GUIDANCE FOR ASSESSING CHEMICAL CONTAMINATION DATA FOR USE IN FISH ADVISORIES

VOLUME III: OVERVIEW OF RISK MANAGEMENT

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Washington, DC

EXECUTIVE SUMMARY

State, local, and federal agencies currently use various methods to estimate risks to human health from the consumption of chemically-contaminated, non-commercial fish. A 1988 survey, funded by the U.S. Environmental Protection Agency (EPA) and conducted by the American Fisheries Society, identified the need for a standardized approach to evaluating risks and developing fish consumption advisories to provide comparable advisories across different jurisdictions (RTI, 1990). Four key components were identified as critical to the development of a consistent risk-based approach: standardized practices for sampling and analyzing fish, standardized risk assessment methods, standardized procedures for making risk management decisions, and standardized approaches to risk communication (RTI, 1990).

To address concerns raised by the survey respondents, EPA has developed a series of four documents designed to provide guidance to state, local, regional, and tribal environmental health officials responsible for issuing fish advisories. The documents are designed as guidance only and do not constitute a regulatory requirement. The documents are:

Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories
- *Volume I: Fish Sampling and Analysis*
- *Volume II: Risk Assessment and Fish Consumption Limits*
- *Volume III: Risk Management*
- *Volume IV: Risk Communication*

It is essential that all four documents be used together, since no single volume addresses all of the topics involved in the development of risk-based fish consumption advisories.

Fish contamination has become a recognized health hazard in some areas in recent

years. While most fish provide an excellent source of nutrition, some fish are sufficiently contaminated to generate health risks (e.g., Minamata disease in Japan). The responsibility for safeguarding the public from contaminated fish is shared by different agencies in the United States. Federal agencies such as the United States Food and Drug Administration (FDA)[1] have responsibility for advisories regarding commercial fish. EPA, the Department of Energy, and the United States Fish and Wildlife Service, are also involved in managing and monitoring waterbodies, controlling pollutant releases, and managing clean up and remediation efforts that impact fish contaminant concentrations. Responsibility for safeguarding the public against effects of contaminants in non-commercial fish falls to state, local, and tribal agencies and groups. The overall objective of this series is to provide guidance to these agencies and groups regarding the development of fish advisories for non-commercial fish.

The field of risk management, as it deals with fish advisories, is a relatively new and evolving area. A few states have long-standing advisory programs; however, written evaluations of these programs were not available for the most part. Consequently, there is limited information available from which to draw conclusions or guidance regarding management strategies. Examples of types of advisories were obtained from ongoing advisory programs. Advisory program staff were consulted regarding their experiences with various management approaches. Due to the information constraints, this document provides an overview of risk management rather than detailed and highly specific guidance. Numerous state and local advisory programs have recently been developed, and it is anticipated that additional information will be available in future editions of this volume.

A variety of options exist for managing health risks through fish advisories. Options for limiting consumption of contaminated fish range from approaches requiring limited resources to resource-intensive approaches such as the development of quantitative health-based advisories. This document presents various options that may be used in fish advisory programs, with a discussion of the types of information and resources required and their advantages and disadvantages. A discussion is included of specific characteristics that may be considered when developing a fish advisory program, including: contaminant and risk levels, resources available for program development, the feasibility and efficacy of the options, and the anticipated impacts of various options on target populations (e.g., on nutrition, economics, traditional activities, communities, risk). A structure for organizing information on options and characteristics is provided and a tiered approach to developing fish advisories is discussed. Templates are included to enable risk managers to organize their information to evaluate needs and to identify the optimal group of options and consumption limits for their area.

[1] See the Glossary for definitions of abbreviations and selected terms.

The risk management approach discussed in this volume includes a discussion of critical decisions required to carry out sampling and analysis, risk assessment, and advisory program development. This highlights for the risk manager those decisions that may have a significant impact on risk estimates and the corresponding advisories. The uncertainties inherent in these decisions are also discussed.

Environmental justice is discussed in this volume because contaminated fish may be consumed in greater quantities by minorities and low-income populations in many areas of the United States. These groups are often subsistence fishers (fishers who rely substantially on fish they catch as a food source) and may be simultaneously exposed to the pollutant found in their fish via other sources as well (in other foods, air, and water). Subsistence fishers live in urban environments, where high pollution levels often have obvious industrial or other sources, as well as in rural areas, where water or soil contamination may occur via long-range transport or from non-point sources.

While health concerns are often the focus of fish advisory development this document also provides information on health benefits of fish consumption and the economic and social impacts of various advisory strategies. Information on the benefits of fishing and fish consumption are provided to enable risk managers to evaluate the potential impacts of advisories; however, information on these topics is limited, often location-specific, and dependent on local characteristics. Quantitative cost-benefit analysis is not discussed in this volume; however, qualitative information on health benefits of fish and limited fishing revenue data are included. Information is also provided on potential societal impacts meriting consideration, such as traditional dietary patterns and religious and social traditions that rely on fishing and fish consumption. Although these types of impacts cannot be quantified or adapted to a balance sheet approach, they merit consideration in the development of advisories. The social, economic, and health impacts of advisories will vary depending upon the characteristics of the local population, and use of local information is encouraged.

A theme carried through this document is to utilize local information and participation where possible and to involve all potentially impacted parties in the decision-making process. It is hoped that the evaluation of potential impacts of fish advisories and broader public participation in decision-making will provide all affected parties access to policy making, and result in well-founded and widely accepted fish advisories.

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ACKNOWLEDGEMENTS

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GLOSSARY & ABBREVIATIONS

acute exposure	exposure at a relatively high level over a short period of time (minutes to a few days). (This is defined in IRIS as 24 hours or less; however, sources consulted utilized exposure periods of up to a few days. Consequently, the more encompassing definition is appropriate in reading this document.)
acceptable risk level	the maximum level of individual lifetime carcinogenic risk considered "acceptable" by risk managers.
agency	state, local, and tribal agencies and groups who have responsibility for managing risks associated with fish contamination are referred to as agencies in this text. These may include departments of environmental protection or health, tribal councils, and other types of regulatory and governing groups.
ATSDR	Agency for Toxic Substances and Disease Registry, U.S. Dept. of Health and Human Services, Public Health Service.
BW	body weight of an individual, expressed in kilograms (kg).
cancer potency	(often used interchangeably with slope factor) the slope of the dose-response curve in the low-dose region used with exposure to calculate the estimated lifetime cancer risk. Often expressed as risk per one milligram of exposure to the toxic chemical per kilogram body weight per day (mg/kg-d). Usually is calculated using the upper 95% confidence limit on the linear term in the linearized multistage (LMS) model.
chronic exposure	multiple exposures occurring over an extended period of time, or a significant fraction of the lifetime

developmental toxicity	adverse effects on the developing organism resulting from exposure prior to conception, during prenatal development, or postnatally up to the time of sexual maturation.
dose-response relationship	relationship between the exposure to an agent and changes in aspects of the biological system, apparently in response to that agent.
efficacy	refers to the degree to which a fish advisory program obtains compliance with advisories on the part of fish consumers.
endpoint	response measure in a toxicity study (e.g., liver damage, developmental toxicity, cancer).
EPA	United States Environmental Protection Agency.
exposure limits	a daily limit on exposure based upon health and toxicity data, which the reader may calculate, using the study data provided in this or other sources (mg/kg-day).
feasibility	refers to the match between the human, material, and financial resources required by an agency to carry out a program and the requirements of the program.
FDA	United States Food and Drug Administration.
fish	refers in this document to non-commercial fish from estuarine and fresh water sources, unless otherwise noted.
incidence	number of new cases of a disease within a specified time.
kg	kilogram, one thousand grams (10^3), equivalent to 2.205 pounds (avoirdupois).
mg	milligrams, one thousandth (10^{-3}) of a gram.
mg/kg-day	milligrams exposure per kilogram body weight of the exposed individual per day.

mutagenic	capable of inducing changes in genetic material (e.g., DNA).
recreational fishers	non-commercial and non-subsistence fishers. Synonymous with sport fishers in this document.
Reference Dose (RfD)	estimate (with uncertainty spanning perhaps an order of magnitude) of a daily exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of adverse non-carcinogenic effects during a lifetime. Units are mg/kg-day.
risk	the probability of injury, disease, or death under specific circumstances.
SF	see cancer potency. (Not to be confused with safety factor approaches used in non-cancer analyses.)
sport fishers	non-commercial and non-subsistence fishers. Synonymous with recreational fishers in this document.
subsistence fishers	refers in this document to be people who rely on non-commercial fish as a major source of protein.
threshold	dose or exposure below which a significant adverse effect is not expected.

SECTION 1

INTRODUCTION

1.1 Overview and Objectives

The objective of this volume is to provide state, local, and tribal agencies with risk management guidance for developing fish advisories. Fish contamination has been recognized as a potential health hazard in recent years. While most fish provide an excellent source of nutrition, some fish are sufficiently contaminated to cause health problems (e.g., Minamata disease in Japan).

The field of risk management, as it deals with fish advisories, is a relatively new and evolving area. Although a few states have long-standing advisory programs, written evaluations of these programs are generally not available. Consequently, limited information is available from which to draw conclusions or guidance regarding management strategies. Examples of types of advisories were obtained from ongoing advisory programs. Advisory program staff were consulted regarding their experiences with various management approaches. This document therefore provides an overview of risk management rather than detailed and highly specific guidance. EPA will provide more detail on the experiences and recommendations of state and local programs in future editions of this volume.

This risk management volume is part of a series that provides information on:

- identifying and quantifying fish contamination,
- evaluating risks associated with contamination,
- managing those risks, and
- communicating risk information and protective strategies to the public.

Various agencies have responsibility for issuing fish advisories and preventing fish contamination. State, local, and tribal agencies have primary responsibility for safeguarding the public against effects of contaminants in non-commercial fish.[1]

[1] State, local, and tribal agencies are referred to as "agencies" in this document and include groups responsible for managing risks associated with fish contamination. These may include departments of environmental protection or health, tribal councils, and other types of regulatory and governing groups.

Federal agencies are responsible for commercial fish and for activities related to preventing fish contamination. The United States Food and Drug Administration (FDA)[2] is responsible primarily for developing advisories regarding commercial fish. The United States Environmental Protection Agency (EPA), the Department of Energy (DOE), and the United States Fish and Wildlife Service are also involved in managing and monitoring waterbodies, controlling pollutant releases, and clean-up and remediation efforts that impact fish contaminant concentrations (see Section 2.5).

This volume addresses factors to be considered in both the development of advisory programs and the establishment of health-based fish advisories. This process is complex due to the variety of factors involved:

- the type of contamination,
- the level of contamination,
- local fish consumption practices,
- local population characteristics, and
- resources available for an advisory program.

The various options for limiting consumption of contaminated fish can be tailored to fit local characteristics and needs. These options range from approaches that require limited resources and have limited effectiveness (e.g., general advisories), to more resource-intensive and effective approaches (e.g., quantitative advisories). This document presents various options that may be used in fish advisory programs and discusses their strengths and weaknesses. Other relevant characteristics like resources available for program development, risk levels, and economic and cultural impacts, are also discussed. Templates for organizing information on options and characteristics are included.

Agencies currently employ a range of methods to estimate risks to human health from consumption of chemically-contaminated fish. Results of a 1988 survey of such methods, funded by the U.S. Environmental Protection Agency (EPA)[3] and conducted by the American Fisheries Society, indicated the need for a more consistent approach to assessing risks from contaminated fish.[4] The four key components identified as critical in a risk-based approach to developing fish

[2] See the Glossary for definitions of abbreviations and selected terms.

[3] Throughout this document the abbreviation EPA will be used to represent the U.S. Environmental Protection Agency.

[4] In this document, fish refers to non-commercial fish from estuarine and fresh water sources.

consumption advisories were:

- standard practices for sampling and analyzing fish,
- standardized risk assessment methods,
- standard procedures for making risk management decisions, and
- standardized approaches to risk communication.

