

# **Literature Review of Fish Consumption Rate Research Conducted in the State of Alaska**

**March 2015**

Originally Prepared by  
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for

Alaska Department of Conservation

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## **Acronyms**

ADEC	Alaska Department of Environmental Conservation
ADF&G	Alaska Department of Fish and Game
APDES	Alaska Pollutant Discharge Elimination System
ASFDB	Alaska Subsistence Fisheries Database
ATSDR	U.S. Agency for Toxic Substances and Disease Registry
BBAHC	Bristol Bay Area Health Corporation
CSIS	Community Subsistence Information System
CWA	Clean Water Act
DDT	Dichloro-diphenyl-trichloroethane
DHSS	Alaska Department of Health and Social Services
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
FCR	Fish Consumption Rate
FFQ	Food Frequency Questionnaire
FMRs	Fishery Management Reports
g/day	Grams per day
HHC	Human health criteria
IHS	U.S. Indian Health Service
NSHC	Norton Sound Health Corporation
PCB	Polychlorinated biphenyls
SEARHC	Southeast Alaska Regional Health Consortium
TCC	Tanana Chief's Conference Region
YKHC	Yukon-Kuskokwim Health Corporation

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The initial draft report was developed by The Cadmus Group Inc. (Cadmus) under DEC Contract 18-6002-15-02. Cadmus, under contract with the Alaska Department of Environmental Conservation, Division of Water developed a report titled *Literature Review of Fish Consumption Rate Research Conducted in the State of Alaska (2014)* to identify research that may be relevant to State efforts to revise human health criteria in water quality standards. Cadmus is an EPA-approved contractor and has conducted similar forms of research in the past. This document evolved out of that report.

### **External Peer Review Workgroup**

This document has been subject to external peer review. General process guidance was provided by EPA's Peer Review Handbook (2012).

Potential areas for conflict of interest have been investigated via direct inquiry with the potential peer reviewers and review of their current and past affiliations. Reviewers did not have conflicts of interest.

The peer review panel included:

Dr. Lon Kissinger- U.S. EPA. Region 10. Risk Evaluation Unit

Dr. Philip Loring. University of Alaska-Fairbanks. Water and Environmental Research Center

Dr. Angela Matz- U.S Dept. of Fish and Wildlife. Fairbanks Field Station

Dr Elizabeth Nobmann- EDN Nutrition Consulting.

A record of the peer review process is available upon request to the Department.

## **1. Introduction**

Aquatic life (fresh and marine fish)\* are a fundamental part of the Alaskan lifestyle and economy. Alaska is the largest supplier of domestically-produced seafood in the United States, directly employs over 27,000 Alaska residents in the seafood industry (McDowell, 2013), and draws visitors from around the world to participate in its sportfishing opportunities. Data collected in 2007 determined that over 475,000 resident and non-resident licenced anglers fished 2.5 million days in Alaska and spent nearly 1.4 billion dollars on fishing related goods and services (Southwick Associates Inc., 2008)

For many Alaskans, fish are part of their regular diet, with some studies showing that Alaskans consume six times more fish than the average U.S. citizen (Nobmann, 1992). Alaska health officials recommend that everyone eat fish at least twice a week to obtain important health benefits (DHSS, 2014). While fish are considered to be part of a healthy diet, some fish species can bioaccumulate potentially harmful contaminants, such as mercury, in fish tissue. To protect human health from the risks associated with ingesting fish and shellfish that have been exposed to toxic contaminants, the U.S. Environmental Protection Agency (EPA) and states derive water quality criteria for use in state water quality standards. A critical component of developing these human health criteria (HHC) is accurately estimating how individuals may be exposed to contaminants through consumption of fish.

The Clean Water Act (CWA) regulations direct States to adopt criteria based upon the 304(a) National Recommended Water Quality Criteria, or in the State's discretion, 304(a) criteria modified to reflect site-specific conditions or other scientifically defensible methods (40 CFR 131.11 (b)). EPA states in its 2000 Methodology for Deriving Ambient Criteria for the Protection of Human Health at page 2-14 that if a site-specific fish consumption rate is used instead of EPA's national default rate, the State must assemble appropriate survey data to defend the local fish consumption rate (EPA, 2000a).

DEC intends to use this document to engage multiple audiences in discussions on issues associated with development of human health criteria, including the revision of state fish consumption rates. The purpose of the document is technical in nature and not designed to resolve policy issues or establish rule making. Rather, it is designed to provide useful information to interested parties on the amount of dietary data specific to Alaska that may be considered during the regulatory process. The primary question addressed in this document is:

- What is currently known about fish consumption habits and rates for people in Alaska?

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\* In most places in this document, unless noted otherwise, aquatic life (fish) refers to both finfish and shellfish.

The report will NOT address such issues as:

- establishing statewide, regional, or local fish consumption rates in Alaska;
- determining methods for deriving HHC using local fish consumption rates;
- implementing revised HHC in the Alaska Pollutant Discharge Elimination System (APDES) permits; or
- evaluating economic outcomes that could result from any future rule making .

The remainder of this report is organized as follows:

- **Section 2** provides an overview of HHC and fish consumption rates;
- **Section 3** describes the methods used to acquire the information summarized in this report;
- **Section 4** presents a review of existing studies and data on fish consumption rates in Alaska;
- **Section 5** describes data gaps and limitations; and
- **Section 6** provides recommendations for future research.

## **2. Human Health Ambient Water Quality Criteria and Fish Consumption Rates**

Some contaminants in water, such as mercury and persistent organic pollutants, can bioaccumulate and have toxicological impacts to fish, shellfish, and other aquatic organisms. Contaminants that bioaccumulate can biomagnify up the food chain. This means that the contaminant becomes more concentrated at each higher level of the food chain. Mercury is of particular concern for humans because it affects the central nervous system. Persistent organic pollutants, including polychlorinated biphenyls (commonly known as PCBs) and dichloro-diphenyl-trichloroethane (commonly known as DDT), are a group of pollutants that do not readily degrade and pose myriad human health impacts (Department of Health and Social Services (DHSS), 2007; EPA, 2012).

An HHC sets a target concentration for a given pollutant, below which levels are not expected to pose a significant risk to humans. States and authorized tribes (hereinafter referred to as states) can adopt the nationally-recommended HHC or modify them based on site-specific conditions. Because certain populations may be at an increased risk from contaminants in fish (e.g., children, pregnant women, and people who consume a lot of fish and shellfish), fish consumption rate (FCR) is considered when deriving HHC for these types of toxic pollutants. FCR refers to a person's fish or shellfish consumption per unit of time (i.e. grams per day) (EPA, 2014a). To increase the protection of human health from exposure to certain toxic contaminants, EPA has developed recommended HHC for 126 "priority" toxic pollutants (EPA, 2000a).

### EPA HHC Equation

In order for states and tribes to have a mechanism for deriving new or revising existing HHC that is scientifically valid and reflective of local conditions, EPA issued *Methodology for Deriving Ambient Water Quality Criteria for the Protection of Human Health (2000)* (hereafter the “methodology”). The methodology defines the equation used to derive HHC as well as default factors EPA intends states to use in evaluating consistence of State water quality standards with the requirements of the CWA (EPA, 2000a). Using a risk assessment approach, two specific end points are identified in the methodology; carcinogenic and non-carcinogenic effects. The Equation includes toxicological and exposure assessment parameters which are derived from scientific analysis, science policy, and risk management decisions. The generalized equations are:

#### **Noncancer Effects<sup>2</sup>**

Images: EPA 2000a

$$AWQC = RfD \cdot RSC \cdot \left( \frac{BW}{DI + \sum_{i=2}^4 (FI_i \cdot BAF_i)} \right) \quad (\text{Equation 1-1})$$

#### **Cancer Effects: Nonlinear Low-Dose Extrapolation**

$$AWQC = \frac{POD}{UF} \cdot RSC \cdot \left( \frac{BW}{DI + \sum_{i=2}^4 (FI_i \cdot BAF_i)} \right) \quad (\text{Equation 1-2})$$



**Cancer Effects: Linear Low-Dose Extrapolation**

$$AWQC = RSD \cdot \left( \frac{BW}{DI + \sum_{i=2}^4 (FI_i \cdot BAF_i)} \right) \quad (\text{Equation 1-3})$$

where:

AWQC	=	Ambient Water Quality Criterion (mg/L)
RfD	=	Reference dose for noncancer effects (mg/kg-day)
POD	=	Point of departure for carcinogens based on a nonlinear low-dose extrapolation (mg/kg-day), usually a LOAEL, NOAEL, or LED <sub>10</sub>
UF	=	Uncertainty Factor for carcinogens based on a nonlinear low-dose extrapolation (unitless)
RSD	=	Risk-specific dose for carcinogens based on a linear low-dose extrapolation (mg/kg-day) (dose associated with a target risk, such as 10 <sup>-6</sup> )
RSC	=	Relative source contribution factor to account for non-water sources of exposure. (Not used for linear carcinogens.) May be either a percentage (multiplied) or amount subtracted, depending on whether multiple criteria are relevant to the chemical.
BW	=	Human body weight (default = 70 kg for adults)
DI	=	Drinking water intake (default = 2 L/day for adults)
FI <sub>i</sub>	=	Fish intake at trophic level (TL) I (I = 2, 3, and 4) (defaults for total intake = 0.0175 kg/day for general adult population and sport anglers, and 0.1424 kg/day for subsistence fishers). Trophic level breakouts for the general adult population and sport anglers are: TL2 = 0.0038 kg/day; TL3 = 0.0080 kg/day; and TL4 = 0.0057 kg/day.
BAF <sub>i</sub>	=	Bioaccumulation factor at trophic level I (I=2, 3 and 4), lipid normalized (L/kg)

**Explanation of Terms**

AWQC: In the context of this paper *Ambient Water Quality Criteria* is the EPA-equivalent to human health criteria.

