EPA 822-R-16-001
January 2016

Development of National Bioaccumulation Factors: Supplemental Information for EPA's 2015 Human Health Criteria Update

U.S. Environmental Protection Agency
Office of Water
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Washington, DC

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1. Purpose

This document describes the procedures and calculations EPA used to compute the national bioaccumulation factors (BAFs) that were, in turn, used to calculate the Agency's updated national recommended water quality criteria for human health for 94 chemicals (USEPA 2015). For a scientific discussion of and rationale for using these methods, see EPA's 2000 *Methodology for Deriving Ambient Water Quality Criteria for the Protection of Human Health* (2000 Methodology), *Technical Support Document Volume 2: Development of National Support Factors* (TSD), and EPA's final 94 criteria documents that describe the development of each chemical-specific bioaccumulation factor included in the 2015 update on the *National Recommended Water Quality Criteria – Human Health Criteria Table* webpage (USEPA 2000; USEPA 2003a; USEPA 2015).

2. Summary

EPA searched peer-reviewed journal articles, federal and state reports, and databases to obtain input variables—including species-level lipid content, trophic level (TL), degree of ionization and metabolism of the chemical, and chemical-specific octanol-water coefficient (K_{ow})—to calculate BAFs used to update 94 national recommended human health criteria. EPA used data from the searches to classify each chemical, using the decision framework presented in Figure 3-1 of EPA's TSD (reproduced as Figure 1 in this document) to derive the most appropriate BAFs according to EPA's 2000 Methodology and its TSD (USEPA 2000; USEPA 2003a).

EPA documented source information and reviewed and confirmed the derivation of each value. In addition, quality control checks of data calculations and data entries were performed and any errors found were corrected before BAF values were finalized. BAFs were rounded in accordance with EPA's 2000 Methodology and quality control checks were performed to ensure that the significant digits for each result were correct (USEPA 2000). The procedures followed for calculating national BAF values were documented in each of the 94 criteria documents.

The remainder of this document is organized into sections 3 through 7 and a list of references. Section 3, Chemical Procedure Classification, provides details about the procedure decision framework used to classify each chemical. Section 4, Baseline BAFs, presents the basic equations used for computing baseline BAFs. Section 5, National BAFs, provides the basic equations used for computing national BAFs as a function of final baseline BAFs. The basic equations in sections 4 and 5 are supported by additional methods and steps for establishing the K_{ow}, food chain multiplier (FCM), fraction freely dissolved (f_{fd}), lipid content, and trophic levels (TLs), which are summarized in section 6, Supporting Procedures. Section 7, Examples, provides numerical examples that demonstrate the approach to estimate baseline and national BAFs for the chemicals endrin and fluorene.

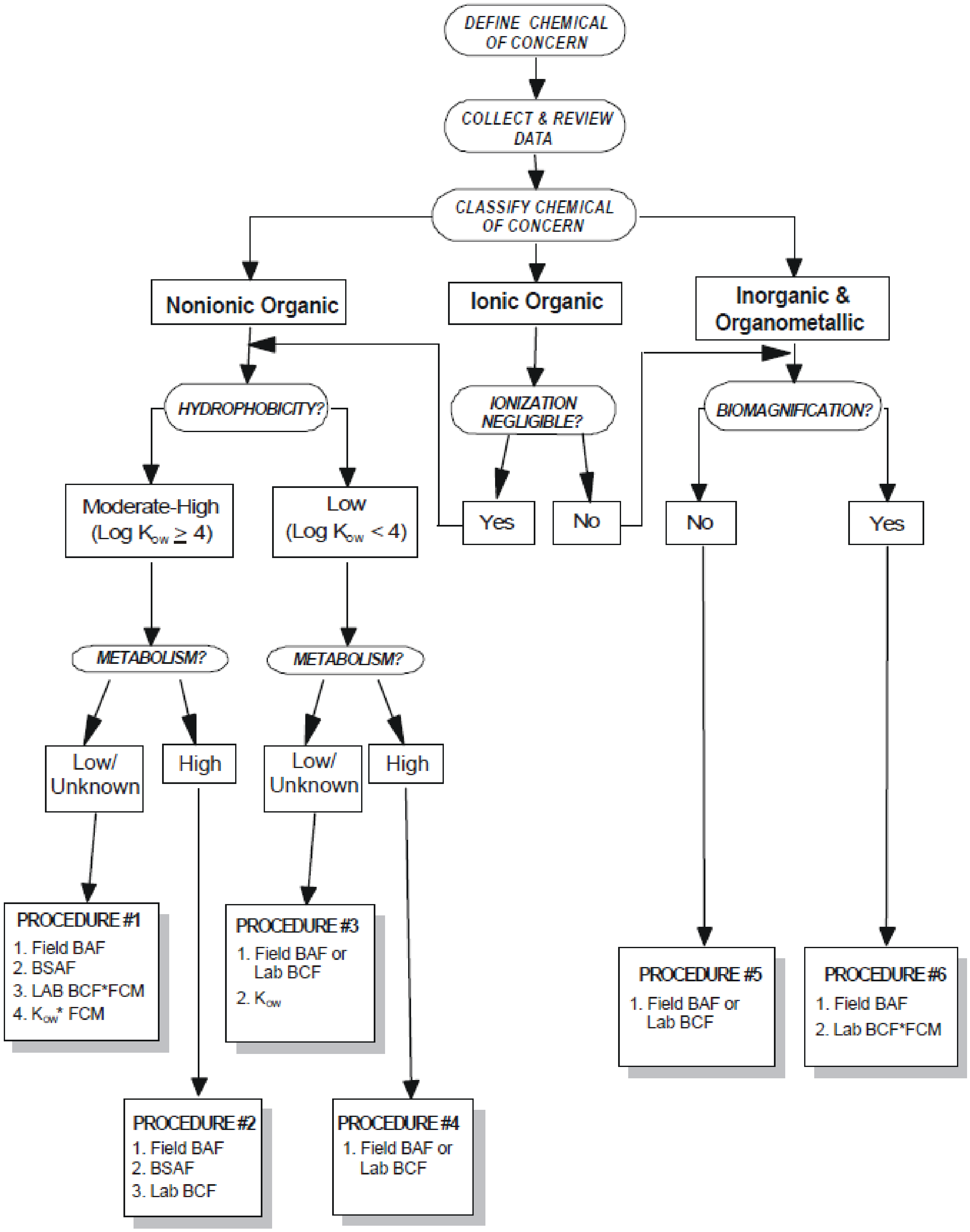

Figure 1. Framework for Selecting Methods for Deriving National BAFs (Source: USEPA 2003a, Figure 3-1, p. 3-2)

3. Chemical Procedure Classification

As explained in each of the updated 94 criteria documents (USEPA 2015), EPA used the decision framework presented in its TSD to identify procedures to derive national TL-specific BAFs for each chemical based on that chemical's properties (e.g., ionization and hydrophobicity), metabolism, and biomagnification potential (see Figure 1) (USEPA 2003a).

EPA followed the guidelines provided in section 5.5 of the TSD to assess the occurrence of cationic and anionic forms of the chemicals at typical environmental pH ranges. As explained in section 5.5, when a significant fraction of the total chemical concentration is expected to be present as the ionized species in water, procedures for deriving the national BAF rely on empirical (measured) methods (i.e., procedures #5 and #6 in Figure 1) (USEPA 2003a).

When an insignificant fraction of the total chemical is expected to be present as the ionized species (i.e., the chemical exists essentially in the neutral form), the national BAF is derived following procedures established for nonionic organic chemicals (e.g., procedures #1 through #4 in Figure 1) (USEPA 2003a). To evaluate whether ionization was negligible, EPA reviewed dissociation constant (pK_a) information provided in Hazardous Substances Data Bank (HSDB) sources referenced in the individual criteria documents (USEPA 2015).

For chemicals for which ionization was determined to be negligible at typical environmental pH ranges, EPA followed the steps in section 3.2.3 of the TSD to determine the procedures for deriving the national BAFs for nonionic organic chemicals (USEPA 2003a). EPA evaluated the log K_{ow} values provided in the Agency for Toxic Substances and Disease Registry (ATSDR) and HSDB sources referenced in the individual criteria documents to determine whether chemicals should be classified as moderate-high hydrophobic (i.e., log $K_{ow} \geq 4$) or low hydrophobic (i.e., log $K_{ow} < 4$). Those chemicals were further evaluated to determine whether metabolism was low/unknown or high; sources of information found on the metabolism of the chemicals are referenced in the individual criteria documents.

For organic chemicals for which ionization was determined not to be negligible at typical environmental pH ranges and for the inorganic chemical included in the 2015 criteria update (i.e., cyanide), EPA followed the guidelines in section 3.2.1 of the TSD to evaluate the biomagnification potential of the chemicals (USEPA 2003a). The ATSDR, HSDB, and EPA sources used for the evaluations are referenced in the individual criteria documents.

The characteristics of each chemical used to derive national TL-specific BAFs are documented in section 4.4.2 of each criteria document.

Following this decision framework, EPA selected the method that provided BAF estimates for all three TLs (TL2–TL4) in the following priority:

1. BAF estimates using the BAF method (i.e., based on field-measured BAFs), if possible.
2. BAF estimates using the bioconcentration factor (BCF) method if (a) the BAF method did not produce estimates for all three TLs, and (b) the BCF method produced national-level BAF estimates for all three TLs.
3. BAF estimates using the K_{ow} method if (a) procedure #1 or #3 was applicable (see Figure 1), and (b) the BAF and BCF methods did not produce BAF estimates for all three TLs.

If the procedure called for the BAF method but there were fewer than three TL estimates and the K_{ow} method did not apply, EPA estimated the BAF for the reported TLs by using a geometric mean when there were two BAFs and using the single estimate when only one was available. EPA did not mix values from the BAF and BCF methods. If the BAF method did not have sufficient reliable data for any TLs, EPA used the BCF method estimates in the same manner. If none of these methods provided sufficient data or were appropriate for the procedure, EPA used the BCF from the previously recommended 2002/2003 criteria (USEPA 2002a; USEPA 2003b).

4. Baseline BAFs

Three methods for computing baseline BAFs ($(\text{Baseline BAF})_{TL\ n}$) are described in this section: K_{ow}, BAF, and BCF methods. Refer to section 3 to determine the applicability of each method to a particular chemical. In particular, note that the K_{ow} method applies to chemicals that fall under procedure #1 or procedure #3 and does not apply to chemicals that are highly metabolized or have significant ionization. Also, including an FCM in the equations is applicable to chemicals that fall under procedure #1 using the K_{ow} and BCF methods, or procedure #6 using the BCF method. For other chemicals, the FCM can be dropped from the equations in this section (or equivalently set to 1.0).

EPA used field-measured BAFs and laboratory-measured BCFs available from peer-reviewed, publicly available databases to develop baseline BAFs (Arnot and Gobas 2006; Environment Canada 2006). BAF and BCF values from additional peer-reviewed sources also were collected and evaluated. If measurement units were not provided, the data from those sources were considered “unverified.” Those values were recorded but, ultimately, not used to calculate BAFs for use in revising the 94 criteria. The chemicals for which additional sources were used to calculate baseline BAFs are listed below:

- 1,4-Dichlorobenzene (Calamari et al. 1982)
- 2,4,5-TP (Kenaga 1980; USEPA 1995)
- 2,4-D (Wang et al. 1994)
- Benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, indeno(1,2,3-cd)pyrene—Field-measured BAF for benzo(a)pyrene, an index polycyclic aromatic hydrocarbon (PAH), was used as a surrogate for estimating BAFs for other PAHs. This approach is consistent with conclusions of Neff (2002) that benzo(a)pyrene is a good indicator of the presence of pyrogenic PAHs in the environment and that these types of PAHs are expected to concentrate in organisms such as fish and shellfish as does benzo(a)pyrene.
- Cyanide (USEPA 2003b)
- Dinitrophenols (USEPA 2002b)

4.1 K_{ow} Method

The K_{ow} method of computing baseline BAFs is applicable to chemicals that fall under procedures #1 and #3. It is a function of K_{ow} and an appropriate FCM. One baseline BAF can be calculated for each combination of chemical and TL to which the K_{ow} method applies. As described in section 5.4 of the TSD, this method is used for each nonionic, moderate-to-highly hydrophobic chemical with metabolism that is considered negligible or is unknown (USEPA

2003a). In this method, the K_{ow} is assumed to be equal to the baseline BCF, and thus the organic carbon and lipid normalization procedures are not needed. To account for biomagnification, the K_{ow} value is multiplied by an appropriate FCM. The K_{ow} method baseline BAF equation is shown below (USEPA 2003a, p. 5-23):

$$(\text{Baseline BAF})_{\text{TL n}} = K_{ow} \cdot (\text{FCM})_{\text{TL n}}$$

where:

$(\text{Baseline BAF})_{\text{TL n}}$	=	baseline BAF for TL “n” (L/kg-lipid)
FCM	=	FCM for TL “n”
K_{ow}	=	n-octanol-water partition coefficient

For chemicals that fall under procedure #3 (log K_{ow} < 4), the FCM can be dropped from the equation (or equivalently set to 1.0). See section 6.1, K_{ow}, and section 6.2, Food Chain Multiplier, for information on how the K_{ow} and FCM were determined. See section 7.1, K_{ow} Method: Endrin, for an example of how to apply the K_{ow} method for computing both baseline and national BAFs for endrin.

4.2 BAF Method

The BAF method is applicable to all chemicals. In the BAF method, a baseline BAF is calculated for each field sample BAF as shown in the equation below (USEPA 2003a, p. 5-1):

$$(\text{Baseline BAF})_{\text{i}} = \left[\frac{\text{BAF}_{\text{T}}^{\text{t}}}{\text{f}_{\text{fd}}} - 1\right] \cdot \frac{1}{\text{f}_{\ell}}$$

where:

$(\text{Baseline BAF})_{\text{i}}$	=	baseline BAF for field sample i (L/kg-lipid)
$\text{BAF}_{\text{T}}^{\text{t}}$	=	total BAF from field sample (i.e., total concentration of chemical in tissue / total concentration of chemical in water [L/kg-tissue])
f_{fd}	=	fraction of the total concentration of chemical in water that is freely dissolved
f_{ℓ}	=	fraction of tissue that is lipid

Multiple $(\text{Baseline BAF})_{\text{i}}$ are averaged to a $(\text{Baseline BAF})_{\text{TL n}}$ by using the following procedure:

1. Compute the geometric mean across each chemical, computation method, TL, and species to compute a set of “species-mean baseline BAFs.”
2. Compute the geometric mean across each chemical, computation method, and TL to compute a set of “trophic level-mean baseline BAFs” using the results from the previous step.

See section 6.3, Fraction Freely Dissolved, for information on computing the fraction of the total concentration of chemical in water that is freely dissolved, and section 6.4, Lipid Content, for information on estimating the fraction of tissue that is lipid. See section 7.2.1, BAF Method, for an example of how to apply the BAF method to fluorene.

4.3 BCF Method

The BCF method is applicable to all chemicals. In the BCF method, a baseline BAF is calculated for each laboratory-measured BCF as shown in the equation below (USEPA 2003a, p. 5-19):

$$(\text{Baseline BAF})_{\text{i}} = (\text{FCM})_{\text{TL n}} \cdot \left[\frac{\text{BCF}_{\text{T}}^{\text{t}}}{\text{f}_{\text{fd}}} - 1\right] \cdot \frac{1}{\text{f}_{\ell}}$$

where:

$(\text{Baseline BAF})_i$	=	baseline BAF for laboratory sample i (L/kg-lipid)
FCM	=	FCM for TL associated with species from laboratory measurement
BCF_T^t	=	total BCF from laboratory measure (i.e., total concentration of chemical in tissue / total concentration of chemical in water [L/kg-tissue])
f_{fd}	=	fraction of the total concentration of chemical in water that is freely dissolved
f_{ℓ}	=	fraction of tissue that is lipid

For chemicals that fall under procedures #1 and #6 and when the log K_{ow} is greater than or equal to 4, the species must be assigned to a particular TL (i.e., 2, 3, or 4) and the appropriate FCM selected. For other cases, the FCM can be dropped from the equation (or equivalently set to 1.0).

Multiple $(\text{Baseline BAF})_i$ are averaged to a $(\text{Baseline BAF})_{\text{TL n}}$ by using the same procedure as described in section 4.2, BAF Method. See section 6.3, Fraction Freely Dissolved, for information on computing the fraction of the total concentration of chemical in water that is freely dissolved, and section 6.4, Lipid Content, for information on estimating the fraction of tissue that is lipid. See section 7.2.2, BCF Method, for an example of how to apply the BCF method to fluorene.

5. National BAFs

Final baseline BAFs are used to compute national BAFs. EPA's TSD presents the formula for computing national TL-specific BAFs as follows (USEPA 2003a, p. 6-1):

$$\text{National BAF}_{(\text{TL n})} = [(\text{Final Baseline BAF})_{\text{TL n}} \cdot (\text{f}_{\ell})_{\text{TL n}} + 1] \cdot (\text{f}_{\text{fd}})$$

where:

National BAF	=	national BAF (L/kg-tissue)
$(\text{Final Baseline BAF})_{\text{TL n}}$	=	mean baseline BAF for TL "n" (L/kg-lipid)
$f_{\ell(\text{TL n})}$	=	fraction of tissue that is lipid in aquatic organisms at TL "n"
f_{fd}	=	fraction of the total concentration of chemical in water that is freely dissolved

To derive national BAFs, EPA uses national default values of lipid fraction (f_{ℓ}) that are specific to each TL. The national default values of lipid fraction for TLs 2, 3, and 4 are:

$f_{\ell(TL\ 2)}$ = 0.019
$f_{\ell(TL\ 3)}$ = 0.026
$f_{\ell(TL\ 4)}$ = 0.030

These values reflect consumption-weighted mean values of the lipid fraction of aquatic organisms that are commonly consumed throughout the United States. See section 6.2 of EPA's TSD for a description of the technical basis of EPA's national default values for lipid fraction (USEPA 2003a).

See section 6.3, Fraction Freely Dissolved, for information on computing the fraction of the total concentration of chemical in water that is freely dissolved. See section 7, Examples, for examples of calculated national BAFs.

6. Supporting Procedures

This section discusses selected supporting procedures used to calculate baseline and national BAFs, including K_{ow}, FCM, f_{fd}, lipid content, and species TL.

6.1 K_{ow}

K_{ow} values were selected from ATSDR or HSDB sources with preference given to ATSDR. An average log K_{ow} was computed if a range or multiple values was reported from the selected source. The K_{ow} values that were used are provided in the BAF Calculation Table.xlsx spreadsheet, on the Chemical-Level Reference tab.

6.2 Food Chain Multiplier

For chemicals that fall under procedure #1 and either the K_{ow} method or the BCF method is being applied, or that fall under procedure #6 and the BCF method is being used, the FCM is selected from Table 4-6 in the TSD (reproduced as Table 1 in this document) using the chemical's Log K_{ow} and linear interpolation (USEPA 2003a, p. 4-39). Chemicals with a Log K_{ow} less than 4 have an FCM equal to 1.0. The calculated FCMs for each chemical are provided in the BAF Calculation Table.xlsx spreadsheet, on the Chemical-Level Reference tab.

6.3 Fraction Freely Dissolved

The fraction of the total concentration of chemical in water that is freely dissolved (f_{fd}) is included in both the BCF method and the national BAF equations. The equation used to compute f_{fd} is shown below (USEPA 2003a, p. 4-7):

$$f_{fd} = \frac{1}{1 + POC \cdot K_{ow} + DOC \cdot 0.08 \cdot K_{ow}}$$

where:

POC = concentration of particulate organic carbon (POC) in water (kilograms of particulate organic carbon per liter of water) (kg/L)
DOC = concentration of dissolved organic carbon (DOC) in water (kilograms of dissolved organic carbon per liter of water) (kg/L)
K_{ow} = n-octanol-water partition coefficient

Table 1. Food Chain Multipliers for Trophic Levels 2, 3, and 4 (Source: USEPA 2003a, Table 4-6, p. 4-39)

Log K_{ow}	Trophic Level 2	Trophic Level 3	Trophic Level 4	Log K_{ow}	Trophic Level 2	Trophic Level 3	Trophic Level 4	Log K_{ow}	Trophic Level 2	Trophic Level 3	Trophic Level 4
4.0	1	1.23	1.07	5.7	1	7.40	9.54	7.4	1	12.0	19.5
4.1	1	1.29	1.09	5.8	1	8.21	11.2	7.5	1	11.5	17.6
4.2	1	1.36	1.13	5.9	1	9.01	13.0	7.6	1	10.8	15.5
4.3	1	1.45	1.17	6.0	1	9.79	14.9	7.7	1	10.1	13.3
4.4	1	1.56	1.23	6.1	1	10.5	16.7	7.8	1	9.31	11.2
4.5	1	1.70	1.32	6.2	1	11.2	18.5	7.9	1	8.46	9.11
4.6	1	1.87	1.44	6.3	1	11.7	20.1	8.0	1	7.60	7.23
4.7	1	2.08	1.60	6.4	1	12.2	21.6	8.1	1	6.73	5.58
4.8	1	2.33	1.82	6.5	1	12.6	22.8	8.2	1	5.88	4.19
4.9	1	2.64	2.12	6.6	1	12.9	23.8	8.3	1	5.07	3.07
5.0	1	3.00	2.51	6.7	1	13.2	24.4	8.4	1	4.33	2.20
5.1	1	3.43	3.02	6.8	1	13.3	24.7	8.5	1	3.65	1.54
5.2	1	3.93	3.68	6.9	1	13.3	24.7	8.6	1	3.05	1.06
5.3	1	4.50	4.49	7.0	1	13.2	24.3	8.7	1	2.52	0.721
5.4	1	5.14	5.48	7.1	1	13.1	23.6	8.8	1	2.08	0.483
5.5	1	5.85	6.65	7.2	1	12.8	22.5	8.9	1	1.70	0.320
5.6	1	6.60	8.01	7.3	1	12.5	21.2	9.0	1	1.38	0.210

For deriving the national BAF f_{fd} term, EPA uses national default DOC and POC values for estimating a representative fraction of chemical that is freely dissolved in U.S. surface waters. The national default values of DOC and POC are (USEPA 2003a, p. 6-2):

DOC = 2.9×10^{-6} kg/L [= 2.9 mg/L]
POC = 0.5×10^{-6} kg/L [= 0.5 mg/L]

See section 6.3 of EPA's TSD for a description of the technical basis of EPA's national default values for DOC and POC (USEPA 2003a).

The calculated f_{fd} for each chemical is provided in the BAF Calculation Table.xlsx spreadsheet, on the Chemical-Level Reference tab.

6.4 Lipid Content

The following hierarchical steps were used to select lipid content for baseline BAF calculation:

1. Use measured values if provided.
2. Select a lipid content based on species from Tables 4-5 and 6-3 in the TSD (USEPA 2003a, p. 4-37, 6-18).
3. Use an average species value from all studies in database with reported values.
4. Apply national lipid fractions based on assigned tropic level, as listed below:

$f_{\ell(TL\ 2)}$ = 0.019
$f_{\ell(TL\ 3)}$ = 0.026
$f_{\ell(TL\ 4)}$ = 0.030

Measured values, values in Tables 6-3 and 4-5 in the TSD, and database average species values all were reported as lipid content (USEPA 2003a). To convert to a lipid fraction, the values were multiplied by 0.01. No conversion was needed for national TL lipid fractions.

The selected lipid fraction for each BAF or BCF value is provided in the BAF Calculation Table.xlsx spreadsheet, on the Baseline BAFs tab. To derive national BAFs, EPA uses national default values of lipid fraction (f_ℓ) that are specific to each TL (see section 5, National BAFs).

6.5 Species Trophic Level

TL assignment information was primarily obtained from the EPA 2014 NHANES Fish Consumption Rate Report and Fishbase.org and used to determine TLs for organisms in the BCF and BAF data sources (USEPA 2014; Froese and Pauly 2015). When no primary source was available, an expert fishery biologist and an expert invertebrate zoologist provided TL identifications. These experts checked all TL identifications for correctness and consistency. The following university websites were consulted to inform the experts' review:

- Central Michigan University Zooplankton of the Great Lakes (McNaught 2015)
- Encyclopedia of Life (Encyclopedia of Life 2015)
- The Murray-Darling Freshwater Research Centre Australian Freshwater Invertebrates Guide (Murray-Darling Freshwater Research Centre 2013)
- University of Maine School of Marine Science (University of Maine 2015)
- University of Michigan Animal Diversity Web (Myers et al. 2015)

The results of this analysis are provided in the BAF Calculation Table.xlsx spreadsheet, on the Species-Level Reference tab.

7. Examples

This section presents examples that collectively demonstrate the K_{ow}, BCF, and BAF methods of deriving baseline and national BAFs. The reader can compare these examples to the companion BAF Calculation Table.xlsx spreadsheet.

7.1 K_{ow} Method: Endrin

The Log K_{ow} for endrin from ATSDR ranges from 5.34 to 5.6 (see BAF Calculation Table.xlsx, Chemical-Level Reference tab). Thus, an average Log K_{ow} value of 5.47 was used ($K_{ow} = 10^{5.47}$). Based on the FCMs presented in Table 1, the FCMs for TLs 3 and 4 were interpolated to be 5.637 and 6.299, respectively. The FCM for TL 2 is 1.0. Multiplying the interpolated FCMs by K_{ow} yielded values of 295,120.92, 1,663,596.64, and 1,858,966.69 L/kg as the baseline BAFs for TLs 2, 3, and 4, respectively. The calculation of endrin's baseline BAF for TL 4 is shown below:

$$\mathbf{(Baseline\ BAF)_{TL\ 4} = K_{ow} \cdot (FCM)_{TL\ 4}}$$

$$(\text{Baseline BAF})_{\text{TL 4}} = 10^{5.47} \cdot 6.299 = 1{,}858{,}966.69\ \text{L/kg-lipid}$$

Converting the baseline BAF expressed on a L/kg-lipid content to a national BAF expressed on a L/kg-tissue basis relies on the national default values of lipid fraction (f_ℓ) and fraction of the total concentration of chemical in water that is freely dissolved (f_{fd}). The calculation of f_{fd} for endrin is shown below:

$$\mathbf{f_{fd}} = \frac{\mathbf{1}}{\mathbf{1 + POC \cdot K_{ow} + DOC \cdot 0.08 \cdot K_{ow}}}$$

$$f_{fd} = \frac{1}{1 + 0.5 \times 10^{-6} \cdot 10^{5.47} + 2.9 \times 10^{-6} \cdot 0.08 \cdot 10^{5.47}} = 0.8223$$

The f_{fd} value is substituted into the national BAF equation along with the trophic-specific value for f_ℓ. Continuing with the endrin example and TL 4 ($f_{\ell(TL\ 4)}$=0.030), the national BAF is calculated using the following equation:

$$\mathbf{National\ BAF_{(TL\ 4)} = [(Final\ Baseline\ BAF)_{TL\ 4} \cdot (f_\ell)_{TL\ 4} + 1] \cdot (f_{fd})}$$

$$\text{National BAF}_{(TL\ 4)} = [1{,}858{,}966.69 \cdot 0.030 + 1] \cdot 0.8223 = 45{,}862.41 \text{ L/kg-tissue}$$

The corresponding values for TLs 2 and 3 were computed as 4,611.98 and 35,570.31 L/kg-tissue, respectively. Rounding the values to two significant figures yields national BAF values of 4,600, 36,000, and 46,000 L/kg-tissue for TLs 2, 3, and 4, respectively.

7.2 BAF and BCF Methods: Fluorene

The Log K_{ow} for fluorene from ATSDR is 4.18 ($K_{ow} = 10^{4.18}$) (see BAF Calculation Table.xlsx, Chemical-Level Reference tab). Based on the FCMs presented in Table 1, the FCMs for TLs 3 and 4 were interpolated to be 1.346 and 1.122, respectively. The FCM for TL 2 is 1.0.

The calculation of f_{fd} for fluorene is shown below:

$$\mathbf{f_{fd}} = \frac{\mathbf{1}}{\mathbf{1 + POC \cdot K_{ow} + DOC \cdot 0.08 \cdot K_{ow}}}$$

$$f_{fd} = \frac{1}{1 + 0.5 \times 10^{-6} \cdot 10^{4.18} + 2.9 \times 10^{-6} \cdot 0.08 \cdot 10^{4.18}} = 0.9890$$

The f_{fd} term is part of the equations for the BAF method, BCF method, and the national BAF equation. Calculations of fluorene's baseline and national BAFs using the BAF and BCF methods for TL 2 are explained in the sections that follow.

7.2.1 BAF Method

One field sample was available for fluorene with a BAF of 79,432.8 L/kg for an amphipod (*Pontoporeia hoyi*) (TL 2). No BAF samples were available for TLs 3 and 4. A baseline BAF is calculated for each field sample available. The fraction lipid (f_ℓ) in this equation is determined as described in section 6.4, Lipid Content. In this example, f_ℓ was not provided with the source data and was estimated as 0.03 based on data from the TSD's Tables 4-5 and 6-3 (USEPA 2003a).The calculation of baseline BAF using the BAF method for fluorene is shown below:

$$\mathbf{(Baseline\ BAF)_i} = \left[\frac{\mathbf{BAF_T^t}}{\mathbf{f_{fd}}} - \mathbf{1}\right] \cdot \frac{\mathbf{1}}{\mathbf{f_\ell}}$$

$$(\text{Baseline BAF})_i = \left[\frac{79432.8}{0.9890} - 1\right] \cdot \frac{1}{0.03} = 2{,}677{,}062.70 \text{ L/kg-lipid}$$

If multiple baseline BAFs were derived, they were averaged prior to computing the national BAF by calculating a geometric mean first by species, then by TL. In this example for fluorene, however, only one field sample was available.

Thus, the calculated baseline BAF above, the f_{fd} value, and the national default trophic-specific value for fraction lipid (f_ℓ) are substituted into the national BAF equation. Continuing with the fluorene example and TL 2 ($f_{\ell(TL\ 2)}$=0.019), the national BAF is calculated using the following equation:

$$\textbf{National BAF}_{(\textbf{TL 2})} = [(\textbf{Final Baseline BAF})_{\textbf{TL 2}} \cdot (\mathbf{f}_{\boldsymbol{\ell}})_{\textbf{TL 2}} + \mathbf{1}] \cdot (\mathbf{f}_{\mathbf{fd}})$$

$$\text{National BAF}_{(\text{TL 2})} = [2{,}677{,}062.7 \cdot 0.019 + 1] \cdot 0.9890 = 50{,}307.82 \text{ L/kg-tissue}$$

Rounding this value to two significant figures yields a national BAF value using the BAF method of 50,000 L/kg-tissue for TL 2.

7.2.2 BCF Method

Twelve laboratory-derived BCF values were available for fluorene for six species at all three TLs. Focusing on TL 2 for this example, six BCF values were available for two species: an oligochaete (*Lumbriculus variegatus*) and a water flea (*Daphnia magna*). The oligochaete laboratory-derived BCF values are 330, 380, 490, 405, and 500 L/kg. The water flea BCF value is 506 L/kg. In the BCF method, a baseline BAF is calculated for each laboratory-measured BCF value. Calculation of the baseline BAF using the BCF method for fluorene using the BCF value of 330 L/kg is shown below:

$$(\textbf{Baseline BAF})_{\mathbf{i}} = (\textbf{FCM})_{\textbf{TL n}} \cdot \left[\frac{\textbf{BCF}_{\textbf{T}}^{\textbf{t}}}{\mathbf{f}_{\mathbf{fd}}} - \mathbf{1}\right] \cdot \frac{\mathbf{1}}{\mathbf{f}_{\boldsymbol{\ell}}}$$

$$(\text{Baseline BAF})_i = 1 \cdot \left[\frac{330}{0.9890} - 1\right] \cdot \frac{1}{0.03} = 11{,}088.54 \text{ L/kg-lipid}$$

The other oligochaete baseline BAF values calculated using the BCF method are 12,773.67, 16,480.96, 13,616.24, and 16,817.99 L/kg-lipid. The water flea baseline BAF value calculated using the BCF method is 10,212.12 L/kg-lipid. Multiple (Baseline BAF)$_i$ are averaged to a (Baseline BAF)$_{TL\ n}$ by taking a geometric mean first by species, then by TL. For fluorene at TL 2, a geometric mean of 13,983.01 L/kg-lipid was calculated for the oligochaete and only one water flea baseline BCF value of 10,212.12 L/kg-lipid was available. The geometric mean of those two values is 11,949.74 L/kg-lipid, which is the derived baseline BAF for fluorene TL 2 using the BCF method. The corresponding values for TLs 3 and 4 were computed as 17,652.38 and 23,784.77 L/kg-lipid, respectively.

The calculated baseline BAF values above, the f_{fd} value, and the national default trophic-specific value for fraction lipid (f_ℓ) are substituted into the national BAF equation. Continuing with the fluorene example and TL 2 ($f_{\ell(TL\ 2)}$=0.019), the national BAF is calculated using the following equation:

$$\textbf{National BAF}_{(\textbf{TL 2})} = [(\textbf{Final Baseline BAF})_{\textbf{TL 2}} \cdot (\mathbf{f}_{\boldsymbol{\ell}})_{\textbf{TL 2}} + \mathbf{1}] \cdot (\mathbf{f}_{\textbf{fd}})$$

$$\text{National BAF}_{(\text{TL 2})} = [11{,}949.74 \cdot 0.019 + 1] \cdot 0.9890 = 225.55 \text{ L/kg-tissue}$$

The corresponding values for TLs 3 and 4 were computed as 454.92 and 706.71 L/kg-tissue, respectively. Rounding the values to two significant figures yields national BAF values using the BCF method of 230, 450, and 710 L/kg-tissue for TLs 2, 3, and 4, respectively.

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Estimated Fish Consumption Rates for the U.S. Population and Selected Subpopulations (NHANES 2003-2010)

Final Report

April 2014
EPA-820-R-14-002

Acknowledgments

The U.S. Environmental Protection Agency (EPA) Project Manager for this project was Jeffrey D. Bigler, who provided management and technical direction for the project. EPA was supported in this effort by Westat under EPA Contract No. EP-C-10-023. The Westat project manager was Rebecca Jeffries Birch who was responsible for the overall technical accuracy and quality of the project. John Rogers served as the senior statistician. The methodology developed for the project was externally peer-reviewed by Versar under EPA Contract No. EP-C-13-010.

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Figures

Background 1

The U.S. population is exposed to environmental contaminants through the consumption of contaminated finfish and shellfish (Thompson and Boekelheide, 2013; National Research Council, 2000; Ahmed, Hattis, Wolke, and Steinman, 1993). The analysis presented here provides EPA's recommended methodology for developing a national-level fish consumption rate (FCR) for use in developing ambient water quality criteria as required under Section 304(a) of the Clean Water Act.

As more current data are available and new analytical methodologies have been developed, the Office of Water has conducted a new analysis of FCR. These new FCRs were estimated using data from the National Health and Nutrition Examination Survey (NHANES) 2003-2010. NHANES is a continuous survey designed to collect data on the health and nutritional status of the U.S. population. Each 2-year cycle is designed to be representative of the general U.S. population.

An individual's FCR is the expected quantity of fish consumed per unit time. For a population, there is a distribution of FCR; some individuals consume more fish per unit time and some less. With adequate data, we can calculate the average FCR across the population or percentiles, such as the 90th percentile (10 percent of the population has an individual FCR greater than the 90th percentile).

Different time units can be used to express the same rate, e.g., per day or per week. The FCR is a theoretical quantity and is often estimated using statistical analysis. It may change over time, for example, be higher in the summer than the winter. Thus, the FCR depends on the time frame (e.g., summer, winter, annual).

Due to the infrequent consumption of fish, the estimated FCR may be variable or imprecise. If a person eats fish for dinner every Friday and not at other times, the FCR is one fish meal per week and the estimated FCR is likely to be relatively constant. If a fish meal is consumed on average once every 7 days but sometimes 3 days in a week and other times not for several weeks, the estimated FCR over a short time frame can be quite variable, even though the true FCR is constant and is the same as in the first example. As the time frame covered by the data gets longer, the estimated FCR becomes less variable. Assuming the true long-term FCR is constant over time, if the time frame covered by the data is very long, the estimated FCR becomes a relatively precise estimate of the true long-term or usual FCR.

Assuming the FCR is constant over time, methodologies can be designed to estimate the distribution of the true, long-term, FCR even though the data are collected over a limited time frame. We can add the term “usual” to “fish consumption rate” (UFCR) to imply that the resulting estimates are those that correspond to long-term averages, rather than short-term estimates and to avoid a distinction between the true rate and the estimated rate.

In the mid-2000s, the National Cancer Institute (NCI) developed a statistical methodology to estimate usual intake of episodically consumed foods. This method, known as the NCI Method, has been published and statistical programs are available on NCI’s web site. There are other methods that have been developed to estimate the distribution of usual intake of episodically consumed foods. However, the NCI Method is preferred because it accounts for days without consumption; distinguishes within-person from between-person variation; allows for the correlation between the probability of consumption and the consumption-day amount; and can use covariate data to better predict usual intake.

The NCI Method provides estimates of UFCR representing the long-term average grams of fish consumed per day. Due to the episodic nature of fish consumption, the NCI Method models both the probability of consumption on a given day and the amount consumed on days when some fish is consumed. These two predicted values are then multiplied together to get a usual intake value. The calculations using the NCI Method are very time consuming. To get estimates in a reasonable time, EPA created a program, hereinafter referred to as the EPA Method, which approximates the results from the NCI Method. Details of the NCI Method, the EPA Method, and how they compare are provided in Section 4, Statistical Methods.

UFCRs were estimated for the general U.S. population, the youth population under 21 years of age, and the adult population 21 years and older. UFCR estimates were calculated for various subpopulations, e.g., by age, gender, race/ethnicity, income, U.S. Census region, and coastal and noncoastal populations. We estimated UFCR for 18 different categories of fish, both raw weight of edible portion and as-prepared weight. These fish types were chosen as they represent various categories of interest to states and tribes. For example, a coastal state may be interested in knowing the UFCRs of total fish and of marine and freshwater + estuarine, separately. An inland state may only be interested in freshwater fish UFCRs. Additionally, as fish bioaccumulate toxins at different rates depending on their trophic level, UFCR were also calculated for fish by trophic level. The fish types are the following:

- Total fish;
- Total finfish;
- Total shellfish;
- Marine fish;
- Freshwater fish;
- Estuarine fish;
- Freshwater + estuarine fish;
- Freshwater + marine fish;
- Estuarine + marine fish;
- Trophic level 2 fish;
- Trophic level 3 fish;
- Trophic level 4 fish;
- Marine trophic level 2 fish;
- Marine trophic level 3 fish;
- Marine trophic level 4 fish;
- Freshwater + estuarine trophic level 2 fish;
- Freshwater + estuarine trophic level 3 fish; and
- Freshwater + estuarine trophic level 4 fish.

This report presents the methodologies used to extract fish consumption data from the NHANES data sets, the habitat apportionment methodology, the trophic level assignment methodology, the statistical methodology, and the UFCR estimates and 95 percent confidence intervals (95% CI) of the mean and the 25th, 50th, 75th, 90th, 95th, 97th, and 99th percentiles.

National Health and Nutrition Examination Survey 2

2.1 Survey Description

NHANES is designed to assess the health and nutritional status of adults and children in the United States. It is conducted by the National Center for Health Statistics (NCHS, 2013), part of the Centers for Disease Control and Prevention (CDC) that is responsible for producing vital and health statistics for the United States. NHANES began in the 1960s. In 1999, the survey became a continuous program that examines a nationally representative sample of about 5,000 persons located in 15 counties across the country each year.

The NHANES interview includes demographic, socioeconomic, dietary, and health-related questions. The examination component consists of medical, dental, and physiological measurements, as well as laboratory tests.

NHANES collects 2 days of dietary data from all participants. The first day, the data are collected in person at the examination portion of the survey. The second day's data are collected by telephone interview 3 to 10 days after the in-person interview. Both interviews include a 24-hour dietary recall section. The primary goal of the 24-hour recall is to collect a detailed list of all the foods and beverages consumed within a 24-hour period. Food models are used to help participants estimate the amount consumed. The in-person interview also includes a section on the frequency of consumption of fish and shellfish in the past 30 days (NCHS, 2009). Survey participants are not asked to provide detailed recipes for mixed dishes. For those, standard default recipes are used.

A complex, multistage probability sampling design is used to select participants representative of the civilian, noninstitutionalized U.S. population.

- Stage 1: Primary sampling units (PSUs) are selected with probability proportional to a measure of size (PPS). These are mostly single counties or, in a few cases, groups of contiguous counties.
- Stage 2: The PSUs are divided up into segments (generally city blocks or their equivalent). As with each PSU, sample segments are selected with PPS.

- Stage 3: Households within each segment are listed, and a household sample is randomly drawn. In geographic areas where the proportion of age, ethnic, or income groups selected for oversampling is high, the probability of selection for those groups is greater than in other areas.

- Stage 4: Individuals are chosen to participate in NHANES from a list of all persons residing in selected households. Individuals are drawn at random within designated age-sex-race/ethnicity screening subdomains. On average, 1.6 persons are selected per household. Oversampling of certain population subgroups is done to increase the reliability and precision of health status indicator estimates for these groups.

The NHANES data files include analysis weights to account for the complex survey design (including oversampling), survey nonresponse, and poststratification. Weighted NHANES results describe the U.S. Census civilian noninstitutionalized population. A person's analysis weight is a measure of the number of people in the population represented by that sampled person.

2.2 Survey Data

2.2.1 24-Hour Recall

The 24-hour dietary recall interview data provide (1) what food items the participants ate and (2) how much of each food item they ate. All NHANES participants are eligible for the dietary interview component that occurs during the examination portion of the survey. The first interview is conducted in person via a computer-assisted dietary interview software program that was developed for NHANES. The interviewer uses a standard set of measuring guides to help the participant report the volume and dimensions of the foods consumed. The second dietary interview is conducted via telephone. It occurs 3 to 10 days after the first dietary interview. The participants are given a set of measuring guides to take home and use during the telephone interview.

The 24-hour recall data are collected using the USDA Automated Multiple-Pass Method (AMPM). Detailed information on the method can be found on USDA's web site at http://www.ars.usda.gov/Services/docs.htm?docid=7710. The method is computerized and research based. It uses five steps designed to assist participants with complete and accurate food recall and reduce respondent burden.

The five steps follow:

1. Collect a list of foods and beverages consumed the previous day.
2. Probe for foods forgotten during step 1.
3. Collect the time and the name of the eating occasion for each food.
4. For each food, collect detailed description, amount, and additions (i.e., anything that may have been added to the food). Review 24-hour day.
5. Final probe for anything else consumed.

We assume that the reports of 24-hour consumption are unbiased estimates of each respondent's true consumption.

2.2.2 30-Day Fish Consumption Frequency

The 30-day fish consumption frequency data are derived from questionnaire data that ask participants how often in the past 30 days they consumed different fish species. These species are clams, crabs, crayfish, lobster, mussels, oysters, scallops, shrimp, other shellfish, unknown shellfish, breaded fish products, tuna, bass, catfish, cod, flatfish, haddock, mackerel, perch, pike, pollock, porgy, salmon, sardines, sea bass, shark, swordfish, trout, walleye, other fish, and unknown fish. Using these data, we can derive a variable for the number of times fish was consumed in the past 30 days by summing up the values for all 31 variables. This information improves intake estimates for episodically consumed foods like fish, as even people who consumed fish frequently do not do so every day; therefore, it is not always reported in 24-hour recall data. This derived frequency of consumption can then be used as a predictor in statistical models of the probability of fish consumption and fish consumption amount.

In 2003-2004, only children less than 6 years of age and women 16 to 49 years old were asked these questions. As frequency of fish consumption is an important predictor in the statistical models, we only included these age and gender groups from NHANES 2003-2004 in the analysis. The analysis weights of male participants in 2005-2010 and females not in these age groups were adjusted to account for this difference. Since they are only in three of the four cycles of NHANES their weights were multiplied by a factor of 4/3.

2.3 Regions

Patterns of fish and shellfish consumption may vary by geography, such as between U.S. residents who live on or near the coast and those who live inland, or among regions of the United States as defined by the U.S. Census Bureau (Mahaffey, Clickner, and Jeffries, 2009). Fish consumption patterns may also vary by specific coast (e.g., residents near the Atlantic coast may have different fish consumption patterns than those on the Gulf of Mexico coast). To estimate FCRs by region and coast, we assigned NHANES respondents to U.S. Census Bureau regions and coastal or noncoastal status, which when combined created the following: Atlantic Coast, Northeast, Great Lakes, Midwest, South, Gulf of Mexico, West, and Pacific Coast. The geography data were obtained from the NCHS Research Data Center through its restricted-use data access procedures.

The geographic unit used by NHANES is a county or county equivalent; therefore our definitions of coastal and noncoastal were limited to county boundaries. All counties that bordered the Pacific or Atlantic Oceans, the Gulf of Mexico or any of the Great Lakes were defined as coastal. Additionally, counties that bordered estuaries and bays were defined as coastal as were counties whose centroid was within approximately 25 miles of any coast even if not directly bordering a coast. The four coastal regions were then defined based on nearest body of water. The following provides definitions of each region:

- U.S. Census Regions
  - Midwest = OH, MI, IN, WI, IL, MO, IA, MN, SD, ND, NE, and KS
  - Northeast = PA, NY, NJ, CT, RI, MA, NH, VT, and ME
  - South = DE, MD, DC, VA, WV, KY, TN, NC, SC, GA, AL, MS, FL, LA, AR, OK, and TX
  - West = NM, CO, WY, MT, ID, UT, AZ, NV, CA, OR, WA, AK, and HI
- Coastal and Inland Regions
  - Pacific Coast = coastal counties in CA, OR, WA, AK, and HI
  - Atlantic Coast = coastal counties in CT, DE, DC, FL (bordering Atlantic Ocean), GA, ME, MD, MA, NH, NJ, NY, NC, PA, RI, SC, and VA
  - Gulf of Mexico Coast = coastal counties in AL, FL (bordering Gulf of Mexico), LA, MS, and TX
  - Great Lakes Coast = counties bordering the Great Lakes in MI, WI, OH, NY, MN, IN, IL, and PA

- Inland West = remaining counties in CA, OR, WA, AK, and HI and all of NM, CO, WY, MT, ID, UT, AZ, and NV
- Inland South = remaining non-coastal counties in DE, MD, DC, VA, NC, SC, GA, AL, MS, FL, LA, and TX and all of WV, KY, TN, AR, and OK
- Inland Northeast = remaining counties in PA, NY, NJ, CT, RI, MA, NH, and ME and all of VT.
- Inland Midwest = remaining counties in OH, MI, IN, WI, IL, and MN and all of MO, IA, SD, ND, NE, and KS.