To address concerns raised by the survey, EPA is developing a series of four documents to provide guidance to agencies issuing fish advisories for non-commercial fish (i.e., self-caught fresh water and estuarine fish). These four volumes comprise the *Guidance for Assessing Chemical Contamination Data for Use in Fish Advisories:*

Volume I: Fish Sampling and Analysis (EPA, 1993a),

Volume II: Development of Risk-Based Intake Limits (EPA, 1994a),

Volume III: Overview of Risk Management, and

Volume IV: Risk Communication (EPA, 1994c).

Supplements to Volume II have also recently been released. These provide information regarding exposure assessment, including fish consumption patterns, risk characterization, and mapping. The four volumes and the supplements should be used together, since no one volume provides all the necessary information to evaluate and make decisions regarding the issuance of fish consumption advisories. While these volumes are designed to provide guidance to agencies developing fish advisory programs, **they do not constitute a regulatory requirement.** To provide further information, EPA recently developed the National Listing of Fish Consumption Advisories data base, available from the Office of Water on five disks in a PC format.

1.2 Series Summary

To provide guidance on using a human health risk-based approach to determine both the level of the advisory and the most appropriate type of advisory, this series presents the following features:

- methods to assess contaminant levels in fish tissues,

- methods to evaluate population risks for specific groups, waterbodies, and geographic areas;

- discussion on identifying target populations, with information on especially susceptible subpopulations;

- descriptions of various risk management options for fish advisory programs, with the experiences of agencies that have utilized the options;

- factors that may be considered in selecting program options and protection levels, including organizational factors such as feasibility and efficacy, and the impacts of various options on target populations (e.g., on nutrition, economics, traditional activities, communities, and risk);
  and

- methods for organizing information on risk, options impacts, and target populations' characteristics.

- methods of risk communication

Table 1.1 provides more specific information on the major activities covered in the documents in this series. All the activities carried out in the process of developing fish advisories and managing risks associated with contaminated fish are listed in the table. Volume I provides guidance on developing a sampling and analysis program to characterize the nature of the fish contamination distribution in waterbodies throughout an area. Volume II provides an overview of risk assessment, chemical-specific risk values, and methods for calculating meal intake limits. It also provides the groundwork for a population risk evaluation. Volume III, this document, provides information on selecting and implementing various options for reducing risks associated with contaminated fish consumption. This document focuses on fish advisories, although other related activities are discussed. Volume IV provides guidance on methods for communicating risk information and for evaluating the target audience for risk advisories to determine the best approach for communicating risk.

Table 1.1. Activities Related to the Development of Fish Advisories and Risk Management and Volumes in the Series Containing Discussions of These Activities

ACTIVITY	Sampling and Analysis	Risk Assessment	Calculate Health-Based Intake Limits	Evaluate Options	Select Appropriate Risk Management Options[5]
DATA GENERATED	1.concentration in fish tissue (V. I) 2.geographic distribution of contaminant (V. I)	1. individual risks (V. 2) 2. population and subgroup risks (V. 3) 3. identify groups at highest risk (V. 3)	1. health-based consumption limits (V. 2 & 3) 2. maximum acceptable contamination levels (V. 2 & 3)	1. potential options and administrative requirements (V. 3) 2. benefits and adverse impacts of options (V. 3) 3. other mechanisms for reducing contamination and risk (V. 3)	1. identify options that are optimal for a specific locality (V. 3)
RELATED ACTIVITIES **NOT** COVERED IN THIS SERIES	evaluate sources of contamination and transit pathways	determine if medical monitoring or intervention is warranted (primarily relevant to high exposures)	determine what actions are needed to lower contamination to minimal risk levels	work with remediation and enforcement agencies to reduce contamination	integrate programs with relevant local activities ongoing through other agencies or groups

[5] Risk communication activities related to fish advisories are discussed in Volume IV of this series.

Major functions are listed in the first row. The data or conclusions generated by each step are listed below the activities, along with the volume in which the activities are discussed. Some related activities relevant to fish advisories but beyond the scope of this series are listed in the final row. As Table 1.1 shows, the development of advisories depends on the collection of appropriate data in the early stages of program development and proceeds through analysis (risk assessment) to decision-making (risk management).

1.3 Volume III Contents

Figure 1.1 shows how Volume III fits into the overall series and lists the major categories of information provided. This volume covers topics necessary for decision-making to manage risks related to chemically contaminated fish. The sequential order of the sections follow the anticipated sequence of activities to be carried out in developing a risk management program.

Section 2 contains a discussion of various options for limiting contaminated fish consumption. Federal roles and activities are identified. Regulatory and other options for state, local, and tribal governments are presented with discussions of the organizational features of each option. Some anecdotal information is provided on the experiences of various agencies in implementing different program options.

Section 3 provides information on the potential impacts of limiting consumption, including social, economic, cultural, and nutritional impacts, costs, feasibility, legislative and political constraints, and other factors. The impacts vary depending on the specific circumstances of an area and the population of concern.

Section 4 contains a discussion of methods for comparing health risks associated with consumption to impacts of limiting consumption. It provides schematics for organizing information on a site-specific basis regarding various risk management options, their applicability to an area, and attributes and requirements for their implementation. A tiered approach to developing fish advisories is discussed. Templates are included to help risk managers organize their information to evaluate needs and to identify the optimal group of options and consumption limits.

Section 5 contains a list of references consulted and cited.

Figure 1.1 Series Summary: Guidance for Assessing Chemical Contamination Data for Use in Fish Advisories

1.4 Methods and Sources

This document was developed using information from a variety of sources:

- State documents related to the development and implementation of fish advisories were consulted. These sources provided data on existing programs and, in some cases, comments on their efficacy.

- Staff members of some agencies and tribal groups with long-standing programs were consulted regarding their experiences and recommendations. Due to the recent development in many states of extensive advisory programs, limited information on management strategies exists. Future editions of this volume are expected to contain additional information on program development processes and strategies.

- Government publications and journal articles were consulted for information on scientific issues including nutrition and economics.

- Government documents and programs were consulted for information on mapping methods (e.g., GIS mapping), regulatory roles of various agencies, and information on existing programs designed to address pollution prevention and waterbody remediation.

- Workgroup members[6] and other experts from state, local, tribal, and federal governments, academic institutions, and advocacy groups were contacted by phone, and provided both information about their current programs and experiences and ideas for future activities.

1.5 Underlying Assumptions

Risk management for any environmental program requires numerous staff and management decisions. The decision-making process is aided by comprehensive information on both the nature of the problem to be addressed and the

[6] Work on this document was guided by a workgroup of experts on fish contamination issues. Their names and affiliations are listed in the Acknowledgements section in the front of this volume. This group reviewed the outline and drafts of the document, and made numerous comments and recommendations on the content.

characteristics and implications of options for remediation. The approach to risk management described in this volume is based upon underlying assumptions regarding decision-making in the public sector:

Chemical contamination of fish may pose health risks. These risks are dependent on the nature and severity of the contamination and the characteristics of the exposed population. Risk estimation is a developing science that cannot predict precise effects in individuals or populations. Consequently, uncertainty exists regarding the type and extent of health risks. Risk estimates can be used, however, with other relevant information, to make decisions regarding fish advisory programs.

The goal of developing fish advisories is to minimize the health risks to fish consumers as well as minimize any negative effects of restricting consumption. When fish contamination levels pose sufficiently elevated health risks (determined on a local basis), agencies may elect to take restrictive action to protect public health. Because many risk reduction options are associated with some negative impacts, decision-makers must also consider potential impacts on all affected parties.[7] These impacts include social, cultural, economic, health, and any other impacts associated with options for reducing risks.

Most options for reducing risks will require trade-offs between risk reduction and social, economic, and other costs. Decision-making to select options is primarily a policy activity rather than a scientific one. Consequently, it is beneficial to make such decisions with input from all affected parties.

Each agency and exposed population has unique characteristics, resources, strengths, goals, and constraints. Consequently, there is no one best approach to developing and implementing fish advisory programs. Each agency should design a program based upon the unique characteristics of its contamination problem, populations at risk, and affected parties. EPA does not recommend specific target intake limits or risk levels for contaminants. It also does not recommend using FDA action levels for site-specific fish consumption advisories.

*The **ultimate** goal of a fish contamination risk reduction program is to return waterbodies to a condition in which fish are no longer contaminated at a level that will pose unacceptable risks to human health.* While remediation of contaminated water is beyond the scope of this document, it is briefly discussed

[7] Affected parties may include fish consumers, individuals whose livelihood or lifestyle are dependent on non-commercial fishing, and individuals whose land use or value are related to non-commercial fishing.

in Section 2.5, which contains a listing of federal programs that may provide assistance.

1.6 Critical Decisions

Both science and policy are components of a fish advisory program. In the policy arena, decisions are required to establish and achieve policies and goals. Decisions are also required to conduct risk assessments and determine how science will be used in establishing policies. Many elements of risk assessment involve significant uncertainty (e.g., animal to human extrapolations, differences in susceptibility over a lifespan, the effects of exposure to a mixture of contaminants). Although some scientific data on these topics exist, they are rarely definitive. Under these circumstances, the decisions that transcend current scientific knowledge may be considered policy decisions, and both policy and scientific experts should participate in the decision-making process to arrive at the best choice. Scientists may be able to best describe the uncertainties and some alternatives, while policy makers may bring non-scientific issues to bear and consider potential impacts of decisions on a broader level.

In this document (and in others in the series) many issues that are decision points can be found in phrases like "readers may wish to...," where the reader may determine the best course of action. Minor decisions may be related to the use of specific resources (e.g., a particular laboratory method, a set of toxicological information sources). These decisions are expected to have a relatively minor impact on overall program activities and efficacy. Alternatively, critical decisions (or groups of decisions) are those that may have a significant impact on the target population, their level of risk or protection, and program efficacy.

Table 1-2 lists critical decisions in risk management for a fish advisory program, along with the section in which they are addressed. As stated above, the four volumes in the series *Guidance for Assessing Chemical Contamination Data for Use in Fish Advisories* are designed to be used together, although they address different topics regarding fish advisory development. Volume III, addressing risk management, provides an overview of the critical decisions made throughout the fish advisory development process. Relevant discussions also appear in other volumes in the series (e.g., decisions regarding sampling and analysis [Volume I], risk assessment [Volume II], and risk communication [Volume IV]). The critical decisions listed in Table 1-2 are discussed briefly in this section, and in more depth in subsequent sections of this volume.

Table 1-2. Critical Decisions

Nature of Decision (Category)	Section of Volume III or Volume Number
1. sampling and analysis	Vol. I
2. population risk estimation (risk assessment) including: consumption rates - subpopulation selection non-fish exposure - air, water, soil, occupational, non-fish food sources risk values - RfDs, cancer potency values, other values	Vol.II Supplement A
3. selection of target populations or risk levels	Vol.II Supplement A
4. risk management options under consideration	2.2
5. consideration of positive and negative impacts	3, 4.2
6. selection of most appropriate risk management options	4.3
7. level of protection afforded by advisories including: carcinogenic effects - acceptable risk level non-cancer effects - value selected as benchmark	4.4 and Vol. II Supplement A
8. level of program effort and funding	4.5
9. program evaluation and modification	4.6

Category 1. Sampling and Analysis

Decisions regarding sampling and analysis are discussed in Volume I. These decisions include sampling location, frequency, the chemicals analyzed, and those levels and frequency of occurrence that trigger the decisions to issue advisories. In most cases, it is neither economically feasible nor necessary to sample and analyze all waterbodies. When sampling has not been conducted previously, no scientific information is available on which to base sampling decisions. Consequently, sampling and analysis decisions may be based on policy or on the likelihood of contamination (e.g., using TRI data, the presence of Superfund sites, or clusters of environmentally-related disease).

Category 2. Population Risk Estimation.

Methods for calculating population risk require risk assessors to combine information on consumption patterns, contaminant levels, and risk values (e.g., RfDs) to obtain an overall estimate of risk for various population subgroups.[8] These methods are described in Supplements A and B to Volume II. Risk assessment used to establish risk-based fish advisories incorporates many decisions that involve policy considerations because they transcend current scientific knowledge. Examples of these decisions include choosing a health endpoint among many credible endpoints, and the degree of safety incorporated in risk values and subsequent risk estimates.

A range of values for the inputs used in risk calculations are discussed in Volume II. The exposure and toxicity values used affect the outcome of risk estimates. Risk estimates, in turn, are often used to determine the appropriate course of action, the population groups or geographic areas requiring action, and the fish advisory levels.

