

**ESTIMATED USUAL INTAKE OF CANNED
TUNA BY U.S. WOMEN AGE 15-44**

**Prepared for:
U.S. Tuna Foundation**

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ESTIMATED USUAL INTAKE OF CANNED TUNA BY U.S. WOMEN AGE 15-44

I. Executive Summary

ENVIRON International Corporation (ENVIRON), under contract with the United States Tuna Foundation, estimated the usual consumption of canned tuna by U.S. women age 15-44 years. Estimates of usual consumption were based on Monte Carlo simulations bringing together distributions of the amount of canned tuna women consume on those occasions when they consume it with distributions of the frequency in times per month that they consume canned tuna.

Estimates of the amount of canned tuna women eat per occasion were based on data from the Continuing Survey of Food Intakes by Individuals conducted in 1994-96 and 1998. Three different sources of data on the frequency of consumption of canned tuna were used to generate three independent estimates of usual consumption. The three sources were the Third National Health and Nutrition Examination Survey conducted in 1988-94, the NPD Group's National Eating Trends surveys conducted in 1996-2000, and a 1993-94 pilot study for a proposed (but never implemented) National Seafood Survey. In all cases, only individuals who eat canned tuna were included.

The three estimates of usual consumption of canned tuna by women age 15-44 were remarkably similar. All indicate that the usual consumption of canned tuna by women who eat it averages less than 7 g/day; at the 95th percentile of intake it is less than 20 g/day. Expressed in ounces per week, the 95th percentile of consumption is less than 5 oz/week.

II. Introduction

ENVIRON International Corporation (ENVIRON) is pleased to provide to the United States Tuna Foundation (USTF) estimates of the distribution of usual consumption of canned tuna by U.S. women age 15-44. These estimates are based on data on the amount of canned tuna consumed per eating occasion and on the frequency of consumption of canned tuna.

In order to determine the contribution of canned tuna to women's exposure to mercury, it is necessary to estimate their "usual intake" of canned tuna—i.e., the average amount per day they consume over an extended period of time. "Usual intake" of a food cannot be directly observed in most food consumption surveys because they are typically based on respondents' reports of consumption for only a few days. Rather, two separate types of information are required: first, the amount of canned tuna women consume when they eat it—the portion size; second, the frequency with which they eat canned tuna.

Of course, women do not all choose the same portion sizes of canned tuna, nor do they all eat it with the same frequency. Both of these types of data may be expressed in distributions representing the range of individual differences. If both types of data are available for the same individuals, they can be directly linked. However, if they are not available for the same people, then the linkage must be accomplished probabilistically by using a mathematical model to bring the two distributions together. This is what was done in the Environmental Protection Agency's 1997 Mercury Study Report to Congress (EPA, 1997), and the same procedure is followed here.

III. Methods

A. Portion Size

The food consumption data used to establish the distribution of portion sizes for canned tuna were results of the 1994-96 USDA Continuing Survey of Food Intakes by Individuals (CSFII) and its Supplemental Children's Survey (CSFII 1998), as provided on CD-ROM (USDA, 2000).

The CSFII 1994-96 was conducted between January 1994 and January 1997 with noninstitutionalized individuals in the United States. In each of the three survey years, data were collected from a nationally representative sample of individuals of all ages. The CSFII 1998 was a survey of children ages 0 through 9 which was supplemental to the CSFII 1994-96. It used the same sample design as the CSFII 1994-96 and was intended to be merged with CSFII 1994-96 to increase the sample size for children. The merged surveys are designated as CSFII 1994-96, 1998.

In the CSFII 1994-96, 1998, dietary intakes were collected through in-person interviews using 24-hour recalls on 2 nonconsecutive days approximately one week apart. A total of 21,662 individuals provided data for the first day; of those individuals, 20,607 provided data for a second day. For the USTF analyses, subjects were limited to women ages 15-44 who provided two complete days of dietary recall data.

