI)	90th Percentile (90% BI)	95th Percentile (90% BI)	99th Percentile (90% BI)
Freshwater and Estuarine					
Females					
14 and under	5,182	1.6 (1.2–1.9)	0.0 (0.0–0.5)	5.8 (4.4–10.2)	40.0 (33.7–52.0)
15 to 44	2,332	4.3 (3.4–5.1)	5.1 (2.8–7.9)	23.9 (21.8–28.6)	82.9 (75.2–111.2)
45 and older	2,654	4.8 (4.0–5.6)	11.8 (5.7–16.8)	32.7 (26.7–40.1)	79.4 (74.2–87.0)
All ages	10,168	3.9 (3.3–4.4)	4.9 (2.6–6.3)	23.8 (22.1–27.5)	77.1 (74.3–85.2)
Males					
14 and under	5,277	2.1 (1.6–2.6)	0.0 (0.0–0.6)	6.6 (4.4–10.4)	60.8 (42.7–74.2)
15 to 44	2,382	5.7 (4.8–6.6)	10.4 (9.2–12.4)	38.6 (33.7–49.0)	112.7 (91.5–125.1)
45 and older	2,780	7.4 (6.3–8.5)	23.6 (19.7–28.1)	56.6 (52.3–57.2)	112.3 (107.5–130.1)
All ages	10,439	5.3 (4.7–6.0)	9.3 (7.1–10.9)	37.1 (32.1–40.3)	107.1 (97.1–125.1)
Both Sexes					
3 to 5	4,391	1.5 (1.2–1.8)	0.1 (0.00–1.0)	5.1 (4.1–6.2)	38.7 (32.9–43.6)
6 to 10	1,670	2.1 (1.4–2.9)	0.0 (0.0–0.6)	5.9 (3.2–12.7)	60.9* (51.0–86.0)
11 to 15	1,005	3.0 (2.2–3.8)	1.4 (0.5–5.5)	18.2 (14.8–21.1)	69.5* (56.0–75.1)
16 to 17	363	3.4 (1.6–5.3)	0.0 (0.0–1.5)	31.1* (5.2–29.2)	81.2* (42.0–117.0)
18 and older	9,596	5.5 (4.9–6.0)	11.7 (9.9–14.7)	38.0 (34.7–43.0)	105.1 (91.5–113.5)
14 and under	10,459	1.8 (1.5–2.1)	0.0 (0.0–0.0)	6.0 (5.5–9.5)	51.7 (39.4–61.2)
15 to 44	4,714	5.0 (4.4–5.6)	8.6 (5.3–10.4)	31.7 (28.6–36.8)	98.9 (85.5–125.1)
45 and older	5,434	6.0 (5.2–6.7)	17.4 (13.9–22.1)	42.7 (37.1–52.8)	104.2 (91.0–112.0)
All ages	20,607	4.6 (4.2–5.0)	6.6 (5.3–8.5)	29.7 (28.1–31.6)	91.0 (82.6–100.1)
Marine					
Females					
14 and under	5,182	3.6 (3.0–4.2)	10.8 (8.1–13.5)	28.1 (24.3–31.0)	61.3 (51.2–70.5)
15 to 44	2,332	7.0 (6.1–7.9)	27.9 (24.3–28.2)	48.1 (42.6–53.7)	97.0 (86.6–137.6)
45 and older	2,654	10.9 (9.6–12.1)	42.0 (38.4–42.5)	63.3 (57.8–66.3)	128.5 (120.5–138.3)
All ages	10,168	7.6 (6.9–8.3)	28.1 (27.9–29.2)	49.6 (46.6–52.4)	106.6 (95.2–119.2)
Males					
14 and under	5,277	4.3 (3.6–5.1)	11.8 (8.4–14.0)	29.1 (26.7–31.4)	84.4 (77.0–113.3)
15 to 44	2,382	9.4 (8.2–10.6)	36.6 (28.0–43.1)	72.8 (58.8–82.8)	127.4 (116.3–153.6)
45 and older	2,780	11.9 (10.5–13.2)	47.1 (42.2–54.5)	71.4 (64.4–81.3)	140.1 (114.9–149.6)
All ages	10,439	8.9 (8.1–9.8)	34.2 (28.2–38.5)	63.3 (59.0–73.2)	122.8 (109.4–139.6)
Both Sexes					
3 to 5	4,391	3.7 (3.2–4.3)	11.1 (10.4–12.6)	27.9 (24.4–29.1)	59.8 (52.4–71.3)
6 to 10	1,670	4.2 (3.5–4.9)	13.1 (9.7–17.0)	28.7 (27.6–33.8)	78.6* (49.2–84.4)
11 to 15	1,005	5.5 (4.2–6.7)	13.9 (9.8–20.6)	38.5 (30.8–50.3)	102.3* (84.4–113.6)
16 to 17	363	4.7 (2.9–6.4)	0.0 (0.0–6.9)	24.2* (7.8–71.5)	107.8* (68.4–118.9)
18 and older	9,596	9.8 (9.0–10.6)	38.6 (36.6–41.5)	63.8 (58.8–68.8)	126.3 (117.3–140.1)
14 and under	10,459	4.0 (3.5–4.5)	10.8 (10.1–13.5)	28.2 (27.9–29.8)	79.0 (63.0–98.8)
15 to 44	4,714	8.2 (7.4–9.1)	28.2 (27.9–34.3)	56.6 (54.5–68.9)	115.7 (98.5–143.8)
45 and older	5,434	11.3 (10.3–12.3)	42.7 (42.0–45.7)	65.1 (63.9–68.0)	136.9 (125.6–140.3)
All ages	20,607	8.3 (7.6–8.9)	29.2 (28.2–32.1)	55.8 (54.7–56.9)	114.6 (108.9–120.8)

Table 10-29. Per Capita Distributions of Fish (finfish and shellfish) Intake (g/day), as Prepared[a] (continued)

Age (years)	*N*	Mean (90% CI)	90th Percentile (90% BI)	95th Percentile (90% BI)	99th Percentile (90% BI)
			All Fish		
Females					
14 and under	5,182	5.2 (4.4–5.9)	18.9 (15.3–21.1)	37.5 (30.0–41.7)	80.2 (72.6–83.0)
15 to 44	2,332	11.3 (10.0–12.7)	41.2 (36.6–46.2)	66.3 (61.0–73.0)	143.4 (128.0–148.4)
45 and older	2,654	15.6 (14.0–17.3)	56.2 (52.7–60.6)	82.9 (75.6–88.0)	158.9 (141.6–170.6)
All ages	10,168	11.4 (10.5–12.4)	42.2 (39.0–45.7)	66.8 (63.2–71.4)	140.8 (128.5–148.4)
Males					
14 and under	5,277	6.4 (5.5–7.3)	21.1 (15.7–24.9)	42.2 (34.0–52.5)	114.3 (98.4–130.6)
15 to 44	2,382	15.1 (13.6–16.6)	58.4 (51.0–70.3)	89.1 (85.6–97.5)	177.2 (163.0–185.3)
45 and older	2,780	19.2 (17.6–20.9)	67.7 (65.0–72.2)	98.6 (92.7–105.1)	167.5 (157.0–193.3)
All ages	10,439	14.3 (13.4–15.2)	55.9 (51.0–59.4)	86.1 (84.3–89.7)	162.6 (155.8–178.7)
Both Sexes					
3 to 5	4,391	5.2 (4.6–5.8)	18.9 (15.3–21.3)	35.3 (31.1–39.5)	72.2 (66.7–81.4)
6 to 10	1,670	6.3 (5.3–7.3)	23.9 (21.1–27.0)	39.6 (34.3–51.5)	107.8* (91.6–130.6)
11 to 15	1,005	8.5 (6.9–10.0)	28.1 (24.9–31.4)	60.3 (53.4–74.2)	122.2* (106.8–131.9)
16 to 17	363	8.1 (5.4–10.8)	18.6 (7.0–40.9)	73.8* (29.2–89.8)	142.3* (107.9–200.4)
18 and older	9,596	15.3 (14.3–16.2)	56.2 (55.4–58.3)	86.1 (84.3–87.5)	162.6 (155.8–171.0)
14 and under	10,459	5.8 (5.2–6.5)	19.4 (17.2–21.2)	38.2 (36.6–42.1)	96.5 (83.0–114.3)
15 to 44	4,714	13.2 (12.2–14.2)	50.0 (45.3–56.2)	82.9 (76.2–86.1)	162.6 (147.2–176.2)
45 and older	5,434	17.3 (16.0–18.6)	61.1 (56.6–64.2)	90.5 (86.5–93.2)	162.7 (158.4–170.6)
All ages	20,607	12.8 (12.1–13.6)	48.2 (46.2–49.9)	79.0 (74.6–83.3)	153.2 (145.9–160.9)

[a] Estimates were projected from sample size to the U.S. population using 4-year combined survey weights.
N = Sample size.
CI = Confidence interval.
BI = Bootstrap interval (BI); percentile intervals were estimated using the percentile bootstrap method with 1,000 bootstrap replications.
* The sample size does not meet minimum reporting requirements as described in the "Third Report on Nutrition Monitoring in the United States" (FASEB/LSRO, 1995).

Source: U.S. EPA (2002).

Table 10-30. Per Capita Distribution of Fish (finfish and shellfish) Intake (mg/kg-day), as Prepared[a]

Age (years)	*N*	Mean (90% CI)	90th Percentile (90% BI)	95th Percentile (90% BI)	99th Percentile (90% BI)
Freshwater and Estuarine					
Females					
14 and under	4,879	56 (46–66)	0.0 (0.0–3.4)	208 (162–268)	1,516 (1,305–1,801)
15 to 44	2,275	67 (53–81)	75 (40–107)	380 (306–435)	1,329 (1,238–2,021)
45 and older	2,569	72 (58–85)	184 (75–247)	491 (369.3–606.2)	1,339 (1,133–1,462)
All ages	9,723	66 (58–75)	80 (44–104)	398 (364–435)	1,352 (1,222–1,528)
Males					
14 and under	4,994	65 (52–78)	0.0 (0.0–17)	279 (179–384)	1,767 (1,470–1,888)
15 to 44	2,369	72 (60–83)	131 (101–170)	481 (425–574)	1,350 (1,228–1,729)
45 and older	2,764	88 (75–101)	272 (212–321)	666 (540–712)	1,378 (1,260–1,508)
All ages	10,127	75 (67–84)	131 (107–181)	504 (455–560)	1,470 (1,378–1,568)
Both Sexes					
3 to 5	4,112	82.9(67–99)	0.0 (0.0–56)	284 (240–353)	2,317 (1,736–2,463)
6 to 10	1,553	59.3 (39–79)	0.0 (0.0–5.3)	178 (88–402)	1,662* (1,433–2,335)
11 to 15	975	53.3 (42–64)	0.0 (0.0–78)	312 (253–390)	1,237* (950–1,521)
16 to 17	360	49.5(23–76)	0.0 (0.0–33)	213* (106–390)	1,186* (600–2,096)
18 and older	9,432	74 (67–82)	158 (125–198)	502 (452–567)	1,353 (1,238–1,511)
14 and under	9,873	61 (52–70)	0.0 (0.0–0.0)	230 (187–283)	1,689 (1,470–1,805)
15 to 44	4,644	69 (61–78)	104 (72–139)	431 (390–476)	1,335 (1,238–1,684)
45 and older	5,333	79 (69–90)	236 (188–284)	557 (493.7–666)	1,351 (1,260–1,462)
All ages	19,850	71 (65–77)	106 (87–128)	451 (424–484)	1,432 (1,325–1,521)
Marine					
Females					
14 and under	4,879	147 (125–168)	381 (324–506)	1,028 (908–1,149)	2,819 (2,481–2,908)
15 to 44	2,275	114 (98–129)	423 (365–485)	768 (650–881)	1,648 (1,428–2,177)
45 and older	2,569	166 (147–185)	620 (567–658)	950 (900–1,042)	2,022 (1,899–2,683)
All ages	9,723	139 (127–150)	501 (465–534)	892 (847–923)	2,151 (1,858–2,484)
Males					
14 and under	4,994	154 (132–176)	426 (357–494)	1,081 (975–1,293)	2,678 (2,383–3,073)
15 to 44	2,369	118 (104–132)	444 (368–547)	880 (760–954)	1,643 (1,454–1,819)
45 and older	2,764	149 (133–166)	568 (504–673)	889 (831–990)	1,859 (1,725–2,011)
All ages	10,127	136 (125–147)	494 (445–543)	908 (868–954)	1,965 (1,817–2,247)
Both Sexes					
3 to 5	4,112	209 (181–237)	614 (525–696)	1,537 (1,340–1,670)	3,447 (3,274–3,716)
6 to 10	1,553	150 (123–177)	416 (326–546)	1,055 (969–1,275)	2,800* (2,021–3,298)
11 to 15	975	109 (84–133)	338 (179–413)	821 (629–1,034)	1,902* (1,537–2,366)
16 to 17	360	75 (46–103)	0.0 (0.0–124)	381* (132–951)	1,785* (1,226–2,342)
18 and older	9,432	137 (126–147)	527 (501–575)	881 (840–945)	1,798 (1,708–1,971)
14 and under	9,873	150 (134–167)	413 (366–476)	1,037(1,002–1,163)	2,692 (2,481–2,823)
15 to 44	4,644	116 (104–128)	440 (389–488)	830 (750–920)	1,651.83 (1,487–1,793)
45 and older	5,333	158 (144–173)	601 (562–642)	921 (882–977)	1,975.67 (1,785–2,118)
All ages	19,850	137 (128–147)	497 (480–517)	903 (869–938)	2,014.52 (1,947–2,158)

Table 10-30. Per Capita Distribution of Fish (finfish and shellfish) Intake (mg/kg-day), as Prepared[a] (continued)

Age (years)	*N*	Mean (90% CI)	90th Percentile (90% BI)	95th Percentile (90% BI)	99th Percentile (90% BI)
			All Fish		
Females					
14 and under	4,879	203 (178–227)	693 (929–1,408)	1,344 (1,224–1,489)	3,297 (2,823–3,680)
15 to 44	2,275	181 (158–204)	641 (641–879)	1,040 (910–1,226)	2,292 (2,096–2,494)
45 and older	2,569	238 (212–263)	812 (797–956)	1,265 (1,165–1,353)	2,696 (2,247–2,974)
All ages	9,723	205 (188–221)	731 (797–912)	1,211 (1,128–1,256)	2,651 (2,358–2,823)
Males					
14 and under	4,994	219 (252–356)	745 (583–881)	1,470 (1,282–1,775)	3,392 (2,893–3,954)
15 to 44	2,369	190 (219–263)	756 (689–851)	1,165 (1,060–1,239)	2,238 (2,045–2,492)
45 and older	2,764	237 (225–277)	849 (812–920)	1,253 (1,183–1,282)	2,310 (2,079–2,438)
All ages	10,127	211 (240–279)	792 (727–884)	1,239 (1,201–1,282)	2,537 (2,324–2,679)
Both Sexes					
3 to 5	4,112	292 (260–326)	1,057 (931–1,232)	1,988 (1,813–2,147)	4,089 (3,733–4,508)
6 to 10	1,553	209 (176–242)	780 (644–842)	1,357 (1,173–1,451)	3,350* (2,725–4,408)
11 to 15	975	162 (133–191)	570 (476–664)	1,051 (991–1,313)	2,305* (1,908–2,767)
16 to 17	360	124 (83–165)	261 (110–600)	1,029* (390–1,239)	2,359* (2,096–2,676)
18 and older	9,432	211 (197–225)	779 (743–816)	1,198 (1,165–1,238)	2,327 (2,198–2,438)
14 and under	9,873	211 (191–231)	713 (652–780)	1,429 (1,344–1,499)	3,354 (3,224–3,458)
15 to 44	4,644	185 (170–200)	714 (645–803)	1,139 (1,014–1,228)	2,290 (2,082–2,476)
45 and older	5,333	238 (219–256)	836 (767–883)	1,261 (1,185–1,314)	2,386 (2,158–2,672)
All ages	19,850	208 (196–220)	762 (737–790)	1,227 (1,198–1,251)	2,539 (2,476–2,679)

[a] Estimates were projected from sample size to the U.S. population using 4-year combined survey weights.

N = Sample size.

CI = Confidence interval.

BI = Bootstrap interval; percentile intervals (BI) were estimated using the percentile bootstrap method with 1,000 bootstrap replications.

* The sample size does not meet minimum reporting requirements as described in the *Third Report on Nutrition Monitoring in the United States* (FASEB/LSRO, 1995).

Source: U.S. EPA (2002).

Table 10-31. Per Capita Distribution of Fish (finfish and shellfish) Intake (g/day), Uncooked Fish Weight[a]

Age (years)	*N*	Mean (90% CI)	90th Percentile (90% BI)	95th Percentile (90% BI)	99th Percentile (90% BI)
Freshwater and Estuarine					
Females					
14 and under	5,182	2.3 (1.8–2.8)	0.0 (0.0–0.2)	13.1 (9.9–16.4)	58.8 (45.8–86.4)
15 to 44	2,332	5.8 (4.6–6.9)	6.3 (4.7–11.4)	32.4 (27.7–38.0)	109.8 (100.4–154.5)
45 and older	2,654	6.4 (5.3–7.4)	17.7 (8.9–23.6)	44.9 (37.4–55.4)	108.8 (95.4–123.9)
All ages	10,168	5.2 (4.5–5.9)	7.3 (3.8–11.9)	31.9 (28.3–37.4)	102.1(95.5–114.0)
Males					
14 and under	5,277	3.0 (2.3–3.7)	0.0 (0.0–0.2)	13.5 (10.2–17.0)	79.0 (55.2–97.9)
15 to 44	2,382	7.9 (6.7–9.1)	15.6 (13.2–19.8)	49.7 (45.7–66.4)	151.2 (126.4–183.4)
45 and older	2,780	10.2 (8.6–11.7)	32.5 (27.3–37.2)	73.5 (66.2–77.1)	165.9 (147.7–190.7)
All ages	10,439	7.4 (6.6–8.3)	14.6 (12.6–17.7)	49.3 (45.6–53.2)	147.8 (132.3–183.4)
Both Sexes					
3 to 5	4,391	2.2 (1.8–2.6)	0.1 (0.0–1.5)	12.2 (10.3–14.1)	52.5 (45.6–61.5)
6 to 10	1,670	3.0 (1.9–4.1)	0.0 (0.0–0.5)	13.1 (4.8–20.1)	78.5* (63.8–110.5)
11 to 15	1,005	4.3 (3.2–5.4)	2.3 (0.1–7.7)	25.8 (21.0–28.9)	94.8* (83.1–109.5)
16 to 17	363	4.6 (2.2–6.9)	0.0 (0.0–1.9)	19.3* (13.3–36.8)	109.2* (57.7–154.5)
18 and older	9,596	7.5 (6.8–8.3)	17.4 (14.3–21.6)	49.6 (46.9–55.4)	143.4 (125.3–156.8)
14 and under	10,459	2.6 (2.2–3.1)	0.0 (0.0–0.0)	13.1 (11.9–14.8)	73.7 (51.5–86.4)
15 to 44	4,714	6.8 (6.0–7.6)	13.0 (8.6–15.6)	43.6 (37.8–47.4)	135.9 (121.0–167.0)
45 and older	5,434	8.1 (7.1–9.2)	24.8 (18.8–28.6)	56.5 (48.9–69.7)	144.3 (121.7–156.8)
All ages	20,607	6.3 (5.7–6.9)	11.7 (8.4–13.7)	41.1 (37.9–43.7)	123.9 (114.0–138.8)
Marine					
Females					
14 and under	5,182	5.2 (4.5–6.0)	18.8 (13.5–21.9)	40.1 (37.9–47.7)	81.3 (67.0–98.4)
15 to 44	2,332	9.0 (7.8–10.1)	37.5 (31.0–37.9)	61.7 (55.8–71.2)	120.6 (116.5–132.5)
45 and older	2,654	13.7 (12.0–15.4)	51.4 (49.0–55.4)	80.4 (76.9–82.6)	155.6 (148.7–179.2)
All ages	10,168	9.8 (8.9–10.6)	37.8 (37.3–40.2)	64.7 (59.2–67.7)	128.5 (119.4–142.9)
Males					
14 and under	5,277	6.0 (4.9–7.0)	17.0 (13.0–21.4)	39.7 (35.9–41.1)	113.3 (106.3–140.3)
15 to 44	2,382	12.0 (10.5–13.5)	41.7 (37.8–56.3)	90.2 (75.7–106.7)	151.5 (134.9–192.5)
45 and older	2,780	15.0 (13.3–16.7)	58.0 (53.5–68.3)	90.7 (85.4–97.3)	168.8 (157.1–186.9)
All ages	10,439	11.5 (10.4–12.5)	41.3 (37.8–49.7)	82.9 (75.7–96.8)	152.3 (136.6–166.9)
Both Sexes					
3 to 5	4,391	5.5 (4.8–6.2)	19.8 (16.6–23.1)	39.4 (37.7–41.4)	82.3 (73.0–95.4)
6 to 10	1,670	5.6 (4.6–6.5)	18.9 (14.2–24.3)	38.4 (37.9–41.6)	99.8* (62.8–111.4)
11 to 15	1,005	7.6 (5.9–9.4)	25.3 (16.4–34.5)	56.5 (45.3–67.1)	131.8* (110.3–148.7)
16 to 17	363	6.1 (3.7–8.4)	0.0 (0.0–9.3)	29.5* (11.6–90.7)	135.6* (92.0–177.1)
18 and older	9,596	12.4 (11.5–13.4)	48.9 (47.1–51.2)	80.7 (77.8–83.5)	150.8 (139.7–164.3)
14 and under	10,459	5.59 (4.9–6.3)	18.7 (16.1–19.7)	40.2 (39.6–40.4)	103.4 (82.6–123.5)
15 to 44	4,714	10.5 (9.4–11.6)	37.9 (37.5–41.3)	75.3 (67.3–83.5)	137.1 (122.0–151.0)
45 and older	5,434	14.3 (13.0–15.6)	55.7 (53.1–57.9)	83.4 (80.7–85.8)	166.0 (155.5–178.0)
All ages	20,607	10.6 (9.8–11.4)	38.4 (37.8–40.6)	74.9 (69.9–75.6)	139.2 (131.3–148.3)

Table 10-31. Per Capita Distribution of Fish (finfish and shellfish) Intake (g/day), Uncooked Fish Weight[a] (continued)

Age (years)	*N*	Mean (90% CI)	90th Percentile (90% BI)	95th Percentile (90% BI)	99th Percentile (90% BI)
			All Fish		
Females					
14 and under	5,182	7.5 (6.5–8.5)	28.5 (25.4–34.0)	55.2 (49.0–59.2)	103.9 (95.1–126.2)
15 to 44	2,332	14.7 (13.0–16.5)	53.6 (46.6–58.8)	85.2 (77.3–94.6)	189.9 (165.1–197.1)
45 and older	2,654	20.1 (17.9–22.2)	73.4 (67.7–77.3)	104.0 (96.7–112.1)	213.7 (190.1–221.6)
All ages	10,168	15.0 (13.7–16.2)	56.2 (51.0–59.2)	86.3 (81.2–93.2)	185.7 (162.6–187.2)
Males					
14 and under	5,277	9.0 (7.6–10.3)	31.5 (24.6–37.5)	56.5 (49.0–69.9)	165.2 (141.6–177.4)
15 to 44	2,382	19.9 (18.0–21.7)	77.0 (65.8–88.8)	118.6 (110.7–127.1)	242.7 (224.3–254.9)
45 and older	2,780	25.2 (23.0–27.3)	89.7 (86.5–94.2)	130.7 (125.8–135.5)	226.5 (207.3–278.3)
All ages	10,439	18.9 (17.7–20.1)	73.5 (66.6–80.5)	113.4 (110.7–118.6)	219.3 (204.8–236.5)
Both Sexes					
3 to 5	4,391	7.7 (6.9–8.6)	32.6 (27.6–34.0)	51.0 (46.3–56.7)	100.5 (89.1–111.4)
6 to 10	1,670	8.5 (7.1–10.0)	32.6 (27.0–37.9)	56.4 (49.6–69.8)	144.4* (117.4–183.4)
11 to 15	1,005	12.0 (9.7–14.2)	43.4 (36.7–50.8)	87.4 (69.6–102.6)	170.7* (147.9–176.8)
16 to 17	363	10.6 (7.0–14.2)	29.3 (9.4–48.7)	83.5* (42.3–114.5)	192.5* (120.5–266.0)
18 and older	9,596	19.9 (18.7–21.1)	74.8 (71.7–75.7)	111.4 (110.0–114.0)	215.7 (197.1–228.5)
14 and under	10,459	8.2 (7.3–9.2)	29.0 (27.6–32.6)	56.3 (52.2–56.7)	127.2 (118.2–149.5)
15 to 44	4,714	17.3 (15.9–18.7)	64.6 (57.0–73.5)	107.7 (99.2–113.6)	211.3 (197.1–242.3)
45 and older	5,434	22.4 (20.7–24.1)	80.6 (75.0–85.3)	115.3 (111.7–122.2)	215.7 (208.3–227.6)
All ages	20,607	16.9 (15.9–17.9)	63.5 (59.5–66.2)	102.3 (97.9–107.6)	198.2 (190.7–208.8)

[a] Estimates were projected from sample size to the U.S. population using 4-year combined survey weights.

N = Sample size.

CI = Confidence interval.

BI = Bootstrap interval; percentile intervals (BI) were estimated using the percentile bootstrap method with 1,000 bootstrap replications.

* The sample size does not meet minimum reporting requirements as described in the *Third Report on Nutrition Monitoring in the United States* (FASEB/LSRO, 1995).

Source: U.S. EPA (2002).

Table 10-32. Per Capita Distribution of Fish (finfish and shellfish) Intake (mg/kg-day), Uncooked Fish Weight[a]

Age (years)	*N*	Mean (90% CI)	90th Percentile (90% BI)	95th Percentile (90% BI)	99th Percentile (90% BI)
Freshwater and Estuarine					
Females					
14 and under	4,879	83 (69–96)	0.0 (0.0–1.6)	443 (269–572)	2,179 (1,866–2,345)
15 to 44	2,275	91 (71–110)	107 (57–145)	482 (403–538)	1,818 (1,633–2,767)
45 and older	2,569	96 (78–113)	250 (123–322)	655 (485–776)	1,822 (1,515–1,909)
All ages	9,723	91 (79–103)	117 (63–165)	535 (485–613)	1,871 (1,629–2,025)
Males					
14 and under	4,994	95 (76–113)	0.0 (0.0–1.7)	534 (371–605)	2,351 (1,920–2,501)
15 to 44	2,369	99 (84–115)	201 (151–254)	623 (558–810)	1,910 (1,760–2,221)
45 and older	2,764	121 (102–140)	378 (317–429)	891 (754–974)	1,963 (1,731–2,132)
All ages	10,127	106 (94–117)	208 (165–272)	697 (629–782)	2,034 (1,856–2,221)
Both Sexes					
3 to 5	4,112	124 (102–146)	0.0 (0.0–83)	712 (599–784)	3,091 (2,495–3,475)
6 to 10	1,553	84 (55–112)	0.0 (0.0–1.4)	354 (116–685)	2,322* (1,856–2,994)
11 to 15	975	77 (60–94)	20 (0.0–116)	477 (411–618)	1,610* (1,358–2,203)
16 to 17	360	65 (30–100)	0.0 (0.0–23)	285* (167–491)	1,542* (760–2,767)
18 and older	9,432	102 (92–112)	236 (183–277)	669 (597–749)	1,886 (1,700–2,049)
14 and under	9,873	89 (76–101)	0.0 (0.0–0.0)	485 (411–557)	2,246 (1,987–2,495)
15 to 44	4,644	95 (83–107)	150 (115–195)	558 (506–623)	1,893 (1,683–2,221)
45 and older	5,333	108 (94–122)	322 (250–379)	751 (653.97–870)	1,868 (1,709–1,941)
All ages	19,850	98 (90–107)	159 (131–198)	631 (590–675)	1,943 (1,816–2,086)
Marine					
Females					
14 and under	4,879	212 (183–242)	592 (508–785)	1,532 (1,418–1,703)	3,708 (3,276–4,295)
15 to 44	2,275	146 (126–166)	557 (463–632)	995 (874–1,078)	2,056 (1,848–2,330)
45 and older	2,569	209 (185–233)	802 (757–844)	1,184 (1,132–1,281)	2,464 (2,282–2,820)
All ages	9,723	181 (167–196)	657 (601–718)	1,158 (1,094–1,216)	2,716 (2,382–3,051)
Males					
14 and under	4,994	214 (183–244)	609 (480–808)	1,542 (1,380–1,887)	3,603 (3,212–4,131)
15 to 44	2,369	150 (132–168)	576 (461–675)	1,113 (963–1,226)	1,990 (1,782–2,317)
45 and older	2,764	187 (167–208)	713 (658–851)	1,138 (1,103–1,213)	2,275 (1,993–2,495)
All ages	10,127	175 (161–189)	649 (575–711)	1,205 (1,127–1,233)	2,545 (2,314–2,705)
Both Sexes					
3 to 5	4,112	309 (270–348)	1,108 (984–1,332)	2,314 (2,097–2,481)	4,608 (4,301–5,354)
6 to 10	1,553	198 (161–235)	600 (474–733)	1,481 (1,310–1,549)	3,684* (2,458–4,353)
11 to 15	975	153 (117–189)	481 (361–609)	1,251 (808–1,390)	2,381* (2,162–3,207)
16 to 17	360	98 (58–137)	0.0 (0.0–177)	460* (197–1,079)	2,148* (1,648–3,901)
18 and older	9,432	173 (160–186)	672 (651–732)	1,115 (1,078–1,182)	2,157 (2,024–2,412)
14 and under	9,873	213 (190–237)	606 (517–688)	1,543 (1,491–1,670)	3,694 (3,318–4,065)
15 to 44	4,644	148 (132–163)	568 (502–630)	1,052 (973–1,184)	2,023 (1,925–2,197)
45 and older	5,333	199 (181–217)	767 (718–828)	1,156 (1,115–1,214)	2,389 (2,273–2,546)
All ages	19,850	178 (167–190)	651 (620–675)	1,178 (1,134–1,226)	2,587 (2,454–2,705)

Table 10-32. Per Capita Distribution of Fish (finfish and shellfish) Intake (mg/kg-day), Uncooked Fish Weight[a] (continued)

Age (years)	*N*	Mean (90% CI)	90th Percentile (90% BI)	95th Percentile (90% BI)	99th Percentile (90% BI)
			All Fish		
Females					
14 and under	4,879	295 (261–330)	1,046 (885–1,262)	2,03,8 (1,853–2,251)	4,548 (4,117–4,977)
15 to 44	2,275	237 (206–267)	834.58 (771–981)	1,362 (1,181–1,556)	3,113 (2,767,–3,361)
45 and older	2,569	305 (272–338)	1,065.15 (98–1,200)	1,568 (1,472–1,671)	3,071 (2,716–3,941)
All ages	9,723	272 (251–294)	970.64 (906–1,040)	1,566 (1,511–1,633)	3,566 (3,270–3,782)
Males					
14 and under	4,994	308 (273–344)	1,122 (774–1,310)	2,136 (1,856–2,371)	4,518 (4,055–5,465)
15 to 44	2,369	249 (226–272)	982 (908–1,154)	1,533 (1,407–1,619)	3,011 (2,820–3,349)
45 and older	2,764	309 (282–335)	1,128 (1,078–1,206)	1,605 (1,534–1,731)	2,821 (2,587–3,204)
All ages	10,127	281 (264–297)	1,058 (962–1,201)	1,644 (1,559–1,731)	3,369 (3,204–3,680)
Both Sexes					
3 to 5	4,112	433 (385–482)	1,842 (1,555–1,957)	2,964 (2,790–3,194)	5,604 (5,231–6,135)
6 to 10	1,553	282 (235–328)	1,045 (744.58–1,219)	1,854 (1,638–2,175)	4,371* (3,433–5,814)
11 to 15	975	231 (186–275)	824 (657–952)	1,531 (1,362–1,850)	3,651* (2,745–3,795)
16 to 17	360	163 (107–219)	406 (145–756)	1,272* (558–1,500)	3,544* (2,767–3,946)
18 and older	9,432	275 (258–292)	1,017 (975–1,065)	1,549 (1,481–1,591)	3,060 (2,771–3,204)
14 and under	9,873	302 (274–330)	1,072 (961–1,162)	2,089 (1,987–2,207)	4,539 (4,391–5,108)
15 to 44	4,644	243 (223–262)	938 (878–1,019)	1,451 (1,342–1,602)	3,094 (2,788–3,349)
45 and older	5,333	307 (283–331)	1,112 (1,002–1,168)	1,591 (1,517–1,685)	3,014 (2,714–3,226)
All ages	19,850	276 (261–292)	1,013 (976–1,052)	1,613 (1,561–1,651)	3,457 (3,349–3,680)

[a] Estimates were projected from sample size to the U.S. population using 4-year combined survey weights.
N = Sample size.
CI = Confidence interval.
BI = Bootstrap interval; percentile intervals (BI) were estimated using the percentile bootstrap method with 1,000 bootstrap replications.
* The sample size does not meet minimum reporting requirements as described in the *Third Report on Nutrition Monitoring in the United States* (FASEB/LSRO, 1995).

Source: U.S. EPA (2002).

Table 10-33. Consumer-Only Distribution of Fish (finfish and shellfish) Intake (g/day), as Prepared[a]

Age (years)	*N*	Mean (90% CI)	90th Percentile (90% BI)	95th Percentile (90% BI)	99th Percentile (90% BI)
Freshwater and Estuarine					
Females					
14 and under	445	32.7 (26.8–36.6)	79.9 (77.1–103.9)	111.0 (103.0–163.5)	185.4 (163.5–384.3)
15 to 44	325	55.4 (45.9–64.8)	125.9 (117.0–157.8)	189.4 (154.2–259.9)	341.4 (260.2–853.4)
45 and older	449	49.0 (44.3–53.6)	122.8 (118.7–128.0)	158.3 (151.3–165.8)	284.7 (241.2–308.5)
All ages	1,219	49.4 (44.5–54.3)	122.7 (117.0–126.6)	163.2 (151.5–193.8)	320.6 (260.2–345.2)
Males					
14 and under	442	41.7 (34.9–48.4)	121.5 (85.3–148.4)	161.9 (138.6–229.2)	260.8 (260.2–292.5)
15 to 44	361	66.6 (59.7–73.6)	165.0 (158.8–171.0)	226.3 (194.2–250.2)	336.9 (327.0–402.9)
45 and older	553	65.8 (59.0–72.6)	154.3 (148.1–174.0)	214.4 (200.2–222.3)	400.2 (300.8–571.0)
All ages	1,356	62.9 (57.8–67.9)	158.2(148.4–165.8)	215.4 (202.4–226.5)	335.9 (316.5–437.1)
Both Sexes					
3 to 5	442	27.1 (23.2–31.1)	72.6 (65.0–79.0)	95.6 (87.2–109.6)	159.0* (136.1–260.2)
6 to 10	147	43.5 (31.8–55.2)	121.6* (82.5–187.3)	186.7* (114.8–260.2)	260.4* (172.1–261.3)
11 to 15	107	49.0 (39.4–58.5)	126.6* (103.9–148.4)	149.9* (134.6–192.7)	307.1* (192.7–384.3)
16 to 17	28	75.8* (58.9–92.7)	158.5* (151.1–171.0)	167.8* (158.8–484.4)	371.6* (171.0–484.4)
18 and older	1,633	59.2 (54.9–63.4)	150.2 (141.8–154.2)	201.0 (181.9–216.6)	338.2 (308.5–345.2)
14 and under	887	36.8 (32.5–41.1)	103.1 (75.5–120.7)	146.8 (114.8–167.4)	260.0 (250.2–292.5)
15 to 44	686	61.3 (56.4–66.2)	157.8 (150.3–163.5)	217.1 (181.8–253.2)	342.6 (321.1–484.4)
45 and older	1,002	57.3 (51.9–62.7)	141.1 (127.6–151.0)	182.5 (170.5–200.1)	306.9 (261.8–345.5)
All ages	2,575	56.3 (52.5–60.0)	145.3 (138.6–151.3)	188.8 (178.5–211.9)	332.9 (308.5–361.3)
Marine					
Females					
14 and under	670	48.7 (43.7–53.7)	98.1 (93.3–112.6)	135.9 (112.6–162.2)	196.2 (162.2–238.4)
15 to 44	412	71.0 (66.2–75.7)	158.5 (128.0–170.8)	181.5 (167.4–202.8)	286.7 (234.6–293.2)
45 and older	588	82.3 (75.9–88.6)	153.3 (140.1–166.1)	203.5 (181.2–252.5)	362.3 (275.4–485.4)
All ages	1,670	72.2 (68.6–75.8)	146.3 (140.3–158.7)	181.6 (169.0–201.6)	286.6 (269.5–293.2)
Males					
14 and under	677	59.5 (51.3–67.7)	144.6 (113.3–168.7)	168.8 (167.0–227.2)	265.1 (170.0–291.6)
15 to 44	412	99.1 (91.3–106.9)	186.1 (174.7–199.5)	232.5 (214.0–254.4)	403.8 (321.5–407.2)
45 and older	623	90.0 (84.9–95.1)	179.8 (167.3–200.1)	224.4 (207.2–280.1)	306.3 (292.5–380.9)
All ages	1,712	88.7 (83.7–93.7)	178.2 (170.0–181.2)	226.1 (214.4–232.7)	354.2 (315.3–403.6)
Both Sexes					
3 to 5	682	44.5 (40.6–48.5)	90.6 (84.3–104.8)	119.1 (102.0–142.8)	227.6* (168.7–292.5)
6 to 10	217	59.4 (52.6–66.1)	128.7 (111.6–158.4)	159.2* (134.9–219.05)	242.5* (219.0–291.6)
11 to 15	122	72.4 (59.9–84.9)	165.3* (157.6–202.8)	203.6* (168.8–227.2)	245.6* (213.6–268.6)
16 to 17	37	96.9* (65.3–128.5)	218.9* (179.6–237.8)	237.5* (179.6–292.5)	365.3* (229.8–428.0)
18 and older	1.978	85.1 (81.3–88.9)	168.9 (168.9–174.6)	214.1 (195.9–227.2)	337.2 (306.4–380.9)
14 and under	1,347	54.1 (48.4–59.9)	119.1 (112.3–144.8)	162.3 (141.9–168.7)	238.2 (219.0–269.4)
15 to 44	824	85.0 (79.5–90.4)	172.0 (168.8–179.6)	213.7 (194.3–229.7)	343.7 (304.9–404.2)
45 and older	1,211	85.8 (81.5–90.2)	168.4 (158.7–181.2)	218.7 (207.3–229.8)	320.1 (299.2–485.4)
All ages	3,382	80.2 (76.6–83.8)	168.9 (165.6–169.0)	207.6 (197.0–214.4)	310.2 (299.2–383.5)

Table 10-33. Consumer-Only Distribution of Fish (finfish and shellfish) Intake (g/day), as Prepared[a] (continued)

Age (years)	*N*	Mean (90% CI)	90th Percentile (90% BI)	95th Percentile (90% BI)	99th Percentile (90% BI)
			All Fish		
Females					
14 and under	836	54.2 (49.3–59.0)	112.5 (97.2–136.9)	155.4 (128.5–162.2)	237.5 (197.9–285.6)
15 to 44	554	82.5 (74.8–90.2)	170.8 (151.0–184.7)	221.7 (197.9–260.2)	336.5 (294.3–345.2)
45 and older	751	90.5 (85.3–95.7)	170.5 (158.7–181.7)	219.8 (197.0–242.5)	326.0 (308.5–612.9)
All ages	2,141	81.5 (77.3–85.7)	163.6 (151.3–171.0)	208.2 (193.8–238.4)	327.0 (285.6–359.6)
Males					
14 and under	836	69.1 (61.9–76.3)	157.0 (136.1–168.8)	227.5 (168.7–260.2)	276.0 (269.4–292.5)
15 to 44	565	111.9 (106.0–117.9)	210.6 (195.0–242.5)	296.1 (249.7–316.5)	427.9 (403.6–465.6)
45 and older	849	106.5 (101.5–111.5)	210.3 (193.3–229.8)	271.1 (241.4–292.5)	392.5 (330.6–535.5)
All ages	2,250	102.9 (99.0–106.8)	206.0 (192.7–219.0)	262.0 (251.3–285.8)	404.1 (380.9–428.4)
Both Sexes					
3 to 5	834	50.2 (46.3–54.0)	103.1 (94.5–124.9)	133.9 (120.7–151.8)	260.0* (195.3–293.3)
6 to 10	270	70.6 (63.8–77.4)	154.7 (130.0–183.2)	218.2* (197.9–261.3)	280.9* (260.2–291.6)
11 to 15	172	79.6 (70.4–88.7)	167.1* (154.0–192.7)	208.8* (205.9–257.0	285.2* (263.8–327.0)
16 to 17	52	104.1* (75.0–133.1)	200.5* (167.4–242.5)	241.9* (215.7–484.4)	451.0* (292.5–484.4)
18 and older	2,634	97.56 (93.7–101.4)	191.8 (184.7–197.9)	253.2 (243.6–261.8)	399.5 (359.1–407.2)
14 and under	1,672	61.7 (56.6–66.8)	138.4 (125.1–150.1)	168.7 (162.4–232.8)	271.4 (260.2–291.6)
15 to 44	1,119	97.2 (92.1–102.4)	195.1 (183.2–206.0)	256.0 (240.2–283.9)	404.0 (352.4–450.4)
45 and older	1,600	98.1 (93.6–102.6)	187.0 (184.1–198.0)	248.5 (238.00–260.2)	381.4 (300.6–413.0)
All ages	4,391	92.0 (88.5–95.5)	184.5 (179.6–195.0)	249.3 (234.3–259.8)	379.0 (340.2–413.0)

[a] Estimates were projected from sample size to the U.S. population using 4–year combined survey weights; consumers only are those individuals who consumed fish at least once during the 2-day reporting period.