Data Processing Methodology 3

3.1 Habitat Apportionment

To make estimates of FCRs for marine fish, estuarine fish, freshwater fish, and various combinations of these types, the fish species reported as consumed by NHANES participants were apportioned to habitats. The assignments of species were completed by a fisheries biologist. Appendix A contains the detailed documentation of the assignments for each species.

The fish were apportioned to align with EPA's long-standing interpretation of section 303(c) (2) (A) of the Clean Water Act that state and tribal waters should support safe consumption of fish and shellfish and that the standards need to be set to enable residents to safely consume from local waters the amount of fish they would normally consume from all fresh and estuarine (including near coastal) waters. Thus marine species that are harvested in near coastal waters were assigned to the estuarine habitat in order to be included in the freshwater + estuarine FCR. The following decisions concerning habitat assignments were made:

- Estuarine fish and shellfish include estuarine species harvested in near-coastal areas (clams, mussels, crabs, lobster, shrimp) and single species that live in both marine and estuarine habitats (e.g., specific clam and octopus species or the single jellyfish species that constitutes the U.S. jellyfish fishery).

- Tilapia was assigned 50 percent freshwater and 50 percent estuarine, even though it is rare in U.S. waters, to be consistent with EPA's long-standing interpretation of section 303(c) (2) (A) of the Clean Water Act, as mentioned above, that the standards need to be set to enable residents to safely consume from local waters the amount of fish they would normally consume from all fresh and estuarine (including near coastal) waters.

- Shrimp was assigned 17.6 percent marine and 82.4 percent estuarine. National Oceanic and Atmospheric Administration (NOAA) landings data show that 17.6 percent of shrimp harvested in 2009-2010 were "Ocean Shrimp (Oregon Pink Shrimp)," "Rock Shrimp," "Royal Red Shrimp," and "Marine Shrimp, Other."

- Salmon was assigned 96 percent marine, 0.5 percent freshwater, and 3.5 percent estuarine. The freshwater percent is landlocked sockeye salmon (Kokanee) found natively in Alaska, Washington, and Oregon, but they have also been introduced to many other states for recreational fishing. The estuarine percent includes saltwater trout, which are included in the NHANES salmon group, and the small proportion of salmon that are harvested in estuaries. Note that farmed Atlantic salmon were assigned to the marine habitat as they are produced outside of the United States in marine waters.

Table 1 presents the final proportion of each NHANES fish group that is assigned to marine, freshwater, and estuarine habitats. Note that unspecified fish consumed was assigned the overall average habitat apportionment of all species reported consumed. The remainder of Section 3.1 describes the habitat apportionment methodology.

Table 1. Habitat assignments of NHANES fish groups

Species/group	Proportion		
	Marine	Freshwater	Estuarine
Abalone	1.000	0.000	0.000
Anchovy	0.000	0.000	1.000
Barracuda	1.000	0.000	0.000
Breaded Fish Products (e.g., fish sticks)	1.000	0.000	0.000
Carp	0.000	1.000	0.000
Catfish	0.000	0.900	0.100
Clam	0.840	0.000	0.160
Cod	1.000	0.000	0.000
Conch	1.000	0.000	0.000
Crab	0.273	0.000	0.727
Crayfish	0.000	1.000	0.000
Croaker	0.071	0.050	0.879
Eel	0.000	1.000	0.000
Fish, not specified	0.520	0.160	0.320
Flatfish	0.870	0.000	0.130
Haddock	0.945	0.050	0.006
Halibut	0.780	0.000	0.220
Herring	0.304	0.010	0.686
Jellyfish	0.000	0.000	1.000
Lobster	0.044	0.000	0.956
Mackerel	0.411	0.000	0.589
Mullet	0.000	0.000	1.000
Mussel	0.000	0.000	1.000
Octopus	0.620	0.000	0.380
Oyster	0.000	0.000	1.000
Perch	0.000	1.000	0.000
Pike	0.000	1.000	0.000
Pompano	0.661	0.002	0.338
Rockfish/Ocean Perch	0.925	0.000	0.075
Roe	0.085	0.235	0.680
Salmon	0.960	0.005	0.035
Sardine	0.900	0.000	0.100
Scallop	0.000	0.000	1.000
Scup/Porgy	0.981	0.000	0.019
Sea Bass	0.925	0.025	0.050
Shad	0.304	0.010	0.686
Shark	0.866	0.000	0.134
Shrimp	0.176	0.000	0.824
Snail	0.450	0.100	0.450

Table 1. Habitat assignments of NHANES fish groups (continued)

Species/group	Proportion		
	Marine	Freshwater	Estuarine
Snapper	0.981	0.000	0.019
Squid	0.800	0.000	0.200
Sturgeon	0.000	0.420	0.580
Swordfish	1.000	0.000	0.000
Tilapia	0.000	0.500	0.500
Trout	0.106	0.869	0.025
Tuna	1.000	0.000	0.000
Whelk	0.000	0.000	1.000
Whitefish	0.877	0.000	0.123
Whiting	1.000	0.000	0.000

3.1.1 NHANES Fish Groupings

When the raw 24-hour recall data are processed by NHANES, fish species reported consumed are grouped, and foods (e.g., Pompano, baked or broiled) are assigned food codes. The list below presents the species of fish that are specified in the USDA Food and Nutrient Database for Dietary Studies (FNDDS) and the additional species that are included in each group.

- Abalone
- Anchovy
- Barracuda
- Carp (bream; buffalofish; and sucker)
- Catfish (bullhead)
- Clams
- Cod
- Conch
- Crab
- Crayfish
- Croaker (angelfish; butterflyfish; drumfish; goatfish; kingfish; sea trout; freshwater sheepshead; spadefish; spot; surgeonfish; weakfish; weke; goo; and gaspergou)
- Eel
- Fish stick, patty, or fillet, not specified as to type (commercial products such as Mrs. Paul's, Gorton's, Van de Kamp's)
- Fish, not specified as to type
- Flounder (dab; fluke; halibut; sole; and turbot)
- Haddock (blowfish; burbot; cusk; hake; ling; monkfish; pollock; and scrod)
- Halibut
- Herring (alewife; milkfish; and shad)
- Jellyfish
- Lobster
- Mackerel (garfish; ono; needlefish; and wahoo)
- Mullet
- Mussels
- Ocean perch (bocaccio; menpachi; orange roughy; redfish; and rockfish)
- Octopus
- Oysters
- Perch (freshwater bass; bluegill; crappie; sunfish; and walleye)
- Pike (muskellunge; and pickerel)

- Pompano (akule; blackfish; bluefish; butterfish; dolphinfish; jack; mahimahi; paplo; parrot fish; sablefish; scad; tilefish; ulva; and yellowtail)
- Porgy (scup; sea bream; marine sheepshead; and snapper)
- Ray (skate) [not reported ever consumed]
- Roe
- Roe, sturgeon (caviar)
- Salmon (saltwater trout)
- Sardines
- Scallops
- Sea bass (grouper; striped bass; wreakfish; and bass)
- Shark (dogfish and grayfish)
- Shrimp
- Smelt [not reported ever consumed in the 2003-2010 data]
- Snails
- Snapper
- Squid (cuttlefish)
- Sturgeon
- Swordfish (marlin)
- Tilapia
- Trout (cisco; lake herring; steelhead; and whitefish)
- Tuna (ahi; aku; and bonito)
- Whelk
- Whitefish
- Whiting

This grouping of species complicates the assignment of habitat because in many cases, the grouped fish inhabit different habitats. For example, burbot, a freshwater fish, is part of the haddock group, which is defined by the Order Gadiformes (excluding cod). All of the other species in this group are marine and estuarine. For these groups, we used raw (uncoded) 24-hour recall files from NHANES from 2007-2008 (which are not publically available, and the only cycle made available to us) and counted the number of times a species was reported. Using the haddock group as an example, in 2007-2008 blowfish, burbot, cusk, hake, ling, and monkfish were reported 0 times, pollock was reported 10 times, scrod was reported 2 times, and haddock was reported 4 times. These counts were then used to assign proportions of each species in the group to the total group. No species in a group was assigned 0 percent based on a 0 count in the files, because it may be reported in another NHANES cycle. These species were assigned between 1 and 5 percent depending on how many species are included in the group and how many times other species in their group were reported consumed. Appendix A provides the percentages assigned to each species. The assigned proportions were then multiplied by the habitats and summed to get the total habitat proportions for the fish group.

3.1.2 Use of NOAA Landings Data

Other assignments were complicated by the fact that a species lives in multiple habitat types, either at different life stages or because different species occupy different habitats. For these species, habitat apportionment was aided by using the NOAA landings data (http://www.st.nmfs.noaa.gov/commercial-fisheries/).

Table 2 is an example of the NOAA landings data for clams for 2010. To apportion the total consumption of clams to estuarine and marine, we first assigned a habitat to each clam species listed. According to these data, excluding the catch-all category, 84 percent of all clams landed in 2010 were from the marine environment and 16 percent were from the estuarine environment (multiplying the proportion of total without catch-all by the habitat proportion for each species and then summing for each habitat). These proportions excluding the catch-all category were then applied to the catch-all category, and the overall proportions were re-calculated.

This methodology was used to assist the apportionment of the following species: catfish, clam, crab, flatfish, flounder, sole, halibut, lobster, mackerel, porgy, shrimp, and whiting and species in the following food code groups: croaker, pompano, sardine, and trout.

3.1.3 Imported Fish and Farmed Fish

It is known that the United States imports a large proportion of the fish consumed from overseas. According to NOAA Fish Watch, 86 percent of the fish consumed in the United States are imported (http://www.fishwatch.gov/wild_seafood/outside_the_us.htm). The top imported species are shrimp, freshwater fish (mainly tilapia and catfish), tuna, salmon, groundfish (e.g., cod, haddock, flounder), crab, and squid. As marine fish are not harvested from U.S. waters for which states would be developing water quality standards, the issue of importation for these species is not relevant. However, shrimp is the most commonly consumed fish by U.S. consumers. It is unknown whether the proportion consumed that was harvested in non-U.S. waters is distributed equally across the distribution of fish consumers. For example, it is possible that high fish consumers eat more locally caught fish as they may be more likely to be recreational or subsistence fishers. For the purposes of developing UFCR, we assumed that all estuarine, freshwater, and near coastal fish that were consumed were from U.S. waters. The reason for this is that standards need to be set to enable residents to safely consume from local waters the amount of fish they would normally consume from all fresh and estuarine (including near coastal) waters.

Table 2. NOAA landings data, clam apportionment

	Pounds landed, 2010	Proportion of total	Proportion of total (without catch-all category)	Habitat	Habitat percent
Clam, Arc, Blood	23,738	0.0003	0.0003	Estuarine & marine harvested near coast	100E
Clam, Atlantic Jackknife	67,334	0.0008	0.0008	Estuarine	100E
Clam, Atlantic Surf	37,465,740	0.4188	0.4542	Marine	100M
Clam, Butter	15,133	0.0002	0.0002	Estuarine & marine harvested near coast	100E
Clam, Manila	937,915	0.0105	0.0114	Estuarine	100E
Clam, Northern Quahog	4,406,313	0.0493	0.0534	Estuarine	100E
Clam, Ocean Quahog	31,704,091	0.3544	0.3844	Marine	100M
Clam, Pacific Geoduck	2,777,529	0.0310	0.0337	Estuarine & marine harvested near coast	100E
Clam Pacific Littleneck	26,811	0.0003	0.0003	Estuarine & marine harvested near coast	100E
Clam, Pacific Razor	138,826	0.0016	0.0017	Marine	100M
Clam Pacific Gaper	6,061	0.0001	0.0001	Estuarine & marine harvested near coast	100E
Clam, Quahog	634,131	0.0071	0.0077	Estuarine	100E
Clam, Softshell	4,278,356	0.0478	0.0519	Estuarine & marine harvested near coast	100E
Clams or Bivalves	6,980,468	0.0780		estuarine & marine (catch-all category)	16E/84M
Total Pounds	89,462,446				
Total Pounds without catch-all	82,481,978				
Without catch-all	Proportion Estuarine	0.15971			
	Proportion Marine	0.84029			
Total	**Proportion Estuarine**	**0.15973**			
	Proportion Marine	0.84027			

There are similar issues with farmed freshwater fish. Freshwater fish can be farmed in man-made ponds or tanks for which the states will not be developing water quality standards. However, as noted above in the discussion concerning imported fish, the proportion of freshwater fish consumed that is farmed may not be evenly distributed across the distribution of consumption. Again, it is possible that high fish consumers are eating locally caught fish through recreational or subsistence fishing and thus eating a smaller proportion of farmed fish than those at the middle and low end of the consumption distribution. Therefore farmed species were assumed to be wild caught. This allows residents to safely consume from local waters the amount of fish they would normally consume from fish farms.

3.2 Trophic Level Assignments

The trophic level of an organism is the place it occupies in the food web. Organisms with higher trophic levels have higher exposures to environmental contaminants.

- Trophic level 1 organisms are primary producers (plants and algae).
- Trophic level 2 organisms are herbivores, also called primary consumers.
- Trophic level 3 organisms are carnivores that consume herbivores.
- Trophic level 4 organisms are carnivores that consume other carnivores.
- Trophic level 5 organisms are the apex predators.

Trophic level assignments were made using the data provided in the following documents: (1) *Methodology for Deriving Ambient Water Quality Criteria for the Protection of Human Health (2000),* Table 6-4 (U.S. Environmental Protection Agency, 2003) and (2) *Trophic Level and Exposure Analyses for Selected Piscivorous Birds and Mammals: Volume III: Appendices* (U.S Environmental Protection Agency, 2002b).

For species that were not in those documents, we performed a search of literature available on the Internet and applied the same rules that were described in the December 2003 document:

- For game fish, data were used for edible size ranges (about 20 cm [8 inches] or larger).
- For species where multiple size ranges were available, preference was given to the larger specimens in determining the species trophic level.

- Trophic level 2 was assigned to a species if appropriate trophic level data ranged between 1.6 and 2.4; trophic level 3 if trophic level data ranged from 2.5 to 3.4; and trophic level 4 if trophic level data were 3.5 or higher. This is consistent with the approach taken in the Great Lakes Water Quality Initiative guidance (U.S. Environmental Protection Agency, 1995).

- In determining NHANES fish grouping trophic level assignments, best professional judgment was used. If the vast majority of the species in a group are within one trophic level, then that trophic level is assigned. If species span two levels it is split 50-50. For example, the NHANES grouping for catfish includes four species that are assigned to trophic level 3 and three species assigned to trophic level 4. Thus, it is assumed that half (50 percent) of consumption in the catfish NHANES grouping is from TL3 and half from TL4. Other fish this rule applies to are croaker, flatfish, and shrimp.

Table 3 presents the final trophic level assignments.

Table 3. Trophic level assignments

Fish species/group	Proportion of Assigned to Trophic Level		
	Trophic level 2	Trophic level 3	Trophic level 4
ABALONE	1	0	0
ANCHOVY	0.5	0.5	0
BARRACUDA	0	0	1
BREADED FISH PRODUCTS (e.g., fish sticks)	0	0.5	0.5
CARP	0	1	0
CATFISH	0	0.5	0.5
CLAM	1	0	0
COD	0	0	1
CONCH	1	0	0
CRAB	0	1	0
CRAYFISH	0	1	0
CROAKER	0	0.5	0.5
EEL	0	0	1
FISH NOT SPECIFIED	0	0.5	0.5
FLATFISH	0	0.5	0.5
HADDOCK	0	0	1
HALIBUT	0	0	1
HERRING	0	1	0
JELLYFISH	1	0	0
LOBSTER	0	1	0
MACKEREL	0	0	1
MULLET	1	0	0
MUSSEL	1	0	0
ROCKFISH/OCEAN PERCH	0	0	1
OCTOPUS	0	0.5	0.5
OYSTER	1	0	0
PERCH	0	0	1
PIKE	0	0	1
POMPANO	0	0	1
PORGY/SCUP	0	0	1
ROE	0	0	0
SALMON	0	0	1

Table 3. Trophic level assignments (continued)

Fish species/group	Proportion of Assigned to Trophic Level		
	Trophic level 2	Trophic level 3	Trophic level 4
SARDINE	0	1	0
SCALLOP	1	0	0
SEA BASS	0	0	1
SHAD	0	1	0
SHARK	0	0	1
SHRIMP	0.5	0.5	0
SNAIL	1	0	0
SNAPPER	0	0	1
SQUID	0	0.5	0.5
STURGEON	0	0	1
SWORDFISH	0	0	1
TILAPIA	1	0	0
TROUT	0	0	1
TUNA	0	0	1
WHELK	1	0	0
WHITEFISH	0	1	0
WHITING	0	1	0

3.3 Extracting Reported Amounts of Fish Consumed

The FNDDS is the underlying database used to code dietary intakes for NHANES. It is a database of foods, their nutrient values, and gram weight equivalents for various ingredients in the foods. For each new version of FNDDS, foods, gram weights, and nutrient values are reviewed and updated to reflect the U.S. food supply by incorporating new foods based on what is reported in the survey and updating existing entries.

In FNDDS, each food is given an 8-digit food code. The first digit identifies one of nine major food groups. The second, third, and fourth digits identify increasingly more specific subgroups. Most fish-containing foods are found under "26 – Fish and Shellfish," "27 – Meat, Poultry, Fish with nonmeat items," and 28, which includes soups and frozen meals. Other fish-containing foods are found under "5 – Grains" such as seafood pizza and pasta dishes and "7 – Vegetables" for dishes that are mainly vegetables but also contain fish and/or shellfish.

The NHANES 24-hour recall data include these same food codes for each reported food consumed; therefore the reported foods can be merged to the FNDDS files to obtain recipe information. The FNDDS files are available from the Agriculture Research Service of the USDA (USDA, 2006; USDA, 2008; USDA 2010; Ahuja et al., 2012). FNDDS includes several files (or tables), including a file that is linked to the USDA National Nutrient Database for Standard Reference (SR) that provides recipes for reported foods. For example, the standard recipe for "Perch, baked or broiled," consists of the ingredients (1) fish, perch, mixed species, raw; (2) margarine, stick, salted; (3) lemon juice, raw; and (4) salt, table. The FNDDS-SR link file provides weights in grams for each ingredient in each recipe. In the above example, these amounts are 907.2 grams of fish, 28.2 grams of margarine, 30.5 grams of lemon juice, and 6 grams of table salt. From these amounts, the fraction by weight of the recipe that is fish can be calculated. In the example, 907.2 / (907.2+28.2+30.5+6) = 0.933 grams of prepared fish per gram of recipe.

The FNDDS files were searched to find all food codes that contain finfish and/or shellfish. These records were then processed to determine the weight of each fish ingredient as a fraction of the weight across all ingredients in the recipe. The recipe ingredients may be raw, canned (cooked), or otherwise processed before being put into the recipes. The FNDDS description of each ingredient generally includes the processing before the ingredient is added to the recipe. After the dish is prepared from the ingredients, the food dish may have additional cooking or processing, such as baking. This processing is often described in the FNDDS food description.

As NHANES participants report the amount consumed "as prepared" (which is converted to a weight, in grams, in the NHANES file), it is relatively easy to estimate the grams of prepared fish that is consumed. However, because cooking can change the moisture content of the fish, calculating the grams of raw fish consumed requires to a weight conversion based on the likely moisture loss due to cooking. The calculation of the weight of as-prepared and raw fish consumed are based on the following:

- Estimates of the moisture loss associated with various cooking methods.
- Assuming the weight of fish as a proportion of the weight of the food is the same for the recipe in the FNDDS files as in the final as-prepared dish. In effect, we assume the proportional weight loss due to cooking of the prepared recipe as the same for the fish and non-fish ingredients.
- If the recipe specifies two cooking steps, one for the fish used in the recipe (for example, using canned ingredients) and one for the prepared recipe (for example, baking before serving), assuming a moisture loss associated with the cooking method with the most moisture loss.

The uncooked amount of fish was determined using the recipe databases, which list the amount of each ingredient in the food code. The weight of each ingredient as a fraction of the weight of the recipe was calculated, as above. During this data processing, each fish ingredient in the recipe was apportioned to marine, estuarine, and freshwater habitat and to trophic levels 2, 3, and 4, as discussed in Sections 3.1 and 3.2. As many food codes comprise multiple fish species, each of these values was summed, along with total fish percent, across all fish-containing ingredients to get total values for each habitat, trophic level, and total fish for each fish-containing food code.

The adjustment factors for cooking by dry heat, moist heat, and frying and the adjustment factors for canning and restructured fish are also used in the analysis of the CSFII data published in 2002 (EPA, 2002a) and in the *Mercury Study Report to Congress* (EPA, 1997, Volume 4). These cooking and processing methods represent 90 percent of all reported fish consumed. The percent moisture loss for the remaining cooking and processing methods (dried, kippered, smoked, salted, and pickled) are estimated using the FNDDS "MoistNFatAdjust" file. This file provides the percent moisture and fat loss or gain due to cooking, by food code; there is a file specific to each NHANES release. These adjustments are used in the calculations of nutrient intake (e.g., calcium, protein) for NHANES participants. However, for many food codes they are set to zero because the FNDDS recipe uses a cooked or processed fish as the ingredient, and no further adjustments were needed for nutrient intake calculations. We calculated the mean value of moisture loss for the remaining cooking methods for those fish food codes that did not have a 0 value, using this file. Table 4 provides the adjustments applied by cooking and processing method. For unspecified cooking method, approximately 5 percent of all reported fish consumed, an average adjustment across all reported fish food codes was applied (22 percent moisture loss).

Table 4. Estimated moisture loss due to cooking or processing

Cooking/Processing method	Percent moisture loss
Dried	57
Kippered	46
Smoked, (other than salmon)	36
Salted	33
Canned	25
Cooked, dry heat	25
Restructured	25
Cooked, moist heat	21
Smoked salmon	17
Pickled	16
Fried	12
Raw	0

There is uncertainty associated with these values. They are average values of moisture loss given the various processing and cooking methods. If participants cooked their fish a bit longer, then the moisture loss would be a bit greater than average, and if they cooked it a bit less, the moisture loss would be a bit less than average.

Appendix B provides a detailed description of how the fish foods were abstracted and processed from FNDDS and it provides the final number of grams of raw weight, of the edible portion fish per 1 gram of the final prepared recipe in each fish-containing food code reported in the NHANES data 2003-2010. It contains the values for total, marine, estuarine, freshwater, and trophic levels 2 through 4 fish.

As an example calculation, the standard recipe for food code 27250400 "shrimp cake or patty" contains 0.475 grams of shrimp per gram of total recipe. The shrimp ingredient in the recipe is canned; therefore moisture loss is estimated to be 25 percent. We divide .475 by 0.75 to get the grams of raw fish in 1 gram of the final prepared recipe, which is .633 g. Shrimp was apportioned to the habitats as 17.6 percent marine and 82.4 percent estuarine. We then multiply these percentages by the grams of raw shrimp in 1 gram of the final prepared recipe, 0.176*.633 = .111 grams raw marine fish in 1 gram of the final prepared recipe, and 0.824*.633 = .522 grams raw estuarine fish in 1 gram of the final prepared recipe. Similar calculations are made to determine grams of raw fish by trophic levels in 1 gram of the prepared recipe. These amounts are then multiplied by the reported grams of food code 27250400 consumed by the participants and summed across all fish-containing food codes reported by each respondent to get the reported 24-hour intake.

Using this example, we can see the uncertainty added to the estimates by using standard recipes. Recipes used for shrimp cakes could vary from the assumed 47.5 percent fish by weight composition by using more or less eggs or bread crumbs. Or the shrimp cake could have been prepared using raw shrimp that was fried, instead of canned shrimp, which would change the weight loss estimate to 12 percent. Thus a participant who reported consuming a shrimp cake probably consumed somewhat less or somewhat more than is estimated through the calculations. Nevertheless, these data are the best data available on a nationally representative sample.

An additional complication is that recipes may include two steps of processing; for example, a salmon loaf may list canned salmon as an ingredient, but it is then mixed with other ingredients and baked. Canning and baking have different moisture losses in Table 4. It was decided to use the adjustment that indicates the greatest moisture loss and apply that to the estimation of raw weight. In some recipes the second processing step is not categorized. We reviewed these and were able to impute the logical unreported process (e.g., pizza is baked, soup is wet cooked in moist heat) for many recipes; those that remained uncategorized were assumed to have the average moisture reduction described above.

Statistical Methodology 4

The NCI Method (Tooze et al., 2006; Tooze et al., 2010) is the preferred approach for estimating usual dietary intake, such as usual fish consumption. NHANES has data for many individuals, allowing fitting models with many parameters. With many individuals and many parameters, the computation time to implement the NCI Method was unacceptable. Therefore, EPA developed an alternate approach to estimate the usual fish consumption that requires relatively little computation time and provides a good approximation to the results from the NCI Method. The following sections describe both the NCI and the EPA Methods and compare the two approaches. Appendix C provides some further discussion and Appendix D provides the macro code for estimating parameters and simulating the UFCR.

4.1 Overview of the NCI Method

The NCI Method can be used to estimate the distribution of usual intake for a population or subpopulation. Two steps are required to estimate usual intake:

1. Fit the NCI model to the reported consumption data.
2. Calculate the usual intake from the model parameters.

The premise of the NCI model (step 1 above) is that usual fish intake is equal to the probability of consumption on a given day times the average amount consumed on a day when some fish is consumed, i.e., a "consumption day." For episodically consumed foods, such as fish, the NCI model consists of two parts, or sub-models. The first sub-model estimates the probability of consumption using logistic regression with a person-specific random effect. The second sub-model uses linear regression on a transformed scale to estimate the consumption-day amount, also with a person-specific random effect. The two sub-models are linked by allowing the person-specific effects to be correlated and by including common predictors in both sub-models. Data from one or more non-consecutive 24-hour recalls provide the values for the dependent variable. At least a subset of the population (generally 50 or more individuals) needs to have reported fish consumption from two or more 24-hour recalls. Predictors related to either the probability of consumption or consumption amount, such as gender, age, race, and income can be included in the modeling. In most cases, the most important predictor is a measure of frequency of consumption of the food of interest (in this case, fish) obtained from a food frequency questionnaire.

In the second step, the parameters from the NCI model are used to estimate population and subpopulation distributions of usual fish intake. The NCI Method calculates the distribution using simulated values for the probability of fish consumption and the mean consumption amount. The usual fish consumption (or usual fish intake) is the product of the probability of fish consumption and the mean amount of fish consumed, when it is consumed.

Evidence for the validity of the NCI Method has been published in a series of papers in the *Journal of the American Dietetic Association, Statistics in Medicine,* and *Biometrics* (Dodd et al., 2006; Tooze et al., 2006; Tooze et al., 2010; Kipnis et al., 2009).

The NCI Method is an improvement over other methods designed to estimate usual intake of episodically consumed foods because it:

- Accounts for reported days without consumption or for consumption-day amounts that are positively skewed;
- Distinguishes within-person from between-person variation;
- Allows for the correlation between the probability of consumption and the consumption-day amount; and
- Relates covariate information to usual intake.

The sub-model predicting the probability of fish consumption in a 24-hour period is a logistic regression model. The logistic regression model is commonly used to model the probability of an event, such as consuming fish. The model assumes the logit-transformed probability is a linear function of various continuous and discrete predictor variables. The logit transformation is commonly used as the link between the continuous predictors and the probability of a discrete outcome, as in logistic regression. The sub-model has two variance components, person-specific random effects for an individual's long-term probability of consuming fish and within-individual binomial variation between days when fish was or was not consumed. The logit-transformed person-specific random effects are assumed to be normally distributed.

The amount sub-model involves a Box-Cox transformation such that the transformed amount of fish consumed in a 24-hour recall is reasonably normally distributed. The Box-Cox transformation is a power transformation, such as raising the amount to the ¼ power (taking the fourth root), followed by rescaling to keep the variance relatively constant. In the transformed units, the amount sub-model has two variance components, person-specific random effects for an individual's long-term mean fish consumption and within-individual differences in the amount of fish consumed on different days. In the transformed units, the person-specific mean fish consumption and the within-individual daily fish consumption are assumed to have normal distributions.

The person-specific random effects in the two sub-models may be correlated, for example, those with a higher probability of consuming fish in a 24-hour period may also tend to consume larger daily amounts of fish. The assumption that the random effects are normally distributed is a characteristic of the model which is not directly testable. However, the distribution of the Box-Cox-transformed reported consumption amounts is roughly normally distributed, suggesting that the assumption is at least reasonable.

Both sub-models can have additional predictors, such as person-specific demographic characteristics and reported frequency of fish consumption. In addition, the model can incorporate the following within-person predictors: (1) differences between weekends (Friday to Sunday) and weekdays (Monday to Thursday),[1] and (2) consistent differences between the first 24-hour recall and the second 24-hour recall in NHANES (the first was completed in person and the second was completed by phone).

We consider the NCI Method as the preferred method for estimating fish consumption rates and believe the results to have minimal bias. However, with large sample sizes and many predictors, the computation time required to run the NCI Method and calculate confidence intervals was unacceptable given the schedule and budget. Additionally, our preferred model has more predictors than the NCI Method is set up to handle. The EPA Method was developed to provide acceptably unbiased estimates within a reasonable computation time. We are using non-publically available data from NHANES that can only be accessed on site at NCHS. This precludes our use of alternative computing scenarios that might reduce the computation time.

The following illustrates the time savings. We ran a simplified model with 4 main effects (age, race/ethnicity, income, and frequency of fish consumption). The NCI Method took 9.5 hours for

[1] The NCI Method includes Friday as part of the weekend. A study of CSFII data showed that intake on Friday was more similar to Saturday and Sunday than to the rest of the weekdays, Monday through Thursday (Haines, Hama, Guilkey, and Popkin, 2003).

one run of one fish type. To obtain an estimate of the precision of the estimates, we need to run the model 65 times, one for each replicate weight. This gives us an estimated time of over 25 days of continuous computer time for each fish type. There are 18 fish types. Therefore, to obtain estimates for all fish types would take 450 days. The EPA Method took 1.5 minutes to run the same model, approximately 1.5 hours for each fish type.

The NCI Method can be implemented using two SAS macros (programs) available from the NCI web site (the MIXTRAN and DISTRIB macros). The equations fit using the NCI macros are presented below. More information concerning the NCI Method can be found in Tooze et al., 2006, Tooze et al., 2010, and on NCI's web site at:
http://appliedresearch.cancer.gov/diet/usualintakes/method.html.

EPA created a SAS macro to approximate the results from the NCI Method while taking considerably less time for the calculations, referred to as the EPA Method in this report. The following sections describe both the NCI and EPA Methods. The macro code for estimating parameters and simulating the usual fish consumption is in Appendix D.

4.2 Calculation Steps for the NCI and EPA Models

4.2.1 NCI Method

In the NHANES data, each individual (indicated by i) has results from one or two 24-hour dietary recalls (indicated by *j*, *j* = 1 or 2). In the data, most individuals have two 24-hour recalls; only a portion of individuals have 24-hour recalls reporting fish consumption, and a smaller portion have two 24-hour recalls with reported fish consumption. Using the *i* and *j* subscripts, the following describes the statistical model fit using the NCI MIXTRAN macro. The parameters and variables are described below. In these equations, the parameters for the probability model are represented by π, the parameters for the amount model are represented by α, the standard deviations of the variance components are represented by σ.

Data for each individual and 24-hour recall, extracted from the NHANES data files follow:

- A_{ij} is the reported grams of fish consumed (zero if no fish consumption was reported in the 24-hour recall).

- W_{ij} is an indicator of whether the 24-hour recall was for a weekday ($W_{ij} = 0$) or weekend ($W_{ij} = 1$).

- S_{ij} indicates if the 24-hour recall was the first (in-person, $S_{i1} = 0$) or the second (by phone, $S_{i2} = 1$) dietary recall.

- $\boldsymbol{X}_{ik}$ represent *k* individual level covariates (demographic variables; see Section 4.5 for additional details).

Transformed data:

- C_{ij} is an indicator for reported fish consumption in a 24-hour recall (1 indicates fish consumption, otherwise 0). This is the dependent variable in the logistic probability model.

$$C_{ij} = \begin{cases} 0 & A_{ij} = 0 \\ 1 & A_{ij} > 0 \end{cases}$$

- T_{ij} is the amount of fish consumed after being transformed using a Box-Cox power transformation. This is the dependent variable for the linear regression model predicting the consumption-day amount of fish consumed.

Parameters for the probability sub-model:

- π_0 is the intercept parameter for the probability model.

- $\boldsymbol{\pi}_{Xk}$ is a vector of regression parameters for the *k* person-specific covariates in the probability model.

- π_W is the regression parameter for the difference between weekend and weekday days.

- π_S is the regression parameter for the difference between the second 24-hour recall and the first 24-hour recall.

- π_i is the person-specific random effect for the probability model, assumed to be normally distributed on the logit scale. This value has theoretical meaning but is not observed.

- P_{ij} is the probability of fish consumption for a 24-hour recall. This value has theoretical meaning but is not observed.

Parameters for the amount sub-model:

- λ is the power used for the Box-Cox transformation.
- α_0 is the intercept parameter for the amount model.
- $\boldsymbol{\alpha}_{Xk}$ is a vector of regression parameters for the *k* person-specific covariates in the amount model.
- α_W is the regression parameter for the difference between weekend and weekday days.
- α_S is the regression parameter for the difference between the second 24-hour recall and the first 24-hour recall.
- α_i is the person-specific random effect for the amount model, assumed to be normally distributed. This value has theoretical meaning but is not observed.
- α_{ij} is the within-person random effect for the amount model representing different amounts for fish consumed on different days, assumed to be normally distributed. This value has theoretical meaning but is not observed.

Variance and correlation parameters:

- σ_1^2 is the variance of the person-specific random effect in the probability model (π_i).
- σ_2^2 is the variance of the person-specific random effect in the amount model (α_i).
- ρ is the correlation between π_i and α_i.
- σ_3^2 is the variance of the within-person random effect in the amount model (α_{ij}).

The NCI macro fits some preliminary models to obtain approximate parameter estimates to use as starting values for the NLMIXED procedure (a SAS procedure that fits non-linear mixed models), which fits the following set of equations simultaneously, using maximum likelihood. The following equations describe the model fit using the NCI Method. The tilde (~) symbol can be read as "is distributed as."

$$Logit(P_{ij}) = log\left(\frac{P_{ij}}{1-P_{ij}}\right) = \pi_0 + \boldsymbol{X}_{ik}\boldsymbol{\pi}_{Xk} + \pi_i + W_{ij}\pi_W + S_{ij}\pi_S$$

$$C_{ij} \sim Binomial(1, P_{ij})$$

$$If\ A_{ij} > 0\ then\ T_{ij} = \frac{{A_{ij}}^{\lambda} - 1}{\lambda} = \alpha_0 + \boldsymbol{X}_{ik}\boldsymbol{\alpha}_{Xk} + W_{ij}\alpha_W + S_{ij}\alpha_S + \alpha_{ij} + \alpha_i$$

$$\alpha_{ij} \sim Normal(0, \sigma_3^2)$$

$$[\pi_i \quad \alpha_i] \sim BivariateNormal\left([0 \quad 0], \begin{bmatrix} \sigma_1^2 & \rho\sigma_1\sigma_2 \\ \rho\sigma_1\sigma_2 & \sigma_2^2 \end{bmatrix}\right)$$

The NCI model can be fit assuming the probability of consuming fish and the amount of fish consumed, if consumed, are uncorrelated, i.e., $\rho = 0$. However, we assume these values may be correlated and thus specified a correlated model when using the NCI Method to compare the NCI and EPA Method results.

4.2.2 EPA Method

The EPA and NCI Methods differ as follows:

- As part of fitting the model, the NCI Method finds the power transformation (λ) that best fits the data and is consistent with the assumption that the variance components are normally distributed, as judged by maximum likelihood. The EPA Method finds the power transformation that makes the transformed fish consumption amounts (T_{ij}) roughly normally distributed as judged by the correlation between the transformed amounts and the expected values for a normal distribution. The power with the highest correlation is then used when fitting the amount sub-model.

- The EPA Method assumes the person-specific random effects in the probability and amount sub-models are uncorrelated. The assumption of zero correlation is for computational convenience, not because these values should be uncorrelated. When using the NCI Method, we assumed these random effects may be correlated and let the NCI algorithm estimate the correlation. The correlation estimates were generally close to zero.

- When assuming the person-specific random effects are uncorrelated, the two sub-models can be fit separately rather than simultaneously. The EPA Method fits the two models separately.

- For the probability sub-model, the NCI model fits the parameter values and random effects in one non-linear mixed model. The EPA Method approximates that approach using two steps: (1) using logistic regression without random effects to estimate the parameter values and calculate predicted values (in the logit scale); and (2) using a non-linear mixed model to fit the random effects using only the predicted values from the previous logistic regression as a predictor.

- For the amount sub-model, the NCI Method fits the parameter values, transformation, and random effects in one non-linear mixed model. The EPA Method approximates that approach by (1) selecting the transformation as described above; (2) using linear regression without random effects to estimate the parameter values and calculate predicted values; and (3) using a non-linear mixed model to fit the random effects using the predicted values from linear regression as the only predictor.

The equations for the EPA Method are described below using the same notation as above for the NCI Method. The EPA Method has the following steps:

1. Estimate λ.

2. Use logistic regression to predict the probability of fish consumption as a function of various predictors; save the predicted values.

3. Use a non-linear mixed model to estimate the person-specific variance component using the predicted values from logistic regression as the predictor.

4. Use linear regression to predict the Box-Cox-transformed amount of fish consumed, when consumed, as a function of various predictors; save the predicted values.

5. Use a non-linear mixed model to estimate the variance components for the amount model using the predicted values from linear regression as the predictor.

In the NCI Method, the maximum likelihood procedure finds the best transformation, defined byλ, consistent with the data and the assumption that the random effects are normally distributed. In the EPA model, $\lambda = \lambda^*$ is set prior to fitting the amount sub-model, using the following steps:

1. Calculate normal scores associated with each observation by first, ignoring the distinction between the first and second recall; second, for amounts greater than zero, summing the weights across tied values (values with the same reported amounts) to get one record for each unique amount (A_r) and the associated weight (W_r); third, sorting the R unique amounts from smallest to largest; fourth, calculating cumulative weight for the each unique value, $S_r = \sum_{m=1}^{r} W_m$; and fifth, calculating the normal scores as

$$Z_r = \Phi\left(\frac{S_r - \frac{W_r}{2}}{S_R}\right)$$

2. Using values of λ^* which are multiples of 0.01 between -0.20 and 0.30, find the λ^* value, which maximizes the Pearson correlation between Z_r and

$$T_r = \begin{cases} log(A_r)G & \lambda^* = 0 \\ \dfrac{{A_r}^{\lambda^*} - 1}{G^{(\lambda^*-1)}\lambda^*} & \lambda^* \neq 0 \end{cases}$$

   where G is the geometric mean of A_r. This form of the Box-Cox transformation allows $\lambda^* = 0$, corresponding to using a log transformation.

3. If $\lambda^* = 0$ then set $\lambda^* = 0.005$ (this case was encountered for marine tropic level 2 fish).

Table 5 shows the λ^* values used for each of the dependent variables.

Table 5. λ* values used for each combination of dependent variable and data set

Dependent variable	λ*
All fish	0.21
Marine fish	0.24
Estuarine fish	0.13
Freshwater fish	-0.04
Finfish	0.25
Shellfish	0.11
Freshwater + estuarine fish	0.11
Marine + estuarine fish	0.21
Marine + freshwater fish	0.21
Trophic level 2 fish	0.11
Trophic level 3 fish	0.16
Trophic level 4 fish	0.20
Marine trophic level 2 fish	0.005
Marine trophic level 3 fish	0.09
Marine trophic level 4 fish	0.23
Freshwater + estuarine trophic level 2 fish	0.08
Freshwater + estuarine trophic level 3 fish	0.12
Freshwater + estuarine trophic level 4 fish	-0.05

For two types of fish consumption (freshwater and freshwater plus estuarine trophic level 4), λ^* was less than zero. The NCI Method constrains λ to be greater than 0.01. As a result, the results from the NCI Method and the EPA Method differ somewhat when $\lambda^* < 0.01$.

The transformed consumption amounts for 24-hour recalls with reported fish consumption are shown in the following equation:

$$T_{ij} = \frac{{A_{ij}}^{\lambda^*} - 1}{\lambda^*}$$

To estimate the probability of consumption, the following logistic regression model was fit using the SAS SURVEYLOGISTIC procedure and the NHANES survey weights, strata, and PSU variables. This logistic regression model predicts the probability of consuming fish in a 24-hour recall without considering a person-specific random effect; B'_{ij} is the linear predictor of the logit transformed probability. The apostrophes indicate values from the logistic model that has no random effects.

$$Logit(P'_{ij}) = log\left(\frac{P'_{ij}}{1 - P'_{ij}}\right) = \pi'_0 + \boldsymbol{X}_{ik}\boldsymbol{\pi}'_{Xk} + W_{ij}\pi'_W + S_{ij}\pi'_S = B'_{ij}$$

The person-specific random effect is included by assuming the predicted logit (B_{ij}) when including the random effect is proportional to the predicted logit when excluding the random effect (B'_{ij}). This approximation is justified in Appendix C. The following non-linear mixed model is fit to estimate the variance of the person-specific random effect and the inflation factor (β) for scaling the parameter estimates from the model above.

$$Logit(P_{ij}) = log\left(\frac{P_{ij}}{1 - P_{ij}}\right) = \beta * B'_{ij} + \pi_i$$
$$\pi_i \sim Normal(0, \sigma_1^2)$$
$$C_{ij} \sim Binomial(1, P_{ij})$$

The SAS SURVEYREG procedure is used to fit the amount sub-model assuming no person-specific random effect. The variance of the regression error (σ_4^2) is the combination of the variance of the person-specific random effect and the within-person variation. D_{ij} is the linear predictor of the transformed amount of fish consumed.

$$If\ A_{ij} > 0\ then\ T_{ij} = \frac{{A_{ij}}^{\lambda^*} - 1}{\lambda^*} = \alpha_0 + \boldsymbol{X}_{ik}\boldsymbol{\alpha}_{Xk} + W_{ij}\alpha_W + S_{ij}\alpha_S + a'_{ij} = D_{ij} + a'_{ij}$$
$$a'_{ij} \sim Normal(0, \sigma_4^2)$$

The variance of the within-person and between-person variance components is estimated using a non-linear mixed model with the linear predictor from the regression above as the only predictor.

$$If\ A_{ij} > 0\ then\ T_{ij} = \frac{{A_{ij}}^{\lambda^*} - 1}{\lambda^*} = D_{ij} + \alpha_{ij} + \alpha_i$$
$$\alpha_{ij} \sim Normal(0, \sigma_3^2), \alpha_i \sim Normal(0, \sigma_2^2)$$

Because of different estimation methods, the parameters calculated using the NCI Method are slightly different than those from the EPA Method.

4.3 Simulation of the Usual Fish Consumption

The distribution of usual fish consumption can be calculated from the model parameters. Due to the complexity of the model, the direct calculation of the distribution of usual fish consumption involves numerical integration and is relatively complex. The integration is simplified by (1) simulating values of usual fish consumption and (2) calculating mean and percentiles of fish consumption rates from the simulated values. When using simulations, the estimated fish consumption rates have a small random component that can be reduced by increasing the number of simulations. The default number of simulations in the NCI DISTRIB macro is 100. Analysis of preliminary results showed that the precision of the parameter estimates increased as the number of simulations increased; however, the precision was similar when using either 50 or 100 simulations. The final analysis used 100 simulated fish consumption values for each NHANES respondent. The NHANES data set provides the population distribution of the independent predictors in the probability and amount sub-models. For each NHANES respondent, the simulated values represent possible fish consumption rates for a respondent with the same independent predictors as the NHANES respondent.

Because usual fish consumption is different from reported fish consumption, the equation used to simulate usual fish consumption is slightly different from the equation fit to the data from the 24-hour recalls. The equation fit to the data was modified as follows to simulate usual fish consumption:

- The simulated values reflect a standard week (3 weekend days and 4 weekday days) rather than the distribution of weekday and weekend recalls in the data. Given Friday is part of the weekend, the average for the standard week would be 4/7 x (weekday average) + 3/7 x (weekend average). Since the weekend parameter models the difference between the three weekend days and the four weekday days, this average can be obtained by setting the parameter for the weekend variable to 3/7.

- The simulated values assume the first (in-person) 24-hour recall is unbiased by ignoring the difference between the first and second recall, i.e., $\alpha_S = \pi_S = 0$.

- The simulated values do not include the within-person variation, i.e., binomial variation within persons in the probability model and the within-person variation in the amount model.

The equations for simulating usual fish consumption use the parameters estimated from the models predicting probability of reported fish consumption and the amount for fish consumed, when consumed.

In the equations below, the V subscript represents the simulation number (V = 1 to 100). The following equations are used by the NCI DISTRIB macro to simulate an individual's long-term probability of fish consumption (Q_{Vi}) and transformed long-term mean fish consumption when fish is consumed (T_{Vi}); the logistic function is the inverse of the Logit function.

$$Q_{Vi} = Logistic\left(\pi_0 + \boldsymbol{X}_{ik}\boldsymbol{\pi}_{Xk} + \pi_{Vi} + \frac{3}{7}\pi_W\right)$$

$$T_{Vi} = \alpha_0 + \boldsymbol{X}_{ik}\boldsymbol{\alpha}_{Xk} + \alpha_{Vi} + \frac{3}{7}\pi_W$$

$$[\pi_{Vi} \quad \alpha_{Vi}] \sim BivariateNormal\left([0 \quad 0], \begin{bmatrix} \sigma_1^2 & \rho\sigma_1\sigma_2 \\ \rho\sigma_1\sigma_2 & \sigma_2^2 \end{bmatrix}\right)$$

A slightly modified version of these equations is used in the EPA procedure because the EPA approach uses a two-step procedure with the inflation factor (β) to fit the probability model and assumes the random effects are uncorrelated. The EPA equations are as follows:

$$Q_{Vi} = Logistic\left(\left(\pi_0' + \boldsymbol{X}_{ik}\boldsymbol{\pi}_{Xk}' + \frac{3}{7}\pi_W'\right)\beta + \pi_{Vi}\right)$$

$$T_{Vi} = \alpha_0 + \boldsymbol{X}_{ik}\boldsymbol{\alpha}_{Xk} + \alpha_{Vi} + \frac{3}{7}\alpha_W$$

$$[\pi_{Vi} \quad \alpha_{Vi}] \sim BivariateNormal\left([0 \quad 0], \begin{bmatrix} \sigma_1^2 & 0 \\ 0 & \sigma_2^2 \end{bmatrix}\right)$$

Finally, the simulated transformed consumption amounts are untransformed using the following equation (see Tooze et al., 2010):

$$\mathrm{B}_{Vi} = (T_{Vi}\lambda + \mathbf{1})^{(\mathbf{1}/\lambda)} + \frac{\sigma_3^2(\mathbf{1} - \lambda)}{2}(T_{Vi}\lambda + \mathbf{1})^{(\mathbf{1}/\lambda - \mathbf{2})}$$

This equation includes an adjustment involving the within person variance in the fish consumption amount (σ_3^2). The NCI Method assumes the reported fish consumption amounts in the 24-hour recalls are unbiased. This adjustment makes the untransformed usual fish consumption essentially unbiased.