Critical decisions include the type of consumption data used (e.g., survey data collected locally, "average" consumption values from various studies, "high-end" estimates from studies), the location and nature of contaminant sampling (which may depend on available resources), the sources of concurrent exposure to the same contaminants considered, the risk values used to estimate risk, and the level of protection afforded by the advisory. Decisions on these factors involve policy rather than science and should be considered by risk managers in developing an overall fish advisory program.

[8] EPA is currently reviewing risk assessment methods for carcinogens and non-carcinogens. Information will be provided on any new recommended approaches (e.g., the benchmark dose approach, non-linear cancer extrapolation, categorical regression) in future editions of this series.

Category 3. Target Populations and Risk Levels.

Identifying target populations is a critical decision, because it may determine which groups will be the focus of risk reduction activities. This decision may be linked to those regarding sampling locations and groups to be considered in selecting consumption data (either through surveys or based on previous studies in the literature). If a risk-based approach is taken to population selection, targeted populations will be those groups identified following a risk assessment as having unacceptably high risk levels.

Decisions are also required to determine the breadth of the population to protect through advisories. Choosing members of the fish consuming population who eat an average (50th percentile) amount of fish versus those who consume larger amounts (i.e., at the 80, 90, or 99th percentiles) is a policy rather than a scientific decision.

The selection of unacceptable and acceptable risk levels are significant policy decisions and may involve evaluating various assumptions underlying the risk estimates. Risk managers may choose to focus on a particular risk level for carcinogens (e.g., one in one million) or specific types of risks (e.g., developmental, cancer, organ-specific toxicity to susceptible subpopulations) as being of critical importance. Others may focus on particular communities or population groups at risk. These decisions are very important because they may determine levels of protection, who is protected, and the scope and nature of fish advisory programs.

Considerable trade-offs exist in many cases between maximizing public protection and minimizing an advisory's negative impacts. If the goal is to protect 99% of the population, including the highest consuming individuals in a high-consumption population group, advisories will be much more prevalent (and any negative impacts more pronounced) than if a program were to target the average consumer's behavior. However, focusing on average exposure and risk levels may not protect the high-risk populations who need to obtain information that they can use to protect their health.

Category 4. Options Under Consideration

Risk managers determine which program options are under consideration in a fish advisory program (e.g., posting notices, catch and release, restricting waterbody access). From this set of options a subset is usually identified that will actually be employed. The decision to consider all possible strategies for risk reduction is important because it provides wide latitude in addressing the needs of target populations. Very restrictive options, such as restricting

waterbody access, are rarely employed in practice.

In many areas, risk managers may choose options to reduce fish-related risks under a specific set of constraints. For example, agencies responsible for tracking contaminant levels in fish may not have the regulatory authority to restrict fishing access. In most areas, however, the health department has authority to restrict access in cases where a clear and present danger to the public exists. In many cases, budgetary constraints may curtail significantly the number and types of risk management options available. Because the options have differing potentials for reducing risk, limiting the types of available program options may affect the risk reduction potential of a program significantly.

Category 5. Consideration of Positive and Negative Impacts

Recommending limitations in fish consumption involves tradeoffs with respect to health, recreation, economics, community and traditional activities, personal interests, and other perceived benefits of fish consumption. Although risk managers are encouraged to consider all risks and impacts in some way, managers may elect to focus on one or a few of the potential risks or impacts. The types of options and the strength of the advisories recommended will depend on how various population groups and their risks are evaluated and upon the impacts that are considered most important. Deciding how to prioritize and balance the risks and impacts involved will have a pronounced effect on fish advisory programs.

Category 6. Selection of Most Appropriate Options

Selecting appropriate fish advisory program options from those that have been considered is obviously a critical decision in developing a program. Although this decision appears to be the most important one, it generally corresponds to individual or community risk levels and characteristics. The various decisions that have been made up to this point regarding consumption rates, sampling and analysis, selection of risk values, treatment of non-fish exposures, and consideration of impacts, all contribute significantly to the basis for selection and the ultimate choice of appropriate options, target populations, and protection levels.

Category 7. Level of Protection

Risk managers may choose from various risk values (RfDs and cancer potencies) to establish consumption limits. These values may generate consumption limits that vary by orders of magnitude for a single contaminant, especially when cancer-based and non-cancer-based values are compared. In

addition, targeted acceptable risk levels are used in setting limits for carcinogens. Decisions regarding risk values can have a substantial impact on consumption advisories and on potential risks to the population.

Carcinogenic Effects - Acceptable Risk Levels

Cancer risks are evaluated based upon an assumed relationship between exposure and lifetime risk as defined in the cancer potency values for each target analyte. Risk managers determine the level of risk (e.g., one in one million) that is acceptable. This decision enables them to select appropriate exposure level. The acceptable level of risk can be determined by the needs and goals of the target population, the decision-makers, or, under ideal circumstances, by joint discussions between the two groups. Meal consumption limits provided for the carcinogenic target analytes in Volume II are listed for three cancer risk levels: one in ten thousand, one in one hundred thousand, and one in one million. The method used to calculate the values is presented in Volume II so that alternative risk levels can be calculated.

Non-cancer Effects - Value Selected as Benchmark

The potential for non-carcinogenic effects can be evaluated by comparing exposures to a Reference Dose (RfD) or some other benchmark of a "safe" exposure level. Volume II presents the RfDs developed by EPA, along with a summary of toxicological information for the 23 target analytes. In the summary data, recent study results are presented for some analytes regarding developmental, neurological, and other types of toxicity. Risk managers may choose which benchmark value they consider most appropriate for their target population of concern. In some cases, more than one value may be selected for various population subgroups (e.g., children, women of reproductive age).

Category 8. Level of Program Effort and Funding

As noted above under Section 4 (Selection of Most Appropriate Options), financial constraints may affect the choice of options for developing a fish advisory program. Financial and other resource factors (e.g., staff, materials, access to information) also affect the methods used to implement options, how extensively they are implemented throughout an area, and ultimately how effective the programs are.

Category 9. Program Evaluation and Modification.

Program evaluation and modification are important activities to be considered even in the initial planning of a program. Reviews of a program's design are

necessary to determine how effective it is: who it is reaching, whether their behavior has changed, and whether the target population requires additional information. Program evaluation also enables the risk manager to determine how the program might be altered to better address its goals. Accordingly, flexibility is vital so that necessary modifications can be made both in the initial design and over time as needs change. The decision to include these elements in a program design will help provide for the long-range success of a fish advisory program.

This document provides an overview of a wide variety of risk management options and their potential utility and impacts. State, local, and tribal risk managers are urged to review the various options and to include all interested parties in the decision-making process in order to develop the best possible programs for their areas.

1.7 Environmental Justice

This document reflects EPA's policy regarding environmental equity and justice. The President's Executive Order (Feb 11, 1994), *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, specifically directs federal agencies to identify and address disproportionately high adverse human health or environmental effects on minority and low-income populations and workers.[9]

Environmental justice is particularly relevant to the work discussed in this document because contaminated fish may be consumed in greater quantities by minorities and low-income populations in many areas of the United States. These groups often comprise subsistence fishers and may be simultaneously exposed to the same or similar acting contaminants in air, water, and other foods. This exposure may occur both in an urban environment, where high pollution levels often have obvious industrial or other sources, and in less developed areas, where water or soil contamination may occur via long-range transport or from non-point sources.

Many specific recommendations of the executive order address program coordination and activities tracking at the federal level. Additional recommendations may be useful to state, local, and tribal governments for better addressing environmental justice issues. These include the following:

- promote the enforcement of all health and environmental statutes in areas with

[9] Readers are encouraged to review Executive Order 12898 in its entirety.

minority populations and low-income populations;

- ensure greater public participation;
- improve research and data collection relating to the health and environment of minority populations and low-income populations;
- identify differential patterns of natural resources consumption among minority populations and low-income populations; and
- identify multiple and cumulative exposures.

The executive order contains some specific recommendations regarding subsistence consumption of fish and wildlife that may also be relevant for state, local, and tribal governments:

- collect, maintain, and analyze information on the consumption patterns of populations who rely principally on fish and/or wildlife for subsistence (urban and rural);
- communicate to the public the risks of those consumption patterns;
- provide guidance reflecting the latest scientific information available concerning methods for evaluating the human health risks associated with consuming pollutant-bearing fish or wildlife. Consider such guidance in developing policies and rules;
- translate crucial public documents, notices, and hearings relating to human health or the environment for limited English-speaking populations; and
- ensure that public documents, notices, and hearings relating to human health or the environment are concise, understandable, and readily accessible to the public.

These recommendations to federal offices are generally covered by the caveat that such activities should be carried out whenever practicable and appropriate. While these are potentially useful and necessary activities, this information does not constitute a requirement for state, local, and tribal governments, although the values espoused are useful for consideration. If additional assistance is needed on environmental justice issues and strategies, readers may wish to contact:

U.S. EPA Office of Environmental Justice
401 M. St. S.W.

Washington, D.C.
20460
phone: (202) 260-6357

This guidance document addresses concerns regarding environmental justice through the variety of mechanisms discussed below. A major focus of risk management is to evaluate and reduce risks to the most highly exposed individuals or population groups. With respect to fish contaminants, these people are often subsistence fishers, although in some areas they may be primarily sport fishers.

Highest consuming **or** most susceptible subgroups of concern include subsistence fishers, pregnant women, children, groups with poor nutritional status, and individuals with certain pre-existing health problems. Volume II provides substantial toxicological information regarding susceptible subgroups on a chemical-specific and chemical class-specific basis. Information is also provided on characteristics of population subgroups that may cause them to be generally more susceptible to chemical exposures. These subgroups, such as women of reproductive age and children, may be targeted for special efforts in advisory programs (discussed in this volume). Specific methods for calculating advisories tailored to children of various ages and other subgroups are presented in Volume II and discussed further in this document.

The discussions of exposure assessment in Volume II and its Supplements include information regarding fish consumption patterns of highly exposed minority groups such as Asian and Native American communities. The results of numerous recently completed studies show higher consumption rates among these groups than among the general fisher population.

Studies have indicated that highly polluted areas contain disproportionate numbers of minority and low-income populations. To avoid an unsafe exposure level, groups exposed to the same or similar-acting contaminants in media other than fish may require lower consumption limits than if their exposure occurred only through fish. To address this concern, this volume contains information regarding methods for estimating total exposure including air, water, soil, food, and workplace exposures. This information, important for any groups exposed through multiple media, is particularly relevant for groups who reside in highly polluted areas, such as industrialized urban areas and near hazardous waste sites.

Throughout this text, readers are reminded of aspects of the risk management process that may involve public participation. Encouraging participation by traditionally-disenfranchised groups may improve fish advisory program implementation and efficacy. Decisions on the type of risk reduction programs to be established in a community, the pursuit of remediation efforts, and the level of

acceptable risk for a community requires community participation to be the most effective. Discussions of critical decisions in this volume emphasize the value of community member participation and the need for information regarding affected communities.

The potential community, societal, and economic impacts of risk management fish advisory options are discussed in this volume. Subsistence fishers and some other fisher groups consume higher quantities of non-commercial fish; Consequently, they are at greater risk of negative nutritional, economic, or community impacts if their fish consumption is reduced. The negative impacts of consumption reductions are discussed in Section 3. Numerous representatives of Native American, Asian American, urban fishers, rural fishers, and other groups were contacted to obtain their ideas regarding the various options for reducing risks associated with contaminated fish consumption (see the expert source list under Acknowledgements in the front of this document).

Many individuals consulted from community and tribal groups requested information regarding environmental remediation and pollution prevention be included in this volume. These groups frequently expressed the sentiment that the ultimate goal should be to improve environmental quality so that fish advisories are no longer necessary. This has been EPA's goal since its inception and has been shared by many state, local, and tribal programs. In response to these requests, information was collected from a variety of federal, state, tribal, and other sources regarding rights and responsibilities in environmental remediation and pollution prevention. The information summarized in Section 2 provides a road map through various offices at the federal level responsible for remedial action and pollution prevention. Information on federal activities and responsibilities may provide both risk managers and affected groups with the ability to evaluate ongoing efforts, obtain additional information, and participate in determining future activities where necessary. Because state, regional, local, and tribal programs vary considerably, a summary of their activities was beyond the scope of this document.