N = Sample size.

CI = Confidence interval.

BI = Bootstrap interval; percentile intervals (BI) were estimated using the percentile bootstrap method with 1,000 bootstrap replications.

* The sample size does not meet minimum reporting requirements as described in the *Third Report on Nutrition Monitoring in the United States* (FASEB/LSRO, 1995).

Source: U.S. EPA (2002).

Table 10-34. Consumer-Only Distributions of Fish (finfish and shellfish) Intake (mg/kg-day), as Prepared[a]

Age (years)	*N*	Mean (90% CI)	90th Percentile (90% BI)	95th Percentile (90% BI)	99th Percentile (90% BI)
Freshwater and Estuarine					
Females					
14 and under	410	1,198 (1,029–1,367)	3,167 (2,626–3,601)	4,921 (3,601–6,563)	9,106 (6,875–10,967)
15 to 44	315	872 (7,13–1,032)	2,702 (1,777–2,484)	3,153 (2,484–4,067)	5,738 (4,584–15,930)
45 and older	432	736 (658–813)	1,943 (1,803–2,128)	2,487 (2,249–2,706)	3,169 (3,027–7,078)
All ages	1,157	859 (776–943)	2,151 (1,941–2,476)	3,004 (2,602–3,368)	6,102 (5,475–7,078)
Males					
14 and under	419	1,299 (1,106–1,492)	3,556 (3,068–3,830)	4,495 (3,830–4,982)	8,714 (6,266–11,276)
15 to 44	358	841 (751–931)	2,182 (2,057–2,318)	2,819 (2,539–3,241)	4,379 (4,057–4,931)
45 and older	548	782 (701–862)	1,804 (1,696–1,903)	2,511 (2,175–2,652)	4,812 (4,036–6,987)
All ages	1,325	882 (814–950)	2,148 (2,045–2,318)	3,021 (2,867–3,241)	5,333 (4,548–6,775)
Both Sexes					
3 to 5	416	1,532 (1,320–1,743)	4,307 (3,472–4,624)	5,257 (4,926–5,746)	10,644* (9,083–12,735)
6 to 10	132	1,296 (1,004–1,588)	3,453* (2,626–4,671)	4,675* (3,459–8,816)	8,314* (4,684–9,172)
11 to 15	101	869 (724.60–1,013)	2,030* (1,628–2,104)	3,162* (2,104–3,601)	4,665* (3,597–7,361)
16 to 17	28	1,063* (781–1,346)	2,293* (2,096–2,577)	2,505* (2,096–6,466)	5,067* (2,295–6,466)
18 and older	1,599	805 (748–861)	2,025 (1,888–2,072)	2,679 (2,539–2,947)	4,930 (4,285–5,849)
14 and under	829	1,251 (1,135–1,367)	3,456 (3,136–3,597)	4,681 (4,084–5,247)	8,792 (7,361–10,967)
15 to 44	673	855 (778–933)	2,136 (2,057–2,371)	3,071 (2,675–3,478)	5,795 (4,066–6,096)
45 and older	980	759 (694–824)	1,896 (1,739–1,983)	2,512 (2,262–2,706)	4,261 (3,117–6,419)
All ages	2,482	871 (816–926)	2,152 (2,063–2,295)	3,019 (2,924–3,101)	5,839 (4,926–7,078)
Marine					
Females					
14 and under	629	1,988 (1,827–2,148)	4,378 (3,927–4,962)	5,767 (5,041–6,519)	8,185 (6,907–8,842)
15 to 44	403	1,147 (1,061–1,234)	2,404 (2,014–2,660)	3,151 (2,621–3,325)	4,774 (4,523–5,510)
45 and older	568	1,259 (1,159–1,360)	2,430 (2,258–2,627)	3,274 (2,699–4,029)	5,798 (5,365–9,297)
All ages	1,600	1,323 (1,260–1,385)	2,680 (2,477–2,977)	3,644 (3,381–4,305)	5,895 (5,750–6,956)
Males					
14 and under	643	2,084 (1,842–2,326)	4,734 (3,911–5,307)	5,490 (4,944–6,628)	9,004 (7,432–10,962)
15 to 44	409	1,242 (1,151–1,333)	2,448 (2,349–2,773)	2,985 (2,870–3,265)	4,674 (3,637–5,926)
45 and older	621	1,129 (1,063–1,195)	2,294 (2,106–2,452)	2,942 (2,809–3,526)	4,622 (4,094–4,936)
All ages	1,673	1,337 (1,267–1,408)	2,745 (2,513–2,858)	3,636 (3,450–3,922)	5,908 (5,359–6,366)
Both Sexes					
3 to 5	640	2,492 (2,275–2,709)	5,303 (4,873–5,930)	6,762 (6,097–7,168)	11,457* (7,432–14,391)
6 to 10	203	2,120 (1,880–2,361)	4,950 (4,043–5,384)	5,817* (5,333–6,596)	8,092* (6,146–9,184)
11 to 15	120	1,427 (1,203–1,651)	2,971* (2,858–3,741)	4,278* (3,026–4,766)	5,214* (4,647–5,646)
16 to 17	37	1,534* (1,063–2,004)	3,602* (2,974–4,649)	4,475* (3,068–4,685)	4,982* (3,467–5,238)
18 and older	1,944	1,187 (1,137–1,238)	2,386 (2,265–2,450)	2,998 (2,907–3,191)	4,961 (4,523–5,510)
14 and under	1,272	2,037 (1,880–2,195)	4,646 (4,213–4,892)	5,664 (5,384–6,093)	8,611 (7,755–9,184)
15 to 44	812	1,195 (1,127–1,263)	2,442 (2,349–2,660)	3,046 (2,856–3,309)	4,817 (3,932–5,238)
45 and older	1,189	1,198 (1,135–1,261)	2,394 (2,205–2,534)	3,100 (2,933–3,500)	5,436 (4,655–7,504)
All ages	3,273	1,330 (1,278–1,382)	2,710 (2,618–2,870)	3,637 (3,544–3,927)	5,910 (5,646–6,711)

Table 10-34. Consumer-Only Distributions of Fish (finfish and shellfish) Intake (mg/kg-day), as Prepared[a] (continued)

Age (years)	*N*	Mean (90% CI)	90th Percentile (90% BI)	95th Percentile (90% BI)	99th Percentile (90% BI)
			All Fish		
Females					
14 and under	779	2,183 (2,021–2,344)	4,786 (4,422–5,138)	6,218 (5,766–6,738)	10,395 (8,680–10,967)
15 to 44	541	1,317 (1,184–1,451)	2,636 (2,385–3,051)	3,611 (3,225–4,584)	5,712 (4,952–5,849)
45 and older	725	1,380 (1,299–1,460)	2,639 (2,406–2,950)	3,560 (3,008–3,967)	5,929 (5,452–9,905)
All ages	2,045	1,469 (1,400–1,539)	3,008 (2,752–3,169)	4,088 (3,649–4,544)	7,074 (6,519–8,761)
Males					
14 and under	788	2,355 (2,164–2,545)	5,097 (4,680–5,535)	6,712 (6,146–7,432)	9,182 (8,816–11,276)
15 to 44	561	1,409 (1,339–1,478)	2,770 (2,570–3,241)	3,490 (3,092–3,725)	5,612 (5,163–5,926)
45 and older	842	1,311 (1,250–1,373	2,564 (2,501–2,801)	3,133 (3,050–3,584)	4,935 (4,548–6,987)
All ages	2,191	1,518 (1,461–1,575)	3,043 (2,867–3,159)	4,029 (3,779–4,477)	6,736 (6,096–7,117)
Both Sexes					
3 to 5	779	2,828 (2,608–3,049)	5,734 (5,268–6,706)	7,422 (6,907–8,393)	13,829* (11,349–14,391)
6 to 10	250	2,375 (2,199–2,551)	5,135 (4,684–5,816)	6,561* (5,404–8,816)	9,179* (8,130–10,485)
11 to 15	164	1,533 (1,384–1,682)	3,207* (2,945–3,485)	3,924.64* (3,485–4,764)	5,624* (4,764–6,929)
16 to 17	52	1,578*(1,187–1,969)	3,468* (2,676–4,752)	4,504.25* (3,709–6,466)	5,738* (4,752–6,466)
18 and older	2,585	1,349 (1,297–1,401)	2,641 (2,539–2,773)	3,493 (3,258–3,628)	5,708 (5,085–5,926)
14 and under	1,567	2,271 (2,130–2,412)	4,959 (4,647–5,450)	6,531 (5,887–6,929)	10,389 (8,982–10,967)
15 to 44	1,102	1,363 (1,292–1,435)	2,728 (2,570–2,974)	3,583 (3,275–3,999)	5,694 (4,987–5,849)
45 and older	1,567	1,347 (1,288–1,406)	2,619 (2,546–2,752)	3,265 (3,115–3,569)	5,807 (5,073–6,987)
All ages	4,236	1,494 (1,440–1,548)	3,021 (2,941–3,082)	4,055 (3,816–4,218)	6,920 (6,466–7,527)

[a] Estimates were projected from sample size to the U.S. population using 4-year combined survey weights; consumers only are those individuals who consumed fish at least once during the 2-day reporting period..

N = Sample size.

CI = Confidence interval.

BI = Bootstrap interval; percentile intervals (BI) were estimated using the percentile bootstrap method with 1,000 bootstrap replications.

* The sample size does not meet minimum reporting requirements as described in the *Third Report on Nutrition Monitoring in the United States* (FASEB/LSRO, 1995).

Source: U.S. EPA (2002).

Table 10-35. Consumer-Only Distributions of Fish (finfish and shellfish) Intake (g/day), Uncooked Fish Weight[a]

Age (years)	*N*	Mean (90% CI)	90th Percentile (90% BI)	95th Percentile (90% BI)	99th Percentile (90% BI)
Freshwater and Estuarine					
Females					
14 and under	445	47 (40–54)	117 (104–142)	172 (150–204)	243 (220–514)
15 to 44	325	75 (62–88)	173 (155–204)	274 (204–331)	503 (381–1,144)
45 and older	449	66 (59–72)	163 (153–168)	204 (192–226)	394 (303–431)
All ages	1,219	67 (60–74)	163 (154–170)	219 (199–267)	461 (381–508)
Males					
14 and under	442	60 (50–70)	158 (110–196)	199 (189–296)	381 (381–401)
15 to 44	361	93 (82.33–103)	236 (226–246)	305 (272–367)	495 (444–643)
45 and older	553	91 (81.11–100)	221 (204–236)	295 (264–332)	562 (402–764)
All ages	1,356	87 (80–95)	220 (200–232)	296 (289–333)	490 (444–595)
Both Sexes					
3 to 5	442	40 (35–46)	95 (86–102)	129 (120–142)	205* (200–381)
6 to 10	147	61 (44–79)	157* (117–250)	248* (150–381)	386* (221–401)
11 to 15	107	71 (58–83)	173* (166–196)	199* (173–296)	392* (296–514)
16 to 17	28	100* (80–121)	203* (197–248)	242* (206–643)	501* (241–643)
18 and older	1,633	81 (75–87)	200 (190–206)	279 (253–301)	506 (444–508)
14 and under	887	53 (47–59)	144 (101–173)	196 (173–220)	381 (367–401)
15 to 44	686	84 (77–91)	205 (197–226)	295 (253–345)	504 (438–818)
45 and older	1,002	78 (70–86)	191 (170–202)	245 (230–264)	413 (382–505)
All ages	2,575	78 (72–83)	196 (189–202)	258 (243–289)	468 (431–531)
Marine					
Females					
14 and under	670	71 (65–77)	134 (124–155)	183 (151–205)	240 (209–379)
15 to 44	412	91 (85–96)	188 (163–210)	241 (227–265)	376 (347–391)
45 and older	588	104 (94–113)	189 (170–213)	239 (222–283)	441 (359–647)
All ages	1,670	93 (88–98)	183 (174–192)	232 (227–250)	385 (354–397)
Males					
14 and under	677	81 (69–93)	198 (162–227)	231 (225–307)	353 (244–392)
15 to 44	412	127 (116–137)	240 (227–258)	279 (271–370)	568 (488–647)
45 and older	623	113 (107–120)	223 (205–252)	285 (250–324)	384 (359–480)
All ages	1,712	114 (107–120)	227 (223–236)	277 (270–297)	483 (390–501)
Both Sexes					
3 to 5	682	66 (60–71)	125 (114–150)	165 (139–190)	316* (227–390)
6 to 10	217	78 (67–89)	150 (129–201)	202* (165–317)	350* (223–392)
11 to 15	122	102 (85–118)	220* (205–265)	262* (227–307)	320* (277–379)
16 to 17	37	126* (80–171)	281* (241–354)	353* (241–390)	530* (291–650)
18 and older	1,978	108 (103–113)	217 (213–223)	270 (251–283)	464 (391–487)
14 and under	1,347	76 (68–85)	161 (149–201)	220 (183–227)	335 (307–379)
15 to 44	824	109 (101–116)	225 (213–233)	270 (247–279)	483 (390–634)
45 and older	1,211	108 (102–114)	206 (195–224)	272 (250–293)	407 (374–647)
All ages	3,382	103 (98–108)	215 (207–217)	258 (247–270)	395 (390–487)

Table 10-35. Consumer-Only Distributions of Fish (finfish and shellfish) Intake (g/day), Uncooked Fish Weight[a] (continued)

Age (years)	*N*	Mean (90% CI)	90th Percentile (90% BI)	95th Percentile (90% BI)	99th Percentile (90% BI)
			All Fish		
Females					
14 and under	836	79 (73–85)	158 (142–198)	205 (180–218)	372 (254–381)
15 to 44	554	108 (97–118)	221 (197–236)	315 (246–378)	495 (394–508)
45 and older	751	117 (109–124)	215 (200–228)	270 (236–286)	444 (428–817)
All ages	2,141	107 (101–113)	207 (196–227)	275 (246–300)	453 (394–508)
Males					
14 and under	836	96 (85–107)	225 (195–254)	336 (286–353)	390 (381–401)
15 to 44	565	148 (139–156)	272 (253–334)	381 (323–431)	636 (595–647)
45 and older	849	139 (132–146)	274 (285–304)	348 (320–374)	505 (439–693)
All ages	2,250	136 (130–142)	266 (248–289)	354 (315–379)	595 (505–643)
Both Sexes					
3 to 5	834	74 (69–79)	149 (136–165)	184 (172–223)	363* (310–391)
6 to 10	270	95 (85–106)	200 (177–235)	313* (254–381)	387* (381–401)
11 to 15	172	113 (99–127)	227* (205–296)	308* (271–348)	380* (353–409)
16 to 17	52	136* (97–174)	242* (206–358)	357* (266–643)	645* (390–650)
18 and older	2,634	127 (122–133)	248 (236–264)	334 (321–349)	519 (508–634)
14 and under	1,672	88 (80–95)	191 (173–201)	249 (214–330)	381 (367–392)
15 to 44	1,119	128 (121–135)	255 (241–271)	358 (330–381)	609 (508–647)
45 and older	1,600	127 (120–134)	244 (230–258)	317 (304–330)	476 (439–593)
All ages	4,391	121 (116–126)	241 (233–255)	329 (314–343)	507 (486–593)

[a] Estimates were projected from sample size to the U.S. population using 4-year combined survey weights; consumers only are those individuals who consumed fish at least once during the 2-day reporting period..

N = Sample size.

CI = Confidence interval.

BI = Bootstrap interval; percentile intervals (BI) were estimated using the percentile bootstrap method with 1,000 bootstrap replications.

* The sample size does not meet minimum reporting requirements as described in the *Third Report on Nutrition Monitoring in the United States* (FASEB/LSRO, 1995).

Source: U.S. EPA (2002).

Table 10-36. Consumer-Only Distributions of Fish (finfish and shellfish) Intake (mg/kg-day), Uncooked Fish Weight[a]

Age (years)	*N*	Mean (90% CI)	90th Percentile (90% BI)	95th Percentile (90% BI)	99th Percentile (90% BI)
Freshwater and Estuarine					
Females					
14 and under	410	1,776 (1,543–2,009)	4,397 (3,635–4,535)	6,855 (4,881–9,166)	11,544 (9,166–16,108)
15 to 44	315	1,185 (962–1,408)	2,922 (2,294–3,314)	4,260 (3,266–5,973)	8,154 (6,721–20,620)
45 and older	432	986 (880–1,093)	2,655 (2,313–2,875)	3,263 (2,944–3,716)	4,630 (4,037–9,900)
All ages	1,157	1,185 (1,071–1,299)	2,875 (2,654–3,266)	4,033 (3,516–4,406)	8,608 (7,087–9,900)
Males					
14 and under	419	1,895 (1,618–2,172)	4,707 (3,992–4,990)	5,905 (5,522–6,103)	12,628 (8,111–15,495)
15 to 44	358	1,167 (1,034–1,299)	2,998 (2,724–3,349)	4,015 (3,712–4,635)	6,534 (5,511–8,577)
45 and older	548	1,076 (963–1,190)	2,467 (2,378–2,597)	3,447 (3,093–3,849)	6,574 (5,557–9,351)
All ages	1,325	1,238 (1,140–1,336)	3,052 (2,735–3,221)	4,257 (4,039–4,473)	7,998 (6,539–9,351)
Both Sexes					
3 to 5	416	2,292 (2,012–2,572)	5,852 (4,703–6,068)	7,160 (6,950–7,442)	15,600* (11,877–18,670)
6 to 10	132	1,830 (1,416–2,245)	4,688* (3,673–5,987)	6,207* (4,767–12,926)	12,365* (6,763–12,926)
11 to 15	101	1,273 (1,082–1,464)	2,777* (2,091–3,026)	4,419* (3,026–5,522)	5,717* (5,457–9,852)
16 to 17	28	1,401* (10,588–1,744)	2,971* (2,743–3,692)	3,279* (2,767–8,577)	6,819* (3,221–8,577)
18 and older	1,599	1,102 (1,023–1,181)	2,693 (2,507–2,820)	3,744 (3,520–4,037)	7,140 (6,388–8,604)
14 and under	829	1,834 (1,680–1,987)	4,512 (4,045–4,780)	5,986 (5,531–6,867)	12,389 (9,852–15,495)
15 to 44	673	1,175 (1,067–1,282)	2,978 (2,739–3,221)	4,125 (3,815–4,841)	8,580 (5,973–9,477)
45 and older	980	1,032 (941–1,123)	2,508 (2,383–2,797)	3,319 (3,034–3,716)	6,122 (4,422–8,254)
All ages	2,482	1,213 (1,136–1,291)	2,947 (2,808–3,118)	4,135 (4,037–4,287)	8,587 (6,950–9,900)
Marine					
Females					
14 and under	629	2,893 (2,679–3,107)	6,279 (5,286–6,554)	7,899 (7,033–8,478)	10,514 (9,322–11,981)
15 to 44	403	1,475 (1,366–1,584)	3,102 (2,580–3,378)	3,927 (3,440–4,929)	6,491 (5,931–7,802)
45 and older	568	1,579 (1,439–1,719)	3,028 (2,676–3,239)	3,917 (3,584–4,560)	7,416 (6,021–12,395)
All ages	1,600	1,732 (1,649–1,815)	3,558 (3,335–3,880)	4,878 (4,560–5,640)	8,618 (7,802–9,322)
Males					
14 and under	643	2,885 (2,540–3,230)	6,244 (5,390–6,931)	8,068 (6,577–8,707)	11,871 (10,365–14,194)
15 to 44	409	1,579 (1,458–1,701)	3,063 (2,855–3,481)	3,736 (3,554–4,048)	7,103 (4,634–7,701)
45 and older	621	1,412 (1,328–1,496)	2,812 (2,589–3,072)	3,724 (3,386–3,987)	5,504 (5,134–6,321)
All ages					
Both Sexes					
3 to 5	640	3,689 (3,395–3,982)	7,253 (6,777–8,504)	9,270 (8,415–9,991)	16,100* (11,980–17,989)
6 to 10	203	2,787 (2,417–3,157)	5,910 (4,813–7,365)	8,001* (6,375–8,707)	10,754* (8,707–12,055)
11 to 15	120	2,020 (1,741–2,327)	4,224* (3,744–4,781)	5,195* (3,859–6,448)	6,839* (6,076–8,970)
16 to 17	37	2,007* (1,302–2,712)	4,468* (3,880–7,802)	6,537* (3,991–7,802)	7,886* (4,661–7,958)
18 and older	1,944	1,501 (1,440–1,562)	2,971 (2,740–3,098)	3,749 (3,579–3,962)	6,345 (5,653–7,224)
14 and under	1,272	2,892 (2,674–3,111)	6,290 (5,748–6,448)	8,047 (7,365–8,564)	11,507 (10,124–12,054)
15 to 44	812	1,527 (1,441–1,614)	3,093 (2,855–3,318)	3,872 (3,564–4,131)	6,898 (5,287–7,701)
45 and older	1,189	1,501 (1,416–1,586)	2,948 (2,664–3,232)	3,889 (3,494–4,030)	6,229 (5,409–9,759)
All ages					

Table 10-36. Consumer-Only Distributions of Fish (finfish and shellfish) Intake (mg/kg-day), Uncooked Fish Weight[a] (continued)

Age (years)	*N*	Mean (90% CI)	90th Percentile (90% BI)	95th Percentile (90% BI)	99th Percentile (90% BI)
			All Fish		
Females					
14 and under	779	3,202 (2,983–3,421)	6,854 (6,596–7,365)	8,808 (8,451–9,408)	13,907 (11,461–16,108)
15 to 44	541	1,728 (1,547–1,909)	3,437 (3,153–3,925)	5,045 (4,221–6,122)	8,011 (6,721–8,604)
45 and older	725	1,774 (1,657–1,890)	3,422 (3,098–3,767)	4,098 (3,870–4,853)	7,996 (6,121–15,117)
All ages	2,045	1,962 (1,864–2,061)	4,005 (3,831–4,278)	5,792 (5,097–6,059)	9,878 (8,970–12,235)
Males					
14 and under	788	3,314 (3,022–3,607)	7,402 (6,241–7,626)	8,720 (8,323–10,591)	13,025 (12,278–16,803)
15 to 44	561	1,851 (1,754–1,947)	3,599 (3,232–4,197)	4,461 (3,991–5,063)	7,621 (7,361–8,473)
45 and older	842	1,703 (1,616–1,791)	3,395 (3,118–3,638)	4,253 (3,912–4,685)	6,376 (5,514–9,351)
All ages					
Both Sexes					
3 to 5	779	4,198 (3,894–4,502)	8,061 (7,366–9,223)	10,444 (9,475–12,261)	17,874* (15,290–18,670)
6 to 10	250	3,188 (2,923–3,452)	6,544 (6,013–8,707)	8,654* (7,086–11,756)	12,785* (10,930–13,979)
11 to 15	164	2,199 (1,950–2,449)	4,387* (3,785–5,522)	6,234* (4,420–7,589)	8,345* (6,076–8,970)
16 to 17	52	2,066* (1,529–2,603)	3,902* (3,536–7,892)	6,594* (4,661–8,577)	8,210* (7,892–8,577)
18 and older	2,585	1,758 (1,687–1,829)	3,438 (3,303–3,584)	4,492 (4,271–4,810)	7,510 (6,679–8,604)
14 and under	1,567	3,260 (3,062–3,457)	7,120 (6,533–7,859)	8,758 (8,487–9,362)	13,955 (12,926–15,495)
15 to 44	1,102	1,790 (1,696–1,884)	3,549 (3,318–3,833)	4,806 (4,214–5,422)	7,839 (7,361–8,604)
45 and older	1,567	1,740 (1,650–1,830)	3,416 (3,227–3,572)	4,261 (4,017–4,497)	6,704 (6,195–9,351)
All ages					

[a] Estimates were projected from sample size to the U.S. population using 4-year combined survey weights; consumers only are those individuals who consumed fish at least once during the 2-day reporting period..

N = Sample size.

CI = Confidence interval.

BI = Bootstrap interval; percentile intervals (BI) were estimated using the percentile bootstrap method with 1,000 bootstrap replications.

* The sample size does not meet minimum reporting requirements as described in the *Third Report on Nutrition Monitoring in the United States* (FASEB/LSRO, 1995).

Source: U.S. EPA (2002).

Table 10-37. Fish Consumption per kg Body Weight, All Respondents, by Selected Demographic Characteristics (g/kg-day, as-consumed)

State	Demographic Characteristic	Sample Size	Arithmetic Mean	Percent Eating Fish	Percentiles			
					10th	50th	90th	95th
Connecticut								
All		420	0.41	85.1	0.00	0.25	1.00	1.32
Sex								
	Male	201	0.39	86.2	0.00	0.24	1.05	1.34
	Female	219	0.43	84.0	0.00	0.28	0.95	1.30
Age (years)-Sex Category								
	Child 1 to 5	26	0.32	51.7	0.00	0.05	0.95	1.47
	Child 6 to 10	26	0.51	86.7	0.00	0.35	1.13	1.29
	Child 11 to 15	21	0.27	85.6	0.00	0.19	0.52	0.89
	Female 16 to 29	17	0.67	79.9	0.00	0.31	1.06	4.02
	Female 30 to 49	85	0.46	86.7	0.00	0.28	1.00	1.36
	Female 50+	77	0.43	90.6	0.01	0.33	0.96	1.33
	Male 16 to 29	14	0.16	70.5	0.00	0.14	0.41	0.53
	Male 30 to 49	80	0.47	92.8	0.03	0.29	1.13	1.44
	Male 50+	63	0.35	90.5	0.02	0.22	0.86	1.11
	Unknown	11	0.09	76.1	0.00	0.02	0.37	0.45
Race/Ethnicity								
	White, Non-Hispanic	370	0.41	88.7	0.00	0.27	0.98	1.27
	Black, Non-Hispanic	9	0.05	33.5	0.00	0.00	0.17	*
	Hispanic	20	0.48	70.9	0.00	0.21	1.53	2.29
	Asian	19	0.61	59.2	0.00	0.14	1.33	3.80
	Unknown	2	0.01	43.4	0.00	0.00	*	*
Respondent Education								
	0 to 11 years	13	0.33	100.0	0.05	0.15	1.04	1.39
	High School	87	0.38	85.3	0.00	0.22	1.00	1.14
	Some College	62	0.41	88.7	0.00	0.30	0.80	1.41
	College Grad	258	0.43	83.4	0.00	0.25	1.03	1.32
Household Income ($)								
	0 to 20,000	40	0.39	86.4	0.00	0.26	0.96	1.45
	20,000 to 50,000	150	0.47	87.4	0.00	0.28	1.04	1.43
	>50,000	214	0.38	84.1	0.00	0.24	0.99	1.27
	Unknown	16	0.32	73.4	0.00	0.30	0.75	1.00
Florida								
All		15,367	0.47	50.5	0.00	0.06	1.27	1.91
Sexes								
	Male	7,911	0.44	49.2	0.00	0.00	1.22	1.84
	Female	7,426	0.50	51.9	0.00	0.10	1.32	1.98
	Unknown	30	0.41	48.0	0.00	0.00	1.41	2.38

Table 10-37. Fish Consumption per kg Body Weight, All Respondents, by Selected Demographic Characteristics (g/kg-day, as-consumed) (continued)

State	Demographic Characteristic	Sample Size	Arithmetic Mean	Percent Eating Fish	Percentiles			
					10th	50th	90th	95th
Florida (continued)								
Age (years)-Sex Category								
	Child 1 to 5	1,102	0.89	37.8	0.00	0.00	2.75	3.97
	Child 6 to 10	938	0.44	39.4	0.00	0.00	1.37	2.03
	Child 11 to 15	864	0.37	42.9	0.00	0.00	1.02	1.44
	Female 16 to 29	1,537	0.44	49.1	0.00	0.00	1.10	1.75
	Female 30 to 49	2,264	0.53	56.6	0.00	0.20	1.38	1.98
	Female 50+	2,080	0.41	56.5	0.00	0.20	1.14	1.62
	Male 16 to 29	1,638	0.44	46.1	0.00	0.00	1.11	1.72
	Male 30 to 49	2,540	0.43	53.0	0.00	0.11	1.17	1.77
	Male 50+	2,206	0.38	54.5	0.00	0.15	0.98	1.46
	Unknown	198	0.35	54.7	0.00	0.20	0.88	1.22
Race/Ethnicity								
	White, Non-Hispanic	11,607	0.46	51.6	0.00	0.09	1.24	1.84
	Black, Non-Hispanic	1,603	0.54	48.3	0.00	0.00	1.49	2.24
	Hispanic	1,556	0.46	45.9	0.00	0.00	1.20	1.96
	Asian	223	0.58	49.5	0.00	0.00	1.33	1.78
	American Indian	104	0.63	53.4	0.00	0.15	1.95	3.61
	Unknown	274	0.43	45.9	0.00	0.00	1.17	1.71
Respondent Education								
	0 to 11 years	1,481	0.40	41.5	0.00	0.00	1.16	1.69
	High School	4,992	0.46	48.5	0.00	0.00	1.26	1.96
	Some College	4,791	0.49	52.3	0.00	0.11	1.30	1.98
	College Grad	4,012	0.47	54.2	0.00	0.15	1.30	1.85
	Unknown	91	0.46	41.2	0.00	0.00	1.57	2.61
Household Income ($)								
	0 to 20,000	3,314	0.47	45.9	0.00	0.00	1.21	2.11
	20,000 to 50,000	6,678	0.48	50.4	0.00	0.06	1.28	1.92
	>50,000	3,136	0.51	57.5	0.00	0.21	1.38	1.99
	Unknown	2,239	0.35	47.6	0.00	0.00	1.09	1.57
Minnesota								
All Sexes		837	0.31	94.4	0.02	0.18	0.62	1.07
	Male	419	0.26	95.3	0.02	0.16	0.58	1.06
	Female	418	0.36	93.4	0.02	0.21	0.65	1.10
Age (years)-Sex Category								
	Child 1 to 5	47	0.57	97.4	0.05	0.45	1.09	1.74
	Child 6 to 10	46	0.33	88.4	0.00	0.21	0.82	1.34
	Child 11 to 15	68	0.22	92.8	0.02	0.19	0.54	0.59
	Female 16 to 29	47	0.67	96.0	0.02	0.15	0.61	4.48
	Female 30 to 49	132	0.24	95.0	0.02	0.22	0.50	0.58

Table 10-37. Fish Consumption per kg Body Weight, All Respondents, by Selected Demographic Characteristics (g/kg-day, as-consumed) (continued)

State	Demographic Characteristic	Sample Size	Arithmetic Mean	Percent Eating Fish	Percentiles			
					10th	50th	90th	95th
Minnesota (continued)								
Age (years)-Sex Category								
	Female 50+	162	0.34	94.9	0.03	0.21	0.90	1.35
	Male 16 to 29	55	0.10	92.3	0.01	0.07	0.26	0.33
	Male 30 to 49	120	0.24	96.0	0.04	0.16	0.42	0.64
	Male 50+	155	0.24	99.8	0.05	0.19	0.53	0.68
	Unknown	5	0.00	1.6	0.00	0.00	0.00	0.00
Race/Ethnicity								
	White, Non-Hispanic	775	0.27	93.8	0.02	0.17	0.59	0.90
	Black, Non-Hispanic	1	0.00	*	*	*	*	*
	Hispanic	3	0.65	100.0	*	0.27	*	*
	Asian	7	0.53	100.0	0.13	0.47	*	*
	American Indian	12	2.08	100.0	0.09	0.16	*	*
	Unknown	39	0.32	100.0	0.10	0.24	0.79	1.02
Respondent Education								
	0 to 11 years	46	0.34	86.2	0.00	0.19	1.23	1.56
	High School	234	0.29	92.9	0.02	0.17	0.65	1.11
	Some College	259	0.41	95.3	0.03	0.20	0.65	0.95
	College Grad	255	0.26	95.0	0.02	0.17	0.57	1.05
	Unknown	43	0.24	99.7	0.09	0.23	0.41	0.51
Household Income ($)								
	0 to 20,000	87	0.40	91.0	0.03	0.20	1.20	1.61
	20,000 to 50,000	326	0.34	91.3	0.01	0.17	0.62	0.90
	>50,000	327	0.29	97.9	0.03	0.18	0.62	1.09
	Unknown	97	0.24	92.9	0.03	0.21	0.56	0.68
North Dakota								
All Sexes		575	0.32	95.2	0.03	0.18	0.71	1.18
	Male	276	0.32	96.2	0.04	0.19	0.68	1.20
	Female	299	0.32	94.2	0.03	0.17	0.73	1.16
Age (years)-Sex Category								
	Child 1 to 5	30	0.67	94.4	0.04	0.22	1.56	3.83
	Child 6 to 10	44	0.51	92.0	0.07	0.29	1.14	1.49
	Child 11 to 15	55	0.40	97.1	0.06	0.21	1.01	1.24
	Female 16 to 29	42	0.18	89.9	0.00	0.11	0.39	0.63
	Female 30 to 49	95	0.28	98.3	0.04	0.18	0.55	0.86
	Female 50+	99	0.38	93.4	0.02	0.16	0.99	1.47
	Male 16 to 29	36	0.22	100.0	0.04	0.13	0.45	0.56
	Male 30 to 49	90	0.22	97.8	0.04	0.18	0.45	0.54
	Male 50+	81	0.29	94.0	0.01	0.18	0.67	1.16
	Unknown	3	0.11	31.5	0.00	0.00	*	*

Table 10-37. Fish Consumption per kg Body Weight, All Respondents, by Selected Demographic Characteristics (g/kg-day, as-consumed) (continued)

State	Demographic Characteristic	Sample Size	Arithmetic Mean	Percent Eating Fish	Percentiles			
					10th	50th	90th	95th
North Dakota (continued)								
Race/Ethnicity								
	White, Non-Hispanic	528	0.33	95.1	0.03	0.18	0.72	1.21
	Black, Non-Hispanic	2	0.25	100.0	*	0.25	*	*
	Asian	4	0.20	100.0	*	0.18	*	*
	American Indian	9	0.30	100.0	0.08	0.25	0.69	*
	Unknown	32	0.30	93.5	0.05	0.13	0.71	0.94
Respondent Education								
	0 to 11 years	29	0.23	86.6	0.00	0.11	0.65	0.86
	High School	138	0.42	97.3	0.04	0.20	0.89	1.56
	Some College	183	0.28	95.2	0.03	0.18	0.63	0.99
	College Grad	188	0.31	96.7	0.04	0.18	0.69	1.26
	Unknown	37	0.35	87.2	0.00	0.10	0.73	1.32
Household Income ($)								
	0 to 20,000	51	0.52	93.7	0.02	0.17	1.79	2.55
	20,000 to 50,000	235	0.27	94.2	0.02	0.14	0.70	1.13
	>50,000	233	0.31	97.1	0.05	0.22	0.63	1.02
	Unknown	56	0.42	92.7	0.04	0.18	0.79	1.21

* Percentiles cannot be estimated due to small sample size.

Notes: FL consumption is based on a 7-day recall; CT, MN, and ND consumptions are based on rate of consumption.
FL consumption excludes away-from-home consumption by children <18.
Statistics are weighted to represent the general population in the states.

Source: Westat (2006).