RfD: A reference dose describes an estimate, with uncertainty spanning perhaps an order of magnitude, of a daily oral exposure to humans (including sensitive subgroups) that is likely not to result in increased risk of harmful effects. This factor only applies to non-carcinogens.

POD: The Point of Departure is a risk assessment modeling term that describes the lowest reliable part of a dose-response curve in which an effect has been observed in toxicological studies.

UF: The Uncertainty Factor describes the margin a POD may need to be adjusted to account for such things as the nature and extent of human variability and sensitivity to that of experimental animals.

RSD: The Risk Specific Dose (mg/kg-day) describes the amount of a carcinogenic substance a person can be exposed to before an effect has been observed.

RSC: The Relative Source Contribution estimates the total amount of exposure from water and fish consumption to that of other sources (e.g, diet, air, drinking water).

BW: The Body weight value is based on an EPA-recommended value for adults of 80 kg derived from national population statistics.

DW: The Drinking Water value is based on all sources of water that make up part of the human diet in a day. The 2015 EPA-recommended value is 2.4 L/day.

FI: The fish intake (a.k.a. fish consumption rate) reflects the amount of aquatic life a person consumes on an annual basis. This can be further disseminated according to trophic level (status in the food web (i.e. primary versus secondary consumer) and is highly dependent on the methodology used to derive a value for a particular population.

BAF: The Bioaccumulation Factor accounts for the amount of exposure aquatic life experience from all from of media (water, diet, sediment) and elimination processes.

The HHC equation(s) and resulting criteria are for the protection of human health and designed to minimize the risk of adverse effects occurring in humans from chronic (lifetime) exposure to substances through the ingestion of surface drinking water (untreated) and consumption of fish obtained in surface waters. The criteria should be protective of both general as well as subpopulations that may have higher rates of water or fish consumption. Of the various exposure pathways addressed in the equation, fish consumption rates may be the single factor that may experience the most variability due to a myriad of reasons including geographic availability, economic availability, cultural influence, and personal preferences.

The following subsection summarizes the evolution of EPA's recommended FCR since it was first issued in 1992, as well as EPA's recommendations for how states should develop their own FCR when deriving HHC. The *EPA Region 10* subsection describes recent actions in EPA's Region 10 (which includes Alaska) to update and revise the FCRs when deriving HHC. The *Alaska* subsection provides a summary of fish consumption trends in Alaska.

### **EPA's Default FCR and Use in Deriving Water Quality Criteria**

As required by Section 304(a) of the Clean Water Act (CWA), EPA has developed recommended HHC, which states may adopt or modify based on site-specific conditions (EPA, 2000a). The 1992 National Toxics Rule set numeric HHC for 126 priority toxic pollutants and used a default FCR of 6.5 g/day (EPA, 1992). The recommended FCR value in the HHC formula was updated by EPA in 2000 to 17.5 g/day (EPA, 2000a), and proposed in 2014 to increase to 22 g/day (EPA, 2014b). The proposed 2014 FCR of 22 g/day was used by EPA in the draft *Updated National Recommended*

*Water Quality Criteria - Human Health*, which contains updated nationally recommended HHC for 94 chemical pollutants (EPA, 2014b). The default FCR of 22 g/day used in the criteria derivation process represents the 90<sup>th</sup> percentile consumption rate of freshwater and estuarine fish for the U.S. adult population age 21 and over, based on National Health and Nutrition Examination Survey data from 2003 – 2010 (EPA, 2014b). Because the default FCR does not account for consumption of marine fish (including anadromous species), EPA acknowledges that coastal states may instead prefer to use a FCR based on total fish consumption (EPA, 2013).

EPA provides guidance for states on methodology for development of modified HHC (EPA, 2000a). Current methodology guidance provided by EPA recommends protection of the general public to be represented by the 90<sup>th</sup> percentile of a total exposure distribution. EPA encourages individual states to consider adjusting their FCR based on site-specific conditions, such as populations of subsistence fishers, when adopting HHC. In the absence of site-specific information, EPA recommends the 99<sup>th</sup> percentile of per capita fish consumption rate values set in the 2000 recommendation as a surrogate value for subsistence fishers (EPA, 2013), which equates to 142.5 g/day. The 2014 recommendations did not suggest an increase for the subsistence fishers FCR. EPA encourages states to use the best local, state, or regional data available to derive appropriate FCRs as an alternative to EPA's default consumption rate. The preferred data source hierarchy described in the 2014 draft update 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 default intake rates (EPA, 2014b).

### **FCRs in EPA Region 10 States**

Per capita fish consumption is higher in the EPA Region 10 states (Alaska, Washington, Oregon, and Idaho) compared to the U.S. average, particularly among tribes, recreational anglers, and certain minority and immigrant groups (State of Washington, 2013). EPA and the public have requested that the state governments of Washington, Idaho, and Oregon research and recommend FCRs that consider state-specific populations, as opposed to using EPA's default FCR (EPA, 2014b). In 2008, Oregon's Environmental Water quality Commission directed the use a 175 g/day FCR in the development of HHC, which protects up to the 95<sup>th</sup> percentile of Oregonians who consume the most fish. This FCR was derived using research conducted by the Columbia River Inter-Tribal Fish Commission, EPA, and tribal biologists (EPA, 2011). Oregon's updated FCR was used in their revision to HHC for 105 toxic pollutants adopted in Oregon water quality standards and approved by EPA in 2011. (Oregon, 2011). Washington has since proposed a FCR of 175 g/day for use in deriving its September 2014 draft HHC revisions. Idaho is in the process of researching state-specific FCRs to assist in revising their HHC equation for determining numeric chemical criteria. Alaska is now beginning this process.

## **Fish Consumption in Alaska**

Subsistence and personal use fishing are recognized as supporting a traditional way of life for many Alaskans (Fall, 2013). The State of Alaska recognizes four types of fisheries:

- **Commercial fishing** is the taking of fish “with the intent of disposing of them for profit, or by sale, barter, trade or in commercial channels” (AS 16.05.940) (5).
- **Sport fishing** is defined as taking “for personal use, and not for sale or barter, any fresh water, marine or anadromous fish by hook and line held in the hand, or by hook and line with the line attached to a pole or rod which is held in the hand or closely attended or by other means defined by the Board of Fisheries.” (AS 16.05.940)(30).
- **Personal use fishing**, is defined as the taking of fish by Alaska residents for personal use and not for sale or barter with gill or dip net, seine, fish wheel, long line or other mean defined by the Board of Fisheries (AS 16.05.940)(25) and;
- **Subsistence fishing**, is defined as the “the taking of, fishing for, or possession of fish, shellfish, or other fisheries resources by a resident domiciled in a rural area of the state for subsistence uses with gill net, seine, fish wheel, long line, or other means defined by the Board of Fisheries.”(AS 16.05.940(31)). According to Alaska State Regulation, subsistence uses of wild resources are defined as 'noncommercial, customary and traditional uses' for a variety of purposes” (AS 16.05.940) (33).

The Alaska Department of Health and Social Services (DHSS) promotes fish consumption guidelines based on a risk management strategy. This strategy is implemented by weighing the risks of mercury exposure against the health benefits of fish consumption to develop consumption guidance that is both balanced and protective. To evaluate mercury exposure, DHSS uses information from the ADEC Fish Monitoring Program and the Statewide Maternal Hair Mercury Biomonitoring Program, which monitors levels of mercury in the hair of pregnant Alaskans. Elevated levels of mercury may affect how children behave, learn, think and solve problems later in life. Thus, neonates and young children may be exposed to greatest risk for adverse health effects from mercury exposure (DHSS, 2007). Mercury biomonitoring provides public health officials with direct information about the degree of mercury exposure occurring in the most vulnerable subpopulation.. The intent of the DHSS consumption guidelines is to assist individuals, families, and communities in Alaska as they make decisions about fish consumption. The DHSS guidelines are not intended to influence the development of HHC or other regulatory standards (DHSS, 2007).