The environmental justice activities at the federal level are being accelerated as the need to evaluate and address inequities in environmental contamination and health risks is recognized. The approach outlined in this series is designed to assist state, local, and tribal governments in evaluating risks for both the general population and subgroups, allocating resources based on risk levels, and providing more healthful alternatives for all their citizens. EPA welcomes recommendations regarding these issues and approaches to addressing environmental justice.

SECTION 2

MANAGEMENT OPTIONS FOR LIMITING FISH CONSUMPTION

2.1 Overview

A variety of options exist for limiting consumption of contaminated fish. This section provides a description of options commonly employed to reduce fish contamination risks. The focus of this section is on evaluating the options from the perspective of the agency responsible for fish advisories. Some considerations discussed in this section include:

- the feasibility of program implementation — the match between the human, material, and financial resources available to an agency and those required to carry out a program; and

- the efficacy of various options — the degree to which a program obtains compliance with advisories on the part of fish consumers.

Information on the experiences of some actual programs are presented, including the relative success or failure of some options, difficulties in implementation, and other aspects of developing programs. Section 3 provides additional information on this topic with a focus on how options impact the target population or area: economically, socially, culturally, and nutritionally.

No single approach is appropriate for all circumstances. Each location and population of concern vary and require programs designed to address specific local needs and resources. In addition, agencies vary in the resources available to develop programs. EPA does not recommend one or a small group of options as preferable. Rather, they suggest that decision-makers consider all relevant information and choose those options that best serve the needs of fish consumers in their areas.

In evaluating how to approach fish contamination problems, it may be useful for state, local, and tribal risk managers to review the roles and responsibilities of the federal government. The responsibilities of the federal government regarding commercial fish are presented to clarify the distinction between federal oversight of commercial fish versus non-federal responsibilities for non-commercial fish.

Information on remedial responsibilities and activities of the federal government that may impact fish contamination are discussed at the end of this section to provide

additional information on options for reducing contaminant exposures. The discussion includes federal statutes and regulations that may be used to address fish contaminants (directly or indirectly). Sources of additional information on laws and activities related to air, soil, food, and water pollution, and hazardous waste are provided, including hotline numbers at EPA.

2.2 Program Goals

Program goals include the overall objectives of a fish advisory program. They may include a description of geographic areas and populations to be addressed, the targeted reduction in exposure and risk, and other objectives related to contamination reduction. Goals will typically be defined by the specific characteristics of a contamination problem in an area. The goals may depend on the scope of the programs required. The program scope is defined in terms of the number of people who must be reached and the degree of efficacy required to achieve an acceptable level of risk. Goals such as full compliance by all pregnant women may be more stringent when risks are high. The efficacy requirements of a program may depend on how critical it is that the targeted populations comply with recommended changes in their consumption habits.

The goals an agency establishes, along with the need for effective advisory programs and subsequent resource requirements, are linked directly to the scope of the contamination problem in terms of risk and numbers of people exposed. In general:

elevated exposure and risks	---->	*more restrictive advisories*	---->	*greater resource requirements*

The staffing and other resource requirements of a fish advisory program are contingent on the program goals.

When risks are anticipated to be high, significant effort may need to be invested to ensure widespread compliance with recommendations. Information may need to be disseminated through various media and with significant support (e.g., a hot line number, local presentations, press releases, fact sheets).

The exposure and risk levels are determined through sampling and analysis programs (discussed in Volume I) and risk assessment (discussed in Volume II and in Supplements 1 and 2 of this volume). These sources provide guidance on obtaining and using fish contamination data with consumption pattern information to estimate exposure. From this information, risks are estimated for various population subgroups, which are then evaluated for advisory program need. Methods used to map affected populations and other relevant information are

provided in Supplement C to Volume II.

Program goals may also reflect the objective of minimizing an advisory's negative on targeted populations and areas. These negative impacts are discussed in Section 3 and include economic, cultural, nutritional and other potential impacts that may result from fish consumption restrictions.

Program goals are usually constrained by available resources. Because resources are often limited, risk managers must decide who has the greatest need to be reached and what level of program activity will be directed at each of the targeted populations.

2.3. Options for Limiting Consumption

This section focuses on aspects of fish advisory programs directly related to the agency's activities. Options and their feasibility and efficacy are described from the agency's point of view. The feasibility of an option depends on the requirements of an option in relation to the resources of an agency. To evaluate this, it is useful to consider various factors including:

- staffing,
- costs of materials and facilities,
- already-existing program materials,
- inter- and intra-agency support, and
- other considerations.

The requirements of individual fish advisory program options merit separate evaluations to determine program feasibility. Such evaluations are often qualitative because it is usually not possible to precisely quantify the scope, level of professional involvement, and expenditure of resources for each option.

As indicated above, federal agencies have significant responsibilities for commercial fisheries. States, local governments, and tribal agencies (referred to collectively in this section as agencies) have primary responsibility for non-commercial fishing. These responsibilities may be carried out through various departments, including those of:

- environmental protection,
- health,
- fisheries, or
- other public agencies or governing units.

A fish advisory program may be part of a larger program responsible for other related activities including education, pollution prevention, clean-up of contaminated waterbodies, etc. In some areas the health department may be responsible for determining fish advisory levels while the department of environmental protection may implement the programs at the local level and be responsible for enforcement. During new program development, decision-makers may wish to determine those agencies best able to enact program components and allocate responsibilities accordingly.

An option's resource requirements will depend significantly on the scope of the contamination problem and the programs goals. Resource requirements will also depend on the extent to which agencies can use existing information sources and the resources of related agencies or groups performing similar activities. The level of effort and costs required can be reduced somewhat through:

- careful targeting of sampling and analysis programs, the use of consumption limits provided in Volume II,
- obtaining population data from census data bases, and
- identifying readily available sources for other needed information.

Cooperation between health and environmental agencies, community groups, local colleges and universities with relevant program areas, and local health professionals may reduce resource requirements for developing advisories and disseminating information. For example, the state of New Hampshire has involved community groups in the collection of fish samples, thereby saving the state staffing and transportation costs.

Some aspects of program development, such as planning, require time and expertise primarily from within the agency, although support from local professionals may also be sought in this area. Establishing an advisory group of volunteers with expertise in related fields may provide an inexpensive method to gain local support and obtain necessary information. Under most circumstances, involving the local target population will provide essential information and facilitate cooperation in the establishment of effective programs. Although this is easier for local programs to carry out, state programs may also encourage local involvement coordinated through local governments, health departments, school departments, or community groups.

Detailed studies have not been conducted on the resource requirements or efficacy of fish advisory options across programs and states. Consequently, much of the information in this section has been obtained through conversations with state, local, and tribal staff, and other affected parties. Program reports were also reviewed. Although most information provided below is site specific and frequently

anecdotal in nature, we have attempted to include information that has overall relevance to option evaluation and is not specific to single areas and groups. We welcome comments and information on the options discussed in this volume and recommendations for other options to be considered. Most of the data on and about options for reducing health risks associated with consuming contaminated fish have been developed relatively recently. An exchange of information on this topic will provide a more complete basis for decision-making in the future.

Table 2-1 provides a list of options for limiting consumption of contaminated fish. Options are arranged according to the type of activity and in order of the severity of restriction (e.g., limiting a catch is listed before banning fishing).
The options fall into four main categories of activities: no action, development of fish advisories, catch and release restrictions, and fishing bans. Within these categories, a spectrum of activities may be carried out.

The options considered in fish advisory program development are critical to the nature of the final program. A limited number of options can be considered by those developing new programs. Decision-makers must consider any specific constraints that restrict their choices before considering the advantages and disadvantages of the various options. Risk managers may be operating under some constraints regarding their options for reducing fish-related risks, or they may have wide latitude in establishing programs. For example, some agencies may have the authority to restrict fishing access if sufficient risks can be demonstrated. In other areas, options may be limited to notification and education. Options may also be limited by budgetary or other conditions. The choice of which options to consider is one of the critical decisions noted in Section I.

Restricting the options from which a program may choose may significantly affect the risk reduction capabilities of a program because the options have differing potentials for reducing risk.

Table 2-1. Options for Fish Advisory Programs

- No action
- Fish consumption advisory
  - General guidance
  - Quantitative guidance
- Catch-and-release
  - Voluntary
  - Mandatory
- Fishing ban
  - Voluntary
  - Mandatory

Anticipated impacts of the options including those on nutrition, local culture, and the economy are discussed in Section 3. A methodology for considering adverse impacts of options in contrast to benefits of fewer health risks is discussed in Section 4.

Because fish contamination, local conditions, and population characteristics are unique to each area, risk managers may choose to implement different policy options for different waterbodies within the same jurisdiction. Consequently, risk managers may want to consider a variety of options under different circumstances. The use of various options allows programs to be tailored to local needs and, ultimately, to be most effective. Many states have used a variety of strategies to address fish consumption, depending on specific area characteristics. The approach taken in Washington State illustrates this point.

Example: Washington State

The state of Washington has experienced a steady decline in salmon runs over the past fifty years, but a notable and sharp decrease over the last few decades. These recent declines have resulted in a wide variety of fishing restrictions posted throughout the region for management of fish stocks. For example, some waters are closed completely to fishing certain species whose population is endangered. Other waters are catch and release only for both management and public health concerns. Others are open but with strong peer pressure by increasingly knowledgeable fishers, including sportfisher associations, environmental groups and tribal organizations, to selectively harvest fish that are out-competing the native species most valued for recreational and cultural reasons.

With the increased visibility of declining runs, individuals have become more receptive to the need for management strategies protecting the long-term harvest of preferred species. Familiarity with management restrictions designed to allow fish stock regrowth has also made individuals more responsive to restrictions due to public health concerns. Strong emphasis was placed on using restrictions as an interim step for managing fish contamination hazards among community representatives consulted on this issue. They emphasized that preventing water contamination in the first place should be the primary goal (Coombs, 1994; Cole, 1994; Watanabe, 1994).

Although fishing restrictions in this case were employed to allow fish stock regrowth, similar strategies can be employed to limit exposure to contaminated fish.

Many tribal affiliates have indicated that some options for limiting the consumption of contaminated fish would be unacceptable. Fishing bans and catch and release restrictions are contrary to the fishing-based cultures of many of these communities. Both sport fishing organizations and the sport fishing public may also be opposed to certain options that limit access to fishing grounds. Further details about these concerns are discussed in Section 3.

Fish advisory programs, while existing for many years in some areas, are a relatively new undertaking for many risk managers. The options discussed below may prove effective in some areas and not in others. Their success or failure may depend on numerous factors discussed in this and subsequent sections. Because programs can evolve over time, they should change as better ways are found to reach their goals and as circumstances and populations change. Risk managers

may wish to test the efficacy of multiple advisories and determine which strategies use resources most effectively and are most appropriate for various audiences. (This is discussed in Volume IV: Risk Communication.) By maintaining a flexible approach to developing or modifying programs, risk managers are best able to respond to the changing needs of the populations they serve.

2.3.1 No action

The least resource-intensive action for agencies to undertake it to having no fish consumption policy. Under this option, agencies allow unlimited fish consumption, issue no health warnings, permit fishing, and, if necessary, consider discoveries of adverse human health impacts on an individual basis.
This option should be considered when contamination and health risk data indicate that no action is required. The "no action" option is not recommended as a strategy to conserve resources unless sampling and analysis data are available that indicate this is an appropriate approach.

2.3.1.1 Feasibility and Efficacy

A policy of no action may be most appropriate in areas of consistently low fishing activity and low contamination (as determined by a sampling and analysis program). A brief review of the sampling results in relation to the screening values provided in Volume I may indicate minor or minimal risk.
Exercising this option in areas with limited fishing activity in the absence of sampling and analysis data may pose health risks to local fishers if high contamination levels exist. Volumes I and II both provide information on how risk managers may evaluate the likelihood that contamination exists (e.g., proximity of the waterbody to industrial sources, agricultural run-off, known contaminated areas). Long-range transport from industrialized areas to non-industrialized areas is known to occur with mercury contamination and with other contaminants. Consequently, risk managers should consider obtaining sampling data for all waterbodies where fishing occurs. If the data indicate low or no contamination in some areas, less frequent sampling may be planned for those areas.