Although when $A_{ij} = 0$, the transformed fish consumption is defined ($T_{ij} = \frac{-1}{\lambda}$), it is possible to simulate a value of T_{Vi} such that $T_{Vi} < \frac{-1}{\lambda}$, for which the untransformed value is not defined. In the NCI macro, these small simulated values in the transformed scale are set to half of the minimum reported fish consumption for any 24-hour recall. The same procedure is used in the EPA calculations. The probability that $T_{Vi} < \frac{-1}{\lambda}$ depends on several factors. The expected probability is less than or equal to 1/N, where N is the number of respondents with reported fish consumption. In preliminary analysis, no values were set to half the minimum reported value.

The usual fish consumption for a simulated person is then:

$$\mathrm{U}_{Vi} = \mathrm{Q}_{Vi}\mathrm{B}_{Vi}$$

The following summary statistics for the usual fish consumption were calculated using the simulated values (U_{Vi}) and the NHANES analysis weights: mean and 25th, 50th, 75th, 90th, 95th, 97th, and 99th percentiles.

4.4 Calculation of Standard Errors and Confidence Intervals

Both the NCI Method and the EPA Method use the NHANES survey weights for all the calculations (i.e., weighted regressions and weighted estimates of the variance components). The NHANES survey weights are inversely proportional to the probability of selection for each respondent. The survey weights are adjusted for nonresponse and allow for calculation of national estimates.

The SURVEYLOGISTIC and SURVEYREG procedures calculate standard errors for only the linear parameters in the models, using a Taylor series linearization approach. These standard errors were used to select the independent predictors for the probability and amount models. Standard errors for all EPA and NCI Method parameters, including the random effects and percentiles of the distribution of usual fish consumption, can be calculated by (1) preparing replicate weights consistent with the NHANES survey design and strata and PSU variables; (2) running the macros using the full-sample weight and each replicate weight; and (3) combining the results using each weight to estimate the standard errors. EPA constructed replicate weights for calculating the standard errors and confidence intervals for percentiles of usual fish consumption. See Wolter, 1985, for a discussion of variance estimation procedures for complex survey designs such as NHANES.

In general, the variance of the weighted estimates from the NCI Method or the EPA Method can be calculated by repeatedly dividing the sampling PSUs into subgroups (or replicates) and comparing the estimates from each subgroup to the estimate for the entire sample. Several approaches have been developed to efficiently estimate the variance with a minimum number of carefully constructed subgroups. In general, dividing the respondents into subgroups can be achieved by creating an analysis weight for each subgroup, i.e., a replicate weight. One such approach is Balanced Repeated Replication (BRR) which divides the PSUs into two equal size groups on each division. A modification of the basic BRR method due to Fay compares a weighted estimate from one half of the PSUs to a different weighted estimate for the other half of PSUs. The Fay approach was selected because it has advantages when estimating percentiles. The replicate weights for the BRR method using the Fay factor adjustment (Fay factor K = .3) were created using standard procedures (see Judkins, 1990) and the strata and PSU variables in the NHANES files provided for variance estimation. The basic BRR procedure assumes two PSU values in each stratum. However, a few of the NHANES strata have three PSU values, which required slightly modified calculations for creating the weights (Wolter, 1985; Rust, 1986). We created 64 replicate weights. Parameter estimates were calculated using the NHANES (full sample) weight and each of the replicate weights.

Given the replicate BRR weights, the variance of an estimate of θ can be calculated using the steps below; θ might be a regression parameter, an estimated percentile of usual fish consumption, or the log-transformed percentile of usual fish consumption.

1. Calculate θ using the full sample NHANES weight and using each of the 64 replicate weights (θ_g, g = 1 to G, G = 64), and

2. Calculate the variance of θ as

$$Var(\theta) = \frac{1}{G(1-K)^2}\sum_{g=1}^{G}\left(\theta_g - \theta\right)^2$$

3. A 95 percent confidence interval for θ is $\theta - 1.96\sqrt{Var(\theta)}\ to\ \theta + 1.96\sqrt{Var(\theta)}$.

Various summary statistics (means and percentiles) are calculated using the simulated usual fish consumption values. Since the usual fish consumption estimates are generally skewed with a roughly lognormal distribution, calculating the confidence intervals on the log scale appears reasonable and has the beneficial effect that confidence limits cannot be negative. As a result, the confidence intervals for the summary statistics are calculated by (1) fitting the EPA Method using the full sample weight and each replicate weight; (2) log-transforming the estimates; (3) calculating the confidence intervals for the estimates assuming a normal distribution using the equations above; and (4) un-transforming the confidence interval bounds.

See Gilbert (1987) for additional comments on calculating confidence intervals for log-normally distributed values.

4.5 Application of EPA Method

The EPA Method was used to model and predict usual consumption for the following types of fish and shellfish:

- Total finfish and shellfish;
- Finfish;
- Shellfish;
- Marine fish;
- Estuarine fish;
- Freshwater fish;
- Freshwater + estuarine fish;
- Marine + estuarine fish;
- Marine + freshwater fish;
- Trophic level 2 fish;
- Trophic level 3 fish;
- Trophic level 4 fish;
- Freshwater + estuarine trophic level 2 fish;
- Freshwater + estuarine trophic level 3 fish;
- Freshwater + estuarine trophic level 4 fish;
- Marine trophic level 2 fish;
- Marine trophic level 3 fish; and
- Marine trophic level 4 fish.

All models included the weekend indicator and the indicator of the first or second recall for both the amount and probability sub-models.

Other candidate variables for inclusion into the models included the following:

- Age group: 1 to < 3, 3 to <6, 6 to < 11, 11 to < 16, 16 to <18, 18 to < 21, 21 to <35, 35 to <50, 50 to <65, and 65 years and older;
- Income: $0 to <$20K, $20 to <$45K, $45 to <$75K, $75K+, >$20k, Refused/DK Income, Income Missing;
- Male: an indicator, 1 = male 0 = female;
- Race/Ethnicity: Mexican American, other Hispanic, non-Hispanic white, non-Hispanic black, and other race;
- Region: U.S. Census regions (Northeast, Midwest, South, and West);
- Coastal Status: Coastal counties and non-coastal counties;
- Bodyweight, log-transformed; and
- Reported frequency of fish consumption in 30 days ($Fish30$), transformed.

Based on preliminary analysis, the following transformations were used: for the probability sub-model: $Ln(Fish30 + 0.1)$ and for the amount sub-model: $Fish30^{0.45}$.

The following process was used to select the final predictors for the models:

1. For each dependent variable, start with all main effects, sequentially drop the least significant main effect until all remaining main effects are significant at the 5 percent level.
2. Use any main effects that were selected when predicting any dependent variable.
3. For each dependent variable, include the selected main effects and all two-way interactions of the selected main effects, sequentially dropping the least significant interaction until all remaining interactions are significant at the 1 percent level.
4. Use any two-way interaction selected for predicting at least three of the dependent variables.

The selected main effects and two-way interactions were then used as independent predictors in the final models predicting all the dependent variables.

The procedure above was performed separately for the amount model and the probability model. The significance was based on the SURVEYLOGISTIC and SURVEYREG output.

The final lists of independent variables for the probability and amount sub-models follow:

- **Probability Sub-Model:** reported frequency of fish consumption (transformed), bodyweight (log-transformed), race/ethnicity, income, age group, region, coastal status, race/ethnicity*income, race/ethnicity*age group, income*age group, income*region, income*coastal status, and age group*region

- **Amount Sub-model:** reported frequency of fish consumption (transformed), bodyweight (log-transformed), race/ethnicity, male, age group, region, coastal status, race/ethnicity*age group, race/ethnicity*region, male*age group, age group*region, and age group*coastal status

The simulated usual fish consumption values were summarized by the following demographic categories:

- Gender;
- Age group;
- Women of childbearing age (13 to 49 years);
- Race;
- Income;
- Region;
- Coastal status;
- Four coastal regions (Atlantic, Gulf of Mexico, Pacific, and Great Lakes);
- Four inland regions (Inland Northeast, Inland Midwest, Inland South, Inland West);
- Youth (<21 years of age) by gender, race, income, region, coastal status, coastal regions, and inland regions; and
- Adults (≥21 years of age) by gender, race, income, region, coastal status, coastal regions, and inland regions.

When fitting the NCI and EPA Methods, the distribution can be sensitive to the magnitude of the variance components. With small sample sizes, the number of respondents with reported fish consumption on two 24-hour recalls can be small resulting in imprecise variance estimates and possible convergence problems. The authors of the NCI Method (Kipnis et al., 2009) generally recommend having at least 50 respondents with at least two 24-hour recalls with reported consumption of fish (or whatever dietary component is being assessed).

The NCI and EPA Methods can be applied to all NHANES respondents or to subsets, such as subsets defined by demographic characteristics. Fitting one model using all NHANES respondents implicitly assumes that the magnitude of the variance components are the same for all individuals and do not vary by, say, demographic characteristics. Fitting all respondents has the advantage that there are plenty of individuals from which to estimate the variance components. Fitting the models separately by subset allows the variance components to be different for different subsets of individuals. However, small subsets may not have adequate numbers of individuals with two recalls with fish consumption. After considering the trade-offs, the EPA Method was applied to all NHANES respondents. For each fish type, the subgroup estimates were derived from simulated usual fish consumption values and the associated demographic covariates and sampling weights for the NHANES respondents.

4.6 Comparison of Results from the EPA and NCI Methods

In order to evaluate how estimates from the EPA Method compared to estimates from the NCI Method, we ran both methods using different dependent variables, different sets of independent predictors, and different numbers of simulated values. The procedures used to evaluate the EPA Method and to compare the two methods are described in this section.

4.6.1 Analysis of Simulated Data

Fish consumption data (both usual intake and reported intake) were simulated consistent with the model assumed by the NCI Method. Ideally, when analyzing the simulated data, parameter estimates from the NCI and EPA Methods will agree with the parameters used to simulate the data and the estimated percentiles of usual fish consumption will agree with the corresponding percentiles in the simulated data. Differences can indicate programming errors or possible bias associated with to the estimation method. Different scenarios were used to evaluate the EPA Method, with good agreement between the parameter estimates and percentiles compared to the values used to simulate the data.

As an illustration, the following plots (Figure 1) show how the parameters and percentiles from the NCI and EPA Methods compare to the simulated values for data with six different Box-Cox transformations (Lambda = -0.12, -0.06, 0.06, 0.12, 0.18, and 0.30). For these simulations, the other parameters were set to values similar to those found when analyzing freshwater fish for adults (for which Lambda = -0.06), with the exception that the intercept for the probability was increased somewhat to raise the number of simulated individuals with two 24-hour recalls with fish consumption. The plots show the percentile estimates derived from the NCI and EPA models compared to the values from the simulated data. The plots and analysis suggest that the EPA Method provides a good approximation to the NCI Method and the true values when lambda is greater than zero; and, for negative lambda, the EPA Method appears to provide better estimates than the NCI Method when compared to the true values. It should be noted that (1) for positive lambda, whether the NCI or EPA estimates are closer to the true value is different for different simulated data sets using the same simulation parameters; (2) for negative lambda, the NCI and EPA Methods provide more similar results when the magnitudes of the variance components are smaller; and (3) the NCI Method could be modified to allow for negative lambda values.

4.6.2 Confidence Intervals for Percentiles of Fish Consumption

Figure 2 shows confidence intervals for parameters and percentiles of fish consumption, calculated using both the NCI and EPA Methods. Due to the long computation time required for the NCI Method, only simple models with few predictors were used. The confidence intervals were calculated for freshwater and estuarine fish consumption by all respondents, marine fish consumption by all respondents, and shellfish consumption by adults. The predictors are transformed frequency of fish consumption in the past 30 days, an indicator of weekend versus weekday, and the difference between the first and second recall. The first column in Figure 2 compares parameter estimates and confidence intervals. The second column compares percentile estimates and confidence intervals for various percentages and demographic groups. In general, there is good agreement between both the NCI and EPA estimates and the width of the confidence intervals.

Figure 1. Comparison of NCI, EPA, and true percentiles using simulated data and different transformations

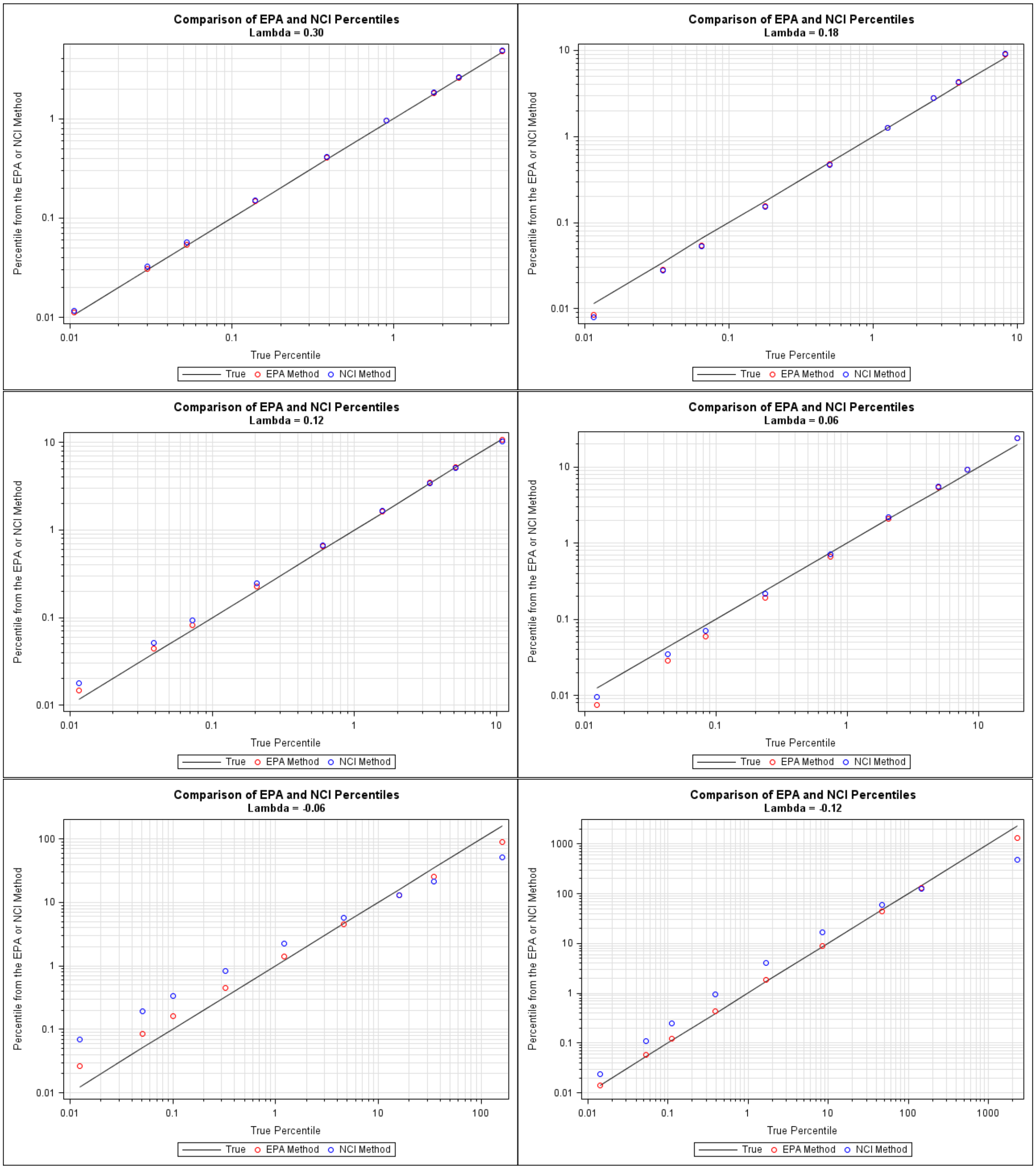
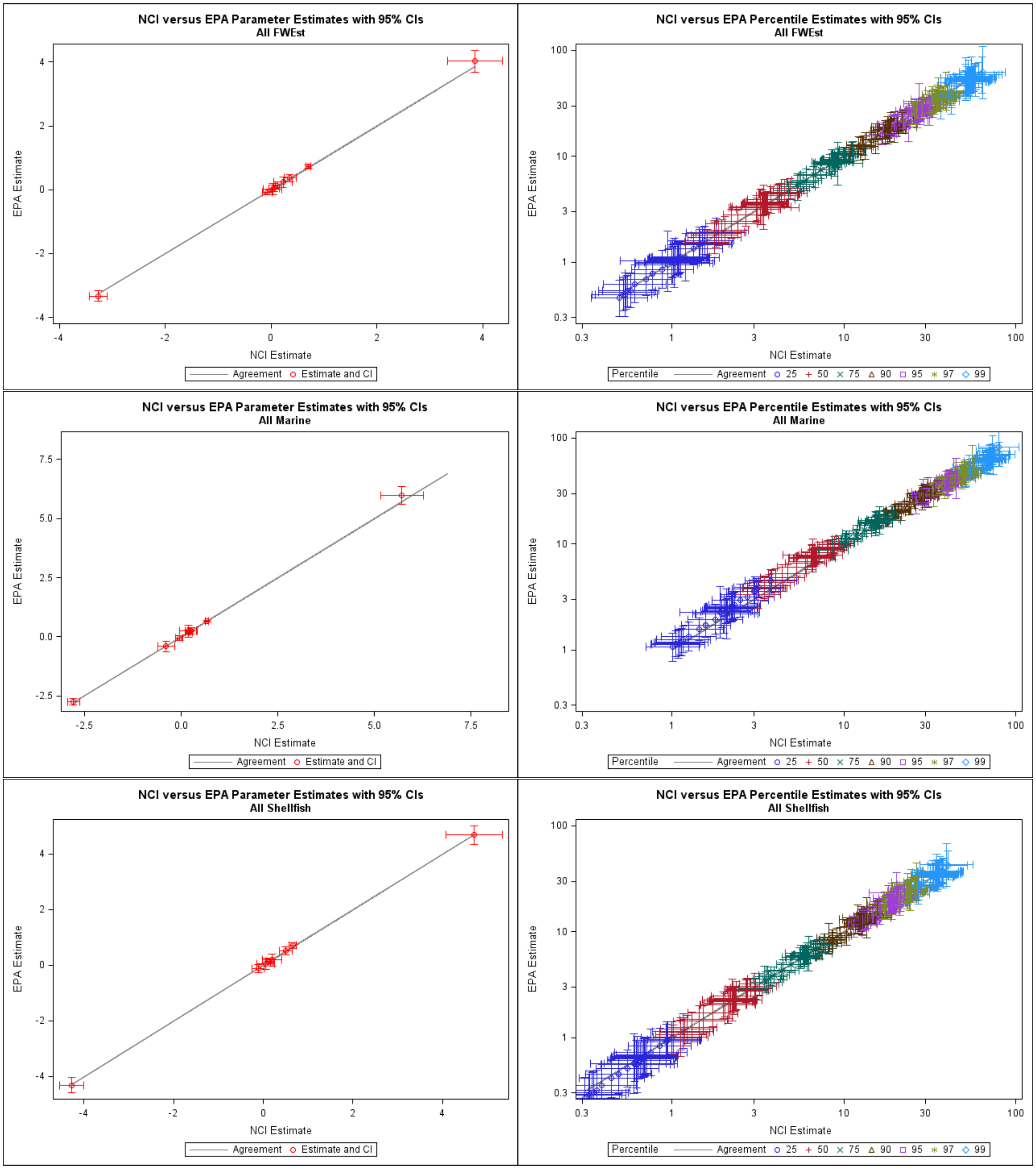


Figure 2. Comparison of confidence intervals using the NCI and EPA Methods



4.6.3 Analysis of NHANES Fish Data Using Various Models

NHANES fish consumption data were analyzed using the NCI and EPA Methods with different sets of independent predictors and different numbers of simulations. These comparisons between the EPA and NCI Methods were selected to represent a range of fish types. Each dependent variable was predicted by different independent variables to assess the effect of the choice of predictors and the number of parameters on the results, all using 50 simulations. Comparisons were also run using different numbers of simulations to assess how many simulations to use. Table 6 summarizes the results followed by example plots comparing the percentile estimates from the two methods.

For each of the comparisons, Table 6 shows the following values:

- Pred Vars: the independent predictors, F = transformed frequency of fish consumption, A = Age groups, I = Income groups, R = Race groups, and M = Male indicator.
- Sim Num: the number of simulated values of usual fish consumption generated for each individual.
- Geo Mean Ratio (EPA/NCI): The geometric mean ratio of the EPA percentile to the NCI percentile across multiple percentiles and population subgroups. A ratio of 1.00 corresponds to no difference between the geometric means, on average.
- RMSE (percent): The RMSE difference between the log-transformed EPA and NCI percentiles estimated across multiple percentiles and population subgroups, converted to a percentage difference. This can be thought of as the average absolute percent difference between the NCI and EPA percentiles. Smaller values are better. Larger values are generally associated with fish types that are consumed less often.
- 90th percentile (Adults≥21): the 90th percentile of fish consumption (a value of particular interest to EPA) calculated using the NCI and EPA Methods.
- Rel. Time (NCI/EPA): the computation time for the NCI Method relative to the EPA Method. These values are not precise and depend on what other programs were running at the same time.
- Num Parms (NCI): the number of parameters in each model.
- NCI Lambda: the power for the Box-Cox transformation estimated using the NCI Method.
- EPA lambda: the power for the Box-Cox transformation used in the EPA Method.

- NCI Rho: The correlation between the person-specific random effects in the probability and amount sub-models, as estimated by the NCI Method.

Note that the geometric mean ratio, RMSE, and percentiles in the table are subject to random variation associated with the simulation process. As a result, somewhat different values would be obtained if the calculations were repeated.

Table 6. Comparison of NCI and EPA methods using NHANES fish data

Fish type	Pred. vars	Sim num	Geo mean ratio (EPA/ NCI)	RMSE (%)	90th percentile (Adults≥21)		Rel. time (NCI/ EPA)	Num parms	NCI lambda	EPA lambda	NCI Rho
					EPA	NCI					
All Fish	F	5	1.008	5.258	48.77	49.89	13.5	13	0.210	0.21	0.17
All Fish	F	10	1.008	4.690	49.64	49.36	12.4	13	0.210	0.21	0.17
All Fish	F	20	1.006	4.367	49.13	49.92	10.1	13	0.210	0.21	0.17
All Fish	F	50	1.004	4.084	49.08	49.73	5.7	13	0.210	0.21	0.17
All Fish	F	100	1.003	4.230	49.14	49.82	2.5	13	0.210	0.21	0.17
All Fish	FA	50	1.002	4.005	51.62	52.51	44.7	31	0.208	0.21	0.18
All Fish	FAIRM	50	1.001	4.361	51.59	52.47	170.2	53	0.211	0.21	0.25
Finfish	F	50	1.006	2.803	36.98	36.13	8.7	13	0.255	0.26	0.03
Finfish	FA	50	1.016	14.544	38.37	41.00	26.0	31	0.252	0.26	-0.01
Finfish	FAIRM	50	1.010	12.936	38.51	40.85	118.2	53	0.256	0.26	-0.07
Fresh	F	50	1.030	36.877	6.70	6.47	8.3	13	0.010	-0.04	-0.21
Fresh	F	50	0.872	21.225	5.92	6.49	9.57	13	0.010	0.01	-0.21
Fresh	FA	50	1.049	35.486	7.43	7.12	77.3	31	0.010	-0.04	-0.19
Fresh	FAIRM	50	1.022	36.953	7.14	6.83	303.7	53	0.010	-0.04	-0.26
FWEst	F	5	0.987	4.746	20.04	20.03	17.2	13	0.105	0.11	0.15
FWEst	F	10	0.992	4.092	20.35	20.41	13.7	13	0.105	0.11	0.15
FWEst	F	20	0.992	2.781	20.19	20.40	6.6	13	0.105	0.11	0.15
FWEst	F	50	0.995	2.500	20.27	20.38	8.3	13	0.105	0.11	0.15
FWEst	F	100	0.991	2.361	20.23	20.38	2.4	13	0.105	0.11	0.15
FWEst	FA	50	0.991	2.998	21.81	22.12	64.6	31	0.104	0.11	0.16
FWEst	FAIRM	50	0.995	2.465	21.91	22.07	290.1	53	0.106	0.11	0.15
Marine	F	5	1.010	8.605	31.16	32.10	11.9	13	0.218	0.23	0.15
Marine	F	10	1.003	8.017	30.96	31.76	8.5	13	0.218	0.23	0.15
Marine	F	20	1.013	7.336	31.09	32.01	3.6	13	0.218	0.23	0.15
Marine	F	50	1.006	7.596	30.96	31.84	5.5	13	0.218	0.23	0.15
Marine	F	100	1.005	7.641	31.11	31.93	1.9	13	0.218	0.23	0.15
Marine	FA	50	1.008	7.410	32.39	33.24	22.1	31	0.218	0.23	0.15
Marine	FAIRM	50	1.004	7.747	32.17	33.10	126.9	53	0.220	0.23	0.18
Shellfish	F	5	0.980	4.629	14.00	14.20	21.5	13	0.112	0.11	0.50
Shellfish	F	10	0.988	4.262	14.17	13.98	19.6	13	0.112	0.11	0.50
Shellfish	F	20	0.990	3.560	14.07	14.05	10.5	13	0.112	0.11	0.50
Shellfish	F	50	0.988	3.059	14.06	14.03	10.1	13	0.112	0.11	0.50
Shellfish	F	100	0.987	3.194	14.06	14.03	3.9	13	0.112	0.11	0.50
Shellfish	FA	50	0.988	3.508	15.34	15.23	48.6	31	0.112	0.11	0.50
Shellfish	FAIRM	50	0.991	3.542	15.40	15.28	228.1	53	0.111	0.11	0.50

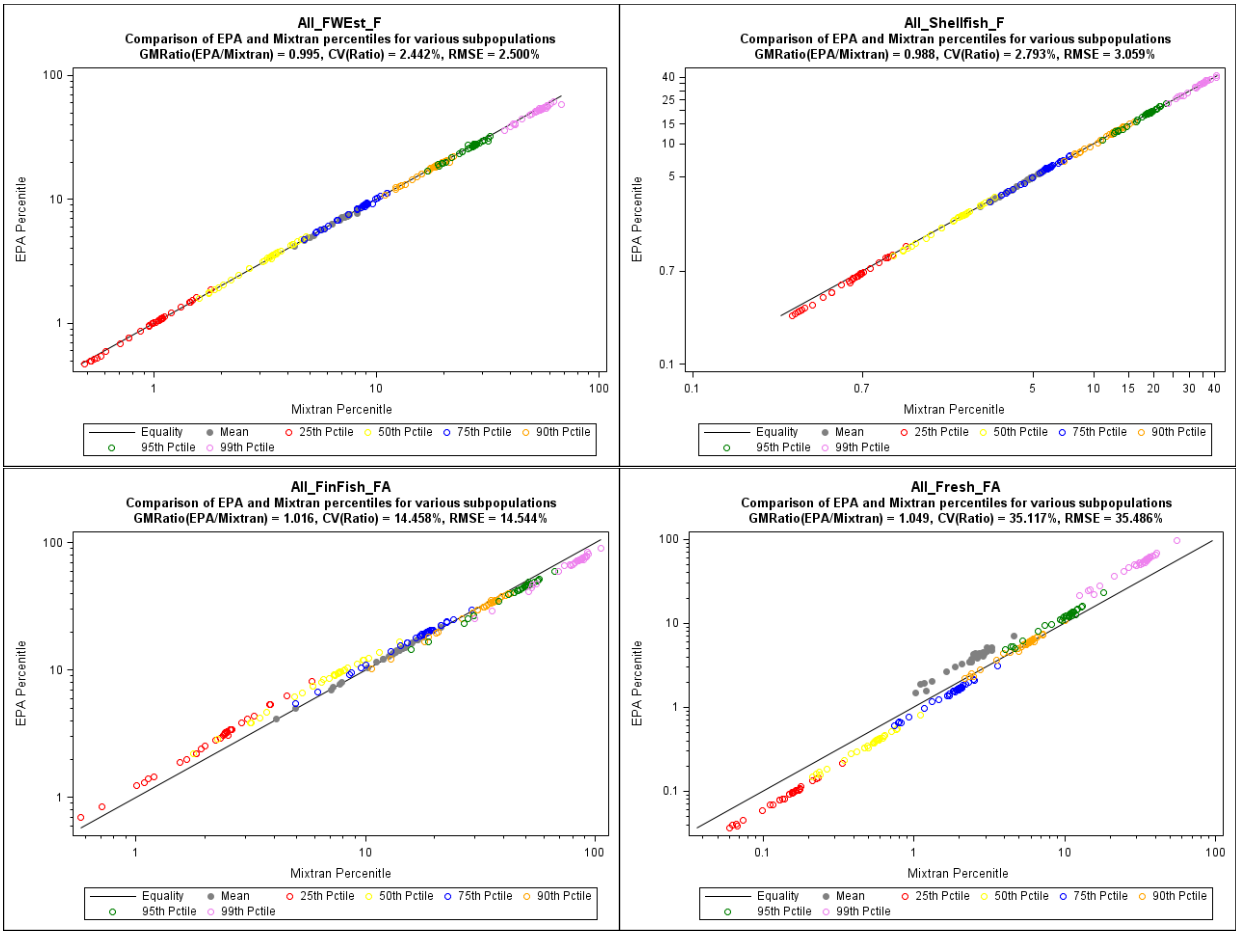
For freshwater and freshwater and estuarine trophic level 2, the lambda estimated using the EPA Method was less than zero (only freshwater is shown in Table 6). The NCI Method constrains lambda to be greater than 0.01. For freshwater fish consumption, the model with frequency of fish consumption as the only predictor was run using the transformation selected for the EPA Method, $\lambda^* = -0.04$, and with $\lambda^* = 0.01$, the transformation used in the NCI Method (see the yellow shaded cell). When the preferred transformation corresponds to a negative lambda, the EPA and NCI Methods give different results (see the cells with the dark border with high RMSE), although the 90th percentiles are relatively close. Based on the simulations in Figure 1, the EPA percentiles appear to be preferred to the NCI percentiles when lambda is less than 0.01.

Analysis of the data in Table 6 suggests the following:

- Relative to the NCI estimates, the percentile estimates from the EPA Method are essentially unbiased (the average of the geometric mean ratio is 0.9923, using only rows with 50 simulations and excluding the cases with negative lambda).
- The results from the EPA Method are acceptably close to those from the NCI Method: the average RMSE is 6.5 percent (using only rows with 50 simulations and excluding the cases with negative lambda).
- There is little additional reduction in RMSE when using more than 50 simulations. The final runs used 100 simulations.
- Uncertainty in the estimated percentiles is associated with (1) the NHANES sampling error (represented by the confidence intervals); (2) selection of independent predictors (which depends in part on what variables are available); (3) which analysis method is used (EPA versus NCI); and (4) the number of simulations. These sources of uncertainty are ordered roughly from most to least important.
- The transformation (λ) estimated for the EPA model is very close to the transformation estimated in the NCI model. Differences in lambda do not explain differences in the 90th percentiles from the two procedures.
- The estimated correlation between the variance components (Rho) is not significantly correlated with the difference between the 90th percentiles from the NCI and EPA Methods.
- Computation time for the NCI Method relative to the EPA Method increases significantly with increasing numbers of parameters.

The shaded rows in Table 6 correspond to the example plots shown in Figure 3. These plots were selected to show the comparison with the best RMSE, the median RMSE, and the worst RMSE among models with positive lambda and 50 simulations, and the comparison for fresh water fish, for which the lambda estimated using the EPA Method is negative. Figure 3 shows EPA versus NCI means and percentiles for different subpopulations.

Figure 3. Comparison of NCI and EPA percentiles of fish consumption rates



Results 5

This section presents the sample sizes and the estimated UFCR (raw weight, edible portion) for all fish, freshwater + estuarine fish, marine fish, all finfish, all shellfish, trophic level 2 fish, trophic level 3 fish, trophic level 4 fish, trophic level 2 freshwater + estuarine fish, trophic level 3 freshwater + estuarine fish, and trophic level 4 freshwater + estuarine fish, for adults and youth, by demographic characteristics and geographic area. Full tables including UFCR for the total population (youth and adults combined), adults only, and youth only are in Appendix E. Appendix F contains the UFCR for as prepared weights. The fish types selected to be presented in the body of the report represent those that are of most interest to EPA, states, and tribes.

Note that the adult population is defined as people aged 21 years and over. The US EPA Exposure Factors Handbook classifies those aged 21 years and over as adults. Children are grouped as follows: 1 to <3 years, 3 to <6 years, 6 to <11 years, 11 to <16 years, 16 to <18 years, and 18 to <21 years. Note that children 1 to <2 and 2 to <3 were combined due to small sample sizes for these age groups.

5.1 Sample Size

Table 7 presents the sample sizes for each subpopulation that reported fish consumption on at least one 24-hour recall. An expanded table that includes the other fish types for which rates were calculated can be found in Appendix G.

Table 7. Sample size and number reporting fish consumption, by fish type

	N	Any fish	FW+ Est	Marine	Fin fish	Shell fish	Trophic level 2	Trophic level 3	Trophic level 4
Total	29,463	6,891	4,868	6,286	5,095	2,612	2,706	4464	4,578
Gender									
Female	15,694	3,807	2,667	3,495	2,792	1,448	1,495	2,435	2,521
Male	13,769	3,084	2,201	2,791	2,303	1,164	1,211	2,029	2,057
Age, years									
1 to <3	2,325	345	198	305	269	101	111	209	243
3 to <6	2,185	350	196	322	272	106	118	225	246
6 to <11	2,705	454	264	416	351	137	143	286	315
11 to <16	2,806	445	310	402	301	179	180	296	273
16 to <18	1,417	252	177	237	164	104	98	173	155
18 to <21	1,662	311	208	294	209	132	131	209	199
21 to <35	4,381	1,070	801	992	723	509	531	745	651
35 to <50	4,522	1,332	997	1,221	962	546	566	883	848
50 to <65	3,730	1,216	901	1,101	938	454	468	775	842
65 and older	3,730	1,116	816	996	906	344	360	663	806
WCA[a] (13 to 49 years)	7,870	1,919	1,421	1,785	1,409	768	839	1,300	1,179
Income									
<$20k	6,679	1,374	897	1,256	1,043	470	491	911	936
$20k to <$45k	8,955	1,969	1,382	1,775	1,442	732	792	1,286	1,263
$45k to <$75k	5,561	1,334	959	1,211	1,002	498	511	856	904
$75k and over	6,288	1,768	1,308	1,634	1,285	739	740	1,108	1,176
>$20k	825	203	151	182	144	81	86	140	126
Ref/DK income[b]	808	164	118	153	122	61	57	111	117
Income missing	347	79	53	75	57	31	29	52	56
Race/Ethnicity									
Mexican American	6,868	1,350	949	1,212	937	535	618	886	828
Other Hispanic	2,405	532	351	490	390	187	202	329	350
Non-Hispanic white	11,980	2,678	1,854	2,509	2,000	1,023	1,006	1,573	1,855
Non-Hispanic black	6,734	1,818	1,308	1,603	1,376	654	669	1,291	1,188
Other race	1,476	513	406	472	392	213	211	385	357
U.S. Region									
Midwest	6,445	1,235	821	1,070	938	400	431	773	853
Northeast	4,475	1,202	805	1,154	867	484	445	733	812
South	11,036	2,688	1,925	2,416	2,003	1,036	1,087	1,828	1,739
West	7,507	1,766	1,317	1,646	1,287	692	743	1,130	1,174
Coastal Status									
Noncoastal	17,251	3,719	2,532	3,377	2,813	1,287	1,345	2,363	2,566
Coastal	12,212	3,172	2,336	2,909	2,282	1,325	1,361	2,101	2,012
US Coastal/Inland Region									
Pacific	3,802	976	739	900	720	385	425	621	646
Atlantic	4,646	1,320	938	1,247	939	553	524	865	840
Gulf of Mexico	1,370	361	292	316	255	196	203	269	202
Great Lakes	2,394	515	367	446	368	191	209	346	324
Inland Northeast	2,584	628	409	600	454	248	234	364	420
Inland Midwest	4,137	741	463	645	588	213	226	437	547
Inland South	6,825	1,560	1,082	1,386	1,204	519	567	1,053	1,071
Inland West	3,705	790	578	746	567	307	318	509	528

[a] Women of childbearing age. [b] Income refused or don't know.

5.2 Usual Fish Consumption Rates

Tables 8 through 18 present the UFCR estimates of raw weight, edible portion for adults 21 years and older for total fish, freshwater + estuarine fish, marine fish, all finfish, all shellfish, trophic level 2 fish, trophic level 3 fish, trophic level 4 fish, trophic level 2 freshwater + estuarine fish, trophic level 3 freshwater + estuarine fish, and trophic level 4 freshwater + estuarine fish. The tables provide the 50th, 75th, 90th, 95th, 97th, and 99th percentiles, along with their respective 95 percent confidence intervals. Tables 19 through 29 present the UFCR estimates of raw weight, edible portion for youth less than 21 years old.

The tables show percentiles for total fish consumed and for various fish types that make up the total. The mean consumption for all fish should be equal, not counting random errors, to the sum of the mean consumption across different types of fish, e.g., marine, estuarine, and freshwater or trophic levels 2, 3, and 4. The same cannot be said about percentiles. At the extreme, the sum of the maximum fish consumption across fish types will not equal the maximum fish consumption for all fish except in the very unusual case where one individual is the largest consumer in all fish type categories. For a selected percentile, the difference between the sum of the percentiles across fish types and the percentile for the sum across all fish types will increase as the percentile of interest increases from the 50th percentile to 90th percentile, 99th percentile, and the maximum. The 90th percentile for all fish will be greater than or equal to the 90th percentile for any one type of fish and will usually be less than the sum of the 90th percentiles across all types.

There are two tables for each fish type, a and b. Tables 8a–29a present the UFCR by demographic characteristics (gender, age, income, and race/ethnicity) and Tables 8b–29b present the UFCR by geographic area.

Table 8a. UFCR estimates (g/day raw weight, edible portion): Total fish, adults, 21 years and older, by demographic characteristics

	Percentiles (95% CI)					
All Finfish and Shellfish	**50th**	**75th**	**90th**	**95th**	**97th**	**99th**
Adults (≥21 yrs)	17.6 (15.8,19.7)	32.8 (30.1,35.7)	52.8 (48.0,58.1)	68.1 (61.2,75.8)	79.7 (71.0,89.5)	105.1 (92.0,120.2)
Age						
21 to <35 yrs	13.1 (11.1,15.4)	26.8 (23.6,30.4)	46.6 (40.5,53.6)	63.5 (54.1,74.5)	77.2 (64.6,92.4)	109.7 (87.5,137.4)
35 to <50 yrs	18.3 (16.0,20.9)	33.1 (29.4,37.2)	52.7 (46.1,60.2)	67.5 (58.4,78.0)	78.5 (67.4,91.5)	102.4 (86.8,120.7)
50 to <65 yrs	22.4 (19.1,26.2)	38.8 (34.2,44.1)	59.3 (52.3,67.2)	74.4 (65.3,84.7)	85.5 (74.7,97.9)	109.1 (94.1,126.5)
65+ yrs	16.9 (14.4,20.0)	31.1 (27.1,35.6)	49.5 (43.2,56.9)	63.8 (55.1,73.9)	74.0 (63.6,86.1)	96.2 (81.6,113.5)
Women of childbearing age (13 to 49 yrs)	11.6 (10.2,13.2)	23.6 (21.5,25.9)	39.4 (35.4,43.8)	51.7 (45.9,58.2)	61.0 (53.7,69.2)	81.5 (70.6,94.1)
Gender						
Female	15.3 (13.7,17.1)	28.4 (26.0,31.0)	45.2 (40.9,50.0)	57.8 (51.7,64.6)	67.1 (59.7,75.5)	87.2 (76.4,99.5)
Male	20.6 (18.2,23.3)	38.0 (34.5,41.8)	60.6 (54.6,67.2)	77.6 (69.2,87.2)	90.5 (79.8,102.5)	118.1 (102.3,136.3)
Race/Ethnicity[1]						
Mexican American	16.7 (13.8,20.1)	31.3 (27.0,36.3)	50.8 (43.8,59.0)	66.1 (56.4,77.4)	77.5 (65.7,91.5)	103.8 (86.2,125.1)
Other Hispanic	16.6 (13.3,20.7)	31.4 (25.8,38.4)	50.7 (42.1,61.1)	65.0 (54.2,77.9)	75.7 (63.3,90.7)	99.5 (82.7,119.7)
Non-Hispanic White	16.7 (14.7,18.9)	31.0 (28.2,34.2)	49.8 (44.8,55.4)	64.3 (57.1,72.4)	75.1 (66.1,85.4)	98.1 (85.0,113.2)
Non-Hispanic Black	19.6 (16.9,22.7)	35.3 (31.5,39.6)	55.7 (49.9,62.2)	71.1 (63.4,79.8)	82.7 (73.2,93.3)	107.2 (93.5,122.8)
Other Race	32.3 (25.8,40.4)	54.0 (44.5,65.5)	81.1 (66.3,99.1)	102.7 (82.7,127.4)	117.6 (93.4,148.1)	153.0 (117.1,200.0)
Income						
$0 to <$20K	13.6 (11.7,15.8)	27.0 (24.1,30.2)	45.2 (40.1,51.1)	59.9 (52.4,68.4)	71.7 (61.9,82.9)	99.6 (82.8,119.9)
$20 to <$45K	15.4 (13.4,17.7)	28.8 (26.0,31.9)	46.7 (42.1,51.8)	61.1 (54.5,68.4)	71.9 (63.9,81.0)	96.7 (84.6,110.5)
$40 to <$75K	16.5 (14.2,19.2)	30.7 (27.2,34.7)	49.6 (43.5,56.5)	64.0 (55.6,73.8)	75.0 (64.6,87.1)	99.8 (84.4,118.1)
$75+K	23.1 (20.5,26.1)	40.1 (36.1,44.6)	61.3 (54.8,68.7)	77.1 (68.2,87.2)	88.6 (77.6,101.1)	113.5 (97.7,131.7)
>$20K	17.1 (12.6,23.0)	31.3 (24.6,39.8)	48.4 (38.9,60.3)	61.7 (49.5,77.0)	72.0 (57.7,89.7)	93.2 (74.7,116.4)
Refused/Don't Know Income	16.9 (10.9,26.2)	36.6 (25.2,53.3)	64.5 (46.9,88.8)	83.5 (62.8,111.2)	96.4 (73.3,126.7)	124.8 (95.5,163.3)
Income Missing	8.8 (4.1,18.8)	22.0 (12.0,40.4)	46.6 (27.0,80.3)	65.0 (40.2,105.0)	76.6 (49.6,118.2)	99.5 (68.3,145.0)

[1] Race/ethnicity is as defined by NHANES. Respondents who self-identified as "Mexican American" were coded as such regardless of their other race-ethnicity identities. Otherwise, self-identified "Hispanic" ethnicity was coded as "Other Hispanic." All other non-Hispanic participants were then categorized based on their self-reported races: non-Hispanic white, non-Hispanic black, and other non-Hispanic race including non-Hispanic multiracial (other race).

Table 8b. UFCR estimates (g/day raw weight, edible portion): Total fish, adults, 21 years and older, by geographic area

	Percentiles (95% CI)					
All Finfish and Shellfish	50th	75th	90th	95th	97th	99th
Adults (≥21 yrs)	17.6 (15.8,19.7)	32.8 (30.1,35.7)	52.8 (48.0,58.1)	68.1 (61.2,75.8)	79.7 (71.0,89.5)	105.1 (92.0,120.2)
Region[1]						
Northeast	23.9 (20.0,28.7)	42.5 (36.3,49.8)	65.2 (55.9,76.1)	82.0 (70.0,96.1)	93.7 (79.9,110.0)	119.6 (100.9,141.6)
Midwest	12.9 (10.6,15.6)	24.1 (20.6,28.3)	39.2 (33.4,46.0)	50.9 (43.1,60.2)	60.0 (50.3,71.6)	79.7 (66.5,95.6)
South	17.6 (15.1,20.4)	32.4 (28.8,36.4)	52.1 (46.3,58.7)	67.4 (59.1,76.8)	79.0 (68.6,90.9)	105.1 (89.0,124.1)
West	20.0 (17.1,23.4)	35.6 (30.7,41.2)	55.7 (47.7,65.0)	71.1 (60.3,83.9)	82.6 (69.5,98.2)	108.4 (89.8,130.9)
Coastal Status[2]						
Noncoastal	15.9 (13.7,18.5)	30.0 (26.4,34.1)	48.3 (42.3,55.3)	62.4 (54.1,72.1)	73.0 (62.8,85.0)	96.2 (81.4,113.7)
Coastal	20.9 (18.4,23.7)	37.9 (34.1,42.1)	59.9 (53.7,66.9)	76.7 (68.3,86.2)	89.3 (78.8,101.2)	115.9 (100.6,133.6)
Coastal/Inland Region[1,2]						
Pacific	22.1 (18.2,26.7)	39.3 (33.2,46.4)	61.2 (51.3,72.9)	78.2 (64.5,94.7)	91.0 (74.3,111.4)	118.7 (94.8,148.5)
Atlantic	24.5 (20.7,28.9)	43.4 (37.6,50.2)	67.2 (58.8,76.9)	84.8 (74.0,97.2)	97.7 (85.0,112.4)	124.6 (106.7,145.4)
Gulf of Mexico	19.0 (15.2,23.8)	34.5 (29.4,40.5)	55.0 (47.1,64.3)	70.6 (59.5,83.7)	82.4 (68.6,98.9)	106.8 (87.9,129.8)
Great Lakes	14.6 (12.1,17.5)	26.5 (22.6,31.1)	41.8 (35.7,49.0)	53.5 (45.6,62.9)	62.2 (52.8,73.2)	80.5 (68.3,94.9)
Inland Northeast	22.1 (17.5,28.0)	39.6 (32.6,48.1)	60.7 (50.3,73.2)	76.1 (62.9,92.0)	87.1 (71.9,105.4)	111.7 (91.4,136.6)
Inland Midwest	12.4 (10.1,15.1)	23.3 (19.7,27.6)	38.3 (32.3,45.4)	49.9 (41.7,59.7)	59.1 (49.0,71.3)	79.5 (64.9,97.4)
Inland South	15.6 (13.1,18.4)	29.0 (25.6,32.9)	46.9 (41.4,53.1)	60.7 (53.0,69.5)	71.2 (61.4,82.6)	95.6 (79.2,115.5)
Inland West	18.4 (15.1,22.5)	32.6 (27.0,39.4)	50.6 (41.5,61.5)	64.2 (52.7,78.3)	74.5 (61.0,91.0)	96.3 (78.6,118.1)

[1] U.S. regions are the U.S. Census Bureau regions. Midwest = OH, MI, IN, WI, IL, MO, IA, MN, SD, ND, NE, KS. Northeast = PA, NY, NJ, CT, RI, MA, NH, VT, ME. South = DE, MD, DC, VA, WV, KY, TN, NC, SC, GA, AL, MS, FL, LA, AR, OK, TX. West = NM, CO, WY, MT, ID, UT, AZ, NV, CA, OR, WA, AK, HI.