Table 10-38. Fish Consumption per kg Body Weight, Consumers Only, by Selected Demographic Characteristics (g/kg-day, as-consumed)

State	Demographic Characteristic	Sample Size	Arithmetic Mean	Percent Eating Fish	Percentiles			
					10th	50th	90th	95th
Connecticut								
All		362	0.48	100	0.07	0.32	1.09	1.37
Sex								
	Male	175	0.45	100	0.08	0.29	1.11	1.40
	Female	187	0.52	100	0.05	0.34	1.03	1.35
Age (years)-Sex Category								
	Child 1 to 5	14	0.61	100	0.16	0.55	1.42	1.56
	Child 6 to 10	22	0.59	100	0.14	0.47	1.15	1.30
	Child 11 to 15	18	0.32	100	0.07	0.19	0.52	0.84
	Female 16 to 29	14	0.84	100	0.11	0.35	1.12	3.10
	Female 30 to 49	74	0.53	100	0.05	0.34	1.12	1.48
	Female 50+	70	0.48	100	0.05	0.37	1.03	1.36
	Male 16 to 29	10	0.23	100	0.08	0.21	0.47	0.56
	Male 30 to 49	74	0.51	100	0.11	0.35	1.15	1.46
	Male 50+	57	0.38	100	0.10	0.26	0.93	1.12
	Unknown	9	0.12	100	0.01	0.04	0.39	*
Race/Ethnicity								
	White, Non-Hispanic	331	0.46	100	0.07	0.32	1.05	1.31
	Black, Non-Hispanic	3	0.15	100	*	0.15	*	*
	Hispanic	15	0.68	100	0.12	0.30	1.86	2.47
	Asian	12	1.03	100	0.09	0.48	1.95	4.78
	Unknown	1	0.01	100	*	*	*	*
Respondent Education								
	0 to 11 years	13	0.32	100	0.05	0.15	0.97	1.37
	High School	76	0.44	100	0.05	0.27	1.04	1.15
	Some College	56	0.46	100	0.10	0.34	0.85	1.43
	College Grad	217	0.51	100	0.08	0.33	1.12	1.39
Household Income ($)								
	0 to 20,000	35	0.45	100	0.08	0.32	1.13	1.47
	20,000 to 50,000	133	0.54	100	0.07	0.33	1.12	1.45
	>50,000	182	0.45	100	0.07	0.30	1.06	1.31
	Unknown	12	0.44	100	0.10	0.41	0.84	1.03
Florida								
All		7,757	0.93	100	0.19	0.58	1.89	2.73
Sexes								
	Male	3,880	0.90	100	0.18	0.55	1.85	2.65
	Female	3,861	0.95	100	0.19	0.62	1.94	2.78
	Unknown	16	0.85	100	0.12	0.69	2.37	2.61

Table 10-38. Fish Consumption per kg Body Weight, Consumers Only, by Selected Demographic Characteristics (g/kg-day, as-consumed) (continued)

State	Demographic Characteristic	Sample Size	Arithmetic Mean	Percent Eating Fish	Percentiles			
					10th	50th	90th	95th
Florida (continued)								
Age (years)-Sex Category								
	Child 1 to 5	420	2.34	100	0.50	1.74	4.67	6.80
	Child 6 to 10	375	1.10	100	0.28	0.81	2.23	2.97
	Child 11 to 15	365	0.85	100	0.20	0.63	1.62	2.16
	Female 16 to 29	753	0.89	100	0.16	0.55	1.77	2.42
	Female 30 to 49	1,287	0.94	100	0.18	0.63	1.86	2.68
	Female 50+	1,171	0.73	100	0.19	0.52	1.52	2.05
	Male 16 to 29	754	0.96	100	0.16	0.52	1.77	2.65
	Male 30 to 49	1,334	0.81	100	0.17	0.53	1.69	2.44
	Male 50+	1,192	0.70	100	0.17	0.50	1.41	1.93
	Unknown	106	0.64	100	0.21	0.49	1.15	1.55
Race/Ethnicity								
	White, Non-Hispanic	5,957	0.88	100	0.18	0.56	1.82	2.61
	Black, Non-Hispanic	785	1.11	100	0.23	0.73	2.27	3.21
	Hispanic	721	1.01	100	0.17	0.60	2.08	2.81
	Asian	110	1.16	100	0.27	0.67	1.78	3.29
	American Indian	57	1.17	100	0.21	0.69	3.13	4.70
	Unknown	127	0.94	100	0.19	0.67	1.73	2.43
Respondent Education								
	0 to 11 years	613	0.96	100	0.22	0.60	1.86	2.81
	High School	2,405	0.96	100	0.18	0.58	1.98	2.83
	Some College	2,511	0.93	100	0.18	0.58	1.91	2.70
	College Grad	2,190	0.87	100	0.19	0.57	1.79	2.47
	Unknown	38	1.13	100	0.25	0.85	2.69	2.74
Household Income ($)								
	0 to 20,000	1,534	1.03	100	0.19	0.61	2.22	2.99
	20,000 to 50,000	3,370	0.95	100	0.19	0.60	1.91	2.78
	>50,000	1,806	0.89	100	0.17	0.56	1.87	2.73
	Unknown	1,047	0.74	100	0.17	0.51	1.61	2.09
Minnesota								
All Sexes		793	0.33	100	0.04	0.2	0.65	1.08
	Male	401	0.28	100	0.04	0.17	0.62	1.07
	Female	392	0.38	100	0.05	0.22	0.7	1.22
Age (years)-Sex Category								
	Child 1 to 5	46	0.58	100	0.07	0.46	1.1	1.75
	Child 6 to 10	42	0.38	100	0.05	0.25	1.01	1.36
	Child 11 to 15	63	0.24	100	0.03	0.21	0.55	0.59

Table 10-38. Fish Consumption per kg Body Weight, Consumers Only, by Selected Demographic Characteristics (g/kg-day, as-consumed) (continued)

State	Demographic Characteristic	Sample Size	Arithmetic Mean	Percent Eating Fish	Percentiles			
					10th	50th	90th	95th
Minnesota (continued)								
Age (years)-Sex Category								
	Female 16 to 29	44	0.69	100	0.02	0.16	0.66	2.95
	Female 30 to 49	127	0.25	100	0.04	0.23	0.51	0.58
	Female 50+	150	0.36	100	0.05	0.22	0.93	1.37
	Male 16 to 29	52	0.11	100	0.02	0.08	0.27	0.33
	Male 30 to 49	115	0.25	100	0.07	0.17	0.42	0.64
	Male 50+	153	0.24	100	0.05	0.19	0.53	0.68
	Unknown	1	0.18	100	*	*	*	*
Race/Ethnicity								
	White, Non-Hispanic	732	0.29	100	0.04	0.19	0.60	0.98
	Black, Non-Hispanic	*	*	100	*	*	*	*
	Hispanic	3	0.65	100	*	0.27	*	*
	Asian	7	0.53	100	0.13	0.46	*	*
	American Indian	12	2.08	100	0.09	0.15	*	*
	Unknown	39	0.32	100	0.10	0.24	0.79	1.01
Respondent Education								
	0 to 11 years	41	0.39	100	0.07	0.20	1.37	1.56
	High School	219	0.31	100	0.04	0.18	0.68	1.13
	Some College	249	0.43	100	0.04	0.22	0.65	0.98
	College Grad	242	0.27	100	0.04	0.19	0.58	1.05
	Unknown	42	0.24	100	0.09	0.23	0.41	0.50
Household Income ($)								
	0 to 20,000	77	0.44	100	0.09	0.20	1.30	1.63
	20,000 to 50,000	301	0.37	100	0.05	0.18	0.65	0.96
	>50,000	321	0.29	100	0.03	0.19	0.62	1.10
	Unknown	94	0.26	100	0.05	0.23	0.57	0.69
North Dakota								
All Sexes		546	0.34	100	0.05	0.19	0.74	1.21
	Male	265	0.33	100	0.04	0.20	0.74	1.22
	Female	281	0.34	100	0.05	0.18	0.74	1.20
Age (years)-Sex Category								
	Child 1 to 5	28	0.70	100	0.05	0.23	1.58	3.82
	Child 6 to 10	41	0.56	100	0.11	0.30	1.17	1.51
	Child 11 to 15	53	0.41	100	0.06	0.22	1.04	1.26
	Female 16 to 29	38	0.20	100	0.04	0.15	0.41	0.67
	Female 30 to 49	93	0.29	100	0.05	0.18	0.56	0.87
	Female 50+	92	0.40	100	0.06	0.17	1.14	1.52
	Male 16 to 29	36	0.22	100	0.04	0.13	0.45	0.56

Table 10-38. Fish Consumption per kg Body Weight, Consumers Only, by Selected Demographic Characteristics (g/kg-day, as-consumed) (continued)

State	Demographic Characteristic	Sample Size	Arithmetic Mean	Percent Eating Fish	Percentiles			
					10th	50th	90th	95th
North Dakota (continued)								
Age (years)-Sex Category								
	Male 30 to 49	88	0.22	100	0.05	0.18	0.45	0.54
	Male 50+	76	0.31	100	0.04	0.19	0.74	1.20
	Unknown	1	0.34	100	*	*	*	*
Race/Ethnicity								
	White, Non-Hispanic	501	0.34	100	0.05	0.19	0.74	1.23
	Black, Non-Hispanic	2	0.25	100	*	0.25	*	*
	Asian	4	0.20	100	*	0.14	*	*
	American Indian	9	0.30	100	0.08	0.25	0.61	*
	Unknown	30	0.32	100	0.05	0.16	0.73	0.95
Respondent Education								
	0 to 11 years	25	0.26	100	0.07	0.12	0.73	0.90
	High School	134	0.43	100	0.05	0.20	0.98	1.62
	Some College	174	0.29	100	0.05	0.20	0.65	1.02
	College Grad	181	0.32	100	0.05	0.19	0.72	1.30
	Unknown	32	0.40	100	0.04	0.13	0.84	1.43
Household Income ($)								
	0 to 20,000	48	0.55	100	0.07	0.19	1.80	2.62
	20,000 to 50,000	221	0.29	100	0.04	0.15	0.73	1.17
	>50,000	225	0.32	100	0.06	0.23	0.64	1.04
	Unknown	52	0.45	100	0.05	0.20	0.82	1.28

* Percentiles cannot be estimated due to small sample size.

Notes: FL consumption is based on a 7-day recall; CT, MN, and ND consumptions are based on rate of consumption.
FL consumption excludes away-from-home consumption by children <18.
Statistics are weighted to represent the general population in the states.

Source: Westat (2006).

Table 10-39. Fish Consumption per kg Body Weight, All Respondents by State, Acquisition Method, (g/kg-day, as-consumed)

State	Category	Sample Size	Arithmetic Mean	Percent Eating Fish	Percentiles			
					10th	50th	90th	95th
Connecticut								
All		420	0.41	85.1	0.00	0.25	1.00	1.32
Acquisition Method								
	Bought	420	0.40	84.8	0.00	0.25	0.96	1.30
	Caught	420	0.01	16.3	0.00	0.00	0.01	0.03
Acquisition Method-Household Income ($) Group								
	Bought; 0 to 20,000	40	0.38	86.4	0.00	0.26	0.96	1.45
	Bought; 20,000 to 50,000	150	0.46	86.6	0.00	0.27	0.93	1.42
	Bought; >50,000	214	0.38	84.1	0.00	0.24	0.99	1.27
	Bought; Unknown	16	0.32	73.4	0.00	0.30	0.75	1.00
	Caught; 0 to 20,000	40	0.01	11.0	0.00	0.00	0.00	0.05
	Caught; 20,000 to 50,000	150	0.01	18.1	0.00	0.00	0.02	0.06
	Caught; >50,000	214	0.01	16.8	0.00	0.00	0.01	0.02
	Caught; Unknown	16	0.00	6.2	0.00	0.00	0.00	0.01
Habitat								
	Freshwater	420	0.01	36.4	0.00	0.00	0.03	0.07
	Estuarine	420	0.10	76.0	0.00	0.04	0.23	0.43
	Marine	420	0.29	84.8	0.00	0.17	0.67	0.97
Fish/Shellfish Type								
	Shellfish	420	0.13	74.6	0.00	0.06	0.30	0.55
	Finfish	420	0.27	82.7	0.00	0.14	0.69	0.95
Florida								
All		15,367	0.47	50.5	0.00	0.06	1.27	1.91
Acquisition Method								
	Bought	15,367	0.41	47.5	0.00	0.00	1.12	1.70
	Caught	15,367	0.06	7.4	0.00	0.00	0.00	0.34
Acquisition Method-Household Income ($) Group								
	Bought; 0 to 20,000	3,314	0.41	42.5	0.00	0.00	1.10	1.84
	Bought; 20,000 to 50,000	6,678	0.41	47.4	0.00	0.00	1.11	1.68
	Bought; >50,000	3,136	0.45	54.2	0.00	0.14	1.27	1.79
	Bought; Unknown	2,239	0.32	45.3	0.00	0.00	0.99	1.45
	Caught; 0 to 20,000	3,314	0.06	6.7	0.00	0.00	0.00	0.32
	Caught; 20,000 to 50,000	6,678	0.07	7.8	0.00	0.00	0.00	0.38
	Caught; >50,000	3,136	0.06	8.4	0.00	0.00	0.00	0.42
	Caught; Unknown	2,239	0.03	5.5	0.00	0.00	0.00	0.16
Habitat								
	Freshwater	15,367	0.04	9.1	0.00	0.00	0.00	0.26
	Estuarine	15,367	0.10	26.5	0.00	0.00	0.32	0.54
	Marine	15,367	0.33	40.3	0.00	0.00	0.90	1.43
Fish/Shellfish Type								
	Shellfish	15,367	0.07	21.1	0.00	0.00	0.22	0.43
	Finfish	15,367	0.39	41.9	0.00	0.00	1.10	1.67

Table 10-39. Fish Consumption per kg Body Weight, All Respondents by State, Acquisition Method, (g/kg-day, as-consumed) (continued)

State	Category	Sample Size	Arithmetic Mean	Percent Eating Fish	Percentiles			
					10th	50th	90th	95th
Minnesota								
All		837	0.31	94.4	0.02	0.18	0.62	1.07
Acquisition Method								
	Bought	837	0.20	89.9	0.00	0.10	0.51	0.76
	Caught	837	0.11	60.6	0.00	0.03	0.22	0.37
Acquisition Method-Household Income ($) Group								
	Bought; 0 to 20,000	87	0.26	90.7	0.02	0.12	0.61	1.06
	Bought; 20,000 to 50,000	326	0.18	84.4	0.00	0.10	0.45	0.58
	Bought; >50,000	327	0.20	93.9	0.02	0.10	0.55	0.86
	Bought; Unknown	97	0.21	91.3	0.01	0.18	0.54	0.65
	Caught; 0 to 20,000	87	0.14	70.4	0.00	0.03	0.28	1.00
	Caught; 20,000 to 50,000	326	0.15	66.0	0.00	0.04	0.25	0.36
	Caught; >50,000	327	0.09	55.5	0.00	0.02	0.24	0.39
	Caught; Unknown	97	0.04	56.7	0.00	0.02	0.12	0.14
Habitat								
	Freshwater	837	0.11	60.6	0.00	0.03	0.22	0.37
	Estuarine	837	0.02	67.5	0.00	0.01	0.05	0.09
	Marine	837	0.18	89.9	0.00	0.09	0.46	0.68
Fish/Shellfish Type								
	Shellfish	837	0.04	67.5	0.00	0.01	0.10	0.18
	Finfish	837	0.27	94.0	0.01	0.15	0.57	0.83
North Dakota								
All		575	0.32	95.2	0.03	0.18	0.71	1.18
Acquisition Method								
	Bought	575	0.23	89.9	0.00	0.10	0.52	0.93
	Caught	575	0.09	68.3	0.00	0.04	0.24	0.40
Acquisition Method-Household Income ($) Group								
	Bought; 0 to 20,000	51	0.41	88.0	0.00	0.12	1.34	2.03
	Bought; 20,000 to 50,000	235	0.21	90.6	0.01	0.09	0.48	1.01
	Bought; >50,000	233	0.19	90.7	0.01	0.10	0.48	0.77
	Bought; Unknown	56	0.30	85.5	0.00	0.10	0.66	0.91
	Caught; 0 to 20,000	51	0.10	53.9	0.00	0.01	0.23	0.45
	Caught; 20,000 to 50,000	235	0.07	59.4	0.00	0.02	0.18	0.30
	Caught; >50,000	233	0.12	76.2	0.00	0.06	0.34	0.46
	Caught; Unknown	56	0.11	85.7	0.00	0.05	0.22	0.23
Habitat								
	Freshwater	575	0.09	68.3	0.00	0.04	0.24	0.40
	Estuarine	575	0.02	71.3	0.00	0.01	0.05	0.08
	Marine	575	0.21	89.9	0.00	0.09	0.45	0.80

Table 10-39. Fish Consumption per kg Body Weight, All Respondents by State, Acquisition Method,g/kg-day, as-consumed) (continued)

State	Category	Sample Size	Arithmetic Mean	Percent Eating Fish	Percentiles			
					10th	50th	90th	95th
North Dakota (continued)								
Fish/Shellfish Type								
	Shellfish	575	0.04	71.3	0.00	0.02	0.09	0.15
	Finfish	575	0.28	94.3	0.02	0.14	0.63	1.01

Notes: FL consumption is based on a 7-day recall; CT, MN, and ND consumptions are based on rate of consumption.
FL consumption excludes away-from-home consumption by children <18.
Statistics are weighted to represent the general population in the states.
A respondent can be represented in more than one row.

Source: Westat (2006).

Table 10-40. Fish Consumption per kg Body Weight, Consumers Only, by State, Acquisition Method (g/kg-day, as-consumed)

State	Category	Sample Size	Arithmetic Mean	Percent Eating Fish	Percentiles			
					10th	50th	90th	95th
Connecticut								
All		362	0.48	100	0.07	0.32	1.09	1.37
Acquisition Method								
	Bought	361	0.47	100	0.07	0.31	1.05	1.38
	Caught	71	0.05	100	0.00	0.02	0.13	0.18
Acquisition Method-Household Income ($) Group								
	Bought; 0 to 20,000	35	0.44	100	0.08	0.30	1.13	1.47
	Bought; 20,000 to 50,000	132	0.53	100	0.07	0.32	1.03	1.46
	Bought; >50,000	182	0.45	100	0.06	0.30	1.04	1.29
	Bought; Unknown	12	0.44	100	0.10	0.41	0.84	1.03
	Caught; 0 to 20,000	4	0.05	100	*	0.01	*	*
	Caught; 20,000 to 50,000	30	0.08	100	0.00	0.02	0.23	0.46
	Caught; >50,000	36	0.03	100	0.00	0.02	0.08	0.11
	Caught; Unknown	1	0.01	100	*	*	*	*
Acquisition Method of Fish/Shellfish Eaten								
	Eats Caught Only	1	0.01	100	*	*	*	*
	Eats Caught and Bought	70	0.49	100	0.10	0.34	1.10	1.33
	Eats Bought Only	291	0.48	100	0.06	0.32	1.06	1.39
Habitat								
	Freshwater	157	0.04	100	0.00	0.02	0.07	0.15
	Estuarine	327	0.14	100	0.01	0.06	0.30	0.51
	Marine	361	0.34	100	0.04	0.23	0.78	1.09
Eats Freshwater/Estuarine Caught Fish								
	Sometimes	50	0.46	100	0.09	0.29	1.10	1.25
	Never	312	0.49	100	0.07	0.32	1.06	1.41
Fish/Shellfish Type								
	Shellfish	320	0.18	100	0.02	0.09	0.37	0.68
	Finfish	353	0.32	100	0.02	0.20	0.77	1.08
Florida								
All		7,757	0.93	100	0.19	0.58	1.89	2.73
Acquisition Method								
	Bought	7,246	0.86	100	0.17	0.54	1.77	2.55
	Caught	1,212	0.83	100	0.15	0.52	1.74	2.36
Acquisition Method-Household Income ($) Group								
	Bought; 0 to 20,000	1,418	0.97	100	0.19	0.58	2.10	2.78
	Bought; 20,000 to 50,000	3,141	0.87	100	0.18	0.56	1.74	2.50
	Bought; >50,000	1,695	0.83	100	0.16	0.53	1.75	2.54
	Bought; Unknown	992	0.71	100	0.16	0.48	1.55	2.06
	Caught; 0 to 20,000	246	0.89	100	0.19	0.60	1.94	2.77
	Caught; 20,000 to 50,000	563	0.90	100	0.15	0.53	1.79	2.38
	Caught; >50,000	274	0.76	100	0.11	0.49	1.63	2.42
	Caught; Unknown	129	0.58	100	0.16	0.41	1.07	1.52

Table 10-40. Fish Consumption per kg Body Weight, Consumers Only, by State, Acquisition Method,(g/kg-day, as-consumed) (continued)

Category / State	Sample Size	Arithmetic Mean	Percent Eating Fish	Percentiles			
				10th	50th	90th	95th
Florida (continued)							
Acquisition Method of Fish/Shellfish Eaten							
Eats Caught Only	511	0.76	100	0.15	0.50	1.67	2.34
Eats Caught and Bought	701	1.81	100	0.50	1.15	3.35	5.09
Eats Bought Only	6,545	0.85	100	0.18	0.54	1.75	2.49
Habitat							
Freshwater	1,426	0.47	100	0.07	0.30	1.09	1.51
Estuarine	4,124	0.37	100	0.07	0.23	0.80	1.14
Marine	6,124	0.81	100	0.15	0.50	1.64	2.40
Eats Freshwater/Estuarine Caught Fish							
Exclusively	235	0.71	100	0.10	0.42	1.60	2.16
Sometimes	458	1.73	100	0.43	1.10	3.44	4.96
Never	7,064	0.88	100	0.18	0.56	1.81	2.60
Fish/Shellfish Type							
Shellfish	3,260	0.35	100	0.07	0.21	0.74	1.02
Finfish	6,428	0.94	100	0.24	0.60	1.85	2.72
Minnesota							
All	793	0.33	100	0.04	0.20	0.65	1.08
Acquisition Method							
Bought	755	0.22	100	0.03	0.12	0.55	0.83
Caught	593	0.18	100	0.02	0.07	0.30	0.57
Acquisition Method-Household Income ($) Group							
Bought; 0 to 20,000	76	0.29	100	0.04	0.13	0.64	1.08
Bought; 20,000 to 50,000	284	0.22	100	0.03	0.13	0.47	0.74
Bought; >50,000	312	0.21	100	0.03	0.11	0.57	0.97
Bought; Unknown	83	0.23	100	0.02	0.2	0.54	0.65
Caught; 0 to 20,000	56	0.19	100	0.02	0.05	0.49	1.09
Caught; 20,000 to 50,000	232	0.23	100	0.02	0.08	0.30	0.46
Caught; >50,000	235	0.16	100	0.02	0.08	0.37	0.65
Caught; Unknown	70	0.07	100	0.02	0.03	0.14	0.16
Acquisition Method of Fish/Shellfish Eaten							
Eats Caught Only	38	0.16	100	0.02	0.08	0.37	0.51
Eats Caught and Bought	555	0.40	100	0.08	0.23	0.70	1.32
Eats Bought Only	200	0.23	100	0.02	0.14	0.56	0.91
Habitat							
Freshwater	593	0.18	100	0.02	0.07	0.30	0.57
Estuarine	559	0.03	100	0.00	0.01	0.07	0.12
Marine	755	0.20	100	0.02	0.10	0.50	0.73
Eats Freshwater/Estuarine Caught Fish							
Exclusively	38	0.16	100	0.02	0.08	0.37	0.51
Sometimes	555	0.40	100	0.08	0.23	0.70	1.32
Never	200	0.23	100	0.02	0.14	0.56	0.91

Table 10-40. Fish Consumption per kg Body Weight, Consumers Only, by State, Acquisition Method,(g/kg-day, as-consumed) (continued)

State / Category	Sample Size	Arithmetic Mean	Percent Eating Fish	Percentiles 10th	50th	90th	95th
Minnesota (continued)							
Fish/Shellfish Type							
Shellfish	559	0.06	100	0.01	0.02	0.14	0.24
Finfish	791	0.28	100	0.03	0.16	0.57	0.86
North Dakota							
All	546	0.34	100	0.05	0.19	0.74	1.21
Acquisition Method							
Bought	516	0.25	100	0.03	0.12	0.61	1.02
Caught	389	0.14	100	0.02	0.07	0.34	0.46
Acquisition Method-Household Income ($) Group							
Bought; 0 to 20,000	45	0.47	100	0.05	0.14	1.54	2.22
Bought; 20,000 to 50,000	213	0.23	100	0.03	0.11	0.52	1.03
Bought; >50,000	210	0.21	100	0.03	0.11	0.48	0.79
Bought; Unknown	48	0.35	100	0.03	0.14	0.70	1.08
Caught; 0 to 20,000	27	0.19	100	0.01	0.08	0.42	0.64
Caught; 20,000 to 50,000	142	0.11	100	0.02	0.05	0.25	0.40
Caught; >50,000	173	0.15	100	0.02	0.08	0.38	0.53
Caught; Unknown	47	0.13	100	0.03	0.06	0.23	0.24
Acquisition Method of Fish/Shellfish Eaten							
Eats Caught Only	30	0.21	100	0.05	0.14	0.33	0.51
Eats Caught and Bought	359	0.39	100	0.07	0.23	0.82	1.25
Eats Bought Only	157	0.25	100	0.03	0.10	0.53	0.97
Habitat							
Freshwater	389	0.14	100	0.02	0.07	0.34	0.46
Estuarine	407	0.03	100	0.00	0.01	0.06	0.10
Marine	516	0.23	100	0.02	0.10	0.54	0.86
Eats Freshwater/Estuarine Caught Fish							
Exclusively	30	0.21	100	0.05	0.14	0.33	0.51
Sometimes	359	0.39	100	0.07	0.23	0.82	1.25
Never	157	0.25	100	0.03	0.10	0.53	0.97
Fish/Shellfish Type							
Shellfish	407	0.05	100	0.01	0.02	0.13	0.21
Finfish	541	0.30	100	0.04	0.16	0.67	1.08

Notes: FL consumption is based on a 7-day recall; CT, MN, and ND consumptions are based on rate of consumption.
FL consumption excludes away-from-home consumption by children <18.
Statistics are weighted to represent the general population in the states.
A respondent can be represented in more than one row.

Source: Westat (2006).

Table 10-41. Fish Consumption per kg Body Weight, All Respondents, by Selected Demographic Characteristics, Uncooked (g/kg-day)

State	Demographic Characteristic	Sample Size	Arithmetic Mean	Percent Eating Fish	Percentiles			
					10th	50th	90th	95th
Connecticut								
All		420	0.56	85.1	0.00	0.35	1.37	1.76
Sex								
	Male	201	0.53	86.2	0.00	0.34	1.48	1.78
	Female	219	0.59	84.0	0.00	0.39	1.29	1.73
Age (years)-Sex Category								
	Child 1 to 5	26	0.43	51.7	0.00	0.07	1.25	1.95
	Child 6 to 10	26	0.71	86.7	0.00	0.48	1.55	1.74
	Child 11 to 15	21	0.37	85.6	0.00	0.25	0.71	1.20
	Female 16 to 29	17	0.88	79.9	0.00	0.43	1.41	5.25
	Female 30 to 49	85	0.64	86.7	0.00	0.39	1.39	1.80
	Female 50+	77	0.59	90.6	0.01	0.45	1.28	1.74
	Male 16 to 29	14	0.23	70.5	0.00	0.21	0.55	0.74
	Male 30 to 49	80	0.64	92.8	0.04	0.43	1.56	1.97
	Male 50+	63	0.47	90.5	0.03	0.36	1.15	1.55
	Unknown	11	0.12	76.1	0.00	0.03	0.52	0.62
Race/Ethnicity								
	White, Non-Hispanic	370	0.56	88.7	0.00	0.38	1.32	1.69
	Black, Non-Hispanic	9	0.07	33.5	0.00	0.00	0.23	*
	Hispanic	20	0.67	70.9	0.00	0.29	2.14	3.43
	Asian	19	0.81	59.2	0.00	0.18	1.74	4.96
	Unknown	2	0.01	43.4	0.00	0.00	*	*
Respondent Education								
	0 to 11 years	13	0.43	100.0	0.07	0.20	1.34	1.74
	High School	87	0.51	85.3	0.00	0.30	1.40	1.55
	Some College	62	0.56	88.7	0.00	0.41	1.09	1.87
	College Grad	258	0.58	83.4	0.00	0.36	1.40	1.78
Household Income ($)								
	0 to 20,000	40	0.52	86.4	0.00	0.34	1.28	1.86
	20,000 to 50,000	150	0.64	87.4	0.00	0.39	1.40	1.93
	>50,000	214	0.52	84.1	0.00	0.34	1.37	1.69
	Unknown	16	0.45	73.4	0.00	0.42	1.02	1.36
Florida								
All		15,367	0.59	50.5	0.00	0.08	1.59	2.39
Sexes								
	Male	7,911	0.55	49.2	0.00	0.00	1.51	2.32
	Female	7,426	0.62	51.9	0.00	0.14	1.66	2.48
	Unknown	30	0.51	48.0	0.00	0.00	1.73	2.90

Table 10-41. Fish Consumption per kg Body Weight, All Respondents, by Selected Demographic Characteristics, Uncooked (g/kg-day) (continued)

State	Demographic Characteristic	Sample Size	Arithmetic Mean	Percent Eating Fish	Percentiles			
					10th	50th	90th	95th
Florida (continued)								
Age (years)-Sex Category								
	Child 1 to 5	1,102	1.10	37.8	0.00	0.00	3.41	4.85
	Child 6 to 10	938	0.54	39.4	0.00	0.00	1.69	2.55
	Child 11 to 15	864	0.46	42.9	0.00	0.00	1.27	1.92
	Female 16 to 29	1,537	0.55	49.1	0.00	0.00	1.42	2.20
	Female 30 to 49	2,264	0.67	56.6	0.00	0.27	1.73	2.56
	Female 50+	2,080	0.52	56.5	0.00	0.27	1.44	2.04
	Male 16 to 29	1,638	0.55	46.1	0.00	0.00	1.41	2.20
	Male 30 to 49	2,540	0.54	53.0	0.00	0.16	1.49	2.21
	Male 50+	2,206	0.49	54.5	0.00	0.20	1.24	1.86
	Unknown	198	0.45	54.7	0.00	0.27	1.07	1.53
Race/Ethnicity								
	White, Non-Hispanic	11,607	0.57	51.6	0.00	0.12	1.56	2.33
	Black, Non-Hispanic	1,603	0.67	48.3	0.00	0.00	1.87	2.77
	Hispanic	1,556	0.57	45.9	0.00	0.00	1.52	2.46
	Asian	223	0.72	49.5	0.00	0.00	1.65	2.34
	American Indian	104	0.78	53.4	0.00	0.20	2.46	4.52
	Unknown	274	0.53	45.9	0.00	0.00	1.45	2.14
Respondent Education								
	0 to 11 years	1,481	0.50	41.5	0.00	0.00	1.45	2.16
	High School	4,992	0.58	48.5	0.00	0.00	1.59	2.45
	Some College	4,791	0.61	52.3	0.00	0.15	1.59	2.47
	College Grad	4,012	0.60	54.2	0.00	0.20	1.64	2.34
	Unknown	91	0.58	41.2	0.00	0.00	2.04	3.05
Household Income ($)								
	0 to 20,000	3,314	0.59	45.9	0.00	0.00	1.55	2.61
	20,000 to 50,000	6,678	0.61	50.4	0.00	0.08	1.61	2.42
	>50,000	3,136	0.65	57.5	0.00	0.27	1.77	2.53
	Unknown	2,239	0.45	47.6	0.00	0.00	1.36	1.99
Minnesota								
All Sexes		837	0.41	94.4	0.03	0.24	0.83	1.43
	Male	419	0.35	95.3	0.03	0.22	0.77	1.41
	Female	418	0.48	93.4	0.02	0.27	0.87	1.46

Table 10-41. Fish Consumption per kg Body Weight, All Respondents, by Selected Demographic Characteristics, Uncooked (g/kg-day) (continued)

State	Demographic Characteristic	Sample Size	Arithmetic Mean	Percent Eating Fish	Percentiles			
					10th	50th	90th	95th
Minnesota (continued)								
Age (years)-Sex Category								
	Child 1 to 5	47	0.76	97.4	0.06	0.60	1.46	2.32
	Child 6 to 10	46	0.44	88.4	0.00	0.28	1.09	1.79
	Child 11 to 15	68	0.29	92.8	0.02	0.25	0.72	0.78
	Female 16 to 29	47	0.89	96.0	0.03	0.20	0.81	5.97
	Female 30 to 49	132	0.32	95.0	0.03	0.29	0.67	0.77
	Female 50+	162	0.46	94.9	0.04	0.28	1.19	1.80
	Male 16 to 29	55	0.13	92.3	0.01	0.09	0.35	0.44
	Male 30 to 49	120	0.32	96.0	0.06	0.22	0.56	0.85
	Male 50+	155	0.32	99.8	0.06	0.25	0.70	0.91
	Unknown	5	0.00	1.6	0.00	0.00	0.00	0.00
Race/Ethnicity								
	White, Non-Hispanic	775	0.36	93.8	0.02	0.23	0.79	1.19
	Black, Non-Hispanic	1	0.00	*	*	*	*	*
	Hispanic	3	0.86	100	*	0.36	*	*
	Asian	7	0.71	100	0.18	0.63	*	*
	American Indian	12	2.77	100	0.12	0.21	*	*
	Unknown	39	0.43	100	0.14	0.31	1.05	1.36
Respondent Education								
	0 to 11 years	46	0.45	86.2	0.00	0.25	1.64	2.08
	High School	234	0.39	92.9	0.02	0.22	0.86	1.48
	Some College	259	0.54	95.3	0.04	0.27	0.86	1.27
	College Grad	255	0.34	95.0	0.03	0.23	0.76	1.40
	Unknown	43	0.32	99.7	0.12	0.30	0.55	0.68
Household Income ($)								
	0 to 20,000	87	0.53	91.0	0.04	0.27	1.60	2.14
	20,000 to 50,000	326	0.45	91.3	0.02	0.23	0.83	1.20
	>50,000	327	0.38	97.9	0.04	0.24	0.82	1.46
	Unknown	97	0.33	92.9	0.04	0.29	0.74	0.91
North Dakota								
All Sexes		575	0.43	95.2	0.05	0.24	0.95	1.58
	Male	276	0.43	96.2	0.05	0.25	0.91	1.60
	Female	299	0.43	94.2	0.04	0.23	0.97	1.55

Table 10-41. Fish Consumption per kg Body Weight, All Respondents, by Selected Demographic Characteristics, Uncooked (g/kg-day) (continued)

State	Demographic Characteristic	Sample Size	Arithmetic Mean	Percent Eating Fish	Percentiles			
					10th	50th	90th	95th
North Dakota (continued)								
Age (years)-Sex Category								
	Child 1 to 5	30	0.89	94.4	0.05	0.30	2.08	5.10
	Child 6 to 10	44	0.68	92.0	0.09	0.39	1.52	1.99
	Child 11 to 15	55	0.53	97.1	0.07	0.28	1.35	1.65
	Female 16 to 29	42	0.24	89.9	0.00	0.15	0.52	0.84
	Female 30 to 49	95	0.38	98.3	0.05	0.24	0.74	1.14
	Female 50+	99	0.50	93.4	0.03	0.21	1.32	1.95
	Male 16 to 29	36	0.29	100.0	0.05	0.17	0.61	0.75
	Male 30 to 49	90	0.29	97.8	0.05	0.23	0.59	0.71
	Male 50+	81	0.38	94.0	0.02	0.23	0.90	1.54
	Unknown	3	0.14	31.5	0.00	0.00	*	*
Race/Ethnicity								
	White, Non-Hispanic	528	0.43	95.1	0.04	0.24	0.96	1.62
	Black, Non-Hispanic	2	0.33	100.0	*	0.33	*	*
	Asian	4	0.26	100.0	*	0.24	*	*
	American Indian	9	0.40	100.0	0.11	0.33	0.92	*
	Unknown	32	0.40	93.5	0.06	0.18	0.95	1.25
Respondent Education								
	0 to 11 years	29	0.30	86.6	0.00	0.15	0.86	1.15
	High School	138	0.56	97.3	0.06	0.26	1.19	2.08
	Some College	183	0.37	95.2	0.04	0.25	0.84	1.32
	College Grad	188	0.41	96.7	0.05	0.25	0.92	1.69
	Unknown	37	0.46	87.2	0.00	0.13	0.98	1.76
Household Income ($)								
	0 to 20,000	51	0.69	93.7	0.03	0.23	2.39	3.40
	20,000 to 50,000	235	0.36	94.2	0.03	0.18	0.93	1.51
	>50,000	233	0.41	97.1	0.06	0.30	0.84	1.36
	Unknown	56	0.55	92.7	0.05	0.24	1.05	1.62

* Percentiles cannot be estimated due to small sample size.

Notes: FL consumption is based on a 7-day recall; CT, MN, and ND consumptions are based on rate of consumption.
FL consumption excludes away-from-home consumption by children <18.
Statistics are weighted to represent the general population in the states.

Source: Westat (2006).

Table 10-42. Fish Consumption per kg Body Weight, Consumers Only, by Selected Demographic Characteristics, Uncooked (g/kg-day)

State	Demographic Characteristic	Sample Size	Arithmetic Mean	Percent Eating Fish	Percentiles 10th	50th	90th	95th
Connecticut								
All		362	0.66	100	0.10	0.43	1.51	1.80
Sex								
	Male	175	0.61	100	0.11	0.41	1.54	1.85
	Female	187	0.70	100	0.09	0.47	1.40	1.77
Age (years)-Sex Category								
	Child 1 to 5	14	0.83	100	0.21	0.74	1.88	2.07
	Child 6 to 10	22	0.81	100	0.21	0.74	1.57	1.76
	Child 11 to 15	18	0.43	100	0.12	0.30	0.72	1.14
	Female 16 to 29	14	1.10	100	0.15	0.47	1.50	4.07
	Female 30 to 49	74	0.73	100	0.08	0.47	1.60	1.97
	Female 50+	70	0.65	100	0.07	0.50	1.39	1.76
	Male 16 to 29	10	0.32	100	0.11	0.30	0.63	0.78
	Male 30 to 49	74	0.69	100	0.15	0.48	1.58	1.98
	Male 50+	57	0.52	100	0.14	0.38	1.25	1.55
	Unknown	9	0.16	100	0.01	0.05	0.54	*
Race/Ethnicity								
	White, Non-Hispanic	331	0.63	100	0.10	0.43	1.41	1.75
	Black, Non-Hispanic	3	0.20	100	*	0.20	*	*
	Hispanic	15	0.95	100	0.16	0.39	2.95	3.52
	Asian	12	1.36	100	0.12	0.69	2.57	6.24
	Unknown	1	0.03	100	*	*	*	*
Respondent Education								
	0 to 11 years	13	0.43	100	0.07	0.20	1.27	1.72
	High School	76	0.60	100	0.06	0.37	1.47	1.56
	Some College	56	0.63	100	0.16	0.46	1.16	1.89
	College Grad	217	0.70	100	0.11	0.45	1.53	1.85
Household Income ($)								
	0 to 20,000	35	0.60	100	0.10	0.43	1.53	1.90
	20,000 to 50,000	133	0.73	100	0.12	0.46	1.55	1.98
	>50,000	182	0.62	100	0.09	0.41	1.49	1.75
	Unknown	12	0.61	100	0.13	0.57	1.14	1.41
Florida								
All		7,757	1.16	100	0.24	0.73	2.39	3.37
Sexes								
	Male	3,880	1.12	100	0.23	0.69	2.33	3.32
	Female	3,861	1.20	100	0.25	0.77	2.42	3.48
	Unknown	16	1.05	100	0.15	0.91	2.90	3.19

Table 10-42. Fish Consumption per kg Body Weight, Consumers Only, by Selected Demographic Characteristics, Uncooked (g/kg-day) (continued)

State	Demographic Characteristic	Sample Size	Arithmetic Mean	Percent Eating Fish	Percentiles			
					10th	50th	90th	95th
Florida (continued)								
Age (years)-Sex Category								
	Child 1 to 5	420	2.92	100	0.63	2.16	5.73	8.37
	Child 6 to 10	375	1.37	100	0.38	1.01	2.72	3.45
	Child 11 to 15	365	1.06	100	0.28	0.79	2.02	2.78
	Female 16 to 29	753	1.12	100	0.23	0.71	2.22	3.10
	Female 30 to 49	1,287	1.18	100	0.24	0.78	2.39	3.31
	Female 50+	1,171	0.91	100	0.24	0.66	1.92	2.53
	Male 16 to 29	754	1.19	100	0.22	0.66	2.26	3.30
	Male 30 to 49	1,334	1.02	100	0.22	0.67	2.18	3.05
	Male 50+	1,192	0.89	100	0.22	0.62	1.75	2.51
	Unknown	106	0.81	100	0.27	0.61	1.50	2.02
Race/Ethnicity								
	White, Non-Hispanic	5,957	1.11	100	0.24	0.71	2.30	3.28
	Black, Non-Hispanic	785	1.39	100	0.30	0.91	2.81	3.92
	Hispanic	721	1.25	100	0.23	0.75	2.53	3.57
	Asian	110	1.46	100	0.35	0.84	2.34	4.08
	American Indian	57	1.45	100	0.28	0.90	4.02	5.73
	Unknown	127	1.16	100	0.24	0.81	2.23	3.10
Respondent Education								
	0 to 11 years	613	1.20	100	0.27	0.74	2.38	3.53
	High School	2,405	1.20	100	0.23	0.73	2.49	3.58
	Some College	2,511	1.16	100	0.24	0.72	2.39	3.39
	College Grad	2,190	1.10	100	0.24	0.73	2.25	3.17
	Unknown	38	1.40	100	0.32	1.06	3.08	3.17
Household Income ($)								
	0 to 20,000	1,534	1.28	100	0.25	0.77	2.77	3.66
	20,000 to 50,000	3,370	1.20	100	0.25	0.75	2.41	3.45
	>50,000	1,806	1.13	100	0.22	0.71	2.39	3.37
	Unknown	1,047	0.93	100	0.23	0.64	2.06	2.52
Minnesota								
All Sexes		793	0.44	100	0.06	0.26	0.86	1.44
	Male	401	0.37	100	0.05	0.23	0.82	1.43
	Female	392	0.51	100	0.06	0.29	0.93	1.62

Table 10-42. Fish Consumption per kg Body Weight, Consumers Only, by Selected Demographic Characteristics, Uncooked (g/kg-day) (continued)

State	Demographic Characteristic	Sample Size	Arithmetic Mean	Percent Eating Fish	Percentiles			
					10th	50th	90th	95th
Minnesota (continued)								
Age (years)-Sex Category								
	Child 1 to 5	46	0.78	100	0.09	0.62	1.47	2.33
	Child 6 to 10	42	0.50	100	0.06	0.33	1.35	1.81
	Child 11 to 15	63	0.32	100	0.04	0.28	0.73	0.78
	Female 16 to 29	44	0.92	100	0.03	0.21	0.88	3.93
	Female 30 to 49	127	0.34	100	0.05	0.30	0.68	0.78
	Female 50+	150	0.48	100	0.07	0.29	1.24	1.82
	Male 16 to 29	52	0.14	100	0.02	0.11	0.36	0.44
	Male 30 to 49	115	0.33	100	0.09	0.23	0.56	0.86
	Male 50+	153	0.33	100	0.06	0.25	0.70	0.91
	Unknown	1	0.24	100	*	*	*	*
Race/Ethnicity								
	White, Non-Hispanic	732	0.38	100	0.05	0.25	0.81	1.31
	Black, Non-Hispanic	*	*	100	*	*	*	*
	Hispanic	3	0.86	100	*	0.36	*	*
	Asian	7	0.71	100	0.18	0.62	*	*
	American Indian	12	2.77	100	0.12	0.21	*	*
	Unknown	39	0.43	100	0.14	0.31	1.05	1.34
Respondent Education								
	0 to 11 years	41	0.53	100	0.10	0.26	1.83	2.08
	High School	219	0.42	100	0.06	0.24	0.90	1.51
	Some College	249	0.57	100	0.05	0.29	0.86	1.31
	College Grad	242	0.36	100	0.05	0.25	0.78	1.41
	Unknown	42	0.32	100	0.12	0.31	0.55	0.67
Household Income ($)								
	0 to 20,000	77	0.59	100	0.12	0.27	1.73	2.17
	20,000 to 50,000	301	0.49	100	0.07	0.24	0.86	1.28
	>50,000	321	0.39	100	0.04	0.25	0.83	1.46
	Unknown	94	0.35	100	0.07	0.30	0.76	0.92
North Dakota								
All Sexes		546	0.45	100	0.07	0.25	0.99	1.62
	Male	265	0.44	100	0.06	0.27	0.99	1.62
	Female	281	0.46	100	0.07	0.24	0.99	1.60

Table 10-42. Fish Consumption per kg Body Weight, Consumers Only, by Selected Demographic Characteristics, Uncooked (g/kg-day) (continued)

State	Demographic Characteristic	Sample Size	Arithmetic Mean	Percent Eating Fish	Percentiles			
					10th	50th	90th	95th
North Dakota (continued)								
Age (years)-Sex Category								
	Child 1 to 5	28	0.94	100	0.07	0.31	2.11	5.09
	Child 6 to 10	41	0.74	100	0.14	0.40	1.56	2.02
	Child 11 to 15	53	0.54	100	0.08	0.29	1.39	1.68
	Female 16 to 29	38	0.27	100	0.05	0.19	0.54	0.89
	Female 30 to 49	93	0.38	100	0.06	0.24	0.75	1.16
	Female 50+	92	0.54	100	0.08	0.23	1.53	2.02
	Male 16 to 29	36	0.29	100	0.05	0.17	0.60	0.75
	Male 30 to 49	88	0.29	100	0.06	0.25	0.60	0.72
	Male 50+	76	0.41	100	0.05	0.25	0.99	1.60
	Unknown	1	0.45	100	*	*	*	*
Race/Ethnicity								
	White, Non-Hispanic	501	0.45	100	0.06	0.25	0.99	1.64
	Black, Non-Hispanic	2	0.33	100	*	0.33	*	*
	Asian	4	0.26	100	*	0.18	*	*
	American Indian	9	0.40	100	0.11	0.33	0.82	*
	Unknown	30	0.42	100	0.07	0.21	0.98	1.27
Respondent Education								
	0 to 11 years	25	0.35	100	0.09	0.16	0.97	1.20
	High School	134	0.57	100	0.07	0.27	1.30	2.16
	Some College	174	0.38	100	0.06	0.26	0.87	1.36
	College Grad	181	0.43	100	0.07	0.25	0.95	1.73
	Unknown	32	0.53	100	0.05	0.17	1.12	1.91
Household Income ($)								
	0 to 20,000	48	0.74	100	0.09	0.25	2.40	3.49
	20,000 to 50,000	221	0.39	100	0.05	0.20	0.97	1.55
	>50,000	225	0.42	100	0.08	0.31	0.85	1.39
	Unknown	52	0.60	100	0.06	0.27	1.10	1.71

* Percentiles cannot be estimated due to small sample size.