In areas of high fish contamination, particularly where adverse health effects are likely to occur, having no policy may incur significant risks to fishers and their families and has the potential to confuse and anger the public. It also minimizes public awareness of fish contamination and related issues (e.g., water pollution risks) (NY DEC, 1985).

Example: Midwest High-Risk Fishing Population

In one midwestern state, community groups are aware of the fish contamination problem in their areas. In a substantially contaminated area, the director of a large community organization was consulted for this document regarding fish advisories. Waterbodies in this urban area are surrounded by industry, landfills and transportation routes. Runoff from agricultural lands also eventually reaches the waterbodies, and both runoff and air emissions from numerous other point and non-point sources are discharging into the water.

The director indicated that the state and city have not put up signs at major community fishing sites. The advisories are not distributed or available to either the fishing or consuming population (each is a distinct population) through means that are readily accessible to area communities. Advisory information, provided by the state with fishing licenses, is not readily accessible to the low-income minority fishers, who typically do not obtain licenses primarily for economic reasons. The director also noted that a large low income black population fishes the polluted waters, and the catch is distributed widely through local (illegal) fish markets and shared with extended family, friends, and neighbors. The director felt that signs were not posted because the agencies were concerned about panicking the community. The community perceives, however, the lack of regulatory attention as a reflection of the agency's indifference to their well being.

Further consultation with state staff on this issue indicated that the state develops advisories based on a widespread sampling program. Elevated contaminant levels had been detected in the areas of concern and signs were posted in the past. This practice was discontinued due to extreme displeasure from local park authorities. Although additional information was not available from park authority personnel, the attraction that this area has for many tourists and seasonal fishers, both of whom contribute substantially to the local economy, may have played a role in the no-posting policy.

As this example illustrates, the lack of effective action in this case may minimize costs and certain negative advisory impacts (e.g., discouraging recreational fishers). Conversely, it generates an entirely new set of problems that may undermine the fundamental attitudes towards, and trust of, governmental agencies on the part of affected communities. Inattention to these types of problems may lead community members and leaders to the conclusion that their health and other concerns are not a priority for local agencies and political leaders.

In general, a "no action" policy maximizes fish consumption and its associated nutritional and other benefits (see Section 3). It also minimizes costs and effort required by governmental bodies and requires no specific governmental structure, planning, or empowerment. Local circumstances will determine the advisability of this option. If strong business interests are tied to maintaining current fishing levels, a "no action" policy may have significant support from the business community and, consequently, to some politicians and agency staff. Alternatively, if the affected populations in contaminated areas are environmentally aware and health conscious, such a policy may incur substantial risk to the agency. It is not recommended that agencies base their choice of options solely on political factors, although, in reality, they are usually considered. Risk managers may want to consider potential health risks and benefits as primary considerations in determining whether the option of "no action" is appropriate for a water body.

2.3.2 Fish Consumption Advisories

Fish consumption advisories are designed to reduce risks to fish consumers by providing information that will lead them to voluntarily restrict their fish consumption to healthy levels. The advisories provide information to the public warning of potential health hazards associated with consuming contaminated fish. These advisories generally include qualitative guidance on minimizing risk, and may or may not provide specific meal consumption guidelines. The advisories may take many forms, from posting warnings near waterbodies, to booklets and public service announcements. The various ways to communicate fish advisories are discussed in Volume IV on risk communication. The following discussion covers two major categories of advisories: general advisories, which provide non-quantitative information, and quantitative advisories, which provide specific meal consumption limits. Information on advisories developed by agencies nationwide may be of interest to risk managers. A summary of all current advisories was recently compiled by EPA: *National Listing of Fish Consumption Advisories*, on five disks in a PC format. They can be obtained from EPA's Office of Water.

2.3.2.1 General Fish Consumption Advisories

General fish consumption advisories provide qualitative guidance on reducing risk through selective fishing, preparation, and cooking techniques. Specific information may be provided on the safest or most hazardous species and sizes of fish to consume. For example, smaller, younger fish within a species tend to be less contaminated than older, larger fish. Numerous state fish advisories recommend keeping smaller fish for eating and releasing larger fish. For those individuals choosing to consume larger fish, recommended practices often include eating smaller meals and freezing part of the catch to space meals out over time (ND DOHCL, 1992, MO DOH, 1993).

Other information related to specific species or categories of fish may be conveyed. For example, prey species tend to be less contaminated with bioaccumulative contaminants than predatory fish, and lean species tend to have fewer fat-soluble contaminants than fatty species (See Supplement A). The North Dakota fish advisory recommends eating more prey species like perch, sunfish, and crappie than large predator species like walleye or northern pike (ND DOHCL, 1992). Using guidance regarding fish species and size, risk managers may encourage fishers to practice selective fishing or catch-and-release fishing to decrease their probable dose of fish contaminants.

Information on where fish contaminants are found in the fish body may also be provided. Studies have indicated that exposure to certain fish contaminants may be decreased by proper trimming and cooking techniques. Supplement A to Volume II discusses studies in detail. Several states include discussions of these techniques in their fish advisories, as well as diagrams indicating appropriate fish tissues to be trimmed (s.f., MN DOH, 1992, MO DOH, 1993). Some also list particular species for which trimming is recommended. New York, for example, suggests trimming fatty tissues from smallmouth bass, brown trout, lake trout, coho salmon, and striped bass (NY DEC, 1985). They also advise not eating "grossly diseased fish" or fish liver.

Advisories may contain specific health information regarding contaminants, such as a description of adverse effects known or suspected of being associated with contaminants, along with recommendations to limit consumption. Risk managers may elect to provide information regarding the benefits of fish consumption (discussed in Section 3) with information regarding health risks. Qualitative or quantitative information on health risks may be appropriate, depending on the audience and goals of the program. Section 5 in Volume II contains a description of potential health effects, including developmental toxicity, neurotoxicity, and other types of organ toxicity. EPA risk values and a breakdown of especially susceptible subgroups in the population are provided in the same section for each target analyte.

Risk managers may provide a synopsis of potential health risks in the form of a "fact sheet" to give the consumer the most complete information available regarding contaminants to which they are being exposed. General qualitative descriptions of potential health effects, similar to those in many community "Right to Know" programs, may be included. Volume IV provides additional guidance on methods to communicate risk-related information.

Fish advisory information may be provided to the general fishing population if risks are expected to be widespread. When risks are known to be greater for some subpopulations, more specific guidance may be given to these groups. For

example, if mercury is known to exist at levels posing risks to children and women of reproductive age, advisories may be designed specifically to reach these audiences. Information may be disseminated to health care providers, schools, agencies issuing fish permits, etc., as well as to fish consumers, to facilitate distribution and provide resources for explaining potential impacts of consumption. When planning fish advisory programs risk managers may want to consider the requirements that may be placed on their staff if consumers call for clarification or additional information.

Fish advisories may also be of a very general nature and simply recommend that certain waterbodies be avoided or the fish taken from them be limited. Limiting overall fish consumption by some segments of the population may be recommended, without providing specific information on waterbodies, seasonality, or other issues discussed above.

2.3.2.2 Feasibility and Efficacy

General advisories may be the least resource- and labor-intensive option for limiting exposure to fish contaminants, depending on the scope of the program and the type of information conveyed. Consequently, a general fish advisory program may be appropriate if resources are extremely limited. The development of this type of advisory may or may not require agencies to obtain site, consumer, or fish species-specific information, depending on the type of information the agency wishes to convey. If a program targets a small group or provides only very general information through limited sources, the advisory program may be relatively inexpensive and have limited staff requirements. Alternatively, programs providing substantial information through a variety of media to a large number of subpopulations will require more resources.

The efficacy of general advisories depends in large part on adequate education and outreach to fish consumers. Alliances with other local and state agencies and community groups may facilitate information distribution. Many states currently issue the fish advisories with fishing licenses to fishers who apply for the permits; this is another useful mechanism for disseminating information. Volume IV contains guidance on risk communication, including different strategies spanning a range of resource requirements.

General advisories may be most useful in cases where risks from eating contaminated fish have been and are expected to continue to be relatively low. In these cases, general health advisories provide information allowing consumers to make decisions regarding exposure to fish contaminants. In low risk situations, inappropriate decisions by consumers on how much fish to eat do not generally pose a significant hazard. However, misinterpretation could be hazardous to

fishers who consume very large quantities of fish. Conversely, general guidance regarding fish preparation is less subject to misunderstanding on the part of the consumer, and may be useful under appropriate circumstances. Where contamination data indicate that risks from consuming even small amounts of fish are relatively high, general health advisories may be insufficient to protect consumers from developing adverse health effects.

2.3.2.3 Quantitative Advisories

In addition to the type of information provided in the general advisories described above, risk managers may also develop advisories containing specific information regarding meal consumption limits. Quantitative fish consumption advisories provide fish consumers with site-specific, species-specific, and sometimes size-specific (within species) information on the maximum amount of fish that can be safely consumed within a given time period.

The introduction to a fish consumption advisory may describe the contaminants found in local sport fish, where the contaminants accumulate in fish tissues, and methods for minimizing exposure to these contaminants (MN DOH, 1992, GLSFATF, 1993). Specific fish consumption advice follows in a descriptive narrative or in a table and/or map (s.f., NY DEC, 1985, MN DOH, 1992, MO DOH, 1993). As discussed under general advisories, above, information may also include:

- types of health risks associated with elevated consumption,
- groups within the population who are at particular risk and why (as discussed under general advisories above),
- sources of additional information, and
- recommended food preparation methods.

Most states issuing advisories now use a risk-based approach. The EPA method described in detail in Volume II of this series uses a risk-based approach to calculate the recommended meals per month, based on contaminant level and the risks associated with each target analyte. Advisory levels have been calculated for all target analytes for various meal sizes (4 ounces to 16 ounces) and for adults and children. Methods are provided to also make adjustments for various body sizes and for different assumptions regarding toxicity and meal size.

State fish consumption advisories currently vary widely in the complexity of the information provided and in the methodology used in their development. Missouri's and Minnesota's state fish consumption advisories are described below for illustrative purposes. In addition, details from a number of state fish consumption advisories are given in Table 2-2 below. As Table 2-2 shows, many states have

developed a tiered approach providing different advisories for various population subgroups. Subgroups considered in these advisories have included:

- short-term recreational fishers,
- seasonal fishers,
- long-term fishers,
- subsistence fishers,
- general adults,
- young children,
- women of childbearing age,
- pregnant or nursing women, and
- children under certain ages.

Agencies may wish to consider the characteristics of their target populations to determine how best to structure their consumption advisories, based on risks to various subgroups and potential impacts of fish consumption restrictions.

Example: Missouri's Fish Advisory

Missouri's proposed fish advisory provides the simplest advice of the four state fish advisories listed in Table 2-2. It gives general guidance on fish consumption over wide regions of the state, and only mentions specific species and waterbodies where they represent exceptions to this advice. Consumption advice is based on two broad groups of fish: fatty fish (catfish, carp, buffalo, drum, suckers, and paddlefish), and non-fatty fish (bass, sunfish, crappie, and walleye). Advice is given for three consumption rate categories: no restrictions, eat only one pound per week or less, and do not eat any fish. Pregnant women and children are advised to consume "less" contaminated fish than general adult fishers (MO DOH, 1993).