A CSFII Food Code-to-Commodity Translation File was developed in a joint effort by USDA and EPA to allow estimation of human exposures to pesticide residues and environmental contaminants through intakes of foods and beverages (EPA, 2000). This file translates each CSFII food code into EPA commodity percentages. There is a specific EPA commodity code for tuna, 80001590. This code includes both fresh and canned tuna. Consequently, each foodcode that includes this commodity code as an ingredient was inspected; those foodcodes that indicate that the fish content is "fresh tuna" were removed from the analysis. If the source of tuna is not specified in a recipe, such as for tuna casserole, it was assumed to be canned tuna and the foodcode was included in the analysis.

ENVIRON used the USDA-EPA Food Code-to-Commodity Translation File to quantify the relative amounts of canned tuna in each CSFII food code. After quantifying the canned tuna percentages for each CSFII food code, they were further characterized using the CSFII Recipe Ingredient File provided on CD-ROM (USDA, 2000). Data on percentages of canned tuna determined for each CSFII code are shown in the Appendix.

Each individual eating occasion that included canned tuna was identified for women age 15-44, and the amount of canned tuna consumed was determined. There were 211 such eating occasions in the data set.

Following the method employed by EPA for its 1997 report to Congress (EPA, 1997, Appendix D), a lognormal approximation was developed to represent the distribution of consumption of canned tuna per eating occasion. The parameters of the empirical and lognormal distributions are as follows (Table 1):

Table 1. Consumption of Canned Tuna per Eating Occasion, Women Age 15-44, Empirical Data v. Lognormal Approximation

| | Canned Tuna Consumption (g) | |
|-------------------------------|-----------------------------|-------------------------|
| | Empirical Data | Lognormal Approximation |
| Mean | 60.3 | 60.6 |
| Standard Deviation | 40.9 | 40.9 |
| 25 th Percentile | 31.7 | 33.0 |
| 50 th Percentile | 55.8 | 49.9 |
| 75 th Percentile | 72.9 | 75.5 |
| 90 th Percentile | 111.6 | 109.7 |
| 95 th Percentile | 154.4 | 137.2 |
| 97.5 th Percentile | 168.9 | 166.5 |
| 99 th Percentile | 181.8 | 208.6 |

B. Frequency of Consumption of Canned Tuna

Frequency of consumption of foods is less often measured in representative food consumption surveys than is amount consumed. ENVIRON is not aware of any single database that provides publicly available national data regarding the frequency of consumption of canned tuna by women age 15-44. We have located three sources of such data, each of them limited in some way. Consequently, we have taken the approach of developing estimates based on each different frequency database; we then examined these three independent estimates for congruence. The three sources of data, each of which is described in more detail below, are:

- Frequency of consumption of all fish by women age 15-44 (NHANES III, as reported in EPA, 1967)
- Reported eating occasions of canned tuna at home over 14 days by women age 18-44 (NPD Group National Eating Trends Survey)
- Reported eating occasions of canned tuna by adults (pilot study for proposed National Seafood Survey)

1. NHANES III

In its 1997 report to Congress (EPA, 1997, p. 4-17), EPA cited a question asked to adults in the Third National Health and Nutrition Examination Survey (NHANES III), which was conducted by the National Center for Health Statistics in 1988-94. This question asked respondents about the frequency of eating two types of seafood in times per day, per week, or per month (or never). The two types of seafood were "shrimp, clams, oysters, crabs, and lobster" and "fish including fillets, fish sticks, fish sandwiches, and tuna fish." EPA combined the two questions to produce estimates of the frequency of consumption of combined fish/shellfish (EPA, 1997, p. 4-17, Table 4-14).

The distribution of fish consumption frequency by women age 15-44 as calculated by EPA is shown below in Table 2. Also shown is ENVIRON's point estimates of the ranges provided by EPA.