[2] Coastal regions include counties bordering the 3 coasts (Pacific, Atlantic, and Gulf of Mexico) and the Great Lakes and estuaries and bays. Additionally, any county that did not directly border a coast, but the central point was within 25 miles of a coast was defined as coastal. The inland regions are the remaining counties in each of the 4 Census Regions.

Table 9a. UFCR estimates (g/day raw weight, edible portion): Freshwater + estuarine fish, adults, 21 years and older, by demographic characteristics

Freshwater + Estuarine Finfish and Shellfish	Percentiles (95% CI)					
	50th	75th	90th	95th	97th	99th
Adults (≥21 yrs)	5.0 (4.1,6.0)	11.4 (9.9,13.1)	22.0 (19.1,25.4)	31.8 (26.9,37.6)	40.2 (33.3,48.5)	61.1 (48.7,76.6)
Age						
21 to <35 yrs	3.8 (3.1,4.8)	9.9 (8.3,11.7)	21.1 (17.6,25.1)	32.2 (26.2,39.7)	42.3 (33.3,53.7)	68.1 (50.1,92.5)
35 to <50 yrs	5.2 (4.1,6.6)	11.9 (9.6,14.8)	23.0 (18.4,28.7)	33.0 (26.0,41.8)	41.4 (32.2,53.1)	62.5 (46.8,83.4)
50 to <65 yrs	6.3 (5.0,7.9)	13.2 (10.9,15.9)	23.8 (19.7,28.9)	33.3 (26.9,41.3)	41.4 (32.7,52.4)	60.4 (45.9,79.4)
65+ yrs	4.5 (3.3,6.1)	9.9 (7.9,12.4)	18.7 (15.4,22.7)	26.5 (21.9,32.2)	33.1 (26.9,40.6)	48.8 (38.4,62.1)
Women of childbearing age (13 to 49 yrs)	2.9 (2.3,3.6)	7.6 (6.4,9.1)	15.8 (13.2,19.0)	23.5 (19.2,28.7)	29.9 (24.1,37.0)	46.6 (36.4,59.6)
Gender						
Female	4.1 (3.4,5.0)	9.3 (8.1,10.8)	18.0 (15.4,21.0)	25.7 (21.5,30.7)	32.1 (26.4,39.1)	48.2 (38.0,61.2)
Male	6.2 (5.0,7.6)	13.8 (11.8,16.2)	26.3 (22.4,30.9)	38.0 (31.6,45.6)	47.7 (39.0,58.4)	71.9 (56.4,91.8)
Race/Ethnicity[1]						
Mexican American	6.8 (5.3,8.6)	15.3 (12.4,18.9)	28.7 (23.1,35.8)	40.9 (32.2,51.9)	51.0 (39.6,65.6)	75.7 (56.8,100.8)
Other Hispanic	6.1 (4.4,8.6)	14.1 (10.3,19.3)	27.2 (19.5,37.9)	38.7 (27.5,54.5)	47.8 (33.7,67.6)	69.7 (48.3,100.6)
Non-Hispanic White	4.2 (3.4,5.2)	9.4 (8.0,11.1)	17.9 (15.1,21.1)	25.5 (21.2,30.8)	31.9 (26.0,39.0)	47.9 (37.2,61.6)
Non-Hispanic Black	7.2 (5.8,8.9)	15.4 (13.0,18.1)	28.2 (23.8,33.4)	39.6 (32.7,48.0)	48.8 (39.4,60.3)	70.8 (55.0,91.3)
Other Race	12.6 (9.4,16.9)	25.1 (19.2,32.9)	44.5 (33.3,59.6)	62.3 (45.2,86.1)	78.3 (55.0,111.5)	114.7 (76.4,172.1)
Income						
$0 to <$20K	3.5 (2.8,4.4)	9.1 (7.7,10.7)	19.2 (16.3,22.6)	28.9 (24.2,34.6)	37.4 (30.9,45.4)	59.3 (47.5,74.0)
$20 to <$45K	4.3 (3.5,5.4)	9.9 (8.5,11.5)	19.4 (16.6,22.7)	28.4 (23.7,33.9)	35.9 (29.6,43.6)	55.4 (43.8,70.0)
$40 to <$75K	4.8 (3.8,6.2)	10.8 (9.1,12.9)	20.6 (17.6,24.3)	29.6 (24.6,35.5)	37.3 (30.4,45.9)	56.8 (43.4,74.4)
$75+K	6.6 (5.4,8.1)	13.9 (11.7,16.6)	25.6 (21.3,30.8)	36.2 (29.4,44.5)	45.0 (35.9,56.5)	66.2 (51.1,85.9)
>$20K	5.5 (3.6,8.3)	12.1 (8.5,17.1)	22.3 (16.5,30.2)	30.9 (23.3,40.9)	38.7 (29.2,51.1)	56.1 (41.8,75.4)
Refused/Don't Know Income	5.4 (3.2,9.1)	13.8 (9.2,20.8)	29.0 (19.7,42.6)	43.1 (28.6,65.0)	56.6 (36.3,88.3)	88.6 (54.5,144.1)
Income Missing	1.9 (0.8,4.5)	7.1 (3.6,13.9)	18.9 (10.6,33.7)	31.7 (18.4,54.5)	41.6 (24.5,70.7)	65.9 (39.3,110.5)

[1] Race/ethnicity is as defined by NHANES. Respondents who self-identified as "Mexican American" were coded as such regardless of their other race-ethnicity identities. Otherwise, self-identified "Hispanic" ethnicity was coded as "Other Hispanic." All other non-Hispanic participants were then categorized based on their self-reported races: non-Hispanic white, non-Hispanic black, and other non-Hispanic race including non-Hispanic multiracial (other race).

Table 9b. UFCR estimates (g/day raw weight, edible portion): Freshwater + estuarine fish, adults, 21 years and older, by geographic area

Freshwater + Estuarine Finfish and Shellfish	Percentiles (95% CI) 50th	75th	90th	95th	97th	99th
Adults (≥21 yrs)	5.0 (4.1,6.0)	11.4 (9.9,13.1)	22.0 (19.1,25.4)	31.8 (26.9,37.6)	40.2 (33.3,48.5)	61.1 (48.7,76.6)
Region[1]						
Northeast	5.8 (4.4,7.6)	12.6 (9.9,16.0)	23.1 (18.3,29.2)	32.3 (25.4,41.0)	39.9 (31.0,51.5)	58.5 (44.2,77.5)
Midwest	3.2 (2.5,4.2)	7.4 (6.0,9.0)	14.3 (11.8,17.4)	20.8 (16.9,25.7)	26.3 (21.0,33.0)	41.1 (31.3,54.0)
South	6.4 (4.7,8.5)	14.0 (11.3,17.4)	26.3 (21.6,32.0)	37.5 (30.5,46.1)	46.7 (37.6,58.1)	69.0 (54.3,87.7)
West	5.1 (3.9,6.6)	11.4 (8.8,14.8)	22.4 (16.8,29.8)	32.7 (23.9,44.9)	42.0 (30.0,58.8)	66.9 (45.4,98.5)
Coastal Status[2]						
Noncoastal	4.2 (3.4,5.2)	9.8 (8.2,11.6)	19.0 (15.8,22.9)	27.4 (22.3,33.8)	34.6 (27.7,43.3)	52.8 (40.7,68.4)
Coastal	6.6 (5.1,8.4)	14.4 (11.8,17.5)	27.1 (22.4,32.8)	38.6 (31.4,47.6)	48.4 (38.6,60.6)	72.7 (55.6,95.0)
Coastal/Inland Region[1,2]						
Pacific	6.3 (4.4,9.0)	14.0 (10.1,19.5)	27.3 (19.3,38.6)	39.7 (27.4,57.7)	51.2 (34.3,76.3)	81.2 (51.6,127.8)
Atlantic	8.3 (6.4,10.7)	17.0 (13.9,20.8)	30.8 (25.3,37.5)	42.8 (34.5,53.0)	52.3 (41.8,65.5)	75.8 (58.8,97.7)
Gulf of Mexico	7.3 (4.8,11.1)	15.7 (11.7,21.1)	28.6 (22.5,36.4)	40.1 (31.8,50.6)	50.3 (39.3,64.4)	73.8 (55.6,97.8)
Great Lakes	4.0 (3.1,5.1)	8.7 (7.1,10.7)	16.5 (13.5,20.2)	23.6 (19.1,29.1)	29.4 (23.5,36.8)	44.5 (34.1,57.9)
Inland Northeast	5.0 (3.5,7.3)	11.3 (8.0,16.0)	21.0 (14.8,29.7)	29.5 (20.6,42.2)	36.5 (25.3,52.8)	54.4 (36.7,80.6)
Inland Midwest	3.0 (2.3,4.0)	6.9 (5.5,8.7)	13.5 (10.8,17.0)	19.8 (15.5,25.2)	25.1 (19.4,32.6)	39.5 (29.1,53.5)
Inland South	5.3 (4.0,7.1)	12.0 (9.7,14.9)	22.8 (18.6,27.9)	32.7 (26.2,40.7)	40.9 (32.3,51.7)	61.0 (46.7,79.7)
Inland West	4.3 (3.3,5.4)	9.4 (7.4,12.1)	18.2 (13.7,24.3)	26.3 (19.1,36.1)	33.3 (23.8,46.7)	51.6 (35.5,74.9)

[1] U.S. regions are the U.S. Census Bureau regions. Midwest = OH, MI, IN, WI, IL, MO, IA, MN, SD, ND, NE, KS. Northeast = PA, NY, NJ, CT, RI, MA, NH, VT, ME. South = DE, MD, DC, VA, WV, KY, TN, NC, SC, GA, AL, MS, FL, LA, AR, OK, TX. West = NM, CO, WY, MT, ID, UT, AZ, NV, CA, OR, WA, AK, HI.

[2] Coastal regions include counties bordering the 3 coasts (Pacific, Atlantic, and Gulf of Mexico) and the Great Lakes and estuaries and bays. Additionally, any county that did not directly border a coast, but the central point was within 25 miles of a coast was defined as coastal. The inland regions are the remaining counties in each of the 4 Census Regions.

Table 10a. UFCR estimates (g/day raw weight, edible portion): Marine fish, adults, 21 years and older, by demographic characteristics

Marine Finfish and Shellfish	Percentiles (95% CI)					
	50th	75th	90th	95th	97th	99th
Adults (≥21 yrs)	9.9 (8.5,11.5)	19.4 (17.4,21.7)	32.8 (29.6,36.3)	43.3 (38.8,48.4)	51.5 (45.5,58.1)	69.4 (60.1,80.2)
Age						
21 to <35 yrs	7.3 (6.0,9.0)	15.4 (13.2,18.0)	27.4 (23.4,32.1)	37.4 (31.5,44.5)	45.5 (37.7,54.9)	64.7 (51.7,81.0)
35 to <50 yrs	10.2 (8.7,11.8)	19.2 (17.0,21.8)	31.8 (27.8,36.5)	41.7 (35.8,48.5)	49.3 (41.8,58.0)	66.4 (54.7,80.5)
50 to <65 yrs	13.0 (10.6,16.1)	24.0 (20.4,28.1)	38.3 (33.3,44.0)	49.4 (42.9,56.9)	57.8 (49.8,67.0)	75.6 (64.5,88.5)
65+ yrs	9.5 (7.5,12.1)	18.9 (15.8,22.5)	32.3 (27.6,37.8)	42.9 (36.3,50.7)	51.0 (42.8,60.6)	68.8 (56.8,83.5)
Women of childbearing age (13 to 49 yrs)	6.8 (5.8,8.0)	14.5 (13.0,16.1)	25.3 (22.8,28.1)	34.0 (30.2,38.2)	40.5 (35.7,45.9)	55.5 (47.8,64.4)
Gender						
Female	8.9 (7.5,10.5)	17.5 (15.5,19.7)	29.3 (26.1,32.9)	38.6 (34.1,43.6)	45.7 (40.2,52.1)	61.8 (53.0,72.2)
Male	11.2 (9.6,13.1)	21.8 (19.5,24.3)	36.4 (32.7,40.4)	47.9 (42.6,53.8)	56.7 (49.8,64.5)	75.7 (65.1,88.1)
Race/Ethnicity[1]						
Mexican American	7.9 (6.4,9.8)	15.7 (13.4,18.5)	26.6 (22.8,31.0)	35.5 (30.2,41.8)	42.2 (35.6,50.0)	57.9 (47.6,70.4)
Other Hispanic	8.2 (6.6,10.2)	16.4 (13.6,19.8)	28.4 (23.5,34.3)	38.1 (31.5,46.2)	45.5 (37.5,55.2)	62.2 (50.3,76.8)
Non-Hispanic White	9.9 (8.3,11.9)	19.4 (17.0,22.2)	32.5 (28.7,36.9)	42.9 (37.6,49.0)	50.9 (44.1,58.7)	68.6 (58.3,80.7)
Non-Hispanic Black	9.3 (7.8,11.1)	18.1 (15.8,20.8)	30.6 (26.6,35.2)	40.7 (34.9,47.5)	48.6 (41.1,57.4)	66.0 (54.4,80.0)
Other Race	17.3 (13.6,22.2)	30.8 (25.5,37.2)	47.7 (39.7,57.4)	60.4 (49.0,74.3)	70.2 (56.2,87.7)	92.4 (71.3,119.7)
Income						
$0 to <$20K	7.4 (6.0,9.0)	15.5 (13.4,17.9)	27.3 (23.8,31.3)	36.9 (31.9,42.6)	44.6 (38.2,52.2)	62.7 (51.5,76.3)
$20 to <$45K	8.4 (7.0,9.9)	16.5 (14.5,18.7)	28.4 (25.2,31.9)	37.9 (33.4,43.0)	45.5 (39.8,52.1)	62.6 (53.4,73.4)
$40 to <$75K	9.5 (8.0,11.4)	18.6 (16.0,21.6)	31.3 (27.0,36.4)	41.5 (35.6,48.3)	49.1 (42.0,57.3)	66.4 (55.9,78.9)
$75+K	13.4 (11.4,15.8)	24.3 (21.7,27.3)	38.5 (34.4,43.1)	49.6 (43.8,56.3)	58.1 (50.7,66.6)	76.2 (65.2,89.2)
>$20K	9.4 (6.6,13.4)	18.0 (13.8,23.4)	29.8 (23.3,38.1)	39.2 (30.6,50.2)	46.1 (35.9,59.1)	62.7 (48.4,81.1)
Refused/Don't Know Income	9.6 (6.2,14.9)	22.1 (15.0,32.6)	40.5 (28.9,56.8)	54.8 (40.1,74.9)	64.6 (47.6,87.6)	85.5 (63.6,114.9)
Income Missing	5.2 (2.5,10.8)	13.8 (7.5,25.3)	27.9 (16.2,48.2)	39.4 (24.1,64.5)	48.4 (30.4,77.2)	67.4 (43.6,104.1)

[1] Race/ethnicity is as defined by NHANES. Respondents who self-identified as "Mexican American" were coded as such regardless of their other race-ethnicity identities. Otherwise, self-identified "Hispanic" ethnicity was coded as "Other Hispanic." All other non-Hispanic participants were then categorized based on their self-reported races: non-Hispanic white, non-Hispanic black, and other non-Hispanic race including non-Hispanic multiracial (other race).

Table 10b. UFCR estimates (g/day raw weight, edible portion): Marine fish, adults, 21 years and older, by geographic area

	Percentiles (95% CI)					
Marine Finfish and Shellfish	**50th**	**75th**	**90th**	**95th**	**97th**	**99th**
Adults (≥21 yrs)	9.9 (8.5,11.5)	19.4 (17.4,21.7)	32.8 (29.6,36.3)	43.3 (38.8,48.4)	51.5 (45.5,58.1)	69.4 (60.1,80.2)
Region[1]						
Northeast	15.0 (12.1,18.6)	28.1 (23.5,33.4)	44.4 (37.5,52.6)	56.7 (47.8,67.3)	65.8 (55.5,78.1)	85.4 (70.9,102.7)
Midwest	7.4 (5.7,9.6)	14.6 (11.5,18.3)	24.6 (19.7,30.8)	32.9 (26.2,41.4)	39.2 (31.0,49.5)	53.5 (42.1,68.1)
South	8.8 (7.6,10.1)	16.9 (15.3,18.8)	28.4 (25.2,31.9)	37.6 (32.7,43.2)	44.9 (38.4,52.4)	61.5 (50.6,74.6)
West	12.2 (9.8,15.2)	22.5 (18.8,26.9)	36.1 (30.6,42.7)	46.7 (39.5,55.2)	54.9 (46.0,65.5)	72.2 (59.6,87.6)
Coastal Status[2]						
Noncoastal	9.1 (7.4,11.2)	18.0 (15.3,21.3)	30.7 (26.1,35.9)	40.5 (34.4,47.7)	48.2 (40.7,57.1)	65.5 (54.2,79.1)
Coastal	11.4 (9.6,13.6)	22.0 (19.1,25.3)	36.3 (31.8,41.4)	47.6 (41.5,54.8)	56.2 (48.6,65.1)	74.9 (63.7,88.1)
Coastal/Inland Region[1,2]						
Pacific	13.0 (10.4,16.1)	24.1 (20.3,28.6)	38.6 (33.0,45.2)	49.9 (42.2,58.9)	58.5 (49.1,69.8)	77.0 (63.2,93.7)
Atlantic	13.1 (10.2,16.7)	24.9 (20.0,30.9)	40.6 (33.1,50.0)	52.8 (43.2,64.5)	61.8 (50.6,75.5)	81.1 (66.3,99.3)
Gulf of Mexico	9.5 (7.9,11.3)	18.1 (15.7,20.8)	29.7 (25.4,34.8)	39.7 (32.8,48.1)	47.1 (38.5,57.6)	64.3 (50.6,81.7)
Great Lakes	8.0 (6.3,10.2)	15.4 (12.6,18.9)	25.5 (20.9,31.1)	33.5 (27.2,41.2)	39.8 (32.2,49.1)	54.5 (43.0,69.0)
Inland Northeast	14.0 (11.1,17.6)	26.4 (21.9,31.8)	41.7 (34.8,50.0)	53.6 (44.4,64.8)	62.1 (51.2,75.2)	80.7 (65.8,98.8)
Inland Midwest	7.2 (5.4,9.6)	14.3 (11.1,18.4)	24.4 (19.2,31.0)	32.8 (25.6,41.9)	39.1 (30.4,50.2)	53.4 (41.4,68.8)
Inland South	7.9 (6.5,9.5)	15.2 (13.2,17.6)	25.7 (22.1,29.9)	34.1 (28.8,40.3)	40.7 (33.8,48.9)	56.6 (45.0,71.3)
Inland West	11.6 (8.8,15.4)	21.2 (16.6,27.2)	33.9 (26.8,43.0)	43.6 (34.6,55.0)	51.3 (40.6,64.9)	68.2 (53.0,87.7)

[1] U.S. regions are the U.S. Census Bureau regions. Midwest = OH, MI, IN, WI, IL, MO, IA, MN, SD, ND, NE, KS. Northeast = PA, NY, NJ, CT, RI, MA, NH, VT, ME. South = DE, MD, DC, VA, WV, KY, TN, NC, SC, GA, AL, MS, FL, LA, AR, OK, TX. West = NM, CO, WY, MT, ID, UT, AZ, NV, CA, OR, WA, AK, HI.

[2] Coastal regions include counties bordering the 3 coasts (Pacific, Atlantic, and Gulf of Mexico) and the Great Lakes and estuaries and bays. Additionally, any county that did not directly border a coast, but the central point was within 25 miles of a coast was defined as coastal. The inland regions are the remaining counties in each of the 4 Census Regions.

Table 11a. UFCR estimates (g/day raw weight, edible portion): Total finfish, adults, 21 years and older, by demographic characteristics

	Percentiles (95% CI)					
All Finfish	**50th**	**75th**	**90th**	**95th**	**97th**	**99th**
Adults (≥21 yrs)	12.8 (11.3,14.6)	24.1 (21.9,26.5)	39.3 (35.5,43.5)	51.2 (45.7,57.3)	60.1 (53.2,67.9)	80.1 (69.8,92.0)
Age						
21 to <35 yrs	9.2 (7.6,11.1)	18.7 (16.2,21.6)	32.9 (28.3,38.4)	44.9 (37.9,53.2)	54.6 (45.5,65.5)	77.5 (62.5,95.9)
35 to <50 yrs	12.4 (10.6,14.5)	22.8 (20.2,25.7)	37.1 (32.6,42.1)	48.6 (42.0,56.2)	57.3 (49.1,66.7)	76.7 (64.6,91.0)
50 to <65 yrs	17.1 (14.2,20.6)	29.9 (25.7,34.8)	46.0 (39.7,53.2)	57.9 (49.7,67.5)	66.8 (57.1,78.2)	85.6 (72.4,101.4)
65+ yrs	13.8 (11.6,16.4)	24.9 (21.6,28.9)	39.5 (33.9,46.0)	50.6 (43.1,59.4)	59.0 (50.0,69.6)	77.9 (65.0,93.5)
Women of childbearing age (13 to 49 yrs)	8.2 (7.1,9.4)	16.7 (15.2,18.3)	28.6 (25.8,31.7)	38.1 (33.9,42.8)	45.6 (40.1,51.9)	62.2 (53.8,71.8)
Gender						
Female	11.4 (10.1,12.9)	21.5 (19.5,23.6)	34.7 (31.2,38.6)	44.9 (39.9,50.6)	52.5 (46.2,59.6)	69.1 (59.7,80.1)
Male	14.6 (12.6,16.9)	27.2 (24.4,30.3)	44.1 (39.4,49.5)	57.2 (50.7,64.6)	67.1 (59.1,76.1)	89.0 (77.4,102.3)
Race/Ethnicity[1]						
Mexican American	11.3 (9.1,13.9)	21.5 (18.3,25.4)	35.4 (30.0,41.7)	46.7 (39.3,55.7)	55.5 (46.3,66.6)	75.6 (61.9,92.3)
Other Hispanic	10.7 (8.4,13.5)	21.5 (17.1,27.1)	36.3 (28.8,45.8)	48.4 (38.5,60.8)	57.5 (45.7,72.2)	78.3 (61.8,99.3)
Non-Hispanic White	12.3 (10.6,14.2)	22.9 (20.5,25.5)	36.9 (32.8,41.5)	47.8 (42.0,54.4)	55.9 (48.6,64.2)	73.5 (62.9,85.8)
Non-Hispanic Black	14.6 (12.3,17.4)	27.1 (23.6,31.0)	43.8 (38.5,49.8)	56.7 (49.7,64.7)	66.5 (57.9,76.4)	88.1 (75.0,103.6)
Other Race	24.2 (18.8,31.3)	41.0 (32.7,51.4)	62.2 (50.3,76.8)	78.8 (63.6,97.5)	90.0 (72.4,112.0)	114.9 (91.6,144.0)
Income, finer detail						
$0 to <$20K	10.4 (8.9,12.3)	20.8 (18.7,23.3)	35.4 (31.5,39.8)	47.3 (41.7,53.7)	56.4 (49.5,64.4)	78.0 (66.9,91.0)
$20 to <$45K	11.9 (10.1,13.9)	22.1 (19.6,24.8)	36.1 (32.2,40.4)	47.3 (41.9,53.4)	55.8 (49.2,63.3)	75.0 (65.3,86.2)
$40 to <$75K	12.2 (10.3,14.5)	23.1 (19.8,26.9)	37.7 (32.0,44.3)	49.2 (41.5,58.3)	57.9 (48.7,69.0)	78.3 (64.9,94.5)
$75+K	15.9 (13.6,18.5)	28.2 (24.9,32.0)	44.1 (38.5,50.5)	56.1 (48.6,64.8)	64.8 (55.8,75.3)	84.4 (71.2,100.0)
>$20K	12.1 (8.3,17.6)	23.3 (17.0,32.0)	38.9 (29.0,52.2)	51.5 (38.2,69.4)	61.3 (45.2,83.2)	81.4 (59.9,110.7)
Refused/Don't Know Income	10.7 (6.5,17.4)	24.3 (17.0,34.8)	43.6 (32.9,57.8)	57.7 (44.0,75.6)	67.6 (51.5,88.6)	87.4 (63.6,120.1)
Income Missing	4.9 (2.2,11.2)	13.0 (6.7,25.2)	28.8 (14.8,55.9)	41.9 (22.9,76.8)	53.0 (30.8,91.1)	75.7 (48.9,117.2)

[1] Race/ethnicity is as defined by NHANES. Respondents who self-identified as "Mexican American" were coded as such regardless of their other race-ethnicity identities. Otherwise, self-identified "Hispanic" ethnicity was coded as "Other Hispanic." All other non-Hispanic participants were then categorized based on their self-reported races: non-Hispanic white, non-Hispanic black, and other non-Hispanic race including non-Hispanic multiracial (other race).

Table 11b. UFCR estimates (g/day raw weight, edible portion): Total finfish, adults, 21 years and older, by geographic area

	Percentiles (95% CI)					
All Finfish	**50th**	**75th**	**90th**	**95th**	**97th**	**99th**
Adults (≥21 yrs)	12.8 (11.3,14.6)	24.1 (21.9,26.5)	39.3 (35.5,43.5)	51.2 (45.7,57.3)	60.1 (53.2,67.9)	80.1 (69.8,92.0)
Region[1]						
Northeast	15.4 (12.6,18.7)	28.5 (23.9,33.9)	45.0 (37.7,53.6)	57.2 (47.9,68.5)	66.1 (55.1,79.4)	85.6 (70.2,104.3)
Midwest	10.3 (8.1,13.2)	19.4 (15.9,23.7)	32.0 (26.4,38.7)	42.0 (34.5,51.0)	49.9 (40.7,61.2)	67.7 (54.5,84.1)
South	12.5 (10.8,14.4)	23.4 (21.2,26.0)	38.4 (34.4,42.9)	50.1 (44.2,56.8)	59.0 (51.6,67.6)	79.0 (67.8,92.2)
West	14.9 (12.6,17.7)	27.0 (22.7,32.1)	43.0 (35.8,51.5)	55.4 (46.1,66.6)	64.9 (53.8,78.3)	86.0 (70.8,104.3)
Coastal Status[2]						
Noncoastal	12.1 (10.3,14.3)	22.9 (20.0,26.1)	37.2 (32.5,42.6)	48.4 (41.9,56.0)	56.8 (48.8,66.1)	76.0 (64.3,89.9)
Coastal	14.2 (12.4,16.2)	26.4 (23.7,29.4)	42.9 (38.3,48.0)	55.7 (49.4,62.9)	65.2 (57.4,74.0)	85.5 (74.2,98.5)
Coastal/Inland Region[1,2]						
Pacific	15.5 (12.9,18.7)	28.5 (23.9,34.1)	45.5 (37.9,54.6)	59.0 (48.8,71.4)	69.2 (56.9,84.3)	90.6 (73.7,111.2)
Atlantic	15.8 (13.3,18.7)	29.1 (25.0,33.7)	46.5 (40.2,53.7)	59.6 (51.4,69.1)	68.9 (59.1,80.3)	88.9 (74.8,105.7)
Gulf of Mexico	12.5 (10.0,15.5)	23.2 (19.7,27.5)	38.2 (31.8,45.9)	49.6 (40.6,60.6)	58.7 (47.3,73.0)	77.4 (62.1,96.5)
Great Lakes	10.7 (8.4,13.7)	19.7 (16.0,24.2)	32.1 (26.4,39.0)	42.1 (34.6,51.2)	49.6 (40.7,60.5)	67.0 (54.8,81.8)
Inland Northeast	14.7 (11.8,18.3)	27.4 (22.7,32.9)	42.8 (35.9,51.1)	54.5 (45.7,64.9)	63.0 (52.8,75.3)	82.0 (68.4,98.3)
Inland Midwest	10.2 (7.9,13.2)	19.3 (15.6,23.8)	31.9 (26.0,39.1)	41.8 (33.9,51.5)	49.9 (40.0,62.2)	67.8 (53.4,86.1)
Inland South	11.5 (9.7,13.7)	21.8 (19.2,24.7)	35.7 (31.7,40.2)	46.9 (40.9,53.7)	55.2 (47.8,63.8)	75.1 (62.9,89.6)
Inland West	14.5 (11.5,18.3)	25.8 (20.4,32.7)	40.8 (32.1,51.9)	52.5 (41.3,66.7)	61.2 (48.2,77.7)	81.0 (64.2,102.4)

[1] U.S. regions are the U.S. Census Bureau regions. Midwest = OH, MI, IN, WI, IL, MO, IA, MN, SD, ND, NE, KS. Northeast = PA, NY, NJ, CT, RI, MA, NH, VT, ME. South = DE, MD, DC, VA, WV, KY, TN, NC, SC, GA, AL, MS, FL, LA, AR, OK, TX. West = NM, CO, WY, MT, ID, UT, AZ, NV, CA, OR, WA, AK, HI.

[2] Coastal regions include counties bordering the 3 coasts (Pacific, Atlantic, and Gulf of Mexico) and the Great Lakes and estuaries and bays. Additionally, any county that did not directly border a coast, but the central point was within 25 miles of a coast was defined as coastal. The inland regions are the remaining counties in each of the 4 Census Regions.

Table 12a. UFCR estimates (g/day raw weight, edible portion): Total shellfish, adults, 21 years and older, by demographic characteristics

All Shellfish	Percentiles (95% CI)					
	50th	75th	90th	95th	97th	99th
Adults (≥21 yrs)	3.1 (2.4,3.9)	7.6 (6.4,9.0)	15.6 (13.2,18.5)	23.1 (19.2,27.8)	29.1 (23.9,35.4)	43.7 (35.2,54.2)
Age						
21 to <35 yrs	2.7 (2.0,3.7)	7.2 (5.7,9.1)	15.6 (12.4,19.6)	24.1 (18.8,30.7)	31.3 (24.2,40.5)	49.4 (36.7,66.6)
35 to <50 yrs	3.7 (2.8,4.8)	8.8 (6.9,11.2)	17.6 (13.6,22.8)	25.6 (19.3,33.9)	31.8 (23.7,42.6)	46.9 (33.9,64.8)
50 to <65 yrs	3.7 (2.8,4.7)	8.3 (6.7,10.4)	16.0 (12.7,20.1)	22.7 (17.8,28.9)	28.0 (21.9,35.9)	39.9 (31.1,51.3)
65+ yrs	1.9 (1.4,2.7)	5.1 (3.8,6.8)	11.1 (8.6,14.5)	16.9 (13.2,21.6)	21.8 (17.0,27.9)	33.3 (25.8,43.1)
Women of childbearing age (13 to 49 yrs)	2.0 (1.5,2.7)	5.4 (4.4,6.6)	11.4 (9.5,13.8)	17.1 (13.9,20.9)	21.8 (17.5,27.0)	32.7 (25.5,41.8)
Gender						
Female	2.5 (2.0,3.2)	6.2 (5.2,7.3)	12.5 (10.6,14.8)	18.2 (15.1,22.0)	22.9 (18.7,28.0)	33.7 (27.1,42.0)
Male	3.8 (3.0,4.9)	9.4 (7.8,11.4)	19.0 (15.7,23.0)	27.9 (22.7,34.3)	35.0 (28.2,43.5)	51.5 (40.5,65.6)
Race/Ethnicity[1]						
Mexican American	3.6 (2.6,4.9)	8.9 (6.9,11.6)	18.2 (13.8,24.0)	26.7 (19.9,35.9)	33.6 (24.7,45.8)	49.5 (34.7,70.8)
Other Hispanic	3.6 (2.2,5.8)	9.1 (6.1,13.6)	18.2 (12.9,25.7)	26.4 (19.0,36.7)	32.9 (23.8,45.4)	48.1 (34.4,67.3)
Non-Hispanic White	2.9 (2.2,3.7)	7.1 (5.9,8.6)	14.5 (12.0,17.6)	21.4 (17.4,26.3)	27.0 (21.7,33.4)	40.1 (31.9,50.5)
Non-Hispanic Black	2.8 (2.1,3.6)	6.9 (5.6,8.4)	14.0 (11.4,17.3)	20.7 (16.3,26.1)	26.0 (20.3,33.2)	38.3 (29.5,49.9)
Other Race	5.9 (3.9,9.0)	13.5 (9.3,19.6)	27.0 (18.6,39.3)	39.7 (26.9,58.7)	50.2 (33.6,74.9)	73.4 (48.7,110.6)
Income, finer detail						
$0 to <$20K	1.9 (1.3,2.6)	5.2 (4.1,6.7)	11.7 (9.4,14.5)	18.1 (14.5,22.6)	23.7 (18.7,30.1)	37.4 (28.4,49.2)
$20 to <$45K	2.4 (1.8,3.2)	5.9 (4.7,7.4)	12.2 (10.0,14.9)	18.2 (14.9,22.2)	23.5 (19.1,28.9)	36.2 (29.1,45.1)
$40 to <$75K	2.8 (2.1,3.8)	6.8 (5.3,8.6)	13.8 (10.9,17.5)	20.6 (16.0,26.4)	26.2 (20.1,34.1)	40.3 (29.8,54.4)
$75+K	4.9 (3.9,6.0)	10.8 (9.1,13.0)	20.3 (16.6,24.8)	28.3 (22.8,35.3)	34.7 (27.6,43.7)	49.3 (38.4,63.3)
>$20K	2.7 (1.4,5.2)	6.6 (4.2,10.3)	13.5 (9.6,19.1)	19.8 (14.3,27.5)	25.1 (18.0,34.8)	37.5 (26.4,53.4)
Refused/Don't Know Income	3.6 (1.7,7.9)	10.9 (5.4,22.0)	24.6 (13.3,45.3)	36.7 (20.6,65.2)	45.7 (26.6,78.8)	63.7 (37.8,107.5)
Income Missing	0.9 (0.2,4.9)	4.7 (1.4,16.0)	17.4 (6.5,46.4)	30.1 (12.2,74.3)	40.4 (17.8,91.6)	60.8 (31.8,116.2)

[1] Race/ethnicity is as defined by NHANES. Respondents who self-identified as "Mexican American" were coded as such regardless of their other race-ethnicity identities. Otherwise, self-identified "Hispanic" ethnicity was coded as "Other Hispanic." All other non-Hispanic participants were then categorized based on their self-reported races: non-Hispanic white, non-Hispanic black, and other non-Hispanic race including non-Hispanic multiracial (other race).

Table 12b. UFCR estimates (g/day raw weight, edible portion): Total shellfish, adults, 21 years and older, by geographic area

	Percentiles (95% CI)					
All Shellfish	50th	75th	90th	95th	97th	99th
Adults (≥21 yrs)	3.1 (2.4,3.9)	7.6 (6.4,9.0)	15.6 (13.2,18.5)	23.1 (19.2,27.8)	29.1 (23.9,35.4)	43.7 (35.2,54.2)
Region[1]						
Northeast	5.9 (4.5,7.7)	13.3 (10.7,16.5)	24.6 (19.6,30.8)	34.2 (27.1,43.2)	41.7 (32.8,53.0)	58.3 (44.8,75.8)
Midwest	1.6 (1.1,2.2)	3.7 (2.7,5.2)	7.6 (5.4,10.6)	11.1 (7.8,15.9)	14.2 (9.8,20.5)	21.5 (14.6,31.5)
South	3.4 (2.4,4.8)	8.0 (6.0,10.7)	15.7 (11.9,20.8)	22.7 (17.2,30.1)	28.4 (21.5,37.5)	41.7 (31.8,54.7)
West	3.5 (2.4,5.0)	8.0 (5.6,11.3)	15.8 (11.1,22.6)	23.2 (16.0,33.5)	29.1 (19.9,42.5)	43.8 (29.1,65.8)
Coastal Status[2]						
Noncoastal	2.4 (1.9,3.1)	6.0 (4.8,7.4)	12.3 (9.8,15.5)	18.2 (14.2,23.5)	23.3 (17.8,30.5)	35.4 (26.4,47.4)
Coastal	4.7 (3.5,6.2)	10.9 (8.6,13.8)	21.0 (16.6,26.4)	29.8 (23.5,37.8)	36.9 (29.0,46.9)	53.2 (41.6,68.0)
Coastal/Inland Region[1,2]						
Pacific	4.6 (3.0,7.0)	10.5 (7.0,15.7)	20.3 (13.4,30.7)	29.0 (18.8,44.5)	36.1 (23.2,56.2)	53.4 (34.1,83.5)
Atlantic	6.4 (4.8,8.6)	13.9 (10.9,17.8)	25.7 (20.3,32.5)	35.2 (28.0,44.3)	42.8 (33.8,54.3)	59.5 (46.0,76.8)
Gulf of Mexico	4.8 (3.2,7.4)	10.8 (7.7,15.2)	20.1 (14.7,27.4)	28.4 (21.0,38.4)	35.0 (26.1,46.9)	48.6 (37.0,64.0)
Great Lakes	2.3 (1.6,3.3)	5.4 (3.9,7.5)	10.5 (7.5,14.6)	15.0 (10.6,21.2)	18.8 (13.3,26.7)	27.5 (19.2,39.2)
Inland Northeast	4.9 (3.4,6.9)	11.2 (8.2,15.2)	20.7 (14.8,28.9)	28.7 (20.1,41.0)	35.3 (24.4,51.0)	49.0 (32.9,73.1)
Inland Midwest	1.4 (1.0,2.0)	3.3 (2.3,4.6)	6.6 (4.7,9.4)	9.8 (6.8,14.2)	12.6 (8.6,18.5)	19.2 (12.9,28.7)
Inland South	2.6 (1.9,3.7)	6.1 (4.7,7.9)	12.1 (9.5,15.3)	17.6 (13.8,22.4)	22.2 (17.2,28.7)	33.6 (25.7,44.0)
Inland West	2.7 (1.9,3.9)	6.1 (4.4,8.5)	11.8 (8.5,16.5)	17.1 (12.1,24.0)	21.4 (15.0,30.6)	31.6 (21.9,45.7)

[1] U.S. regions are the U.S. Census Bureau regions. Midwest = OH, MI, IN, WI, IL, MO, IA, MN, SD, ND, NE, KS. Northeast = PA, NY, NJ, CT, RI, MA, NH, VT, ME. South = DE, MD, DC, VA, WV, KY, TN, NC, SC, GA, AL, MS, FL, LA, AR, OK, TX. West = NM, CO, WY, MT, ID, UT, AZ, NV, CA, OR, WA, AK, HI.

[2] Coastal regions include counties bordering the 3 coasts (Pacific, Atlantic, and Gulf of Mexico) and the Great Lakes and estuaries and bays. Additionally, any county that did not directly border a coast, but the central point was within 25 miles of a coast was defined as coastal. The inland regions are the remaining counties in each of the 4 Census Regions.

Table 13a. UFCR estimates (g/day raw weight, edible portion): Total trophic level 2 fish, adults, 21 years and older, by demographic characteristics

Trophic Level 2 Finfish and Shellfish	Percentiles (95% CI)					
	50th	75th	90th	95th	97th	99th
Adults (≥21 yrs)	1.9 (1.5,2.4)	4.7 (4.0,5.5)	9.6 (8.3,11.0)	14.2 (12.1,16.8)	18.1 (15.1,21.8)	27.7 (21.8,35.2)
Age						
21 to <35 yrs	1.6 (1.2,2.2)	4.2 (3.5,5.1)	9.0 (7.7,10.6)	13.7 (11.4,16.5)	17.7 (14.4,21.6)	27.9 (21.5,36.1)
35 to <50 yrs	2.1 (1.5,2.8)	5.3 (4.1,6.8)	11.2 (8.5,14.7)	16.7 (12.2,22.9)	21.4 (15.2,30.3)	32.6 (21.9,48.6)
50 to <65 yrs	2.3 (1.7,3.2)	5.1 (3.9,6.6)	9.6 (7.6,12.2)	13.8 (10.9,17.4)	17.1 (13.5,21.7)	24.9 (19.3,32.2)
65+ yrs	1.4 (1.0,1.9)	3.7 (2.8,4.8)	7.7 (6.0,9.8)	11.4 (8.9,14.5)	14.5 (11.2,18.6)	21.5 (16.4,28.3)
Women of childbearing age (13 to 49 yrs)	1.2 (0.9,1.6)	3.1 (2.6,3.9)	6.7 (5.6,8.1)	10.1 (8.2,12.4)	12.9 (10.2,16.3)	19.7 (14.6,26.5)
Gender						
Female	1.5 (1.2,2.0)	3.7 (3.2,4.4)	7.5 (6.5,8.7)	11.0 (9.3,13.0)	13.8 (11.5,16.7)	20.6 (16.3,26.1)
Male	2.4 (1.9,3.1)	5.8 (4.9,6.9)	11.9 (10.1,14.0)	17.5 (14.5,21.1)	22.2 (17.9,27.5)	33.3 (25.6,43.4)
Race/Ethnicity[1]						
Mexican American	2.9 (2.2,3.9)	7.2 (5.7,9.0)	14.5 (11.5,18.4)	21.3 (16.4,27.7)	26.9 (20.3,35.5)	40.5 (29.0,56.7)
Other Hispanic	2.5 (1.7,3.6)	6.3 (4.5,8.6)	12.7 (9.3,17.5)	18.5 (13.1,26.1)	23.4 (16.3,33.7)	34.2 (22.5,52.1)
Non-Hispanic White	1.7 (1.3,2.2)	4.1 (3.4,4.9)	8.3 (7.0,9.8)	12.3 (10.2,14.9)	15.6 (12.7,19.2)	23.7 (18.3,30.8)
Non-Hispanic Black	2.1 (1.6,2.9)	5.1 (4.0,6.4)	10.0 (8.0,12.6)	14.5 (11.4,18.4)	18.3 (14.2,23.6)	26.9 (20.4,35.6)
Other Race	3.5 (2.2,5.5)	7.9 (5.3,11.6)	15.1 (10.4,21.9)	21.8 (14.8,32.1)	27.3 (18.0,41.3)	39.8 (24.8,63.9)
Income						
$0 to <$20K	1.2 (0.9,1.7)	3.4 (2.6,4.4)	7.6 (6.1,9.5)	11.9 (9.5,14.8)	15.7 (12.4,19.8)	25.1 (19.1,32.9)
$20 to <$45K	1.6 (1.2,2.2)	4.0 (3.2,5.0)	8.3 (7.0,10.0)	12.6 (10.5,15.0)	16.2 (13.5,19.4)	25.2 (20.2,31.4)
$40 to <$75K	1.8 (1.3,2.4)	4.3 (3.5,5.3)	8.8 (7.4,10.5)	13.1 (10.7,16.0)	16.6 (13.4,20.6)	25.2 (19.6,32.5)
$75+K	2.7 (2.2,3.4)	6.0 (5.1,7.1)	11.6 (9.6,14.0)	16.5 (13.2,20.7)	20.7 (16.0,26.9)	30.4 (21.9,42.2)
>$20K	1.9 (1.1,3.2)	4.5 (3.1,6.6)	9.3 (6.8,12.6)	13.6 (9.9,18.5)	17.6 (12.8,24.3)	27.6 (19.3,39.5)
Refused/Don't Know Income	2.1 (0.8,5.4)	6.1 (2.9,12.9)	13.5 (7.3,25.2)	20.5 (11.5,36.4)	26.2 (14.8,46.6)	39.0 (19.5,78.3)
Income Missing	0.6 (0.1,2.8)	2.6 (0.8,8.3)	9.1 (3.5,23.5)	15.6 (6.5,37.5)	21.5 (9.2,50.4)	36.0 (16.2,79.7)

[1] Race/ethnicity is as defined by NHANES. Respondents who self-identified as “Mexican American” were coded as such regardless of their other race-ethnicity identities. Otherwise, self-identified “Hispanic” ethnicity was coded as “Other Hispanic.” All other non-Hispanic participants were then categorized based on their self-reported races: non-Hispanic white, non-Hispanic black, and other non-Hispanic race including non-Hispanic multiracial (other race).

Table 13b. UFCR estimates (g/day raw weight, edible portion): Total trophic level 2 fish, adults, 21 years and older, by geographic area

Trophic Level 2 Finfish and Shellfish	Percentiles (95% CI)					
	50th	75th	90th	95th	97th	99th
Adults (≥21 yrs)	1.9 (1.5,2.4)	4.7 (4.0,5.5)	9.6 (8.3,11.0)	14.2 (12.1,16.8)	18.1 (15.1,21.8)	27.7 (21.8,35.2)
Region[1]						
Northeast	3.1 (2.4,3.9)	7.1 (5.6,8.9)	13.6 (10.3,18.0)	19.6 (14.0,27.3)	24.3 (16.8,35.1)	35.9 (23.0,56.1)
Midwest	1.0 (0.7,1.4)	2.4 (1.7,3.4)	4.9 (3.4,7.2)	7.4 (4.9,11.1)	9.5 (6.2,14.6)	14.7 (9.2,23.4)
South	2.3 (1.6,3.3)	5.4 (4.2,7.0)	10.7 (8.7,13.1)	15.4 (12.6,18.9)	19.4 (15.7,24.0)	28.8 (22.7,36.6)
West	2.0 (1.4,2.8)	4.7 (3.5,6.2)	9.3 (7.3,11.9)	13.7 (10.7,17.7)	17.4 (13.4,22.6)	26.8 (20.1,35.6)
Coastal Status[2]						
Noncoastal	1.5 (1.2,2.0)	3.8 (3.1,4.7)	7.9 (6.3,10.0)	11.9 (9.0,15.7)	15.3 (11.3,20.8)	24.4 (16.9,35.2)
Coastal	2.7 (2.0,3.7)	6.3 (5.1,7.9)	12.3 (10.2,14.8)	17.5 (14.5,21.0)	21.8 (17.9,26.5)	31.8 (25.3,40.0)
Coastal/Inland Region[1,2]						
Pacific	2.5 (1.7,3.8)	5.8 (4.2,8.1)	11.3 (8.4,15.3)	16.2 (12.0,21.9)	20.4 (15.0,27.7)	30.2 (21.9,41.6)
Atlantic	3.8 (2.8,5.1)	8.1 (6.6,10.1)	15.1 (12.3,18.4)	20.9 (16.9,25.8)	25.3 (20.1,31.7)	35.8 (26.5,48.3)
Gulf of Mexico	2.9 (1.9,4.6)	6.6 (4.8,9.1)	12.5 (9.7,16.1)	17.4 (13.7,22.2)	21.4 (16.8,27.1)	31.2 (23.7,41.0)
Great Lakes	1.4 (0.9,2.1)	3.3 (2.3,4.8)	6.6 (4.6,9.6)	9.6 (6.5,14.2)	12.0 (8.0,17.9)	17.9 (11.4,28.0)
Inland Northeast	2.6 (1.8,3.7)	6.1 (4.1,8.9)	11.8 (7.5,18.8)	17.3 (10.3,29.0)	21.9 (12.6,38.1)	33.4 (18.2,61.3)
Inland Midwest	0.9 (0.6,1.3)	2.1 (1.5,3.1)	4.4 (2.9,6.7)	6.6 (4.3,10.2)	8.6 (5.4,13.6)	13.5 (8.2,22.2)
Inland South	1.9 (1.3,2.6)	4.4 (3.4,5.6)	8.7 (7.0,10.9)	12.9 (10.1,16.5)	16.4 (12.7,21.3)	25.5 (18.5,35.1)
Inland West	1.6 (1.2,2.3)	3.7 (2.9,4.9)	7.4 (5.7,9.7)	11.0 (8.4,14.6)	14.2 (10.6,19.0)	22.4 (15.9,31.5)

[1] U.S. regions are the U.S. Census Bureau regions. Midwest = OH, MI, IN, WI, IL, MO, IA, MN, SD, ND, NE, KS. Northeast = PA, NY, NJ, CT, RI, MA, NH, VT, ME. South = DE, MD, DC, VA, WV, KY, TN, NC, SC, GA, AL, MS, FL, LA, AR, OK, TX. West = NM, CO, WY, MT, ID, UT, AZ, NV, CA, OR, WA, AK, HI.