Currently, DHSS does not recommend restrictions on fish consumptions for certain populations such as teenage boys, adult men, and women who cannot become pregnant (DHSS, 2007). This recommendation is due to the benefits (both health-related and cultural) of fish consumption by Alaskans. Women who are or can become pregnant, nursing mothers, and children aged 12 years and under are generally advised to continue unrestricted fish consumption from Alaskan

waters that are low in mercury, although some restrictions are advised for species such as salmon shark, dogfish, and large halibut (>90 pounds) that are known to have elevated mercury levels (DHSS, 2007).

DHSS has estimated that FCRs in some Alaskan villages may be more than 10 times greater than the 6.5 g/day consumption rate currently used in the derivation of Alaska HHC (DHSS, 2007). Given EPA's current nationally recommended default FCR of 17.5 g/day (*note* that the 2014 22 g/day was in draft form at the time this report was prepared), ADEC recognizes the potential need to update the FCR used in deriving the state's HHC to better protect Alaskan populations from contaminants in aquatic life. and has identified research of fish consumption rates to be high priority issue (citation needed?).

### **3. Research Methods**

The research methods described below were used to perform a comprehensive search of scientific information and existing data on fish and shellfish consumption in Alaska, including dietary surveys and fish harvest data. Several sources of information were obtained directly from government staff and other technical experts; additional sources were identified using traditional literature search techniques. The subsequent sections of this report provide a literary analysis of the information acquired during the research phase of the project.

#### **Literature Search**

A search for available information was performed using online search engines (e.g., Web of Science, Google Scholar, and Academic search engines for published literature), government websites, and websites maintained by other creditable sources, including peer reviewed literature, government reports, and proceedings from relevant scientific meetings. To ensure all relevant sources were captured during the literature review, a combination of techniques was used, including a keyword search, backward search (i.e., reviewing the references, authors, and keywords of the articles and reports identified from the keyword search), and forward search (i.e., reviewing additional articles that have cited an article of interest and reviewing what authors have published following the article of interest). Preference was given to data sources published within the last 25 years (i.e., 1989 to 2014). Key metadata for all of the relevant sources of information and data were cataloged in a Microsoft Excel-based bibliography.

#### **Consultation with Subject Matter Experts**

Approximately seven phone interviews were conducted with subject matter experts from various government agencies and other groups including: Alaska Department of Fish and Game (ADF&G); University of Alaska – Fairbanks; ADEC, Seldovia Village Tribe – Environmental Office; DHSS; and IDM Consulting. Interview participants were given a brief description of the project at the start

of each phone interview. Although no standardized questionnaire was used, all participants were asked the following:

1. Do you develop or use data related to fish consumption?
2. Do you know of any specific fish consumption data sources that should be reviewed as part of this effort?
3. What do you feel are the main knowledge gaps in Alaska fish consumption data?

Information provided during the interviews varied in accordance with the perspective and subject matter expertise of the individual. The interviews assisted in identifying current sources of data on fish consumption in Alaska and in better understanding how data are used by different programs in the state.

#### **4. Review of Data Sources**

This section provides a summary of existing sources and types of data on FCRs in Alaska that were identified during the discovery phase of this project. This includes data collection methods, a description of data presented, findings on fish consumption, and relevance to EPA recommended methods for determining FCRs.

##### **Dietary Surveys**

Dietary surveys are typically used by researchers to discover the habitual nutrient intakes of individuals. As with any clinical data collection effort, there are numerous potential sources of error in dietary assessment studies. Error (defined as the difference between the true value of a measurement and the recorded value of a measurement) has two sources: random error (variability) has no preferred direction and can be minimized with large sample sizes; and systemic error (bias) has a net direction and cannot be eliminated through increases to the sample size (Penn State, 2014). Three major sources of bias in dietary assessments include: selection bias (the manner in which subjects are selected from a study population); measurement bias (errors in data collection and data management); and confounding bias (a distortion created when the relationship between an exposure and an outcome is influenced by a third variable). Study design, data collection methods, and quality assurance protocols are critical for minimizing bias (Lennernäs, 1998).

Common dietary survey methods include a dietary record, 24-hour recall, and food frequency questionnaires (FFQ) (Johnson, 2009). The FFQ has become the primary method for measuring comparative dietary intake in epidemiological studies (Willett, 1998). An FFQ is defined as a questionnaire in which the respondent is presented with a list of foods and indicates frequency and often quantity consumed over a defined period of time. Advantages of FFQs are that they allow the measurement of typical diet in one interview and are inexpensive when compared to multiple 24-hour recalls. One disadvantage of the FFQ is that information may be lost by the limited number of foods included in the list; omission of certain foods from the questionnaire is

one example of systemic error in the data collection methods that can result in measurement bias.

EPA's 2000 *Methodology for Deriving Ambient Water Quality Criteria for Protection of Public Health* explains that if a state proposes to use a site-specific FCR instead of the EPA national default FCR, appropriate dietary survey data must be available to defend that FCR. Dietary surveys containing fish consumption data can be difficult to evaluate due to variation in survey objectives and high variability in fish consumption patterns (Washington Dept. of Ecology, 2013; Moya, 2004). Several criteria are important when considering whether fish consumption data from dietary surveys are applicable to development of FCRs including: timing of interviews, training of interviewers, consideration of fish species, identification of fish source, study population, sample size, and quality assurance/quality control (QA/QC) procedures (Moya, 2004).

It has been shown that the dietary intake of Alaska Natives differs from the general U.S. population (Nobmann, 1992). Alaska Natives consume both the foods available in community stores and their traditional subsistence foods. Subsistence food harvests vary by region within Alaska. In some regions, salmon is a main food, while in others, land mammals (e.g., caribou, moose, etc.) or sea mammals (e.g., whales, seals, walrus, etc.) are common foods. In nearly all regions, people eat wild greens and berries (Johnson, 2009). Much of the existing fish consumption data are contained in dietary surveys conducted with the objective of learning more about the diet of Alaska Natives.

Table 1 summarizes the dietary survey information reviewed in this report. It provides a brief overview of key study information and the findings reported. A detailed assessment of each dietary survey study is provided after the table.



**Table 1. Literature Summary Matrix of Dietary Survey Information**

Title	Author	Year	Data Collection Method	Study Location	Average Fish Intake	Other Findings
<b>The Final Report on the Alaska Traditional Diet Survey</b>	Alaska Native Health Board and the Alaska Native Epidemiology Center of the Alaska Native Health Board	2002	Dietary Survey (in person interview)	13 Villages throughout Alaska		Reported per person median and maximum fish consumption in pounds for each region.
<b>Evaluation of Seafood and Plant Data Collected from Cook Inlet near Native Villages of Port Graham, Nanwalek, Seldovia and Tyonek, Alaska</b>	Agency for Toxic Substances and Disease Registry, Division of Health Assessment and Consultation	2009	Food Frequency Interviews	Port Graham, AK	142-256 g/day (teens and adults averaged)	
<b>Investigation into Potential Exposures to Mercury Vapor in Small Scale and Recreational Mining – 2012</b>	Alaska Department of Health and Social Services	2012	Exposure Questionnaire (administered in Person)	Nome, AK		Results of questionnaire not presented in report.
<b>Dietary Intake of Alaska People in Two Regions and Implications of Health</b>	Johnson et al.	2002-2004	Four 24-hour dietary recalls (in person interview)	Yukon-Kuskokwim Region and Maniilaq Region		Data presented describes food type as a percentage of total calories consumed.



Title	Author	Year	Data Collection Method	Study Location	Average Fish Intake	Other Findings
<b>Seafood as Local Food: Food Security and Locally Caught Seafood in Alaska's Kenai Peninsula</b>	Loring, Gerlach & Harrison	2011-2012	Mail Survey	Kenai Peninsula		Survey describes the percent of the population that harvests and consumes fish
<b>The Diet of Alaska Native adults: 1987-1988</b>	Nobmann et al.	1992	Five 24-hour Dietary Recall Surveys (in person interview)	11 Alaska Native communities throughout AK	109 g/day (fish and shellfish)	
<b>Assessment of Cook Inlet Tribe Subsistence Consumption</b>	Seldovia Village Tribe Environmental Department	2012	Dietary Recall Survey (in person interview)	Seldovia, Port Graham Nanwalek and Tyonek	94.8 (+/- 23.5) g/day	
<b>Amchitka Island, Alaska, Biological Monitoring Report 2011 Sampling Results</b>	U.S. Department of Energy	1998-1999	Secondary data	Atka, Nikolski, Unalaska, and St. Paul,	Composite Diet 100 g/day St. Paul (min) 10/g day Nikolski (max) 520 g/day	

## **The Final Report on the Alaska Traditional Diet Survey**

***The Alaska Native Epidemiology Center of the Alaska Native Health Board, March 2004***

### *General Information*

The Alaska Traditional Diet Survey Final Report is the result of a collaborative effort between researchers from the Alaska Native Health Board, the Institute for Circumpolar Health Studies at the University of Alaska – Anchorage, and IDM Consulting. The primary objective of the survey was to quantify the intake of subsistence foods among residents of rural villages in Alaska using a retrospective dietary assessment survey. The survey was the first step in a long term project to help people evaluate health benefits and potential risks of consuming subsistence foods and to make informed dietary choices.