Notes: FL consumption is based on a 7-day recall; CT, MN, and ND consumptions are based on rate of consumption.
FL consumption excludes away-from-home consumption by children <18.
Statistics are weighted to represent the general population in the states.

Source: Westat (2006).

Table 10-43. Fish Consumption per kg Body Weight, All Respondents, by State, Acquisition Method, Uncooked (g/kg-day)

State	Characteristic	Sample Size	Arithmetic Mean	Percent Eating Fish	Percentiles			
					10th	50th	90th	95th
Connecticut								
All		420	0.56	85.1	0.00	0.35	1.37	1.76
Acquisition Method								
	Bought	420	0.55	84.8	0.00	0.34	1.30	1.76
	Caught	420	0.01	16.3	0.00	0.00	0.02	0.04
Acquisition Method-Household Income ($) Group								
	Bought; 0 to 20,000	40	0.51	86.4	0.00	0.34	1.28	1.86
	Bought; 20,000 to 50,000	150	0.62	86.6	0.00	0.37	1.22	1.93
	Bought; >50,000	214	0.52	84.1	0.00	0.33	1.34	1.64
	Bought; Unknown	16	0.45	73.4	0.00	0.42	1.02	1.36
	Caught; 0 to 20,000	40	0.01	11.0	0.00	0.00	0.00	0.06
	Caught; 20,000 to 50,000	150	0.02	18.1	0.00	0.00	0.03	0.08
	Caught; >50,000	214	0.01	16.8	0.00	0.00	0.01	0.03
	Caught; Unknown	16	0.00	6.2	0.00	0.00	0.00	0.01
Habitat								
	Freshwater	420	0.02	36.4	0.00	0.00	0.05	0.09
	Estuarine	420	0.15	76.0	0.00	0.06	0.36	0.59
	Marine	420	0.40	84.8	0.00	0.23	0.90	1.29
Fish/Shellfish Type								
	Shellfish	420	0.19	74.6	0.00	0.09	0.43	0.76
	Finfish	420	0.36	82.7	0.00	0.19	0.94	1.28
Florida								
All		15,367	0.59	50.5	0.00	0.08	1.59	2.39
Acquisition Method								
	Bought	15,367	0.51	47.5	0.00	0.00	1.41	2.16
	Caught	15,367	0.08	7.40	0.00	0.00	0.00	0.45
Acquisition Method-Household Income ($) Group								
	Bought; 0 to 20,000	3,314	0.51	42.5	0.00	0.00	1.34	2.32
	Bought; 20,000 to 50,000	6,678	0.52	47.4	0.00	0.00	1.40	2.12
	Bought; >50,000	3,136	0.57	54.2	0.00	0.19	1.58	2.27
	Bought; Unknown	2,239	0.40	45.3	0.00	0.00	1.21	1.82
	Caught; 0 to 20,000	3,314	0.08	6.7	0.00	0.00	0.00	0.42
	Caught; 20,000 to 50,000	6,678	0.09	7.8	0.00	0.00	0.00	0.48
	Caught; >50,000	3,136	0.08	8.4	0.00	0.00	0.00	0.53
	Caught; Unknown	2,239	0.04	5.5	0.00	0.00	0.00	0.21
Habitat								
	Freshwater	15,367	0.05	9.1	0.00	0.00	0.00	0.33
	Estuarine	15,367	0.13	26.5	0.00	0.00	0.43	0.73
	Marine	15,367	0.40	40.3	0.00	0.00	1.11	1.76
Fish/Shellfish Type								
	Shellfish	15,367	0.11	21.1	0.00	0.00	0.32	0.61
	Finfish	15,367	0.48	41.9	0.00	0.00	1.35	2.08

Table 10-43. Fish Consumption per kg Body Weight, All Respondents, by State, Acquisition MethodUncooked (g/kg-day) (continued)

State	Characteristic	Sample Size	Arithmetic Mean	Percent Eating Fish	Percentiles			
					10th	50th	90th	95th
Minnesota								
All		837	0.41	94.4	0.03	0.24	0.83	1.43
Acquisition Method								
	Bought	837	0.27	89.9	0.00	0.14	0.68	1.01
	Caught	837	0.15	60.6	0.00	0.03	0.30	0.49
Acquisition Method-Household Income ($) Group								
	Bought; 0 to 20,000	87	0.35	90.7	0.02	0.15	0.82	1.42
	Bought; 20,000 to 50,000	326	0.25	84.4	0.00	0.13	0.60	0.77
	Bought; >50,000	327	0.27	93.9	0.02	0.14	0.74	1.15
	Bought; Unknown	97	0.28	91.3	0.02	0.23	0.72	0.86
	Caught; 0 to 20,000	87	0.18	70.4	0.00	0.04	0.38	1.33
	Caught; 20,000 to 50,000	326	0.20	66.0	0.00	0.06	0.33	0.48
	Caught; >50,000	327	0.12	55.5	0.00	0.03	0.31	0.53
	Caught; Unknown	97	0.05	56.7	0.00	0.02	0.16	0.19
Habitat								
	Freshwater	837	0.15	60.6	0.00	0.03	0.30	0.49
	Estuarine	837	0.03	67.5	0.00	0.01	0.06	0.12
	Marine	837	0.24	89.9	0.00	0.12	0.61	0.91
Fish/Shellfish Type								
	Shellfish	837	0.06	67.5	0.00	0.02	0.13	0.24
	Finfish	837	0.36	94.0	0.02	0.19	0.76	1.11
North Dakota								
All		575	0.43	95.2	0.05	0.24	0.95	1.58
Acquisition Method								
	Bought	575	0.30	89.9	0.00	0.13	0.69	1.24
	Caught	575	0.13	68.3	0.00	0.05	0.31	0.53
Acquisition Method-Household Income ($) Group								
	Bought; 0 to 20,000	51	0.55	88.0	0.00	0.15	1.79	2.71
	Bought; 20,000 to 50,000	235	0.28	90.6	0.01	0.13	0.65	1.35
	Bought; >50,000	233	0.26	90.7	0.01	0.13	0.64	1.02
	Bought; Unknown	56	0.41	85.5	0.00	0.14	0.88	1.21
	Caught; 0 to 20,000	51	0.14	53.9	0.00	0.01	0.31	0.61
	Caught; 20,000 to 50,000	235	0.09	59.4	0.00	0.03	0.23	0.40
	Caught; >50,000	233	0.15	76.2	0.00	0.08	0.45	0.61
	Caught; Unknown	56	0.15	85.7	0.00	0.07	0.29	0.31
Habitat								
	Freshwater	575	0.13	68.3	0.00	0.05	0.31	0.53
	Estuarine	575	0.03	71.3	0.00	0.01	0.06	0.10
	Marine	575	0.28	89.9	0.00	0.11	0.60	1.07

Table 10-43. Fish Consumption per kg Body Weight, All Respondents, by State, Acquisition MethodUncooked (g/kg-day) (continued)

State	Characteristic	Sample Size	Arithmetic Mean	Percent Eating Fish	Percentiles			
					10th	50th	90th	95th
North Dakota (continued)								
Fish/Shellfish Type								
	Shellfish	575	0.05	71.3	0.00	0.02	0.12	0.20
	Finfish	575	0.38	94.3	0.03	0.19	0.84	1.35

Notes: FL consumption is based on a 7-day recall; CT, MN, and ND consumptions are based on rate of consumption.
FL consumption excludes away-from-home consumption by children <18.
Statistics are weighted to represent the general population in the states.
A respondent can be represented in more than one row.

Source: Westat (2006).

Table 10-44. Fish Consumption per kg Body Weight, Consumers Only, by State, Acquisition Method, Uncooked (g/kg-day)

State	Category	Sample Size	Arithmetic Mean	Percent Eating Fish	Percentiles			
					10th	50th	90th	95th
Connecticut								
All		362	0.66	100	0.10	0.43	1.51	1.80
Acquisition Method								
	Bought	361	0.65	100	0.10	0.43	1.43	1.80
	Caught	71	0.07	100	0.00	0.02	0.17	0.23
Acquisition Method-Household Income ($) Group								
	Bought; 0 to 20,000	35	0.59	100	0.10	0.41	1.53	1.90
	Bought; 20,000 to 50,000	132	0.71	100	0.11	0.45	1.40	1.98
	Bought; >50,000	182	0.62	100	0.08	0.41	1.45	1.75
	Bought; Unknown	12	0.61	100	0.13	0.57	1.14	1.41
	Caught; 0 to 20,000	4	0.07	100	*	0.02	*	*
	Caught; 20,000 to 50,000	30	0.11	100	0.01	0.03	0.30	0.62
	Caught; >50,000	36	0.04	100	0.00	0.02	0.11	3.15
	Caught; Unknown	1	0.01	100	*	*	*	*
Acquisition Method of Fish/Shellfish Eaten								
	Eats Caught Only	1	0.03	100	*	*	*	*
	Eats Caught and Bought	70	0.67	100	0.13	0.46	1.54	1.71
	Eats Bought Only	291	0.66	100	0.09	0.43	1.50	1.82
Habitat								
	Freshwater	157	0.05	100	0.00	0.03	0.10	0.21
	Estuarine	327	0.19	100	0.01	0.09	0.40	0.69
	Marine	361	0.47	100	0.06	0.31	1.03	1.45
Eats Freshwater/Estuarine Caught Fish								
	Sometimes	50	0.64	100	0.12	0.39	1.53	1.68
	Never	312	0.66	100	0.10	0.44	1.50	1.83
Fish/Shellfish Type								
	Shellfish	320	0.26	100	0.03	0.14	0.56	0.91
	Finfish	353	0.43	100	0.03	0.26	1.03	1.45
Florida								
All		7,757	1.16	100	0.24	0.73	2.39	3.37
Acquisition Method								
	Bought	7,246	1.07	100	0.23	0.68	2.22	3.18
	Caught	1,212	1.05	100	0.20	0.64	2.18	3.03
Acquisition Method-Household Income ($) Group								
	Bought; 0 to 20,000	1,418	1.20	100	0.24	0.72	2.54	3.44
	Bought; 20,000 to 50,000	3,141	1.09	100	0.24	0.70	2.18	3.21
	Bought; >50,000	1,695	1.05	100	0.22	0.67	2.18	3.17
	Bought; Unknown	992	0.89	100	0.22	0.60	1.96	2.50
	Caught; 0 to 20,000	246	1.14	100	0.26	0.76	2.40	3.72
	Caught; 20,000 to 50,000	563	1.14	100	0.20	0.67	2.31	3.13
	Caught; >50,000	274	0.95	100	0.16	0.61	2.09	3.06
	Caught; Unknown	129	0.74	100	0.22	0.54	1.36	2.03

Table 10-44. Fish Consumption per kg Body Weight, Consumers Only, by State, Acquisition Method, Uncooked (g/kg-day) (continued)

State	Category	Sample Size	Arithmetic Mean	Percent Eating Fish	Percentiles 10th	50th	90th	95th
Florida (continued)								
Acquisition Method of Fish/Shellfish Eaten								
	Eats Caught Only	511	0.97	100	0.20	0.64	2.14	2.89
	Eats Caught and Bought	701	2.28	100	0.65	1.48	4.38	6.37
	Eats Bought Only	6,545	1.06	100	0.23	0.68	2.20	3.08
Habitat								
	Freshwater	1,426	0.59	100	0.09	0.37	1.36	1.89
	Estuarine	4,124	0.50	100	0.10	0.31	1.05	1.46
	Marine	6,124	0.99	100	0.20	0.62	2.01	2.94
Eats Freshwater/Estuarine Caught Fish								
	Exclusively	235	0.91	100	0.13	0.56	2.14	2.7
	Sometimes	458	2.21	100	0.56	1.40	4.54	6.17
	Never	7,064	1.11	100	0.24	0.71	2.27	3.24
Fish/Shellfish Type								
	Shellfish	3,260	0.50	100	0.10	0.30	1.07	1.42
	Finfish	6,428	1.15	100	0.29	0.73	2.28	3.32
Minnesota								
All		793	0.44	100	0.06	0.26	0.86	1.44
Acquisition Method								
	Bought	755	0.30	100	0.04	0.16	0.73	1.10
	Caught	593	0.24	100	0.02	0.09	0.40	0.76
Acquisition Method-Household Income ($) Group								
	Bought; 0 to 20,000	76	0.39	100	0.05	0.18	0.85	1.44
	Bought; 20,000 to 50,000	284	0.29	100	0.04	0.17	0.63	0.99
	Bought; >50,000	312	0.28	100	0.03	0.15	0.76	1.30
	Bought; Unknown	83	0.30	100	0.03	0.26	0.73	0.87
	Caught; 0 to 20,000	56	0.26	100	0.02	0.07	0.65	1.45
	Caught; 20,000 to 50,000	232	0.31	100	0.03	0.10	0.41	0.61
	Caught; >50,000	235	0.21	100	0.03	0.11	0.5	0.86
	Caught; Unknown	70	0.09	100	0.02	0.04	0.19	0.21
Acquisition Method of Fish/Shellfish Eaten								
	Eats Caught Only	38	0.21	100	0.02	0.11	0.49	0.68
	Eats Caught and Bought	555	0.53	100	0.11	0.31	0.93	1.76
	Eats Bought Only	200	0.31	100	0.03	0.18	0.75	1.21
Habitat								
	Freshwater	593	0.24	100	0.02	0.09	0.4	0.76
	Estuarine	559	0.04	100	0.00	0.02	0.09	0.16
	Marine	755	0.26	100	0.03	0.14	0.67	0.97
Eats Freshwater/Estuarine Caught Fish								
	Exclusively	38	0.21	100	0.02	0.11	0.49	0.68
	Sometimes	555	0.53	100	0.11	0.31	0.93	1.76
	Never	200	0.31	100	0.03	0.18	0.75	1.21

Table 10-44. Fish Consumption per kg Body Weight, Consumers Only, by State, Acquisition Method, Uncooked (g/kg-day) (continued)

State	Category	Sample Size	Arithmetic Mean	Percent Eating Fish	Percentiles 10th	50th	90th	95th
Minnesota (continued)								
Fish/Shellfish Type								
	Shellfish	559	0.08	100	0.01	0.03	0.19	0.32
	Finfish	791	0.38	100	0.04	0.21	0.77	1.15
North Dakota								
All		546	0.45	100	0.07	0.25	0.99	1.62
Acquisition Method								
	Bought	516	0.34	100	0.04	0.15	0.81	1.36
	Caught	389	0.18	100	0.02	0.09	0.46	0.61
Acquisition Method-Household Income ($) Group								
	Bought; 0 to 20,000	45	0.63	100	0.06	0.19	2.06	2.97
	Bought; 20,000 to 50,000	213	0.30	100	0.04	0.15	0.69	1.37
	Bought; >50,000	210	0.28	100	0.04	0.15	0.64	1.05
	Bought; Unknown	48	0.47	100	0.04	0.19	0.93	1.44
	Caught; 0 to 20,000	27	0.25	100	0.02	0.10	0.56	0.86
	Caught; 20,000 to 50,000	142	0.15	100	0.02	0.07	0.33	0.54
	Caught; >50,000	173	0.20	100	0.03	0.11	0.51	0.71
	Caught; Unknown	47	0.17	100	0.04	0.08	0.30	0.32
Acquisition Method of Fish/Shellfish Eaten								
	Eats Caught Only	30	0.28	100	0.07	0.18	0.43	0.68
	Eats Caught and Bought	359	0.52	100	0.10	0.31	1.10	1.66
	Eats Bought Only	157	0.33	100	0.03	0.13	0.71	1.29
Habitat								
	Freshwater	389	0.18	100	0.02	0.09	0.46	0.61
	Estuarine	407	0.04	100	0.01	0.01	0.08	0.14
	Marine	516	0.31	100	0.03	0.13	0.72	1.15
Eats Freshwater/Estuarine Caught Fish								
	Exclusively	30	0.28	100	0.07	0.18	0.43	0.68
	Sometimes	359	0.52	100	0.10	0.31	1.10	1.66
	Never	157	0.33	100	0.03	0.13	0.71	1.29
Fish/Shellfish Type								
	Shellfish	407	0.07	100	0.01	0.03	0.17	0.27
	Finfish	541	0.40	100	0.05	0.21	0.89	1.44

* Percentiles cannot be estimated due to small sample size.

Notes: FL consumption is based on a 7-day recall; CT, MN, and ND consumptions are based on rate of consumption.
FL consumption excludes away-from-home consumption by children <18.
Statistics are weighted to represent the general population in the states.
A respondent can be represented in more than one row.

Source: Westat (2006).

Table 10-45. Fish Consumption per kg Body Weight, All Respondents, by State, Subpopulation, and Sex (g/kg-day, as-consumed)

State	Category	Sample Size	Arithmetic Mean	Percent Eating Fish	Percentiles			
					10th	50th	90th	95th
Connecticut								
Population for Sample Selection								
	Anglers	250	0.64	97.6	0.08	0.40	1.51	2.07
	Aquaculture Students	25	0.22	76.0	0.00	0.07	0.65	0.89
	Asians	396	1.15	99.2	0.30	0.91	2.28	3.15
	Commercial Fishermen	173	0.65	96.0	0.05	0.44	1.51	1.63
	EFNEP Participants	67	1.00	86.6	0.00	0.31	2.46	3.50
	General	420	0.41	85.1	0.00	0.25	1.00	1.32
	WIC Participants	699	0.80	79.1	0.00	0.42	1.93	3.02
Population for Sample Selection and Sex Group								
	Angler; Males	197	0.68	97.5	0.08	0.41	1.68	2.16
	Angler; Females	53	0.49	98.1	0.10	0.30	1.06	1.45
	Aquaculture Students; Males	10	0.21	90.0	0.00	0.09	0.75	0.85
	Aquaculture Students; Females	15	0.24	66.7	0.00	0.03	0.62	0.91
	Asians; Males	188	1.06	99.5	0.27	0.88	1.99	2.44
	Asians; Females	208	1.24	99.0	0.36	0.92	2.85	3.33
	Commercial Fishermen; Males	94	0.67	92.6	0.05	0.46	1.54	1.62
	Commercial Fishermen; Females	79	0.63	100	0.06	0.42	1.40	1.93
	EFNEP Participants; Males	25	1.05	88.0	0.00	0.33	2.83	3.80
	EFNEP Participants; Females	42	0.96	85.7	0.00	0.26	2.02	3.95
	General; Males	201	0.39	86.2	0.00	0.24	1.05	1.34
	General; Females	219	0.43	84.0	0.00	0.28	0.95	1.30
	WIC Participants; Males	312	0.94	79.2	0.00	0.45	2.30	3.52
	WIC Participants; Females	387	0.69	79.1	0.00	0.40	1.64	2.43
Florida								
Population for Sample Selection								
	General	15,367	0.47	50.5	0.00	0.06	1.27	1.91
Population for Sample Selection and Sex Group								
	General; Males	7,911	0.44	49.2	0.00	0.00	1.22	1.84
	General; Females	7,426	0.50	51.9	0.00	0.10	1.32	1.98
	Unknown	30	0.41	48.0	0.00	0.00	1.41	2.38
Minnesota								
Population for Sample Selection								
	American Indians	216	0.21	88.9	0.00	0.13	0.52	0.64
	Anglers	1,152	0.31	96.3	0.04	0.17	0.66	0.97
	General	837	0.31	94.4	0.02	0.18	0.62	1.07
	New Mothers	401	0.33	85.0	0.00	0.15	0.80	1.21

Table 10-45. Fish Consumption per kg Body Weight, All Respondents, by State, Subpopulation, and Sex (g/kg-day, as-consumed) (continued)

State	Category	Sample Size	Arithmetic Mean	Percent Eating Fish	Percentiles			
					10th	50th	90th	95th
Minnesota (continued)								
Population for Sample Selection and Sex Group								
	American Indians; Males	108	0.19	89.8	0.00	0.14	0.46	0.55
	American Indians; Females	108	0.23	88.0	0.00	0.12	0.57	0.93
	Anglers; Males	606	0.30	96.9	0.04	0.18	0.63	0.93
	Anglers; Females	546	0.31	95.6	0.04	0.17	0.70	1.04
	General; Males	419	0.26	95.3	0.02	0.16	0.58	1.06
	General; Females	418	0.36	93.4	0.02	0.21	0.65	1.10
	New Mothers; Males	205	0.27	86.3	0.00	0.15	0.67	0.93
	New Mothers; Females	196	0.39	83.7	0.00	0.14	0.95	1.42
North Dakota								
Population for Sample Selection								
	American Indians	106	0.35	60.4	0.00	0.04	1.10	2.27
	Anglers	854	0.32	94.6	0.04	0.19	0.77	1.14
	General	575	0.32	95.2	0.03	0.18	0.71	1.18
Population for Sample Selection and Sex Group								
	American Indians; Males	50	0.35	58.0	0.00	0.04	0.76	1.39
	American Indians; Females	56	0.36	62.5	0.00	0.05	1.34	2.32
	Anglers; Males	467	0.32	95.3	0.04	0.19	0.77	1.14
	Anglers; Females	387	0.33	93.8	0.03	0.19	0.77	1.18
	General; Males	276	0.32	96.2	0.04	0.19	0.68	1.20
	General; Females	299	0.32	94.2	0.03	0.17	0.73	1.16

Notes: FL consumption is based on a 7-day recall; CT, MN, and ND consumptions are based on rate of consumption.
FL consumption excludes away-from-home consumption by children <18.
Statistics are weighted to represent the general population in the states. Subpopulations statistics are unweighted.
EFNEP = Expanded Food and Nutrition Education Program.
WIC = USDA's Women, Infants, and Children Program.

Source: Westat (2006).

Table 10-46. Fish Consumption per kg, Consumers Only, by State, Subpopulation, and Sex (g/kg-day, as-consumed)

State	Category	Sample Size	Arithmetic Mean	Percent Eating Fish	Percentiles			
					10th	50th	90th	95th
Connecticut								
Population for Sample Selection								
	Angler	244	0.66	100	0.10	0.40	1.55	2.07
	Aquaculture Students	19	0.30	100	0.02	0.14	0.75	0.91
	Asians	393	1.16	100	0.31	0.91	2.28	3.16
	Commercial Fisherman	166	0.68	100	0.09	0.46	1.53	1.65
	EFNEP Participants	58	1.15	100	0.11	0.39	2.69	4.51
	General	362	0.48	100	0.07	0.32	1.09	1.37
	WIC Participants	553	1.01	100	0.12	0.61	2.30	3.39
Population for Sample Selection and Sex Group								
	Angler; Male	192	0.70	100	0.10	0.42	1.69	2.17
	Angler; Female	52	0.50	100	0.11	0.33	1.07	1.45
	Aquaculture Students; Male	9	0.23	100	0.01	0.11	0.74	*
	Aquaculture Students; Female	10	0.36	100	0.03	0.31	0.75	1.00
	Asians; Male	187	1.06	100	0.28	0.88	1.99	2.44
	Asians; Female	206	1.25	100	0.37	0.93	2.86	3.34
	Commercial Fishermen; Male	87	0.72	100	0.12	0.54	1.57	1.63
	Commercial Fishermen; Female	79	0.63	100	0.06	0.42	1.40	1.91
	EFNEP Participants; Male	22	1.20	100	0.14	0.42	2.89	3.75
	EFNEP Participants; Female	36	1.12	100	0.07	0.39	2.38	4.50
	General; Male	175	0.45	100	0.08	0.29	1.11	1.40
	General; Female	187	0.52	100	0.05	0.34	1.03	1.35
	WIC Participants; Male	247	1.18	100	0.12	0.69	2.89	3.78
	WIC Participants; Female	306	0.87	100	0.12	0.59	1.87	2.73
Population for Sample Selection and Eats Freshwater/Estuarine Caught Fish Group								
	Angler; Exclusively	1	0.04	100	*	*	*	*
	Angler; Sometimes	190	0.74	100	0.14	0.44	1.69	2.18
	Angler; Never	53	0.38	100	0.05	0.27	0.89	1.00
	Aquaculture Students; Sometimes	2	0.34	100	*	0.21	*	*
	Aquaculture Students; Never	17	0.29	100	0.02	0.14	0.80	0.93
	Asians; Sometimes	199	1.23	100	0.30	0.93	2.94	3.50
	Asians; Never	194	1.09	100	0.34	0.87	2.03	2.39
	Commercial Fishermen; Sometimes	120	0.78	100	0.18	0.54	1.58	1.98
	Commercial Fishermen; Never	46	0.41	100	0.03	0.30	0.89	1.36
	EFNEP Participants; Sometimes	8	0.25	100	0.14	0.22	0.40	*
	EFNEP Participants; Never	50	1.29	100	0.09	0.52	2.82	6.09
	General; Sometimes	50	0.46	100	0.09	0.29	1.10	1.25
	General; Never	312	0.49	100	0.07	0.32	1.06	1.41
	WIC Participants; Sometimes	67	1.49	100	0.28	0.91	3.43	5.12
	WIC Participants; Never	486	0.95	100	0.10	0.60	2.02	3.12

Table 10-46. Fish Consumption per kg, Consumers Only, by State, Subpopulation, and Sex (g/kg-day, as-consumed) (continued)

State	Category	Sample Size	Arithmetic Mean	Percent Eating Fish	Percentiles			
					10th	50th	90th	95th
Florida								
Population for Sample Selection								
	General	7,757	0.93	100	0.19	0.58	1.89	2.73
Population for Sample Selection and Sex Group								
	General; Male	3,880	0.90	100	0.18	0.55	1.85	2.65
	General; Female	3,861	0.95	100	0.19	0.62	1.94	2.78
	Unknown	16	0.85	100	0.12	0.69	2.37	2.61
Population for Sample Selection and Eats Freshwater/Estuarine Caught Fish Group								
	General; Exclusively	235	0.71	100	0.10	0.42	1.60	2.16
	General; Sometimes	458	1.73	100	0.43	1.10	3.44	4.96
	General; Never	7,064	0.88	100	0.18	0.56	1.81	2.60
Minnesota								
Population for Sample Selection								
	American Indian	192	0.24	100	0.02	0.15	0.53	0.70
	Anglers	1,109	0.32	100	0.05	0.18	0.67	0.99
	General	793	0.33	100	0.04	0.20	0.65	1.08
	New Mothers	341	0.38	100	0.04	0.20	0.89	1.30
Population for Sample Selection and Sex Group								
	American Indians; Male	97	0.21	100	0.03	0.15	0.49	0.55
	American Indians; Female	95	0.26	100	0.02	0.16	0.59	0.95
	Anglers; Male	587	0.31	100	0.05	0.18	0.63	0.93
	Anglers; Female	522	0.33	100	0.05	0.18	0.72	1.05
	General; Male	401	0.28	100	0.04	0.17	0.62	1.07
	General; Female	392	0.38	100	0.05	0.22	0.70	1.22
	New Mothers; Male	177	0.31	100	0.04	0.19	0.75	1.06
	New Mothers; Female	164	0.46	100	0.05	0.21	1.04	1.83
Population for Sample Selection and Eats Freshwater/Estuarine Caught Fish Group								
	American Indians; Exclusively	31	0.18	100	0.01	0.07	0.42	0.55
	American Indians; Sometimes	136	0.28	100	0.05	0.18	0.57	0.92
	American Indians; Never	25	0.05	100	0.01	0.04	0.12	0.15
	Anglers; Exclusively	57	0.35	100	0.02	0.16	0.89	1.93
	Anglers; Sometimes	879	0.34	100	0.07	0.20	0.71	1.05
	Anglers; Never	173	0.20	100	0.03	0.10	0.46	0.66
	General; Exclusively	38	0.16	100	0.02	0.08	0.37	0.51
	General; Sometimes	555	0.40	100	0.08	0.23	0.70	1.32
	General; Never	200	0.23	100	0.02	0.14	0.56	0.91
	New Mothers; Exclusively	17	0.06	100	0.02	0.09	0.20	0.25
	New Mothers; Sometimes	189	0.47	100	0.07	0.27	1.00	1.32
	New Mothers; Never	135	0.30	100	0.03	0.12	0.74	1.35

Table 10-46. Fish Consumption per kg, Consumers Only, by State, Subpopulation, and Sex (g/kg-day, as-consumed) (continued)

State	Category	Sample Size	Arithmetic Mean	Percent Eating Fish	Percentiles			
					10th	50th	90th	95th
North Dakota								
Population for Sample Selection								
	American Indians	64	0.58	100	0.03	0.19	1.75	2.65
	Anglers	808	0.34	100	0.05	0.20	0.81	1.17
	General	546	0.34	100	0.05	0.19	0.74	1.21
Population for Sample Selection and Sex Group								
	American Indians; Male	29	0.60	100	0.03	0.18	1.31	3.67
	American Indians; Female	35	0.57	100	0.02	0.19	2.25	2.55
	Anglers; Male	445	0.33	100	0.05	0.20	0.78	1.14
	Anglers; Female	363	0.35	100	0.05	0.21	0.83	1.29
	General; Male	265	0.33	100	0.04	0.20	0.74	1.22
	General; Female	281	0.34	100	0.05	0.18	0.74	1.20
Population for Sample Selection and Eats Freshwater/Estuarine Caught Fish Group								
	American Indians; Exclusively	4	0.05	100	*	0.05	*	*
	American Indians; Sometimes	30	1.08	100	0.13	0.60	2.65	3.62
	American Indians; Never	30	0.16	100	0.02	0.07	0.36	0.66
	Anglers; Exclusively	47	0.19	100	0.01	0.07	0.61	1.02
	Anglers; Sometimes	660	0.38	100	0.07	0.23	0.84	1.29
	Anglers; Never	101	0.18	100	0.02	0.10	0.41	0.53
	General; Exclusively	30	0.21	100	0.05	0.14	0.33	0.51
	General; Sometimes	359	0.39	100	0.07	0.23	0.82	1.25
	General; Never	157	0.25	100	0.03	0.10	0.53	0.97

* Percentiles cannot be estimated due to small sample size.

Notes: FL consumption is based on a 7-day recall; CT, MN, and ND consumptions are based on rate of consumption.
FL consumption excludes away-from-home consumption by children <18.
Statistics are weighted to represent the general population in the states. Subpopulations statistics are unweighted.

Source: Westat (2006).

Table 10-47. Fish Consumption Among General Population in Four States, Consumers Only (g/kg-day, as-consumed)

	N	Mean	CI	Percentiles						Maximum
				10th	25th	50th	75th	90th	95th	
Connecticut										
1 to <6 years	14	0.61	0.42–0.81	0.16	0.26	0.55	0.83	1.4	1.6	1.6
6 to <11 years	22	0.59	0.040–0.77	0.14	0.23	0.47	0.96	1.2	1.3	1.5
11 to <16 years	18	0.32	0.17–0.46	0.07	0.14	0.19	0.38	0.52	0.84	1.3
16 to <30 years										
Females	14	0.84	0.10–1.58	0.11	0.30	0.35	0.87	1.1	3.1	7.0
Males	10	0.23	0.14–0.32	0.08	0.13	0.21	0.25	0.47	0.56	0.58
30 to <50 years										
Females	74	0.53	0.37–0.70	0.05	0.15	0.34	0.67	1.1	1.5	4.5
Males	74	0.51	0.40–0.61	0.11	0.18	0.35	0.70	1.2	1.5	2.2
>50 years										
Females	70	0.48	0.37–0.59	0.05	0.13	0.37	0.72	1.0	1.4	2.7
Males	57	0.38	0.30–0.46	0.10	0.17	0.26	0.50	0.93	1.1	1.4
Eats Caught Only	1	0.01	-	-	-	-	-	-	-	0.01
Eats Caught and Bought	70	0.49	0.36–0.61	0.10	0.17	0.34	0.75	1.1	1.3	2.2
Eats Bought Only	291	0.48	0.40–0.57	0.06	0.16	0.32	0.61	1.1	1.4	7.0
Anglers	244	0.66	-	0.10	0.20	0.40	0.80	1.6	2.1	3.5
General Population	362	0.48	-	0.07	0.16	0.32	0.63	1.1	1.4	2.4
Florida										
1 to <6 years	420	2.3	2.05–2.63	0.5	1.0	1.7	2.8	4.7	6.8	14.6
6 to <11 years	375	1.1	0.98–1.22	0.28	0.52	0.81	1.4	2.2	3.0	9.4
11 to <16 years	365	0.85	0.73–0.98	0.20	0.36	0.63	0.99	1.6	2.2	11.0
16 to <30 years										
Females	753	0.89	0.74–1.04	0.16	0.31	0.55	0.95	1.8	2.4	25
Males	754	0.96	0.80–1.12	0.16	0.28	0.52	0.99	1.8	2.7	34
30 to <50 years										
Females	1,287	0.94	0.87–1.00	0.18	0.33	0.63	1.0	1.9	2.7	20
Males	1,334	0.81	0.74–0.88	0.17	0.28	0.53	0.95	1.7	2.4	23
>50 years										
Females	1,171	0.73	0.69–0.77	0.19	0.31	0.52	0.94	1.5	2.1	7.4
Males	1,192	0.70	0.66–0.75	0.17	0.27	0.50	0.84	1.4	1.9	14
Eats Caught Only	511	0.76	0.66–0.86	0.15	0.30	0.50	0.90	1.7	2.3	7.4
Eats Caught and Bought	701	1.8	1.6–2.1	0.50	0.76	1.2	2.0	3.4	5.1	34
Eats Bought Only	6,545	0.85	0.81–0.89	0.18	0.30	0.54	0.98	1.8	2.5	24

Table 10-47. Fish Consumption Among General Population Children in Four States, Consumers Only (g/kg-day, as-consumed) (continued)

	N	Mean	CI	Percentiles						Maximum
				10th	25th	50th	75th	90th	95th	
Minnesota										
1 to <6 years	46	0.58	0.32–0.85	0.07	0.15	0.46	0.73	1.1	1.8	8.0
6 to <11 years	42	0.38	0.21–0.54	0.05	0.07	0.25	0.47	1.0	1.4	5.3
11 to <16 years	63	0.24	0.16–0.31	0.03	0.06	0.21	0.32	0.55	0.59	1.4
16 to <30 years										
Females	44	0.69	–0.21–1.59	0.02	0.08	0.16	0.29	0.66	3.0	9.2
Males	52	0.11	0.07–0.15	0.02	0.02	0.08	0.14	0.27	0.33	0.74
30 to <50 years										
Females	127	0.25	0.21–0.30	0.04	0.10	0.23	0.32	0.51	0.58	1.3
Males	115	0.25	0.17–0.32	0.07	0.11	0.17	0.30	0.42	0.64	1.9
>50 years										
Females	150	0.36	0.26–0.46	0.05	0.11	0.22	0.38	0.93	1.4	1.9
Males	153	0.24	0.20–0.29	0.05	0.11	0.19	0.28	0.53	0.68	1.3
Eats Caught Only	38	0.16	0.05–0.26	0.02	0.03	0.08	0.25	0.37	0.51	0.57
Eats Caught and Bought	555	0.40	0.27–0.52	0.08	0.11	0.23	0.49	0.70	1.3	9.2
Eats Bought Only	200	0.23	0.18–0.28	0.02	0.05	0.14	0.26	0.56	0.91	8.0
Anglers	1,109	0.32	-	0.05	0.10	0.18	0.34	0.67	0.99	2.2
General Population	793	0.33	-	0.04	0.10	0.20	0.34	0.65	1.1	1.8
North Dakota										
1 to <6 years	28	0.70	0.24–1.17	0.05	0.12	0.23	0.68	1.6	3.8	6.8
6 to <11 years	41	0.56	0.31–0.81	0.11	0.21	0.30	0.66	1.2	1.5	4.3
11 to <16 years	53	0.41	0.23–0.59	0.06	0.12	0.22	0.54	1.0	1.3	2.3
16 to <30 years										
Females	38	0.20	0.14–0.26	0.04	0.06	0.15	0.26	0.41	0.67	0.80
Males	36	0.22	0.13–0.31	0.04	0.07	0.13	0.23	0.45	0.56	1.9
30 to <50 years										
Females	93	0.29	0.22–0.36	0.05	0.10	0.18	0.36	0.56	0.87	2.6
Males	88	0.22	0.17–0.27	0.05	0.08	0.18	0.26	0.45	0.54	1.3
>50 years										
Females	92	0.40	0.27–0.54	0.06	0.10	0.17	0.52	1.1	1.5	4.2
Males	76	0.31	0.20–0.41	0.04	0.08	0.19	0.33	0.74	1.2	1.8
Eats Caught Only	30	0.21	0.09–0.32	0.05	0.09	0.14	0.22	0.33	0.51	1.8
Eats Caught and Bought	359	0.39	0.29–0.49	0.07	0.13	0.23	0.43	0.82	1.3	4.3
Eats Bought Only	157	0.25	0.13–0.36	0.03	0.05	0.10	0.24	0.53	0.97	6.8
Anglers	808	0.34	-	0.05	0.10	0.20	0.39	0.81	1.2	2.0
General Population	546	0.34	-	0.05	0.09	0.19	0.35	0.74	1.2	2.2

N = Sample size.
CI = Confidence interval.
- Not reported.