[2] Coastal regions include counties bordering the 3 coasts (Pacific, Atlantic, and Gulf of Mexico) and the Great Lakes and estuaries and bays. Additionally, any county that did not directly border a coast, but the central point was within 25 miles of a coast was defined as coastal. The inland regions are the remaining counties in each of the 4 Census Regions.

Table 14a. UFCR estimates (g/day raw weight, edible portion): Total trophic level 3 fish, adults, 21 years and older, by demographic characteristics

Trophic Level 3	Percentiles (95% CI)					
Finfish and Shellfish	**50th**	**75th**	**90th**	**95th**	**97th**	**99th**
Adults (≥21 yrs)	4.7 (3.9,5.7)	9.6 (8.5,10.8)	16.6 (14.7,18.8)	22.4 (19.4,25.9)	27.0 (23.0,31.6)	37.4 (30.7,45.7)
Age						
21 to <35 yrs	3.7 (2.9,4.8)	8.2 (6.8,9.8)	15.4 (12.9,18.3)	22.0 (17.9,27.1)	27.6 (21.6,35.3)	41.3 (29.1,58.5)
35 to <50 yrs	5.0 (4.1,6.1)	9.8 (8.3,11.6)	16.8 (14.1,20.0)	22.5 (18.7,27.1)	26.9 (22.0,32.7)	36.5 (29.3,45.5)
50 to <65 yrs	6.0 (4.9,7.4)	11.3 (9.5,13.3)	18.4 (15.4,21.9)	23.9 (19.7,28.9)	28.1 (22.9,34.4)	37.4 (29.3,47.7)
65+ yrs	4.0 (3.0,5.3)	8.2 (6.8,10.0)	14.6 (12.7,16.9)	20.1 (17.4,23.2)	24.3 (20.8,28.4)	33.8 (27.9,40.8)
Women of childbearing age (13 to 49 yrs)	3.1 (2.5,3.8)	6.7 (5.9,7.8)	12.4 (10.8,14.2)	17.1 (14.6,19.9)	20.8 (17.6,24.6)	29.6 (24.4,35.9)
Gender						
Female	4.0 (3.3,4.9)	8.2 (7.1,9.3)	14.1 (12.4,16.1)	19.0 (16.4,22.0)	22.7 (19.4,26.6)	31.1 (25.8,37.4)
Male	5.6 (4.6,6.8)	11.2 (9.8,12.8)	19.2 (16.6,22.2)	25.7 (21.8,30.4)	30.8 (25.7,36.9)	42.4 (33.9,53.1)
Race/Ethnicity[1]						
Mexican American	5.2 (4.0,6.6)	10.4 (8.6,12.5)	17.7 (14.6,21.3)	23.5 (19.2,28.9)	28.1 (22.5,35.2)	38.2 (29.5,49.5)
Other Hispanic	4.4 (3.2,6.1)	9.1 (6.8,12.1)	15.6 (11.9,20.4)	21.0 (16.0,27.5)	25.2 (19.0,33.3)	34.2 (25.0,46.9)
Non-Hispanic White	4.2 (3.4,5.2)	8.4 (7.3,9.7)	14.5 (12.5,16.7)	19.3 (16.5,22.7)	23.1 (19.3,27.5)	31.4 (25.4,38.9)
Non-Hispanic Black	6.1 (5.1,7.4)	11.8 (10.2,13.5)	19.5 (16.8,22.5)	25.6 (21.7,30.2)	30.1 (25.2,35.9)	40.0 (32.6,49.3)
Other Race	11.9 (9.2,15.5)	21.2 (16.8,26.7)	33.2 (26.0,42.3)	42.4 (31.9,56.2)	49.1 (35.9,67.1)	62.0 (43.1,89.3)
Income						
$0 to <$20K	3.8 (3.0,4.9)	8.4 (7.1,9.9)	15.3 (13.2,17.8)	21.1 (18.0,24.8)	25.8 (21.7,30.6)	37.0 (29.8,46.0)
$20 to <$45K	4.1 (3.3,5.2)	8.5 (7.2,10.0)	14.8 (12.8,17.2)	20.2 (17.4,23.5)	24.5 (20.8,28.7)	34.7 (28.6,42.2)
$40 to <$75K	4.4 (3.6,5.5)	8.8 (7.5,10.3)	15.3 (13.2,17.9)	20.9 (17.5,24.8)	25.3 (20.8,30.7)	35.4 (27.7,45.3)
$75+K	6.0 (5.0,7.3)	11.5 (9.9,13.3)	19.1 (16.2,22.5)	25.0 (20.8,30.2)	29.5 (24.3,35.9)	39.6 (31.6,49.8)
>$20K	4.6 (3.0,7.2)	9.1 (6.8,12.2)	15.2 (11.8,19.5)	20.2 (15.9,25.7)	23.9 (18.6,30.6)	32.2 (24.7,42.1)
Refused/Don't Know Income	5.1 (3.0,8.4)	11.7 (7.7,17.9)	21.6 (14.8,31.7)	29.1 (19.1,44.2)	35.0 (22.4,54.7)	47.7 (29.3,77.5)
Income Missing	1.7 (0.6,4.7)	5.4 (2.4,12.4)	14.7 (6.6,32.6)	22.8 (10.9,47.5)	29.4 (15.1,57.1)	42.1 (24.6,72.1)

[1] Race/ethnicity is as defined by NHANES. Respondents who self-identified as "Mexican American" were coded as such regardless of their other race-ethnicity identities. Otherwise, self-identified "Hispanic" ethnicity was coded as "Other Hispanic." All other non-Hispanic participants were then categorized based on their self-reported races: non-Hispanic white, non-Hispanic black, and other non-Hispanic race including non-Hispanic multiracial (other race).

Table 14b. UFCR estimates (g/day raw weight, edible portion): Total trophic level 3 fish, adults, 21 years and older, by geographic area

Trophic Level 3 Finfish and Shellfish	Percentiles (95% CI) 50th	75th	90th	95th	97th	99th
Adults (≥21 yrs)	4.7 (3.9,5.7)	9.6 (8.5,10.8)	16.6 (14.7,18.8)	22.4 (19.4,25.9)	27.0 (23.0,31.6)	37.4 (30.7,45.7)
Region[1]						
Northeast	5.9 (4.5,7.7)	11.7 (9.3,14.6)	19.4 (15.6,24.1)	25.3 (20.3,31.5)	29.7 (23.7,37.3)	39.7 (30.9,51.0)
Midwest	3.0 (2.2,3.9)	5.8 (4.7,7.2)	10.1 (8.2,12.5)	13.6 (11.0,17.0)	16.5 (13.1,20.8)	23.0 (17.9,29.6)
South	5.4 (4.3,6.9)	10.6 (8.9,12.6)	17.9 (15.1,21.1)	23.8 (19.9,28.5)	28.4 (23.6,34.1)	38.8 (31.5,47.9)
West	5.6 (4.3,7.1)	10.8 (8.7,13.4)	18.6 (14.7,23.4)	25.1 (19.5,32.3)	30.3 (23.2,39.6)	42.1 (30.6,57.9)
Coastal Status[2]						
Noncoastal	4.1 (3.3,5.1)	8.3 (7.1,9.8)	14.6 (12.5,17.1)	19.7 (16.6,23.5)	23.7 (19.7,28.6)	32.8 (26.4,40.7)
Coastal	6.0 (4.9,7.4)	11.8 (10.1,13.7)	19.9 (17.0,23.2)	26.5 (22.3,31.4)	31.7 (26.2,38.3)	43.3 (34.0,54.9)
Coastal/Inland Region[1,2]						
Pacific	6.4 (4.9,8.4)	12.7 (9.8,16.5)	21.7 (16.5,28.6)	29.4 (21.9,39.6)	35.3 (25.7,48.5)	48.2 (32.8,70.8)
Atlantic	7.2 (5.7,9.1)	13.2 (11.1,15.8)	21.6 (18.3,25.4)	27.9 (23.6,33.1)	32.8 (27.3,39.4)	43.7 (34.9,54.5)
Gulf of Mexico	6.3 (4.5,8.7)	12.2 (9.7,15.2)	20.2 (16.7,24.5)	26.8 (21.9,32.8)	31.9 (25.9,39.4)	43.4 (34.0,55.5)
Great Lakes	3.7 (2.9,4.7)	7.0 (5.7,8.6)	11.7 (9.4,14.5)	15.4 (12.2,19.4)	18.3 (14.4,23.4)	24.9 (19.2,32.4)
Inland Northeast	5.3 (3.9,7.1)	10.6 (8.3,13.6)	17.7 (13.9,22.7)	23.4 (18.1,30.2)	27.5 (21.1,35.8)	36.9 (27.8,48.9)
Inland Midwest	2.7 (2.0,3.7)	5.4 (4.3,6.9)	9.5 (7.6,11.9)	13.0 (10.2,16.4)	15.7 (12.3,20.0)	22.2 (17.0,29.0)
Inland South	4.7 (3.7,6.0)	9.3 (7.8,11.1)	15.9 (13.5,18.8)	21.3 (17.8,25.4)	25.5 (21.0,30.9)	35.0 (28.1,43.6)
Inland West	4.9 (3.7,6.6)	9.4 (7.3,12.0)	15.8 (12.3,20.2)	21.0 (16.3,27.1)	25.2 (19.2,33.0)	34.2 (25.6,45.7)

[1] U.S. regions are the U.S. Census Bureau regions. Midwest = OH, MI, IN, WI, IL, MO, IA, MN, SD, ND, NE, KS. Northeast = PA, NY, NJ, CT, RI, MA, NH, VT, ME. South = DE, MD, DC, VA, WV, KY, TN, NC, SC, GA, AL, MS, FL, LA, AR, OK, TX. West = NM, CO, WY, MT, ID, UT, AZ, NV, CA, OR, WA, AK, HI.

[2] Coastal regions include counties bordering the 3 coasts (Pacific, Atlantic, and Gulf of Mexico) and the Great Lakes and estuaries and bays. Additionally, any county that did not directly border a coast, but the central point was within 25 miles of a coast was defined as coastal. The inland regions are the remaining counties in each of the 4 Census Regions.

Table 15a. UFCR estimates (g/day raw weight, edible portion): Total trophic level 4 fish, adults, 21 years and older, by demographic characteristics

Trophic Level 4 Finfish and Shellfish	Percentiles (95% CI)					
	50th	75th	90th	95th	97th	99th
Adults (≥21 yrs)	8.6 (7.5,9.9)	17.1 (15.5,18.8)	28.8 (26.1,31.9)	38.3 (34.1,42.9)	45.5 (40.1,51.7)	61.6 (53.2,71.2)
Age						
21 to <35 yrs	6.0 (4.8,7.4)	12.9 (10.9,15.3)	23.8 (19.9,28.6)	33.2 (27.2,40.5)	40.9 (33.0,50.5)	58.4 (45.9,74.3)
35 to <50 yrs	8.3 (7.1,9.8)	16.0 (14.1,18.2)	26.7 (23.2,30.8)	35.4 (30.3,41.5)	42.2 (35.6,50.1)	57.0 (47.1,69.0)
50 to <65 yrs	11.8 (9.7,14.3)	21.5 (18.3,25.3)	34.4 (29.3,40.3)	44.4 (37.6,52.4)	51.8 (43.5,61.7)	68.1 (56.5,82.0)
65+ yrs	9.5 (7.7,11.6)	17.8 (15.1,21.0)	29.3 (24.7,34.7)	38.5 (32.1,46.2)	45.3 (37.5,54.9)	60.8 (49.2,75.0)
Women of childbearing age (13 to 49 yrs)	5.4 (4.6,6.3)	11.7 (10.5,13.0)	20.8 (18.7,23.1)	28.2 (25.1,31.6)	33.9 (29.9,38.4)	46.7 (40.4,54.0)
Gender						
Female	7.8 (6.8,8.9)	15.4 (14.1,16.9)	25.9 (23.3,28.7)	34.1 (30.3,38.3)	40.3 (35.4,45.9)	54.2 (46.3,63.3)
Male	9.7 (8.3,11.3)	19.0 (17.0,21.2)	32.0 (28.6,35.9)	42.6 (37.5,48.5)	50.5 (44.1,57.8)	68.4 (58.4,80.1)
Race/Ethnicity[1]						
Mexican American	6.4 (5.2,8.0)	13.1 (11.1,15.4)	22.8 (19.3,26.8)	30.7 (25.7,36.7)	37.3 (30.7,45.3)	52.9 (42.0,66.6)
Other Hispanic	6.8 (5.3,8.8)	14.2 (11.1,18.1)	25.2 (19.9,31.9)	34.1 (27.1,43.0)	41.1 (32.9,51.5)	57.2 (45.7,71.6)
Non-Hispanic White	8.8 (7.5,10.2)	17.1 (15.4,19.1)	28.7 (25.7,32.1)	38.0 (33.5,43.1)	45.1 (39.3,51.8)	60.8 (52.0,71.1)
Non-Hispanic Black	8.4 (6.9,10.1)	16.4 (14.1,19.2)	28.0 (24.0,32.8)	37.3 (31.8,43.9)	44.5 (37.6,52.7)	60.7 (50.4,73.1)
Other Race	14.2 (10.6,19.0)	25.6 (20.0,32.7)	39.6 (31.3,50.3)	51.1 (40.3,64.9)	59.5 (46.4,76.4)	80.0 (59.9,107.0)
Income						
$0 to <$20K	6.9 (5.7,8.2)	14.5 (12.9,16.3)	25.6 (22.6,29.0)	34.9 (30.3,40.2)	42.4 (36.1,49.7)	59.3 (49.0,71.8)
$20 to <$45K	7.7 (6.5,9.2)	15.1 (13.4,17.1)	25.7 (22.7,29.1)	34.4 (30.1,39.3)	41.1 (35.7,47.4)	56.8 (47.9,67.3)
$40 to <$75K	8.3 (6.9,9.9)	16.4 (14.0,19.1)	27.6 (23.4,32.5)	36.7 (30.8,43.8)	43.8 (36.4,52.7)	59.2 (48.5,72.1)
$75+K	11.1 (9.5,13.0)	20.5 (18.1,23.1)	33.0 (29.1,37.4)	42.7 (37.3,48.9)	50.0 (43.2,57.9)	66.1 (56.2,77.8)
>$20K	7.9 (5.3,11.8)	16.0 (11.3,22.6)	27.7 (19.8,38.7)	36.8 (26.2,51.7)	44.2 (31.3,62.4)	60.5 (43.2,84.7)
Refused/Don't Know Income	7.3 (4.4,12.1)	18.0 (12.2,26.6)	34.6 (25.4,47.1)	47.4 (35.8,62.8)	56.4 (43.1,73.9)	74.9 (57.1,98.2)
Income Missing	3.7 (1.7,8.4)	10.9 (5.3,22.2)	23.5 (11.8,46.5)	33.8 (17.8,64.3)	41.6 (23.2,74.6)	60.7 (37.9,97.3)

[1] Race/ethnicity is as defined by NHANES. Respondents who self-identified as "Mexican American" were coded as such regardless of their other race-ethnicity identities. Otherwise, self-identified "Hispanic" ethnicity was coded as "Other Hispanic." All other non-Hispanic participants were then categorized based on their self-reported races: non-Hispanic white, non-Hispanic black, and other non-Hispanic race including non-Hispanic multiracial (other race).

Table 15b. UFCR estimates (g/day raw weight, edible portion): Total trophic level 4 fish, adults, 21 years and older, by geographic area

Trophic Level 4	Percentiles (95% CI)					
Finfish and Shellfish	**50th**	**75th**	**90th**	**95th**	**97th**	**99th**
Adults (≥21 yrs)	8.6 (7.5,9.9)	17.1 (15.5,18.8)	28.8 (26.1,31.9)	38.3 (34.1,42.9)	45.5 (40.1,51.7)	61.6 (53.2,71.2)
Region[1]						
Northeast	11.5 (9.4,14.1)	22.0 (18.4,26.2)	36.0 (30.1,43.1)	46.7 (38.8,56.2)	55.0 (45.5,66.5)	73.1 (60.1,89.0)
Midwest	7.2 (5.4,9.6)	14.5 (11.5,18.3)	24.8 (19.9,30.8)	33.1 (26.6,41.3)	39.8 (31.6,50.0)	54.5 (42.7,69.6)
South	7.6 (6.6,8.9)	15.1 (13.4,17.0)	25.8 (22.6,29.4)	34.2 (29.6,39.6)	40.9 (34.9,48.0)	56.0 (46.5,67.3)
West	10.2 (8.5,12.3)	19.1 (16.1,22.8)	31.2 (25.9,37.6)	40.8 (33.5,49.7)	48.0 (39.2,58.8)	63.5 (51.4,78.4)
Coastal Status[2]						
Noncoastal	8.3 (7.0,9.8)	16.3 (14.3,18.7)	27.5 (23.9,31.6)	36.4 (31.3,42.3)	43.4 (36.9,50.9)	58.7 (49.1,70.2)
Coastal	9.3 (7.9,11.0)	18.4 (16.3,20.9)	31.2 (27.5,35.4)	41.4 (36.2,47.3)	49.1 (42.7,56.5)	65.9 (56.3,77.1)
Coastal/Inland Region[1,2]						
Pacific	10.5 (8.5,12.9)	19.9 (16.5,24.1)	32.8 (27.0,39.8)	42.7 (34.8,52.3)	50.4 (40.7,62.5)	66.8 (53.0,84.1)
Atlantic	10.4 (8.4,12.9)	20.4 (17.0,24.5)	34.5 (28.9,41.2)	45.7 (38.1,54.8)	53.9 (44.9,64.7)	72.1 (59.0,88.0)
Gulf of Mexico	7.6 (6.0,9.5)	14.9 (12.3,18.1)	25.7 (21.0,31.6)	33.8 (27.5,41.6)	40.3 (32.6,49.8)	53.9 (43.0,67.5)
Great Lakes	7.0 (5.2,9.5)	14.1 (11.0,18.2)	24.4 (19.2,30.9)	32.6 (25.8,41.1)	39.0 (30.9,49.2)	53.7 (42.0,68.8)
Inland Northeast	11.1 (8.8,13.8)	21.1 (17.6,25.3)	34.2 (28.7,40.7)	44.0 (37.0,52.3)	51.6 (43.1,62.0)	68.7 (56.6,83.4)
Inland Midwest	7.3 (5.4,9.9)	14.6 (11.4,18.7)	24.8 (19.7,31.2)	33.2 (26.3,42.0)	40.0 (31.3,51.1)	54.7 (42.2,71.0)
Inland South	7.1 (5.9,8.5)	13.9 (12.0,16.2)	23.7 (20.3,27.7)	31.6 (26.6,37.5)	37.5 (31.3,44.8)	52.2 (41.8,65.1)
Inland West	10.0 (7.8,12.9)	18.5 (14.5,23.5)	30.0 (23.4,38.4)	39.0 (30.4,50.1)	45.9 (35.8,58.9)	60.8 (47.6,77.7)

[1] U.S. regions are the U.S. Census Bureau regions. Midwest = OH, MI, IN, WI, IL, MO, IA, MN, SD, ND, NE, KS. Northeast = PA, NY, NJ, CT, RI, MA, NH, VT, ME. South = DE, MD, DC, VA, WV, KY, TN, NC, SC, GA, AL, MS, FL, LA, AR, OK, TX. West = NM, CO, WY, MT, ID, UT, AZ, NV, CA, OR, WA, AK, HI.

[2] Coastal regions include counties bordering the 3 coasts (Pacific, Atlantic, and Gulf of Mexico) and the Great Lakes and estuaries and bays. Additionally, any county that did not directly border a coast, but the central point was within 25 miles of a coast was defined as coastal. The inland regions are the remaining counties in each of the 4 Census Regions.

Table 16a. UFCR estimates (g/day raw weight, edible portion): Total freshwater + estuarine trophic level 2 fish, adults, 21 years and older, by demographic characteristics

Freshwater + Estuarine Trophic Level 2 Finfish and Shellfish	Percentiles (95% CI)					
	50th	75th	90th	95th	97th	99th
Adults (≥21 yrs)	1.5 (1.1,1.9)	3.6 (3.0,4.4)	7.6 (6.4,9.1)	11.5 (9.4,14.0)	14.7 (11.8,18.3)	23.0 (17.6,30.2)
Age						
21 to <35 yrs	1.4 (1.0,1.9)	3.6 (2.9,4.3)	7.8 (6.6,9.3)	12.0 (9.8,14.6)	15.5 (12.5,19.2)	24.7 (18.7,32.5)
35 to <50 yrs	1.6 (1.2,2.3)	4.2 (3.1,5.6)	8.9 (6.5,12.1)	13.4 (9.5,18.7)	17.3 (12.1,24.7)	27.1 (18.1,40.6)
50 to <65 yrs	1.7 (1.2,2.4)	3.8 (2.9,5.0)	7.4 (5.7,9.5)	10.6 (8.2,13.8)	13.3 (10.1,17.4)	20.0 (14.6,27.2)
65+ yrs	1.0 (0.7,1.4)	2.7 (2.0,3.6)	5.7 (4.4,7.5)	8.7 (6.6,11.4)	11.1 (8.3,14.8)	16.8 (12.3,23.0)
Women of childbearing age (13 to 49 yrs)	0.9 (0.7,1.3)	2.6 (2.0,3.2)	5.6 (4.5,7.0)	8.5 (6.6,10.9)	11.0 (8.4,14.4)	17.1 (12.4,23.7)
Gender						
Female	1.2 (0.9,1.6)	3.0 (2.5,3.7)	6.2 (5.1,7.5)	9.2 (7.4,11.3)	11.6 (9.2,14.7)	17.7 (13.3,23.5)
Male	1.8 (1.4,2.3)	4.4 (3.6,5.4)	9.3 (7.6,11.2)	13.8 (11.1,17.2)	17.8 (14.0,22.5)	27.5 (20.6,36.6)
Race/Ethnicity[1]						
Mexican American	2.5 (1.8,3.3)	6.2 (4.9,7.9)	12.9 (9.9,16.6)	19.1 (14.3,25.5)	24.5 (18.0,33.5)	37.6 (26.3,53.9)
Other Hispanic	2.0 (1.3,3.0)	5.1 (3.5,7.3)	10.5 (7.3,15.1)	15.3 (10.3,22.7)	19.6 (12.9,29.6)	29.7 (18.7,47.3)
Non-Hispanic White	1.2 (0.9,1.6)	3.1 (2.5,3.8)	6.3 (5.1,7.7)	9.3 (7.5,11.6)	11.9 (9.3,15.1)	18.2 (13.6,24.3)
Non-Hispanic Black	1.8 (1.3,2.4)	4.3 (3.4,5.5)	8.6 (6.7,11.1)	12.6 (9.6,16.5)	15.8 (11.9,21.1)	23.6 (17.2,32.6)
Other Race	3.0 (1.9,4.8)	6.9 (4.6,10.3)	13.3 (9.0,19.4)	19.0 (12.6,28.4)	23.6 (15.4,36.3)	35.0 (21.2,57.8)
Income						
$0 to <$20K	1.0 (0.7,1.3)	2.7 (2.1,3.5)	6.4 (5.1,7.9)	10.0 (8.0,12.7)	13.3 (10.4,17.0)	21.9 (16.1,29.8)
$20 to <$45K	1.2 (0.9,1.7)	3.1 (2.5,4.0)	6.7 (5.5,8.3)	10.4 (8.5,12.7)	13.6 (10.9,16.8)	21.6 (16.8,27.7)
$40 to <$75K	1.4 (1.0,1.9)	3.4 (2.8,4.2)	7.0 (5.8,8.5)	10.5 (8.5,12.9)	13.4 (10.7,16.9)	21.3 (16.0,28.3)
$75+K	2.1 (1.6,2.7)	4.6 (3.7,5.7)	9.0 (7.1,11.4)	13.0 (9.9,17.0)	16.3 (12.1,21.9)	24.5 (17.1,35.1)
>$20K	1.4 (0.8,2.5)	3.5 (2.3,5.2)	7.4 (5.4,10.2)	11.1 (8.0,15.3)	14.5 (10.4,20.2)	23.1 (16.0,33.5)
Refused/Don't Know Income	1.6 (0.6,4.3)	4.7 (2.1,10.1)	10.5 (5.6,19.8)	16.3 (9.0,29.5)	21.6 (12.0,38.6)	34.3 (17.1,68.7)
Income Missing	0.5 (0.1,2.3)	2.1 (0.7,6.4)	7.4 (2.9,19.2)	13.1 (5.5,31.3)	17.8 (7.8,40.4)	30.4 (14.0,65.8)

[1] Race/ethnicity is as defined by NHANES. Respondents who self-identified as "Mexican American" were coded as such regardless of their other race-ethnicity identities. Otherwise, self-identified "Hispanic" ethnicity was coded as "Other Hispanic." All other non-Hispanic participants were then categorized based on their self-reported races: non-Hispanic white, non-Hispanic black, and other non-Hispanic race including non-Hispanic multiracial (other race).

Table 16b. UFCR estimates (g/day raw weight, edible portion): Total freshwater + estuarine trophic level 2 fish, adults, 21 years and older, by geographic area

Freshwater + Estuarine Trophic Level 2 Finfish and Shellfish	Percentiles (95% CI)					
	50th	75th	90th	95th	97th	99th
Adults (≥21 yrs)	1.5 (1.1,1.9)	3.6 (3.0,4.4)	7.6 (6.4,9.1)	11.5 (9.4,14.0)	14.7 (11.8,18.3)	23.0 (17.6,30.2)
Region[1]						
Northeast	2.1 (1.5,2.8)	4.8 (3.5,6.6)	9.5 (6.6,13.6)	13.9 (9.3,20.7)	17.6 (11.5,27.1)	27.0 (16.4,44.4)
Midwest	0.8 (0.5,1.1)	1.9 (1.3,2.8)	4.1 (2.7,6.1)	6.2 (4.0,9.5)	8.0 (5.1,12.7)	12.8 (7.7,21.2)
South	1.9 (1.3,2.8)	4.5 (3.4,5.9)	9.0 (7.2,11.3)	13.2 (10.6,16.4)	16.7 (13.3,21.0)	25.4 (19.4,33.2)
West	1.5 (1.0,2.3)	3.7 (2.7,5.0)	7.7 (5.7,10.2)	11.5 (8.6,15.4)	14.7 (10.9,19.9)	23.2 (16.7,32.1)
Coastal Status[2]						
Noncoastal	1.2 (0.9,1.5)	3.0 (2.4,3.8)	6.3 (4.8,8.3)	9.6 (7.1,13.0)	12.5 (9.0,17.4)	20.2 (13.9,29.3)
Coastal	2.1 (1.5,2.9)	4.9 (3.9,6.3)	9.8 (7.9,12.1)	14.1 (11.4,17.5)	17.7 (14.1,22.2)	26.5 (20.3,34.8)
Coastal/Inland Region[1,2]						
Pacific	1.9 (1.2,3.1)	4.6 (3.1,6.8)	9.2 (6.5,13.2)	13.5 (9.5,19.0)	16.9 (12.0,23.9)	25.9 (18.1,37.2)
Atlantic	2.8 (2.0,3.9)	6.2 (4.8,8.0)	11.6 (9.1,14.8)	16.4 (12.7,21.2)	20.4 (15.4,27.1)	29.6 (20.9,42.1)
Gulf of Mexico	2.3 (1.4,3.7)	5.3 (3.8,7.3)	10.4 (8.0,13.5)	14.6 (11.5,18.6)	18.4 (14.2,23.8)	27.1 (20.3,36.2)
Great Lakes	1.1 (0.7,1.7)	2.7 (1.8,3.9)	5.4 (3.7,8.0)	7.9 (5.3,12.0)	10.1 (6.6,15.5)	15.6 (9.7,25.1)
Inland Northeast	1.7 (1.1,2.7)	4.1 (2.6,6.6)	8.2 (4.8,14.1)	12.1 (6.7,21.9)	15.5 (8.3,28.8)	24.3 (12.4,47.5)
Inland Midwest	0.7 (0.5,1.0)	1.7 (1.1,2.5)	3.6 (2.3,5.6)	5.5 (3.5,8.9)	7.2 (4.4,11.9)	11.6 (6.7,20.0)
Inland South	1.6 (1.1,2.2)	3.7 (2.8,4.9)	7.6 (5.8,9.8)	11.3 (8.6,15.0)	14.6 (10.8,19.6)	23.1 (16.3,32.9)
Inland West	1.3 (0.9,1.8)	2.9 (2.2,4.0)	6.2 (4.6,8.3)	9.3 (6.8,12.9)	12.3 (8.7,17.3)	20.0 (13.6,29.4)

[1] U.S. regions are the U.S. Census Bureau regions. Midwest = OH, MI, IN, WI, IL, MO, IA, MN, SD, ND, NE, KS. Northeast = PA, NY, NJ, CT, RI, MA, NH, VT, ME. South = DE, MD, DC, VA, WV, KY, TN, NC, SC, GA, AL, MS, FL, LA, AR, OK, TX. West = NM, CO, WY, MT, ID, UT, AZ, NV, CA, OR, WA, AK, HI.

[2] Coastal regions include counties bordering the 3 coasts (Pacific, Atlantic, and Gulf of Mexico) and the Great Lakes and estuaries and bays. Additionally, any county that did not directly border a coast, but the central point was within 25 miles of a coast was defined as coastal. The inland regions are the remaining counties in each of the 4 Census Regions.

Table 17a. UFCR estimates (g/day raw weight, edible portion): Total freshwater + estuarine trophic level 3 fish, adults, 21 years and older, by demographic characteristics

Freshwater + Estuarine Trophic Level 3 Finfish and Shellfish	Percentiles (95% CI)					
	50th	75th	90th	95th	97th	99th
Adults (≥21 yrs)	2.0 (1.6,2.5)	4.5 (3.9,5.3)	8.6 (7.2,10.2)	12.2 (9.9,15.0)	15.2 (12.0,19.3)	22.5 (16.6,30.6)
Age						
21 to <35 yrs	1.6 (1.2,2.1)	3.9 (3.2,4.9)	8.1 (6.4,10.3)	12.4 (9.3,16.5)	16.1 (11.6,22.4)	25.8 (16.5,40.5)
35 to <50 yrs	2.1 (1.6,2.8)	4.8 (3.8,6.0)	9.0 (7.2,11.2)	12.7 (9.9,16.2)	15.6 (12.0,20.4)	22.6 (16.5,31.1)
50 to <65 yrs	2.6 (2.0,3.4)	5.3 (4.3,6.5)	9.4 (7.5,11.8)	12.9 (9.9,16.7)	15.7 (11.7,20.9)	22.2 (15.6,31.7)
65+ yrs	1.5 (1.2,2.1)	3.6 (2.8,4.7)	7.0 (5.6,8.9)	10.0 (7.9,12.7)	12.4 (9.6,15.9)	17.7 (13.0,24.0)
Women of childbearing age (13 to 49 yrs)	1.2 (0.9,1.5)	3.0 (2.5,3.5)	6.0 (4.9,7.2)	8.7 (7.0,10.9)	11.1 (8.7,14.1)	16.7 (12.4,22.7)
Gender						
Female	1.6 (1.3,2.1)	3.7 (3.1,4.3)	6.9 (5.8,8.3)	9.7 (7.9,12.0)	12.0 (9.4,15.3)	17.5 (12.9,23.7)
Male	2.5 (2.0,3.2)	5.5 (4.7,6.6)	10.3 (8.5,12.5)	14.6 (11.6,18.4)	18.1 (14.0,23.5)	26.5 (19.0,37.1)
Race/Ethnicity[1]						
Mexican American	2.6 (2.0,3.4)	5.7 (4.6,7.1)	10.5 (8.2,13.4)	14.6 (11.1,19.2)	18.0 (13.3,24.2)	25.6 (18.1,36.2)
Other Hispanic	2.3 (1.6,3.3)	5.2 (3.7,7.4)	9.7 (6.8,13.7)	13.7 (9.5,19.7)	16.9 (11.5,24.8)	24.4 (16.0,37.3)
Non-Hispanic White	1.7 (1.3,2.2)	3.8 (3.2,4.6)	7.2 (5.9,8.7)	10.1 (8.1,12.7)	12.5 (9.7,16.0)	18.2 (13.3,24.7)
Non-Hispanic Black	2.7 (2.2,3.3)	5.7 (4.8,6.7)	10.3 (8.5,12.5)	14.3 (11.4,17.9)	17.5 (13.6,22.6)	25.3 (18.4,34.9)
Other Race	5.3 (4.0,7.0)	10.3 (7.8,13.6)	17.7 (12.4,25.4)	24.2 (15.5,37.6)	29.5 (17.9,48.5)	41.9 (23.5,74.7)
Income						
$0 to <$20K	1.5 (1.1,2.1)	3.9 (3.1,4.8)	7.9 (6.6,9.5)	11.7 (9.7,14.2)	15.0 (12.2,18.4)	23.4 (18.1,30.1)
$20 to <$45K	1.7 (1.3,2.2)	3.9 (3.2,4.7)	7.5 (6.2,9.0)	10.7 (8.6,13.3)	13.4 (10.5,17.1)	20.1 (14.8,27.2)
$40 to <$75K	1.9 (1.5,2.4)	4.1 (3.4,5.1)	7.7 (6.2,9.6)	11.0 (8.5,14.2)	13.7 (10.2,18.3)	20.3 (13.7,30.2)
$75+K	2.7 (2.1,3.4)	5.6 (4.7,6.8)	10.1 (8.2,12.4)	13.9 (10.9,17.7)	17.0 (12.9,22.3)	24.2 (17.3,34.0)
>$20K	1.8 (1.1,2.9)	4.0 (2.9,5.5)	7.4 (5.5,10.1)	10.5 (7.6,14.5)	12.9 (9.1,18.4)	18.4 (12.1,28.0)
Refused/Don't Know Income	2.4 (1.3,4.2)	6.0 (3.8,9.5)	12.2 (8.0,18.6)	17.6 (10.7,29.1)	22.2 (12.8,38.5)	32.7 (17.3,61.7)
Income Missing	0.9 (0.3,2.8)	3.2 (1.3,7.7)	8.9 (4.1,19.6)	14.8 (7.2,30.6)	19.8 (9.9,39.8)	30.2 (16.1,56.4)

[1] Race/ethnicity is as defined by NHANES. Respondents who self-identified as "Mexican American" were coded as such regardless of their other race-ethnicity identities. Otherwise, self-identified "Hispanic" ethnicity was coded as "Other Hispanic." All other non-Hispanic participants were then categorized based on their self-reported races: non-Hispanic white, non-Hispanic black, and other non-Hispanic race including non-Hispanic multiracial (other race).

Table 17b. UFCR estimates (g/day raw weight, edible portion): Total freshwater + estuarine trophic level 3 fish, adults, 21 years and older, by geographic area

Freshwater + Estuarine Trophic Level 3 Finfish and Shellfish	Percentiles (95% CI)					
	50th	75th	90th	95th	97th	99th
Adults (≥21 yrs)	2.0 (1.6,2.5)	4.5 (3.9,5.3)	8.6 (7.2,10.2)	12.2 (9.9,15.0)	15.2 (12.0,19.3)	22.5 (16.6,30.6)
Region[1]						
Northeast	2.6 (2.0,3.4)	5.5 (4.4,6.8)	9.7 (7.7,12.1)	13.1 (10.2,16.8)	15.7 (12.0,20.6)	22.2 (15.8,31.3)
Midwest	1.0 (0.8,1.4)	2.3 (1.8,2.9)	4.3 (3.4,5.5)	6.2 (4.8,8.1)	7.8 (5.9,10.3)	12.0 (8.7,16.5)
South	2.7 (1.9,3.7)	5.6 (4.3,7.3)	10.2 (7.9,13.0)	14.2 (10.9,18.4)	17.5 (13.2,23.1)	25.2 (18.5,34.4)
West	2.3 (1.7,3.0)	4.9 (3.7,6.5)	9.2 (6.6,12.8)	13.3 (9.1,19.4)	16.7 (11.0,25.3)	25.2 (15.1,42.3)
Coastal Status[2]						
Noncoastal	1.7 (1.3,2.1)	3.8 (3.2,4.4)	7.2 (5.9,8.7)	10.2 (8.1,12.7)	12.6 (9.8,16.3)	18.6 (13.6,25.4)
Coastal	2.8 (2.1,3.7)	5.9 (4.7,7.5)	10.9 (8.7,13.7)	15.3 (11.8,19.7)	18.9 (14.2,25.1)	27.7 (19.1,40.1)
Coastal/Inland Region[1,2]						
Pacific	2.8 (1.9,4.1)	6.0 (4.2,8.7)	11.4 (7.7,16.9)	16.3 (10.5,25.5)	20.5 (12.5,33.7)	31.0 (16.6,57.7)
Atlantic	3.6 (2.7,4.7)	7.1 (5.8,8.8)	12.3 (10.0,15.2)	16.6 (13.1,21.0)	20.1 (15.4,26.2)	28.5 (20.4,39.7)
Gulf of Mexico	3.2 (2.0,5.0)	6.6 (4.8,9.2)	11.9 (8.9,15.7)	16.4 (12.5,21.7)	20.2 (15.1,27.0)	28.9 (20.9,40.0)
Great Lakes	1.4 (1.0,2.0)	3.0 (2.3,3.8)	5.4 (4.3,6.9)	7.6 (5.9,9.7)	9.3 (7.1,12.1)	13.7 (10.1,18.7)
Inland Northeast	2.3 (1.6,3.3)	4.9 (3.7,6.6)	8.8 (6.5,11.8)	11.9 (8.7,16.4)	14.3 (10.2,20.1)	20.3 (13.7,30.2)
Inland Midwest	0.9 (0.7,1.3)	2.1 (1.6,2.7)	3.9 (3.0,5.2)	5.7 (4.2,7.7)	7.2 (5.2,10.0)	11.2 (7.7,16.3)
Inland South	2.2 (1.7,3.0)	4.7 (3.8,5.9)	8.6 (6.7,10.9)	11.9 (9.1,15.5)	14.7 (11.0,19.6)	21.4 (15.2,30.0)
Inland West	1.9 (1.4,2.5)	3.9 (3.1,5.0)	7.3 (5.4,9.9)	10.3 (7.2,14.6)	12.9 (8.8,18.9)	19.0 (12.2,29.4)

[1] U.S. regions are the U.S. Census Bureau regions. Midwest = OH, MI, IN, WI, IL, MO, IA, MN, SD, ND, NE, KS. Northeast = PA, NY, NJ, CT, RI, MA, NH, VT, ME. South = DE, MD, DC, VA, WV, KY, TN, NC, SC, GA, AL, MS, FL, LA, AR, OK, TX. West = NM, CO, WY, MT, ID, UT, AZ, NV, CA, OR, WA, AK, HI.

[2] Coastal regions include counties bordering the 3 coasts (Pacific, Atlantic, and Gulf of Mexico) and the Great Lakes and estuaries and bays. Additionally, any county that did not directly border a coast, but the central point was within 25 miles of a coast was defined as coastal. The inland regions are the remaining counties in each of the 4 Census Regions.

Table 18a. UFCR estimates (g/day raw weight, edible portion): Total freshwater + estuarine trophic level 4 fish, adults, 21 years and older, by demographic characteristics

Freshwater + Estuarine Trophic Level 4 Finfish and Shellfish	Percentiles (95% CI)					
	50th	75th	90th	95th	97th	99th
Adults (≥21 yrs)	0.6 (0.4,0.9)	1.9 (1.5,2.5)	5.1 (4.0,6.4)	9.1 (7.0,11.7)	13.2 (10.0,17.4)	27.1 (19.4,38.0)
Age						
21 to <35 yrs	0.3 (0.2,0.5)	1.0 (0.7,1.4)	3.0 (2.2,4.1)	5.8 (4.2,8.1)	9.1 (6.2,13.3)	20.9 (12.1,36.0)
35 to <50 yrs	0.6 (0.4,0.9)	1.7 (1.2,2.3)	4.2 (3.1,5.8)	7.3 (5.2,10.2)	10.4 (7.2,15.0)	20.4 (13.2,31.7)
50 to <65 yrs	1.0 (0.7,1.5)	2.9 (2.1,4.0)	7.4 (5.4,10.2)	12.8 (9.0,18.2)	18.2 (12.6,26.4)	37.0 (23.4,58.4)
65+ yrs	0.8 (0.5,1.3)	2.4 (1.5,3.7)	6.0 (3.8,9.5)	10.6 (6.7,16.8)	15.1 (9.5,24.0)	29.7 (18.1,48.7)
Women of childbearing age (13 to 49 yrs)	0.3 (0.2,0.5)	1.0 (0.7,1.5)	2.9 (2.1,3.9)	5.3 (3.8,7.4)	7.7 (5.4,11.0)	16.1 (10.4,24.8)
Gender						
Female	0.5 (0.4,0.7)	1.6 (1.2,2.1)	4.2 (3.3,5.4)	7.5 (5.7,9.7)	10.8 (8.1,14.3)	21.4 (15.2,30.0)
Male	0.7 (0.5,1.1)	2.3 (1.7,3.0)	6.0 (4.6,7.8)	10.8 (8.2,14.3)	15.8 (11.7,21.3)	32.8 (22.7,47.6)
Race/Ethnicity[1]						
Mexican American	0.6 (0.4,0.9)	1.9 (1.3,2.7)	5.1 (3.6,7.3)	9.2 (6.3,13.6)	13.5 (8.8,20.6)	28.8 (16.9,49.0)
Other Hispanic	0.5 (0.3,0.9)	1.7 (0.9,3.0)	4.6 (2.5,8.7)	8.2 (4.1,16.5)	11.7 (5.5,25.1)	23.4 (9.8,55.9)
Non-Hispanic White	0.5 (0.4,0.8)	1.5 (1.2,2.0)	3.9 (3.0,5.1)	6.8 (5.1,9.0)	9.6 (7.2,13.0)	18.7 (13.1,26.7)
Non-Hispanic Black	1.1 (0.7,1.6)	3.2 (2.3,4.5)	8.4 (6.2,11.4)	14.7 (10.7,20.2)	21.1 (15.0,29.6)	41.2 (28.0,60.8)
Other Race	2.4 (1.3,4.3)	6.6 (3.8,11.3)	16.1 (9.3,27.7)	28.2 (16.0,49.7)	40.2 (22.5,72.0)	77.9 (41.4,146.5)
Income						
$0 to <$20K	0.5 (0.3,0.7)	1.6 (1.2,2.2)	4.7 (3.6,6.0)	8.6 (6.5,11.2)	12.6 (9.5,16.7)	26.4 (18.8,37.2)
$20 to <$45K	0.5 (0.4,0.8)	1.7 (1.2,2.3)	4.5 (3.4,6.1)	8.3 (6.1,11.2)	12.1 (8.8,16.7)	25.1 (17.4,36.1)
$40 to <$75K	0.6 (0.4,0.9)	1.9 (1.4,2.5)	5.2 (4.0,6.7)	9.4 (7.0,12.6)	13.7 (10.0,18.8)	28.5 (19.6,41.4)
$75+K	0.8 (0.5,1.1)	2.2 (1.7,2.9)	5.5 (4.2,7.2)	9.4 (7.0,12.7)	13.5 (9.8,18.6)	26.9 (17.9,40.4)
>$20K	0.6 (0.3,1.2)	2.0 (1.2,3.6)	5.5 (3.2,9.3)	9.5 (5.8,15.5)	13.7 (8.5,22.2)	27.2 (16.8,44.2)
Refused/Don't Know Income	0.6 (0.3,1.2)	2.2 (1.3,3.5)	6.7 (4.3,10.5)	12.8 (7.9,20.7)	19.6 (11.5,33.4)	43.7 (23.6,80.6)
Income Missing	0.1 (0.0,0.5)	0.9 (0.3,2.4)	3.7 (1.5,9.0)	8.2 (3.7,18.3)	13.0 (6.1,27.8)	28.3 (13.5,59.3)

[1] Race/ethnicity is as defined by NHANES. Respondents who self-identified as "Mexican American" were coded as such regardless of their other race-ethnicity identities. Otherwise, self-identified "Hispanic" ethnicity was coded as "Other Hispanic." All other non-Hispanic participants were then categorized based on their self-reported races: non-Hispanic white, non-Hispanic black, and other non-Hispanic race including non-Hispanic multiracial (other race).