### *Study Population*

Residents over the age of 13 living in the participating villages were invited to join the study. In villages with a population of more than 150 people, the study coordinators were asked to recruit 80 men and women in proportion to the village's age demographics. In villages with less than 150 people, coordinators recruited as many eligible participants as possible, regardless of sex. All eligible and interested participants were included in the survey.

The final study sample included 665 participants from 13 villages located in five regional health corporations in Alaska, including Norton Sound Health Corporation (NSHC), Yukon-Kuskokwim Health Corporation (YKHC), Bristol Bay Area Health Corporation (BBAHC), Tanana Chiefs Conference Region (TCC), and the Southeast Alaska Regional Health Consortium (SEARHC). These health corporations represent geographically diverse areas of Alaska. Participants were between 13 and 88 years in age and included 253 men and 401 women (gender information was missing for 11 participants). The vast majority (95%) of study participants described their ethnicity as Alaska Native.

### *Data Collection Methods*

Each village was asked to designate two interviewers and one study coordinator. The interviewers traveled to Anchorage to receive two days of training on the data collection methods. Data collection took place during the summer of 2002, during which a single interview was conducted with each participant. Interviewers used a FFQ to record what types and quantities of foods individuals consumed during the previous 12 months. The questionnaire also allowed participants to indicate whether each specific food was eaten year-round or seasonally. The questionnaire was administered in a standardized manner using three-dimensional food models, dishes, cups, bowls and serving utensils to help participants estimate portion sizes. Interviewers also used reference documents to help identify plant, fish, and animal species. Each of the interviews lasted approximately 75 minutes, although some lasted several hours; a time-limit was not placed on the interview. Questionnaire forms were created in Cardiff TELEform Elite

Version 6.1; paper forms were used during the interviews to record responses. The completed forms were reviewed by the Project Coordinator at the Alaska Native Epidemiology Center and then scanned into the project database.

### *Description of Data*

Data were collected on all food consumed, frequency of consumption, and typical portion sizes. The report includes the following information: the gram weight of each specific food and beverage consumed by each participant; nutrient content per gram of each food and beverage; nutrient intake of each participant from each specific food and beverage; and total nutrient intake of each participant.

In total, the nutrient content database contains 238 distinct food items. The survey captured reported intake of many subsistence foods that are not included in standard nutrient content databases; in these cases, substitutions were made that matched the physiology and trophic level of the reported food item as closely as possible in order to calculate nutritional content.

Data were further analyzed to rank food by total amount consumed and to estimate the contribution of food to nutrient intakes. The study also ranks foods by the reported amount of a particular food consumed in each region, the proportion of residents in each region who ate a particular food, and the median and maximum consumption of specific foods for individuals in each region.

### *Quality Assurance/Quality Control (QA/QC) Procedures*

The Alaska Traditional Diet Project was approved by the Alaska Area Institutional Review Board and the National Indian Health Service, and received village council resolutions in the 13 participating villages and the five Tribal Health Corporations to which the 13 villages belong. In addition, the project was guided by a broad Oversight Committee, which provided operational advice and technical assistance.

The FFQ was translated into Inupiaq and Central Yup'ik and back into English by native speakers to preserve meaning. Many interviewers were bilingual or utilized bilingual assistants.

The questionnaires received a QA review for completeness and consistency; forms were then scanned into a database and verified by a registered dietitian. Also, manual duplicate entry was performed on 10% of the questionnaires. An error rate of less than 1% was found on the scanned forms.

### *Findings on Fish Consumption*

In all five of the regions surveyed, at least one species of locally harvested fish was in the top 25 foods consumed (in terms of aggregate total pounds). The types of fish reported by survey participants to be eaten most varied by region. The types are reported using their "common"

names and include: Herring, Red Salmon (sockeye), White Salmon (chinook), King Salmon (chinook), Chum Salmon, Whitefish, and Silver Salmon (coho). Overall, the results indicated fish and seafood comprise a significant amount of the participants' dietary intake.

The study also included an analysis of subsistence food consumption in median and maximum pounds per person for each region. This analysis highlighted vast differences in individual consumption of subsistence foods, even within the same health corporation. For example, results from the YKHC show that 98% of respondents consumed dried King Salmon, with a median yearly per-person intake of 19 pounds and a maximum yearly per-person intake of 611 pounds. In all five regions, fish were a prominent part of the dietary intake. In most regions, participants reported that multiple species of locally harvested fish were prepared in a variety of ways. In all regions, at least two thirds of participants reported consuming several species of fish in the previous 12 months.

#### *Applicability of the Data for use in Determining FCRs*

This survey serves as a useful resource for supporting the determination of FCRs because individual level data on median and maximum fish consumption is provided in pounds for a number of different species of fish. The reported maximum consumption values are particularly important because they provide a conservative estimate of consumption for individuals in each region. The survey findings also demonstrate the regional and individual differences in fish consumption among several Alaska Native communities.

A limitation of this study is that only a single interview was conducted with each participant. During the interview, participants were asked to recall their dietary habits for the previous 12 months, which could result in incomplete or inaccurate reporting due to the long recall period. The long recall period can also impact information reported on seasonal fluctuations in diet, thereby potentially obscuring important data related to short term increases in fish consumption. There also may be concern about the exceptionally high rates of consumption assigned to certain foods. This may be attributed to interpretation and/or confusion on the part of the interviewees and/or interviewers.

#### **Evaluation of Seafood and Plant Data Collected from Cook Inlet near the Native Villages of Port Graham, Nanwalek, Seldovia, and Tyonek, Alaska.**

***U.S. Agency for Toxic Substances and Disease Registry, Division of Health Assessment and Consultation, 2009***

#### *General Information*

The Native Villages of Port Graham, Nanwalek, Seldovia, and Tyonek requested assistance from ATSDR in 2003 to assess potential health effects from consumption of subsistence foods by residents of the Cook Inlet region in Southcentral Alaska. Residents had expressed concern that

contaminants were potentially released from oil and gas operations into Cook Inlet in quantities that could be harmful to human health.

Following concerns expressed by village residents, the scope of the project was to be expanded from evaluating data reported by the EPA for whole fish, mussel/clam, other invertebrate, and plant samples collected from Cook Inlet in 2000 (EPA, 2000b). to include an exposure analysis using data from the ADEC fish monitoring study (ADEC, 2005) and the Cook Inlet Regional Citizens Advisory Council Environmental Monitoring Program (Lees, 1999). The EPA datasets provided information on the concentrations of contaminants present in the tissue of sampled fish, bivalves, and other marine invertebrates in the region. Exposure due to the consumption of aquatic life was derived using dietary survey data from the Village of Port Graham that was conducted in 2004. The survey was developed by ATSDR and the Alaskan Native Health Board for use in this consultation. This consumption data was assumed to be representative of the other villages included in the health consultation.

### *Study Population*

Participation in the study was voluntary for residents of Port Graham. Participants included 23 females and 21 males in the following three age groups: elders (65 years of age or older; n = 12); adults (20–64 years; n = 28); and teenagers (n = 4).

### *Data Collection Methods*

A FFQ was used to identify the types and amounts of subsistence foods consumed by study participants during the previous 12 months.

### *Description of Data*

The Village Council provided ATSDR with an Excel database containing responses from the 44 individuals participating in the survey. ATSDR's Division of Health Studies evaluated the data for the Village Council. ATSDR used the data from the Port Graham dietary survey as a guide in estimating the dose of exposure to contaminants that residents might receive from eating fish caught in Cook Inlet.

The ATSDR Health Consultation Report presents estimated total daily and yearly fish consumption per person for all survey respondents, for each age group.

### *QA/QC Procedures*

No information was provided on the QA/QC procedures utilized during data collection or analysis.

### *Findings on Fish Consumption*

The study found that the primary traditional food consumed was fish, which ranged from 68% of the traditional foods for the teenage age group to 76% of the traditional foods for the elder age

group. Overall, fish comprised 70% of traditional native foods consumed. The average fish ingestion rates ranged from 142 g/day to 256 g/day, with an overall village-wide average of 198 g/day. At the request of village residents, ATSDR used a range of daily FCRs to estimate residents' potential exposure from eating Cook Inlet fish. Specifically, ATSDR used daily fish ingestion rates of 198 g/day, 397 g/day, and 510 g/day for adults. While the average for the village was 198 g/day per day, the upper estimates of 397 g/day and 510 g/day likely represent the FCR for some residents in the village who eat two fish meals a day.