Source: Moya et al. (2008).

Table 10-48. Estimated Number of Participants in Marine Recreational Fishing by State and Subregion

Subregion	State	Coastal Participants	Non-Coastal Participants	Out of State[a]	Total Participants[a]
Pacific	Southern California	902	8	159	910
	Northern California	534	99	63	633
	Oregon	265	19	78	284
	TOTAL	1,701	126		
North Atlantic	Connecticut	186	*[b]	47	186
	Maine	93	9	100	102
	Massachusetts	377	69	273	446
	New Hampshire	34	10	32	44
	Rhode Island	97	*	157	97
	TOTAL	787	88		
Mid-Atlantic	Delaware	90	*	159	90
	Maryland	540	32	268	572
	New Jersey	583	9	433	592
	New York	539	13	70	552
	Virginia	294	29	131	323
	TOTAL	1,046	83		
South Atlantic	Florida	1,201	*	741	1,201
	Georgia	89	61	29	150
	North Carolina	398	224	745	622
	South Carolina	131	77	304	208
	TOTAL	1,819	362		
Gulf of Mexico	Alabama	95	9	101	104
	Florida	1,053	*	1,349	1,053
	Louisiana	394	48	63	442
	Mississippi	157	42	51	200
	TOTAL	1,699	99		
	GRAND TOTAL	8,053	760		

[a] Not additive across states. One person can be counted as "OUT OF STATE" for more than one state.
[b] An asterisk (*) denotes no non-coastal counties in state.

Source: NMFS (1993).

Table 10-49. Estimated Weight of Fish Caught (Catch Type A and B1) by Marine Recreational Fishermen, by Wave and Subregion

	Atlantic and Gulf		Pacific	
	Region	Weight (1,000 kg)	Region	Weight (1,000 kg)
Jan/Feb	South Atlantic	1,060	So. California	418
	Gulf	3,683	N. California	101
	TOTAL	4,743	Oregon	165
			TOTAL	684
Mar/Apr	North Atlantic	310	So. California	590
	Mid-Atlantic	1,030	N. California	346
	South Atlantic	1,913	Oregon	144
	Gulf	3,703	TOTAL	1,080
	TOTAL	6,956		
May/Jun	North Atlantic	3,272	So. California	1,195
	Mid-Atlantic	4,815	N. California	563
	South Atlantic	4,234	Oregon	581
	Gulf	5,936	TOTAL	2,339
	TOTAL	18,257		
Jul/Aug	North Atlantic	4,003	So. California	1,566
	Mid-Atlantic	9,693	N. California	1,101
	South Atlantic	4,032	Oregon	39
	Gulf	5,964	TOTAL	2,706
	TOTAL	23,692		
Sep/Oct	North Atlantic	2,980	So. California	859
	Mid-Atlantic	7,798	N. California	1,032
	South Atlantic	3,296	Oregon	724
	Gulf	7,516	TOTAL	2,615
	TOTAL	21,590		
Nov/Dec	North Atlantic	456	So. California	447
	Mid-Atlantic	1,649	N. California	417
	South Atlantic	2,404	Oregon	65
	Gulf	4,278	TOTAL	929
	TOTAL	8,787		
	GRAND TOTAL	84,025	GRAND TOTAL	10,353

Source: NMFS (1993).

Table 10-50. Average Daily Intake (g/day) of Marine Finfish, by Region and Coastal Status

	Intake Among Anglers	
Region[a]	Mean	95th Percentile
North Atlantic	6.2	20.1
Mid-Atlantic	6.3	18.9
South Atlantic	4.7	15.9
All Atlantic	5.6	18.0
Gulf	7.2	26.1
Southern California	2.0	5.5
Northern California	2.0	5.7
Oregon	2.2	8.9
All Pacific	2.0	6.8

[a] North Atlantic—ME, NH, MA, RI, and CT; Mid-Atlantic—NY, NJ, MD, DE, and VA; South Atlantic—NC, SC, GA, and FL (Atlantic Coast); Gulf—AL, MS, LA, and FL (Gulf Coast).

Source: NMFS (1993).

Table 10-51. Estimated Weight of Fish Caught (Catch Type A and B1)[a] by Marine Recreational Fishermen, by Species Group and Subregion

	North Atlantic (1,000 kg)	Mid-Atlantic (1,000 kg)	South Atlantic (1,000 kg)	Gulf (1,000 kg)	All Atlantic and Gulf (1,000 kg)
Cartilaginous Fishes	66	1,673	162	318	2,219
Eels	14	9	*[b]	0[c]	23
Herrings	118	69	1	89	177
Catfishes	0	306	138	535	979
Toadfishes	0	7	0	*	7
Cods and Hakes	2,404	988	4	0	1,396
Searobins	2	68	*	*	70
Sculpins	1	*	0	0	1
Temperate Basses	837	2,166	22	4	2,229
Sea Basses	22	2,166	644	2,477	5,309
Bluefish	4,177	3,962	1,065	158	5,362
Jacks	0	138	760	2,477	3,375
Dolphins	65	809	2,435	1,599	4,908
Snappers	0	*	508	3,219	3,727
Grunts	0	9	239	816	1,064
Porgies	132	417	1,082	2,629	4,160
Drums	3	2,458	2,953	9,866	15,280
Mullets	1	43	382	658	1,084
Barracudas	0	*	356	244	600
Wrasses	783	1,953	46	113	2,895
Mackerels and Tunas	878	3,348	4,738	4,036	13,000
Flounders	512	4,259	532	377	5,680
Triggerfishes/Filefishes	0	48	109	544	701
Puffers	*	16	56	4	76
Other fishes	105	72	709	915	1,801

Species Group	Southern California (1,000 kg)	Northern California (1,000 kg)	Oregon (1,000 kg)	All Pacific
Cartilaginous fish	35	162	1	198
Sturgeons	0[b]	89	13	102
Herrings	10	15	40	65
Anchovies	*[c]	7	0	7
Smelts	0	71	0	71
Cods and Hakes	0	0	0	0
Silversides	58	148	0	206
Striped Bass	0	51	0	51
Sea Basses	1,319	17	0	1,336
Jacks	469	17	1	487
Croakers	141	136	0	277
Sea Chubs	53	1	0	54
Surfperches	74	221	47	342
Pacific Barracuda	866	10	0	876
Wrasses	73	5	0	78
Tunas and Mackerels	1,260	36	1	1,297
Rockfishes	409	1,713	890	3,012
California Scorpionfish	86	0	0	86
Sablefishes	0	0	5	5
Greenlings	22	492	363	877
Sculpins	6	81	44	131
Flatfishes	106	251	5	362
Other fishes	89	36	307	432

[a] For Catch Type A and B1, the fish were not thrown back.
[b] An asterisk (*) denotes data not reported.
[c] Zero (0) = <1,000 kg.

Source: NMFS (1993).

Table 10-52. Percent of Fishing Frequency During the Summer and Fall Seasons in Commencement Bay, Washington

Fishing Frequency	Frequency Percent in the Summer[a]	Frequency Percent in the Fall[b]	Frequency Percent in the Fall[c]
Daily	10.4	8.3	5.8
Weekly	50.3	52.3	51.0
Monthly	20.1	15.9	21.1
Bimonthly	6.7	3.8	4.2
Biyearly	4.4	6.1	6.3
Yearly	8.1	13.6	11.6

[a] Summer—July through September, includes 5 survey days and 4 survey areas (i.e., Areas #1, #2, #3, and #4)

[b] Fall—September through November, includes 4 survey days and 4 survey areas (i.e., Areas #1, #2, #3, and #4)

[c] Fall—September through November, includes 4 survey days described in footnote b plus an additional survey area (5 survey areas) (i.e., Areas #1, #2, #3, #4, and #5)

Source: Pierce et al. (1981).

Table 10-53. Selected Percentile Consumption Estimates (g/day) for the Survey and Total Angler Populations Based on the Re-Analysis of the Puffer et al. (1982) and Pierce et al. (1981) Data

	50th Percentile	90th Percentile
Survey Population		
Puffer et al. (1982)	37	225
Pierce et al. (1981)	19	155
Average	28	190
Total Angler Population		
Puffer et al. (1982)	2.9[a]	35[b]
Pierce et al. (1981)	1.0	13
Average	2.0	24

[a] Estimated based on the average intake for the 0–90th percentile anglers.

[b] Estimated based on the average intake for the 91st–96th percentile anglers.

Source: Price et al. (1994).

Table 10-54. Median Intake Rates Based on Demographic Data of Sport Fishermen and Their Family/Living Group

	Percent of Total Interviewed	Median Intake Rates (g/person-day)
Ethnic Group		
Caucasian	42	46.0
Black	24	24.2
Mexican American	16	33.0
Asian/Samoan	13	70.6
Other	5	-[a]
Age (years)		
<17	11	27.2
18 to 40	52	32.5
41 to 65	28	39.0
>65	9	113.0

[a] Not reported.

Source: Puffer et al. (1982).

Table 10-55. Cumulative Distribution of Total Fish/Shellfish Consumption by Surveyed Sport Fishermen in the Metropolitan Los Angeles Area

Percentile	Intake Rate (g/person-day)
5	2.3
10	4.0
20	8.3
30	15.5
40	23.9
50	36.9
60	53.2
70	79.8
80	120.8
90	224.8
95	338.8

Source: Puffer et al. (1982).

Table 10-56. Catch Information for Primary Fish Species Kept by Sport Fishermen (*N* = 1,059)

Species	Average Weight (Grams)	Percent of Fishermen who Caught
White Croaker	153	34
Pacific Mackerel	334	25
Pacific Bonito	717	18
Queenfish	143	17
Jacksmelt	223	13
Walleye Perch	115	10
Shiner Perch	54	7
Opaleye	307	6
Black Perch	196	5
Kelp Bass	440	5
California Halibut	1,752	4
Shellfish[a]	421	3

[a] Crab, mussels, lobster, abalone.

Source: Modified from Puffer et al. (1982).

Table 10-57. Fishing and Crabbing Behavior of Fishermen at Humacao, Puerto Rico

	Mean ± Standard Error
Crabbing	
Number of interviews	20
Number of people in group	3.5 ± 0.4
Number of adults (>21 years)	2.3 ± 0.3
Visits to site/month	3.8 ± 0.7
No. crabs caught per season	21.4 ± 4.7
Crabs/hour	21.6 ± 4.9
Crabs eaten/week	13.3 ± 2.3
Range in no. eaten/week	0–25
Fishing	
Number of interviews	25
Number of people in group	2.9 ± 0.3
Number of adults (>21 years)	2.3 ± 0.2
Visits to site/month	2.8 ± 0.4
No. fish caught per season	16.9 ± 3.5
Fish/hour	11.3 ± 2.5
Fish eaten/week	6.8 ± 0.7
Range in no. eaten/week	3–30

Source: Burger and Gochfeld (1991).

Table 10-58. Fish Consumption of Delaware Recreational Fishermen and Their Households

	N	Mean Consumption (g/day)	SE (%)
All respondents	867	17.5	5.3
Sex			
Males	496	18.6	6.6
Females	369	15.9	8.7
Age (years)			
0 to 9	73	6.0	13.4
10 to 19	102	11.4	16.8
20 to 29	95	11.7	10.9
30 to 39	148	18.1	13.9
40 to 49	144	12.6	8.5
50 to 59	149	28.6	11.1
60 to 69	124	23.0	12.4
70 to 79	28	21.8	33.4
80 to 89	4	53.9	68.3
Race			
African American	81	14.9	27.1
Asian	12	5.6	31.2
Hispanic	12	3.0	35.2
Caucasian	748	18.2	5.3

N = Sample size.
SE = Standard error.

Source: KCA Research Division (1994).

Table 10-59. Seafood Consumption Rates of All Fish by Ethnic and Income Groups of Santa Monica Bay

Category	*N*	Consumption (g/day) Mean	95% CI	50th	90th
All respondents	555	49.6	9.3	21.4	107.1
Ethnicity					
White	217	58.1	19.1	21.4	112.5
Hispanic	137	28.2	5.9	16.1	64.3
Black	57	48.6	18.9	24.1	85.7
Asian	122	51.1	18.7	21.4	115.7
Other	14	137.3	92.2	85.7	173.6
Income					
<$5,000	20	42.1	18.0	32.1	64.3
$5,000 to $10,000	27	40.5	29.1	21.4	48.2
$10,000 to $25,000	90	40.4	9.3	21.4	80.4
$25,000 to $50,000	149	46.9	10.5	21.4	113.0
>$50,000	130	58.9	20.6	21.4	128.6

N = Sample size.
CI = Confidence interval.

Source: Santa Monica Bay Restoration Project (1995).

Table 10-60. Means and Standard Deviations of Selected Characteristics by Population Groups in Everglades, Florida

Variables (N[a] = 330)	Mean ± SD[b]	Range
Age (years)	38.6 ± 18.8	2 to 81
Sex		
Female	38%	-
Male	62%	-
Race/ethnicity		
Black	46%	-
White	43%	-
Hispanic	11%	-
Number of Years Fished	15.8 ± 15.8	0–70
Number Per Week Fished in Past 6 Months of Survey Period	1.8 ± 2.5	0–20
Number Per Week Fished in Last Month of Survey Period	1.5 ± 1.4	0–12
Aware of Health Advisories	71%	-

[a] *N* = Number of respondents who reported consuming fish.
[b] SD = Standard deviation.
- Not reported.

Source: Florida State Department of Health and Rehabilitative Services (1995).

Table 10-61. Grams per Day of Self-Caught Fish Consumed by Recreational Anglers—Alcoa/Lavaca Bay

Cohort	Mean	95% Upper Confidence Limit on Mean	90th or 95th Percentile of Distribution[a]
Finfish			
Adult men	24.8	27.7	68.1
Adult women	17.9	19.7	47.8
Women of childbearing age	18.8	22.1	45.4
Small children	11.4	14.2	30.3
Youths	15.6	17.8	45.4
Shellfish			
Adult men	1.2	1.6	5.1
Adult women	0.8	1.1	2.4
Women of childbearing age	0.9	1.2	4.0
Small children	0.4	0.6	2.0
Youths	0.7	1.0	4.5

[a] For shellfish, the 95th percentile value is provided because less than 90% of the individuals consumed shellfish, resulting in a 90th percentile of zero.

Source: Alcoa (1998).

Table 10-62. Number of Meals and Portion Sizes of Self-Caught Fish Consumed by Recreational Anglers Lavaca Bay, Texas

Age Group	Number of Meals		Portion Size (ounces)[a]	
	Mean	95% Upper Confidence Limit on Mean	Mean	95% Upper Confidence Limit on Mean
Finfish				
Adult Men	3.2	3.5	8.0	8.2
Adult Women	2.6	3.0	6.8	7.1
Women of Childbearing Age	2.8	3.2	6.8	7.3
Small children (<6 years)	2.6	3.1	4.5	4.7
Youths (6 to 19 years)	2.4	2.7	6.6	6.9
Shellfish				
Adult Men	0.3	0.4	3.7	4.3
Adult Women	0.3	0.4	2.9	3.4
Women of Childbearing Age	0.3	0.5	3.3	4.3
Small children (<6 years)	0.3	0.5	2.0	2.4
Youths (6 to 19 years)	0.3	0.4	2.5	2.9

[a] Converted from ounces; 1 ounce = 28.35 grams.

Source: Alcoa (1998).

Table 10-63. Consumption Patterns of People Fishing and Crabbing in Barnegat Bay, New Jersey

	Males	Females
N	434	81
% Eat fish	84.1	78.05
% Give away fish	55.0	41.2
% Eat crabs	87.9	94.7
% Give away crabs	48.2	53.1
Number of times fish eaten/month	5.21 ± 0.33	5.21 ± 0.33
% Eaten that are self-caught	48.7 ± 2.15	48.7 ± 2.15
Number of times crabs eaten/month	2.14 ± 0.32	2.14 ± 0.32
Average serving size (ounces)	10.12 ± 0.32	10.12 ± 0.32
Average consumption (males and females) (g/day)	48.3	

N = Sample size.

Source: Burger et al. (1998).

Table 10-64. Fish Intake Rates of Members of the Laotian Community of West Contra Costa County, California

Group	Sample Size	Consumption (g/day)					
		Mean	Percentile			Max	Min
			50th	90th	95th		
All respondents	229	18.3	9.1	42.5	85.1	182.3	--
Fish consumers[a]	199	21.4	9.1	42.5	85.1	--	1.5

[a] "Fish consumers" were those who reported consumption of fish at least once a month.
Max = Maximum.
Min = Minimum.

Source: Chiang (1998).

Table 10-65. Consumption Rates (g/day) Among Recent Consumers[a] by Demographic Factor

				Percentiles			
	N	Mean	SD	10th	50th	90th	95th
Overall	465	23.0	32.1	4.0	16.0	48.0	80.0
Sex							
Male	410	22.7	32.3	4.0	16.0	48.0	72.0
Female	35	22.3	26.8	6.0	16.0	53.2	84.0
Age (years)							
18 to 45	256	24.2	32.2	5.3	12.0	48.0	84.0
46 to 65	148	21.0	32.9	4.0	16.0	32.0	64.0
65 and older	43	21.8	24.4	4.0	16.0	64.0	72.0
Ethnicity							
African American	41	26.7	38.3	8.0	16.0	48.0	6.04
Asian-Chinese	26	27.8	34.8	4.0	12.0	80.0	128.0
Asian-Filipino	70	32.7	48.8	5.3	16.0	72.0	176.0
Asian-Other	31	22.0	27.6	4.0	8.0	72.0	72.0
Asian-Pacific Islander	12	38.0	44.2	4.0	24.0	96.0	184.0
Asian-Vietnamese	51	21.8	20.7	4.0	16.0	48.0	72.0
Hispanic	52	22.0	29.5	4.0	16.0	48.0	84.0
Caucasian	158	18.9	27.0	4.0	10.7	36.0	56.0
Education							
<12th Grade	73	24.2	28.7	4.0	16.0	48.0	64.0
HS/GED	142	21.5	28.0	4.0	12.0	48.0	72.0
Some college	126	22.7	29.0	5.3	16.0	45.0	84.0
>4 years college	94	25.0	42.1	4.0	12.0	53.2	96.0
Annual income							
<$20,000	101	21.9	27.8	4.0	8.0	48.0	72.0
$20,000 to $45,000	119	21.7	32.9	4.0	8.0	40.0	56.0
>$45,000	180	25.3	35.3	5.3	8.0	56.0	108.0
Season							
Winter	70	19.4	28.2	4.0	8.0	48.0	80.0
Spring	76	22.1	37.6	4.0	8.0	40.0	144.0
Summer	189	23.9	30.6	7.9	16.0	48.0	72.0
Fall	130	24.4	32.1	5.4	16.0	64.0	96.0

[a] Recent consumers are defined in the study as anglers who report consuming fish caught from San Francisco Bay in the 4 weeks prior to the date they were interviewed. Recent consumers are a subset of the overall consumer group.

N = Sample size.

SD = Standard deviation.

HS/GED= High school/general education development.

Source: SFEI (2000).

Table 10-66. Mean ± SD Consumption Rates for Individuals Who Fish or Crab in the Newark Bay Area

	People that crab	People that fish	People that both crab and fish	
			Crab values	Fish values
Sample size	110	111	33	33
Number of times per month consuming	3.39 ± 0.42	4.06 ± 0.76	2.96 ± 0.45	3.56 ± 0.66
Serving size				
Number of crabs	6.15 ± 0.85	-	7.27 ± 0.91	-
Fish or crabs (grams) (crabs assumed to weigh 70 grams each)	439 ± 61.2	331 ± 42.1	509 ± 63.8	428 ± 57.6
Monthly consumption (g/month)	1,980 ± 561	1,410 ± 266	1,620 ± 330	1,630 ± 358
Number of months per year fishing and/or crabbing	3.31 ± 0.13	4.92 ± 0.33	3.5 ± 0.37	7.24 ± 0.74
Yearly consumption (g/year)	5,760 ± 1,360	8,120 ± 2,040	6,230 ± 1,790	13,600 ± 3,480
Average daily consumption (g/day)[a]	15.8 ± 3.7	22.2 ± 5.6	17.1 ± 4.9	37.3 ± 9.5

[a] Estimated by U.S. EPA by dividing yearly consumption rate by 365 days/year.
SD = Standard deviation.
Note: Sample size is slightly different from that reported in the text of Burger (2002a).

Source: Burger (2002a).

Table 10-67. Consumption Rates (g/day) for Marine Recreational Anglers in King County, WA

Location	Sample Size	Mean	SD	SE	Percentiles		
					50th	90th	95th
Marine Fish Consumption							
Duwamish River[a]	50	8	13	2	2	23	42
Elliott Bay	377	63	91	5	31	145	221
North King County	67	32	40	5	17	85	102
All Locations	494	53	83	4	21	121	181
Shellfish Consumption							
Duwamish River[a]	16	20	33	8	4	77	123
Elliott Bay	49	28	33	5	14	74	119
North King County	31	22	33	6	12	62	132
All Locations	96	25	33	3	11	60	119

[a] The Duwamish River is tidally influenced by Elliott Bay, and anglers caught marine species; therefore, data for these locations were considered to represent marine locations.
SD = Standard deviation.
SE = Standard error.

Source: Mayfield et al. (2007).

Table 10-68. Percentile and Mean Intake Rates for Wisconsin Sport Anglers (all respondents)

Percentile	Annual Number of Sport-Caught Meals	Intake Rate of Sport-Caught Meals (g/day)
25th	4	2.6
50th	10	6.2
75th	25	15.5
90th	50	31.3
95th	60	37.2
98th	100	62.1
100th	365	227
Mean	18	11.2

Source: Raw data on sport-caught meals from Fiore et al. (1989). U.S. EPA calculated distributions of intake rates using a value of 227 grams per fish meal.

Table 10-69. Mean Fish Intake Among Individuals Who Eat Fish and Reside in Households With Recreational Fish Consumption

Group	All Fish meals/week	Recreational Fish meals/week	*N*	Total Fish g/day	Recreational Fish g/day	Total Fish g/kg-day	Recreational Fish g/kg-day
All household members	0.686	0.332	2,196	21.9	11.0	0.356	0.178
Respondents (i.e., licensed anglers)	0.873	0.398	748	29.4	14.0	0.364	0.168
Age groups (years)							
1 to 5	0.463	0.223	121	11.4	5.63	0.737	0.369
6 to 10	0.49	0.278	151	13.6	7.94	0.481	0.276
11 to 20	0.407	0.229	349	12.3	7.27	0.219	0.123
21 to 40	0.651	0.291	793	22	10.2	0.306	0.139
41 to 60	0.923	0.42	547	29.3	14.2	0.387	0.186
61 to 70	0.856	0.431	160	28.2	14.5	0.377	0.193
71 to 80	1.0	0.622	45	32.3	20.1	0.441	0.271
80+	0.8	0.6	10	26.5	20	0.437	0.345

N = Sample size.

Source: U.S. EPA analysis using data from West et al. (1989).

Table 10-70. Comparison of 7-Day Recall and Estimated Seasonal Frequency for Fish Consumption

Usual Fish Consumption Frequency Category	Mean Fish Meals/Week 7-day Recall Data	Usual Frequency Value Selected for Data Analysis (times/week)
Almost daily	no data	4 (if needed)
2 to 4 times a week	1.96	2
Once a week	1.19	1.2
2 to 3 times a month	0.840 (3.6 times/month)	0.7 (3 times/month)
Once a month	0.459 (1.9 times/month)	0.4 (1.7 times/month)
Less often	0.306 (1.3 times/month)	0.2 (0.9 times/month)

Source: U.S. EPA analysis using data from West et al. (1989).

Table 10-71. Distribution of Usual Fish Intake Among Survey Main Respondents Who Fished and Consumed Recreationally Caught Fish

	All Fish Meals/Week	Recreational Fish Meals/Week	All Fish Intake g/day	Recreational Fish Intake g/day	All Fish Intake g/kg-day	Recreational Fish Intake g/kg-day
N	738	738	738	738	726	726
Mean	0.859	0.447	27.74	14.42	0.353	0.1806
10%	0.300	0.040	9.69	1.29	0.119	0.0159
25%	0.475	0.125	15.34	4.04	0.187	0.0504
50%	0.750	0.338	24.21	10.90	0.315	0.1357
75%	1.200	0.672	38.74	21.71	0.478	0.2676
90%	1.400	1.050	45.20	33.90	0.634	0.4146
95%	1.800	1.200	58.11	38.74	0.747	0.4920

N = Sample size.

Source: U.S. EPA analysis using data from West et al. (1989).

Table 10-72. Estimates of Fish Intake Rates of Licensed Sport Anglers in Maine During the 1989–1990 Ice Fishing or 1990 Open-Water Seasons[a]

	Intake Rates (g/day)			
	All Waters[b]		Rivers and Streams	
Percentile Rankings	All Anglers[c] (*N* = 1,369)	Consuming Anglers[d] (*N* = 1,053)	River Anglers[e] (*N* = 741)	Consuming Anglers[d] (*N* = 464)
50th (median)	1.1	2.0	0.19	0.99
66th	2.6	4.0	0.71	1.8
75th	4.2	5.8	1.3	2.5
90th	11.0	13.0	3.7	6.1
95th	21.0	26.0	6.2	12.0
Arithmetic Mean[f]	5.0 [79]	6.4 [77]	1.9 [82]	3.7 [81]

[a] Estimates are based on rank except for those of arithmetic mean.

[b] All waters based on fish obtained from all lakes, ponds, streams, and rivers in Maine, from other household sources, and from other non-household sources.

[c] Licensed anglers who fished during the seasons studied and did or did not consume freshwater fish, and licensed anglers who did not fish but ate freshwater fish caught in Maine during those seasons.

[d] Licensed anglers who consumed freshwater fish caught in Maine during the seasons studied.

[e] Those of the "all anglers" who fished on rivers or streams (consumers and non-consumers).

[f] Values in brackets [ ] are percentiles at the mean consumption rates.

Source: ChemRisk (1992); Ebert et al. (1993).

Table 10-73. Analysis of Fish Consumption by Ethnic Groups for "All Waters" (g/day)[a]

	Consuming Anglers[b]					
	French Canadian Heritage	Irish Heritage	Italian Heritage	Native American Heritage	Other White Non-Hispanic Heritage	Scandinavian Heritage
N of Cases	201	138	27	96	533	37
Median (50th percentile)[c,d]	2.3	2.4	1.8	2.3	1.9	1.3
66th percentile[c,d]	4.1	4.4	2.6	4.7	3.8	2.6
75th percentile[c,d]	6.2	6.0	5.0	6.2	5.7	4.9
Arithmetic mean[c]	7.4	5.2	4.5	10	6.0	5.3
Percentile at the mean[d]	80	70	74	83	76	78
90th percentile[c,d]	15	12	12	16	13	9.4
95th percentile[c,d]	27	20	21	51	24	25
Percentile at 6.5 g/day[d,e]	77	75	81	77	77	84

[a] "All Waters" based on fish obtained from all lakes, ponds, streams, and rivers in Maine, from other household sources, and from other non-household sources.

[b] "Consuming Anglers" refers to only those anglers who consumed freshwater fish obtained from Maine sources during the 1989–1990 ice fishing or 1990 open water fishing seasons.

[c] The average consumption per day by freshwater fish consumers in the household.

[d] Calculated by rank without any assumption of statistical distribution.

[e] Fish consumption rate recommended by U.S. EPA (1984) for use in establishing ambient water quality standards.

Source: ChemRisk (1992).

Table 10-74. Total Consumption of Freshwater Fish Caught by All Survey Respondents During the 1990 Season

	Ice Fishing		Lakes and Ponds		Rivers and Streams	
Species	Quantity Consumed (#)	Grams ($\times 10^3$) Consumed	Quantity Consumed (#)	Grams ($\times 10^3$) Consumed	Quantity Consumed (#)	Grams ($\times 10^3$) Consumed
Landlocked salmon	832	290	928	340	305	120
Atlantic salmon	3	1.1	33	9.9	17	11
Togue (lake trout)	483	200	459	160	33	2.7
Brook trout	1,309	100	3,294	210	10,185	420
Brown trout	275	54	375	56	338	23
Yellow perch	235	9.1	1,649	52	188	7.4
White perch	2,544	160	6,540	380	3,013	180
Bass (smallmouth and largemouth)	474	120	73	5.9	787	130
Pickerel	1,091	180	553	91	303	45
Lake whitefish	111	20	558	13	55	2.7
Hornpout (catfish and bullheads)	47	8.2	1,291	100	180	7.8
Bottom fish (suckers, carp, and sturgeon)	50	81	62	22	100	6.7
Chub	0	0	252	35	219	130
Smelt	7,808	150	428	4.9	4,269	37
Other	201	210	90	110	54	45
TOTALS	15,463	1,583.4	16,587	1,590	20,046	1,168

Source: ChemRisk (1992).

Table 10-75. Socio-Demographic Characteristics of Respondents

Category	Subcategory	Percent of Total[a]
Geographic Distribution	Upper Hudson	18%
	Mid Hudson	35%
	Lower Hudson	48%
Age Distribution (years)	<14	3%
	15 to 29	26%
	30 to 44	35%
	45 to 59	23%
	>60	12%
Annual Household Income	<$10,000	16%
	$10,000 to 29,999	41%
	$30,000 to 49,999	29%
	$50,000 to 69,999	10%
	$70,000 to 89,999	2%
	>$90,000	3%
Ethnic Background	Caucasian American	67%
	African American	21%
	Hispanic American	10%
	Asian American	1%
	Native American	1%

[a] A total of 336 shore-based anglers were interviewed.

Source: Hudson River Sloop Clearwater, Inc. (1993).

Table 10-76. Mean Sport-Fish Consumption by Demographic Variables, Michigan Sport Anglers Fish Consumption Study, 1991–1992

	N	Mean (g/day)	95% CI
Income[a]			
<$15,000	290	21.0	16.3–25.8
$15,000 to $24,999	369	20.6	15.5–25.7
$25,000 to $39,999	662	17.5	15.0–20.1
>$40,000	871	14.7	12.8–16.7
Education			
Some High School	299	16.5	12.9–20.1
High School Degree	1,074	17.0	14.9–19.1
Some College-College Degree	825	17.6	14.9–20.2
Post-Graduate	231	14.5	10.5–18.6
Residence Size[b]			
Large City/Suburb (>100,000)	487	14.6	11.8–17.3
Small City (20,000 to 100,000)	464	12.9	10.7–15.0
Town (2,000 to 20,000)	475	19.4	15.5–23.3
Small Town (100 to 2,000)	272	22.8	16.8–28.8
Rural, Non-Farm	598	17.7	15.1–20.3
Farm	140	15.1	10.3–20.0
Age (years)			
16 to 29	266	18.9	13.9–23.9
30 to 39	583	16.6	13.5–19.7
40 to 49	556	16.5	13.4–19.6
50 to 59	419	16.5	13.6–19.4
60+	596	16.2	13.8–18.6
Sex[a]			
Male	299	17.5	15.8–19.1
Female	1,074	13.7	11.2–16.3
Race/Ethnicity[b]			
Minority	160	23.2	13.4–33.1
White	2,289	16.3	14.9–17.6

[a] $p < 0.01$, F test.
[b] $p < 0.05$, F test.
N = Sample size.
CI = Confidence interval.

Source: West et al. (1993).

Table 10-77. Mean Per Capita Freshwater Fish Intake of Alabama Anglers

	Mean Consumption (g/day)					
	Harvest Method[a]			4-Ounce Serving Method[b]		
	N	Site meals	All meals	*N*	Site Meals	All Meals
All respondents	563	32.6	43.1	1,303	30.3	45.8
All respondents; all meals; 4-ounce serving method	-	-	-	-	-	44.8
Age (years)						16
20 to 30	-	-	-	-	-	39
31 to 50	-	-	-	-	-	76
51 and over	-	-	-	-	-	
Race/Ethnicity						
African American	113	35.4	49.6	232	33.4	50.7
Native American	0	0	0	2	22.7	22.7
Asian	2	74.7	74.7	3	44.1	44.1
Hispanic	2	0	0	2	0	0
Caucasian	413	33.9	48.6	925	29.4	49.7
Seasons						
Fall	130	29.7	43.4	303	32.0	49.4
Winter	56	26.2	34.2	177	30.8	43.9
Spring	185	21.5	29.3	414	20.5	33.6[c]
Summer	192	46.7	57.0	417	36.4	53.0[c]

[a] The Harvest Method used the actual harvest of fish and dressing method reported to calculate consumption rates.
[b] The 4-ounce Serving Method estimated consumption based on a typical 4-ounce serving size.
[c] Statistical difference at $p < 0.05$.
N = Number of respondents.

Source: Alabama Department of Environmental Management (ADEM) (1994).

Table 10-78. Distribution of Fish Intake Rates (from all sources and from sport-caught sources) for 1992 Lake Ontario Anglers

Percentile of Lake Ontario Anglers	Fish From All Sources (g/day)	Sport-Caught Fish (g/day)
25%	8.8	0.6
50%	14.1	2.2
75%	23.2	6.6
90%	34.2	13.2
95%	42.3	17.9
99%	56.6	39.8

Source. Connelly et al. (1996).

Table 10-79. Mean Annual Fish Consumption (g/day) for Lake Ontario Anglers, 1992, by Socio-Demographic Characteristics

	Mean Consumption	
Demographic Group	Fish From All Sources	Sport-Caught Fish
Overall	17.9	4.9
Residence		
Rural	17.6	5.1
Small City	20.8	6.3
City (25 to 100,000)	19.8	5.8
City (>100,000)	13.1	2.2
Income		
<$20,000	20.5	4.9
$21,000 to 34,000	17.5	4.7
$35,000 to 50,000	16.5	4.8
>$50,000	20.7	6.1
Age (years)		
<30	13.0	4.1
30 to 39	16.6	4.3
40 to 49	18.6	5.1
50+	21.9	6.4
Education		
<High School	17.3	7.1
High School Graduate	17.8	4.7
Some College	18.8	5.5
College Graduate	17.4	4.2
Some Post-Grad.	20.5	5.9

Note Scheffe's test showed statistically significant differences between residence types (for all sources and sport caught) and age groups (all sources).
Source: Connelly et al. (1996).

Table 10-80. Seafood Consumption Rates of Nine Connecticut Population Groups (cooked, edible meat, g/day)

	N	Mean	SD	Minimum	Maximum
General population	437	27.7	42.7	0	494.8
Sport-fishing households	502	51.1	66.1	0	586.0
Commercial fishing households	178	47.4	58.5	0	504.3
Minority	861	50.3	57.5	0	430.0
South East Asians	329	59.2	49.3	0.13	245.6
Non-Asians	532	44.8	61.5	0	430.0
Limited income households	937	43.1	60.4	0	571.9
Women aged 15 to 45 years	497	46.5	57.4	0	494.8
Children ≤15 years old	559	18.3	29.8	0	324.8

N = Sample size.
SD = Standard deviation.
Source: Balcom et al. (1999).

Table 10-81. Fishing Patterns and Consumption Rates of People Fishing Along the Savannah River (Mean ± SE)

	N	Age (years)	Years Fished	Years Fished Savannah River	Distance Traveled (km)	How Often Eat Fish/Month	Serving Size (grams)	Fish/Month (kg)	Fish/Year (kg)
Ethnicity									
White	180	42 ± 1	31 ± 1	24 ± 1	42 ± 9	2.88 ± 0.30	370 ± 6.60	1.17 ± 0.14	14.0 ± 1.70
Black	72	47 ± 2	34 ± 2	24 ± 2	15 ± 1	5.37 ± 0.57	387 ± 10.2	2.13 ± 0.24	25.6 ± 2.92
Income									
≤$20,000	138	43 ± 1	32± 2	24 ± 2	31 ± 4	3.39 ± 0.52	379 ± 7.27	1.44 ± 0.24	17.3 ± 2.82
>$20,000	99	42 ± 1	30± 1	22 ± 2	32 ± 9	3.97 ± 0.36	375 ± 8.10	1.58 ± 0.16	18.9 ± 1.88
Education									
Not high school graduate	45	49 ± 2	36 ± 2	23 ± 3	24 ± 4	5.93 ± 0.85	383 ± 13.3	2.61 ± 0.44	31.3 ± 5.26
High school graduate	154	43 ± 1	31 ± 1	26 ± 1	36 ± 9	3.02 ± 0.27	366 ± 6.81	1.15 ± 0.11	13.8 ± 1.36
College or technical training	59	41 ± 2	28 ± 2	17 ± 2	54 ± 24	3.36 ± 0.67	398 ± 11.8	1.52 ± 0.31	18.2 ± 3.66
Overall mean (all respondents)									48.7 g/day

N = Sample size.
SE = Standard error.

Source: Burger et al. (1999).

Table 10-82. Fish Consumption Rates for Indiana Anglers—Mail Survey (g/day)

			Percentile			
	N	Mean	50th	80th	90th	95th
Active Consumers	1,045	19.8	9.5	28.4	37.8	60.5
Potential and Active Consumers	1,261	16.4	7.6	23.6	37.8	60.5

N = Sample size.

Source: Williams et al. (1999).

Table 10-83. Fish Consumption Rates for Indiana Anglers—On-Site Survey (g/day)

			Percentile			
	N	Mean	50th	80th	90th	95th
Active Consumers						
White	177	20.0	7.6	23.6	37.8	113.4
Minority	143	27.2	7.6	30.2	90.7	136.1
Income						
<$25,000	101	18.9	7.5	18.9	37.8	136.1
$25,000 to $34,999	62	18.8	7.6	23.6	60.5	90.7
$35,000 to $49,999	55	15.2	5.7	23.6	23.6	45.4
>$50,000	60	48.9	11.3	113.4	181.4	181.4
Potential and Active Consumers						
White	361	6.8	0	5.7	15.1	37.8
Minority	217	15.3	3.8	13.2	37.8	90.7
Income						
<$25,000	180	10.2	3.8	9.5	23.6	37.8
$25,000 to $34,999	117	7.4	0	7.6	15.1	37.8
$35,000 to $49,999	91	6.8	0	5.7	22.7	23.6
>$50,000	126	13.6	0	7.6	37.8	113.4

N = Sample size.

Source: Williams et al. (2000).