Table 18b. UFCR estimates (g/day raw weight, edible portion): Total freshwater + estuarine trophic level 4 fish, adults, 21 years and older, by geographic area

Freshwater + Estuarine Trophic Level 4 Finfish and Shellfish	Percentiles (95% CI)					
	50th	75th	90th	95th	97th	99th
Adults (≥21 yrs)	0.6 (0.4,0.9)	1.9 (1.5,2.5)	5.1 (4.0,6.4)	9.1 (7.0,11.7)	13.2 (10.0,17.4)	27.1 (19.4,38.0)
Region[1]						
Northeast	0.4 (0.3,0.6)	1.3 (0.9,1.8)	3.2 (2.3,4.4)	5.5 (4.0,7.6)	7.8 (5.5,10.9)	15.1 (10.3,22.1)
Midwest	0.5 (0.3,1.1)	1.8 (1.0,3.1)	4.9 (2.9,8.1)	8.9 (5.4,14.5)	13.0 (8.0,21.2)	26.6 (16.1,44.0)
South	0.8 (0.5,1.1)	2.4 (1.8,3.2)	6.3 (4.9,8.2)	11.2 (8.5,14.9)	16.2 (12.1,21.8)	32.7 (22.8,46.8)
West	0.7 (0.5,0.9)	1.9 (1.5,2.5)	5.0 (3.6,6.9)	8.9 (5.9,13.3)	12.8 (8.0,20.5)	27.1 (14.6,50.0)
Coastal Status[2]						
Noncoastal	0.6 (0.4,0.9)	1.8 (1.3,2.4)	4.9 (3.6,6.5)	8.7 (6.4,11.8)	12.6 (9.2,17.5)	25.8 (17.8,37.5)
Coastal	0.7 (0.5,1.0)	2.1 (1.6,2.7)	5.4 (4.3,7.0)	9.7 (7.4,12.7)	14.2 (10.5,19.1)	29.0 (20.2,41.8)
Coastal/Inland Region[1,2]						
Pacific	0.7 (0.5,1.1)	2.2 (1.5,3.1)	5.9 (3.9,8.7)	10.5 (6.6,16.7)	15.6 (9.1,26.5)	33.8 (17.1,66.9)
Atlantic	0.8 (0.5,1.1)	2.2 (1.7,3.0)	5.8 (4.3,7.8)	10.2 (7.4,13.9)	14.7 (10.5,20.7)	28.8 (19.6,42.5)
Gulf of Mexico	0.7 (0.5,1.2)	2.1 (1.5,3.0)	5.4 (3.8,7.7)	9.7 (6.7,14.2)	13.8 (9.1,20.9)	28.1 (17.1,46.1)
Great Lakes	0.5 (0.2,0.9)	1.5 (0.9,2.5)	4.0 (2.5,6.5)	7.3 (4.5,11.9)	10.9 (6.6,18.3)	22.9 (12.8,41.0)
Inland Northeast	0.4 (0.3,0.6)	1.2 (0.8,1.7)	3.1 (2.2,4.4)	5.3 (3.7,7.6)	7.5 (5.1,10.9)	14.6 (9.7,22.1)
Inland Midwest	0.6 (0.3,1.2)	1.8 (1.0,3.4)	5.1 (3.0,8.8)	9.3 (5.5,15.7)	13.5 (8.1,22.5)	27.8 (16.4,46.9)
Inland South	0.7 (0.5,1.1)	2.3 (1.7,3.1)	6.1 (4.6,8.1)	10.9 (8.1,14.8)	15.8 (11.5,21.9)	32.5 (22.0,48.0)
Inland West	0.6 (0.5,0.9)	1.7 (1.3,2.4)	4.3 (3.0,6.3)	7.4 (4.7,11.7)	10.7 (6.4,17.8)	20.9 (10.9,40.3)

[1] U.S. regions are the U.S. Census Bureau regions. Midwest = OH, MI, IN, WI, IL, MO, IA, MN, SD, ND, NE, KS. Northeast = PA, NY, NJ, CT, RI, MA, NH, VT, ME. South = DE, MD, DC, VA, WV, KY, TN, NC, SC, GA, AL, MS, FL, LA, AR, OK, TX. West = NM, CO, WY, MT, ID, UT, AZ, NV, CA, OR, WA, AK, HI.

[2] Coastal regions include counties bordering the 3 coasts (Pacific, Atlantic, and Gulf of Mexico) and the Great Lakes and estuaries and bays. Additionally, any county that did not directly border a coast, but the central point was within 25 miles of a coast was defined as coastal. The inland regions are the remaining counties in each of the 4 Census Regions.

Table 19a. UFCR estimates (g/day raw weight, edible portion): Total fish, youth, <21 years, by demographic characteristics

	Percentiles (95% CI)					
All Finfish and Shellfish	**50th**	**75th**	**90th**	**95th**	**97th**	**99th**
Youth (<21 yrs)	4.9 (4.0,6.1)	12.5 (10.6,14.7)	24.0 (20.5,28.3)	34.2 (28.6,40.8)	42.4 (35.1,51.3)	61.7 (49.1,77.5)
Age						
1 to <3 yrs	2.7 (1.9,3.8)	6.7 (5.0,9.0)	12.7 (9.8,16.4)	17.9 (13.8,23.2)	22.3 (17.0,29.2)	32.8 (24.1,44.4)
3 to <6 yrs	3.6 (2.6,5.1)	8.8 (6.9,11.2)	16.3 (13.3,19.8)	22.5 (18.4,27.7)	27.5 (22.2,34.1)	39.6 (31.4,50.1)
6 to <11 yrs	5.1 (3.6,7.3)	12.8 (9.2,17.7)	24.2 (16.7,35.1)	34.1 (22.6,51.4)	41.9 (26.9,65.0)	58.6 (36.6,93.8)
11 to <16 yrs	5.0 (3.6,7.0)	12.3 (9.5,15.9)	22.6 (17.9,28.5)	30.9 (24.5,39.0)	37.4 (29.8,47.1)	53.2 (42.7,66.2)
16 to <18 yrs	6.1 (4.3,8.8)	14.5 (11.5,18.3)	26.9 (22.0,32.7)	36.8 (30.4,44.7)	44.3 (36.4,54.0)	61.0 (49.7,74.8)
18 to <21 yrs	9.1 (6.3,13.0)	20.9 (15.5,28.2)	38.5 (28.2,52.5)	53.4 (37.9,75.4)	65.0 (45.3,93.3)	88.1 (60.6,128.0)
Gender						
Female	4.5 (3.6,5.6)	11.4 (9.7,13.5)	21.9 (19.0,25.4)	30.8 (26.7,35.5)	37.7 (32.6,43.5)	52.9 (44.4,63.1)
Male	5.5 (4.4,6.8)	13.5 (11.2,16.3)	26.1 (21.2,32.1)	37.6 (29.7,47.6)	47.1 (36.4,60.9)	69.2 (51.8,92.4)
Race/Ethnicity[1]						
Mexican American	4.4 (3.4,5.8)	10.9 (9.0,13.2)	20.3 (17.1,24.1)	28.9 (24.2,34.6)	36.2 (30.0,43.8)	54.3 (43.4,67.8)
Other Hispanic	4.2 (2.7,6.5)	10.9 (7.5,15.9)	20.8 (14.8,29.1)	28.7 (20.5,40.1)	35.0 (24.9,49.2)	49.4 (34.2,71.3)
Non-Hispanic White	4.2 (3.3,5.5)	10.9 (8.7,13.7)	21.4 (16.7,27.5)	30.8 (23.3,40.6)	38.9 (28.9,52.4)	58.9 (41.0,84.6)
Non-Hispanic Black	7.8 (6.0,10.1)	16.8 (13.7,20.7)	28.9 (23.9,35.0)	38.6 (32.1,46.3)	45.8 (38.2,55.0)	62.3 (51.7,74.9)
Other Race	10.3 (7.4,14.2)	23.8 (18.6,30.3)	40.9 (31.9,52.4)	53.4 (40.3,70.8)	62.7 (46.6,84.2)	83.4 (62.2,111.8)
Income						
$0 to <$20K	5.0 (3.8,6.7)	13.0 (10.4,16.3)	24.5 (20.2,29.8)	33.7 (27.8,41.0)	41.0 (33.9,49.8)	57.3 (46.8,70.2)
$20 to <$45K	4.9 (3.9,6.2)	12.1 (10.2,14.4)	23.2 (19.8,27.2)	33.3 (27.9,39.8)	41.7 (33.8,51.4)	61.9 (44.3,86.5)
$40 to <$75K	5.0 (3.7,6.6)	13.0 (9.9,16.9)	26.0 (19.3,35.1)	38.0 (27.6,52.5)	46.9 (33.4,65.9)	69.1 (47.6,100.5)
$75+K	5.1 (3.9,6.6)	12.5 (10.0,15.7)	23.5 (18.7,29.4)	32.4 (25.4,41.4)	39.7 (30.4,51.7)	56.5 (41.5,76.9)
>$20K	3.8 (1.8,7.9)	8.2 (4.5,15.0)	15.4 (8.8,27.1)	21.2 (12.0,37.3)	25.9 (14.4,46.7)	38.0 (20.8,69.6)
Refused/Don't Know Income	4.2 (0.9,18.7)	10.7 (2.4,48.1)	27.5 (6.8,111.8)	43.8 (15.4,124.3)	54.8 (25.4,118.3)	76.2 (44.7,130.1)
Income Missing	6.4 (2.6,15.7)	17.0 (7.4,39.0)	39.2 (15.6,98.4)	55.9 (23.4,133.5)	67.9 (30.1,152.8)	87.2 (44.2,172.2)

[1] Race/ethnicity is as defined by NHANES. Respondents who self-identified as "Mexican American" were coded as such regardless of their other race-ethnicity identities. Otherwise, self-identified "Hispanic" ethnicity was coded as "Other Hispanic." All other non-Hispanic participants were then categorized based on their self-reported races: non-Hispanic white, non-Hispanic black, and other non-Hispanic race including non-Hispanic multiracial (other race).

Table 19b. UFCR estimates (g/day raw weight, edible portion): Total fish, youth, <21 years, by geographic area

	Percentiles (95% CI)					
All Finfish and Shellfish	**50th**	**75th**	**90th**	**95th**	**97th**	**99th**
Youth (<21 yrs)	4.9 (4.0,6.1)	12.5 (10.6,14.7)	24.0 (20.5,28.3)	34.2 (28.6,40.8)	42.4 (35.1,51.3)	61.7 (49.1,77.5)
Region[1]						
Northeast	5.7 (4.1,7.8)	14.1 (11.2,17.7)	27.6 (21.1,36.1)	40.4 (27.4,59.6)	50.6 (31.3,82.0)	75.1 (43.6,129.5)
Midwest	3.3 (2.5,4.3)	8.8 (7.4,10.5)	17.5 (15.1,20.3)	25.5 (21.9,29.6)	31.7 (27.1,37.1)	47.7 (40.2,56.6)
South	5.7 (4.2,7.7)	13.5 (10.7,17.0)	24.6 (19.9,30.3)	33.9 (27.4,41.9)	41.1 (33.0,51.3)	58.5 (45.6,75.1)
West	5.9 (4.1,8.7)	14.6 (10.3,20.6)	27.8 (19.5,39.7)	39.2 (27.3,56.3)	47.6 (33.1,68.4)	67.0 (46.4,96.8)
Coastal Status[2]						
Noncoastal	4.5 (3.5,5.7)	11.5 (9.3,14.2)	22.2 (17.6,28.1)	31.7 (24.3,41.4)	39.8 (29.8,53.2)	58.8 (41.5,83.2)
Coastal	5.9 (4.7,7.4)	14.5 (12.2,17.1)	27.2 (23.4,31.8)	38.0 (32.4,44.6)	46.4 (39.1,55.1)	65.7 (54.1,79.7)
Coastal/Inland Region[1,2]						
Pacific	5.9 (4.3,8.1)	15.1 (11.3,20.0)	28.8 (22.2,37.5)	40.2 (31.1,52.0)	48.9 (37.7,63.4)	68.6 (52.1,90.1)
Atlantic	7.2 (5.4,9.6)	16.4 (13.3,20.2)	29.3 (24.4,35.3)	40.3 (33.6,48.3)	48.6 (40.4,58.5)	68.2 (55.8,83.4)
Gulf of Mexico	7.0 (4.3,11.5)	16.0 (11.0,23.3)	29.8 (20.6,43.3)	41.5 (27.4,62.9)	51.6 (33.1,80.5)	72.6 (45.2,116.6)
Great Lakes	3.9 (2.9,5.2)	10.2 (8.2,12.8)	20.1 (15.9,25.5)	28.4 (21.7,37.1)	35.5 (26.9,46.7)	50.4 (36.9,68.9)
Inland Northeast	5.1 (3.6,7.2)	12.9 (9.9,16.8)	25.9 (17.8,37.6)	39.1 (21.7,70.4)	50.5 (24.6,103.6)	76.6 (35.3,166.1)
Inland Midwest	3.1 (2.3,4.1)	8.3 (6.8,10.1)	16.4 (14.0,19.3)	24.0 (20.4,28.2)	29.9 (25.4,35.3)	45.6 (38.1,54.6)
Inland South	4.9 (3.7,6.4)	12.1 (9.6,15.2)	22.0 (17.7,27.3)	30.3 (24.3,37.6)	36.6 (29.4,45.5)	51.3 (41.2,63.8)
Inland West	6.0 (3.5,10.1)	14.2 (8.9,22.8)	27.1 (16.1,45.5)	38.4 (22.2,66.5)	46.6 (26.9,80.8)	65.8 (38.5,112.5)

[1] U.S. regions are the U.S. Census Bureau regions. Midwest = OH, MI, IN, WI, IL, MO, IA, MN, SD, ND, NE, KS. Northeast = PA, NY, NJ, CT, RI, MA, NH, VT, ME. South = DE, MD, DC, VA, WV, KY, TN, NC, SC, GA, AL, MS, FL, LA, AR, OK, TX. West = NM, CO, WY, MT, ID, UT, AZ, NV, CA, OR, WA, AK, HI.

[2] Coastal regions include counties bordering the 3 coasts (Pacific, Atlantic, and Gulf of Mexico) and the Great Lakes and estuaries and bays. Additionally, any county that did not directly border a coast, but the central point was within 25 miles of a coast was defined as coastal. The inland regions are the remaining counties in each of the 4 Census Regions.

Table 20a. UFCR estimates (g/day raw weight, edible portion): Freshwater + estuarine fish, youth, <21 years, by demographic characteristics

Freshwater + Estuarine Finfish and Shellfish	Percentiles (95% CI)					
	50th	75th	90th	95th	97th	99th
Youth (<21 yrs)	1.1 (0.8,1.4)	3.3 (2.7,4.2)	8.0 (6.6,9.8)	12.9 (10.5,15.9)	17.3 (13.9,21.6)	28.9 (22.2,37.7)
Age						
1 to <3 yrs	0.6 (0.3,1.2)	1.9 (1.2,3.2)	4.7 (3.1,7.0)	7.5 (5.1,10.9)	10.1 (6.9,14.7)	17.1 (11.3,25.9)
3 to <6 yrs	0.7 (0.4,1.3)	2.4 (1.6,3.6)	5.8 (4.1,8.3)	9.5 (6.7,13.5)	12.9 (8.9,18.7)	22.3 (13.8,36.1)
6 to <11 yrs	1.1 (0.8,1.5)	3.3 (2.5,4.4)	7.7 (5.7,10.5)	12.3 (8.8,17.3)	16.3 (11.3,23.5)	27.3 (18.3,40.7)
11 to <16 yrs	1.1 (0.7,1.7)	3.4 (2.4,4.9)	8.3 (6.4,10.7)	13.2 (10.4,16.7)	17.7 (14.0,22.4)	29.6 (22.9,38.2)
16 to <18 yrs	1.4 (0.7,2.8)	4.2 (2.5,6.9)	9.5 (6.5,13.8)	14.9 (10.6,21.0)	19.3 (13.7,27.2)	32.2 (22.6,45.9)
18 to <21 yrs	1.7 (1.1,2.7)	5.0 (3.5,7.2)	11.6 (8.3,16.2)	18.2 (12.8,25.8)	23.8 (16.4,34.4)	37.5 (24.3,57.8)
Gender						
Female	0.9 (0.7,1.3)	3.0 (2.3,4.0)	7.4 (5.8,9.5)	12.1 (9.5,15.4)	16.2 (12.5,20.9)	27.2 (20.4,36.3)
Male	1.2 (0.9,1.6)	3.6 (2.9,4.5)	8.6 (7.0,10.5)	13.7 (11.1,16.9)	18.4 (14.7,23.0)	30.5 (23.1,40.2)
Race/Ethnicity[1]						
Mexican American	1.3 (1.0,1.9)	3.9 (3.0,5.1)	8.7 (6.9,11.0)	13.6 (10.8,17.2)	18.0 (14.1,23.0)	29.9 (22.2,40.2)
Other Hispanic	1.1 (0.6,2.2)	3.6 (1.9,6.9)	8.7 (4.5,16.9)	13.9 (6.8,28.4)	18.6 (8.8,39.6)	30.3 (13.4,68.6)
Non-Hispanic White	0.7 (0.5,1.0)	2.2 (1.7,3.0)	5.1 (3.9,6.7)	8.1 (6.1,10.8)	10.7 (7.9,14.5)	18.0 (12.6,25.7)
Non-Hispanic Black	2.6 (1.8,3.9)	7.2 (5.3,9.9)	15.1 (11.2,20.1)	22.4 (16.7,30.0)	28.5 (21.2,38.2)	44.5 (32.8,60.4)
Other Race	2.7 (1.7,4.2)	7.4 (4.9,11.1)	15.3 (9.9,23.6)	22.5 (14.1,35.6)	28.2 (17.3,45.9)	43.0 (25.7,71.8)
Income						
$0 to <$20K	1.1 (0.7,1.7)	3.6 (2.6,5.0)	8.7 (6.6,11.6)	14.0 (10.7,18.4)	18.7 (14.2,24.6)	30.2 (22.4,40.9)
$20 to <$45K	1.2 (0.8,1.7)	3.4 (2.5,4.7)	8.2 (6.2,10.7)	13.0 (9.9,17.1)	17.2 (13.0,22.9)	28.4 (21.0,38.5)
$40 to <$75K	0.9 (0.6,1.4)	2.9 (2.0,4.1)	7.0 (5.0,9.7)	11.4 (8.3,15.6)	15.4 (11.3,21.1)	26.4 (19.1,36.4)
$75+K	1.2 (0.9,1.6)	3.6 (3.0,4.4)	8.3 (6.8,10.1)	13.1 (10.5,16.3)	17.3 (13.6,22.0)	29.0 (21.5,39.1)
>$20K	0.6 (0.2,2.4)	2.2 (0.9,5.5)	6.1 (3.1,12.0)	10.2 (5.3,19.6)	14.4 (7.6,27.4)	24.7 (12.5,48.8)
Refused/Don't Know Income	0.3 (0.1,0.9)	1.3 (0.6,3.0)	4.4 (1.8,11.0)	8.8 (3.2,24.6)	14.6 (4.8,45.0)	32.6 (8.9,119.7)
Income Missing	1.0 (0.3,3.3)	4.3 (1.0,18.6)	15.0 (2.7,84.4)	25.6 (5.2,126.3)	35.6 (8.2,155.0)	55.4 (15.5,198.1)

[1] Race/ethnicity is as defined by NHANES. Respondents who self-identified as "Mexican American" were coded as such regardless of their other race-ethnicity identities. Otherwise, self-identified "Hispanic" ethnicity was coded as "Other Hispanic." All other non-Hispanic participants were then categorized based on their self-reported races: non-Hispanic white, non-Hispanic black, and other non-Hispanic race including non-Hispanic multiracial (other race).

Table 20b. UFCR estimates (g/day raw weight, edible portion): Freshwater + estuarine fish, youth, <21 years, by geographic area

Freshwater + Estuarine Finfish and Shellfish	Percentiles (95% CI)					
	50th	75th	90th	95th	97th	99th
Youth (<21 yrs)	1.1 (0.8,1.4)	3.3 (2.7,4.2)	8.0 (6.6,9.8)	12.9 (10.5,15.9)	17.3 (13.9,21.6)	28.9 (22.2,37.7)
Region[1]						
Northeast	0.9 (0.5,1.4)	2.6 (1.7,4.0)	6.0 (3.8,9.5)	9.5 (5.9,15.4)	12.6 (7.7,20.5)	20.7 (12.4,34.6)
Midwest	0.7 (0.5,1.0)	2.3 (1.6,3.2)	5.8 (4.2,8.1)	10.0 (7.0,14.4)	14.0 (9.6,20.5)	25.2 (16.6,38.4)
South	1.6 (1.0,2.6)	4.6 (3.2,6.8)	10.4 (7.5,14.4)	16.2 (11.8,22.2)	21.3 (15.4,29.5)	34.7 (24.7,48.7)
West	1.2 (0.8,1.7)	3.5 (2.5,5.0)	8.3 (5.9,11.8)	13.3 (9.3,19.1)	17.7 (12.1,25.8)	28.6 (18.5,44.1)
Coastal Status[2]						
Noncoastal	0.9 (0.6,1.2)	2.7 (2.1,3.4)	6.3 (5.1,7.8)	10.1 (8.1,12.6)	13.7 (10.9,17.1)	22.9 (17.7,29.8)
Coastal	1.6 (1.1,2.3)	4.8 (3.5,6.5)	11.1 (8.4,14.8)	17.5 (13.1,23.4)	22.9 (16.9,31.0)	37.0 (26.3,52.0)
Coastal/Inland Region[1,2]						
Pacific	1.5 (0.9,2.3)	4.5 (3.0,6.8)	10.6 (7.2,15.6)	16.7 (11.2,25.0)	22.0 (14.5,33.3)	34.6 (21.8,54.8)
Atlantic	1.9 (1.3,2.9)	5.4 (3.8,7.7)	12.0 (8.6,16.7)	18.4 (13.2,25.4)	23.8 (17.1,33.1)	37.2 (25.9,53.3)
Gulf of Mexico	2.3 (1.1,4.9)	6.3 (3.3,11.8)	13.8 (7.8,24.4)	21.3 (11.9,38.0)	27.9 (15.3,50.9)	46.4 (25.4,84.7)
Great Lakes	1.0 (0.6,1.7)	3.3 (2.1,5.3)	8.6 (5.3,14.0)	14.3 (8.5,24.0)	19.4 (11.3,33.3)	32.9 (18.7,58.1)
Inland Northeast	0.7 (0.4,1.2)	2.2 (1.3,3.6)	5.1 (3.0,8.5)	7.8 (4.5,13.6)	10.1 (5.7,17.9)	16.2 (8.8,29.8)
Inland Midwest	0.6 (0.4,0.9)	1.9 (1.3,2.7)	4.7 (3.4,6.5)	8.0 (5.7,11.1)	11.2 (7.8,15.9)	19.9 (13.1,30.3)
Inland South	1.2 (0.8,1.9)	3.6 (2.6,5.2)	8.2 (6.2,11.0)	12.8 (9.7,16.9)	16.8 (12.7,22.2)	27.5 (20.6,36.8)
Inland West	1.0 (0.7,1.5)	2.9 (2.0,4.2)	6.7 (4.8,9.6)	10.6 (7.4,15.2)	14.1 (9.7,20.6)	23.0 (15.1,35.2)

[1] U.S. regions are the U.S. Census Bureau regions. Midwest = OH, MI, IN, WI, IL, MO, IA, MN, SD, ND, NE, KS. Northeast = PA, NY, NJ, CT, RI, MA, NH, VT, ME. South = DE, MD, DC, VA, WV, KY, TN, NC, SC, GA, AL, MS, FL, LA, AR, OK, TX. West = NM, CO, WY, MT, ID, UT, AZ, NV, CA, OR, WA, AK, HI.

[2] Coastal regions include counties bordering the 3 coasts (Pacific, Atlantic, and Gulf of Mexico) and the Great Lakes and estuaries and bays. Additionally, any county that did not directly border a coast, but the central point was within 25 miles of a coast was defined as coastal. The inland regions are the remaining counties in each of the 4 Census Regions.

Table 21a. UFCR estimates (g/day raw weight, edible portion): Marine fish, youth, <21 years, by demographic characteristics

	Percentiles (95% CI)					
Marine Finfish and Shellfish	50th	75th	90th	95th	97th	99th
Youth (<21 yrs)	3.1 (2.4,4.1)	8.1 (6.5,10.0)	16.4 (13.3,20.3)	24.3 (19.3,30.5)	31.0 (24.2,39.6)	48.2 (35.6,65.2)
Age						
1 to <3 yrs	1.7 (1.2,2.5)	4.4 (3.2,6.0)	8.8 (6.6,11.9)	12.9 (9.6,17.4)	16.5 (12.1,22.6)	25.2 (17.7,35.7)
3 to <6 yrs	2.3 (1.6,3.4)	5.7 (4.3,7.6)	11.0 (8.6,14.2)	15.8 (12.4,20.3)	19.7 (15.3,25.4)	29.3 (22.4,38.4)
6 to <11 yrs	3.2 (2.1,5.0)	8.3 (5.5,12.5)	16.7 (10.3,27.0)	24.2 (14.0,41.9)	30.2 (16.9,54.1)	44.5 (24.1,82.4)
11 to <16 yrs	3.1 (2.1,4.5)	7.7 (5.6,10.6)	14.7 (10.9,19.8)	20.6 (15.2,27.9)	25.3 (18.6,34.5)	36.8 (26.8,50.5)
16 to <18 yrs	3.9 (2.8,5.5)	9.6 (7.5,12.3)	18.3 (14.6,23.0)	25.7 (20.4,32.4)	31.7 (25.0,40.2)	45.6 (35.5,58.4)
18 to <21 yrs	5.6 (3.7,8.5)	14.3 (9.8,20.9)	29.4 (19.3,44.8)	43.5 (26.7,70.8)	54.1 (31.7,92.4)	80.3 (45.3,142.2)
Gender						
Female	2.7 (2.1,3.6)	7.1 (5.8,8.8)	14.2 (11.8,17.1)	20.5 (17.0,24.7)	25.6 (21.1,31.1)	37.9 (30.9,46.5)
Male	3.5 (2.6,4.7)	9.1 (7.1,11.7)	18.7 (14.4,24.4)	28.1 (21.0,37.7)	36.2 (26.3,49.7)	56.7 (37.7,85.4)
Race/Ethnicity[1]						
Mexican American	2.4 (1.7,3.3)	6.1 (4.7,8.0)	12.2 (9.8,15.2)	18.0 (14.6,22.3)	22.9 (18.4,28.5)	36.1 (28.3,45.9)
Other Hispanic	2.3 (1.4,3.6)	6.2 (4.2,9.2)	12.6 (9.1,17.5)	18.1 (13.2,24.7)	22.2 (16.0,30.8)	31.7 (21.3,47.3)
Non-Hispanic White	3.0 (2.2,4.2)	8.0 (5.9,10.8)	16.4 (12.1,22.2)	24.5 (17.7,33.8)	31.4 (22.3,44.3)	49.9 (32.1,77.6)
Non-Hispanic Black	3.6 (2.7,4.8)	8.4 (6.8,10.4)	15.4 (12.8,18.6)	21.3 (17.7,25.5)	25.9 (21.6,31.1)	37.0 (30.6,44.8)
Other Race	6.3 (4.4,9.0)	15.8 (11.6,21.4)	29.8 (22.8,38.9)	40.7 (30.6,54.3)	48.6 (35.1,67.4)	67.8 (45.2,101.9)
Income						
$0 to <$20K	2.9 (2.2,4.0)	7.8 (6.2,9.9)	15.7 (12.5,19.8)	22.7 (17.8,29.0)	28.5 (22.2,36.6)	43.1 (33.1,56.1)
$20 to <$45K	2.9 (2.3,3.7)	7.5 (6.1,9.1)	15.2 (12.5,18.4)	22.6 (18.1,28.3)	29.3 (22.2,38.6)	47.2 (28.0,79.6)
$40 to <$75K	3.2 (2.3,4.5)	8.5 (6.1,11.8)	18.1 (12.4,26.4)	27.4 (18.1,41.7)	35.5 (22.7,55.6)	56.5 (33.1,96.4)
$75+K	3.4 (2.4,4.8)	8.8 (6.6,11.6)	17.0 (13.0,22.2)	24.2 (18.3,32.2)	30.1 (22.4,40.3)	44.3 (32.3,60.8)
>$20K	2.5 (1.1,6.0)	5.5 (2.8,10.7)	10.5 (5.4,20.3)	15.1 (7.7,29.3)	18.5 (9.3,36.8)	26.5 (12.9,54.5)
Refused/Don't Know Income	2.5 (0.6,11.4)	7.1 (1.5,34.2)	20.0 (4.3,93.7)	35.3 (9.6,129.5)	47.1 (16.5,134.6)	70.9 (36.2,138.6)
Income Missing	3.9 (1.5,9.9)	11.0 (4.6,26.5)	25.9 (11.1,60.7)	39.4 (17.4,89.3)	49.2 (22.8,106.3)	69.5 (35.8,134.6)

[1] Race/ethnicity is as defined by NHANES. Respondents who self-identified as "Mexican American" were coded as such regardless of their other race-ethnicity identities. Otherwise, self-identified "Hispanic" ethnicity was coded as "Other Hispanic." All other non-Hispanic participants were then categorized based on their self-reported races: non-Hispanic white, non-Hispanic black, and other non-Hispanic race including non-Hispanic multiracial (other race).

Table 21b. UFCR estimates (g/day raw weight, edible portion): Marine fish, youth, <21 years, by geographic area

Marine Finfish and Shellfish	Percentiles (95% CI)					
	50th	75th	90th	95th	97th	99th
Youth (<21 yrs)	3.1 (2.4,4.1)	8.1 (6.5,10.0)	16.4 (13.3,20.3)	24.3 (19.3,30.5)	31.0 (24.2,39.6)	48.2 (35.6,65.2)
Region[1]						
Northeast	4.0 (2.6,6.0)	10.3 (7.3,14.6)	21.4 (14.2,32.0)	32.7 (18.8,56.9)	43.0 (21.9,84.5)	68.5 (31.1,150.9)
Midwest	2.2 (1.6,3.0)	5.8 (4.5,7.5)	12.0 (9.8,14.6)	17.6 (14.7,21.1)	22.1 (18.5,26.4)	33.8 (28.2,40.6)
South	3.3 (2.4,4.4)	8.0 (6.2,10.3)	15.6 (12.2,19.9)	22.3 (17.2,28.9)	27.9 (21.2,36.6)	42.4 (31.1,57.8)
West	3.7 (2.3,6.1)	9.6 (6.0,15.3)	19.5 (12.0,31.8)	28.6 (17.3,47.0)	35.5 (21.9,57.8)	51.0 (32.2,80.8)
Coastal Status[2]						
Noncoastal	2.9 (2.1,4.1)	7.7 (5.7,10.3)	15.8 (11.5,21.6)	23.2 (16.3,33.0)	29.8 (20.4,43.7)	47.2 (29.4,75.8)
Coastal	3.5 (2.7,4.4)	8.8 (7.4,10.5)	17.8 (15.1,20.9)	26.0 (21.9,30.7)	32.9 (27.6,39.2)	49.5 (40.0,61.4)
Coastal/Inland Region[1,2]						
Pacific	3.5 (2.4,5.0)	9.3 (6.9,12.6)	19.2 (14.5,25.4)	28.6 (21.5,38.0)	35.7 (27.1,47.2)	50.8 (37.4,69.0)
Atlantic	4.3 (3.2,5.9)	10.2 (7.9,13.1)	19.5 (15.3,24.9)	27.9 (21.7,35.8)	35.0 (27.0,45.4)	53.5 (39.2,73.2)
Gulf of Mexico	3.8 (2.6,5.7)	9.3 (6.6,13.2)	18.7 (12.8,27.3)	28.0 (18.3,42.9)	36.2 (22.8,57.5)	56.6 (33.7,95.2)
Great Lakes	2.2 (1.6,3.1)	6.1 (4.9,7.7)	12.6 (10.1,15.6)	18.5 (14.4,23.7)	23.3 (17.7,30.7)	34.4 (24.8,47.7)
Inland Northeast	3.7 (2.4,5.8)	9.8 (6.7,14.4)	20.7 (12.0,35.8)	32.8 (14.4,74.5)	44.5 (16.9,117.4)	73.6 (25.7,211.4)
Inland Midwest	2.1 (1.5,3.1)	5.8 (4.3,7.8)	11.8 (9.2,15.1)	17.3 (13.9,21.5)	21.8 (17.8,26.8)	33.6 (27.7,40.8)
Inland South	2.9 (2.1,3.9)	7.3 (5.5,9.7)	14.3 (10.7,19.1)	20.3 (15.0,27.4)	25.2 (18.5,34.3)	37.2 (27.2,50.9)
Inland West	3.9 (2.0,7.6)	9.8 (5.2,18.6)	19.7 (9.9,39.4)	28.5 (13.9,58.3)	35.4 (17.4,71.8)	51.1 (26.1,100.0)

[1] U.S. regions are the U.S. Census Bureau regions. Midwest = OH, MI, IN, WI, IL, MO, IA, MN, SD, ND, NE, KS. Northeast = PA, NY, NJ, CT, RI, MA, NH, VT, ME. South = DE, MD, DC, VA, WV, KY, TN, NC, SC, GA, AL, MS, FL, LA, AR, OK, TX. West = NM, CO, WY, MT, ID, UT, AZ, NV, CA, OR, WA, AK, HI.

[2] Coastal regions include counties bordering the 3 coasts (Pacific, Atlantic, and Gulf of Mexico) and the Great Lakes and estuaries and bays. Additionally, any county that did not directly border a coast, but the central point was within 25 miles of a coast was defined as coastal. The inland regions are the remaining counties in each of the 4 Census Regions.

Table 22a. UFCR estimates (g/day raw weight, edible portion): Total finfish, youth, <21 years, by demographic characteristics

	Percentiles (95% CI)					
All Finfish	**50th**	**75th**	**90th**	**95th**	**97th**	**99th**
Youth (<21 yrs)	3.8 (3.0,4.8)	9.4 (7.9,11.3)	18.5 (15.4,22.2)	26.8 (21.8,32.9)	33.8 (26.9,42.5)	51.7 (39.1,68.4)
Age						
1 to <3 yrs	2.1 (1.5,2.9)	5.2 (4.1,6.8)	10.1 (8.1,12.7)	14.6 (11.6,18.4)	18.4 (14.5,23.5)	27.2 (20.4,36.2)
3 to <6 yrs	2.7 (1.9,4.0)	6.6 (5.1,8.7)	12.8 (10.2,16.0)	18.2 (14.5,22.8)	22.6 (17.8,28.6)	33.1 (25.4,43.2)
6 to <11 yrs	4.2 (2.9,6.1)	10.4 (7.3,14.7)	20.1 (13.3,30.4)	28.1 (17.6,45.0)	34.6 (20.8,57.6)	49.9 (28.4,87.7)
11 to <16 yrs	3.8 (2.5,5.6)	9.1 (6.6,12.4)	16.6 (12.7,21.8)	23.1 (17.7,30.2)	28.7 (22.0,37.5)	42.7 (32.2,56.5)
16 to <18 yrs	4.5 (3.1,6.5)	10.5 (8.0,14.0)	19.7 (15.1,25.6)	27.5 (20.9,36.1)	34.2 (26.0,44.9)	50.5 (38.7,65.9)
18 to <21 yrs	6.3 (4.3,9.1)	15.2 (10.9,21.2)	30.1 (20.5,44.4)	43.8 (27.7,69.2)	54.9 (33.2,90.7)	78.5 (46.7,131.9)
Gender						
Female	3.4 (2.6,4.3)	8.6 (7.1,10.3)	16.8 (14.1,19.9)	23.8 (19.9,28.6)	29.6 (24.6,35.6)	43.3 (35.9,52.2)
Male	4.2 (3.2,5.4)	10.3 (8.5,12.6)	20.3 (16.4,25.2)	29.9 (23.1,38.7)	38.1 (28.3,51.4)	59.2 (40.6,86.5)
Race/Ethnicity[1]						
Mexican American	3.3 (2.5,4.5)	8.2 (6.6,10.2)	15.6 (12.9,18.9)	22.3 (18.3,27.1)	28.2 (23.0,34.6)	44.0 (34.8,55.7)
Other Hispanic	3.2 (1.9,5.4)	8.4 (5.7,12.4)	16.8 (12.2,23.2)	24.3 (17.7,33.5)	30.1 (21.5,42.1)	43.9 (30.4,63.3)
Non-Hispanic White	3.4 (2.5,4.5)	8.5 (6.6,10.9)	17.0 (12.8,22.4)	24.8 (18.1,34.0)	31.8 (22.5,45.0)	50.4 (32.5,78.1)
Non-Hispanic Black	5.6 (4.2,7.3)	12.0 (9.5,15.1)	21.0 (16.7,26.4)	28.6 (22.7,36.0)	34.4 (27.3,43.5)	48.4 (38.2,61.2)
Other Race	6.8 (4.5,10.1)	17.1 (12.5,23.3)	31.4 (23.3,42.3)	42.7 (30.4,60.0)	51.6 (35.9,74.1)	69.4 (45.7,105.4)
Income, finer detail						
$0 to <$20K	4.1 (3.0,5.6)	10.5 (8.2,13.4)	20.0 (15.8,25.3)	28.0 (22.0,35.8)	34.4 (26.7,44.4)	50.9 (39.0,66.4)
$20 to <$45K	3.6 (2.7,4.7)	8.8 (7.0,11.1)	17.1 (13.9,21.1)	24.7 (19.7,30.9)	31.4 (24.3,40.6)	48.5 (30.2,77.9)
$40 to <$75K	4.1 (3.0,5.7)	10.7 (7.8,14.8)	21.9 (15.2,31.5)	32.6 (21.8,48.7)	41.8 (27.1,64.5)	64.9 (40.2,104.7)
$75+K	3.7 (2.7,5.0)	8.9 (7.1,11.3)	16.8 (13.3,21.3)	23.7 (18.2,31.0)	29.5 (22.1,39.4)	43.7 (30.7,62.3)
>$20K	2.6 (1.3,5.3)	6.2 (3.2,12.1)	12.7 (5.8,27.8)	18.2 (7.7,43.1)	22.5 (9.3,54.5)	32.7 (13.1,81.4)
Refused/Don't Know Income	2.9 (0.6,14.2)	8.0 (1.4,46.8)	23.1 (3.8,141.6)	38.0 (8.8,163.8)	50.5 (15.4,165.8)	73.3 (32.4,165.7)
Income Missing	4.9 (1.7,13.5)	13.2 (6.4,27.2)	26.4 (14.9,46.8)	37.3 (22.9,60.7)	45.2 (28.3,72.2)	65.3 (40.5,105.4)

[1] Race/ethnicity is as defined by NHANES. Respondents who self-identified as "Mexican American" were coded as such regardless of their other race-ethnicity identities. Otherwise, self-identified "Hispanic" ethnicity was coded as "Other Hispanic." All other non-Hispanic participants were then categorized based on their self-reported races: non-Hispanic white, non-Hispanic black, and other non-Hispanic race including non-Hispanic multiracial (other race).

Table 22b. UFCR estimates (g/day raw weight, edible portion): Total finfish, youth, <21 years, by geographic area

	Percentiles (95% CI)					
All Finfish	**50th**	**75th**	**90th**	**95th**	**97th**	**99th**
Youth (<21 yrs)	3.8 (3.0,4.8)	9.4 (7.9,11.3)	18.5 (15.4,22.2)	26.8 (21.8,32.9)	33.8 (26.9,42.5)	51.7 (39.1,68.4)
Region[1]						
Northeast	4.1 (2.7,6.3)	10.0 (7.1,13.9)	20.2 (13.2,31.1)	31.4 (16.9,58.4)	42.0 (19.8,88.7)	70.1 (31.2,157.3)
Midwest	2.6 (1.9,3.8)	7.0 (5.4,8.9)	13.8 (11.3,16.8)	20.1 (16.6,24.3)	25.1 (20.6,30.6)	38.2 (30.9,47.3)
South	4.2 (3.2,5.5)	10.0 (7.9,12.7)	18.5 (14.7,23.4)	25.7 (20.2,32.7)	31.4 (24.6,40.2)	45.1 (34.8,58.4)
West	4.5 (2.9,7.1)	11.5 (7.6,17.5)	22.8 (14.7,35.5)	32.6 (20.7,51.6)	40.8 (25.6,65.1)	58.6 (37.2,92.5)
Coastal Status[2]						
Noncoastal	3.5 (2.7,4.7)	9.0 (7.1,11.4)	17.7 (13.6,23.0)	25.7 (18.8,35.0)	32.5 (22.9,46.2)	50.9 (33.0,78.5)
Coastal	4.2 (3.3,5.4)	10.3 (8.5,12.4)	20.0 (16.7,23.9)	28.7 (23.9,34.5)	35.9 (29.8,43.2)	52.8 (43.1,64.6)
Coastal/Inland Region[1,2]						
Pacific	4.2 (2.9,6.0)	11.1 (7.9,15.6)	22.5 (16.1,31.4)	32.6 (23.4,45.5)	40.8 (29.2,57.1)	57.9 (41.0,81.6)
Atlantic	4.9 (3.6,6.9)	11.1 (8.5,14.4)	20.8 (16.4,26.4)	29.4 (23.0,37.6)	36.6 (28.2,47.4)	55.5 (41.2,74.7)
Gulf of Mexico	4.8 (3.2,7.0)	11.3 (8.0,15.8)	21.2 (15.2,29.8)	29.8 (21.4,41.4)	36.7 (26.4,50.9)	50.3 (35.7,70.9)
Great Lakes	3.0 (2.0,4.3)	7.7 (5.6,10.5)	15.1 (11.0,20.8)	21.8 (15.3,31.0)	27.4 (18.9,39.8)	41.5 (28.0,61.6)
Inland Northeast	3.9 (2.4,6.1)	9.5 (6.6,13.7)	19.6 (11.0,34.8)	31.3 (12.9,76.0)	43.1 (15.3,121.4)	73.0 (24.9,213.8)
Inland Midwest	2.5 (1.8,3.7)	6.7 (5.2,8.7)	13.3 (10.9,16.1)	19.2 (16.1,22.8)	24.2 (20.5,28.5)	36.3 (30.9,42.8)
Inland South	3.8 (2.9,4.9)	9.3 (7.3,11.9)	17.3 (13.5,22.3)	23.9 (18.3,31.2)	29.3 (22.2,38.6)	41.9 (31.8,55.3)
Inland West	4.8 (2.6,8.7)	11.8 (6.8,20.6)	23.0 (12.5,42.6)	32.6 (17.0,62.7)	40.9 (20.8,80.4)	59.1 (30.5,114.6)

[1] U.S. regions are the U.S. Census Bureau regions. Midwest = OH, MI, IN, WI, IL, MO, IA, MN, SD, ND, NE, KS. Northeast = PA, NY, NJ, CT, RI, MA, NH, VT, ME. South = DE, MD, DC, VA, WV, KY, TN, NC, SC, GA, AL, MS, FL, LA, AR, OK, TX. West = NM, CO, WY, MT, ID, UT, AZ, NV, CA, OR, WA, AK, HI.

[2] Coastal regions include counties bordering the 3 coasts (Pacific, Atlantic, and Gulf of Mexico) and the Great Lakes and estuaries and bays. Additionally, any county that did not directly border a coast, but the central point was within 25 miles of a coast was defined as coastal. The inland regions are the remaining counties in each of the 4 Census Regions.

Table 23a. UFCR estimates (g/day raw weight, edible portion): Total shellfish, youth, <21 years, by demographic characteristics

	Percentiles (95% CI)					
All Shellfish	**50th**	**75th**	**90th**	**95th**	**97th**	**99th**
Youth (<21 yrs)	0.6 (0.4,0.9)	1.9 (1.5,2.5)	4.8 (3.9,6.1)	8.1 (6.4,10.2)	11.0 (8.4,14.4)	19.2 (13.9,26.7)
Age						
1 to <3 yrs	0.3 (0.2,0.6)	0.9 (0.5,1.8)	2.1 (1.1,4.0)	3.2 (1.6,6.5)	4.4 (2.1,9.0)	7.3 (3.2,16.5)
3 to <6 yrs	0.5 (0.3,1.0)	1.6 (0.9,2.7)	3.5 (2.2,5.6)	5.5 (3.5,8.6)	7.2 (4.6,11.4)	12.0 (7.2,20.0)
6 to <11 yrs	0.5 (0.3,0.9)	1.5 (0.9,2.2)	3.4 (2.4,4.8)	5.5 (3.9,7.9)	7.5 (5.0,11.1)	13.0 (7.4,22.8)
11 to <16 yrs	0.7 (0.4,1.2)	2.2 (1.5,3.4)	5.5 (3.7,8.2)	9.0 (6.1,13.3)	12.0 (8.1,17.8)	19.8 (13.3,29.7)
16 to <18 yrs	0.9 (0.5,1.7)	2.8 (1.7,4.6)	6.8 (4.5,10.2)	10.9 (7.5,15.9)	14.6 (10.1,21.2)	23.2 (15.5,34.6)
18 to <21 yrs	1.1 (0.5,2.4)	3.5 (2.0,6.3)	8.5 (5.3,13.6)	13.6 (8.4,22.0)	18.1 (10.9,30.0)	28.7 (16.3,50.8)
Gender						
Female	0.6 (0.4,0.9)	1.9 (1.4,2.5)	4.8 (3.7,6.1)	8.0 (6.2,10.3)	10.9 (8.3,14.5)	19.2 (13.7,26.9)
Male	0.6 (0.4,0.9)	2.0 (1.5,2.6)	4.9 (3.8,6.4)	8.1 (6.1,10.7)	11.1 (8.1,15.1)	19.3 (13.2,28.4)
Race/Ethnicity[1]						
Mexican American	0.7 (0.4,1.0)	2.0 (1.4,2.7)	4.8 (3.5,6.4)	7.9 (5.7,10.9)	10.9 (7.6,15.6)	19.8 (12.5,31.3)
Other Hispanic	0.5 (0.2,1.5)	1.8 (0.7,4.2)	4.8 (2.2,10.5)	8.3 (3.8,17.8)	11.5 (5.4,24.5)	19.4 (9.3,40.6)
Non-Hispanic White	0.5 (0.3,0.7)	1.4 (1.0,2.1)	3.4 (2.4,5.0)	5.7 (3.9,8.4)	7.8 (5.2,11.7)	14.0 (8.9,22.1)
Non-Hispanic Black	1.2 (0.8,1.8)	3.4 (2.4,4.8)	7.7 (5.6,10.7)	12.0 (8.7,16.7)	15.8 (11.3,22.1)	25.0 (17.5,35.8)
Other Race	1.8 (1.0,3.3)	5.0 (3.0,8.3)	10.5 (6.3,17.6)	15.7 (9.1,27.2)	19.8 (10.8,36.4)	29.9 (15.1,59.5)
Income, finer detail						
$0 to <$20K	0.5 (0.3,0.8)	1.6 (1.1,2.4)	4.0 (2.8,5.6)	6.6 (4.7,9.2)	8.9 (6.3,12.6)	15.1 (10.4,21.9)
$20 to <$45K	0.8 (0.5,1.1)	2.2 (1.6,3.1)	5.3 (4.0,7.0)	8.5 (6.4,11.4)	11.5 (8.6,15.5)	19.4 (13.9,27.2)
$40 to <$75K	0.5 (0.3,0.8)	1.5 (1.0,2.3)	3.9 (2.7,5.7)	6.7 (4.5,9.8)	9.2 (6.1,13.8)	15.9 (10.0,25.4)
$75+K	0.8 (0.5,1.2)	2.3 (1.5,3.3)	5.6 (4.0,7.9)	9.2 (6.5,13.2)	12.4 (8.5,18.0)	21.1 (13.6,32.6)
>$20K	0.3 (0.1,1.6)	0.9 (0.3,3.1)	2.2 (0.8,6.1)	3.7 (1.4,10.2)	5.2 (1.9,14.1)	9.2 (3.2,26.8)
Refused/Don't Know Income	0.2 (0.0,1.5)	1.3 (0.3,5.8)	4.5 (1.2,16.7)	8.3 (2.4,28.7)	11.6 (3.3,40.4)	22.9 (5.9,89.1)
Income Missing	0.6 (0.1,2.2)	3.4 (0.6,18.7)	15.0 (1.8,126.0)	27.9 (4.8,163.5)	37.4 (9.6,146.3)	42.2 (23.6,75.5)

[1] Race/ethnicity is as defined by NHANES. Respondents who self-identified as "Mexican American" were coded as such regardless of their other race-ethnicity identities. Otherwise, self-identified "Hispanic" ethnicity was coded as "Other Hispanic." All other non-Hispanic participants were then categorized based on their self-reported races: non-Hispanic white, non-Hispanic black, and other non-Hispanic race including non-Hispanic multiracial (other race).