Table 2-2. Comparison of EPA and Sample State Fish Consumption Advisories

Advisory Component	EPA	Great Lakes	Minnesota	Missouri	New York	North Dakota
Consumption categories:						
Unlimited consumption	x	x	x	x	x	x
Restricted consumption	0.5 through 17 meals per month 1 through 10 meals per 10 days	One meal/week One meal/month One meal/two months	1 or 2 1/2-lb[a] meals/week 0.5, 1, or 2 meals/month 1 meal/yr	General adults: ≤1 lb/wk Pregnant or nursing women and young children: <1 lb/wk	≤ One 1/2-lb meal[a] per month	One 1/2-lb meal[a]/day 1 through 6 meals/week 1 through 4 meals/month
No consumption	x	x	x	x	x	x

Table 2-2. Comparison of EPA and Sample State Fish Consumption Advisories

Targeted fisher populations						
By exposure duration	Short-term recreational fishers: eat non-commercial fish regularly 10 days/yr Seasonal fishers: eat non-commercial fish regularly 10 days to 3 mo/yr Subsistence fishers: eat non-commercial fish regularly 3 mo/yr or more	--[b]	Vacation fishers: eat non-commercial fish regularly 1-3 wks/yr Seasonal fishers: eat non-commercial fish regularly 3 wks to 3 mo/yr Annual fishers: eat non-commercial fish regularly 3 mo/yr or more	--	--	vacation fishers seasonal fishers long-term fishers
By sensitivity to adverse health effects	General adults Young children Women of childbearing age	--[b]	General adults Young children and women of child-bearing age	General adult fishers Pregnant or nursing women and young children	General adult fishers Women of childbearing age, infants, and children under 15	General adult fishers Women who are pregnant, breast-feeding, or plan to become pregnant, and children under the age of 15

Table 2-2. Comparison of EPA and Sample State Fish Consumption Advisories

Information contained in consumption guidelines						
Specific recommendations to sensitive populations?	Yes	No[b]	Yes	Broadly	Yes	Yes
Species-specific recommendations?	Yes	Yes	Yes	Two broad categories: 1. low-fat fish and trout 2. fatty fish	Yes	Yes
Recommendations by fish length?	Possible	Yes	Yes	No	Yes	Yes
Recommendations by location?	Yes	Yes	Yes	Yes, broadly	Yes	Yes
Includes map?	No	No	No	Yes	No	No

Sources: GLSFATF, draft 1993; MN DOH, 1992; MO DOH, 1993; ND DOHCL, 1992; NY DEC, 1985.

[a] Meal size of 1/2 lb is scaled to a 150 lb (70 kg) person.

[b] Although the Great Lakes Sport Fish Advisory Task Force doesn't have separate consumption guidelines for different fisher populations, it has based its advisory on several adverse health endpoints (reproductive, neurologic, immunologic and cancer) and on the most sensitive populations, in an effort to be protective of the sensitive populations while providing an extra margin of safety to less sensitive sport fish consumers (GLSFATF, 1993).

Example: Minnesota's Fish Advisory

Minnesota's fish consumption advisory represents the most complex advisory of those examined. Consumption guidelines are given in tables by specific waterbodies, fish species, and fish lengths (in five-inch increments).[1] Separate guidance is given for fisher populations with varying exposure periods (vacation, seasonal, and year-round fishers) and sensitivities to adverse health endpoints (general adults versus women of childbearing age and children). In addition, advisories indicate the contaminants on which the consumption advice is based.

Minnesota's advisories employ simple symbols (e.g., squares and circles) and various degrees of shading to incorporate a substantial amount of information into a readable format.

While detailed advisories can provide specific guidance on the most appropriate consumption for each waterbody and population group, the approach may have drawbacks for some population groups, particularly if information is conveyed primarily in written form. Kathy Bero of the Lake Michigan Federation (Bero, 1994) noted that advisories providing detailed information will not necessarily reach the urban fishers who may have low literacy rates or inadequate English skills. This population also includes many people who are at or below the poverty level and fish to supplement their food supply, not merely for recreation. Overly-complicated advisories are less likely to be followed very carefully by these particularly high risk populations (personal communication with Kathy Bero, 1994). In addition, some fishers do not obtain fishing licenses, particularly those who are economically disadvantaged. Consequently, fish advisory information distributed with fishing licenses may not reach these fishers.

2.3.2.4 Feasibility and Efficacy

Although fish consumption advisories require more time and resources than general health advisories to develop, they also provide consumers more site- and species-

[1] Providing fish consumption limits by fish length is more expensive because of the additional sampling and analysis required. Greater accuracy is provided, however, since fish contamination within species is often correlated with fish size and length.

specific information and give specific quantitative guidance. They are less likely than general advisories to be misinterpreted regarding the "safe" levels of consumption, and provide consumers with specific consumption goals.
A variety of types of information are required to develop quantitative advisories:

- contamination in edible fish tissues (obtained from sampling and analysis programs discussed in Volume I);

- cancer potencies and/or Reference Doses (or other risk values) of the contaminants of concern (see Volume II);

- local non-commercial fish preparation and meal consumption patterns obtained from local surveys if possible (see Supplement A to Volume II);

- average body weights of non-commercial fish consumers (see Volume II); and

- contributions to exposure from other sources such as air, water, and other foods (see Supplement A to Volume II).

Various information sources exist for most of the data required to develop fish advisories. While collecting all of the above data may not be feasible for many programs, combining existing data sources and local information may enable well-targeted programs to be conducted with relatively limited resources. For agencies wishing to obtain the maximum guidance from EPA, thereby minimizing their staffing requirements, the approach described below uses the information contained in this series to develop quantitative fish advisories. It is still recommended, however, that some local information be collected regarding fish contamination and consumption patterns.

As discussed above, Volume II provides a detailed description of how to calculate risk-based consumption limits and includes meal consumption limit tables for the 23 target analytes. Information is also provided on methods for calculating consumption limits for multiple species diets and for multiple contaminant exposures. The information in Volume II may be used in conjunction with contamination data from local sampling programs and local fish consumption surveys (or the consumption data provided in Supplement A) to select appropriate consumption limits. The consumption limits may then be used with other types of information such as benefits of fish consumption (discussed in Section 3) and other potential impacts of limiting consumption on the population to establish health advisories.

If risk managers choose to use the meal intake limits listed in Volume II, they should

consider that these limits were not modified for exposure to other sources of the same contaminants (due to the highly variable nature of such exposures). Estimating total exposure and relative source contributions are discussed in Supplement A of this volume. Adjustments to intake limits should be made based on local exposure conditions and take into account all likely sources of contamination. If non-fish source contributions are not considered in areas with contaminants in other media, fish consumers may be exposed to unsafe total exposures even though the fish exposures alone may not pose risks. Risk managers may choose to focus on the most highly exposed individuals, or average exposures to non-fish sources.

Note that while exposure reductions can theoretically be made in any contaminated media, fish consumption may be the only source that can be readily reduced. It may not be possible to reduce air or water contaminant levels quickly, while fish advisories have the potential for rapid exposure reduction in a population. Because fish consumption may contribute significantly to overall exposure for some population groups, modified consumption patterns may reduce overall exposure considerably.

Risk assessors and managers may develop highly specific meal consumption limits. The choice of what information to convey and to whom is a decision to be made based on the target population's information needs. Presenting various levels of information has advantages and disadvantages. Missouri's fish consumption advisory, as discussed above, has the advantage of being sufficiently straightforward and general so that a fisher could readily memorize the information it contains. In addition, the recommendations are based in part on regional hydrology and fish species characteristics; individuals fishing in areas for which no advisories are available could use this information to potentially lower their exposure. Because the meal consumption advice is written in simple prose, the advisory may also be more readily used by non-native English speakers who might not understand how to use more complex advisories.

One agency has reported that advisories must reduce a great deal of information into a concise, understandable format without losing the technical basis for the recommended dietary consumption (ND DOHCL, 1991). As the authors of North Dakota's fish consumption advisory warned, "advisories containing extensive details for consumption advice can be overwhelming...and become impractical if ignored by the public" (ND DOHCL, 1991).

More complex advisories, such as the Minnesota advisory described above, provide more information that fish consumers may use to maximize their benefits from eating fish while minimizing their risk of developing adverse health effects. The Minnesota advisory program uses extensive site- and species-specific data, as well

as up-to-date toxicological data and methodology so that the accuracy of consumption recommendations is expected to be high. The advisory's complexity, however, may make it less readily memorized or generalized to new areas, and it may confuse fishers not accustomed to interpreting tables. To address this concern, Minnesota also provides brochures using a simpler format and are very accessible to any literate population. The Minnesota advisory program reflects a significant time investment in the development of advisories conveying a large amount of information in a readable format and different types of advisories.

Risk managers may have to choose the type of information to communicate to the public and select the most relevant information to include (i.e., an advisory which uses an average meal size). Risk managers may wish to consider developing advisory materials with varying levels of detail so that materials can be provided to groups according to their level of interest and understanding (see risk communication discussed in Volume IV).

As voluntary activities, fish consumption advisories may be more readily supported by the public than mandatory advisory programs (i.e. prohibiting fishing in an area). The efficacy of quantitative fish consumption advisories is determined by the extent to which:

- the advisories accurately reflect local conditions and potential health risks, and

- non-commercial fish consumers use them appropriately.

Even when fish consumption advisories portray health risks accurately, non-commercial fish consumers may not follow the advisories if they are not readily available, too difficult to follow, and/or ignored. Effective risk communication is critical to making this (or any voluntary policy option) work.

In summary, the resources required to develop quantitative fish consumption advisories are greater than those required to develop more general health advisories, and often require expertise in quantitative and health areas. Resources needed for public education will probably be similar to those for general advisories; however, quantitative information may require more explanation by staff and require more detailed risk communication efforts. As noted above, the extent to which resources outside a program can be used in developing and maintaining it may have a significant impact on the resources required and on the feasibility of conducting various aspects of a program. A program's efficacy will depend on the effort directed at outreach and the appropriateness of the materials for the target audience.

2.3.3. Catch and Release

Catch and release programs have been used in some areas to address concerns regarding health risks of contaminated fish for sport fishers. A catch-and-release fishing policy allows fishers to catch fish as a recreational activity, but encourages or requires them to release the live fish once they have caught them. As part of this policy, risk managers may additionally choose to:

- require a special permit to catch-and-release fish, or
- allow catch-and-release fishing only in a supervised tournament setting.

Example: New York's Catch and Release Program

Catch and release programs have been used in New York State where sampling and analysis programs indicate that fish in specific waterbodies are sufficiently contaminated so as to pose a public health threat if consumed at all. A report from the New York State Department of Environmental Conservation (NY DEC) suggests that risk managers may chose to recommend or enforce zero consumption, though still allowing catch-and-release fishing or fishing for trophies (NY DEC, 1985).

According to NY DEC, fishers generally accept and respect the intent of enforced catch-and-release regulations New York State has promulgated for species management purposes, especially when contrasted with outright fishing bans. However, their state report indicates that such strategies require both agency and fisher efforts and cooperation:

> Enforcement [of fishing bans] is difficult at best, and enforcement of catch and release fishing is not expected to be much more successful. Since a high percentage of fishing activities take place in remote areas, the effectiveness of enforced catch and release fishing is highly dependent on considerable peer pressure and self-policing. (NY DEC, 1985).

One potential variation on this option would be to require fishers to obtain state fishing permits for catch-and-release fishing. This practice allows risk managers an opportunity to provide educational materials when the permits are issued, thereby ensuring that fishers are fully aware of up-to-date health advisory information. The likelihood that fishers will comply with the catch-and-release

regulations therefore increases. This option would have the same public health objectives as catch-and-release fishing without a special permit, but would increase the knowledge of people fishing legally. Requiring a permit would, however, add an administrative burden to both authorities and the public (NY DEC, 1985).

Another variation on this option is to allow fishing in highly contaminated fisheries only at structured tournaments. The agency would then have an opportunity to inform every registered angler of the health risks of eating contaminated fish, making enforcement of catch-and-release fishing much easier (NY DEC, 1985). This policy would likely require regulation to be effective, since it mandates that fishers join tournaments and pay a fee to fish. The policy significantly favors both competitive tournament fishing and fishers belonging to organized tournament-oriented fishing organizations over fishers who do not meet tournament fishing criteria. Such restrictions could have the effect of placing private organizations in the position of managing a public resource (NY DEC, 1985). The NY DEC expressed the concern that:

> Many [anglers] would consider a tournament-only regulation as an unacceptable, unreasonable, and unfair attempt to satisfy special interest groups. This would promote and aggravate violations to the law and would reduce the credibility of the Department as to its professional, unbiased implementation of sportfishing regulations (NY DEC, 1985).

Still, this policy may be preferable to a total fishing ban in highly contaminated non-commercial fisheries.