#### *Applicability of the Data for use in Determining FCRs*

The survey provides data that can be used to estimate general fish consumption in the Village of Port Graham. The consumption estimates may also be applicable for residents of other villages in close proximity to Cook Inlet. Several limitations to this study should be considered prior to using the data in FCR calculations. The survey size is considered to be small (particularly for some age categories) and the report provides limited detail regarding data collection methods. Additionally, the analyses conducted by ATSDR did not include information on specific fish species consumed. Although information on specific species consumed may have been collected during the initial interviews, in accordance with the data-sharing agreement between the Village Council and ATSDR, all food survey data were returned to the Council. The Port Graham Village Council expressed concern about the quality of the data collected from the survey due to the voluntary nature of participation, and the potential for recall bias (residents were asked to estimate the amount of foods consumed during a 12 month period). The Village Council also noted that the interviewers who collected the information were not familiar with traditional harvesting and gathering practices; therefore, consumption of native foods may have been underreported.

### **Investigation into Potential Exposures to Mercury Vapor in Small-Scale and Recreational Mining – 2012: Nome Small Scale Mining Areas - Nome, Alaska**

***Alaska Department of Health and Social Services, September, 2013***

#### *General Information*

The DHSS Section of Epidemiology, in collaboration with federal and state partners, conducted an exposure investigation at the Nome Small-Scale Mining site in Nome, Alaska. Health officials had expressed concern that miners at the site were potentially exposed to mercury vapor from mining operations, purifying, and heating gold. The exposure investigation assessed urine mercury levels in 18 people who may have been exposed to mercury from gold mining and gold processing activities. In an effort to assess the potential pathways of mercury exposure, a questionnaire was administered to participants, which captured information on fish consumption.

#### *Study Population*

Participation in the study was voluntary, and any gold miners who reported contact with mercury or gold amalgams were eligible to participate. Also, people over seven years of age who reported being near miners or others who may have been exposed to mercury in the three weeks prior to testing were eligible. Participants included 15 gold miners, one person who frequently heated gold, and two residents whose homes were in close proximity to a gold heating operation.

#### *Data Collection Methods*

The exposure questionnaire was administered in person by the DHSS Section of Epidemiology, and data collected were reviewed by ATSDR personnel. The questionnaire was used to collect information from gold miners, members of their households and residents of the community on their mercury exposure from indoor and outdoor environments in the three weeks prior to the exposure investigation.

#### *Description of Data*

Study participants were asked if they had consumed fish (including smoked or dried) that they caught themselves, ate at a restaurant, ate at home, or ate from a can (e.g., canned tuna) within the previous three weeks. Participants who consumed fish during that time were asked to specify the quantity and type of fish consumed at various intervals throughout the previous three weeks (i.e., 24 hours, one week, two weeks, and three weeks).

#### *QA/QC Procedures*

The health consultation report notes that the questionnaire was not fully validated or tested prior to administration. Additional detail on QA/QC on collection and analysis of the questionnaire data was not provided.

#### *Findings on Fish Consumption*

Data collected on fish consumption were not presented in the report.

#### *Applicability of the Data for use in Determining FCRs*

The information collected on fish consumption was not presented in the report, so it is not possible to assess the significance or completeness of the fish consumption data. Additionally, the investigation had a small sample size, and was not intended to be distributed in a representative manner across age and gender. There is likely some bias in the data collected since the investigation primarily recruited miners and members of their households, so the data are not likely representative of the general Nome community or other communities in the region. However, the temporal scale of the data is unique in that the quantity and type of fish consumed is assessed over a series of relatively short periods (24 hours to three weeks). This provides an opportunity to better understand fluctuations in consumption, as well as the potential for acute contaminant exposures through short term increases in fish consumption. Additionally, the

potential for recall bias is reduced due to the limited the length of time for which participants are asked to report consumption. Alternatively, there is potential to misclassify a participant's contaminant exposure if their fish consumption is highly variable between months or seasons. Ultimately, the dataset would need to be obtained from DHSS and reviewed before a determination of applicability for developing FCRs can be made.

### **Dietary Intake of Alaska Native People in Two Regions and Implications of Health: The Alaska Native Dietary and Subsistence Food Assessment Project**

***Jennifer S. Johnson, Elizabeth D. Nobmann, Elvin Assay & Anne P. Lanier; International Journal of Circumpolar Health, 2009***

#### *General Information*

Researchers from the Alaska Native Tribal Health Consortium and EDN Nutrition Consulting undertook a study to better understand the energy and nutrient intake from various food types among Alaska Native people in two regions of Alaska. The purpose of the study was to explore the impact of food choices on the development of chronic disease among Alaska Native people.

#### *Study Population*

The study drew participants from the Yukon-Kuskokwim Region (population of 20,714) in Southwestern Alaska and the Maniilaq Region (population of 6,876) in northwest Alaska. Both regions are remote and villages are accessible only by plane or boat. A total of 12 Yup'ik/Cup'ik, Athabaskan, and Inupiat Eskimo villages within the two regions were selected for inclusion in the study. Alaska Native residents aged 13 and over were invited to participate in the study. The goal was to enroll a minimum of 20 participants per village with equal numbers in each age category. In total, the survey had 333 participants ages 13 to 88, including 218 women and 115 men.

#### *Data Collection Methods*

Between 2002 and 2004, trained interviewers conducted four 24-hour dietary recalls in which participants were asked to describe all food and beverages consumed during the previous 24-hours. The initial recall was conducted during an in-person visit, while the three subsequent recalls were conducted over the telephone. Recalls were conducted in each of the four seasons to capture temporal variability in dietary consumption. The recalls had no predetermined time constraint, allowing participants the opportunity to provide unlimited detail on type of food, food source, food processing method, food preparation, and other relevant information. Participants received a standard set of measuring cups and spoons to assist with description of portion sizes.

#### *Description of Data*

Information was collected on all food consumed, including store bought food and locally harvested foods such as fish, wild greens, berries, and wild game, as well as oil and meat from seals, walrus, and whales. Commonly reported fish consumed included sheefish, king salmon,



dried chum salmon, and whitefish- all locally harvested. Other types of fish consumed, such as tuna and fish sticks, were categorized as store bought. In total, participants reported consuming 1,818 different foods including more than 100 subsistence foods. Data presented in the report are expressed as proportion of energy and specific nutrients contributed to total diet by defined food groups.

### *QA/QC Procedures*

The study was approved by the Alaska Area Institutional Review Board, the Yukon Kuskokwim Health Center, the Maniilaq Association, and the Tribal Councils of all participating communities. Interviewers were trained prior to conducting the recalls and translation was provided for participants speaking Yup'ik or Inupiaq. A multi-pass method was utilized to ensure that all foods consumed were recorded, and multiple recalls were used both to improve the ability of the participants to reflect typical intake and to capture seasonal variation in consumption of certain foods.

### *Findings on Fish Consumption*

Of the 100 subsistence foods reported during the recalls, those occurring most often included salmon (mostly king and chum), white fish, and sheefish. Locally harvest fish and seafood accounted for 10% of total calories consumed by study participants, 27% of protein, and 11% of fat. Fish and seafood also contributed substantially to selenium, magnesium, and vitamin D and E in the diet of participants. Mean intakes of omega-3 fatty acids (from locally harvested fish and seas mammals) were found to be more than twenty times greater than in the general U.S. population. Results demonstrated increased levels of Eicosapentaenoic acid (an omega-3 fatty acid) in the Yukon-Kuskokwim participants, which likely reflects greater consumption of fish and/or seas mammals in this region.

### *Applicability of the Data for use in Determining FCRs*

The findings from this study do not report the volume of fish consumed by participants, nor the specific type of fish or seafood consumed. The report characterizes the diet of participants in the two study regions using consolidated food groups. The results do provide the relative percent of caloric intake that is contributed to the participants' diet from locally sourced fish and seafood. Findings of specific nutrients, such as omega-3 fatty acids, indicate that fish and seafood consumption among the study population is greater than that of the general U.S. population, and that fish and seafood consumption varies between the two study regions. Although information on fish consumption by species and volume are not reported, the dietary intake measurements collected during the recalls likely contain information that may be useful for the development of a FCR for the specific regions studied, if the original data can be obtained.

## **The Diet of Alaska Native Adults: 1987-1988**

***Elizabeth D. Nobmann, Tim Byers, Anne. P Lanier, Jean H. Hankin and M. Yvonne Jackson;  
American Journal of Clinical Nutrition, 1992***

### *General Information*

Researchers investigated the role of diet in chronic diseases such as heart disease, cancer, diabetes, and iron deficiency-anemia by assessing the seasonal dietary intakes of more than 300 Alaska Native adults from 11 communities during 1987-1988. Prior to this, no comprehensive study of the diet of Alaska Natives had been conducted. The objectives of the research were to: determine the eating practices of Alaska Native adults; identify differences in between the Alaska Native diet and that of the U.S. as a whole; identify changes in diet over time; and provide practical dietary recommendations for chronic disease prevention in the Alaska Native population.