Table 23b. UFCR estimates (g/day raw weight, edible portion): Total shellfish, youth, <21 years, by geographic area

All Shellfish	Percentiles (95% CI)					
	50th	75th	90th	95th	97th	99th
Youth (<21 yrs)	0.6 (0.4,0.9)	1.9 (1.5,2.5)	4.8 (3.9,6.1)	8.1 (6.4,10.2)	11.0 (8.4,14.4)	19.2 (13.9,26.7)
Region[1]						
Northeast	0.7 (0.4,1.5)	2.3 (1.3,4.2)	5.6 (3.1,10.1)	9.1 (5.1,16.3)	12.3 (7.0,21.7)	20.6 (11.9,35.6)
Midwest	0.4 (0.2,0.7)	1.2 (0.7,2.0)	3.1 (1.9,5.0)	5.3 (3.3,8.5)	7.4 (4.5,12.0)	13.5 (8.0,22.9)
South	0.8 (0.5,1.2)	2.2 (1.5,3.3)	5.4 (3.7,7.7)	8.7 (6.1,12.6)	11.8 (8.1,17.3)	20.6 (13.3,32.0)
West	0.7 (0.4,1.1)	2.2 (1.5,3.2)	5.6 (3.9,8.0)	9.3 (6.2,13.9)	12.6 (7.9,20.0)	21.2 (11.4,39.3)
Coastal Status[2]						
Noncoastal	0.5 (0.3,0.7)	1.5 (1.1,2.1)	3.7 (2.8,4.9)	6.1 (4.6,8.1)	8.1 (6.0,11.0)	13.9 (9.8,19.8)
Coastal	0.9 (0.6,1.3)	2.8 (2.1,3.8)	7.1 (5.4,9.4)	11.7 (8.6,15.9)	15.8 (11.3,22.0)	26.4 (17.4,39.9)
Coastal/Inland Region[1,2]						
Pacific	0.9 (0.6,1.4)	2.9 (2.0,4.3)	7.5 (5.0,11.3)	12.4 (7.4,20.7)	16.9 (9.2,30.9)	27.8 (13.6,56.7)
Atlantic	1.2 (0.7,1.8)	3.5 (2.4,5.0)	8.2 (5.8,11.7)	12.8 (9.0,18.3)	16.7 (11.8,23.8)	26.1 (18.0,37.9)
Gulf of Mexico	1.1 (0.5,2.3)	3.3 (1.6,6.6)	8.1 (4.1,16.1)	13.9 (6.7,29.1)	20.2 (8.9,45.9)	37.4 (19.2,73.1)
Great Lakes	0.6 (0.3,1.0)	1.8 (1.1,2.8)	4.5 (2.8,7.2)	7.5 (4.4,12.8)	10.2 (5.7,18.4)	17.7 (8.9,35.0)
Inland Northeast	0.6 (0.3,1.3)	2.0 (1.0,3.8)	4.6 (2.5,8.3)	7.2 (4.1,12.6)	9.4 (5.4,16.4)	15.6 (9.1,26.7)
Inland Midwest	0.3 (0.2,0.6)	1.0 (0.6,1.8)	2.5 (1.5,4.4)	4.3 (2.4,7.5)	6.0 (3.4,10.7)	10.9 (5.8,20.3)
Inland South	0.6 (0.4,0.9)	1.7 (1.2,2.4)	3.9 (2.9,5.2)	6.2 (4.7,8.2)	8.3 (6.2,11.0)	13.7 (9.9,19.0)
Inland West	0.6 (0.3,1.0)	1.8 (1.1,2.9)	4.3 (2.6,7.0)	7.0 (4.2,11.5)	9.4 (5.5,15.8)	15.5 (8.6,28.0)

[1] U.S. regions are the U.S. Census Bureau regions. Midwest = OH, MI, IN, WI, IL, MO, IA, MN, SD, ND, NE, KS. Northeast = PA, NY, NJ, CT, RI, MA, NH, VT, ME. South = DE, MD, DC, VA, WV, KY, TN, NC, SC, GA, AL, MS, FL, LA, AR, OK, TX. West = NM, CO, WY, MT, ID, UT, AZ, NV, CA, OR, WA, AK, HI.

[2] Coastal regions include counties bordering the 3 coasts (Pacific, Atlantic, and Gulf of Mexico) and the Great Lakes and estuaries and bays. Additionally, any county that did not directly border a coast, but the central point was within 25 miles of a coast was defined as coastal. The inland regions are the remaining counties in each of the 4 Census Regions.

Table 24a. UFCR estimates (g/day raw weight, edible portion): Total trophic level 2 fish, youth, <21 years, by demographic characteristics

Trophic Level 2	Percentiles (95% CI)					
Finfish and Shellfish	**50th**	**75th**	**90th**	**95th**	**97th**	**99th**
Youth (<21 yrs)	0.4 (0.3,0.6)	1.2 (0.9,1.6)	3.1 (2.4,4.0)	5.2 (4.0,6.7)	7.1 (5.3,9.3)	12.0 (8.6,16.6)
Age						
1 to <3 yrs	0.2 (0.1,0.4)	0.6 (0.4,1.0)	1.5 (1.0,2.2)	2.4 (1.7,3.5)	3.3 (2.2,4.9)	5.8 (3.7,9.2)
3 to <6 yrs	0.3 (0.2,0.6)	0.9 (0.6,1.5)	2.3 (1.5,3.5)	3.8 (2.6,5.6)	5.2 (3.6,7.6)	8.8 (6.0,12.9)
6 to <11 yrs	0.3 (0.1,0.5)	0.8 (0.5,1.3)	2.2 (1.5,3.3)	3.9 (2.6,6.1)	5.6 (3.5,9.0)	10.5 (6.1,18.1)
11 to <16 yrs	0.5 (0.3,1.0)	1.7 (1.0,2.7)	4.0 (2.5,6.3)	6.4 (4.1,10.1)	8.6 (5.4,13.5)	14.0 (8.8,22.3)
16 to <18 yrs	0.5 (0.2,1.0)	1.5 (0.9,2.5)	3.6 (2.3,5.5)	5.6 (3.7,8.4)	7.3 (4.8,11.0)	11.6 (7.4,18.4)
18 to <21 yrs	0.6 (0.3,1.1)	1.8 (1.1,3.1)	4.4 (2.7,7.1)	7.1 (4.3,11.6)	9.3 (5.5,15.7)	14.9 (8.7,25.7)
Gender						
Female	0.4 (0.2,0.6)	1.2 (0.9,1.6)	3.0 (2.3,4.0)	5.1 (3.9,6.7)	7.0 (5.3,9.2)	11.8 (8.5,16.4)
Male	0.4 (0.3,0.6)	1.2 (0.9,1.7)	3.2 (2.3,4.3)	5.2 (3.8,7.2)	7.1 (5.1,9.9)	12.1 (8.3,17.7)
Race/Ethnicity[1]						
Mexican American	0.6 (0.4,0.9)	1.7 (1.2,2.4)	4.1 (3.0,5.4)	6.4 (4.8,8.6)	8.4 (6.2,11.5)	13.8 (9.5,20.0)
Other Hispanic	0.4 (0.1,0.9)	1.2 (0.5,2.6)	2.8 (1.4,5.8)	4.6 (2.2,9.3)	6.0 (2.9,12.3)	10.1 (4.9,20.6)
Non-Hispanic White	0.3 (0.2,0.4)	0.8 (0.5,1.3)	2.2 (1.4,3.3)	3.7 (2.4,5.7)	5.1 (3.3,8.1)	9.2 (5.7,14.8)
Non-Hispanic Black	0.6 (0.4,0.9)	1.8 (1.3,2.3)	4.1 (3.0,5.4)	6.5 (4.8,8.8)	8.6 (6.2,11.9)	14.0 (9.8,20.0)
Other Race	1.1 (0.5,2.4)	3.2 (1.7,6.3)	6.9 (3.6,12.9)	10.1 (5.3,19.2)	12.6 (6.7,23.9)	18.5 (9.7,35.0)
Income						
$0 to <$20K	0.3 (0.2,0.6)	1.1 (0.7,1.6)	2.7 (1.9,3.8)	4.4 (3.2,6.2)	6.0 (4.3,8.3)	9.8 (6.9,14.0)
$20 to <$45K	0.5 (0.3,0.7)	1.5 (1.1,2.0)	3.5 (2.7,4.7)	5.7 (4.3,7.6)	7.7 (5.7,10.4)	13.0 (9.4,17.9)
$40 to <$75K	0.3 (0.2,0.5)	0.9 (0.6,1.5)	2.5 (1.6,3.8)	4.2 (2.7,6.5)	5.8 (3.7,9.2)	10.0 (6.0,16.6)
$75+K	0.4 (0.3,0.7)	1.3 (0.9,2.1)	3.4 (2.2,5.2)	5.7 (3.7,8.7)	7.7 (5.0,11.9)	12.9 (8.2,20.3)
>$20K	0.2 (0.1,0.8)	0.6 (0.2,1.9)	1.5 (0.6,4.1)	2.6 (1.0,6.7)	3.6 (1.4,9.2)	6.3 (2.4,16.6)
Refused/Don't Know Income	0.1 (0.0,0.8)	0.6 (0.1,3.3)	2.6 (0.7,10.2)	4.5 (1.3,15.5)	6.3 (1.8,21.8)	11.7 (3.2,42.1)
Income Missing	0.3 (0.1,1.4)	1.6 (0.3,7.8)	7.2 (1.1,45.2)	12.3 (3.1,47.7)	15.4 (5.3,44.6)	20.0 (10.2,39.3)

[1] Race/ethnicity is as defined by NHANES. Respondents who self-identified as "Mexican American" were coded as such regardless of their other race-ethnicity identities. Otherwise, self-identified "Hispanic" ethnicity was coded as "Other Hispanic." All other non-Hispanic participants were then categorized based on their self-reported races: non-Hispanic white, non-Hispanic black, and other non-Hispanic race including non-Hispanic multiracial (other race).

Table 24b. UFCR estimates (g/day raw weight, edible portion): Total trophic level 2 fish, youth, <21 years, by geographic area

Trophic Level 2 Finfish and Shellfish	Percentiles (95% CI) 50th	75th	90th	95th	97th	99th
Youth (<21 yrs)	0.4 (0.3,0.6)	1.2 (0.9,1.6)	3.1 (2.4,4.0)	5.2 (4.0,6.7)	7.1 (5.3,9.3)	12.0 (8.6,16.6)
Region[1]						
Northeast	0.4 (0.2,0.8)	1.3 (0.8,2.3)	3.3 (1.8,6.3)	5.5 (2.8,10.8)	7.5 (3.7,15.0)	12.9 (6.5,25.7)
Midwest	0.2 (0.1,0.4)	0.8 (0.5,1.4)	2.1 (1.2,3.6)	3.7 (2.2,6.1)	5.1 (3.1,8.3)	8.9 (5.5,14.5)
South	0.4 (0.3,0.7)	1.3 (0.9,2.0)	3.2 (2.3,4.6)	5.3 (3.7,7.6)	7.2 (5.1,10.3)	12.2 (8.6,17.3)
West	0.5 (0.3,0.8)	1.5 (1.0,2.4)	3.9 (2.5,6.1)	6.3 (3.9,10.3)	8.4 (5.0,14.0)	13.4 (7.6,23.7)
Coastal Status[2]						
Noncoastal	0.3 (0.2,0.5)	1.0 (0.7,1.4)	2.4 (1.8,3.2)	3.9 (2.9,5.3)	5.3 (3.9,7.2)	9.1 (6.4,12.9)
Coastal	0.6 (0.4,0.8)	1.8 (1.3,2.5)	4.5 (3.4,6.1)	7.3 (5.4,9.9)	9.7 (7.0,13.4)	15.5 (10.9,22.0)
Coastal/Inland Region[1,2]						
Pacific	0.6 (0.4,1.1)	2.1 (1.3,3.3)	5.0 (3.0,8.5)	7.9 (4.5,13.9)	10.2 (5.7,18.5)	16.1 (8.9,29.2)
Atlantic	0.6 (0.4,0.9)	1.9 (1.4,2.8)	4.8 (3.2,7.1)	7.6 (4.9,11.7)	10.1 (6.4,15.8)	16.2 (10.0,26.3)
Gulf of Mexico	0.7 (0.4,1.2)	2.1 (1.2,3.8)	5.3 (3.0,9.3)	8.7 (5.2,14.6)	11.5 (7.2,18.4)	17.3 (12.0,25.1)
Great Lakes	0.3 (0.2,0.6)	1.1 (0.7,2.0)	3.1 (1.9,5.1)	5.1 (3.2,8.2)	6.9 (4.3,11.0)	11.6 (7.2,18.6)
Inland Northeast	0.4 (0.2,0.7)	1.1 (0.6,2.0)	2.7 (1.5,4.8)	4.1 (2.3,7.6)	5.6 (3.1,10.1)	9.3 (5.1,17.1)
Inland Midwest	0.2 (0.1,0.4)	0.7 (0.4,1.1)	1.7 (1.0,2.9)	3.0 (1.7,5.0)	4.2 (2.4,7.1)	7.4 (4.1,13.3)
Inland South	0.4 (0.2,0.6)	1.0 (0.7,1.6)	2.4 (1.7,3.4)	3.8 (2.7,5.4)	5.1 (3.6,7.2)	8.5 (6.0,12.1)
Inland West	0.4 (0.2,0.7)	1.2 (0.7,2.0)	3.0 (1.8,5.0)	5.0 (3.0,8.3)	6.7 (4.0,11.3)	11.1 (6.3,19.5)

[1] U.S. regions are the U.S. Census Bureau regions. Midwest = OH, MI, IN, WI, IL, MO, IA, MN, SD, ND, NE, KS. Northeast = PA, NY, NJ, CT, RI, MA, NH, VT, ME. South = DE, MD, DC, VA, WV, KY, TN, NC, SC, GA, AL, MS, FL, LA, AR, OK, TX. West = NM, CO, WY, MT, ID, UT, AZ, NV, CA, OR, WA, AK, HI.

[2] Coastal regions include counties bordering the 3 coasts (Pacific, Atlantic, and Gulf of Mexico) and the Great Lakes and estuaries and bays. Additionally, any county that did not directly border a coast, but the central point was within 25 miles of a coast was defined as coastal. The inland regions are the remaining counties in each of the 4 Census Regions.

Table 25a. UFCR estimates (g/day raw weight, edible portion): Total trophic level 3 fish, adults, youth, <21 years, by demographic characteristics

Trophic Level 3 Finfish and Shellfish	Percentiles (95% CI)					
	50th	75th	90th	95th	97th	99th
Youth (<21 yrs)	1.4 (1.0,1.8)	3.5 (2.8,4.5)	7.4 (6.0,9.2)	11.1 (8.9,13.8)	14.1 (11.2,17.7)	21.5 (16.5,27.9)
Age						
1 to <3 yrs	0.8 (0.5,1.3)	2.1 (1.4,3.2)	4.2 (2.7,6.3)	6.0 (4.0,9.0)	7.5 (5.0,11.4)	11.4 (7.4,17.8)
3 to <6 yrs	1.1 (0.8,1.7)	2.9 (2.1,4.0)	5.9 (4.5,7.6)	8.5 (6.6,10.9)	10.7 (8.3,13.8)	15.7 (11.8,20.8)
6 to <11 yrs	1.6 (1.1,2.4)	4.2 (2.7,6.3)	8.8 (5.7,13.7)	13.1 (8.2,20.9)	16.6 (10.2,27.1)	25.4 (15.0,42.9)
11 to <16 yrs	1.3 (0.9,2.0)	3.3 (2.3,4.7)	6.8 (5.1,9.1)	10.0 (7.5,13.2)	12.7 (9.6,16.8)	19.4 (14.8,25.5)
16 to <18 yrs	1.2 (0.7,2.1)	3.1 (2.1,4.8)	7.2 (5.3,9.8)	11.6 (8.5,15.6)	15.1 (11.0,20.7)	23.6 (16.6,33.5)
18 to <21 yrs	2.2 (1.4,3.3)	5.3 (3.8,7.5)	10.0 (7.4,13.5)	14.0 (10.2,19.1)	17.0 (12.1,23.8)	23.9 (16.1,35.7)
Gender						
Female	1.2 (0.9,1.6)	3.2 (2.5,4.0)	6.8 (5.5,8.5)	10.2 (8.2,12.8)	13.1 (10.4,16.5)	20.3 (15.6,26.5)
Male	1.5 (1.1,2.1)	3.9 (3.0,5.1)	8.0 (6.2,10.3)	11.8 (9.1,15.3)	14.9 (11.4,19.5)	22.4 (16.6,30.1)
Race/Ethnicity[1]						
Mexican American	1.1 (0.8,1.5)	2.7 (2.1,3.5)	5.5 (4.4,6.9)	8.2 (6.4,10.4)	10.4 (8.0,13.5)	16.0 (11.5,22.2)
Other Hispanic	0.9 (0.6,1.5)	2.5 (1.6,4.0)	5.2 (3.2,8.5)	7.6 (4.4,13.2)	9.7 (5.5,17.0)	14.7 (8.0,26.9)
Non-Hispanic White	1.1 (0.8,1.6)	2.8 (2.1,3.8)	5.6 (4.1,7.6)	8.1 (5.9,11.2)	10.3 (7.3,14.4)	15.8 (10.7,23.1)
Non-Hispanic Black	3.1 (2.3,4.2)	7.0 (5.4,9.2)	12.6 (9.9,16.2)	17.1 (13.4,21.9)	20.7 (16.2,26.4)	28.6 (22.2,36.9)
Other Race	3.6 (2.4,5.6)	8.3 (5.7,12.0)	15.2 (10.1,22.9)	20.3 (12.9,32.0)	24.1 (14.9,38.9)	32.1 (19.5,52.9)
Income						
$0 to <$20K	1.6 (1.2,2.1)	4.3 (3.2,5.7)	8.9 (6.9,11.5)	12.8 (9.9,16.7)	16.1 (12.3,21.0)	23.6 (17.8,31.3)
$20 to <$45K	1.4 (1.0,1.8)	3.5 (2.8,4.3)	7.1 (5.7,8.8)	10.5 (8.4,13.1)	13.4 (10.7,16.8)	20.3 (16.1,25.5)
$40 to <$75K	1.3 (0.9,2.0)	3.4 (2.3,5.1)	7.3 (4.7,11.3)	10.7 (6.8,16.9)	13.5 (8.5,21.4)	19.8 (12.4,31.6)
$75+K	1.3 (0.9,1.9)	3.3 (2.4,4.6)	6.9 (5.2,9.2)	10.3 (7.7,14.0)	13.3 (9.6,18.4)	20.5 (13.7,30.5)
>$20K	1.1 (0.4,2.6)	2.4 (1.2,4.9)	4.7 (2.7,8.2)	6.7 (3.9,11.4)	8.4 (4.9,14.4)	12.4 (6.9,22.3)
Refused/Don't Know Income	1.8 (0.4,9.3)	4.3 (1.0,17.9)	8.4 (2.9,24.8)	12.4 (5.1,29.9)	15.4 (6.9,34.4)	24.4 (10.7,56.0)
Income Missing	1.3 (0.4,4.2)	5.3 (1.3,21.8)	16.1 (3.0,86.1)	29.6 (6.3,139.9)	38.2 (10.2,143.0)	51.8 (19.7,136.7)

[1] Race/ethnicity is as defined by NHANES. Respondents who self-identified as "Mexican American" were coded as such regardless of their other race-ethnicity identities. Otherwise, self-identified "Hispanic" ethnicity was coded as "Other Hispanic." All other non-Hispanic participants were then categorized based on their self-reported races: non-Hispanic white, non-Hispanic black, and other non-Hispanic race including non-Hispanic multiracial (other race).

Table 25b. UFCR estimates (g/day raw weight, edible portion): Total trophic level 3 fish, youth, <21 years, by geographic area

Trophic Level 3	Percentiles (95% CI)					
Finfish and Shellfish	**50th**	**75th**	**90th**	**95th**	**97th**	**99th**
Youth (<21 yrs)	1.4 (1.0,1.8)	3.5 (2.8,4.5)	7.4 (6.0,9.2)	11.1 (8.9,13.8)	14.1 (11.2,17.7)	21.5 (16.5,27.9)
Region[1]						
Northeast	1.4 (0.8,2.3)	3.4 (2.2,5.2)	6.5 (4.2,10.1)	9.3 (5.8,14.7)	11.5 (7.2,18.3)	17.0 (10.6,27.1)
Midwest	0.9 (0.6,1.3)	2.4 (1.7,3.3)	5.2 (3.9,7.0)	8.0 (5.9,10.9)	10.4 (7.4,14.5)	16.6 (11.4,24.2)
South	1.9 (1.3,2.7)	4.7 (3.4,6.4)	9.3 (7.0,12.4)	13.5 (10.2,18.0)	16.9 (12.7,22.7)	25.4 (18.4,35.1)
West	1.4 (0.9,2.0)	3.6 (2.5,5.2)	7.8 (5.2,11.7)	11.7 (7.5,18.3)	14.9 (9.2,24.1)	22.3 (12.9,38.6)
Coastal Status[2]						
Noncoastal	1.2 (0.9,1.6)	3.1 (2.4,4.0)	6.4 (4.9,8.3)	9.6 (7.3,12.6)	12.2 (9.1,16.2)	18.6 (13.4,25.8)
Coastal	1.8 (1.3,2.4)	4.5 (3.4,5.9)	9.2 (7.1,12.0)	13.5 (10.3,17.7)	17.0 (12.8,22.6)	25.6 (18.5,35.3)
Coastal/Inland Region[1,2]						
Pacific	1.5 (1.0,2.2)	4.0 (2.8,5.6)	8.6 (6.0,12.4)	13.0 (8.7,19.5)	16.4 (10.5,25.5)	23.6 (14.5,38.6)
Atlantic	2.3 (1.5,3.4)	5.4 (3.8,7.7)	10.4 (7.7,14.1)	14.7 (10.9,19.7)	18.0 (13.4,24.1)	25.8 (19.3,34.4)
Gulf of Mexico	2.3 (1.2,4.3)	5.7 (3.3,9.7)	11.2 (6.8,18.4)	16.8 (9.5,30.0)	22.3 (11.4,43.4)	37.6 (17.5,80.9)
Great Lakes	1.2 (0.9,1.7)	3.2 (2.4,4.2)	6.7 (4.7,9.5)	9.9 (6.4,15.4)	12.8 (7.9,20.6)	19.4 (11.2,33.6)
Inland Northeast	1.2 (0.8,1.9)	2.9 (2.0,4.2)	5.5 (3.9,7.8)	7.7 (5.4,11.0)	9.6 (6.6,13.9)	14.0 (9.5,20.8)
Inland Midwest	0.8 (0.6,1.2)	2.1 (1.5,3.0)	4.5 (3.3,6.2)	6.9 (4.9,9.8)	9.1 (6.3,13.0)	14.8 (10.2,21.6)
Inland South	1.6 (1.2,2.2)	4.0 (3.1,5.2)	8.1 (6.3,10.3)	11.7 (9.1,15.0)	14.6 (11.3,18.8)	21.4 (16.6,27.7)
Inland West	1.3 (0.8,2.2)	3.4 (2.0,5.6)	7.2 (4.0,12.9)	10.7 (5.5,20.5)	13.6 (6.7,27.9)	21.1 (9.3,47.8)

[1] U.S. regions are the U.S. Census Bureau regions. Midwest = OH, MI, IN, WI, IL, MO, IA, MN, SD, ND, NE, KS. Northeast = PA, NY, NJ, CT, RI, MA, NH, VT, ME. South = DE, MD, DC, VA, WV, KY, TN, NC, SC, GA, AL, MS, FL, LA, AR, OK, TX. West = NM, CO, WY, MT, ID, UT, AZ, NV, CA, OR, WA, AK, HI.

[2] Coastal regions include counties bordering the 3 coasts (Pacific, Atlantic, and Gulf of Mexico) and the Great Lakes and estuaries and bays. Additionally, any county that did not directly border a coast, but the central point was within 25 miles of a coast was defined as coastal. The inland regions are the remaining counties in each of the 4 Census Regions.

Table 26a. UFCR estimates (g/day raw weight, edible portion): Total trophic level 4 fish, youth, <21 years, by demographic characteristics

Trophic Level 4	Percentiles (95% CI)					
Finfish and Shellfish	**50th**	**75th**	**90th**	**95th**	**97th**	**99th**
Youth (<21 yrs)	2.5 (1.9,3.1)	6.4 (5.3,7.7)	13.1 (10.8,15.9)	19.6 (15.8,24.4)	25.3 (19.9,32.3)	40.5 (28.8,56.9)
Age						
1 to <3 yrs	1.3 (0.9,1.8)	3.3 (2.5,4.2)	6.6 (5.2,8.4)	9.7 (7.5,12.4)	12.5 (9.7,16.3)	19.3 (14.3,26.1)
3 to <6 yrs	1.8 (1.2,2.7)	4.4 (3.3,6.1)	8.6 (6.6,11.3)	12.4 (9.5,16.1)	15.5 (11.8,20.4)	23.2 (16.9,31.9)
6 to <11 yrs	2.7 (1.9,4.0)	6.9 (4.8,10.0)	13.4 (8.6,21.0)	19.2 (11.6,32.0)	23.8 (13.8,41.0)	34.1 (19.1,60.9)
11 to <16 yrs	2.4 (1.6,3.5)	5.9 (4.3,8.1)	11.3 (8.4,15.3)	16.2 (11.9,22.2)	20.2 (14.5,28.3)	30.4 (20.2,45.7)
16 to <18 yrs	3.2 (2.1,4.9)	7.8 (5.6,10.9)	15.2 (11.0,21.0)	21.4 (15.3,30.1)	26.6 (18.6,38.2)	39.3 (26.7,57.7)
18 to <21 yrs	4.4 (2.9,6.5)	11.6 (7.9,17.0)	24.8 (15.6,39.5)	37.3 (21.3,65.4)	48.4 (26.3,89.1)	72.4 (38.6,135.9)
Gender						
Female	2.2 (1.7,2.8)	5.8 (4.8,7.0)	11.8 (9.7,14.2)	17.2 (14.2,20.9)	21.6 (17.7,26.5)	31.9 (25.6,39.8)
Male	2.7 (2.1,3.5)	7.0 (5.7,8.6)	14.5 (11.6,18.2)	22.1 (16.8,29.2)	29.3 (21.1,40.7)	49.5 (30.7,80.0)
Race/Ethnicity[1]						
Mexican American	2.0 (1.4,2.9)	5.2 (4.0,6.8)	10.7 (8.4,13.7)	16.0 (12.5,20.6)	20.8 (16.0,27.2)	34.0 (25.0,46.4)
Other Hispanic	2.2 (1.2,3.7)	6.1 (3.8,9.7)	12.6 (8.4,19.0)	18.4 (12.2,27.7)	23.1 (15.2,35.1)	33.4 (20.5,54.4)
Non-Hispanic White	2.3 (1.7,3.2)	6.2 (4.7,8.0)	12.8 (9.6,17.1)	19.3 (13.8,26.9)	25.1 (17.2,36.5)	41.3 (24.2,70.5)
Non-Hispanic Black	3.0 (2.3,4.1)	6.9 (5.4,8.8)	12.8 (10.2,16.0)	17.8 (14.2,22.3)	21.9 (17.4,27.4)	31.2 (24.7,39.5)
Other Race	4.2 (2.7,6.5)	11.1 (7.8,15.7)	22.5 (16.7,30.4)	31.7 (22.2,45.3)	39.4 (25.6,60.7)	57.3 (32.3,101.7)
Income						
$0 to <$20K	2.5 (1.8,3.4)	6.5 (5.2,8.2)	13.2 (10.6,16.3)	19.3 (15.1,24.5)	24.3 (18.6,31.8)	38.1 (27.9,52.1)
$20 to <$45K	2.3 (1.7,3.0)	5.8 (4.6,7.3)	12.0 (9.7,14.9)	18.4 (14.5,23.3)	24.0 (17.8,32.3)	39.5 (22.0,70.9)
$40 to <$75K	2.8 (2.0,3.8)	7.4 (5.3,10.4)	15.7 (10.4,23.5)	24.2 (15.5,37.9)	31.9 (19.6,51.9)	52.8 (29.4,94.8)
$75+K	2.5 (1.8,3.5)	6.4 (5.0,8.2)	12.4 (9.7,15.9)	17.9 (13.7,23.3)	22.2 (16.7,29.5)	32.9 (23.9,45.3)
>$20K	1.8 (0.8,3.9)	4.4 (2.2,8.9)	9.6 (4.1,22.4)	14.8 (5.7,38.0)	18.6 (6.9,50.2)	26.1 (9.2,74.2)
Refused/Don't Know Income	2.0 (0.4,9.8)	5.9 (1.0,35.5)	17.4 (2.7,114.0)	31.0 (6.4,150.2)	41.0 (11.2,150.2)	63.9 (25.5,159.9)
Income Missing	2.9 (0.9,9.7)	8.3 (3.3,21.0)	18.0 (9.2,34.9)	26.3 (15.2,45.4)	32.7 (19.5,54.8)	50.0 (29.5,84.7)

[1] Race/ethnicity is as defined by NHANES. Respondents who self-identified as "Mexican American" were coded as such regardless of their other race-ethnicity identities. Otherwise, self-identified "Hispanic" ethnicity was coded as "Other Hispanic." All other non-Hispanic participants were then categorized based on their self-reported races: non-Hispanic white, non-Hispanic black, and other non-Hispanic race including non-Hispanic multiracial (other race).

Table 26b. UFCR estimates (g/day raw weight, edible portion): Total trophic level 4 fish, youth, <21 years, by geographic area

Trophic Level 4 Finfish and Shellfish	Percentiles (95% CI)					
	50th	75th	90th	95th	97th	99th
Youth (<21 yrs)	2.5 (1.9,3.1)	6.4 (5.3,7.7)	13.1 (10.8,15.9)	19.6 (15.8,24.4)	25.3 (19.9,32.3)	40.5 (28.8,56.9)
Region[1]						
Northeast	3.0 (2.0,4.4)	7.6 (5.4,10.5)	16.4 (10.3,26.2)	26.7 (13.0,54.9)	37.0 (15.6,88.0)	63.5 (25.0,161.7)
Midwest	1.8 (1.2,2.7)	4.8 (3.5,6.4)	9.7 (7.7,12.1)	14.2 (11.6,17.4)	18.1 (14.8,22.1)	27.8 (22.3,34.6)
South	2.5 (1.9,3.4)	6.2 (4.9,8.0)	12.1 (9.5,15.5)	17.5 (13.5,22.7)	21.8 (16.6,28.6)	32.9 (24.4,44.4)
West	3.1 (1.9,5.0)	8.2 (5.0,13.2)	16.6 (10.2,27.1)	24.1 (14.9,39.2)	30.3 (19.0,48.3)	44.1 (28.5,68.1)
Coastal Status[2]						
Noncoastal	2.4 (1.8,3.2)	6.4 (5.0,8.2)	13.2 (10.0,17.5)	19.7 (14.2,27.3)	25.3 (17.6,36.4)	40.6 (24.9,66.2)
Coastal	2.5 (1.9,3.3)	6.4 (5.2,7.7)	13.0 (10.9,15.5)	19.5 (16.3,23.4)	25.4 (20.9,30.8)	40.3 (31.3,52.0)
Coastal/Inland Region[1,2]						
Pacific	2.6 (1.7,3.9)	7.2 (5.0,10.2)	15.4 (11.0,21.6)	23.0 (16.4,32.4)	29.5 (20.8,41.9)	44.5 (29.1,68.1)
Atlantic	3.0 (2.2,4.2)	6.9 (5.3,9.0)	13.6 (10.6,17.4)	20.2 (15.2,27.0)	26.6 (19.0,37.2)	45.4 (28.2,73.2)
Gulf of Mexico	2.6 (1.7,4.0)	6.4 (4.5,9.3)	12.9 (8.8,18.9)	19.1 (13.0,28.2)	24.0 (15.9,36.1)	36.6 (22.3,60.1)
Great Lakes	1.8 (1.1,2.8)	4.7 (3.4,6.6)	9.6 (7.0,13.2)	14.2 (10.1,19.9)	18.1 (12.6,26.1)	28.1 (18.2,43.2)
Inland Northeast	2.9 (1.9,4.4)	7.7 (5.3,11.2)	17.1 (9.3,31.5)	28.1 (10.8,73.4)	39.8 (13.2,119.5)	67.2 (21.6,209.3)
Inland Midwest	1.8 (1.2,2.7)	4.8 (3.5,6.5)	9.7 (7.8,12.2)	14.3 (11.8,17.3)	18.1 (15.1,21.7)	27.5 (22.9,33.1)
Inland South	2.4 (1.8,3.1)	6.1 (4.7,7.9)	11.8 (9.0,15.6)	17.0 (12.6,22.9)	21.2 (15.5,29.0)	31.2 (22.5,43.2)
Inland West	3.4 (1.8,6.6)	8.9 (4.7,16.6)	17.4 (9.1,33.5)	24.8 (12.8,48.2)	30.7 (15.9,59.1)	43.8 (23.9,80.4)

[1] U.S. regions are the U.S. Census Bureau regions. Midwest = OH, MI, IN, WI, IL, MO, IA, MN, SD, ND, NE, KS. Northeast = PA, NY, NJ, CT, RI, MA, NH, VT, ME. South = DE, MD, DC, VA, WV, KY, TN, NC, SC, GA, AL, MS, FL, LA, AR, OK, TX. West = NM, CO, WY, MT, ID, UT, AZ, NV, CA, OR, WA, AK, HI.

[2] Coastal regions include counties bordering the 3 coasts (Pacific, Atlantic, and Gulf of Mexico) and the Great Lakes and estuaries and bays. Additionally, any county that did not directly border a coast, but the central point was within 25 miles of a coast was defined as coastal. The inland regions are the remaining counties in each of the 4 Census Regions.

Table 27a. UFCR estimates (g/day raw weight, edible portion): Total freshwater + estuarine trophic level 2 fish, youth, <21 years, by demographic characteristics

Freshwater + Estuarine Trophic Level 2 Finfish and Shellfish	Percentiles (95% CI)					
	50th	75th	90th	95th	97th	99th
Youth (<21 yrs)	0.3 (0.2,0.4)	0.9 (0.7,1.2)	2.3 (1.8,3.0)	4.0 (3.1,5.2)	5.5 (4.2,7.3)	9.8 (7.1,13.4)
Age						
1 to <3 yrs	0.1 (0.1,0.3)	0.5 (0.3,0.8)	1.2 (0.8,1.8)	2.1 (1.4,3.0)	2.9 (2.0,4.3)	5.2 (3.3,8.1)
3 to <6 yrs	0.2 (0.1,0.4)	0.6 (0.4,1.0)	1.7 (1.1,2.7)	3.0 (2.0,4.6)	4.2 (2.8,6.4)	7.5 (5.0,11.2)
6 to <11 yrs	0.2 (0.1,0.4)	0.7 (0.4,1.1)	1.9 (1.3,2.8)	3.5 (2.2,5.5)	5.0 (3.1,8.3)	9.3 (5.3,16.5)
11 to <16 yrs	0.3 (0.2,0.6)	1.1 (0.7,1.7)	2.9 (2.0,4.1)	4.7 (3.4,6.6)	6.4 (4.6,8.9)	11.0 (7.8,15.5)
16 to <18 yrs	0.3 (0.2,0.7)	1.0 (0.6,1.8)	2.5 (1.5,3.9)	3.9 (2.6,6.1)	5.2 (3.4,8.1)	8.7 (5.5,13.8)
18 to <21 yrs	0.4 (0.2,0.8)	1.4 (0.8,2.4)	3.4 (2.2,5.5)	5.6 (3.5,8.9)	7.4 (4.5,12.1)	12.3 (7.4,20.6)
Gender						
Female	0.3 (0.2,0.4)	0.9 (0.6,1.2)	2.4 (1.8,3.1)	4.1 (3.2,5.3)	5.6 (4.3,7.4)	9.9 (7.2,13.5)
Male	0.3 (0.2,0.4)	0.9 (0.6,1.2)	2.3 (1.7,3.1)	3.9 (2.9,5.4)	5.4 (3.9,7.6)	9.6 (6.6,14.0)
Race/Ethnicity[1]						
Mexican American	0.5 (0.3,0.7)	1.5 (1.0,2.1)	3.5 (2.6,4.8)	5.6 (4.1,7.7)	7.5 (5.4,10.4)	12.4 (8.4,18.2)
Other Hispanic	0.3 (0.1,0.8)	1.0 (0.4,2.2)	2.5 (1.2,5.2)	4.1 (2.0,8.4)	5.5 (2.7,11.3)	9.0 (4.3,19.0)
Non-Hispanic White	0.2 (0.1,0.3)	0.5 (0.4,0.8)	1.4 (0.9,2.0)	2.4 (1.6,3.5)	3.3 (2.2,5.0)	6.2 (4.0,9.4)
Non-Hispanic Black	0.5 (0.4,0.7)	1.5 (1.2,2.0)	3.5 (2.7,4.5)	5.6 (4.2,7.4)	7.4 (5.5,10.0)	12.3 (8.8,17.3)
Other Race	0.8 (0.4,1.8)	2.5 (1.2,5.1)	5.5 (2.8,11.0)	8.3 (4.2,16.4)	10.7 (5.4,21.2)	15.5 (7.6,31.8)
Income						
$0 to <$20K	0.3 (0.2,0.4)	0.9 (0.6,1.3)	2.3 (1.6,3.3)	3.8 (2.7,5.4)	5.1 (3.6,7.3)	8.5 (5.7,12.7)
$20 to <$45K	0.4 (0.2,0.5)	1.1 (0.8,1.5)	2.9 (2.1,3.8)	4.8 (3.5,6.5)	6.5 (4.7,8.9)	11.1 (7.8,15.8)
$40 to <$75K	0.2 (0.1,0.3)	0.7 (0.4,1.0)	1.8 (1.2,2.7)	3.2 (2.1,4.8)	4.4 (2.9,6.8)	7.9 (4.9,12.6)
$75+K	0.3 (0.2,0.4)	0.9 (0.6,1.3)	2.3 (1.6,3.4)	4.0 (2.8,5.9)	5.5 (3.7,8.2)	9.8 (6.4,15.1)
>$20K	0.1 (0.0,0.5)	0.4 (0.2,1.2)	1.2 (0.5,3.0)	2.1 (0.8,5.4)	2.9 (1.1,7.5)	5.4 (2.0,14.3)
Refused/Don't Know Income	0.1 (0.0,0.5)	0.4 (0.1,2.2)	1.8 (0.5,7.0)	3.2 (0.9,11.6)	4.6 (1.2,16.9)	9.0 (2.2,37.0)
Income Missing	0.2 (0.1,0.8)	1.2 (0.2,6.0)	5.7 (0.8,41.5)	10.1 (2.4,43.2)	13.0 (4.3,39.9)	18.2 (8.6,38.2)

[1] Race/ethnicity is as defined by NHANES. Respondents who self-identified as "Mexican American" were coded as such regardless of their other race-ethnicity identities. Otherwise, self-identified "Hispanic" ethnicity was coded as "Other Hispanic." All other non-Hispanic participants were then categorized based on their self-reported races: non-Hispanic white, non-Hispanic black, and other non-Hispanic race including non-Hispanic multiracial (other race).

Table 27b. UFCR estimates (g/day raw weight, edible portion): Total freshwater + estuarine trophic level 2 fish, youth, <21 years, by geographic area

Freshwater + Estuarine Trophic Level 2 Finfish and Shellfish	Percentiles (95% CI)					
	50th	75th	90th	95th	97th	99th
Youth (<21 yrs)	0.3 (0.2,0.4)	0.9 (0.7,1.2)	2.3 (1.8,3.0)	4.0 (3.1,5.2)	5.5 (4.2,7.3)	9.8 (7.1,13.4)
Region[1]						
Northeast	0.3 (0.1,0.5)	0.8 (0.5,1.5)	2.1 (1.1,3.7)	3.4 (1.9,6.2)	4.7 (2.6,8.4)	8.0 (4.5,14.3)
Midwest	0.1 (0.1,0.2)	0.5 (0.3,0.8)	1.4 (0.9,2.3)	2.7 (1.7,4.2)	3.8 (2.4,6.1)	7.1 (4.2,11.7)
South	0.4 (0.2,0.6)	1.1 (0.7,1.7)	2.8 (2.0,4.1)	4.7 (3.3,6.7)	6.4 (4.5,9.2)	11.0 (7.6,16.0)
West	0.3 (0.2,0.6)	1.1 (0.7,1.7)	2.9 (1.8,4.6)	4.9 (3.0,8.1)	6.6 (3.9,11.3)	11.2 (6.3,20.0)
Coastal Status[2]						
Noncoastal	0.2 (0.1,0.3)	0.7 (0.5,1.0)	1.8 (1.3,2.5)	3.1 (2.3,4.2)	4.3 (3.2,5.9)	7.7 (5.5,10.9)
Coastal	0.4 (0.3,0.6)	1.3 (0.9,1.8)	3.4 (2.5,4.5)	5.5 (4.1,7.5)	7.4 (5.3,10.3)	12.4 (8.6,17.7)
Coastal/Inland Region[1,2]						
Pacific	0.4 (0.3,0.7)	1.5 (0.9,2.4)	3.8 (2.3,6.4)	6.1 (3.4,10.9)	8.1 (4.4,15.0)	13.5 (7.3,25.0)
Atlantic	0.4 (0.3,0.7)	1.4 (1.0,2.0)	3.5 (2.5,4.8)	5.5 (4.0,7.7)	7.3 (5.1,10.3)	11.7 (7.7,17.8)
Gulf of Mexico	0.5 (0.3,1.0)	1.7 (0.9,3.0)	4.3 (2.4,7.6)	7.1 (4.1,12.3)	9.6 (5.7,16.2)	15.2 (9.9,23.3)
Great Lakes	0.2 (0.1,0.4)	0.7 (0.5,1.2)	2.1 (1.3,3.4)	3.6 (2.2,6.2)	5.1 (3.0,8.8)	9.0 (5.1,15.8)
Inland Northeast	0.2 (0.1,0.4)	0.7 (0.4,1.3)	1.7 (0.9,3.2)	2.7 (1.4,5.3)	3.7 (1.9,7.2)	6.5 (3.3,12.9)
Inland Midwest	0.1 (0.1,0.2)	0.4 (0.3,0.7)	1.2 (0.7,1.9)	2.1 (1.3,3.7)	3.1 (1.8,5.4)	5.9 (3.2,10.7)
Inland South	0.3 (0.2,0.5)	0.9 (0.6,1.4)	2.2 (1.5,3.1)	3.6 (2.5,5.1)	4.9 (3.5,6.9)	8.6 (6.0,12.1)
Inland West	0.3 (0.2,0.5)	0.9 (0.5,1.5)	2.3 (1.4,3.8)	3.9 (2.3,6.6)	5.4 (3.2,9.1)	9.2 (5.2,16.3)

[1] U.S. regions are the U.S. Census Bureau regions. Midwest = OH, MI, IN, WI, IL, MO, IA, MN, SD, ND, NE, KS. Northeast = PA, NY, NJ, CT, RI, MA, NH, VT, ME. South = DE, MD, DC, VA, WV, KY, TN, NC, SC, GA, AL, MS, FL, LA, AR, OK, TX. West = NM, CO, WY, MT, ID, UT, AZ, NV, CA, OR, WA, AK, HI.

[2] Coastal regions include counties bordering the 3 coasts (Pacific, Atlantic, and Gulf of Mexico) and the Great Lakes and estuaries and bays. Additionally, any county that did not directly border a coast, but the central point was within 25 miles of a coast was defined as coastal. The inland regions are the remaining counties in each of the 4 Census Regions.