Table 10-84. Consumption of Sport-Caught and Purchased Fish by Minnesota and North Dakota Residents (g/day)

		Percentile				
	N	50th	75th	90th	95th	99th
Minnesota						
Sport-caught fish only						
Age in years (sex)						
0 to 14	582	1.2	4.2	9.0	13.7	26.7
14 and over (males)	996	4.5	10.6	23.7	39.8	113.9
15 to 44 (females)	505	2.1	5.8	14.0	24.9	75.9
44 and over (females)	460	3.6	8.2	20.8	37.2	101.3
General population	2,312	2.8	7.9	17.3	28.9	78.0
Bois Forte Tribe	232	2.8	6.6	12.0	19.6	120.6
With fishing license	2,020	3.9	9.2	18.9	30.4	94.5
Without fishing license	490	0.0	2.0	4.5	7.0	51.1
Purchased Fish Only						
Age in years (sex)						
0 to 14	582	3.6	9.3	18.0	31.3	61.2
14 and over (males)	996	7.4	15.4	30.3	47.5	91.6
15 to 44 (females)	505	6.1	14.0	29.2	50.3	103.7
44 and over (females)	460	7.1	14.6	25.3	42.5	89.4
General population	2,312	6.6	14.4	27.7	43.2	91.3
Bois Forte Tribe	232	3.4	9.0	14.4	24.1	71.9
With fishing license	2,020	6.4	14.0	25.9	39.7	88.7
Without fishing license	490	5.6	12.7	29.6	55.4	98.7
Total						
Age in years (sex)						
0 to 14	582	6.9	14.0	25.6	38.1	78.2
14 and over (males)	996	15.1	27.2	50.3	72.3	155.6
15 to 44 (females)	505	10.1	19.1	39.5	69.2	147.7
44 and over (females)	460	13.8	22.8	45.2	64.1	139.3
General population	2,312	12.3	22.6	42.8	64.5	128.7
Bois Forte Tribe	232	9.3	14.5	26.0	38.4	123.0
With fishing license	2,020	13.2	23.1	42.3	64.5	133.5
Without fishing license	490	7.5	15.2	30.4	58.7	110.0
North Dakota						
Sport-Caught Fish Only						
Age in years (sex)						
0 to 14	343	1.7	6.0	13.3	21.6	44.3
14 and over (males)	579	2.3	6.8	15.1	24.6	79.8
15 to 44 (females)	311	4.3	10.7	23.8	30.1	89.8
44 and over (females)	278	4.2	11.5	21.8	32.5	87.5
General population	1,406	3.0	9.2	16.4	27.4	80.9
Spirit Lake Nation Tribes	105	0.0	2.9	20.3	36.3	97.6
With fishing license	1,101	4.5	11.2	21.2	30.8	87.2
Without fishing license	391	0.0	1.5	4.8	7.9	23.1

Table 10-84. Consumption of Sport-Caught and Purchased Fish by Minnesota and North Dakota Residents (g/day) (continued)

		Percentile				
	N	50th	75th	90th	95th	99th
Purchased Fish Only						
Age in years (sex)						
0 to 14	343	4.7	14.3	23.1	32.9	90.7
14 and over (males)	579	7.4	15.4	30.3	47.5	91.6
15 to 44 (females)	311	7.1	16.1	33.5	50.6	90.9
44 and over (females)	278	6.1	15.4	30.3	47.0	90.7
General population	1,406	6.4	15.4	29.1	47.8	95.6
Spirit Lake Nation Tribes	105	1.2	16.5	30.0	40.7	143.5
With fishing license	1,101	6.8	15.9	29.5	47.0	95.6
Without fishing license	391	5.7	15.1	30.2	52.8	112.2
Total						
Age in years (sex)						
0 to 14	343	9.2	20.4	35.7	57.1	97.4
14 and over (males)	579	7.4	15.4	30.3	47.5	91.6
15 to 44 (females)	311	14.1	27.3	49.8	80.5	137.5
44 and over (females)	278	13.5	25.4	49.3	78.8	144.5
General population	1,406	12.6	24.1	46.7	71.4	126.3
Spirit Lake Nation Tribes	105	1.4	21.2	50.7	80.8	179.8
With fishing license	1,101	14.0	25.3	49.2	76.2	131.4
Without fishing license	391	7.2	15.9	33.5	54.1	116.1

N = Sample size.

Source: Benson et al. (2001).

Table 10-85. Fishing Patterns and Consumption Rates of Anglers Along the Clinch River Arm of Watts Bar Reservoir (Mean ± SE)

	N	Age (years)	Years Fished	Years Fished, Clinch River	Distance Traveled (km)	How Often Eat fish/month	Serving Size (grams)	Fish/Month (kg)	Fish/Year (kg)
All anglers	202	39.2± 1	31 ± 1	11 ± 1	61 ± 5	1.28 ± 0.12	283 ± 20.9	0.62 ± 0.08	7.40 ± 1.01
Anglers who catch and eat fish from study area	77	41.8 ± 2	34 ± 2	12 ± 2	57 ± 6	2.06 ± 0.22	486 ± 32.7	1.14 ± 0.19	13.7 ± 2.17
Ethnicity									
White	71	42 ± 2	34 ± 2	12 ± 2	59 ± 6	2.14 ± 0.23	501 ± 33.6	1.21 ± 0.20	14.5 ± 2.36
Black	6	43 ± 6	33 ± 7	20 ± 5	44 ± 20	0.94 ± 0.78	307 ± 116	0.34 ± 0.68	4.14 ± 8.11
Income									
≤$20,000	22	42 ± 3	33 ± 4	16 ± 3	49 ± 10	1.37 ±0.40	392 ± 41.7	0.52 ± 0.29	6.29 ± 3.58
$20,000 to $29,000	19	35 ± 3	29 ± 4	8.8 ± 3	37 ± 12	1.84 ± 0.44	548 ± 44.9	1.19 ± 0.32	14.3 ± 3.85
$30,000 to $39,000	18	43 ± 3	37 ± 4	8.9 ± 3	69 ± 11	2.13 ± 0.45	482 ± 46.1	1.11 ± 0.33	13.3 ± 3.95
>$40,000	15	47 ± 4	38 ± 4	13.9 ± 3	81 ± 12	3.01 ± 0.49	452 ± 50.5	1.56 ± 0.36	18.8 ± 4.33
Education									
Not high school graduate	18	44 ± 4	35 ± 4	13 ± 3	57 ± 12	1.67 ± 0.46	439 ± 67.7	0.83 ± 0.39	9.99 ± 4.77
High school graduate	28	40 ± 3	32 ± 3	14 ± 3	55 ± 10	2.12 ± 0.37	551 ± 54.2	1.45 ± 0.32	17.4 ± 3.82
Some college, associates, trade school	20	40 ± 3	35 ± 4	9.0 ± 3	61 ± 11	2.05 ± 0.44	486 ± 64.2	1.11 ± 0.38	13.4 ± 4.52
College, at least a bachelors degree	10	42 ± 5	36 ± 5	10 ± 4	59 ± 16	2.33 ± 0.62	414 ± 90.8	0.92 ± 0.53	11.0 ± 6.39

N = Sample size.

Source: Rouse Campbell et al. (2002).

Table 10-86. Daily Consumption of Wild-Caught Fish, Consumers Only (g/kg-day, as-consumed)

			g/person/day						
Population	*N*	Consumers (%)	Mean	Range	Median	75th	90th	95th	99th
Ethnicity									
Black	39	79	171.0	1.88–590.0	137.0	240.0	446.0	557.0	590.0
White	415	78	38.8	0.35–902.0	15.3	37.6	93.0	129.0	286.0
All	458	78	50.2	0.35–902.0	17.6	47.8	123.0	216.0	538.0
Sex									
Female	149	72	39.1	0.35–412.0	11.6	32.8	123.0	172.0	373.0
Male	308	80	55.2	0.63–902.0	21.3	56.4	127.0	235.0	557.0
All	458	73	50.2	0.35–902.0	17.6	47.8	123.0	216.0	538.0
Age (years)									
<32	145	77	32.6	0.63–412.0	14.2	37.6	66.5	123.0	216.0
33 to 45	159	77	71.3	7.52–902.0	18.8	67.6	177.0	354.0	590.0
>45	150	78	44.0	0.35–538.0	20.0	44.4	100.0	164.0	286.0
Income									
$0 to <20K	98	82	104.0	31.9–590.0	31.9	151.0	285.0	429.0	590.0
$20 to 30K	95	82	32.7	0.35–460.0	15.0	37.2	93.0	120.0	460.0
>$30K	172	76	40.9	0.47–902.0	19.4	45.8	87.9	127.0	216.0

N = Sample size.

Source: Burger (2002b).

Table 10-87. Consumption Rates (g/day) for Freshwater Recreational Anglers in King County, WA

Location	Sample Size	Mean	SD	SE	Percentiles		
					50th	90th	95th
Freshwater Fish Consumption							
King County Lakes (all respondents)	128	10	24	2	0	23	42
King County Lakes (children of respondents)	81	7	20	2	0	17	29

SD = Standard deviation.
SE = Standard error.

Source: Mayfield et al. (2007).

Table 10-88. Number of Grams per Day of Fish Consumed by All Adult Respondents (consumers and non-consumers combined)—Throughout the Year

Number of g/day	Cumulative Percent	Number of g/Day	Cumulative Percent
0.00	8.9%	64.8	80.6%
1.6	9.0%	72.9	81.2%
3.2	10.4%	77.0	81.4%
4.0	10.8%	81.0	83.3%
4.9	10.9%	97.2	89.3%
6.5	12.8%	130	92.2%
7.3	12.9%	146	93.7%
8.1	13.7%	162	94.4%
9.7	14.4%	170	94.8%
12.2	14.9%	194	97.2%
13.0	16.3%	243	97.3%
16.2	22.8%	259	97.4%
19.4	24.0%	292	97.6%
20.2	24.1%	324	98.3%
24.3	27.9%	340	98.7%
29.2	28.1%	389	99.0%
32.4	52.5%	486	99.6%
38.9	52.9%	648	99.7%
40.5	56.5%	778	99.9%
48.6	67.6%	972	100%

N = 500; *N* = sample size.
Weighted Mean = 58.7 g/day.
Weighted SE = 3.64; SE = standard error.
90th Percentile 97.2 g/day < (90th) < 130 g/day.
95th Percentile = 170 g/day.
99th Percentile = 389 g/day.

Source: CRITFC (1994).

Table 10-89. Fish Intake Throughout the Year by Sex, Age, and Location by All Adult Respondents

	N	Weighted Mean (g/day)	Weighted SE
Sex			
Female	278	55.8	4.78
Male	222	62.6	5.60
Total	500	58.7	3.64
Age (years)			
18 to 39	287	57.6	4.87
40 to 59	155	55.8	4.88
60 and Older	58	74.4	15.3
Total	500	58.7	3.64
Location			
On Reservation	440	60.2	3.98
Off Reservation	60	47.9	8.25
Total	500	58.7	3.64

Source: CRITFC (1994).

Table 10-90. Fish Consumption Rates Among Native American Children (age 5 years and under)[a]

g/day	Unweighted Cumulative Percent
0.0	21.1
0.4	21.6
0.8	22.2
1.6	24.7
2.4	25.3
3.2	28.4
4.1	32.0
4.9	33.5
6.5	35.6
8.1	47.4
9.7	48.5
12.2	51.0
13.0	51.5
16.2	72.7
19.4	73.2
20.3	74.2
24.3	76.3
32.4	87.1
48.6	91.2
64.8	94.3
72.9	96.4
81.0	97.4
97.2	98.5
162.0	100

[a] Sample size = 194; unweighted mean = 19.6 g/day; unweighted standard error = 1.94.

Note: Data are compiled from the Umatilla, Nez Perce, Yakama, and Warm Springs tribes of the Columbia River Basin.

Source: CRITFC (1994).

Table 10-91. Number of Fish Meals Eaten per Month and Fish Intake Among Native American Children Who Consume Particular Species

Species	*N*	Fish Meals/Month		Intake (g/day)	
		Unweighted Mean	Unweighted SE	Unweighted Mean	Unweighted SE
Salmon	164	2.3	0.16	19	1.5
Lamprey	37	0.89	0.27	8.1	2.8
Trout	89	0.96	0.12	8.8	1.4
Smelt	39	0.40	0.09	3.8	0.99
Whitefish	21	3.5	2.83	21	16
Sturgeon	21	0.43	0.12	4.0	1.3
Walleye	5	0.22	0.20	2.0	1.5
Squawfish	2	0.00	-	0.0	-
Sucker	4	0.35	0.22	2.6	1.7
Shad	3	0.10	0.06	1.1	0.57

\- Not applicable.
SE = Standard error.

Source: CRITFC (1994).

Table 10-92. Socio-Demographic Factors and Recent Fish Consumption

	Peak Consumption[a]		Recent Consumption[b]			
	Average Meals/Week[c]	≥3 meals/week[d] (%)	Walleye	N. Pike	Muskellunge	Bass
All participants (*N* = 323)	1.7	20	4.2	0.3	0.3	0.5
Sex						
Male (*N* = 148)	1.9	26	5.1	0.5[a]	0.5	0.7[a]
Female (*N* = 175)	1.5	15	3.4	0.2	0.1	0.3
Age (years)						
<35 (*N* = 150)	1.8	23	5.3[a]	0.3	0.2	0.7
≥35 (*N* = 173)	1.6	17	3.2	0.4	0.3	0.3
High School Graduate						
No (*N* = 105)	1.6	18	3.6	0.2	0.4	0.7
Yes (*N* = 218)	1.7	21	4.4	0.4	0.2	0.4
Unemployed						
Yes (*N* = 78)	1.9	27	4.8	0.6	0.6	1.1
No (*N* = 245)	1.6	18	4.0	0.3	0.2	0.3

[a] Highest number of fish meals consumed/week.
[b] Number of meals of each species in the previous 2 months.
[c] Average peak fish consumption.
[d] Percentage of population reporting peak fish consumption of ≥3 fish meals/week.

Source: Peterson et al. (1994).

Table 10-93. Number of Local Fish Meals Consumed per Year by Time Period for All Respondents

Number of Local Fish Meals Consumed Per Year	Time Period											
	During Pregnancy				≤1 Year Before Pregnancy[a]				>1 Year Before Pregnancy[b]			
	Mohawk		Control		Mohawk		Control		Mohawk		Control	
	N	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%
None	63	64.9	109	70.8	42	43.3	99	64.3	20	20.6	93	60.4
1 to 9	24	24.7	24	15.6	40	41.2	31	20.1	42	43.3	35	22.7
10 to 19	5	5.2	7	4.5	4	4.1	6	3.9	6	6.2	8	5.2
20 to 29	1	1.0	5	3.3	3	3.1	3	1.9	9	9.3	5	3.3
30 to 39	0	0.0	2	1.3	0	0.0	3	1.9	1	1.0	1	0.6
40 to 49	0	0.0	1	0.6	1	1.0	1	0.6	1	1.0	1	0.6
50+	4	4.1	6	3.9	7	7.2	11	7.1	18	18.6	11	7.1
Total	97	100.0	154	100.0	97	100.0	154	100.0	97	100.0	154	100.0

[a] $p < 0.05$ for Mohawk vs. Control.
[b] $p < 0.001$ for Mohawk vs. Control.
N = Number of respondents.

Source: Fitzgerald et al. (1995).

Table 10-94. Mean Number of Local Fish Meals Consumed per Year by Time Period for All Respondents and Consumers Only

	All Respondents (*N* = 97 Mohawks and 154 Controls)			Consumers Only (*N* = 82 Mohawks and 72 Controls)		
	During Pregnancy	≤1 Year Before Pregnancy	>1 Year Before Pregnancy	During Pregnancy	≤1 Year Before Pregnancy	>1 Year Before Pregnancy
Mohawk	3.9 (1.2)	9.2 (2.3)	23.4 (4.3)[a]	4.6 (1.3)	10.9 (2.7)	27.6 (4.9)
Control	7.3 (2.1)	10.7 (2.6)	10.9 (2.7)	15.5 (4.2)[a]	23.0 (5.1)[b]	23.0 (5.5)

[a] $p < 0.001$ for Mohawk vs. Controls.
[b] $p < 0.05$ for Mohawk vs. Controls.
( ) = Standard error.

Test for linear trend:
$p < 0.001$ for Mohawk (All participants and consumers only);
$p = 0.07$ for Controls (All participants and consumers only).

Source: Fitzgerald et al. (1995).

Table 10-95. Mean Number of Local Fish Meals Consumed per Year by Time Period and Selected Characteristics for All Respondents (Mohawk, *N* = 97; Control, *N* = 154)

	Time Period					
	During Pregnancy		≤1 Year Before Pregnancy		>1 Year Before Pregnancy	
Variable	Mohawk	Control	Mohawk	Control	Mohawk	Control
Age (years)						
<20	7.7	0.8	13.5	13.9	27.4	10.4
20 to 24	1.3	5.9	5.7	14.5	20.4	15.9
25 to 29	3.9	9.9	15.5	6.2	25.1	5.4
30 to 34	12.0	7.6	9.5	2.9	12.0	5.6
>34	1.8	11.2	1.8	26.2	52.3	22.1[a]
Education (Years)						
<12	6.3	7.9	14.8	12.4	24.7	8.6
12	7.3	5.4	8.1	8.4	15.3	11.4
13 to 15	1.7	10.1	8.0	15.4	29.2	13.3
>15	0.9	6.8	10.7	0.8	18.7	2.1
Cigarette Smoking						
Yes	3.8	8.8	10.4	13.0	31.6	10.9
No	3.9	6.4	8.4	8.3	18.1	10.8
Alcohol Consumption						
Yes	4.2	9.9	6.8	13.8	18.0	14.8
No	3.8	6.3[b]	12.1	4.7[c]	29.8	2.9[d]

[a] F (4,149) = 2.66, $p = 0.035$ for Age Among Controls.
[b] F (1,152) = 3.77, $p = 0.054$ for Alcohol Among Controls.
[c] F (1,152) = 5.20, $p = 0.024$ for Alcohol Among Controls.
[d] F (1,152) = 6.42, $p = 0.012$ for Alcohol Among Controls.
Note: F (r1, r2) = F statistic with r1 and r2 degrees of freedom.

Source: Fitzgerald et al. (1995).

Table 10-96. Fish Consumption Rates for Mohawk Native Americans (g/day)

Population Group	Sample Size	Fish Intake Rate		% Consuming
		Mean	95th Percentile	
Adults—all[a]				
All fish	1,092	28	132	90%
Local fish	1,092	25	131	90%
Adults—consumers only[a]				
All fish	983	31	142	90%
Local fish	972	29	135	90%
Children—all[b]				
Local fish	--	10	54	--
Children—consumers only[b]				
Local fish	--	13	58	--

[a] Value based on assumption that 1 fish meal = 227 grams (1/2 pound) [based on data from Pao et al. (1982)].
[b] Value for 2-year old child, based on assumption that children consume fish at the same frequency as adults but have a smaller meal size (93 grams).

Source: Forti et al. (1995).

Table 10-97. Percentiles and Mean of Adult Tribal Member Consumption Rates (g/kg-day)

	5%	50%	90%	95%	SE	Mean	95% CI
Tulalip Tribes (*N* = 73)							
Anadromous fish	0.006	0.190	1.429	2.114	0.068	0.426	(0.297, 0.555)
Pelagic fish	0.000	0.004	0.156	0.234	0.008	0.036	(0.021, 0.051)
Bottom fish[a]	0.000	0.008	0.111	0.186	0.007	0.033	(0.020, 0.046)
Shellfish[a]	0.000	0.153	1.241	1.5296	0.059	0.362	(0.250, 0.474)
Total finfish	0.010	0.284	1.779	2.149	0.072	0.495	(0.359, 0.631)
Other fish[b]	0.000	0.000	0.113	0.264	0.008	0.031	(0.016, 0.046)
Total fish	0.046	0.552	2.466	2.876	0.111	0.889	(0.679, 1.099)
Squaxin Island Tribe (*N* = 117)							
Anadromous fish	0.016	0.308	1.639	2.182	0.069	0.590	(0.485, 0.695)
Pelagic fish	0.000	0.003	0.106	0.248	0.009	0.043	(0.029, 0.057)
Bottom fish[a]	0.000	0.026	0.176	0.345	0.010	0.063	(0.048, 0.078)
Shellfish[a]	0.000	0.065	0.579	0.849	0.027	0.181	(0.140, 0.222)
Total finfish	0.027	0.383	1.828	2.538	0.075	0.697	(0.583, 0.811)
Other fish[b]	0.000	0.000	0.037	0.123	0.003	0.014	(0.009, 0.019)
Total fish	0.045	0.524	2.348	3.016	0.088	0.891	(0.757, 1.025)
Both Tribes Combined (weighted)							
Anadromous fish	0.010	0.239	1.433	2.085	0.042	0.508	(0.425, 0.591)
Pelagic fish	0.000	0.004	0.112	0.226	0.005	0.040	(0.029, 0.050)
Bottom fish**	0.000	0.015	0.118	0.118	0.005	0.048	(0.038, 0.058)
Shellfish**	0.000	0.115	0.840	1.308	0.030	0.272	(0.212, 0.331)
Total finfish	0.017	0.317	1.751	2.188	0.045	0.596	(0.507, 0.685)
Other fish*	0.000	0.000	0.049	0.145	0.004	0.023	(0.015, 0.030)
Total fish	0.047	0.531	2.312	2.936	0.064	0.890	(0.765, 1.015)

[a] $p < 0.01$ comparing two tribes (Wilcoxon-Mann-Whitney test).
[b] $p < 0.05$
N = Sample size.
SE = Standard error.
CI = Confidence interval.

Source: Toy et al. (1996).

Table 10-98. Median and Mean Consumption Rates by Sex (g/kg-day) within Each Tribe

	Tulalip Tribe				Squaxin Island Tribe			
	N	Median	Mean	95% CI	*N*	Median	Mean	95% CI
Shellfish								
Male	42	0.158	0.370	(0.215, 0.525)	65	0.100	0.202	(0.149, 0.255)
Female	31	0.153	0.353	(0.192, 0.514)	52	0.038	0.155	(0.093, 0.217)
Total finfish								
Male	42	0.414	0.559	(0.370, 0.748)	65	0.500	0.707	(0.576, 0.838)
Female	31	0.236	0.409	(0.218, 0.600)	52	0.272	0.684	(0.486, 0.882)
Total fish[a]								
Male	42	0.623	0.959	(0.666, 1.252)	65	0.775[b]	0.926	(0.771, 1.081)
Female	31	0.472	0.794	(0.499, 1.089)	52	0.353	0.847	(0.614, 1.080)

[a] Total fish includes anadromous, pelagic, bottom shellfish, finfish, and other fish.
[b] $p < 0.05$ for difference in consumption rate by sex within a tribe (Wilcoxon-Mann-Whitney test).
N = Sample size.
CI = Confidence interval.

Source: Toy et al. (1996).

Table 10-99. Median Consumption Rate for Total Fish by Sex and Tribe (g/day)

	Tulalip Tribe	Squaxin Island Tribe
Male	53	66
Female	34	25

Source: Toy et al. (1996).

Table 10-100. Percentiles of Adult Consumption Rates by Age (g/kg-day)

	Tulalip Tribes				Squaxin Island Tribe		
Ages (years)	5%	50%	90%	95%	50%	90%	95%
Shellfish							
18 to 34	0.00	0.181	1.163	1.676	0.073	0.690	1.141
35 to 49	0.00	0.161	1.827	1.836	0.073	0.547	1.094
50 to 64	0.00	0.173	0.549	0.549	0.000	0.671	0.671
65+	0.00	0.034	0.088	0.088	0.035	0.188	0.188
Total finfish							
18 to 34	0.013	0.156	1.129	1.956	0.289	1.618	2.963
35 to 49	0.002	0.533	2.188	2.388	0.383	2.052	2.495
50 to 64	0.156	0.301	1.211	1.211	0.909	3.439	3.439
65+	0.006	0.176	0.531	0.531	0.601	2.049	2.049
Total fish[a]							
18 to 34	0.044	0.571	2.034	2.615	0.500	2.385	3.147
35 to 49	0.006	0.968	3.666	4.204	0.483	2.577	3.053
50 to 64	0.190	0.476	11.586	1.586	1.106	3.589	3.589
65+	0.050	0.195	0.623	0.623	0.775	2.153	2.153

[a] Total fish includes anadromous, pelagic, bottom, shellfish, finfish, and other fish.

Source: Toy et al. (1996).

Table 10-101. Median Consumption Rates by Income (g/kg-day) Within Each Tribe

Income	Tulalip Tribes	Squaxin Island Tribe
Shellfish		
≤ $10,000	0.143	0.078
$10,001 to $15,000	0.071	0.121
$15,001 to $20,000	0.144	0.072
$20,001 to $25,000	0.202	0.000
$25,001 to $35,000	0.416	0.030
$35,001+	0.175	0.090
Total finfish		
≤ $10,000	0.235	0.272
$10,001 to $15,000	0.095	0.254
$15,001 to $20,000	0.490	0.915
$20,001 to $25,000	0.421	0.196
$25,001 to $35,000	0.236	0.387
$35,001+	0.286	0.785
Total fish		
≤$10,000	0.521	0.476
$10,001 to $15,000	0.266	0.432
$15,001 to $20,000	0.640	0.961
$20,001 to $25,000	0.921	0.233
$25,001 to $35,000	0.930	0.426
$35,001+	0.607	1.085

Source: Toy et al. (1996).

Table 10-102. Mean, 50th, and 90th Percentiles of Consumption Rates for Children Age Birth to 5 Years (g/kg-day)

	Mean (SE)	95% CI	50%	90%
		Tulalip Tribes (*N* = 21)		
Shellfish	0.125 (0.056)	(0.014, 0.236)	0.000	0.597
Total finfish	0.114 (0.030)	(0.056, 0.173)	0.060	0.290
Total, all fish	0.239 (0.077)	(0.088, 0.390)	0.078	0.738
		Squaxin Island Tribe (*N* = 48)		
Shellfish	0.228 (0.053)	(0.126, 0.374)	0.045	0.574
Total finfish	0.250 (0.063)	(0.126, 0.374)	0.061	0.826
Total, all fish	0.825 (0.143)	(0.546, 1.105)	0.508	2.056
		Both Tribes Combined (weighted)		
Shellfish	0.177 (0.039)	(0.101, 0.253)	0.012	0.574
Total finfish	0.182 (0.035)	(0.104, 0.251)	0.064	0.615
Total, all fish	0.532 (0.081)	(0.373, 0.691)	0.173	1.357

N = Sample size.
SE = Standard error.
CI = Confidence interval.

Source: Toy et al. (1996).

Table 10-103. Adult Consumption Rate (g/kg-day): Individual Finfish and Shellfish and Fish Groups

Species/Group	All Adult Respondents (Including Non-Consumers)											Consumers Only			
	N	Mean	SE	95% LCL	95% UCL	Percentiles 5th	50th	75th	90th	95th	Max	*N*	%	GM	MSE
Group G															
Abalone	92	0.001	0.001	0.000	0.002	0.000	0.000	0.000	0.000	0.000	0.063	3	3	0.007	3.139
Lobster	92	0.022	0.007	0.008	0.036	0.000	0.000	0.000	0.085	0.139	0.549	22	24	0.052	1.266
Octopus	92	0.019	0.006	0.008	0.030	0.000	0.000	0.015	0.069	0.128	0.407	25	27	0.042	1.231
Limpets	92	0.010	0.009	0.000	0.027	0.000	0.000	0.000	0.000	0.000	0.795	2	2	0.261	3.047
Miscellaneous	92	0.0003	0.0003	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.023	1	1	0.023	
Group A	92	0.618	0.074	0.473	0.763	0.021	0.350	1.002	1.680	2.177	3.469	92	100	0.274	1.167
Group B	92	0.051	0.016	0.019	0.082	0.000	0.003	0.019	0.128	0.270	1.149	49	53	0.025	1.262
Group C	92	0.136	0.025	0.087	0.185	0.000	0.055	0.141	0.369	0.526	1.716	87	95	0.064	1.147
Group D	92	0.097	0.021	0.056	0.138	0.000	0.029	0.076	0.206	0.613	1.069	76	83	0.045	1.168
Group E	92	1.629	0.262	1.115	2.143	0.063	0.740	1.688	4.555	7.749	15.886	91	99	0.703	1.160
Group F	92	0.124	0.016	0.092	0.156	0.000	0.068	0.144	0.352	0.533	0.778	85	92	0.070	1.139
Group G	92	0.052	0.017	0.019	0.084	0.000	0.000	0.038	0.128	0.262	1.344	42	46	0.043	1.240
All Finfish	92	1.026	0.113	1.153	2.208	0.087	0.639	1.499	2.526	3.412	5.516	92	100	0.590	1.128
All Shellfish	92	1.680	0.269	2.049	3.364	0.063	0.796	1.825	4.590	7.754	15.976	91	99	0.727	1.160
All Seafood	92	2.707	0.336	0.000	0.000	0.236	1.672	3.598	6.190	10.087	18.400	92	100	1.530	1.123

N = Sample size.
SE = Standard error.
LCL = Lower confidence limit.
UCL = Upper confidence limit.
GM = Geometric mean.
MSE = Multiplicative standard error.
Note: The minimum consumption for all species and groups was zero, except for "Group A," "All Finfish," and "All Seafood". The minimum rate for "Group A" was 0.005, for "All Finfish" was 0.018, and for "All Seafood" was 0.080.

Source: Duncan (2000).

Table 10-104. Adult Consumption Rate (g/kg-day) for Consumers Only

		Consumers Only					
Group	Species	*N*	Mean	SE	Median	75th Percentile	90th Percentile
Group A	King	63	0.200	0.031	0.092	0.322	0.581
	Sockeye	59	0.169	0.026	0.070	0.293	0.493
	Coho	50	0.191	0.033	0.084	0.247	0.584
	Chum	42	0.242	0.046	0.147	0.280	0.768
	Pink	17	0.035	0.007	0.034	0.057	0.077
	Other or Unspecified Salmon	32	0.159	0.070	0.043	0.172	0.261
	Steelhead	26	0.102	0.035	0.027	0.103	0.398
	Salmon (gatherings)	85	0.074	.0.012	0.031	0.079	0.205
Group B	Smelt	49	0.078	0.024	0.016	0.078	0.247
	Herring	14	0.059	0.020	0.034	0.093	0.197
Group C	Cod	78	0.126	0.024	0.051	0.140	0.319
	Perch	2	0.012	0.002	0.012	---	---
	Pollock	40	0.054	0.020	0.013	0.060	0.139
	Sturgeon	8	0.041	0.021	0.021	0.053	---
	Sable Fish	5	0.018	0.009	0.014	0.034	---
	Spiny Dogfish	1	0.004	---	---	---	---
	Greenling	2	0.013	0.002	0.013	---	---
	Bull Cod	1	0.016	---	---	---	---
Group D	Halibut	74	0.080	0.018	0.029	0.069	0.213
	Sole/Flounder	20	0.052	0.015	0.022	0.067	0.201
	Rock Fish	12	0.169	0.072	0.066	0.231	0.728
Group E	Manila/Littleneck Clams	84	0.481	0.154	0.088	0.284	1.190
	Horse Clams	52	0.073	0.016	0.025	0.070	0.261
	Butter Clams	72	0.263	0.062	0.123	0.184	0.599
	Geoduck	83	0.184	0.039	0.052	0.167	0.441
	Cockles	61	0.233	0.055	0.099	0.202	0.530
	Oysters	60	0.164	0.034	0.068	0.184	0.567
	Mussels	25	0.059	0.020	0.015	0.085	0.155
	Moon Snails	0	---	---	---	---	---
	Shrimp	86	0.174	0.027	0.088	0.196	0.549
	Dungeness Crab	81	0.164	0.028	0.071	0.185	0.425

Table 10-104. Adult Consumption Rate (g/kg-day) for Consumers Only (continued)

Group	Species	Consumers Only					
		N	Mean	SE	Median	75th Percentile	90th Percentile
Group E (cont'd)	Red Rock Crab	19	0.037	0.010	0.012	0.057	0.117
	Scallops	54	0.037	0.009	0.011	0.040	0.110
	Squid	23	0.041	0.017	0.009	0:032	0.188
	Sea Urchin	6	0.025	0.008	0.019	0.048	---
	Sea Cucumber	5	0.056	0.031	0.008	0.130	---
	Oyster (gatherings)	40	0.061	0.014	0.031	0.088	0.152
	Clams (gatherings)	61	0.071	0.016	0.029	0.064	0.165
	Crab (gatherings)	43	0.056	0.019	0.027	0.042	0.100
	Clams (razor, unspecified)	35	0.124	0.036	0.062	0.138	0.284
	Crab (king/snow)	1	0.017	---	---	---	---
Group F	Cabazon	1	0.080	---	---	---	---
	Blue Back (sockeye)	2	0.006	0.004	0.006	---	---
	Trout/Cutthroat	3	0.112	0.035	0.129	---	---
	Tuna (fresh/canned)	83	0.129	0.017	0.071	0.145	0.346
	Groupers	1	0.025	---	---	---	---
	Sardine	1	0.049	---	---	---	---
	Grunter	4	0.056	0.026	0.047	0.110	---
	Mackerel	1	0.008	---	---	---	---
	Shark	1	0.002	---	---	---	---
Group G	Abalone	3	0.022	0.020	0.003	---	---
	Lobster	22	0.092	0.025	0.057	0.130	0.172
	Octopus	25	0.071	0.017	0.044	0.123	0.149
	Limpets	2	0.440	0.355	0.440	---	---
	Miscellaneous	1	0.023	---	---	---	---
	Group A	92	0.618	0.074	0.350	1.002	1.680
	Group B	49	0.095	0.029	0.017	0.098	0.261
	Group C	87	0.144	0.026	0.068	0.141	0.403
	Group D	76	0.118	0.025	0.042	0.091	0.392
	Group E	91	1.647	0.265	0.750	1.691	4.577
	Group F	85	0.134	0.017	0.076	0.163	0.372
	Group G	42	0.113	0.034	0.042	0.118	0.270
	All Finfish	92	1.026	0.113	0.639	1.499	2.526
	All Shellfish	91	1.699	0.271	0.819	1.837	4.600
	All Seafood	92	2.707	0.336	1.672	3.598	6.190

N = Sample size.
SE = Standard error.
--- Not reported.

Table 10-105. Adult Consumption Rate (g/kg-day) by Sex

Species/Group	All Adult Respondents (Including Non-Consumers)										Consumers Only			
	N	Mean	SE	95% LCL	95% UCL	Percentiles 5th	50th	75th	90th	95th	*N*	%	GM[a]	MSE[b]
Group A (p = 0.02)														
Male	46	0.817	0.120	0.582	1.052	0.021	0.459	1.463	2.033	2.236	46	100	0.385	1.245
Female	46	0.419	0.077	0.268	0.570	0.018	0.294	0.521	1.028	1.813	46	100	0.195	1.232
Group B (p = 0.04)														
Male	46	0.089	0.031	0.028	0.150	0.000	0.008	0.076	0.269	0.623	27	59	0.046	1.378
Female	46	0.013	0.004	0.005	0.021	0.000	0.000	0.013	0.044	0.099	22	48	0.012	1.309
Group C (p = 0.03)														
Male	46	0.170	0.043	0.086	0.254	0.007	0.078	0.148	0.432	0.847	46	100	0.075	1.210
Female	46	0.102	0.025	0.053	0.151	0.000	0.047	0.102	0.277	0.496	41	89	0.053	1.215
Group D (p = 0.08)														
Male	46	0.135	0.037	0.062	0.208	0.000	0.045	0.133	0.546	0.948	39	85	0.057	1.274
Female	46	0.060	0.018	0.025	0.095	0.000	0.026	0.056	0.105	0.453	37	80	0.035	1.204
Group E (p = 0.03)														
Male	46	1.865	0.316	1.246	2.484	0.068	1.101	2.608	4.980	7.453	46	100	0.879	1.238
Female	46	1.392	0.419	0.571	2.213	0.029	0.644	0.936	2.462	9.184	45	98	0.559	1.224
Group F (p = 0.6)														
Male	46	0.141	0.026	0.090	0.192	0.000	0.072	0.195	0.413	0.597	40	87	0.089	1.199
Female	46	0.107	0.020	0.068	0.146	0.005	0.052	0.126	0.322	0.451	45	98	0.056	1.198
Group G (p = 0.2)														
Male	46	0.081	0.032	0.018	0.144	0.000	0.001	0.070	0.261	0.476	23	50	0.057	1.395
Female	46	0.023	0.007	0.009	0.037	0.000	0.000	0.016	0.093	0.162	19	41	0.031	1.272
All Finfish (p = 0.007)														
Male	46	1.351	0.193	0.973	1.729	0.115	0.905	1.871	3.341	4.540	46	100	0.800	1.191
Female	46	0.701	0.100	0.505	0.897	0.083	0.465	0.943	1.751	2.508	46	100	0.434	1.169
All Shellfish (p = 0.03)														
Male	46	1.946	0.335	1.289	2.603	0.068	1.121	2.628	5.146	7.453	46	100	0.909	1.240
Female	46	1.415	0.421	0.590	2.240	0.029	0.678	1.007	2.462	9.231	45	98	0.579	1.221
All Seafood (p = 0.008)														
Male	46	3.297	0.458	2.399	4.195	0.232	2.473	4.518	8.563	10.008	46	100	1.971	1.188
Female	46	2.116	0.480	1.175	3.057	0.236	0.965	2.219	4.898	10.400	46	100	1.188	1.158

N = Sample size.
SE = Standard error.
LCL = Lower confidence interval.
UCL = Upper confidence interval.
GM = Geometric mean.
MSE = Multiplicative standard error.
Note *p*-value is 2-sided and based upon Mann-Whitney test. The 95% CL is based on the normal distribution. The 5th and 95th percentile are not reported for groups with less than 20 respondents.

Source: Duncan (2000).

Table 10-106. Adult Consumption Rate (g/kg-day) by Age														
	All Adult Respondents (Including Non-Consumers)										Consumers Only			
						Percentiles								
Species/Age Group	*N*	Mean	SE	95% LCL	95% UCL	5th	50th	75th	90th	95th	*N*	%	GM[a]	MSE[b]
Group A (*p* = 0.04)														
16 to 42 Years	58	0.512	0.083	0.349	0.675	0.015	0.294	0.660	1.544	2.105	58	100	0.215	1.219
43 to 54 Years	15	1.021	0.233	0.564	1.478		1.020	1.596	2.468		15	100	0.645	1.337
55 Years and Over	19	0.623	0.159	0.311	0.935		0.394	0.868	2.170		19	100	0.294	1.402
Group B (*p* = 0.001)														
16 to 42 Years	58	0.042	0.022	0.000	0.085	0.000	0.000	0.009	0.098	0.295	22	38	0.023	1.447
43 to 54 Years	15	0.097	0.047	0.005	0.189		0.019	0.124	0.421		12	80	0.049	1.503
55 Years and Over	19	0.041	0.017	0.008	0.074		0.010	0.054	0.182		15	79	0.017	1.503
Group C (*p* = 0.6)														
16 to 42 Years	58	0.122	0.026	0.071	0.173	0.000	0.055	0.134	0.301	0.578	54	93	0.061	1.186
43 to 54 Years	15	0.117	0.029	0.060	0.174		0.078	0.146	0.339		15	100	0.072	1.335
55 Years and Over	19	0.193	0.091	0.015	0.371		0.050	0.141	0.503		18	95	0.066	1.429
Group D (*p* = 0.2)														
16 to 42 Years	58	0.079	0.023	0.034	0.124	0.000	0.026	0.072	0.164	0.610	44	76	0.043	1.218
43 to 54 Years	15	0.164	0.079	0.009	0.319		0.049	0.094	0.862		15	100	0.056	1.435
55 Years and Over	19	0.102	0.038	0.028	0.176		0.033	0.088	0.513		17	89	0.041	1.434
Group E (*p* = 0.1)														
16 to 42 Years	58	1.537	0.289	0.971	2.103	0.059	0.740	1.715	3.513	8.259	57	98	0.707	1.199
43 to 54 Years	15	2.241	0.571	1.122	3.360		1.679	4.403	6.115		15	100	1.188	1.419
55 Years and Over	19	1.425	0.811	0.000	3.015		0.678	1.159	1.662		19	100	0.456	1.415
Group F (*p* = 0.5)														
16 to 42 Years	58	0.119	0.021	0.078	0.160	0.000	0.044	0.123	0.387	0.563	53	91	0.065	1.180
43 to 54 Years	15	0.154	0.050	0.056	0.252		0.109	0.217	0.472		14	93	0.098	1.339
55 Years and Over	19	0.115	0.029	0.058	0.172		0.072	0.145	0.302		18	95	0.066	1.350
Group G (*p* = 0.6)														
16 to 42 Years	58	0.052	0.024	0.005	0.099	0.000	0.006	0.035	0.126	0.241	30	52	0.037	1.259
43 to 54 Years	15	0.088	0.043	0.004	0.172		0.000	0.116	0.420		5	33	0.207	1.447
55 Years and Over	19	0.023	0.011	0.001	0.045		0.000	0.018	0.091		7	37	0.028	1.875
All Finfish (*p* = 0.03)														
16 to 42 Years	58	0.874	0.136	0.607	1.141	0.087	0.536	1.062	2.471	2.754	58	100	0.489	1.163
43 to 54 Years	15	1.554	0.304	0.958	2.150		1.422	2.005	3.578		15	100	1.146	1.249
55 Years and Over	19	1.074	0.247	0.590	1.558		0.861	1.525	2.424		19	100	0.619	1.329
All Shellfish (*p* = 0.1)														
16 to 42 Years	58	1.589	0.301	3.626	2.179	0.059	0.799	1.834	3.626	8.305	57	98	0.736	1.197
43 to 54 Years	15	2.330	0.586	1.181	3.479		1.724	4.519	6.447		15	100	1.225	1.426
55 Years and Over	19	1.447	0.815	0.000	3.044		0.688	1.160	1.837		19	100	0.464	1.417

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Table 10-106. Adult Consumption Rate (g/kg-day) by Age (continued)

Species/Age Group	All Adult Respondents (Including Non-Consumers)										Consumers Only			
	N	Mean	SE	95% LCL	95% UCL	Percentiles 5th	50th	75th	90th	95th	*N*	%	GM	MSE
All Seafood (*p* = 0.09)														
16 to 42 Years	58	2.463	0.387	1.704	3.222	0.247	1.270	3.410	6.206	9.954	58	100	1.384	1.156
43 to 54 Years	15	3.884	0.781	2.353	5.415		3.869	4.942	9.725		15	100	2.665	1.295
55 Years and Over	19	2.522	0.927	0.705	4.339		1.393	2.574	5.220		19	100	1.340	1.293

N = Sample size.
SE = Standard error.
LCL = Lower confidence interval.
UCL = Upper confidence interval.
GM = Geometric mean.
MSE = Multiplicative standard error.
Note: *p*-value is 2-sided and based upon Kruskul-Wallis test. The 95% CL is based on the normal distribution. The 5th and 95th percentiles are not reported for groups with less than 20 respondents.