2.3.3.1 Feasibility and Efficacy

The efficacy of voluntary catch-and-release options depends on the degree to which effective risk communication and education has taken place. It will also depend on the impact of non-governmental factors, such as traditional activities, economics, and nutritional needs (see Section 4). While quantitative and general fish advisories seek to limit consumption, catch-and-release programs are designed to eliminate consumption (of at least some species from some sources). This option may provide too great a hardship or disruption in lifestyle for some fishers and may, therefore, not be accepted for reasons beyond the control of many fish advisory programs. These types of constraints, often related to negative program impacts, are discussed in detail in Section 3.

Effective use of catch-and-release programs involves extensive public education to ensure that fishers both understand the underlying rationale for such policies and

recognize their own interests in supporting such a program. If fishers do not see the utility of the restrictions, they are unlikely to comply and are likely to incur health risks from consuming highly contaminated fish.

Voluntary Programs.

The feasibility of voluntary catch-and-release options is similar to that of the quantitative fish advisory program. Fewer resources are required by catch-and-release programs to develop and communicate complex fish consumption limits than by quantitative fish advisory programs. On the other hand, more resources may be required to convince fishers of the importance of avoiding fish consumption. With a greater change in behavior required by this option, risk communication activities may require greater effort.

Involuntary Programs.

The characteristics of voluntary catch-and-release programs described above are applicable to involuntary programs. In addition, involuntary programs require labor-intensive activities and physical barriers (e.g., fences). Enforcement staffing and access restrictions are critical to this type of program. The extent of enforcement and related activities will largely determine both the efficacy and costs associated with such a program. The feasibility of these options depends on the availability of human and other resources to carry out the required activities. Due to the highly resource-intensive nature of these options, they may be most appropriate in very limited areas, but would probably be too resource-intensive for large or numerous waterbodies. An involuntary catch-and-release program will likely have greater resource demands than general advisory programs or voluntary catch-and-release programs. The specific requirements will depend on the goals and scope of the program.

The need for an involuntary catch-and-release program may be greatest where cultural or economic factors create significant pressure to continue fishing but not necessarily fish consumption, and contamination levels pose significant health risks.

The efficacy of involuntary catch-and-release options depends on both education and enforcement. Even highly intensive enforcement actions probably cannot limit access to waterbodies completely. Consequently, the degree to which fishers understand and agree with efforts to limit consumption and risks will have an impact on the effectiveness of a program.

As noted above, negative impacts of such restrictive programs may be significant. The feasibility and efficacy of both the voluntary and involuntary programs may be

affected by factors that will mitigate the negative effects. These might include the proximity of other safe fishing sources, easy access to other sources of inexpensive food (e.g., supplementation with food programs), and coordinating program activities with local people to maintain community and traditional activities. These issues are discussed more fully in Section 3.

2.3.4 Fishing ban

This document focuses on fish advisories, which entail voluntary compliance with recommended practices. In determining the most appropriate course of action regarding fish contamination problems, however, some risk managers may choose to consider a ban on fishing in highly contaminated areas. This policy is discussed briefly in this document because it may be a component of an overall fish advisory program or an essential activity necessitated by circumstances.

Fishing bans have regulatory aspects and generate issues not considered in detail in this series. Consequently, readers may wish to consult other sources and discuss fishing bans with risk managers who have implemented this type of action.

A fishing ban may involve banning fishing through closing waterbodies to fishing and/or banning the possession of contaminated fish. A fishing ban, in this discussion, is distinct from a fish advisory in that restrictions on fishing are not voluntary. In a fish advisory, risk managers may recommend no consumption based on health risks and other considerations. This information would be handled, as other fish advisory information is handled, through risk communication activities. In the case of a fishing ban, fishing would be prevented through some active means. A variety of options may be exercised to implement this type of policy including restricting access to contaminated waterbodies, posting signs and levying fines when fishing occurs, or providing monitoring restricted of waterbodies to prevent fishing from occurring.

Example: Fishing Bans in New York, Missouri, and Massachusetts

The New York DEC, for example, uses fishing bans to close recreational fisheries when they ascertain with 95 percent statistical certainty that contaminant levels exceed guidelines for the target contaminant (e.g., PCBs). Once a fishery is closed, New York requires that sampling and analysis data show significant decreases in contamination before they will reopen it, in order to prevent confusion arising from frequent opening and closing of the same fishery. Risk managers might also choose not to reopen a fishery until contamination levels decrease to the point that fish are once again safe to eat, since some fishers may mistake a catch-and-release policy for an indication that they can safely consume the sport fish (NY DEC, 1985).

Missouri has also used fishing bans. They recently changed their advisory in a certain waterbody from a total ban to unlimited consumption based on several years of sampling and analysis data. Massachusetts has also implemented total fishing bans in heavily contaminated fishing areas. These bans applied to both commercial and non-commercial fishing.

The authority required to enforce such a policy may require enabling legislation. Health officials in Massachusetts used the authority given to the health department to prevent the public from imminent hazard as legal justification for taking restrictive action. Due to the justifications they presented for their actions, a legal challenge to their actions was not successful. Most health departments have similar authority and are required to take action when information is received regarding imminent hazard to the public.

2.3.4.1 Feasibility and Efficacy

Banning fishing entirely where significant risks to human health exist is the most effective way to limit consumption of highly contaminated non-commercial fish (NY DEC, 1985). The feasibility of such an action depends largely on intensive use of human and other resources in the restricted areas and will be affected significantly by educational efforts and resulting public attitudes. The resource requirements are obviously greater if contamination occurs in a large water body or in a number of areas.

The New York DEC has found that both the general public and non-commercial fishers in particular do not widely support sport fishing bans as a means to protect public health. Because non-commercial fishing is a largely self-regulated activity,

government intrusion is resented and enforcement is difficult and very staff-intensive. The New York DEC proposed the option of prohibiting the possession of contaminated fish in 1985 and found an overwhelmingly negative response among anglers toward a ban on the possession of contaminated fish (NY DEC, 1985).

Fishing bans are not advisable when they are used to simplify more complicated quantitative data for high risk populations. In many instances, although the communication of advisory information is complicated, individuals relying on fish as a basic nutritional and economic food source are not being shut out completely through the advisory process, as they are with fishing bans. The trust that can be established between community groups and regulatory agencies is already tenuous. Placing a ban on fishing when some fish consumption can be considered safe severely inhibits fishers' willingness to trust the agencies' recommendations in other arenas.

Risk managers may determine that some fish species are highly contaminated within a single waterbody while others are safe to eat. Many states, including Connecticut, New York, and Rhode Island, have enforced a closed fishery for striped bass. Increased problems may arise, however, if large fisheries shared by more than one state or province are covered by conflicting policies.

The efficacy of a ban on fishing depends on both the level of effort regarding enforcement and education and on local circumstances that affect the fishers interest in and ability to comply. As noted for the catch-and-release options above, negative impacts of such restrictive programs may be significant and include economic and nutritional hardships as well as disruption of community or traditional activities. Both feasibility and efficacy may be positively affected by features in the program's design that mitigate the negative impacts of restrictions. These features might include the proximity of other safe fishing sources, easy access to other sources of inexpensive food (e.g., supplementation with food programs), and the coordination of program activities with local people with regard to maintaining community and traditional activities. These issues are discussed more fully in Section 3.

Although fishing bans would usually be viewed as actions of last resort, only to be used in areas where fish are highly contaminated and the risk of adverse health effects is great, risk managers may choose this or a similar policy that aims to provide maximum assurance against consumption of contaminated non-commercial fish.

2.3.5 Summary

Fish consumption policies differ in efficacy, feasibility, and/or economic costs. Table 2-3 summarizes some functional aspects of implementing the options discussed in the preceding section. These aspects include relative costs, staff requirements, anticipated efficacy, and whether regulatory authority is required. As noted above, this section includes only a discussion of issues surrounding the feasibility and efficacy of implementing these policies. Often, the feasibility and efficacy of an option is limited by the budget and/or staffing available to risk managers. Some policies, such as quantitative fish consumption advisories, require significant initial resources for the sampling and analysis program but may not require substantial staffing to implement. Others, such as fishing bans, require substantial ongoing staffing to be effective.

The ranges of feasibility and efficacy listed in Table 2-3 reflect the differing levels of effort that could be employed by risk managers for any given policy, depending on the goals and scope of the programs. For example, a catch-and-release fishing policy may require few resources and have little effect if the risk communication is limited to posting. Conversely, the same policy may require substantial resources for patrolling and public outreach and be much more effective in reducing risk. Intensive efforts to prevent consumption of highly-contaminated non-commercial fish may be prohibitively expensive, both to the authorities upholding the policy and to local economies supported by fishing. Conversely, attempts requiring very little resource expenditure may provide such limited information or reach so few individuals that many fishers may unknowingly consume dangerous quantities of contaminated sport fish.

Table 2-4 provides a template that risk managers can use to enter information regarding the various options under consideration. The options discussed in this section are all listed in the template; however, it is assumed that risk managers may consider only some of these options or may consider others that are not listed. Risk managers may consider the resources available to their programs, as well as the likely outcome, in terms of likelihood of accomplishing program goals, to define the potential options for their programs. The potential impacts of these options on target populations and other groups external to the agency also play a critical role in defining the best options and the success of a program. These impacts are discussed in the next section.

Table 2-3 Feasibility and Efficacy of Risk Management Options[2]

Risk Management Options		Feasibility			Efficacy	
		Staffing	Funding	Regulatory Authority Required	Consumer Education	Source-specific Risk Reduction
No action required		N/A	N/A	no	none	none
Fish consumption advisory	General guidance	moderate	moderate	no	moderate	low to moderate
	Quantitative Guidance	moderate to high	moderate to high	no	moderate to high	moderate to high
Catch and release	Voluntary	low to high	low to high	no	low to high	low to high
	Mandatory	high	high	yes	low to high	high
Fishing ban	Voluntary	moderate to high	low to high	no	low to high	low to high
	Mandatory	high	high	yes	low to high	high

[2] The information provided on the options is based on a program of average scope and with moderate efficacy requirements. If a program is very large or small or if the program requires a very high level of compliance (efficacy) the resource requirements and efficacy will be correspondingly modified.

Table 2-4 Template for Risk Management Options

Risk Management Options		Feasibility			Efficacy	
		Staffing	Funding	Regulatory Authority Required	Consumer Education	Source-specific Risk Reduction
No action						
Fish consumption advisory	General guidance					
	Quantitative Guidance					
Catch and release	Voluntary					
	Mandatory					
Fishing ban	Voluntary					
	Mandatory					

2.4. Outreach and Education

Outreach and education are critical components of any program designed to limit contaminated fish consumption. In most cases risk reduction strategies will use guidance and advisories rather than regulatory approaches. Consequently, the implementation of programs will rely heavily on effectively communicating to the public both what the recommended actions are (consumption limits, fish preparation methods, etc.) and why these actions are important to consumers.

Various approaches for carrying out risk communication activities are discussed in Volume IV in this series: Risk Communication. The volume contains information on evaluating the nature of the population of concern and their characteristics, a variety of strategies for effectively reaching the population with clear information using various media (newspaper, schools, etc), and methods for evaluating a communication program's effectiveness. Readers are urged to consult this volume in planning their fish advisory programs.

2.5 Federal Programs and Additional Resources

In response to requests from state, local and tribal and community group staff consulted for this project, information is provided in this section which can be used to address remediation concerns. The overall goal of many agencies is to have waterbodies and fish that are sufficiently contaminant-free that advisories are no longer necessary. Efforts are ongoing at all levels of the government to address this goal through cleanup efforts, pollution prevention and restrictions on the entry of toxic materials into waterbodies. Although it is beyond the scope of this document to list location-specific programs underway, this section provides a summary of various federal laws and programs relevant to fish contamination.

The applicability of the information provided in this section will depend on the source of the pollutants found in fish. For example, in cases where long-range transport is causing mercury deposition, the Clean Air Act is relevant (a summary of the laws is provided below). Where the pollutant sources are local industrial discharges, however, the Clean Water Act is appropriate. Areas adjacent to hazardous waste sites may fall under Comprehensive Emergency Response, Clean-Up and Liability Act (Superfund). Pesticide contamination may fall under the above acts; in addition, the Federal Pesticide, Insecticide, and Rodenticide Act requires regulation of pesticides in a manner that does not pose unreasonable health or environmental risks. The Community Right to Know Act may be used to obtain information regarding local sources of pollutants.