### *Study Population*

Eleven communities that represent a range of ethnic and socioeconomic regions were selected for the study. Using Indian Health Service (IHS) records of Alaska Native residents with an address in the selected communities, a sample of 873 men and women, aged 21-60 years, was drawn. People who moved, had a mental or physical disability that prevented them from completing the interview, or who could not be contacted after three attempts were excluded from the study. A total of 351 participants were included in the final survey. Ethnic distribution of the survey participants was similar to the distribution of Alaska Natives reported in the 1980 census.

### *Data Collection Methods*

In-person interviews were used to complete 24-hour dietary recalls and collect other questionnaire information on eating practices. The interviewers were either local individuals who were bilingual, or nutritionists with registered dietitian credentials who were streained in administering the dietary recall interviews and were familiar with the local communities; most interviews were conducted in the home by a single interviewer. During the interviews, each participant was asked to recall all foods consumed in the previous 24 hours. Five surveys were conducted over an 18 month period to capture seasonable variability in diet. All participants completed at least one recall survey. In total, 995 24-hour recalls were completed by 351 participants during the study period. Interviewers utilized kits containing gram scales, rulers, measuring cups, spoons, and standard plates and glasses to assist participants with estimating accurate serving sizes.

Information from the dietary recalls and questionnaires was entered into a computer using the Dietetics Automatic Data Processing Application. In addition to the 2400 foods included in the software nutrient database, 210 subsistence foods consumed by Alaska Natives were added.

### *Description of Data*

Food intake was analyzed by the frequency and quantity of foods consumed. The frequency of food consumption was measured by ranking the total number of times a food was mentioned by all respondents; the top 20 most frequently consumed foods are included in the study report.

### *QA/QC Procedures*

Approval to conduct the study was obtained from five Native Regional Health Corporations and the IHS research and publication committee. Informed consent was obtained from all participants.

The interviews were conducted by trained dietary professional with knowledge of the local communities and bilingual capabilities when necessary.

### *Findings on Fish Consumption*

Fish and shellfish ranked fourth in frequency of foods consumed by Alaska Native adults. On average, the mean daily intake of fish and shellfish of Alaska Natives was 109 g/day versus a U.S. average of 17 g/day. Results also showed significant seasonal variation in diet, with fish consumed more frequently in the summer and fall. Among subsistence foods, salmon and other fish were the most frequently consumed.

### *Applicability of the Data for use in Determining FCRs*

The primary objective of this study was to understand the role of diet in chronic diseases. As a result, the information presented in the report is focused on the nutrient intake from reported food sources and comparison of the study population to the general U.S. population. Limited information is provided on the quantity and frequency of fish and shellfish consumed, and detail on fish or shellfish species is not provided. The data captured during the study may be of great value for use in determining FCRs as the survey encompasses multiple communities with different ethnic and socioeconomic characteristics and utilizes a randomly selected sample. The data may be a particularly important tool in identifying both differences and similarities in fish and shellfish consumption across Alaskan communities. The age of the data would have to be considered, as changes in dietary habits in these Alaskan communities may have occurred since the time of the study.

### **Seafood as Local Food: Food Security and Locally Caught Seafood on Alaska's Kenai Peninsula**

***Philip A. Loring, S. Craig Gerlach & Hannah L. Harrison; Journal of Agriculture, Food Systems and Community Development, 2013***

### *General Information*

Researchers from the University of Alaska conducted a study, which took the form of community focus groups and a survey distributed by mail to residents of the Kenai Peninsula region in Southcentral Alaska. The investigation was aimed at exploring the conditions under which access to locally caught seafood contributes to household food security in the Kenai Peninsula Region of Alaska.

### *Study Population*

A sample of 1,500 households was randomly selected from a list of all 24,500 residential addresses on the Kenai Peninsula.

### *Data Collection Methods*

The survey was distributed to the sampled households via the U.S. Postal Service. Surveys were distributed following a modified version of the Tailored Design Method. To improve response rates, researchers sent postcards notifying recipients that their address had been randomly selected and that they should expect to receive a survey. To raise awareness for the project, the research team participated in interviews on Kenai Peninsula public radio stations. A total of 490 survey responses were received, allowing the study to achieve a 95% confidence interval that the sampled population is representative of the population of the Kenai Peninsula.

### *Description of Data*

Respondents were asked to report if anyone in the household fished, and if so, to specify whether this includes fishing commercially, fishing for sport, fishing as a guide or charter, and/or fishing for personal use or subsistence. Next, respondents were asked whether they consumed locally caught fish or other seafood. If respondents indicated that they consumed locally harvested fish and/or seafood, they were asked several additional questions regarding how and where seafood was obtained, with the intention of determining whether respondents caught the fish themselves, purchased it, or obtained it through barter, trade, or as a gift. The survey also asked respondents to report seafood consumption rates during the fishing season (defined as late May through September) and outside the fishing season (October through early May). Options for response included: frequently (almost every day); sometimes (2–5 times per week); rarely (once or fewer times per week); and never. The survey also requested information on how respondents disposed of fish waste (e.g., smoke or can it, feed it to dogs, give it away, throw it away, etc.).

### *QA/QC Procedures*

No information on QA/QC procedures for the data collection or analysis components of the research is reported.

### *Findings on Fish Consumption*

Nearly 95% of respondents reported at least some access to local seafood, with 80% of respondents reporting that someone in their household fished. The majority of respondents (66.5%) described their primary fishing activities as for personal use and subsistence. Sport fishing is the next most common kind of fishing (42%), followed by a much smaller group of commercial fishers (7%) and guide/charter operators (2%). When asked to describe the role of salmon in their household, 67% reported that it is an important part of their diet, 24% responded that it is an important part of their financial security, and 55% reported that salmon are important to their community and/or culture.

65.4% of respondents reported having some fish left over from the previous year when the new fishing season begins. Of those, 30% smoke, can, or otherwise preserve it; 28.1% give it away; 17.6% use it for dog food; 11.9% donate it; 6.7% throw it away; 4% compost it; and 1.7% trade or barter with it.

#### *Applicability of the Data for use in Determining FCRs*

The goal of this project was to capture information regarding access to locally harvested seafood and food security in the Kenai Peninsula. While the survey results provide information on the percentage of the population that harvests and consumes fish, there is limited detail on the quantity and frequency of consumption, or on the types of fish and seafood consumed and harvested. The survey achieved a response rate such that the results can be considered statistically significant (95% CI) for residents of the Kenai Peninsula; therefore, although the results reported are broad in scope, they can serve as useful benchmarks for future research. The information reported on fish waste is also of interest, as it provides insight on how to translate harvest rates to consumption rates in this region. Identifying the portion of harvest that is not consumed, either due to spoilage or alternate use (e.g., trade), is an important consideration when developing methods to utilize harvest rates to predict consumption patterns (Wolfe and Utermohle, 2000).

### **Assessment of Cook Inlet Tribes Subsistence Consumption**

#### ***Seldovia Village Tribe Environmental Department, September 2013***

##### *General Information*

Between November 2011 and September 2012, Seldovia Village Tribe staff undertook a subsistence consumption assessment of Cook Inlet tribal members; the project was funded by EPA's Indian General Assistance Program. The assessment involved an interview-based survey that examined subsistence food consumption rates and patterns of Alaska Natives residing in Seldovia, Port Graham, Nanwalek, and Tyonek.

##### *Study Population*

Seldovia, Port Graham, Nanwalek, and Tyonek residents over the age of 18 were eligible to participate in the survey. A sample size of 19 completed interviews was sought (each from a different household) from each village. The samples were randomly selected from village registry lists. Respondents provided data for themselves and the youngest child living in the household. Compiled data were weighted based upon the number of tribal households in each village. The study procured the sample size necessary to achieve 95% confidence of the mean consumption within a bound of 9 grams, assuming a standard deviation of 30 g/day. The majority of interviews were conducted in May 2012.

### *Data Collection Methods*

Researchers used a single dietary recall survey to obtain information on respondents' diets. The questionnaire asked for consumption information on 29 species of Cook Inlet fish, specifically chosen because they are known to be traditionally harvested by tribal members and because they all can be found locally at least part of the year. Fish fillet (three ounce and five ounce) models were shown to respondents to help them determine accurate consumption amounts, and interviewers were also equipped with fish reference books to ensure species consumed were correctly identified. The 18-page questionnaire consisted of 36 questions within five sections (memory recall, adult consumption of fish, child consumption of fish, adult consumption of non-fish subsistence foods, and obtaining fish). Respondents were asked about the number of fish meals they consume on a weekly basis, on average, and throughout the year, and about their consumption of different fish species and fish parts.

In addition to the types and quantity of fish consumed, the survey also aimed to capture information on seasonal variation in fish consumption. Respondents were asked to identify the two months of the year they consume the most fish and the two months they consume the least fish. Respondents were then asked to estimate the average number of fish meals per week they consumed during the two months they identified as the highest and least months of consumption.

Additional data collected on the questionnaire included information on the source of fish (self-harvested, grocery store, or gift) and preparation methods. The survey also contained questions on consumption of other types of locally available seafood.