Table 28a. UFCR estimates (g/day raw weight, edible portion): Total freshwater + estuarine trophic level 3 fish, youth, <21 years, by demographic characteristics

Freshwater + Estuarine Trophic Level 3 Finfish and Shellfish	Percentiles (95% CI)					
	50th	75th	90th	95th	97th	99th
Youth (<21 yrs)	0.4 (0.3,0.6)	1.3 (1.0,1.7)	3.1 (2.4,3.9)	5.0 (3.9,6.4)	6.7 (5.1,8.9)	11.5 (8.1,16.2)
Age						
1 to <3 yrs	0.2 (0.1,0.4)	0.6 (0.3,1.2)	1.4 (0.8,2.6)	2.2 (1.2,4.1)	3.0 (1.6,5.5)	5.2 (2.7,10.0)
3 to <6 yrs	0.4 (0.2,0.8)	1.2 (0.7,1.9)	2.5 (1.6,3.9)	3.8 (2.5,5.9)	4.9 (3.2,7.6)	7.8 (4.8,12.7)
6 to <11 yrs	0.5 (0.3,0.7)	1.3 (1.0,1.9)	3.1 (2.2,4.5)	5.0 (3.3,7.7)	6.8 (4.3,10.7)	11.3 (6.5,19.5)
11 to <16 yrs	0.3 (0.2,0.5)	1.1 (0.8,1.6)	2.8 (2.1,3.7)	4.8 (3.6,6.4)	6.5 (4.8,8.9)	11.2 (7.9,15.8)
16 to <18 yrs	0.6 (0.3,1.2)	1.6 (1.0,2.8)	3.8 (2.6,5.6)	6.2 (4.2,9.2)	8.4 (5.5,12.9)	14.2 (8.6,23.4)
18 to <21 yrs	0.7 (0.4,1.4)	2.0 (1.2,3.4)	4.6 (3.1,6.8)	7.1 (4.6,11.1)	9.3 (5.7,15.1)	15.0 (8.7,26.0)
Gender						
Female	0.4 (0.3,0.6)	1.2 (0.9,1.6)	3.0 (2.3,3.9)	4.9 (3.7,6.5)	6.7 (4.9,9.1)	11.5 (8.0,16.5)
Male	0.5 (0.3,0.7)	1.3 (1.0,1.8)	3.1 (2.4,4.0)	5.1 (3.9,6.6)	6.8 (5.1,9.0)	11.5 (8.0,16.5)
Race/Ethnicity[1]						
Mexican American	0.5 (0.3,0.7)	1.3 (1.0,1.8)	3.0 (2.2,3.9)	4.7 (3.4,6.4)	6.3 (4.5,9.0)	11.2 (7.3,17.1)
Other Hispanic	0.4 (0.2,0.9)	1.3 (0.7,2.4)	2.8 (1.5,5.4)	4.3 (2.2,8.4)	5.6 (2.8,11.0)	8.9 (4.5,17.6)
Non-Hispanic White	0.3 (0.2,0.5)	0.8 (0.6,1.2)	1.8 (1.3,2.5)	2.7 (1.9,3.9)	3.5 (2.4,5.1)	5.8 (3.6,9.3)
Non-Hispanic Black	1.3 (0.9,1.9)	3.3 (2.4,4.7)	6.7 (4.7,9.3)	9.6 (6.7,13.5)	11.9 (8.3,17.0)	17.7 (12.2,25.9)
Other Race	1.3 (0.8,2.1)	3.4 (2.3,4.9)	6.8 (4.5,10.3)	9.8 (5.9,16.3)	12.4 (7.2,21.4)	17.3 (9.0,33.4)
Income						
$0 to <$20K	0.5 (0.3,0.7)	1.5 (1.1,2.1)	3.7 (2.8,5.0)	6.0 (4.4,8.0)	7.8 (5.7,10.9)	12.7 (8.6,18.7)
$20 to <$45K	0.5 (0.3,0.7)	1.4 (1.0,1.9)	3.2 (2.3,4.3)	5.0 (3.7,6.9)	6.6 (4.7,9.3)	10.8 (7.4,15.7)
$40 to <$75K	0.4 (0.2,0.6)	1.1 (0.7,1.7)	2.7 (1.9,4.0)	4.5 (3.1,6.6)	6.1 (4.2,9.0)	10.2 (6.8,15.4)
$75+K	0.4 (0.3,0.7)	1.3 (0.9,1.8)	2.9 (2.1,3.9)	4.6 (3.4,6.4)	6.2 (4.4,8.9)	10.9 (7.0,17.1)
>$20K	0.2 (0.1,0.9)	0.7 (0.2,2.3)	1.8 (0.7,4.8)	2.9 (1.1,7.7)	3.8 (1.4,10.5)	6.6 (2.3,18.7)
Refused/Don't Know Income	0.1 (0.0,0.5)	0.7 (0.3,2.0)	2.3 (0.9,5.5)	4.5 (1.7,12.1)	7.0 (2.3,21.0)	18.8 (5.1,68.7)
Income Missing	0.4 (0.1,1.2)	1.9 (0.4,9.3)	7.7 (0.8,71.2)	14.8 (2.1,104.0)	19.8 (3.7,105.9)	30.9 (7.7,123.0)

[1] Race/ethnicity is as defined by NHANES. Respondents who self-identified as "Mexican American" were coded as such regardless of their other race-ethnicity identities. Otherwise, self-identified "Hispanic" ethnicity was coded as "Other Hispanic." All other non-Hispanic participants were then categorized based on their self-reported races: non-Hispanic white, non-Hispanic black, and other non-Hispanic race including non-Hispanic multiracial (other race).

Table 28b. UFCR estimates (g/day raw weight, edible portion): Total freshwater + estuarine trophic level 3 fish, youth, <21 years, by geographic area

Freshwater + Estuarine Trophic Level 3 Finfish and Shellfish	Percentiles (95% CI)					
	50th	75th	90th	95th	97th	99th
Youth (<21 yrs)	0.4 (0.3,0.6)	1.3 (1.0,1.7)	3.1 (2.4,3.9)	5.0 (3.9,6.4)	6.7 (5.1,8.9)	11.5 (8.1,16.2)
Region[1]						
Northeast	0.4 (0.2,0.7)	1.1 (0.6,1.8)	2.3 (1.3,4.0)	3.5 (2.0,6.3)	4.6 (2.6,8.4)	7.5 (4.0,14.2)
Midwest	0.3 (0.1,0.5)	0.8 (0.4,1.4)	2.0 (1.2,3.4)	3.4 (1.9,5.9)	4.8 (2.7,8.4)	8.9 (5.0,15.7)
South	0.7 (0.4,1.1)	1.8 (1.2,2.8)	4.2 (2.9,6.0)	6.5 (4.5,9.5)	8.6 (5.9,12.7)	14.0 (9.0,22.0)
West	0.5 (0.3,0.7)	1.4 (1.0,1.9)	3.2 (2.4,4.4)	5.3 (3.7,7.6)	7.1 (4.7,10.8)	12.0 (7.0,20.4)
Coastal Status[2]						
Noncoastal	0.4 (0.2,0.5)	1.1 (0.8,1.5)	2.5 (1.9,3.2)	4.0 (3.1,5.2)	5.4 (4.1,7.1)	9.0 (6.6,12.4)
Coastal	0.6 (0.4,0.9)	1.7 (1.2,2.5)	4.2 (2.9,5.9)	6.7 (4.6,9.7)	9.0 (6.0,13.4)	15.0 (9.5,23.5)
Coastal/Inland Region[1,2]						
Pacific	0.5 (0.3,0.9)	1.6 (1.1,2.5)	4.1 (2.6,6.6)	6.8 (4.0,11.7)	9.2 (5.0,16.9)	15.0 (7.6,29.6)
Atlantic	0.8 (0.5,1.2)	2.1 (1.3,3.2)	4.5 (3.1,6.7)	6.9 (4.7,10.1)	8.9 (6.0,13.1)	13.9 (9.2,20.9)
Gulf of Mexico	0.8 (0.3,1.9)	2.1 (1.0,4.5)	5.1 (2.6,10.2)	8.6 (3.9,18.9)	12.1 (5.0,29.4)	21.2 (9.0,50.2)
Great Lakes	0.4 (0.2,0.6)	1.1 (0.6,2.0)	3.0 (1.6,5.5)	5.1 (2.5,10.3)	7.2 (3.4,15.0)	12.6 (5.9,26.7)
Inland Northeast	0.3 (0.2,0.6)	0.9 (0.5,1.6)	2.0 (1.1,3.4)	2.9 (1.6,5.2)	3.8 (2.1,6.8)	5.9 (3.1,11.4)
Inland Midwest	0.2 (0.1,0.4)	0.7 (0.4,1.2)	1.6 (0.9,3.0)	2.6 (1.4,4.8)	3.7 (2.0,6.7)	6.7 (3.8,11.8)
Inland South	0.6 (0.4,0.8)	1.6 (1.1,2.2)	3.5 (2.6,4.8)	5.5 (4.1,7.5)	7.2 (5.2,10.0)	11.5 (7.9,16.6)
Inland West	0.4 (0.3,0.7)	1.2 (0.8,1.8)	2.7 (1.8,3.8)	4.2 (2.9,6.0)	5.5 (3.8,8.0)	9.0 (5.9,13.8)

[1] U.S. regions are the U.S. Census Bureau regions. Midwest = OH, MI, IN, WI, IL, MO, IA, MN, SD, ND, NE, KS. Northeast = PA, NY, NJ, CT, RI, MA, NH, VT, ME. South = DE, MD, DC, VA, WV, KY, TN, NC, SC, GA, AL, MS, FL, LA, AR, OK, TX. West = NM, CO, WY, MT, ID, UT, AZ, NV, CA, OR, WA, AK, HI.

[2] Coastal regions include counties bordering the 3 coasts (Pacific, Atlantic, and Gulf of Mexico) and the Great Lakes and estuaries and bays. Additionally, any county that did not directly border a coast, but the central point was within 25 miles of a coast was defined as coastal. The inland regions are the remaining counties in each of the 4 Census Regions.

Table 29a. UFCR estimates (g/day raw weight, edible portion): Total freshwater + estuarine trophic level 4 fish, youth, <21 years, by demographic characteristics

Freshwater + Estuarine Trophic Level 4 Finfish and Shellfish	Percentiles (95% CI)					
	50th	75th	90th	95th	97th	99th
Youth (<21 yrs)	0.2 (0.1,0.3)	0.6 (0.4,1.0)	2.0 (1.2,3.2)	3.9 (2.4,6.3)	6.0 (3.6,9.9)	13.2 (7.4,23.5)
Age						
1 to <3 yrs	0.1 (0.0,0.3)	0.4 (0.2,0.9)	1.2 (0.6,2.3)	2.2 (1.2,4.0)	3.3 (1.9,5.8)	7.1 (4.1,12.3)
3 to <6 yrs	0.1 (0.0,0.2)	0.3 (0.2,0.6)	1.1 (0.6,2.1)	2.3 (1.0,5.0)	3.6 (1.4,9.5)	8.5 (1.8,39.4)
6 to <11 yrs	0.2 (0.1,0.3)	0.7 (0.4,1.2)	2.2 (1.3,3.7)	4.1 (2.3,7.5)	6.2 (3.3,11.7)	13.7 (6.7,28.0)
11 to <16 yrs	0.1 (0.1,0.3)	0.6 (0.3,1.1)	1.9 (0.9,3.7)	3.7 (1.8,7.6)	5.6 (2.7,11.8)	12.1 (5.4,27.3)
16 to <18 yrs	0.3 (0.1,1.1)	1.1 (0.4,3.3)	3.2 (1.2,8.7)	5.8 (2.1,15.9)	8.7 (3.2,23.5)	18.4 (6.7,50.0)
18 to <21 yrs	0.2 (0.1,0.5)	0.8 (0.4,1.7)	2.7 (1.3,5.4)	5.3 (2.5,11.1)	8.3 (3.8,17.9)	18.9 (7.3,48.8)
Gender						
Female	0.1 (0.1,0.2)	0.5 (0.3,0.8)	1.5 (0.9,2.3)	2.9 (1.8,4.5)	4.4 (2.8,7.1)	9.8 (5.8,16.7)
Male	0.2 (0.1,0.4)	0.8 (0.5,1.4)	2.5 (1.5,4.3)	4.9 (2.9,8.4)	7.5 (4.2,13.1)	16.5 (8.8,30.8)
Race/Ethnicity[1]						
Mexican American	0.1 (0.1,0.2)	0.4 (0.3,0.7)	1.4 (0.9,2.2)	2.7 (1.7,4.5)	4.3 (2.5,7.2)	9.8 (5.1,18.9)
Other Hispanic	0.1 (0.0,0.4)	0.6 (0.2,1.9)	2.0 (0.4,8.6)	4.1 (0.7,22.7)	6.2 (0.9,43.6)	13.9 (1.3,145.9)
Non-Hispanic White	0.1 (0.1,0.3)	0.5 (0.2,0.9)	1.5 (0.8,3.0)	2.9 (1.4,5.7)	4.3 (2.1,8.8)	9.1 (4.2,19.9)
Non-Hispanic Black	0.4 (0.2,0.8)	1.4 (0.7,2.6)	3.9 (2.1,7.5)	7.3 (3.8,14.1)	10.8 (5.5,20.9)	22.5 (11.1,45.3)
Other Race	0.4 (0.2,0.7)	1.4 (0.7,2.6)	4.4 (2.2,8.7)	8.8 (4.2,18.3)	13.3 (6.0,29.7)	30.7 (10.6,88.8)
Income						
$0 to <$20K	0.2 (0.1,0.3)	0.7 (0.4,1.1)	2.1 (1.3,3.5)	4.1 (2.4,6.9)	6.2 (3.6,10.9)	13.3 (6.9,25.3)
$20 to <$45K	0.1 (0.1,0.3)	0.5 (0.3,0.9)	1.6 (0.9,2.9)	3.2 (1.8,5.8)	5.0 (2.7,9.2)	11.3 (5.6,22.9)
$40 to <$75K	0.2 (0.1,0.3)	0.6 (0.4,1.0)	2.0 (1.2,3.4)	4.0 (2.3,7.0)	6.2 (3.4,11.3)	14.6 (7.2,29.7)
$75+K	0.2 (0.1,0.4)	0.8 (0.4,1.4)	2.3 (1.3,4.1)	4.5 (2.6,7.7)	6.6 (3.7,11.6)	13.9 (7.5,25.8)
>$20K	0.0 (0.0,0.3)	0.3 (0.1,1.6)	1.7 (0.5,5.7)	3.7 (1.2,10.9)	5.8 (2.0,16.2)	14.1 (5.3,37.2)
Refused/Don't Know Income	0.0 (0.0,0.1)	0.1 (0.0,0.5)	0.5 (0.1,2.1)	1.3 (0.3,5.5)	2.4 (0.5,11.5)	9.5 (1.4,64.2)
Income Missing	0.1 (0.0,0.4)	0.4 (0.1,1.9)	1.6 (0.3,7.8)	3.6 (0.8,15.5)	5.5 (1.4,21.4)	12.1 (3.5,41.6)

[1] Race/ethnicity is as defined by NHANES. Respondents who self-identified as "Mexican American" were coded as such regardless of their other race-ethnicity identities. Otherwise, self-identified "Hispanic" ethnicity was coded as "Other Hispanic." All other non-Hispanic participants were then categorized based on their self-reported races: non-Hispanic white, non-Hispanic black, and other non-Hispanic race including non-Hispanic multiracial (other race).

Table 29b. UFCR estimates (g/day raw weight, edible portion): Total freshwater + estuarine trophic level 4 fish, youth, <21 years, by geographic area

Freshwater + Estuarine Trophic Level 4 Finfish and Shellfish	Percentiles (95% CI)					
	50th	75th	90th	95th	97th	99th
Youth (<21 yrs)	0.2 (0.1,0.3)	0.6 (0.4,1.0)	2.0 (1.2,3.2)	3.9 (2.4,6.3)	6.0 (3.6,9.9)	13.2 (7.4,23.5)
Region[1]						
Northeast	0.1 (0.0,0.2)	0.3 (0.1,0.7)	1.0 (0.4,2.3)	2.0 (0.8,5.0)	3.1 (1.1,8.5)	6.9 (1.9,24.9)
Midwest	0.2 (0.0,0.6)	0.7 (0.2,2.3)	2.4 (0.8,7.0)	4.9 (1.8,13.3)	7.6 (2.9,20.0)	17.9 (7.0,45.8)
South	0.2 (0.1,0.4)	0.8 (0.5,1.3)	2.4 (1.6,3.7)	4.6 (2.9,7.3)	6.9 (4.2,11.3)	14.7 (8.3,25.8)
West	0.2 (0.1,0.3)	0.6 (0.4,0.9)	1.7 (1.1,2.7)	3.3 (2.0,5.4)	4.9 (2.9,8.2)	10.2 (5.4,19.3)
Coastal Status[2]						
Noncoastal	0.1 (0.1,0.3)	0.6 (0.3,1.0)	1.8 (1.0,3.1)	3.5 (2.0,6.0)	5.3 (3.0,9.3)	11.7 (6.4,21.6)
Coastal	0.2 (0.1,0.4)	0.7 (0.4,1.3)	2.4 (1.5,4.0)	4.7 (2.8,7.8)	7.2 (4.2,12.3)	15.9 (8.3,30.5)
Coastal/Inland Region[1,2]						
Pacific	0.2 (0.1,0.3)	0.6 (0.3,1.1)	1.9 (1.1,3.2)	3.7 (2.1,6.2)	5.5 (3.1,9.7)	11.8 (6.0,23.2)
Atlantic	0.2 (0.1,0.4)	0.8 (0.4,1.4)	2.4 (1.3,4.3)	4.6 (2.5,8.5)	7.0 (3.7,13.5)	15.3 (6.5,35.8)
Gulf of Mexico	0.3 (0.1,0.5)	0.9 (0.5,1.8)	2.8 (1.5,5.2)	5.4 (3.0,9.8)	8.1 (4.5,14.5)	15.7 (7.7,32.0)
Great Lakes	0.2 (0.1,0.5)	0.8 (0.3,2.2)	2.8 (1.0,7.8)	5.7 (2.0,16.7)	9.1 (3.0,27.9)	22.6 (6.5,78.6)
Inland Northeast	0.1 (0.0,0.2)	0.2 (0.1,0.6)	0.8 (0.3,2.1)	1.7 (0.6,4.9)	2.7 (0.8,8.8)	6.0 (1.3,28.0)
Inland Midwest	0.2 (0.0,0.6)	0.7 (0.2,2.4)	2.3 (0.7,6.9)	4.5 (1.6,12.5)	6.8 (2.6,17.9)	15.7 (6.5,37.9)
Inland South	0.2 (0.1,0.3)	0.7 (0.4,1.1)	2.1 (1.3,3.3)	3.9 (2.4,6.4)	5.9 (3.5,9.9)	12.7 (7.2,22.4)
Inland West	0.2 (0.1,0.3)	0.5 (0.3,0.9)	1.6 (0.9,2.7)	3.0 (1.7,5.2)	4.4 (2.5,7.8)	9.1 (4.6,18.0)

[1] U.S. regions are the U.S. Census Bureau regions. Midwest = OH, MI, IN, WI, IL, MO, IA, MN, SD, ND, NE, KS. Northeast = PA, NY, NJ, CT, RI, MA, NH, VT, ME. South = DE, MD, DC, VA, WV, KY, TN, NC, SC, GA, AL, MS, FL, LA, AR, OK, TX. West = NM, CO, WY, MT, ID, UT, AZ, NV, CA, OR, WA, AK, HI.

[2] Coastal regions include counties bordering the 3 coasts (Pacific, Atlantic, and Gulf of Mexico) and the Great Lakes and estuaries and bays. Additionally, any county that did not directly border a coast, but the central point was within 25 miles of a coast was defined as coastal. The inland regions are the remaining counties in each of the 4 Census Regions.

5.3 Uncertainty

The estimated fish consumption rates may be uncertain due to either bias or random variation. Bias results in a consistently high or consistently low fish consumption rate relative to the true or desired value. Variation results in an uncertain fish consumption rate that might be either higher or lower than the true value.

The primary sources of random variation are the following:

- Sampling error associated with the random selection of NHANES respondents. For example, if different counties and individuals had been selected for the NHANES data collection, the data and FCRs would be different.
- Random differences due to the simulation of usual fish consumption for each NHANES respondent. This source of variation can be reduced by increasing the number of simulations.

The confidence intervals for the fish consumption rates account for both of these sources of variation. Estimates for coastal regions will be less precise than national estimates because the number of respondents in the coastal regions is a fraction of the number of NHANES respondents nationally. As a result, the confidence intervals for coastal regions are wider than for national estimates. Similarly, if there are fewer respondents with reported fish consumption in two 24-hour recalls, there is less data to estimate the parameters and particularly the variance components, resulting in more uncertainty in the fish consumption estimates and wider confidence intervals.

There are multiple sources of bias that can affect the fish consumption rates including:

- Seasonality;
- Respondent bias;
- Use of standard recipes to calculate fish consumption amounts from the NHANES 24-hour recalls;
- Classification of the fish consumed into types of fish habitats;
- Bias associated with the estimation method (either the NCI or EPA Method) and its assumptions; and
- Use of approximate analysis weights for coastal versus non-coastal comparisons.

Each of these sources of bias is discussed in more detail below.

5.3.1 Seasonality

Fish consumption, especially of recreationally or sport-caught fish, is likely to vary by season. NHANES collects data throughout the year. However, NHANES generally collects data in northern counties in the summer and southern counties in the winter. Thus the estimates may overestimate usual intake in the northern regions of the United States and underestimate usual intake in the southern regions of the United States if summer fish consumption is higher than winter fish consumption. There is no way to estimate this season effect as there are little or no NHANES data from northern counties in the winter and southern counties in the summer.

5.3.2 Bias in the Reported Fish Consumption

The reported fish consumption is a combination of the frequency of fish consumption and the amount consumed if fish was consumed. The reported fish consumption may be biased if NHANES respondents tend to report consistently more or less fish consumption in the 24-hour recall than actually occurred. Assessing if the reported values are biased requires comparing reported values to estimates obtained using other data collection approaches, such as analysis of duplicate meals. Over the years, much research has gone into assessing dietary intake, resulting in the procedures used by NHANES. As a result, the estimates from NHANES are generally considered to have minimal bias. Nonetheless, the estimates may be biased and the bias may be different for different communities or subpopulations.

5.3.3 Use of Standard Recipes

The FNDDS utilizes standard recipes for foods reported consumed. NHANES participants do not supply specific recipes of the foods they consumed. They provide details such as whether the fish was breaded, cooked in margarine, baked or broiled, etc., but they do not provide exact recipes (which they are likely not to know anyway). For example, the standard recipe for the food "Scallops and noodles with cheese sauce" is approximately 35 percent fish. However, the true recipe for the food consumed by an NHANES respondent may have less fish or more fish than the standard recipe. Additionally, there is uncertainty associated with the moisture loss values for processing and cooking methods. They are average values of moisture loss given the various processing and cooking methods. If participants cooked their fish a bit longer than the moisture loss would be a bit greater than average, and if they cooked it a bit less, the moisture loss would be a bit less than average.

5.3.4 Habitat Assignments

There is some uncertainty associated with the assignment of habitats to reported fish consumption. When the raw data are processed by NHANES, fish species reported consumed are combined into groups. Generally, these groupings are based on taxonomic groups. This grouping of species complicates the assignment of habitat because in some cases, the grouped fish can inhabit different habitats and there is no way to determine the exact species the participant consumed. For some species, apportioning relied on NOAA landings data to assign species of fish groups with many species (e.g., clams) to habitats. Bias in the proportion of each species assigned to each habitat will directly affect the corresponding fish consumption rate. For example, if more fish are assigned to the estuarine habitat, then the total amount of estuarine fish consumed and the percentiles of fish consumption will be higher than if fewer fish are assigned to the habitat. Even if the allocation to fish habitats is unbiased overall, there may be bias for local estimates. For example, if residents in coastal counties each more locally caught estuarine fish and non-coastal residents eat more commercial non-estuarine fish of the same species, the estimated proportion of estuarine fish will be biased low for the coastal counties and biased high for the non-coastal counties.

5.3.5 Estimation of Usual Fish Consumption

Measurements of usual fish consumption are very difficult to obtain. Since usual fish consumption is a long-term average, we would need many 24-hour recalls over a long time to approximate what "usual intake" is trying to assess; therefore we rely on a statistical model and associated assumptions to estimate usual intake. As a result, the estimates of usual fish consumption depend in part on the statistical assumptions.

The model makes certain assumptions, such as, 24-hour recalls provide unbiased estimates of fish consumption, all respondents are fish consumers (at least occasionally), and the distribution of fish consumption among those reporting consumption in a 24-hour recall is normally distributed for some power transformation. The validity of these assumptions can be discussed and, to some extent evaluated using data.

The estimates of the frequency of fish consumption depend in part on how non-consumers (those who never eat fish or don't eat fish for a long time) are treated. From two 24-hour recalls it is not possible to separate true non-consumers from those who did not happen to report fish consumption in either recall. A similar problem relates to consumption of small amounts for fish. Should a person who never eats an identifiable piece of fish but uses a salad dressing with a small amount of fish in it be considered a regular consumer of a very small amount or a non-consumer of fish? Whether a meal is classified as having fish may depend on the procedures used to ask the questions and the recipes used to estimate fish consumption. Unfortunately we do not have the data needed to identify non-consumers. Having non-consumers in the data will lower the overall probability of fish consumption (P) but increase the variance of the probability of fish consumption among individuals. The resulting effect on the upper percentiles of the distribution is not clear.

The reported amount of fish consumption will vary from one 24-hour recall to another, in part because the respondents may be poor at estimating the amount consumed and in part because the consumption amounts are reported in rounded units, such as a cup or a pint, but not 1.267 cups. The rounding adds some uncertainty to the estimates. The within-person variance component accounts for uncertainty due to poor estimation by the respondent and rounding that is part of the process. Because the definition of usual fish consumption does not include the within-person variation, this source of error should contribute minimal bias to the estimates of usual fish consumption.

The statistical models for the NCI and EPA Methods make some assumptions to simplify the computations, such as an assumption that variance components are normally distributed, additive in the transformed scale, and linearly correlated. The assumption that the person-specific random effect in the probability model is normally distributed is difficult to test without many more 24-hour recalls for each person. The assumption that the two variance components in the amount model are normally distributed is generally consistent with the observation that the Box-Cox transformed consumption amounts are roughly normally distributed. Nevertheless, other assumptions may imply a similar distribution for the reported amounts while using a somewhat different assumption for the person-specific variance component and thus somewhat different estimates of fish consumption. Because the estimated parameters must be consistent with the reported data, the general center and spread of the predicted distribution will be similar regardless of the distributional assumptions. Specific percentiles may be either higher or lower using different assumptions or may be relatively insensitive to the distributional assumptions. Although these assumptions are common in other statistical applications, it is difficult to assess how the estimates might change using other assumptions.

If the model assumptions are accepted as reasonable, then the question is whether the estimates from the model are biased. The estimates are based on maximum likelihood, which can produce biased estimates, particularly variance estimates, with small sample sizes. However, convergence theory says maximum likelihood is best with large sample sizes. Due to the relatively large sample sizes, we expect the estimates to have relatively little bias compared to the size of the confidence intervals.

The fish consumption estimates depend in part on the independent predictors used in the model. When different predictors are used, the estimates change. It is impossible to know what the best set of predictors is. A systematic approach was used to selecting the independent predictors from the available predictors in an effort to minimize any bias. The estimates have unknown bias due to the decisions that were made.

Relative to the NCI Method, the EPA Method uses approximate methods to estimate the parameters and as a result, percentile estimates from the EPA Method may be more biased than from the NCI Method. The analysis of simulated data and the comparison of the FCR percentiles between the NCI and EPA Methods suggest that the results from the EPA Method have little bias overall, although estimates for some percentiles may be more biased than for others. The bias observed in the comparisons between the NCI Method and the EPA Method are very small compared to the spread of the overall distribution, generally small compared to the width of the confidence interval, and on the same order as bias due to other sources such as the selection of the independent predictors.

5.3.6 Weights for Coastal Versus Non-Coastal Regions

The U.S. Census regions are used in the calculation of the NHANES weights. However, the analysis using coastal versus non-coastal regions is looking at smaller areas than intended when the weights were constructed. Some of the coastal/noncoastal regions cross these Census regions. As a result, comparisons among coastal and non-coastal regions may be slightly biased or less precise then indicated by the confidence intervals. At the same time, the weights also adjust for oversampling of some populations and survey nonresponse, so we believe it is important to use the weights. While the estimates may be more imprecise and there may be some uncertainty due to the weighting, they are still a better representation for each coastal/noncoastal area then using unweighted or national estimates.

Discussion 6

Fish consumption is higher among males compared to females and increases with increasing age, although persons aged 65 and over show decreased consumption. People of races other than Black and White have the highest fish consumption rates of all race/ethnicity groups, with significant differences observed across all percentiles and many fish types, excluding freshwater and estuarine fish, trophic level 2 fish, trophic level 2 freshwater and estuarine fish, and trophic level 2 marine fish. The other race category consists of Asian, Native American, Pacific and Caribbean Islander, Alaska Native, multiracial, and unknown race. There is a general increase in consumption as income increases.

People in the Northeast have higher total fish consumption rates than those living in the other Census regions, while people in the Midwest have the lowest rates. Significant differences are observed between the regions. The inland regions generally have lower fish consumption rates than the coastal regions except for the Great Lakes region, which is more similar to an inland region, and the inland Northeast, which appears more similar to a coastal region. This pattern is different for freshwater fish for which the people in the inland south, Great Lakes, and the Gulf of Mexico have the highest consumption rates.

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Chemical-specific Inputs for EPA's 2015 Final Updated Human Health Ambient Water Quality Criteria

Chemical Name	CAS	Cancer Slope Factor, CSF (per mg/kg-d)	Reference Dose, RfD (mg/kg-d)	Relative Source Contribution, RSC (-)	Bioaccumulation Factor			Bioconcen-tration Factor (L/kg tissue)
					Trophic Level 2 (L/kg tissue)	Trophic Level 3 (L/kg tissue)	Trophic Level 4 (L/kg tissue)	
1,1,1-Trichloroethane	71-55-6	ND	2	0.20	6.9	9.0	10	
1,1,2,2-Tetrachloroethane	79-34-5	0.2	0.02	0.20	5.7	7.4	8.4	
1,1,2-Trichloroethane	79-00-5	0.057	0.004	0.20	6.0	7.8	8.9	
1,1-Dichloroethylene	75-35-4	ND	0.05	0.20	2.0	2.4	2.6	
1,2,4,5-Tetrachlorobenzene	95-94-3	ND	0.0003	0.20	17,000	2,900	1,500	
1,2,4-Trichlorobenzene	120-82-1	0.029	0.01	0.20	2,800	1,500	430	
1,2-Dichlorobenzene	95-50-1	ND	0.3	0.20	52	71	82	
1,2-Dichloroethane	107-06-2	0.0033	0.078	0.20	1.6	1.8	1.9	
1,2-Dichloropropane	78-87-5	0.036	0.0893	0.20	2.9	3.5	3.9	
1,2-Diphenylhydrazine	122-66-7	0.8	ND	ND	18	24	27	
1,3-Dichlorobenzene	541-73-1	ND	0.002	0.20	31	120	190	
1,3-Dichloropropene	542-75-6	0.122	0.025	0.20	2.3	2.7	3.0	
1,4-Dichlorobenzene	106-46-7	ND	0.07	0.20	28	66	84	
2,4,5-Trichlorophenol	95-95-4	ND	0.1	0.20	100	140	160	
2,4,6-Trichlorophenol	88-06-2	0.011	0.001	0.20	94	130	150	
2,4-Dichlorophenol	120-83-2	ND	0.003	0.20	31	42	48	
2,4-Dimethylphenol	105-67-9	ND	0.02	0.20	4.8	6.2	7.0	
2,4-Dinitrophenol	51-28-5	ND	0.002	0.20	4.4*	4.4*	4.4*	
2,4-Dinitrotoluene	121-14-2	0.667	0.002	0.20	2.8	3.5	3.9	
2-Chloronaphthalene	91-58-7	ND	0.08	0.80	150	210	240	
2-Chlorophenol	95-57-8	ND	0.005	0.20	3.8	4.8	5.4	
2-Methyl-4,6-Dinitrophenol	534-52-1	ND	0.0003	0.20	6.8	8.9	10	
3,3'-Dichlorobenzidine	91-94-1	0.45	ND	ND	44	60	69	
3-Methyl-4-Chlorophenol	59-50-7	ND	0.1	0.20	25	34	39	
Acenaphthene	83-32-9	ND	0.06	0.20	510*	510*	510*	
Acrolein	107-02-8	ND	0.0005	0.20	1.0	1.0	1.0	
Acrylonitrile	107-13-1	0.54	ND	ND	1.0	1.0	1.0	

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					Trophic Level 2 (L/kg tissue)	Trophic Level 3 (L/kg tissue)	Trophic Level 4 (L/kg tissue)	
Aldrin	309-00-2	17	0.00003	0.20	18,000	310,000	650,000	
alpha-Hexachlorocyclohexane (HCH)	319-84-6	6.3	0.008	0.20	1,700	1,400	1,500	
alpha-Endosulfan	959-98-8	ND	0.006	0.20	130	180	200	
Anthracene	120-12-7	ND	0.3	0.20	610*	610*	610*	
Benzene	71-43-2	0.015 – 0.055	0.0005	0.20	3.6	4.5	5.0	
Benzidine	92-87-5	230	0.003	0.20	1.4	1.6	1.7	
Benzo(a)anthracene	56-55-3	0.73	ND	ND	3,900*	3,900*	3,900*	
Benzo(a)pyrene	50-32-8	7.3	ND	ND	3,900*	3,900*	3,900*	
Benzo(b)fluoranthene	205-99-2	0.73	ND	ND	3,900*	3,900*	3,900*	
Benzo(k)fluoranthene	207-08-9	0.073	ND	ND	3,900*	3,900*	3,900*	
beta-Hexachlorocyclohexane (HCH)	319-85-7	1.8	ND	ND	110	160	180	
beta-Endosulfan	33213-65-9	ND	0.006	0.20	80	110	130	
Bis(2-Chloro-1-Methylethyl) Ether	108-60-1	ND	0.04	0.20	6.7	8.8	10	
Bis(2-Chloroethyl) Ether	111-44-4	1.1	ND	ND	1.4	1.6	1.7	
Bis(2-Ethylhexyl) Phthalate	117-81-7	0.014	0.06	0.20	710*	710*	710*	
Bis(Chloromethyl) Ether	542-88-1	220	ND	ND	1.0	1.0	1.0	
Bromoform	75-25-2	0.0045	0.03	0.20	5.8	7.5	8.5	
Butylbenzyl Phthalate	85-68-7	0.0019	1.3	0.20	19,000*	19,000*	19,000*	
Carbon Tetrachloride	56-23-5	0.07	0.004	0.20	9.3	12	14	
Chlordane	57-74-9	0.35	0.0005	0.20	5,300	44,000	60,000	
Chlorobenzene	108-90-7	ND	0.02	0.20	14	19	22	
Chlorodibromomethane	124-48-1	0.040	0.02	0.20	3.7	4.8	5.3	
Chloroform	67-66-3	ND	0.01	0.20	2.8	3.4	3.8	
Chlorophenoxy Herbicide (2,4-D)	94-75-7	ND	0.21	0.20	13*	13*	13*	
Chlorophenoxy Herbicide (2,4,5-TP) [Silvex]	93-72-1	ND	0.008	0.80	58*	58*	58*	

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					Trophic Level 2 (L/kg tissue)	Trophic Level 3 (L/kg tissue)	Trophic Level 4 (L/kg tissue)	
Chrysene	218-01-9	0.0073	ND	ND	3,900*	3,900*	3,900*	
Cyanide	57-12-5	ND	0.0006	0.20	ND	ND	ND	1**
Dibenzo(a,h)anthracene	53-70-3	7.3	ND	ND	3,900*	3,900*	3,900*	
Dichlorobromomethane	75-27-4	0.034	0.003	0.20	3.4	4.3	4.8	
Dieldrin	60-57-1	16	0.00005	0.20	14,000	210,000	410,000	
Diethyl Phthalate	84-66-2	ND	0.8	0.20	920*	920*	920*	
Dimethyl Phthalate	131-11-3	ND	10	0.20	4,000*	4,000*	4,000*	
Di-n-Butyl Phthalate	84-74-2	ND	0.1	0.20	2,900*	2,900*	2,900*	
Dinitrophenols	25550-58-7	ND	0.002	0.20	ND	ND	ND	1.51**
Endosulfan Sulfate	1031-07-8	ND	0.006	0.20	88	120	140	
Endrin	72-20-8	ND	0.0003	0.80	4,600	36,000	46,000	
Endrin Aldehyde	7421-93-4	ND	0.0003	0.80	440	920	850	
Ethylbenzene	100-41-4	ND	0.022	0.20	100	140	160	
Fluoranthene	206-44-0	ND	0.04	0.20	1,500*	1,500*	1,500*	
Fluorene	86-73-7	ND	0.04	0.20	230	450	710	
gamma- Hexachlorocyclohexane (HCH)	58-89-9	ND	0.0047	0.50	1,200	2,400	2,500	
Heptachlor	76-44-8	4.1	0.0001	0.20	12,000	180,000	330,000	
Heptachlor Epoxide	1024-57-3	5.5	0.000013	0.20	4,000	28,000	35,000	
Hexachlorobenzene	118-74-1	1.02	0.0008	0.20	18,000	46,000	90,000	
Hexachlorobutadiene	87-68-3	0.04	0.0003	0.20	23,000	2,800	1,100	
Hexachlorocyclohexane (HCH)-Technical	608-73-1	1.8	ND	ND	160	220	250	
Hexachlorocyclopentadiene	77-47-4	ND	0.006	0.20	620	1,500	1,300	
Hexachloroethane	67-72-1	0.04	0.0007	0.20	1,200	280	600	
Indeno(1,2,3-cd)pyrene	193-39-5	0.73	ND	ND	3,900*	3,900*	3,900*	
Isophorone	78-59-1	0.00095	0.2	0.20	1.9	2.2	2.4	
Methoxychlor	72-43-5	ND	0.00002	0.80	1,400	4,800	4,400	

Chemical-specific Inputs for EPA's 2015 Final Updated Human Health Ambient Water Quality Criteria

Chemical Name	CAS	Cancer Slope Factor, CSF (per mg/kg-d)	Reference Dose, RfD (mg/kg-d)	Relative Source Contribution, RSC (-)	Bioaccumulation Factor Trophic Level 2 (L/kg tissue)	Bioaccumulation Factor Trophic Level 3 (L/kg tissue)	Bioaccumulation Factor Trophic Level 4 (L/kg tissue)	Bioconcentration Factor (L/kg tissue)
Methyl Bromide	74-83-9	ND	0.02	0.20	1.2	1.3	1.4	
Methylene Chloride	75-09-2	0.002	0.006	0.20	1.4	1.5	1.6	
Nitrobenzene	98-95-3	ND	0.002	0.20	2.3	2.8	3.1	
Pentachlorobenzene	608-93-5	ND	0.0008	0.20	3,500	4,500	10,000	
Pentachlorophenol	87-86-5	0.4	0.005	0.20	44	290	520	
Phenol	108-95-2	ND	0.6	0.20	1.5	1.7	1.9	
p,p'-Dichlorodiphenyldichloroethane (DDD)	72-54-8	0.24	0.0005	0.20	33,000	140,000	240,000	
p,p'-Dichlorodiphenyldichloroethylene (DDE)	72-55-9	0.167	0.0005	0.20	270,000	1,100,000	3,100,000	
p,p'-Dichlorodiphenyltrichloroethane (DDT)	50-29-3	0.34	0.0005	0.20	35,000	240,000	1,100,000	
Pyrene	129-00-0	ND	0.03	0.20	860*	860*	860*	
Tetrachloroethylene (Perchloroethylene)	127-18-4	0.0021	0.006	0.20	49	66	76	
Toluene	108-88-3	ND	0.0097	0.20	11	15	17	
Toxaphene	8001-35-2	1.1	0.00035	0.20	1,700	6,600	6,300	
trans-1,2-Dichloroethylene (DCE)	156-60-5	ND	0.02	0.20	3.3	4.2	4.7	
Trichloroethylene (TCE)	79-01-6	0.05	0.0005	0.20	8.7	12	13	
Vinyl Chloride	75-01-4	1.5	0.003	0.20	1.4	1.6	1.7	

ND = No data.
* This bioaccumulation factor was estimated from laboratory-measured bioconcentration factors; EPA multiplied this bioaccumulation factor by the overall national recommended fish consumption rate of 22.0 g/d (see EPA's 2014 *Estimated Fish Consumption Rates for the U.S. Population and Selected Subpopulations (NHANES 2003-2010)*) to calculate the 2015 final updated human health criteria.
** EPA multiplied this bioconcentration factor by the overall national recommended fish consumption rate of 22.0 g/d (see EPA's 2014 *Estimated Fish Consumption Rates for the U.S. Population and Selected Subpopulations (NHANES 2003-2010)*) to calculate the 2015 final updated human health criteria.

United States Environmental Protection Agency

Office of Water
EPA 820-F-15-001
June 2015

Human Health Ambient Water Quality Criteria: 2015 Update

Summary

EPA published final updated ambient water quality criteria for the protection of human health for 94 chemical pollutants. These updated recommendations reflect the latest scientific information and EPA policies, including updated body weight, drinking water consumption rate, fish consumption rate, bioaccumulation factors, health toxicity values, and relative source contributions. EPA accepted written scientific views from the public from May to August 2014 on the draft updated human health criteria and has published responses to those comments. EPA water quality criteria serve as recommendations to states and tribes authorized to establish water quality standards under the Clean Water Act.

Background

Ambient water quality criteria developed by EPA under Clean Water Act section 304(a) represent specific levels of chemicals or conditions in a water body that are not expected to cause adverse effects to human health. EPA is required to develop and publish water quality criteria that reflect the latest scientific knowledge. These criteria are not rules, nor do they automatically become part of a state's water quality standards. States may adopt the criteria that EPA publishes, modify EPA's criteria to reflect site-specific conditions, or adopt different criteria based on other scientifically-defensible methods. EPA must, however, approve any new water quality standards adopted by a state before they can be used for Clean Water Act purposes.

In this 2015 update, EPA revised 94 of the existing human health criteria to reflect the latest scientific information, including updated exposure factors (body weight, drinking water consumption rates, fish consumption rate), bioaccumulation factors, and toxicity factors (reference dose, cancer slope factor). The criteria have also been updated to follow the current EPA methodology for deriving human health criteria (USEPA 2000). EPA also developed chemical-specific science documents for each of the 94 chemical pollutants. The science documents detail the latest scientific information supporting the updated final human health criteria, particularly the updated toxicity and exposure input values. Specific updates are described below.

Due to outstanding technical issues, EPA did not update human health criteria for the following chemical pollutants at this time: antimony, arsenic, asbestos, barium, beryllium, cadmium, chromium (III or VI), copper, manganese, methylmercury, nickel, nitrates, nitrosamines, N-nitrosodibutylamine, N-nitrosodiethylamine, N-nitrosopyrrolidine, N-nitrosodimethylamine, N-nitrosodi-n-propylamine, N-nitrosodiphenylamine, polychlorinated biphenyls (PCBs), selenium, thallium, zinc, or 2,3,7,8-TCDD (dioxin).

It is important for states and authorized tribes to consider any new or updated section 304(a) criteria as part of their triennial review to ensure that state or tribal water quality standards reflect current science and protect applicable designated uses. EPA recently proposed revisions to its water quality standards regulations that would, if finalized without substantive change, require states during their triennial reviews to consider new or updated section 304(a) recommended criteria and, if they do not adopt new or revised criteria for such pollutants, provide an explanation to EPA as to why the state did not do so. These final updated human health criteria recommendations supersede EPA's previous recommendations.

Updated Exposure Inputs

Body Weight

EPA updated the default body weight for human health criteria to 80 kilograms based on National Health and Nutrition Examination Survey (NHANES) data from 1999 to 2006 (USEPA 2011). This represents the mean body weight for adults ages 21 and older. EPA's previously recommended default body weight was 70 kilograms, which was based on the mean body weight of adults from the NHANES III database (1988-1994).

Drinking Water

EPA updated the default drinking water consumption rate to 2.4 liters per day based on NHANES data from 2003 to 2006 (USEPA 2011). This represents the per capita estimate of community water ingestion at the 90th percentile for adults ages 21 and older. EPA previously recommended a default drinking water consumption rate of 2 liters per day, which represented the per capita community water ingestion rate at the 86th percentile for adults surveyed in the US Department of Agriculture's 1994-1996 Continuing Survey of Food Intake by Individuals (CSFII) analysis and the 88th percentile of adults in the National Cancer Institute study of the 1977-1978 Nationwide Food Consumption Survey.

Fish Consumption

EPA updated the default fish consumption rate to 22 grams per day. This rate represents the 90th percentile consumption rate of fish and shellfish from inland and nearshore waters for the U.S. adult population 21 years of age and older, based on NHANES data from 2003 to 2010 (USEPA 2014). EPA's previously recommended rate of 17.5 grams per day was based on the 90th percentile consumption rate of fish and shellfish from inland and nearshore waters for the U.S. adult population and was derived from 1994-1996 CSFII data.

As described in EPA's human health criteria methodology (USEPA 2000), the level of fish consumption in highly exposed populations varies by geographical location. Therefore, EPA suggests a four preference hierarchy for states and authorized tribes that encourages use of the best local, state, or regional data available to derive fish consumption rates. EPA recommends that states and authorized tribes consider developing criteria to protect highly exposed population groups and use local or regional data in place of a default value as more representative of their target population group(s). The preferred hierarchy is: (1) use of local data; (2) use of data reflecting similar geography/ population groups; (3) use of data from national surveys; and (4) use of EPA's default consumption rates.

Bioaccumulation Factors

EPA's methodology for deriving human health criteria emphasizes using, when possible, measured or estimated bioaccumulation factors (BAFs), which account for chemical accumulation in aquatic organisms from all potential exposure routes (USEPA 2000). Unlike bioconcentration factors, BAFs account for more exposure pathways than direct water contact. As a result, the updated criteria will better represent exposures to pollutants that affect human health. In order to account for the variation in bioaccumulation that is due to trophic position of the organism, EPA's methodology (USEPA 2000) recommends that BAFs be determined and applied to three trophic levels of fish.

EPA selected BAFs using a framework for deriving national trophic level-specific BAFs (USEPA 2000; USEPA 2003). EPA used field-measured BAFs and laboratory-measured bioconcentration factors available from peer-reviewed, publicly available databases to develop national BAFs. If this information was not available, EPA selected octanol-water partition coefficients (Kow values) from peer-reviewed sources for use in calculating national BAFs. As an additional line of evidence, EPA reported model-estimated BAFs for every chemical based on the Estimation Program Interface (EPI) Suite (USEPA 2012) to support the field-measured or predicted BAFs.

Updated Health Toxicity Values

EPA considered all available toxicity values for both noncarcinogenic and carcinogenic toxicological effects to develop the updated human health criteria. EPA's Integrated Risk Information System (IRIS) was the primary source for reference dose and cancer slope factors for this update. For some pollutants, however, more recent toxicity assessments were provided by EPA's Office of Water, EPA's Office of Pesticide Programs, and international or state agencies. EPA followed a systematic process to search for and select the toxicity values used to derive the final updated human health criteria for noncarcinogenic and carcinogenic effects.

Relative Source Contribution

EPA updated the human health criteria to reflect chemical-specific relative source contributions (RSC) ranging from 20 to 80 percent following the Exposure Decision Tree approach described in EPA's methodology (USEPA 2000). EPA recommends inclusion of an RSC when developing human health criteria for threshold non-carcinogens or non-linear carcinogens. The RSC allows a percentage of the reference dose's exposure to be attributed to ambient water and fish consumption (including fish and shellfish from inland and nearshore waters) when there are other potential exposure sources. The rationale for this approach is that the objective of the water quality criteria is to ensure that an individual's total exposure from all sources does not exceed the criteria. Exposures outside of the RSC include, but are not limited to, exposure to a particular pollutant from ocean fish consumption (not included in the fish consumption rate), non-fish food consumption (meats, poultry, fruits, vegetables, and grains), dermal exposure, and respiratory exposure.

Where can I find more information?

To access the Federal Register notice, the final updated criteria, and supporting documents visit EPA's National Recommended Human Health Criteria website at: http://water.epa.gov/scitech/swguidance/standards/criteria/health/.

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