Source: Duncan (2000).

Table 10-107. Consumption Rates for Native American Children (g/kg-day), All Children (including non-consumers): Individual Finfish and Shellfish and Fish Groups

Group	Species	*N*	Mean	SE	95% LCL	95% UCL	p5	Median	p75	p90	p95	Maximum
Group E												
	Manila/Littleneck clams	31	0.095	0.051	0.000	0.195	0.000	0.031	0.063	0.181	0.763	1.597
	Horse clams	31	0.022	0.013	0.000	0.048	0.000	0.000	0.006	0.048	0.269	0.348
	Butter clams	31	0.021	0.014	0.000	0.048	0.000	0.000	0.000	0.041	0.247	0.422
	Geoduck	31	0.112	0.041	0.033	0.191	0.000	0.027	0.116	0.252	0.841	1.075
	Cockles	31	0.117	0.079	0.000	0.271	0.000	0.000	0.054	0.240	1.217	2.433
	Oysters	31	0.019	0.012	0.000	0.043	0.000	0.000	0.056	0.058	0.205	0.362
	Mussels	31	0.001	0.001	0.000	0.002	0.000	0.000	0.000	0.000	0.011	0.026
	Moon snails	31	0.000	-	-	-	0.000	0.000	0.000	0.000	0.000	0.000
	Shrimp	31	0.093	0.038	0.019	0.168	0.000	0.004	0.059	0.394	0.712	0.982
	Dungeness crab	31	0.300	0.126	0.053	0.547	0.000	0.047	0.166	1.251	2.689	2.833
	Red rock crab	31	0.007	0.003	0.001	0.014	0.000	0.000	0.000	0.046	0.064	0.082
	Scallops	31	0.011	0.006	0.000	0.022	0.000	0.000	0.005	0.031	0.089	0.174
	Squid	31	0.002	0.002	0.000	0.005	0.000	0.000	0.000	0.000	0.000	0.411
	Sea urchin	31	0.000	-	-	-	0.000	0.000	0.000	0.000	0.000	0.000
	Sea cucumber	31	0.000	-	-	-	0.000	0.000	0.000	0.000	0.000	0.000
Group A[a]		31	0.271	0.117	0.043	0.499	0.000	0.063	0.216	0.532	2.064	3.559
Group B[b]		31	0.004	0.002	0.000	0.008	0.000	0.000	0.000	0.015	0.038	0.069
Group C[c]		31	0.131	0.040	0.052	0.210	0.000	0.036	0.205	0.339	0.838	1.014
Group D[d]		31	0.030	0.011	0.008	0.053	0.000	0.010	0.037	0.081	0.191	0.342
Group F[e]		31	0.240	0.075	0.094	0.387	0.000	0.092	0.254	0.684	1.571	1.901
All Finfish		31	0.677	0.168	0.346	1.007	0.026	0.306	0.740	2.110	3.549	4.101
All Shellfish		31	0.801	0.274	0.265	1.337	0.000	0.287	0.799	2.319	4.994	7.948
All Seafood		31	1.477	0.346	0.799	2.155	0.042	0.724	1.983	3.374	7.272	9.063

[a] Group A is salmon, including king, sockeye, coho, chum, pink, and steelhead.
[b] Group B is finfish, including smelt and herring.
[c] Group C is finfish, including cod, perch, pollock, sturgeon, sablefish, spiny dogfish, and greenling.
[d] Group D is finfish, including halibut, sole, flounder, and rockfish.
[e] Group F includes tuna, other finfish, and all others not included in Groups A, B, C, and D.
- = Not applicable.
N = Sample size.
SE = Standard error
LCL = Lower confidence limit
UCL = Upper confidence limit
p5...p95 = Percentile value.
Note: The minimum consumption for all species and groups was zero, except for "All Finfish" and "All Seafood." The minimum rate for "All Finfish" was 0.023, and for "All Seafood" was 0.035.

Source: Duncan (2000).

Table 10-108. Consumption Rates for Native American Children (g/kg-day), Consumers Only: Individual Finfish and Shellfish and Fish Groups

Group	Species	*N*	Mean	SE	Median	Percentiles	
						75th	90th
Group E	Manila/Littleneck clams	23	0.128	0.068	0.043	0.066	0.200
	Horse clams	12	0.058	0.032	0.009	0.046	0.308
	Butter clams	6	0.106	0.066	0.032	0.203	-
	Geoduck	22	0.158	0.054	0.053	0.230	0.554
	Cockles	10	0.361	0.233	0.078	0.291	2.230
	Oysters	10	0.060	0.035	0.015	0.074	0.336
	Mussels	1	0.026	-	-	-	-
	Moon snails	0	-	-	-	-	-
	Shrimp	17	0.170	0.064	0.035	0.299	0.621
	Dungeness crab	21	0.443	0.179	0.082	0.305	2.348
	Red rock crab	5	0.046	0.011	0.051	0.067	-
	Scallops	8	0.042	0.019	0.027	0.032	-
	Squid	2	0.033	0.008	0.033	-	-
	Sea urchin	0	-	-	-	-	-
	Sea cucumber	0	-	-	-	-	-
Group A[a]		28	0.300	0.128	0.112	0.246	0.599
Group B[b]		5	0.023	0.012	0.017	0.043	-
Group C[c]		25	0.163	0.048	0.048	0.236	0.493
Group D[d]		17	0.055	0.019	0.033	0.064	0.140
Group F[e] (tuna/other finfish)		24	0.311	0.092	0.177	0.336	1.035
All finfish		31	0.677	0.168	0.306	0.740	2.110
All shellfish		28	0.886	0.299	0.363	0.847	2.466
All seafood		31	1.477	0.346	0.724	1.983	3.374

[a] Group A is salmon, including king, sockeye, coho, chum, pink, and steelhead.
[b] Group B is finfish, including smelt and herring.
[c] Group C is finfish, including cod, perch, pollock, sturgeon, sablefish, spiny dogfish, and greenling.
[d] Group D is finfish, including halibut, sole, flounder, and rockfish.
[e] Group F includes tuna, other finfish, and all others not included in Groups A, B, C, and D.
N = Sample size.
SE = Standard error.
- = No data.

Source: Duncan (2000).

Table 10-109. Percentiles and Mean of Consumption Rates for Adult Consumers Only (g/kg-day)

Species	*N*	Mean	SD	95% CI	Percentiles						
					5th	10th	25th	50th	75th	90th	95th
Squaxin Island Tribe											
Anadromous fish	117	0.672	1.174	(0.522–1.034)	0.016	0.028	0.093	0.308	0.802	1.563	2.086
Pelagic fish	62	0.099	0.203	(0.064–0.181)	0.004	0.007	0.014	0.035	0.086	0.226	0.349
Bottom fish	94	0.093	0.180	(0.065–0.140)	0.006	0.007	0.016	0.037	0.079	0.223	0.370
Shellfish	86	0.282	0.511	(0.208–0.500)	0.006	0.015	0.051	0.126	0.291	0.659	1.020
Other fish	39	0.046	0.066	(0.031–0.073)	0.002	0.005	0.006	0.019	0.046	0.129	0.161
All finfish	117	0.799	1.263	(0.615–1.136)	0.031	0.056	0.139	0.383	1.004	1.826	2.537
All fish	117	1.021	1.407	(0.826–1.368)	0.050	0.097	0.233	0.543	1.151	2.510	3.417
Tulalip Tribe											
Anadromous fish	72	0.451	0.671	(0.321–0.648)	0.010	0.020	0.065	0.194	0.529	1.372	1.990
Pelagic fish	38	0.077	0.100	(0.051–0.118)	0.005	0.011	0.015	0.030	0.088	0.216	0.266
Bottom fish	44	0.062	0.092	(0.043–0.107)	0.006	0.007	0.011	0.030	0.077	0.142	0.207
Shellfish	61	0.559	1.087	(0.382–1.037)	0.037	0.047	0.104	0.196	0.570	1.315	1.824
Other fish	36	0.075	0.119	(0.044–0.130)	0.004	0.004	0.011	0.022	0.054	0.239	0.372
All finfish	72	0.530	0.707	(0.391–0.724)	0.017	0.026	0.119	0.286	0.603	1.642	2.132
All fish	73	1.026	1.563	(0.772–1.635)	0.049	0.074	0.238	0.560	1.134	2.363	2.641

N = Sample size.
SD = Standard deviation.
CI = Confidence interval.

Source: Polissar et al. (2006).

Table 10-110. Percentiles and Mean of Consumption Rates by Sex for Adult Consumers Only (g/kg-day)

Species	Sex	*N*	Mean	SD	95% CI	Percentiles						
						5th	10th	25th	50th	75th	90th	95th
Squaxin Island Tribe												
Anadromous fish	Male	65	0.596	0.629	(0.465–0.770)	0.026	0.039	0.163	0.388	0.816	1.313	1.957
	Female	52	0.766	1.618	(0.463–1.458)	0.016	0.023	0.068	0.184	0.656	1.736	3.321
Pelagic fish	Male	39	0.104	0.235	(0.055–0.219)	0.003	0.008	0.013	0.037	0.074	0.181	0.299
	Female	23	0.091	0.136	(0.050–0.160)	0.005	0.007	0.017	0.030	0.096	0.322	0.349
Bottom fish	Male	55	0.091	0.185	(0.060–0.185)	0.005	0.007	0.017	0.041	0.077	0.180	0.365
	Female	39	0.096	0.175	(0.058–0.177)	0.006	0.007	0.014	0.034	0.089	0.226	0.330
Shellfish	Male	52	0.305	0.586	(0.215–0.645)	0.006	0.014	0.052	0.136	0.337	0.662	0.782
	Female	34	0.245	0.372	(0.149–0.407)	0.007	0.018	0.047	0.119	0.250	0.563	1.163
Other fish	Male	27	0.047	0.066	(0.029–0.085)	0.003	0.005	0.006	0.020	0.061	0.124	0.139
	Female	12	0.045	0.068	(0.016–0.100)	-	0.004	0.008	0.015	0.037	0.144	-
All finfish	Male	65	0.735	0.784	(0.586–0.980)	0.044	0.079	0.226	0.500	1.045	1.552	2.181
	Female	52	0.878	1.686	(0.546–1.652)	0.026	0.039	0.115	0.272	0.840	1.908	3.687
All fish	Male	65	0.999	0.991	(0.794–1.291)	0.082	0.157	0.335	0.775	1.196	2.036	2.994
	Female	52	1.049	1.808	(0.712–1.793)	0.041	0.061	0.183	0.353	1.083	2.918	4.410
Tulalip Tribe												
Anadromous fish	Male	41	0.546	0.754	(0.373–0.856)	0.011	0.020	0.066	0.408	0.570	1.433	2.085
	Female	31	0.327	0.528	(0.189–0.578)	0.014	0.028	0.066	0.134	0.290	0.625	1.543
Pelagic fish	Male	24	0.066	0.099	(0.037–0.119)	0.013	0.014	0.016	0.030	0.064	0.175	0.223
	Female	14	0.096	0.103	(0.046–0.153)	-	0.005	0.016	0.053	0.156	0.227	-
Bottom fish	Male	24	0.061	0.106	(0.035–0.147)	0.006	0.006	0.009	0.030	0.070	0.097	0.142
	Female	20	0.063	0.073	(0.039–0.103)	0.007	0.008	0.014	0.029	0.093	0.179	0.214

Table 10-110. Percentiles and Mean of Consumption Rates by Sex for Adult Consumers Only (g/kg-day) (continued)

Species	Sex	*N*	Mean	SD	95% CI	Percentiles						
						5th	10th	25th	50th	75th	90th	95th
Shellfish	Male	35	0.599	1.261	(0.343–1.499)	0.036	0.048	0.098	0.183	0.505	1.329	1.826
	Female	26	0.505	0.818	(0.292–1.018)	0.043	0.047	0.117	0.215	0.582	1.074	1.357
Other fish	Male	24	0.064	0.114	(0.029–0.134)	0.004	0.004	0.007	0.026	0.043	0.174	0.334
	Female	12	0.097	0.131	(0.041–0.190)	-	0.011	0.015	0.022	0.142	0.254	-
All finfish	Male	41	0.620	0.795	(0.438–0.966)	0.017	0.020	0.098	0.421	0.706	1.995	2.185
	Female	31	0.411	0.561	(0.265–0.678)	0.025	0.036	0.126	0.236	0.404	0.924	1.769
All fish	Male	42	1.140	1.805	(0.785–2.047)	0.049	0.068	0.208	0.623	1.142	2.496	2.638
	Female	31	0.872	1.168	(0.615–1.453)	0.066	0.144	0.305	0.510	0.963	1.938	2.317

N = Sample size.
SD = Standard deviation.
CI = Confidence interval.
\- = No data.

Source: Polissar et al. (2006).

Table 10-111. Percentiles and Mean of Consumption Rates by Age for Adult Consumers Only—Squaxin Island Tribe (g/kg-day)

Species	Age Group (years)	*N*	Mean	SD	95% CI	Percentiles 5th	10th	25th	50th	75th	90th	95th
Anadromous fish	18 to 34	54	0.664	1.392	(0.430–1.438)	0.019	0.026	0.078	0.233	0.863	1.236	1.969
	35 to 49	41	0.563	0.820	(0.376–0.914)	0.023	0.031	0.073	0.292	0.590	1.354	2.062
	50 to 64	11	1.126	1.511	(0.595–2.791)	-	0.212	0.278	0.771	0.948	2.160	-
	≥65	11	0.662	0.681	(0.321–1.097)	-	0.015	0.107	0.522	0.924	1.636	-
Pelagic fish	18 to 34	22	0.067	0.086	(0.040–0.114)	0.006	0.007	0.014	0.035	0.081	0.186	0.228
	35 to 49	30	0.128	0.269	(0.063–0.272)	0.003	0.005	0.014	0.029	0.101	0.248	0.626
	50 to 64	4	0.154	0.239	(0.027–0.396)	-	-	0.033	0.045	0.166	-	-
	≥65	6	0.036	0.023	(0.020–0.053)	-	-	0.017	0.038	0.047	-	-
Bottom fish	18 to 34	41	0.063	0.102	(0.043–0.120)	0.004	0.006	0.012	0.034	0.069	0.115	0.221
	35 to 49	35	0.126	0.225	(0.076–0.276)	0.010	0.013	0.023	0.051	0.111	0.273	0.446
	50 to 64	9	0.159	0.302	(0.029–0.460)	-	0.009	0.014	0.029	0.067	0.451	-
	≥65	9	0.035	0.031	(0.020–0.065)	-	0.006	0.018	0.034	0.043	0.060	-
Shellfish	18 to 34	44	0.335	0.657	(0.211–0.729)	0.014	0.019	0.041	0.127	0.327	0.698	1.046
	35 to 49	27	0.264	0.321	(0.171–0.422)	0.016	0.054	0.082	0.146	0.277	0.582	0.984
	50 to 64	5	0.321	0.275	(0.137–0.589)	-	-	0.100	0.335	0.364	-	-
	≥65	10	0.076	0.079	(0.033–0.124)	-	0.005	0.007	0.042	0.155	0.180	-
Other fish	18 to 34	20	0.079	0.079	(0.053–0.122)	0.004	0.005	0.025	0.046	0.124	0.161	0.218
	35 to 49	10	0.014	0.008	(0.009–0.019)	-	0.005	0.007	0.015	0.020	0.022	-
	50 to 64	2	0.007	0.003	(0.005–0.009)	-	-	-	0.007	-	-	-
	≥65	7	0.010	0.007	(0.006–0.015)	-	-	0.006	0.008	0.014	-	-

Table 10-111. Percentiles and Mean of Consumption Rates by Age for Adult Consumers Only—Squaxin Island Tribe (g/kg-day) (continued)

Species	Age Group (years)	*N*	Mean	SD	95% CI	Percentiles						
						5th	10th	25th	50th	75th	90th	95th
All finfish	18 to 34	54	0.739	1.417	(0.508–1.372)	0.025	0.039	0.105	0.289	0.887	1.466	2.296
	35 to 49	41	0.764	1.001	(0.527–1.173)	0.046	0.082	0.226	0.383	0.816	1.859	2.423
	50 to 64	11	1.312	1.744	(0.690–3.219)	-	0.212	0.297	0.909	1.119	2.188	-
	≥65	11	0.711	0.699	(0.386–1.259)	-	0.027	0.119	0.601	0.986	1.637	-
All fish	18 to 34	54	1.041	1.570	(0.729–1.741)	0.052	0.107	0.217	0.500	1.117	2.669	3.557
	35 to 49	41	0.941	1.217	(0.652–1.453)	0.051	0.136	0.248	0.483	0.975	2.227	3.009
	50 to 64	11	1.459	1.773	(0.770–3.258)	-	0.317	0.327	1.106	1.301	2.936	-
	≥65	11	0.786	0.727	(0.446–1.242)	-	0.058	0.122	0.775	1.091	1.687	-

N = Sample size.
SD = Standard deviation.
CI = Confidence interval.
\- = No data.

Source: Polissar et al. (2006).

Table 10-112. Percentiles and Mean of Consumption Rates by Age for Adult Consumers Only—Tulalip Tribe (g/kg-day)

Species	Age Group (years)	*N*	Mean	SD	95% CI	Percentiles 5th	10th	25th	50th	75th	90th	95th
Anadromous fish	18 to 34	27	0.298	0.456	(0.169–0.524)	0.011	0.016	0.061	0.120	0.315	0.713	1.281
	35 to 49	23	0.725	0.928	(0.436–1.202)	0.010	0.032	0.078	0.431	0.719	2.001	2.171
	50 to 64	16	0.393	0.550	(0.225–0.854)	-	0.059	0.164	0.228	0.420	0.599	-
	≥65	6	0.251	0.283	(0.065–0.475)	-	-	0.022	0.164	0.425	-	-
Pelagic fish	18 to 34	12	0.092	0.099	(0.051–0.173)	-	0.016	0.021	0.054	0.124	0.218	-
	35 to 49	15	0.077	0.118	(0.039–0.206)	-	0.013	0.015	0.021	0.087	0.189	-
	50 to 64	8	0.077	0.085	(0.037–0.160)	-	-	0.027	0.034	0.090	-	-
	≥65	3	0.008	0.009	(0.002–0.014)	-	-	0.003	0.004	0.011	-	-
Bottom fish	18 to 34	14	0.075	0.138	(0.033–0.205)	-	0.007	0.010	0.020	0.078	0.142	-
	35 to 49	16	0.066	0.069	(0.041–0.112)	-	0.007	0.023	0.053	0.077	0.152	-
	50 to 64	11	0.051	0.056	(0.026–0.098)	-	0.007	0.011	0.036	0.069	0.119	-
	≥65	3	0.015	0.005	(0.008–0.018)	-	-	0.013	0.017	0.018	-	-
Shellfish	18 to 34	23	0.440	0.487	(0.289–0.702)	0.049	0.053	0.131	0.196	0.582	1.076	1.410
	35 to 49	19	1.065	1.784	(0.536–2.461)	0.049	0.074	0.123	0.250	1.222	2.265	4.351
	50 to 64	14	0.245	0.216	(0.158–0.406)	-	0.048	0.117	0.224	0.282	0.417	-
	≥65	5	0.062	0.064	(0.027–0.135)	-	-	0.023	0.046	0.060	-	-
Other fish	18 to 34	15	0.097	0.146	(0.043–0.197)	-	0.010	0.017	0.033	0.102	0.319	-
	35 to 49	13	0.057	0.085	(0.022–0.123)	-	0.004	0.006	0.014	0.049	0.187	-
	50 to 64	6	0.075	0.138	(0.015–0.215)	-	-	0.012	0.018	0.038	-	-
	≥65	2	0.024	0.015	(0.014–0.024)	-	-	-	0.024	-	-	-
All finfish	18 to 34	27	0.378	0.548	(0.222–0.680)	0.018	0.022	0.080	0.156	0.438	0.840	1.677
	35 to 49	23	0.821	0.951	(0.532–1.315)	0.020	0.047	0.116	0.602	0.898	2.035	2.268
	50 to 64	16	0.467	0.535	(0.311–0.925)	-	0.186	0.227	0.301	0.503	0.615	-
	≥65	6	0.263	0.293	(0.091–0.518)	-	-	0.030	0.176	0.430	-	-
All fish	18 to 34	27	0.806	0.747	(0.575–1.182)	0.071	0.136	0.231	0.617	1.126	1.960	2.457
	35 to 49	24	1.661	2.466	(0.974–3.179)	0.017	0.069	0.177	0.968	2.005	3.147	5.707
	50 to 64	16	0.710	0.591	(0.513–1.144)	-	0.278	0.370	0.495	0.944	1.070	-
	≥65	6	0.322	0.344	(0.107–0.642)	-	-	0.062	0.195	0.475	-	-

- = No data.

Source: Polissar et al. (2006).

Table 10-113. Percentiles and Mean of Consumption Rates for Child Consumers Only (g/kg-day)

Species	*N*	Mean	SD	Percentiles						
				5th	10th	25th	50th	75th	90th	95th
Squaxin Island Tribe										
Anadromous fish	33	0.392	1.295	0.005	0.006	0.030	0.049	0.130	0.686	0.786
Pelagic fish	21	0.157	0.245	0.010	0.014	0.019	0.044	0.107	0.547	0.712
Bottom fish	18	0.167	0.362	-	0.006	0.014	0.026	0.050	0.482	-
Shellfish	31	2.311	8.605	0.006	0.025	0.050	0.262	0.404	0.769	4.479
Other fish	30	0.577	0.584	0.012	0.051	0.111	0.400	0.566	1.620	1.628
All finfish	35	0.538	1.340	0.005	0.007	0.046	0.062	0.216	1.698	2.334
All fish	36	2.890	8.433	0.012	0.019	0.244	0.704	1.495	2.831	7.668
Tulalip Tribe										
Anadromous fish	14	0.148	0.229	-	0.012	0.026	0.045	0.136	0.334	-
Pelagic fish	7	0.152	0.178	-	-	0.027	0.053	0.165	-	-
Bottom fish	2	0.044	0.005	-	-	-	0.041	-	-	-
Shellfish	11	0.311	0.392	-	0.012	0.034	0.036	0.518	0.803	-
Other fish	1	0.115	0.115	-	-	-	-	-	-	-
All finfish	15	0.310	0.332	-	0.027	0.082	0.133	0.431	0.734	-
All fish	15	0.449	0.529	-	0.066	0.088	0.215	0.601	0.884	-

N = Sample size.
SD = Standard deviation.
- = No data.

Source: Polissar et al. (2006).

Table 10-114. Percentiles and Mean of Consumption Rates by Sex for Child Consumers Only (g/kg-day)

					Percentiles						
Species	Sex	*N*	Mean	SD	5th	10th	25th	50th	75th	90th	95th
Squaxin Island Tribe											
Anadromous fish	Male	15	0.702	1.937	-	0.009	0.026	0.062	0.331	1.082	-
	Female	18	0.155	0.253	-	0.005	0.025	0.046	0.090	0.600	-
Pelagic fish	Male	8	0.102	0.138	-	-	0.015	0.058	0.099	-	-
	Female	13	0.179	0.280	-	0.015	0.020	0.040	0.109	0.681	-
Bottom fish	Male	6	0.038	0.057	-	-	0.016	0.020	0.026	-	-
	Female	12	0.244	0.442	-	0.005	0.010	0.028	0.105	0.736	-
Shellfish	Male	13	0.275	0.244	-	0.036	0.047	0.241	0.353	0.462	-
	Female	18	3.799	11.212	-	0.008	0.050	0.229	0.490	1.333	-
Other fish	Male	13	0.836	0.663	-	0.106	0.232	0.448	1.530	1.625	-
	Female	17	0.400	0.463	-	0.013	0.096	0.311	0.486	0.610	-
All finfish	Male	15	0.787	1.940	-	0.009	0.038	0.062	0.521	1.500	-
	Female	20	0.372	0.719	0.005	0.005	0.037	0.071	0.179	1.408	2.119
All fish	Male	15	1.700	1.965	-	0.061	0.476	1.184	1.937	2.444	-
	Female	21	3.655	10.738	0.008	0.014	0.160	0.599	0.916	2.764	16.374
Tulalip Tribe											
Anadromous fish	Male	7	0.061	0.052	-	-	0.023	0.034	0.067	-	-
	Female	7	0.237	0.306	-	-	0.032	0.080	0.198	-	-
Pelagic fish	Male	5	0.106	0.081	-	-	0.044	0.053	0.128	-	-
	Female	2	0.265	0.350	-	-	-	0.017	-	-	-
Bottom fish	Male	0	-	-	-	-	-	-	-	-	-
	Female	2	0.044	0.005	-	-	-	0.041	-	-	-
Shellfish	Male	5	0.141	0.221	-	-	0.012	0.027	0.110	-	-
	Female	6	0.431	0.459	-	-	0.034	0.219	0.651	-	-
Other fish	Male	0	-	-	-	-	-	-	-	-	-
	Female	1	0.115	0.115	-	-	-	-	-	-	-
All finfish	Male	8	0.208	0.176	-	-	0.087	0.133	0.322	-	-
	Female	7	0.433	0.440	-	-	0.045	0.165	0.652	-	-
All fish	Male	8	0.202	0.169	-	-	0.071	0.122	0.233	-	-
	Female	7	0.745	0.670	-	-	0.155	0.488	0.835	-	-

N = Sample size.
SD = Standard deviation.
- = No data.

Source: Polissar et al. (2006).

Table 10-115. Consumption Rates of API Community Members

Category	*N*	Median (g/kg-day)	Mean (g/kg-day)	Percentage of Consumption[a]	SE	95% LCI (g/kg-day)	95% UCI (g/kg-day)	90th Percentile (g/kg-day)
Anadromous Fish	202	0.093	0.201	10.6%	0.008	0.187	0.216	0.509
Pelagic Fish	202	0.215	0.382	20.2%	0.013	0.357	0.407	0.829
Freshwater Fish	202	0.043	0.110	5.8%	0.005	0.101	0.119	0.271
Bottom Fish	202	0.047	0.125	6.6%	0.006	0.113	0.137	0.272
Shellfish Fish	202	0.498	0.867	45.9%	0.023	0.821	0.913	1.727
Seaweed/Kelp	202	0.014	0.084	4.4%	0.005	0.075	0.093	0.294
Miscellaneous Seafood	202	0.056	0.121	6.4%	0.004	0.112	0.130	0.296
All Finfish	202	0.515	0.818	43.3%	0.023	0.774	0.863	1.638
All Fish	202	1.363	1.807	95.6%	0.042	1.724	1.889	3.909
All Seafood	202	1.439	1.891	100.0%	0.043	1.805	1.976	3.928

[a] Percentage of consumption = the percent of each category that makes up the total (i.e., 10.6% of total fish eaten was anadromous fish).

N = Sample size.
SE = Standard error.
LCI = 95% lower confidence interval.
UCI = 95% upper confidence interval.
Note: Confidence intervals were computed based on the Student's t-distribution. Rates were weighted across ethnic groups.

Source: U.S. EPA (1999).

Table 10-116. Demographic Characteristics of "Higher" and "Lower" Seafood Consumers

		All Finfish		Shellfish	
		Lower Consumers	Higher Consumers[a]	Lower Consumers	Higher Consumers[b]
	N	(%)	(%)	(%)	(%)
Female	107	76	24	71	29
Male	95	81	19	79	21
18 to 29 years	78	85	15	73	27
30 to 54 years	85	79	21	78	22
55+	39	64	36	72	28
Cambodian	20	90	10	70	30
Chinese	30	83	17	70	30
Filipino	30	80	20	87	13
Japanese	29	48	52	79	21
Korean	22	91	9	68	32
Laotian	20	75	25	75	25
Mien	10	90	10	90	10
Hmong	5	100	0	100	0
Samoan	10	100	0	100	0
Vietnamese	26	69	31	50	50
Non-fishermen	136	82	18	76	24
Fishermen	66	71	29	73	27

[a] Higher Consumer: >75 percentile = 1.144 g/kg-day.
[b] Higher Consumer: >75 percentile = 1.072g/kg-day.
N = Sample size.

Source: U.S. EPA (1999).

Table 10-117. Seafood Consumption Rates by Ethnicity for Asian and Pacific Islander Community (g/kg-day)[a]

Category	Ethnicity	*N*	Mean	SE	10 Percentile	Median	90 Percentile	% With Non-Zero Consumption	Consumers (%)	95% LCI	95% UCI
Anadromous fish	Cambodian	20	0.118	0.050	0.000	0.030	0.453	18	90	0.014	0.223
($p < 0.001$)	Chinese	30	0.193	0.052	0.012	0.066	0.587	30	100	0.086	0.300
	Filipino	30	0.152	0.027	0.025	0.100	0.384	29	96.7	0.098	0.206
	Japanese	29	0.374	0.056	0.086	0.251	0.921	29	100	0.261	0.488
	Korean	22	0.091	0.026	0.007	0.048	0.248	22	100	0.037	0.146
	Laotian	20	0.187	0.064	0.002	0.069	0.603	18	90	0.054	0.321
	Mien	10	0.018	0.008	0.000	0.011	0.080	7	70	0.000	0.036
	Hmong	5	0.059	0.013	n/a	0.071	n/a	5	100	0.026	0.091
	Samoan	10	0.067	0.017	0.012	0.054	0.185	10	100	0.030	0.104
	Vietnamese	26	0.124	0.026	0.017	0.072	0.349	26	100	0.071	0.176
	All Ethnicity (1)	202	0.201	0.008	0.016	0.093	0.509	194	96	0.187	0.216
Pelagic Fish	Cambodian	20	0.088	0.021	0.000	0.061	0.293	17	85	0.044	0.131
($p < 0.001$)	Chinese	30	0.325	0.068	0.022	0.171	0.824	30	100	0.187	0.463
	Filipino	30	0.317	0.081	0.051	0.132	0.729	30	100	0.151	0.482
	Japanese	29	0.576	0.079	0.132	0.429	1.072	29	100	0.415	0.737
	Korean	22	0.313	0.056	0.073	0.186	0.843	22	100	0.196	0.429
	Laotian	20	0.412	0.138	0.005	0.115	1.061	20	100	0.124	0.700
	Mien	10	0.107	0.076	0.000	0.09	0.716	7	70	–0.064	0.277
	Hmong	5	0.093	0.028	n/a	0.090	n/a	5	100	0.021	0.164
	Samoan	10	0.499	0.060	0.128	0.535	0.792	10	100	0.365	0.633
	Vietnamese	26	0.377	0.086	0.059	0.208	0.956	26	100	0.201	0.553
	All Ethnicity (1)	202	0.382	0.013	0.046	0.215	0.829	196	97	0.357	0.407
Freshwater Fish	Cambodian	20	0.139	0.045	0.000	0.045	0.565	18	90	0.045	0.232
($p < 0.001$)	Chinese	30	0.084	0.023	0.000	0.015	0.327	24	80	0.037	0.131
	Filipino	30	0.132	0.034	0.018	0.086	0.273	30	100	0.062	0.202
	Japanese	29	0.021	0.006	0.000	0.007	0.071	20	69	0.010	0.032
	Korean	22	0.032	0.015	0.000	0.008	0.160	13	59.1	0.002	0.062
	Laotian	20	0.282	0.077	0.002	0.099	1.006	18	90	0.122	0.442
	Mien	10	0.097	0.039	0.007	0.070	0.407	10	100	0.010	0.184
	Hmong	5	0.133	0.051	n/a	0.081	n/a	5	100	0.002	0.263
	Samoan	10	0.026	0.007	0.000	0.025	0.061	9	90	0.011	0.041
	Vietnamese	26	0.341	0.064	0.068	0.191	1.036	26	100	0.209	0.472
	All Ethnicity (1)	202	0.110	0.005	0.000	0.043	0.271	173	85.6	0.101	0.119

Table 10-117. Seafood Consumption Rates by Ethnicity for Asian and Pacific Islander Community (g/kg-day)[a] (continued)

Category	Ethnicity	*N*	Mean	SE	10 Percentile	Median	90 Percentile	% With Non-Zero Consumption	Consumers (%)	95% LCI	95% UCI
Bottom Fish	Cambodian	20	0.045	0.025	0.000	0.003	0.114	10	50	–0.006	0.097
($p < 0.001$)	Chinese	30	0.082	0.026	0.004	0.033	0.212	28	93.3	0.028	0.135
	Filipino	30	0.165	0.043	0.001	0.103	0.560	27	90	0.078	0.253
	Japanese	29	0.173	0.044	0.023	0.098	0.554	28	96.6	0.083	0.263
	Korean	22	0.119	0.026	0.000	0.062	0.270	19	86.4	0.064	0.173
	Laotian	20	0.066	0.031	0.000	0.006	0.173	13	65	0.000	0.131
	Mien	10	0.006	0.003	0.000	0.00	0.026	4	40	–0.001	0.013
	Hmong	5	0.036	0.021	n/a	0.024	n/a	3	60	–0.017	0.088
	Samoan	10	0.029	0.005	0.008	0.026	0.058	10	100	0.018	0.040
	Vietnamese	26	0.102	0.044	0.000	0.030	0.388	21	80.8	0.013	0.192
	All Ethnicity (1)	202	0.125	0.006	0.000	0.047	0.272	163	80.7	0.113	0.137
Shellfish Fish	Cambodian	20	0.919	0.216	0.085	0.695	2.003	20	100	0.467	1.370
($p < 0.001$)	Chinese	30	0.985	0.168	0.176	0.569	2.804	30	100	0.643	1.327
	Filipino	30	0.613	0.067	0.188	0.505	1.206	30	100	0.477	0.750
	Japanese	29	0.602	0.089	0.116	0.401	1.428	29	100	0.419	0.784
	Korean	22	1.045	0.251	0.251	0.466	2.808	22	100	0.524	1.566
	Laotian	20	0.898	0.259	0.041	0.424	2.990	19	95	0.357	1.439
	Mien	10	0.338	0.113	0.015	0.201	1.058	10	100	0.086	0.590
	Hmong	5	0.248	0.014	n/a	0.252	n/a	5	100	0.212	0.283
	Samoan	10	0.154	0.024	0.086	0.138	0.336	10	100	0.100	0.208
	Vietnamese	26	1.577	0.260	0.247	1.196	4.029	26	100	1.044	2.110
	All Ethnicity (1)	202	0.867	0.023	0.168	0.498	1.727	201	99.5	0.821	0.913
Seaweed/Kelp	Cambodian	20	0.002	0.001	0.000	0.000	0.008	7	35	0.000	0.004
($p < 0.001$)	Chinese	30	0.062	0.022	0.001	0.017	0.314	29	96.7	0.016	0.107
	Filipino	30	0.009	0.004	0.000	0.000	0.025	15	50	0.002	0.016
	Japanese	29	0.190	0.043	0.019	0.082	0.752	29	100	0.101	0.279
	Korean	22	0.200	0.050	0.011	0.087	0.686	21	95.5	0.096	0.304
	Laotian	20	0.004	0.003	0.000	0.000	0.013	6	30	–0.001	0.009
	Mien	10	0.000	0.000	0.000	0.000	0.000	0	0	0.000	0.000
	Hmong	5	0.002	0.001	n/a	0.001	n/a	3	60	0.000	0.004
	Samoan	10	0.000	0.000	0.000	0.000	0.000	0	0	0.000	0.000
	Vietnamese	26	0.017	0.012	0.000	0.000	0.050	6	23.1	–0.008	0.043
	All Ethnicity (1)	202	0.084	0.005	0.000	0.014	0.294	116	57.4	0.075	0.093

Table 10-117. Seafood Consumption Rates by Ethnicity for Asian and Pacific Islander Community (g/kg-day)[a] (continued)

Category	Ethnicity	*N*	Mean	SE	10 Percentile	Median	90 Percentile	% With Non-Zero Consumption	Consumers (%)	95% LCI	95% UCI
Miscellaneous Fish	Cambodian	20	0.113	0.026	0.000	0.087	0.345	18	90	0.058	0.168
($p < 0.001$)	Chinese	30	0.081	0.021	0.003	0.030	0.201	30	100	0.038	0.123
	Filipino	30	0.083	0.025	0.016	0.043	0.182	30	100	0.032	0.134
	Japanese	29	0.246	0.036	0.032	0.206	0.620	29	100	0.173	0.139
	Korean	22	0.092	0.031	0.004	0.047	0.307	21	95.5	0.028	0.156
	Laotian	20	0.074	0.021	0.000	0.025	0.225	15	75	0.029	0.118
	Mien	10	0.015	0.008	0.000	0.002	0.063	7	70	0.003	0.033
	Hmong	5	0.019	0.014	n/a	0.008	n/a	4	80	0.018	0.055
	Samoan	10	0.076	0.028	0.003	0.045	0.276	10	100	0.014	0.138
	Vietnamese	26	0.089	0.013	0.013	0.087	0.184	25	96.2	0.062	0.115
	All Ethnicity (1)	202	0.121	0.004	0.005	0.056	0.296	189	93.6	0.112	0.130
All Finfish	Cambodian	20	0.390	0.098	0.061	0.223	1.379	20	100	0.185	0.594
($p < 0.001$)	Chinese	30	0.683	0.133	0.114	0.338	2.024	30	100	0.412	0.954
	Filipino	30	0.766	0.148	0.268	0.452	1.348	30	100	0.464	1.067
	Japanese	29	1.144	0.124	0.194	1.151	2.170	29	100	0.890	1.398
	Korean	22	0.555	0.079	0.180	0.392	1.204	22	100	0.391	0.719
	Laotian	20	0.947	0.204	0.117	0.722	2.646	20	100	0.523	1.372
	Mien	10	0.228	0.117	0.034	0.097	1.160	10	100	–0.032	0.488
	Hmong	5	0.319	0.073	n/a	0.268	n/a	5	100	0.131	0.507
	Samoan	10	0.621	0.059	0.225	0.682	0.842	10	100	0.490	0.751
	Vietnamese	26	0.944	0.171	0.188	0.543	2.568	26	100	0.593	1.296
	All Ethnicity (1)	202	0.818	0.023	0.166	0.515	1.638	202	100	0.774	0.863

Table 10-117. Seafood Consumption Rates by Ethnicity for Asian and Pacific Islander Community (g/kg-day)[a] (continued)

Category	Ethnicity	*N*	Mean	SE	10 Percentile	Median	90 Percentile	% With Non-Zero Consumption	Consumers (%)	95% LCI	95% UCI
All Fish	Cambodian	20	1.421	0.274	0.245	1.043	3.757	20	100	0.850	1
($p < 0.001$)	Chinese	30	1.749	0.283	0.441	1.337	4.206	30	100	1.172	2.326
	Filipino	30	1.462	0.206	0.660	1.137	2.423	30	100	1.041	1.883
	Japanese	29	1.992	0.214	0.524	1.723	3.704	29	100	1.555	2.429
	Korean	22	1.692	0.275	0.561	1.122	3.672	22	100	1.122	2.262
	Laotian	20	1.919	0.356	0.358	1.467	4.147	20	100	1.176	2.663
	Mien	10	0.580	0.194	0.114	0.288	1.967	10	100	0.149	1.012
	Hmong	5	0.585	0.069	n/a	0.521	n/a	5	100	0.407	0.764
	Samoan	10	0.850	0.078	0.363	0.879	1.188	10	100	0.676	1.025
	Vietnamese	26	2.610	0.377	0.653	2.230	6.542	26	100	1.835	3.385
	All Ethnicity (1)	202	1.807	0.042	0.480	1.363	3.909	202	100	1.724	1.889
All Seafood	Cambodian	20	1.423	0.274	0.245	1.043	3.759	20	100	0.851	1.995
($p < 0.001$)	Chinese	30	1.811	0.294	0.452	1.354	4.249	30	100	1.210	2.411
	Filipino	30	1.471	0.206	0.660	1.135	2.425	30	100	1.050	1.892
	Japanese	29	2.182	0.229	0.552	1.830	3.843	29	100	1.714	2.650
	Korean	22	1.892	0.294	0.608	1.380	4.038	22	100	1.281	2.503
	Laotian	20	1.923	0.356	0.400	1.467	4.147	20	100	1.181	2.665
	Mien	10	0.580	0.194	0.114	0.288	1.967	10	100	0.149	1.012
	Hmong	5	0.587	0.069	n/a	0.521	n/a	5	100	0.410	0.765
	Samoan	10	0.850	0.078	0.363	0.879	1.188	10	100	0.676	1.025
	Vietnamese	26	2.627	0.378	0.670	2.384	6.613	26	100	1.851	3.404
	All Ethnicity (1)	202	1.891	0.043	0.521	1.439	3.928	202	100	1.805	1.976

[a] All consumption rates in g/kg body weight/day. Weighted by population percentage.
N = Sample size.
SE = Standard error.
LCI = Lower confidence interval.
UCI = Upper confidence interval.
Note: *p*-values are based on Kruskal-Wallis test.