Table 2. Frequency of Fish/Shellfish Consumption Based on NHANES III, Women Age 15-44

| Number of Eating Occasions Per Month | | Percent of Women Age 15-44 Years |
|--------------------------------------|-----------------------------|----------------------------------|
| EPA Range | ENVIRON Point Approximation | |
| 0 | 0 | 14 |
| 1 or more | 1.5 | 8 |
| 2 or more | 3.0 | 22 |
| 4 or more | 6.0 | 31 |
| 8 or more | 10.0 | 13 |
| 12 or more | 18.0 | 9 |
| 24 or more | 27.0 | 1 |
| 30 or more | 30.0 | 2 |

Note that this distribution of frequencies includes no instances of consumption of fish less than one time per month, so low-frequency consumers are either left out (recorded as "never eat fish") or overestimated. ENVIRON recalculated the percentages to base them on the 86% of women who are fish consumers and, as was done by EPA in 1997, calculated a lognormal approximation to the frequency distribution. The parameters of the empirical and lognormal distributions are shown in Table 3.

According to CSFII 1994-96, 1998 data, 211 of 717 reported fish-eating occasions by women age 15-44 were of canned tuna. We thus estimated total fish usual consumption and then estimated that 29.4% (211/717) of these occasions included canned tuna.

Table 3. Frequency of Consumption of Fish from NHANES III, Women Age 15-44, Empirical Data v. Lognormal Approximation

| | Times per Month Fish Is Eaten | |
|-------------------------------|-------------------------------|-------------------------|
| | Empirical Data | Lognormal Approximation |
| Mean | 7.5 | 7.6 |
| Standard Deviation | 6.2 | 6.2 |
| 25 th Percentile | 2.4 | 3.6 |
| 50 th Percentile | 4.3 | 5.7 |
| 75 th Percentile | 7.1 | 9.4 |
| 90 th Percentile | 13.0 | 14.5 |
| 95 th Percentile | 16.8 | 18.9 |
| 97.5 th Percentile | 25.6 | 23.7 |
| 99 th Percentile | 28.7 | 30.8 |

2. National Eating Trends Survey

The National Eating Trends (NET) survey is conducted annually by the NPD Group, a commercial research company. Each annual NET survey consists of 2,000 responding households, each of which maintains a daily journal of consumption for food consumed at home or prepared at home and taken away for 14 consecutive days; the panels are staggered to provide coverage throughout the year. In order to obtain an adequate number of respondents, four survey years ending in February 2000 were combined. This provided a sample of 3,881 women age 18-44 (the closest to the age 15-44 target group available). Of these women, 1053 (27.1%) reported eating canned tuna at least one time over the 14-day survey period. Most of them (712, 67.6% of eaters) reported eating canned tuna only one time during the two weeks.

The NET data include only foods consumed at home or prepared at home and taken away. According to data from the 1994-96 CSFII, 19.4% of the occasions on which women age 15-44 consumed canned tuna were away from home; the remaining 80.6% were either meals consumed at home or prepared at home and taken away and thus included in the NET database. In order to account for these additional eating occasions, all NET frequencies were multiplied by 1.24 (100%/80.6%). Thus, a woman who reported eating canned tuna at home 5 times in 14 days was estimated to have eaten it (both at home and away from home) a total of 6.2 times (5 x 1.24) in 14 days, or 13.3 times in 30 days.

To an even greater extent than is true for the estimate based on HNANES III data, these frequency data are overestimates because they are based only on the 27% of women who consume canned tuna frequently enough to have done so during the 14-day survey period. Thus, consumption estimates based on this database are based on only the more frequent consumers.

Again following the EPA method, the empirical frequency distribution was approximated by a lognormal distribution. The parameters of the empirical and lognormal distributions (in times canned tuna is eaten per month) are as shown in Table 4.

Table 4. Frequency of Consumption of Canned Tuna from NET Survey, Women Age 18-44, Empirical Data v. Lognormal Approximation

| | Times per Month Canned Tuna Is Eaten | |
|-------------------------------|--------------------------------------|-------------------------|
| | Empirical Data | Lognormal Approximation |
| Mean | 3.2 | 3.2 |
| Standard Deviation | 2.1 | 2.1 |
| 25 th Percentile | 2.1 | 1.8 |
| 50 th Percentile | 2.1 | 2.7 |
| 75 th Percentile | 2.8 | 4.0 |
| 90 th Percentile | 4.3 | 5.8 |
| 95 th Percentile | 6.1 | 7.2 |
| 97.5 th Percentile | 7.7 | 8.7 |
| 99 th Percentile | 9.5 | 10.8 |