### *Description of Data*

The report presents a substantial amount of information on fish and seafood consumption of adults in children. For adults, results presented include: rates of fish consumption, seasonal consumption rates, consumption of different fish species and parts, fish preparation methods, and the origin of the fish consumed. For children: age when the individual began eating fish, rates of consumption, and consumption of different species and parts.

### *QA/QC Procedures*

Several measures were undertaken to ensure QA/QC during the data collection process. An initial pretest was conducted to identify any potential problems with the delivery of the questions. Interviewers were trained through self-study and a webinar conducted by the Seldovia Village Tribe Environmental Department. For each interview, in addition to the trained interviewer, a monitor was present to ensure the interview was conducted correctly and that the questionnaire was completed. For all participants who consented, the interview was recorded so that responses could later be clarified if needed.

### *Findings on Fish Consumption*

Results revealed that the average daily FCR for Cook Inlet tribal members was 94.8 ( $\pm$  23.5 SE) g/day. Tribal members in their mid to late thirties through early to mid-sixties consumed the most fish; males consumed more fish than females; fishers consumed more fish than non-fishers; and salmon was one of the top consumed fish. The average daily rate of fish consumption for children 5 years old and younger was 34.9 ( $\pm$  17.4 SE) g/day. The average daily consumption rate of shellfish for adults was 12.0 ( $\pm$  3.4 SE) g/day. The two months of highest fish consumption were June and July or July and August for 51.9% of the respondents. For all months identified as high fish consumption months (i.e. months identified by each respondent as their two months of highest fish consumption), respondents consumed an average of 116.4 ( $\pm$  19.3 SE) g/d of fish. During all low-fish consumption months, respondents consumed an average of 41.0 g/d ( $\pm$  6.4 SE).

Coho salmon was the fish species eaten by the greatest number of respondents (89.5% of respondents), followed by halibut (83.9% of respondents), chinook salmon (79.0% of respondents), sockeye salmon (75.4% of respondents), and pink salmon (63.8% of respondents). In terms of quantity (g/day), coho salmon had the highest average daily consumption rate by respondents at 31.2 ( $\pm$  9.7 SE) g/d followed by sockeye salmon at 22.8 ( $\pm$  5.5 SE) g/d and pink salmon at 17.1 ( $\pm$  4.6 SE).

### *Applicability of the Data for use in Determining FCRs*

This study was specifically focused on obtaining and presenting information on fish consumption by residents of Alaska Native communities in the Cook Inlet region. The information presented is directly applicable to determining FCRs in the region. The primary limitation of the data is the small sample sizes, which results in a large standard error. There also exists the potential for misclassification of respondents' consumption due to recall bias, as a single survey was used to analyze consumption over a period of 12 months. Additionally, the surveys were administered at different times throughout the year, which may have impacted reported consumption between respondents. Despite the potential limitations, the data provide detailed information on the type and quantity of fish and seafood consumed by age and gender, as well as detailed information on procurement, food preparation, and seasonal consumption behaviors. The study is likely representative of fish consumption research that can be executed at a local government scale,

given the fiscal and human resource constraints experienced by many municipal health and environmental offices.

**Amchitka Island, Alaska, Biological Monitoring Report 2011 Sampling Results**  
***U.S. Department of Energy, September 2013***

*General Information*

The Long-Term Surveillance and Maintenance Plan for the U.S. Department of Energy (DOE) Office of Legacy Management is an ongoing environmental monitoring effort that has taken place on Amchitka Island, Alaska since before 1965, in an effort to mitigate harmful effects to human health and the environment from three nuclear test sites located on the island. The most recent monitoring report describes data collected from biological and seawater samples from the marine and terrestrial environment of Amchitka Island (adjacent to the three detonation sites) and at a background site, Adak Island, 180 miles to the east.

The first stated objective of the 2011 sampling effort was to collect and analyze marine flora and fauna, lichen, soil, and marine sediments for nuclear test-related radionuclides to determine if subsistence and commercial-catch seafood in the study area is safe to eat. In order to assess exposure, consumption estimates were derived using diet intake surveys previously conducted at three Alaska Native Villages located in the Aleutian Islands: Atka, Nikolski, and Unalaska; and St. Paul Island (Bartell et al. 1999; Hamrick et al. 2003; Hamrick and Smith, 2003). DOE compiled the data and developed a composite Aleut diet used to estimate the potential risk of ingesting seafood harvested (both from a subsistence and commercial basis) from Amchitka.

*Study Population*

The participants of the diet surveys represented a mix of male and female individuals that were 15 years or older, except for a small number of younger participants in part of the Atka diet survey.

*Data Collection Methods*

For the Atka diet data, diet information was reported in terms of g/day for three survey periods: June to September 1998; June to December 1998; and January to April 1999. Given that the first period overlapped with the second period, data for the second period were used, whenever available, with those for the third period to determine the average consumption rates. The reported average daily consumption rates for participants were used. Although the diet assessments do not cover an entire year, it was assumed that the diet pattern was applicable for the entire year.

The diet data for St. Paul, Nikolski, and Unalaska were reported as consumption frequency, expressed as the number of portions per year. The results were multiplied by the corresponding amount in grams per portion, and then divided by 365 days per year to obtain the average daily



intake rates in grams per day. Similar to the Atka diet data, the reported average frequencies for participants were used in the calculations.

For fish types of which multiple varieties are included in the diet, all species were combined to give the total intake rate for that fish or seafood type. This approach was necessary to provide a common basis for developing ingestion rates of different species within the four sets of diet data because the level of detail regarding the varieties of species consumed was not identical between the different studies.

#### *Description of Data*

Average consumption in g/day is presented for each village and as a composite diet for 13 fish, mollusks, and crustaceans. On the basis of these species-specific intake rates, the total seafood intake rate over all species was determined, and the distributions of the total consumption rate among different species were calculated. The consumption rates for the composite diet and those for the four villages represent the seafood diet of an average adult Aleut in Alaska.

#### *QA/QC Procedures*

QA/QC procedures utilized in the development of the average daily consumption rates per village and the composite diet were not documented in the report.

#### *Findings on Fish Consumption*

The report demonstrates a wide range of average daily consumption between villages and the types of fish eaten in each village. Daily consumption ranged from an average of 10 g/day in St. Paul to 520 g/day in Nikolski. Three of the four villages reported that salmon comprised the highest proportion of their seafood diet, while St. Paul reported halibut as the high proportion of seafood consumed. The composite data of the four villages resulted in an average daily intake rate of 100 g/day including 49 g/day of salmon.

#### *Applicability of the Data for use in Determining FCRs*

This report provides a useful example of how data from multiple studies can be used to evaluate consumption rates for a region. The study takes a conservative approach by developing composite consumption values from the four villages, but also retains the village level consumption information to use as a range of potential consumption values. The comparison of the village level data and the composite values highlights the differences in quantity and type of seafood consumed even within a single region, among residents of similar cultural background. One limitation to the aggregate approach is that some specificity on the species of seafood consumed is lost due to variation in the data collection methods.

## **Harvest Assessment Data**

Harvest data are another potential source of information that can be used to develop HHC. While states often have programs in place to monitor fish catch activity, multiple considerations must be taken into account when using fish harvest data to estimate consumption rates. A determination must be made as to what portion of the fish are kept and consumed, what the usable weight of the harvest is, and how that harvest may be shared among households (Kissinger, 2014).

### *General Overview*

The ADF&G is the principle source of fish and seafood harvest data in Alaska. Harvest data are collected and reported by multiple divisions within the department (Fall, 2011), including the following:

- The Division of Commercial Fisheries prepares annual Fishery Management Reports (FMRs) for most fishery management areas in the state. The FMRs focus on commercial fisheries, but also routinely summarize basic data for the programs that collect harvest data for subsistence fisheries and personal use fisheries that the division administers. Annual reports about Subsistence Fishers Harvest Assessment Programs are prepared for the Northwest Alaska, Yukon River, and Kuskokwim River areas.
- The Division of Sport Fish prepares summaries for the personal use salmon fisheries it administers in the Cook Inlet and Prince William Sound (Upper Copper River) areas.
- The Division of Subsistence produces three final products: reports in the Technical Paper Series and Special Publications Series, and two databases; the Community Subsistence Information System; and the Alaska Subsistence Fisheries Database.
  - Since 1999, as part of its Technical Paper Series, the Division of Subsistence has published the Annual Subsistence Fisheries Report Series, which compiles subsistence and personal use fisheries harvest data from all management areas.

### *Data Collection Methods*

The ADF&G Division of Subsistence uses a variety of research methods in its collection of subsistence data including: systematic household studies; mapping harvest areas; key respondent interviews; participant observation; database and library research; and harvest monitoring using permits and post-season surveys (Fall, 2011).

### *Description of Data*

**Alaska Subsistence Fisheries Database:** Initiated in 1999 by ADF&G Division of Subsistence, the Alaska Subsistence Fisheries Database (ASFDB) compiles information from annual subsistence salmon harvest monitoring programs and includes information for all fisheries management areas. Most of the annual harvest monitoring programs focus on salmon, however there is also limited information on other types of fish and marine invertebrates. Most harvest monitoring

programs in the state collect information on total harvest by species, harvest timing, number of participants in the fishery, location of harvest, and residence of participant fisher (Lemons, 2011).