Source: U.S. EPA (1999).

Table 10-118. Consumption Rates by Sex for All Asian and Pacific Islander Community

	Female				Male			
Category	*N*	Mean (g/kg-day)	SE	Median (g/kg-day)	*N*	Mean (g/kg-day)	SE	Median (g/kg-day)
Anadromous Fish (p = 0.8)	107	0.165	0.022	0.076	95	0.169	0.024	0.080
Pelagic Fish (p = 0.4)	107	0.349	0.037	0.215	95	0.334	0.045	0.148
Freshwater Fish (p = 1.0)	107	0.131	0.021	0.054	95	0.137	0.023	0.054
Bottom Fish (p = 0. 6)	107	0.115	0.019	0.040	95	0.087	0.017	0.034
Shellfish (p = 0.8)	107	0.864	0.086	0.432	95	0.836	0.104	0.490
Seaweed/Kelp (p = 0.5)	107	0.079	0.018	0.005	95	0.044	0.010	0.002
Miscellaneous Seafood (p = 0.5)	107	0.105	0.013	0.061	95	0.104	0.015	0.055
All Finfish (p = 0.8)	107	0.759	0.071	0.512	95	0.726	0.072	0.458
All Fish (p = 0.5)	107	1.728	0.135	1.328	95	1.666	0.149	1.202
All Seafood (p = 0.4)	107	1.807	0.139	1.417	95	1.710	0.152	1.257

N = Sample size.
SE = Standard error.
Note: *p*-values are based on Mann-Whitney test.

Source: U.S. EPA (1999).

Table 10-119. Types of Seafood Consumed/Respondents Who Consumed (%)

Type of Seafood		(%)
Anadromous Fish		
	Salmon	93
	Trout	61
	Smelt	45
	Salmon Eggs	27
Pelagic Fish		
	Tuna	86
	Cod	66
	Mackerel	62
	Snapper	50
	Rockfish	34
	Herring	21
	Dogfish	7
	Snowfish	6
Freshwater Fish		
	Catfish	58
	Tilapia	45
	Perch	39
	Bass	28
	Carp	22
	Crappie	17
Bottom Fish		
	Halibut	65
	Sole/Flounder	42
	Sturgeon	13
	Suckers	4
Shellfish		
	Shrimp	98
	Crab	96
	Squid	82
	Oysters	71
	Manila/Littleneck Clams	72
	Lobster	65
	Mussel	62
	Scallops	57

Table 10-119. Types of Seafood Consumed/Respondents Who Consumed (%) (continued)

Type of Seafood	(%)
Butter Clams	39
Geoduck	34
Cockles	21
Abalone	15
Razor Clams	16
Sea Cucumber	15
Sea Urchin	14
Horse Clams	13
Macoma Clams	9
Moonsnail	4
Seaweed/Kelp	
Seaweed	57
Kelp	29

Source: U.S. EPA (1999).

Table 10-120. Mean, Median and 95th Percentile Fish Intake Rates for Different Groups (g/day)

Sample Group	Sample Size	Local Fish Intake[a]			Total Fish Intake[b]		
		Mean	Median	95th	Mean	Median	95th
Ethnicity							
African American	32	31.2	21.3	242.3	48.3	21.3	252.0
Southeast Asian	152	32.3	17.0	129.4	42.8	24.1	180.2
Hmong	67	17.8	14.9	89.6	22.3	19.1	89.6
Lao	30	57.6	21.3	310.4	65.2	24.1	317.5
Vietnamese	33	27.1	21.7	152.4	55.4	36.1	249.3
Asian/Pacific Islander	38	23.8	15.6	148.3	46.1	35.0	156.4
Hispanic	45	25.8	19.1	155.9	36.3	14.2	169.5
Native American	6	6.5	ND[c]	ND	69.9	108.4	ND
White	57	23.6	21.3	138.9	34.7	28.4	139.2
Russian	17	23.7	17.7	ND	36.1	35.5	ND
All Anglers	373	27.4	19.7	126.6	40.6	26.1	147.3
Southeast Asian[d]	286	40.8	17.0	128.5	50.3	25.5	144.5
Hmong[d]	130	21.3	14.9	102.1	26.5	17.0	119.7
Lao[d]	54	47.2	17.0	265.8	54.4	28.4	267.0
Age							
18 to 34	143	32.0	24.6	138.9	44.9	25.5	151.5
35 to 49	130	22.7	14.2	120.5	36.8	24.0	143.9
>49	87	30.6	17.0	207.0	44.3	24.1	217.2
Sex							
Female	35	38.2	22.5	226.8	53.9	24.6	263.1
Male	336	26.4	19.5	129.3	39.3	26.1	146.6
Household Contains							
Women 18 to 49 years	217	33.0	21.2	142.2	46.6	25.5	158.1
Children	174	35.1	22.2	142.8	49.2	27.1	171.9
Awareness[e]							
0	172	24.7	18.2	121.6	35.5	23.0	143.5
1	44	42.8	28.0	361.1	52.9	28.5	361.1
2	115	28.4	21.3	139.6	45.8	28.0	151.7
3	35	12.2	13.8	62.4	28.1	20.8	95.6
4	7	57.1	36.1	ND	65.0	39.0	ND

[a] Locally caught fish.
[b] Locally caught and commercially obtained fish.
[c] Not determined because of insufficient data.
[d] All data shown are for angler surveying, except for these groups which are rates from combined angler and community surveys.
[e] Respondent responses when asked about their awareness of warnings about fish contamination ranged from 0 = no awareness to 4 = high awareness.

Source: Shilling et al. (2010).

Table 10-121. Distribution of Quantity of Fish Consumed (in grams) per Eating Occasion, by Age and Sex

			Percentiles						
Age (years)-Sex Group	Mean	SD	5th	25th	50th	75th	90th	95th	99th
1 to 2 Male-Female	52	38	8	28	43	58	112	125	168
3 to 5 Male-Female	70	51	12	36	57	85	113	170	240
6 to 8 Male-Female	81	58	19	40	72	112	160	170	288
9 to 14 Male	101	78	28	56	84	113	170	255	425
9 to 14 Female	86	62	19	45	79	112	168	206	288
15 to 18 Male	117	115	20	57	85	142	200	252	454
15 to 18 Female	111	102	24	56	85	130	225	270	568
19 to 34 Male	149	125	28	64	113	196	284	362	643
19 to 34 Female	104	74	20	57	85	135	184	227	394
35 to 64 Male	147	116	28	80	113	180	258	360	577
35 to 64 Female	119	98	20	57	85	152	227	280	480
65 to 74 Male	145	109	35	75	113	180	270	392	480
65 to 74 Female	123	87	24	61	103	168	227	304	448
≥75 Male	124	68	36	80	106	170	227	227	336
≥75 Female	112	69	20	61	112	151	196	225	360
Overall	117	98	20	57	85	152	227	284	456

Source: Pao et al. (1982).

Table 10-122. Distribution of Quantity of Canned Tuna Consumed (grams) per Eating Occasion, by Age and Sex

Age (years)-Sex Group	Mean	SE	Percentiles						
			5th	10th	25th	50th	75th	90th	95th
2 to 5									
Male-Female	37	3	5*	8	14	29	56	73	85*
6 to 11									
Male-Female	58	8	14*	20*	28	49	60	99*	157*
12 to 19									
Male	98*	16*	-	18*	49*	84	162*	170*	186*
Female	64	6	14*	18*	28*	56	77*	105*	156*
20 to 39									
Male	84	7	15*	27*	49	57	113	160*	168*
Female	61	5	14*	14*	34	56	74	110*	142*
40 to 59									
Male	72	4	14*	27	37	57	96	127	168*
Female	60	4	13*	15	28	56	74	112	144
60 and older									
Male	64	5	12*	17*	37	56	81	114*	150*
Female	67	4	12*	23	42	57	85	112	153*

SE = Standard error.
* Indicates a statistic that is potentially unreliable because of small sample size or large coefficient of variation.
\- Indicates a percentage that could not be estimated.

Source: Smiciklas-Wright et al. (2002) (based on 1994–1996 CSFII data).

Table 10-123. Distribution of Quantity of Other Finfish Consumed (grams) per Eating Occasion, by Age and Sex

Age (years)-Sex Group	Mean	SE	Percentiles						
			5th	10th	25th	50th	75th	90th	95th
2 to 5									
Male-Female	64	4	8*	16	33	58	77	124	128*
6 to 11									
Male-Female	93	8	17*	31*	50	77	119	171*	232*
12 to 19									
Male	119*	11*	40*	50*	64*	89	170*	185*	249*
Female	89*	13*	20*	26*	47*	67	124*	164*	199*
20 to 39									
Male	117	8	37*	47	68	100	138	205	256*
Female	111	10	26*	36*	50	85	129	209*	289*
40 to 59									
Male	130	7	29*	47	75	110	153	243	287*
Female	107	9	29*	42	51	85	123	174	244*
60 and older									
Male	111	6	37*	45	57	90	133	220	261*
Female	108	6	33*	42	57	90	130	200	229*

SE = Standard error.

* Indicates a statistic that is potentially unreliable because of small sample size or large coefficient of variation.

Source: Smiciklas-Wright et al. (2002) (based on 1994–1996 CSFII data).

Table 10-124. Percentage of Individuals Using Various Cooking Methods at Specified Frequencies

Study	Use Frequency	Bake	Pan Fry	Deep Fry	Broil or Grill	Poach	Boil	Smoke	Raw	Other
Connelly et al. (1992)	Always	24[a]	51	13		24[a]				
	Ever	75[a]	88	59		75[a]				
Connelly et al. (1996)	Always	13	4	4						
	Ever	84	72	42						
CRITFC (1994)	At Least Monthly	79	51	14	27	11	46	31	1	34[b] 29[c] 49[d]
	Ever	98	80	25	39	17	73	66	3	67[b] 71[c] 75[d]
Fitzgerald et al. (1995)	Not Specified		94[e,f]	71[e,g]						
Puffer et al. (1982)	As Primary Method	16.3	52.5	12					0.25	19[h]

[a] 24 and 75 listed as bake, BBQ, or poach.
[b] Dried.
[c] Roasted.
[d] Canned.
[e] Not specified whether deep or pan fried.
[f] Mohawk women.
[g] Control population.
[h] Boil, stew, soup, or steam.

Table 10-125. Mean Percent Moisture and Total Fat Content for Selected Species

Species	Moisture Content (%)	Total Fat Content (%)	Comments
		FINFISH	
Anchovy, European	73.37	4.84	Raw
	50.30	9.71	Canned in oil, drained solids
Bass, Freshwater	75.66	3.69	Raw
	68.79	4,73	Cooked, dry heat
Bass, Striped	79.22	2.33	Raw
	73.36	2.99	Cooked, dry heat
Bluefish	70.86	4.24	Raw
	62.64	5.44	Cooked, dry heat
Burbot	79.26	0.81	Raw
	73.41	1.04	Cooked, dry heat
Butterfish	74.13	8.02	Raw
	66.83	10.28	Cooked, dry heat
Carp	76.31	5.60	Raw
	69.63	7.17	Cooked, dry heat
Catfish, Channel, Farmed	75.38	7.59	Raw
	71.58	8.02	Cooked, dry heat
Catfish, Channel, Wild	80.36	2.82	Raw
	77.67	2.85	Cooked, dry heat
Caviar, Black and Red	47.50	17.90	--
Cisco	78.93	69.80	Raw
	1.91	11.90	Smoked
Cod, Atlantic	81.22	0.67	Raw
	75.61	0.86	Canned, solids and liquids
	75.92	0.86	Cooked, dry heat
	16.14	2.37	Dried and salted
Cod, Pacific	81.28	0.63	Raw
	76.00	0.81	Cooked, dry heat
Croaker, Atlantic	78.03	3.17	Raw
	59.76	12.67	Cooked, breaded and fried
Cusk	76.35	0.69	Raw
	69,68	0.88	Cooked, dry heat
Dolphinfish	77.55	0.70	Raw
	71.22	0.90	Cooked, dry heat
Drum, Freshwater	77.33	4.93	Raw
	70.94	6.32	Cooked, dry heat
Eel	69.26	11.66	Raw
	59.31	14.95	Cooked, dry heat
Flatfish, Flounder, and Sole	79.06	1.19	Raw
	73.16	1.53	Cooked, dry heat
Grouper	79.22	1.02	Raw, mixed species
	73.36	1.30	Cooked, dry heat
Haddock	79.92	0.72	Raw
	74.25	0.93	Cooked, dry heat
	71.48	0.96	Smoked
Halibut, Atlantic and Pacific	77.92	2.29	Raw
	71.69	2.94	Cooked, dry heat

Table 10-125. Mean Percent Moisture and Total Fat Content for Selected Species (continued)

Species	Moisture Content (%)	Total Fat Content (%)	Comments
Halibut, Greenland	70.27	13.84	Raw
	61.88	17.74	Cooked, dry heat
Herring, Atlantic	72.05	9.04	Raw
	64.16	11.59	Cooked, dry heat
	59.70	12.37	Kippered
	55.22	18.00	Pickled
Herring, Pacific	71.52	13.88	Raw
	63.49	17.79	Cooked, dry heat
Ling	79.63	0.64	Raw
	73,88	0.82	Cooked, dry heat
Lingcod	81.03	1.06	Raw
	75.68	1.36	Cooked, dry heat
Mackerel, Atlantic	63.55	13.89	Raw
	53.27	17.81	Cooked, dry heat
Mackerel, Jack	69.17	6.30	Canned, drained solids
Mackerel, King	75.85	2.00	Raw
	69.04	2.56	Cooked, dry heat
Mackerel, Pacific and Jack	70.15	7.89	Raw
	61.73	10.12	Cooked, dry heat
Mackerel, Spanish	71.67	6.30	Raw
	68.46	6.32	Cooked, dry heat
Milkfish	70.85	6.73	Raw
	62.63	8.63	Cooked, dry heat
Monkfish	83.24	1.52	Raw
	78.51	1.95	Cooked, dry heat
Mullet, Striped	77.01	3.79	Raw
	70.52	4.86	Cooked, dry heat
Ocean Perch, Atlantic	78.70	1.63	Raw
	72.69	2.09	Cooked, dry heat
Perch	79.13	0.92	Raw
	73.25	1.18	Cooked, dry heat
Pike, Northern	78.92	0.69	Raw
	72.97	0.88	Cooked, dry heat
Pike, Walleye	79.31	1.22	Raw
	73.47	1.56	Cooked, dry heat
Pollock, Atlantic	78.18	0.98	Raw
	72.03	1.26	Cooked, dry heat
Pollock, Walleye	81.56	0.80	Raw
	74.06	1.12	Cooked, dry heat
Pompano, Florida	71.12	9.47	Raw
	62.97	12.14	Cooked, dry heat
Pout, Ocean	81.36	0.91	Raw
	76.10	1.17	Cooked, dry heat
Rockfish, Pacific	79.26	1.57	Raw
	73.41	2.01	Cooked, dry heat
Roe	67.73	6.42	Raw
	58.63	8.23	Cooked, dry heat
Roughy, Orange	75.67	0.70	Raw
	66.97	0.90	Cooked, dry heat
Sablefish	71.02	15.30	Raw
	62.85	19.62	Cooked, dry heat
	60.14	20.14	Smoked
Salmon, Atlantic, Farmed	68.90	10.85	Raw
	64.75	12.35	Cooked, dry heat
Salmon, Atlantic, Wild	68.50	6.34	Raw
	59.62	8.13	Cooked, dry heat
Salmon, Chinook	71.64	10.43	Raw
	65.60	13.38	Cooked, dry heat
	72.00	4.32	Smoked
Salmon, Chum	75.38	3.77	Raw
	68.44	4.83	Cooked, dry heat
	70.77	5.50	Drained solids with bone
Salmon, Coho, Farmed	70.47	7.67	Raw
	67.00	8.23	Cooked, dry heat
Salmon, Coho, Wild	72.66	5.93	Raw

Table 10-125. Mean Percent Moisture and Total Fat Content for Selected Species (continued)

Species	Moisture Content (%)	Total Fat Content (%)	Comments
	71.50	4.30	Cooked, dry heat
	65.39	7.50	Cooked, moist heat
Salmon, Pink	76.35	3.45	Raw
	69.68	4.42	Cooked, dry heat
	68.81	6.05	Canned, solids with bone and liquid
Salmon, Sockeye	70.24	8.56	Raw
	61.84	10.97	Cooked, dry heat
	67.51	7.31	Canned, drained solids with bone
Sardine, Atlantic	59.61	11.45	Canned in oil, drained solids with bone
Sardine, Pacific	66.65	10.46	Canned in tomato sauce, drained solids with bone
Scup	75.37	2.73	Raw
	68.42	3.50	Cooked, dry heat
Sea Bass	78.27	2.00	Raw
	72.14	2.56	Cooked, dry heat
Seatrout	78.09	3.61	Raw
	71.91	4.63	Cooked, dry heat
Shad, American	68.19	13.77	Raw
	59.22	17.65	Cooked, dry heat
Shark, mixed species	73.58	4.51	Raw
	60.09	13.82	Cooked, batter-dipped and fried
Sheepshead	77.97	2.41	Raw
	69.04	1.63	Cooked, dry heat
Smelt, Rainbow	78.77	2.42	Raw
	72.79	3.10	Cooked, dry heat
Snapper	76.87	1.34	Raw
	70.35	1.72	Cooked, dry heat
Spot	75.95	4.90	Raw
	69.17	6.28	Cooked, dry heat
Sturgeon	76.55	4.04	Raw
	69.94	5.18	Cooked, dry heat
	62.50	4.40	Smoked
Sucker, white	79.71	2.32	Raw
	73.99	2.97	Cooked, dry heat
Sunfish, Pumpkinseed	79.50	0.70	Raw
	73.72	0.90	Cooked, dry heat
Surimi	76.34	0.90	-
Swordfish	75.62	4.01	Raw
	68.75	5.14	Cooked, dry heat
Tilapia	78.08	1.70	Raw
	71.59	2.65	Cooked, dry heat
Tilefish	78.90	2.31	Raw
	70.24	4.69	Cooked, dry heat
Trout, Mixed Species	71.42	6.61	Raw
	63.36	8.47	Cooked, dry heat
Trout, Rainbow, Farmed	72.73	5.40	Raw
	67.53	7.20	Cooked, dry heat
Trout, Rainbow, Wild	71.87	3.46	Raw
	70.50	5.82	Cooked, dry heat
Tuna, Fresh, Bluefin	68.09	4.90	Raw
	59.09	6.28	Cooked, dry heat
Tuna, Fresh, Skipjack	70.58	1.01	Raw
	62.28	1.29	Cooked, dry heat
Tuna, Fresh, Yellowfin	70.99	0.95	Raw
	62.81	1.22	Cooked, dry heat
Tuna, Light	59.83	8.21	Canned in oil, drained solids
	74.51	0.82	Canned in water, drained solids
Tuna, White	64.02	8.08	Canned in oil, drained solids
	73.19	2.97	Canned in water, drained solids
Turbot, European	76.95	2.95	Raw
	70.45	3.78	Cooked, dry heat
Whitefish, mixed species	72.77	5.86	Raw
	65.09	7.51	Cooked, dry heat
	70.83	0.93	Smoked
Whiting, mixed species	80.27	1.31	Raw
	74.71	1.69	Cooked, dry heat

Table 10-125. Mean Percent Moisture and Total Fat Content for Selected Species (continued)

Species	Moisture Content (%)	Total Fat Content (%)	Comments
Wolffish, Atlantic	79.90	2.39	Raw
	74.23	3.06	Cooked, dry heat
Yellowtail, mixed species	74.52	5.24	Raw
	67.33	6.72	Cooked, dry heat
SHELLFISH			
Abalone	74.56	0.76	Raw
	60.10	6.78	Cooked, fried
Clam	81.82	0.97	Raw
	63.64	1.95	Canned, drained solids
	97.70	0.02	Canned, liquid
	61.55	11.15	Cooked, breaded and fried
	63.64	1.95	Cooked, moist heat
Crab, Alaska King	79.57	0.60	Raw
	77.55	1.54	Cooked, moist heat
	74.66	0.46	Imitation, made from surimi
Crab, Blue	79.02	1.08	Raw
	79.16	1.23	Canned
	77.43	1.77	Cooked, moist heat
	71.00	7.52	Crab cakes
Crab, Dungeness	79.18	0.97	Raw
	73.31	1.24	Cooked, moist heat
Crab, Queen	80.58	1.18	Raw
	75.10	1.51	Cooked, moist heat
Crayfish, Farmed	84.05	0.97	Raw
	80.80	1.30	Cooked, moist heat
Crayfish, Wild	82.24	0.95	Raw
	79.37	1.20	Cooked, moist heat
Cuttlefish	80.56	0.70	Raw
	61.12	1.40	Cooked, moist heat
Lobster, Northern	76.76	0.90	Raw
	76.03	0.59	Cooked, moist heat
Lobster, Spiny	74.07	1.51	Raw
	66.76	1.94	Cooked, moist heat
Mussel, Blue	80.58	2.24	Raw
	61.15	4.48	Cooked, moist heat
Octopus	80.25	1.04	Raw
	60.50	2.08	Cooked, moist heat
Oyster, Eastern	86.20	1.55	Raw, farmed
	85.16	2.46	Raw, wild
	85.14	2.47	Canned
	64.72	12.58	Cooked, breaded and fried
	81.95	2.12	Cooked, farmed, dry heat
	83.30	1.90	Cooked, wild, dry heat
	70.32	4.91	Cooked, wild, moist heat
Oyster, Pacific	82.06	2.30	Raw
	64.12	4.60	Cooked, moist heat
Scallop, mixed species	78.57	0.76	Raw
	58.44	10.94	Cooked, breaded and fried
	73.10	1.40	Steamed
Shrimp	75.86	1.73	Raw
	75.85	1.36	Canned
	52.86	12.28	Cooked, breaded and fried
	77.28	1.08	Cooked, moist heat
Squid	78.55	1.38	Raw
	64.54	7.48	Cooked, fried

Source: USDA (2007).

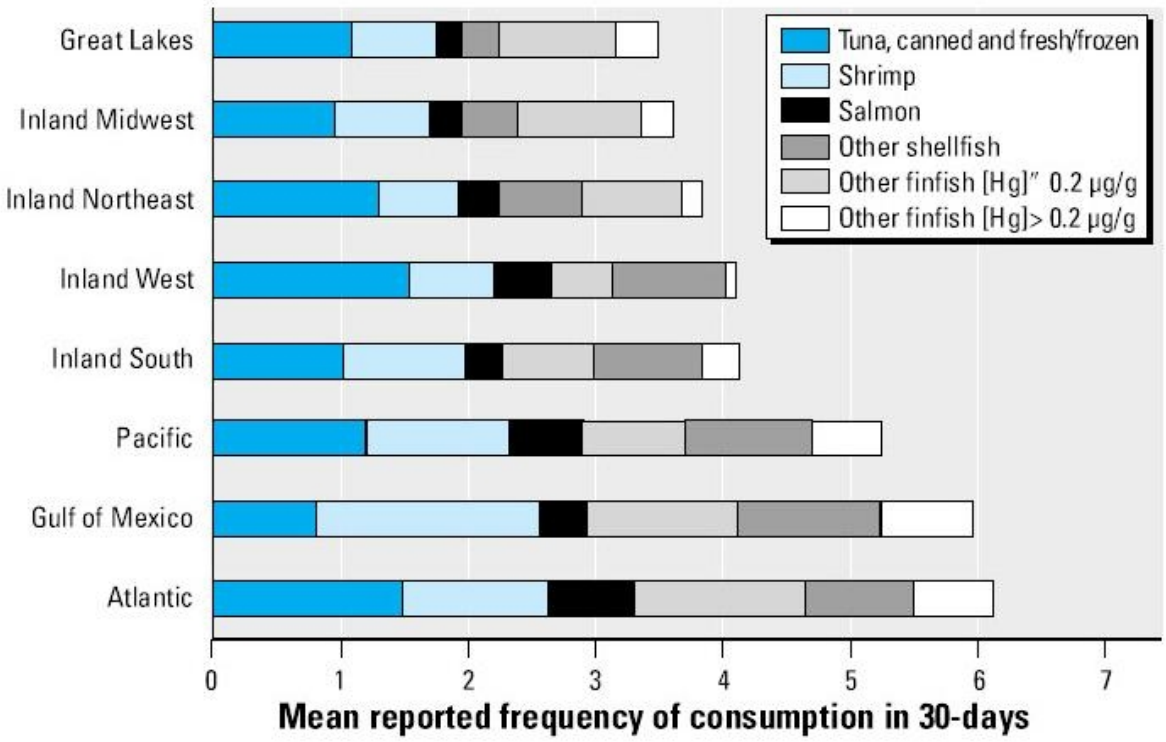

Figure 10-2. Species and Frequency of Meals Consumed by Geographic Residence.

Source: Mahaffey et al. (2009).

APPENDIX 10A:

RESOURCE UTILIZATION DISTRIBUTION

10A.1. RESOURCE UTILIZATION DISTRIBUTION

The percentiles of the resource utilization distribution of Y are to be distinguished from the percentiles of the (standard) distribution of Y. The latter percentiles show what percentage of individuals in the population are consuming below a given level. Thus, the 50^{th} percentile of the distribution of Y is that level such that 50% of individuals consume below it; on the other hand, the 50^{th} percentile of the resource utilization distribution is that level such that 50% of the overall consumption in the population is done by individuals consuming below it.

The percentiles of the resource utilization distribution of Y will always be greater than or equal to the corresponding percentiles of the (standard) distribution of Y, and, in the case of recreational fish consumption, usually considerably exceed the standard percentiles.

To generate the resource utilization distribution, one simply weights each observation in the data set by the Y level for that observation and performs a standard percentile analysis of weighted data. If the data already have weights, then one multiplies the original weights by the Y level for that observation, and then performs the percentile analysis.

Under certain assumptions, the resource utilization percentiles of fish consumption may be related (approximately) to the (standard) percentiles of fish consumption derived from the analysis of creel studies. In this instance, it is assumed that the creel survey data analysis did not employ sampling weights (i.e., weights were implicitly set to one); this is the case for many of the published analyses of creel survey data. In creel studies, the fish consumption rate for the i^{th} individual is usually derived by multiplying the amount of fish consumption per fishing trip (say C_i) by the frequency of fishing (say f_i). If it is assumed that the probability of sampling an angler is proportional to fishing frequency, then sampling weights of inverse fishing frequency ($1/f_i$) should be employed in the analysis of the survey data. Above it was stated that for data that are already weighted, the resource utilization distribution is generated by multiplying the original weights by the individual's fish consumption level to create new weights. Thus, to generate the resource utilization distribution from the data with weights of ($1/f_i$), one multiplies ($1/f_i$) by the fish consumption level of $f_i\ C_i$ to get new weights of C_i.

Now if C_i (amount of consumption per fishing trip) is constant over the population, then these new weights are constant and can be taken to be one. But weights of one is what (it is assumed) were used in the original creel survey data analysis. Hence, the resource utilization distribution is exactly the same as the original (standard) distribution derived from the creel survey using constant weights.

The accuracy of this approximation of the resource utilization distribution of fish by the (standard) distribution of fish consumption derived from an unweighted analysis of creel survey data depends then on two factors, how approximately constant the C_i's are in the population and how approximately proportional the relationship between sampling probability and fishing frequency is. Sampling probability will be roughly proportional to frequency if repeated sampling at the same site is limited or if re-interviewing is performed independent of past interviewing status.

Note: For any quantity Y that is consumed by individuals in a population, the percentiles of the "resource utilization distribution" of Y can be formally defined as follows: $Y_p\ (R)$ is the pth percentile of the resource utilization distribution if p percent of the overall consumption of Y in the population is done by individuals with consumption below $Y_p\ (R)$ and 100-p percent is done by individuals with consumption above $Y_p(R)$.

APPENDIX 10B:

FISH PREPARATION AND COOKING METHODS

Table 10B-1. Percent of Fish Meals Prepared Using Various Cooking Methods by Residence Size[a]

Residence Size	Large City/Suburb	Small City	Town	Small Town	Rural Non-Farm	Farm
Total Fish						
Cooking Method						
Pan Fried	32.7	31.0	36.0	32.4	38.6	51.6
Deep Fried	19.6	24.0	23.3	24.7	26.2	15.7
Boiled	6.0	3.0	3.4	3.7	3.4	3.5
Grilled/Broiled	23.6	20.8	13.8	21.4	13.7	13.1
Baked	12.4	12.4	10.0	10.3	12.7	6.4
Combination	2.5	6.0	8.3	5.0	2.3	7.0
Other (Smoked, etc.)	3.2	2.8	5.2	1.9	2.9	1.8
Don't Know	0	0	0	0.5	0.2	--
Total (*N*)	393	317	388	256	483	94
Sport Fish						
Pan Fried	45.8	45.7	47.6	41.4	51.2	63.3
Deep Fried	12.2	14.5	17.5	15.2	21.9	7.3
Boiled	2.8	2.3	2.9	0.5	3.6	0
Grilled/Broiled	20.2	17.6	10.6	25.3	8.2	10.4
Baked	11.8	8.8	6.3	8.7	9.7	6.9
Combination	2.7	8.5	10.4	6.7	1.9	9.3
Other (smoked, etc.)	4.5	2.7	4.9	1.5	3.5	2.8
Don't Know	0	0	0	0.7	0	0
Total (*N*)	205	171	257	176	314	62

[a] Large City = over 100,000; Small City = 20,000–100,000; Town = 2,000–20,000; Small Town = 100-2,000.

N = Total number of respondents.

Source: West et al. (1993).

Table 10B-2. Percent of Fish Meals Prepared Using Various Cooking Methods by Age

Age (years)	17–30	31–40	41–50	51–64	>64	Overall
Total Fish						
Cooking Method						
Pan Fried	45.9	31.7	30.5	33.9	40.7	35.3
Deep Fried	23.0	24.7	26.9	23.7	14.0	23.5
Boiled	0.0000	6.0	3.6	3.9	4.3	3.9
Grilled or Boiled	15.6	15.2	24.3	16.1	18.8	17.8
Baked	10.8	13.0	8.7	12.8	11.5	11.4
Combination	3.1	5.2	2.2	6.5	6.8	4.7
Other (Smoked, etc.)	1.6	4.2	3.5	2.7	4.0	3.2
Don't Know	0.0	0.0	0.3	0.4	0.0	0.2
Total (*N*)	246	448	417	502	287	1,946
Sport Fish						
Pan Fried	57.6	42.6	43.4	46.6	54.1	47.9
Deep Fried	18.2	21.0	17.3	14.8	7.7	16.5
Boiled	0.0000	4.4	0.8	3.2	3.1	2.4
Grilled/Broiled	15.0	10.1	25.9	12.2	12.2	14.8
Baked	3.6	10.4	6.4	11.7	9.9	8.9
Combination	3.8	7.2	3.0	7.5	8.2	5.9
Other (Smoked, etc.)	1.7	4.3	3.2	3.5	4.8	3.5
Don't Know	0.0	0.0	0.0	0.4	0.0	0.1
Total (*N*)	174	287	246	294	163	1,187

N = Total number of respondents.

Source: West et al. (1993).

Table 10B-3. Percent of Fish Meals Prepared Using Various Cooking Methods by Ethnicity

Ethnicity	Black	Native American	Hispanic	White	Other
Total Fish					
Cooking Method					
Pan Fried	40.5	37.5	16.1	35.8	18.5
Deep Fried	27.0	22.0	83.9	22.7	18.4
Boiled	0	1.1	0	4.3	0
Grilled/Broiled	19.4	9.8	0	17.7	57.6
Baked	1.9	16.3	0	11.7	5.4
Combination	9.5	6.2	0	4.5	0
Other (Smoked, etc.)	1.6	4.2	3.5	2.7	4.0
Don't Know	0	0	0.3	0.4	0
Total (*N*)	52	84	12	1,744	33
Sport Fish					
Pan Fried	44.9	47.9	52.1	48.8	22.0
Deep Fried	36.2	20.2	47.9	15.7	9.6
Boiled	0	0	0	2.7	0
Grilled/Broiled	0	1.5	0	14.7	61.9
Baked	5.3	18.2	0	8.6	6.4
Combination	13.6	8.6	0	5.6	0
Other (Smoked, etc.)	0	3.6	0	3.7	0
Total (*N*)	19	60	4	39	0

N = Total number of respondents.

Source: West et al. (1993).

Table 10B-4. Percent of Fish Meals Prepared Using Various Cooking Methods by Education

Ethnicity	Through Some H.S.	H.S. Degree	College Degree	Post-Graduate Education
Total Fish				
Cooking Method				
Pan Fried	44.7	41.8	28.8	22.9
Deep Fried	23.6	23.6	23.8	19.4
Boiled	2.2	2.8	5.1	5.8
Grilled/Broiled	8.9	10.9	23.8	34.1
Baked	8.1	12.1	11.6	12.8
Combination	10.0	5.1	3.0	3.8
Other (Smoked, etc.)	2.1	3.4	4.0	1.3
Don't Know	0.5	0.3	0	0
Total (*N*)	236	775	704	211
Sport Fish				
Pan Fried	56.1	52.4	41.8	36.3
Deep Fried	13.6	15.8	18.6	12.9
Boiled	2.8	2.4	3.0	0
Grilled/Broiled	6.3	9.4	21.7	28.3
Baked	7.4	10.6	6.1	14.9
Combination	10.1	6.3	3.9	6.5
Other (Smoked, etc.)	2.8	3.3	4.6	1.0
Total (*N*)	0.8	0	0	0
	146	524	421	91

N = Total number of respondents.

Source: West et al. (1993).

Table 10B-5. Percent of Fish Meals Prepared Using Various Cooking Methods by Income			
Ethnicity	0–$24,999	$25,000–$39,999	$40,000–or more
Total Fish			
Cooking Method			
Pan Fried	44.8	39.1	26.5
Deep Fried	21.7	22.2	23.4
Boiled	2.1	3.5	5.6
Grilled/Broiled	11.3	15.8	25.0
Baked	9.1	12.3	13.3
Combination	8.7	2.9	2.5
Other (Smoked, etc.)	2.4	4.0	3.5
Don't Know	0	0.2	0.3
Total (*N*)	544	518	714
Sport Fish			
Pan Fried	51.5	51.4	42.0
Deep Fried	15.8	15.8	17.2
Boiled	1.8	2.1	3.7
Grilled/Broiled	12.0	12.2	19.4
Baked	7.2	10.0	10.0
Combination	9.1	3.8	3.5
Other (Smoked, etc.)	2.7	4.6	3.8
Total (*N*)	0	0	0.3
	387	344	369

N = Total number of respondents.

Source: West et al. (1993).

Table 10B-6. Percent of Fish Meals Where Fat was Trimmed or Skin was Removed, by Demographic Variables

	Total Fish		Sport Fish	
Population	Trimmed Fat (%)	Skin Off (%)	Trimmed Fat (%)	Skin Off (%)
Total Fish				
Residence Size				
Large City/Suburb	51.7	31.6	56.7	28.9
Small City	56.9	34.1	59.3	36.2
Town	50.3	33.4	51.7	33.7
Small Town	52.6	45.2	55.8	51.3
Rural Non-Farm	42.4	32.4	46.2	34.6
Farm	37.3	38.1	39.4	42.1
Age (years)				
17–30	50.6	36.5	53.9	39.3
31–40	49.7	29.7	51.6	29.9
41–50	53.0	32.2	58.8	37.0
51–65	48.1	35.6	48.8	37.2
Over 65	41.6	43.1	43.0	42.9
Ethnicity				
Black	25.8	37.1	16.0	40.1
Native American	50.0	41.4	56.3	36.7
Hispanic	59.5	7.1	50.0	23.0
White	49.3	34.0	51.8	35.6
Other	77.1	61.6	75.7	65.5
Education				
Some High School	50.8	43.9	49.7	47.1
High School Degree	47.2	37.1	49.5	37.6
College Degree	51.9	31.9	55.9	33.8
Post-Graduate	47.6	26.6	53.4	38.7
Income				
<$25,000	50.5	43.8	50.6	47.3
$25,000–$39,999	47.8	34.0	54.9	34.6
$40,000 or more	50.2	28.6	51.7	27.7
Overall	49.0	34.7	52.1	36.5

Source: Modified from West et al. (1993).

Table 10B-7. Method of Cooking of Most Common Species Kept by Sportfishermen

Species	Percent of Anglers Catching Species	Use as Primary Cooking Method (%)				
		Deep Fried	Pan Fry	Bake and Charcoal Broil	Raw	Other[b]
White Croaker	34	19	64	12	0	5
Pacific Mackerel	25	10	41	28	0	21
Pacific Bonito	18	5	33	43	2	17
Queenfish	17	15	70	6	1	8
Jacksmelt	13	17	57	19	0	7
Walleye Perch	10	12	69	6	0	13
Shiner Perch	7	11	72	8	0	11
Opaleye	6	16	56	14	0	14
Black Perch	5	18	53	14	0	15
Kelp Bass	5	12	55	21	0	12
California Halibut	4	13	60	24	0	3
Shellfish[a]	3	0	0	0	0	100

[a] Crab, mussels, lobster, abalone.
[b] Boil, soup, steam, stew.
N = 1,059.

Source: Modified from Puffer et al. (1982).

Table 10B-8. Adult Consumption of Fish Parts

Species	Number Consuming	Weighted Percent Consuming Specific Parts					
		Fillet	Skin	Head	Eggs	Bones	Organs
Salmon	473	95.1	55.8	42.7	42.8	12.1	3.7
Lamprey	249	86.4	89.3	18.1	4.6	5.2	3.2
Trout	365	89.4	68.5	13.7	8.7	7.1	2.3
Smelt	209	78.8	88.9	37.4	46.4	28.4	27.9
Whitefish	125	93.8	53.8	15.4	20.6	6.0	0.0
Sturgeon	121	94.6	18.2	6.2	11.9	2.6	0.3
Walleye	46	100	20.7	6.2	9.8	2.4	0.9
Squawfish	15	89.7	34.1	8.1	11.1	5.9	0.0
Sucker	42	89.3	50.0	19.4	30.4	9.8	2.1
Shad	16	93.5	15.7	0.0	0.0	3.3	0.0

Source: CRITFC (1994).

10B.1. REFERENCES FOR APPENDIX 10B

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