3. National Seafood Survey Pilot Study

In 1993-94, a pilot study, supported by the Commerce Department's National Oceanic and Atmospheric Administration and the National Fisheries Institute, was conducted by Market Facts, Inc., for a planned National Seafood Survey (NSS). Although the national survey was never implemented, in the pilot study 447 adults (both male and female) kept diaries in which they recorded all of the fish or shellfish that they consumed, both at home and away from home, over a period of 4 weeks. In all, 167 respondents, 37.4% of the sample, recorded eating canned tuna at least once during the 28-day survey period. All reported consumption frequencies were converted from "number of times in 28 days" to "number of times in 30 days" or "times per month." Thus, a person who reported eating canned tuna 7 times in 28 days was assumed to eat it 7.5 times in 30 days.

Again following the EPA method, the empirical frequency distribution was approximated by a lognormal distribution. The parameters of the empirical and lognormal distributions (in times canned tuna is eaten per month) are as shown in Table 5.

Table 5. Frequency of Consumption of Canned Tuna from NSS Pilot Study, All Adults, Empirical Data v. Lognormal Approximation

| | Times per Month Canned Tuna Is Eaten | |
|-------------------------------|--------------------------------------|-------------------------|
| | Empirical Data | Lognormal Approximation |
| Mean | 2.4 | 2.4 |
| Standard Deviation | 2.4 | 2.4 |
| 25 th Percentile | 1.1 | 1.0 |
| 50 th Percentile | 1.2 | 1.7 |
| 75 th Percentile | 2.1 | 2.9 |
| 90 th Percentile | 3.7 | 4.9 |
| 95 th Percentile | 5.0 | 6.6 |
| 97.5 th Percentile | 7.3 | 8.6 |
| 99 th Percentile | 13.6 | 11.7 |

C. Monte Carlo Analysis

Crystal Ball®, Version 4.0 (Decisioneering, 1996), was used to run 10,000 Monte Carlo iterations using the two lognormal distributions for each of the three datasets. The output was reported in canned tuna consumed per month; these estimates were divided by 30 to estimate daily consumption and the latter were multiplied by 7 to estimate weekly consumption.

IV. Results and Discussion

The results of these analyses are reported below in Tables 6 and 7.

Table 6: Usual Daily Consumption of Canned Tuna

| | Consumption of Canned Tuna (g/day) | | |
|-------------------------------|------------------------------------|---------------------|--------------------------|
| | Based on NHANES | Based on NET Survey | Based on NSS Pilot Study |
| Mean | 4.5 | 6.6 | 4.9 |
| 25 th Percentile | 1.5 | 2.5 | 1.4 |
| 50 th Percentile | 2.8 | 4.5 | 2.8 |
| 75 th Percentile | 5.4 | 8.1 | 5.7 |
| 90 th Percentile | 9.9 | 13.9 | 11.0 |
| 95 th Percentile | 13.8 | 18.8 | 15.9 |
| 97.5 th Percentile | 19.3 | 25.5 | 22.8 |
| 99 th Percentile | 27.3 | 35.1 | 33.6 |

Table 7: Usual Weekly Consumption of Canned Tuna

| | Consumption of Canned Tuna (oz/week) | | |
|-------------------------------|---|---------------------------|--------------------------------|
| | Based on NHANES | Based on NET Survey | Based on NSS Pilot Study |
| Mean | 1.1 | 1.6 | 1.2 |
| 25 th Percentile | 0.4 | 0.6 | 0.3 |
| 50 th Percentile | 0.7 | 1.1 | 0.7 |
| 75 th Percentile | 1.3 | 2.0 | 1.4 |
| 90 th Percentile | 2.5 | 3.4 | 2.7 |
| 95 th Percentile | 3.4 | 4.7 | 3.9 |
| 97.5 th Percentile | 4.8 | 6.3 | 5.6 |
| 99 th Percentile | 6.7 | 8.7 | 8.3 |