Community Subsistence Information System: The Community Subsistence Information System (CSIS) is the repository of Alaska community harvest information collected by the ADF&G Division of Subsistence. The database includes harvest information by community, resource category, region, State Subsistence Region, Federal Subsistence Region, and information pertaining to specific game management units. It also contains community information on local demographics and economics, as well as documents the methods used to conduct subsistence research in each community. The CSIS can be found online at: <http://www.adfg.alaska.gov/sb/CSIS/>.

Technical Paper Series: The Technical Paper Series is the most complete collection of current information about subsistence in Alaska, and represents a substantial portion of the ADF&G Division of Subsistence's research. The papers cover all regions of the state. Some papers were written in response to specific fish and game management issues, including harvest assessments. Other papers provide detailed data on the subsistence use of particular communities, information that is critical for analysis of multiple scientific and policy issues within Alaska. Analyses of data contained the ASFDB and the CSIS are frequently included in the Technical Paper Series reports. A full description of all the various types of Fishing and Subsistence publications can be found on ADF&G's website at:

<http://www.adfg.alaska.gov/sf/publications/index.cfm?ADFG=main.reportTypes>

#### *Findings on Fish Harvest Assessment*

Technical Paper No. 387 – *Alaska Subsistence and Personal Use Salmon Fisheries 2011 Annual Report* provides the most recent summary of compiled data on subsistence and personal use salmon harvest data. Using the data collected by the harvest monitoring program, ADF&G estimates that more than 1.63 million pounds of salmon are harvested by more than 60,000 permitted households.

*Subsistence in Alaska: A Year 2012 Update* estimates that rural Alaskans harvest approximately 295 pounds of wild foods per person each year on average, and approximately 53% (or 156 pounds) of this subsistence harvest is fish. While there is likely variation in fish harvest between communities, ADF&G estimates that 95% of total rural household participating in subsistence activities use fish and 83% harvest fish themselves.

Technical Paper No. 261 by Robert J. Wolfe and Charles J. Utermohle proposes a standardized method for estimating measures of wild food consumption in Alaska using indirect measures based on annual harvest and use of wild resources from household surveys conducted by ADF&G Division of Subsistence. The report discusses the process of extrapolating consumption estimates, but does not provide specific consumption data. However, Ouzinkie, Kodiak Island is used to demonstrate application of the process and results are presented for mean per capita

harvest, percentage contribution to total harvest, mean wild food use in g/day, 95% percent upper confidence limit of the mean, 50<sup>th</sup> percentile use, 95<sup>th</sup> percentile use, and 100<sup>th</sup> percentile use. These values are provided for more than 25 species of fish. For fish overall, it is estimated that the mean use per person in Ouzinkie is 367.37 g/day (95% CI).

#### *Applicability of the Data for use in Determining FCRs*

The ADF&G has a large amount of data on subsistence harvest of food including data on catch, use, and preparation of fish for different regions throughout the state. Any effort to determine FCRs should be conducted in close consultation with ADF&G to understand what data may be applicable for this purpose. Technical Paper No. 261 provides a potential method that can be applied with ADF&G datasets. The capacity in ADF&G to capture subsistence data is highly developed with monitoring and information gathering programs in place throughout the state. A collaborative effort to understand the systemic differences between use data calculated from harvest data and dietary survey data would be highly beneficial and potentially lead to development of a predictive model of consumption.

## **5. Data Gaps and Potential Limitations**

### **Potential Limitations**

The literature reviewed and summarized in this report provides an overview of existing information and data that may be useful in future efforts to develop a methodology for calculating FCRs for Alaska. In total, eight dietary survey reports were reviewed for potentially applicable data for use in determining FCRs. Of the eight studies, four report FCR findings in g/day including:

- Two surveys conducted in the Cook Inlet Region,
- One study conducted in the Aleutian Region (which used secondary data to create a composite regional FCR) and,
- One survey with sampled population from throughout Alaska.

The following are potential limitations of the studies for use in developing a methodology for calculating FCRs for Alaska:

- Small sample sizes;
- Localized study populations;
- Potential differences in the way the surveys were administered; and
- Varying study objectives, rendering it impossible to identify any single data source that meets all the required criteria to adequately determine an FCR appropriate for use in deriving Alaska HHC, especially at a state-wide level.

Future surveys conducted in support of efforts to calculate FCRs should be designed specifically to avoid these types of limitations.

### **Data Gaps**

Several data gaps and are discussed below.

#### *Populations Assessed*

Data from ADF&G demonstrate that individuals living in rural areas of Alaska are more likely to rely on subsistence fishing and have higher FCRs (ADF&G, 2014). These populations could be prioritized for any potential additional research on fish consumption, as they likely represent maximum FCRs in Alaska; and a potential single statewide consumption rate needs to take into account these populations. If the State of Alaska determines that a regional approach is preferred, additional research could investigate the FCRs of Alaskans who participate in recreational fishing or consume seafood in a manner that is not defined as subsistence so that the sample is more representative of all groups living or recreating in that region. The results of the eight dietary surveys reviewed are representative primarily of Alaska Natives living in rural, often coastal, areas who participate in subsistence harvest practices. Thus, any assumptions of urban consumption patterns would be speculative.

#### *Temporal Variability*

Seasonal fluctuations in fish consumption are difficult to capture using typical dietary survey designs and are potentially substantial, with the greatest variation reported among non-subsistence populations (Moya, 2004). Information on seasonal fish consumption is obscured if dietary recall information over a long time span (e.g., 12 months) is used to develop daily averages. Several studies capture information on seasonal fluctuations (Ballew et al. 2004; Johnson et al. 2009; Loring, Gerlach & Harrison 2013; Nobmann et al. 1992; SVT, 2013) and contain information on the months of highest consumption, but change in FCR is only specified in one report (SVT, 2013). In that study, estimated average FCR for residents of the Seldovia Village Tribe during the highest two consumption months was almost three times greater than FCR during the lowest two consumption months. Additional information from diverse study populations is needed to further understand the specific fluctuations in amount of fish consumed from month to month among Alaskan consumers.

#### *Regional Variances*

Significant variances in consumption patterns are observed within populations of the same ethnicity in similar geographic locations, as well as between individuals in the same village. Further research and analysis would be needed to determine whether the variances are due to differences in the consumption habits, or due to misclassification caused by bias in the survey results.

## **6. Recommendations**

Although the existing data sources reviewed in this report have limitations, they provide findings that can inform preliminary efforts to develop FCRs for Alaska. For instance, Ballew et al. (2004) reports maximum per person consumption in pounds per year in coastal subsistence communities, which provides an estimate of fish consumption for individuals who are likely to be among Alaska's highest fish consumers. Additionally, findings by Nobmann (1992) and the Seldovia Village Tribe (2013) present statistically significant evidence that within the subsistence communities studied, the average FCR exceeds the current EPA default rate of 22 g/day, even when allowing for a large standard error in the study calculations.

Currently there is no standardized process for states to follow when identifying and developing data sources to use in determining FCR for deriving HHC. ADEC may want to consider conducting a review of methodologies used by states to develop FCRs in different regions of the country, and dietary survey methods utilized in various sectors of the scientific community. A comparative analysis of different approaches will be critical in identifying a process that is most compatible with the policy and public health objectives of ADEC.

Alaska's population is diverse and fish consumption practices vary widely. Given, the unique logistical challenges of travel in Alaska, the state may want to explore strategies for capturing fish consumption data that require less fiscal and human resources than a traditional dietary survey effort. One example is a possible harvest-based consumption model that utilizes existing ADF&G data collection capabilities.

Another example of a potential modeling strategy is a statistical method developed by the National Cancer Institute that uses information from two 24-hour dietary recalls to estimate usual intake of episodically-consumed foods. The method accommodates the large number of non-consumption days that arise with foods by separating the probability of consumption from the consumption-day amount, using a two-part model. Covariates, such as sex, age, race, and information from a FFQ, may be used to supplement the information from two or more 24-hour recalls using correlated mixed model regression. The model allows for correlation between the probability of consuming a food on a single day and the consumption-day amount. Percentiles of the distribution of usual intake are computed from the estimated model parameters (Tooze, 2006). The utilization of two 24-hour dietary recalls may serve to reduce the potential for bias that exists with use of FFQs alone; however, conducting the recalls may involve significant resources to implement. The resulting model may also provide insight on consumption patterns in different regions of the state, and could be used to evaluate seasonal fluctuations in fish consumption.

Finally, DEC could consider collaborating with stakeholders on the development of a standardized dietary questionnaire and survey methodology to ensure that the results of any potential future studies are comparable and capture all of the information needed to support the development of FCRs for Alaska. Doing so will help ensure that resources applied to these efforts result in a reliable and relevant source of data.

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