As was noted earlier, each of the sources of information about frequency of consumption of canned tuna has limitations. The NHANES III frequency data included all fish and shellfish; based on CSFII data we estimated that canned tuna constituted 29.4% of all fish eating occasions. This is an accurate indicator of the proportion of fish eating occasions that are canned tuna at the mean, but may not reflect all points of the frequency distribution. The population included in the NHANES-based analysis included all women age 15-44 who reported that they ever eat seafood of any type. This most likely includes some women who never eat tuna, but it also (unlike the other two sources of frequency data) includes all canned tuna eaters, not only those who consume canned tuna with relatively high frequency. This is one possible explanation for the lower estimates of usual consumption that resulted from use of this data source.

Analyses based on the NET survey resulted in the highest estimates of usual consumption of canned tuna. One likely cause of this finding is that the NET-based analysis included only the 27% of women who consumed canned tuna during the 14-day survey period; this obviously over-represents frequent consumers of canned tuna and under-represents infrequent consumers. Another contributor may be the assumption that all women, at whatever point of the consumed-at-home frequency distribution, have 20% of their canned tuna eating occasions away from home. It may be that those women who report a high number of eating occasions at home actually have fewer rather than more eating occasions away from home. If this is true, it would also tend to inflate the upper end of the estimated frequency distribution.

Finally, the NSS pilot survey is likely to provide the best representation of eaters of canned tuna, since it included all individuals who reported consuming canned tuna at least one time during the 28-day survey period. The limitations of this survey include its questionable representativeness (as a pilot study, it was never intended to be used as a basis for national projections) and the fact that it included both men and women.

Recognizing the very different characteristics of these three databases, the estimates generated of usual consumption of canned tuna by women age 15-44 are remarkably consistent. All show that the usual consumption of canned tuna at the 95th percentile of intake among tuna eaters is less than 20 g/day, and even the 99th percentile is not more than 35 g/day. In terms of weekly consumption of canned tuna, all three analyses show that 95% of women age 15-44 who are tuna eaters consume less than 5 oz/week.

V. References

Environmental Protection Agency (EPA) (1997). *Mercury Study Report to Congress; Volume IV: An Assessment of Exposure to Mercury in the United States*; EPA-452/R-97-006.

Environmental Protection Agency. (2000), *Food Commodity Intake Database (FCID)* [CD-ROM], data and documentation. National Technical Information Service, Accession No. PB2000-500101.

US Department of Agriculture, Agricultural Research Service (2000). *1994-96, 1998 Continuing Survey of Food Intakes by Individuals* [CD-ROM], data and documentation. National Technical Information Service, Accession No. PB2000-500027.

Appendix. Translation of CSFII food codes to canned tuna percentages

| Food Code | Foodname | Recipe Modification Code | Fish Species | Processing | Amount of Fish per Food Code (g/100g) |
|-----------|--|--------------------------|--------------|------------|---------------------------------------|
| 26100180 | FISH, NS AS TO TYPE, CANNED | | | | |
| 26155110 | TUNA, CANNED, NS AS TO OIL OR WATER PACK | 0 | tuna, | canned | 74.480 |
| 26155180 | TUNA, CANNED, OIL PACK | 0 | tuna, | canned | 99.180 |
| 26155190 | TUNA, CANNED, WATER PACK | 0 | tuna, | canned | 93.250 |
| 27250160 | TUNA CAKE OR PATTY | 0 | tuna, | canned | 99.180 |
| 27250630 | TUNA NOODLE CASSEROLE W/ (MUSHROOM) SOUP | 0 | tuna, | canned | 42.590 |
| 27250630 | TUNA NOODLE CASSEROLE W/ (MUSHROOM) SOUP | 203749 | tuna, | canned | 27.000 |
| 27250710 | TUNA & RICE W/ (MUSHROOM) SOUP (MIXTURE) | 202593 | tuna, | canned | 27.000 |
| 27350080 | TUNA NOODLE CASSEROLE W/ VEG, CREAM OR WHITE SAUCE | 0 | tuna, | canned | 17.530 |
| 27350080 | TUNA NOODLE CASSEROLE W/ VEG, CREAM OR WHITE SAUCE | 0 | tuna, | canned | 15.330 |
| 27350100 | FISH, NOODLES, VEG (NO CAR/DK GRN), CHEESE SAUCE | 100388 | tuna, | canned | 15.340 |
| 27350410 | TUNA NOODLE CASSEROLE W/ VEG & (MUSHROOM) SOUP | 0 | tuna, | canned | 25.780 |
| 27450060 | TUNA SALAD | 0 | tuna, | canned | 22.470 |
| 27450060 | TUNA SALAD | 201412 | tuna, | canned | 53.660 |
| 27450060 | TUNA SALAD | 200449 | tuna, | canned | 53.790 |
| 27450060 | TUNA SALAD | 202153 | tuna, | canned | 62.530 |
| 27450060 | TUNA SALAD | 200685 | tuna, | canned | 53.180 |
| 27450060 | TUNA SALAD | 200099 | tuna, | canned | 52.990 |
| 27450060 | TUNA SALAD | 200020 | tuna, | canned | 53.760 |
| 27450060 | TUNA SALAD | 100321 | tuna, | canned | 53.660 |
| 27450060 | TUNA SALAD | 100008 | tuna, | canned | 54.150 |
| 27450090 | TUNA SALAD W/ CHEESE | 0 | tuna, | canned | 53.660 |
| 27450100 | TUNA SALAD W/ EGG | 100275 | tuna, | canned | 45.850 |
| | | 0 | tuna, | canned | 46.410 |

| Food Code | Foodname | Recipe Modification Code | Fish Species | Processing | Amount of Fish per Food Code (g/100g) |
|-----------|--|--------------------------|--------------|------------|---------------------------------------|
| 27450100 | TUNA SALAD W/ EGG | | | | |
| 27450100 | TUNA SALAD W/ EGG | 201509 | tuna, | canned | 46.110 |
| 27450100 | TUNA SALAD W/ EGG | 202694 | tuna, | canned | 45.960 |
| 27450100 | TUNA SALAD W/ EGG | 200455 | tuna, | canned | 46.290 |
| 27450100 | TUNA SALAD W/ EGG | 100224 | tuna, | canned | 54.820 |
| 27450100 | TUNA SALAD W/ EGG | 100039 | tuna, | canned | 46.870 |
| 27450100 | TUNA SALAD W/ EGG | 201154 | tuna, | canned | 45.780 |
| 27450510 | TUNA CASSEROLE W/ VEG & SOUP, NO NOODLES | 100026 | tuna, | canned | 46.500 |
| 27550710 | TUNA SALAD SANDWICH W/ LETTUCE | 0 | tuna, | canned | 30.380 |
| 27550720 | TUNA SALAD SANDWICH | 0 | tuna, | canned | 34.240 |
| 27550720 | TUNA SALAD SANDWICH | 0 | tuna, | canned | 36.420 |
| 27550720 | TUNA SALAD SANDWICH | 100053 | tuna, | canned | 35.520 |
| 27550720 | TUNA SALAD SANDWICH | 100844 | tuna, | canned | 36.630 |
| 27550720 | TUNA SALAD SANDWICH | 200109 | tuna, | canned | 36.470 |
| 27550750 | TUNA SALAD SUB, ON ROLL, W/ LETTUCE | 201529 | tuna, | canned | 36.420 |
| 58145120 | MACARONI OR NOODLES W/ CHEESE & TUNA | 0 | tuna, | canned | 26.200 |
| 58145120 | MACARONI OR NOODLES W/ CHEESE & TUNA | 200545 | tuna, | canned | 16.220 |
| 58148130 | MACARONI SALAD W/ TUNA | 0 | tuna, | canned | 16.230 |
| 58148130 | MACARONI SALAD W/ TUNA | 0 | tuna, | canned | 15.080 |
| 58148160 | MACARONI SALAD W/ TUNA & EGG | 202070 | tuna, | canned | 15.070 |
| | | 0 | tuna, | canned | 16.720 |