Agencies and departments outside EPA are involved in various areas that may

impact the extent of fish contamination. The Agency for Toxic Substances and Disease Registry (ATSDR) is involved with assessing the public health concerns from hazardous waste sites. The Army Corps of Engineers, a division of the Department of Defense, is involved with the dredging of contaminated sediments in conjunction with the EPA; contaminated sediments are of concern to consumers of bottom fish, and resuspension of contaminated sediments may pose hazards to consumers of all fish in the area. In addition, the Department of Energy is also involved in clean-up efforts that may directly or indirectly affect the concentrations of fish contaminants in areas of concern.

A variety of programs within these and other federal agencies are currently involved in regulating releases, cleaning up waste sites, and monitoring the release of toxic materials. Most federal agencies involved in this type of work have regional offices which can respond to questions regarding specific local problems. Staff of the regional offices work directly with state environmental and health agencies. Many also work with local, tribal, and community groups to address contamination problems. Table 2-5 contains a listing of relevant statutes and programs with a brief description of the purpose and function of the regulations. This table can be consulted to determine which agencies are most likely to have responsibility for a particular pollutant source.

Table 2-6 contains a listing of hotline numbers and other resources staffed by EPA or EPA contractors. Staff on these lines can provide state, local, and tribal risk managers information on government programs, send written materials, and provide referrals to other staff within agencies who can address specific or local questions. General information, applicable on a national level, regarding federal regulations, guidelines, and programs, is available through national information clearinghouses maintained by offices within federal agencies. The following section summarizes applicable federal statutes and regulations that address releases of toxic materials, clean-up of contaminated waterbodies, sediments, and land sites, and targeted maximum levels of pollutants in various media.

Risk Managers are also encouraged to fully explore the local, state, tribal, and regional resources available through agencies, advocacy groups, industry groups, universities and other groups. These groups often have ongoing grants, privately funded activities, and other resources which may be of assistance to fish advisory programs.

Table 2-5. Environmental Statutes and Programs Potentially Relevant to Fish Contaminants

Statute and Program Descriptions

CAA **Clean Air Act**

The CAA was enacted in 1970, with revisions in both 1977 and 1990, was designed "to protect and enhance the nation's air resources." The CAA has several key provisions used to protect air quality. It establishes National Ambient Air Quality Standards for primary and secondary air pollutants, developed State Implementation Plans to give states the responsibility for achieving these standards, and provided technology based emission limitations for regions that are not in attainment.

CAAA **Clean Air Act Amendments**

The 1990 amendments to the CAA resulted in a number of changes, including specific provisions to address acid rain and the phase-out of chlorofluorocarbons (CFCs), added technology-based regulations of toxic air pollutants.

The CAA and its Amendments may be of interest to resource managers who are concerned about long-range pollutant transport into waterbodies that are frequently fished.

CERCLA (Superfund) **Comprehensive Emergency Response, Clean-Up and Liability Act**

Superfund was enacted in 1980 to provide funding and enforcement authority for cleaning up thousands of hazardous waste sites in the United States and responding to hazardous substance spills in all media. Base funding for these activities comes from specialized taxes on petro and chemical industries, crude oil, and vehicle manufacturers. A revolving fund was also established, making responsible parties liable for the complete costs. Hazardous substances include those indicated in any of the other major federal statutes, and action is triggered by the non-permitted release of any concentration of a listed substance. Superfund was re-authorized in 1986 by the Superfund Amendments and Re-authorization Act (see SARA).

CWA **Clean Water Act**

The CWA, originally created in 1972 as the Federal Water Pollution Control Act until renamed and amended in 1977, was designed to restrict both the degradation of water resources by the discharge of pollutants and the transport of pollutants through waterways. In 1987, extensive amendments were added to remediate waters that exceeded minimum discharge standards to assure water quality. A wide spectrum of water-related issues are covered through the CWA for numerous chemicals. In addition, this act relies on the application of best practicable technology for water treatment. It also provides a permit mechanism to regulate the volume and nature of discharges, relying on technology-based effluent limitations on point sources (best available technology for toxics and best conventional technology for other compounds) and water-quality effluent limitations if water quality is not maintained. Though never specifically mentioned, wetlands (and consequently both fresh and estuarine fish nurseries) have also been interpreted as protected under the Clean Water Act because they are an integral water resource and a key mechanism for retarding the transport of pollutants through the waterways.

EEO **Environmental Equity Office**

This office was created in the early 1990s to address the concern that environmental hazards were more likely to be found in socio-economically disadvantaged communities than in more affluent communities. The EEO primarily encourages every office and division of EPA to address issues of environmental equity within the context of existing contracts and projects, and does not sponsor as many projects directly that deal with the equitable distribution of risk.

EO **Executive Order on Environmental Justice**

Executive Order 12898 was issued by President Clinton on February 11, 1994, to address environmental justice in minority populations and low-income populations. Within this order, he specifically ordered that all agencies take the principles of environmental justice into consideration when creating regulations. Notably, one issue mentioned directly was his concern for subsistence and recreational fishers who may be consuming contaminated fish.

EPCRA **Emergency Planning and Community Right-to-Know Act**

The Right-to-Know Act was enacted as a freestanding provision of the 1986 Superfund Amendments, and is also known independently as SARA Title III. This act was designed to force states and local communities to develop plans for responding to unanticipated releases; to require notification to local, state, and federal authorities of the release of certain substances beyond a developed reportable quantity (threshold value) determined for hazardous chemicals based on their physical and toxic characteristics; and to require all industries to maintain and submit to local, state, and federal authorities Material Safety Data Sheets on all chemicals of concern.

FCP **Fish Contamination Program**

This program, run out of EPA's Office of Water, provides guidance to states, tribes and local agencies for the development of fish advisories. This group maintains the National Listing of Fish Advisories and managed the development of this guidance series.

FIFRA **Federal Insecticide Pesticide and Rodenticide Act**

This act requires balancing risks and benefits. EPA is required to register, or license, pesticides on the basis of data that is adequate to demonstrate that their use, according to label directions, will not cause unreasonable adverse effects on people or the environment. Data are required on a wide range of health effects (e.g., cancer, reproductive effects) and effects on wildlife, fish, and plants, including endangered species. In addition, EPA is responsible under Federal Food, Drug, and Cosmetic Act (FFDCA) for setting tolerances (maximum permissible residue levels) for residues in food or feed, for those pesticides whose use involves food or animal feed crops. EPA is also required to establish safe use practices and to release information obtained on the health and ecological effects of pesticides to the public, on request (with the exception of confidential business information).

RCRA **Resource Conservation and Recovery Act**

RCRA was created in 1976 to treat, store and dispose of all hazardous waste to minimize the present and future threat to human health and the environment. RCRA imposes full life cycle management controls on hazardous waste by regulating the generation, transport, treatment, storage and disposal of risky chemicals. Subtitle I specifically addresses underground storage tanks, an area of particular concern.

SARA **Superfund Amendments and Re-authorization Act**

Significant revisions were made to the Superfund regulations in 1986, expanding the scope of the coverage and requirements, but not altering the intentions of the original act. SARA Title III was also created at this time as a freestanding provision also known as EPCRA, in the wake of the Union Carbide hazardous waste disaster in Bhopal, India. SARA Title III addresses the need for communities to have contingency plans for hazardous emergencies and grants rights to the public to know what hazards they might face from industry (including transport and disposal) in their communities (see EPCRA).

TSCA Toxic Substances Control Act

TSCA was created in 1976 to evaluate the potential hazards form chemical substances through manufacturer testing and may impose restrictions in use, storage, transport or disposal of chemicals accordingly. Three classes of chemicals have been regulated in accordance with TSCA: asbestos, polychlorinated biphenyls (PCBs), and chlorofluorocarbons (CFCs).

Table 2-6: Hotlines and Other Resources for Federal Programs Relevant to Fish Advisories

media/focus	statutes/offices	hotlines / resources available
fish	• FCP	EPA's Fish Contamination Program, c/o the Office of Water, (202) 260-7301, provides guidance to the states for developing fish consumption advisories. This group also maintains the National Listing of Fish Advisories.
water	• CWA	EPA's Office of Water, (202) 260-5700, will direct callers with questions about the CWA and any component of it (e.g., questions regarding MCLs for specific chemicals) to appropriate EPA offices.
drinking water	• SDWA	Safe Drinking Water Hotline, (800) 426-4791, helps individuals who are interested in testing their drinking water, interpreting the results from a state laboratory, water treatment and filters, some general information about possible sources of unsafe drinking water and general information about the SDWA. Weekdays, 9:00 am through 5:30 pm, EST, except federal holidays. Ground Water and Drinking Water Resource Center, (202) 260-7786, in EPA's Office of Water, offers publications and referrals.
air	• CAA	Air RISC Hotline, (919) 541-0888, provides extensive information regarding the CAA/CAAA, has general information, source-specific trends (e.g., if a particular region that has high fish contamination is heavily populated by pulp and paper mills, general information on that industry's emission trends are available), and information on the criteria pollutants (particulate matter, volatile organic chlorides, nitrous oxides, sulfur oxides, and carbon monoxide).
	• CAAA • EPCRA	Additional resources offered through the Air RISC Hotline: Office of Visibility and Ecosystems, (919) 541-0877, focusses on visibility - generally considered a measure of particulate matter (primarily heavy metals and residual organics caught up by the other suspended compounds) and ecosystem health.

Table 2-6: Hotlines and Other Resources for Federal Programs Relevant to Fish Advisories

media / focus	statutes / offices	hotlines / resources available
		Carol Jones, (919) 541-5341, contact for tribal air issues. Technology Transfer Network Bulletin Board System, modem access: (919) 541-5742, has extensive information regarding CAA rules, EPA guidance documents and activities.
hazardous waste	• RCRA • CERCLA • SARA • EPCRA (SARA III) • TSCA	EPCRA Hotline, (800) 535-0202, responds to questions about accidental air releases under CAA §112(r). Weekdays, 8:30 am to 7:30 pm, EST, excluding federal holidays. RCRA/CERCLA/EPCRA Hotline, (800) 424-9346, provides general information on these acts, addresses site-specific concerns on superfund sites and emergency response and accidental release sites, and provides information regarding RCRA's underground storage tanks rules. Weekdays, 8:30 am to 7:30 pm, EST, excluding federal holidays. EPCRA Hotline, (800) 535-0202, responds to questions regarding the emergency planning and right-to-know regulations. Weekdays, 8:30 am to 7:30 pm, EST, excluding federal holidays. TSCA Hotline, (202) 554-1404, addresses questions relating to TSCA standards and provides general information as necessary on the primary chemicals regulated under these standards (asbestos, PCBs and CFCs). Weekdays, 8:30 am to 4:30 pm, EST, excluding federal holidays.
pesticides	• FIFRA	National Pesticide Telecommunications Network, (800) 858-7378 (general public); or (800) 858-7377 (medical and governmental personnel). This service provides a variety of information concerning pesticides, ranging from product information, recognition and management of pesticide poisonings, toxicological profiles, health and environmental effects and cleanup and disposal procedures. Weekdays, 8:00 am to 6:00 pm, CST.
risk communication		Risk Communication Hotline, (202) 260-5606, is primarily designed to address hazardous waste communication, but some of their information may be useful in other contexts.
environmental equity	• RCP	Environmental Equity Office Hotline, (800) 962-6215, will address equity concerns and refer callers to the appropriate offices for additional support.

Table 2-6: Hotlines and Other Resources for Federal Programs Relevant to Fish Advisories

media / focus	statutes / offices	hotlines / resources available
general environmental information from EPA	• EO 12898	Access-EPA (202) 260-2080: The EPA's Public Information Center provides non-technical information and referrals about drinking water, air quality, pesticides, Superfund and other environmental topics. Access-EPA can also be reached via e-mail at public-access@epamail.epa.gov. Department of Defense, general information, (703) 545-6700.
Army Corps of Engineers activities	_____	Department of Energy, general information, (202) 586-5000.
Department of Energy activities	_____	Department of the Interior, general information, (703) 358-1700.
Fish and Wildlife Services activities	_____	ATSDR or the Centers for Disease Control, general information, (404) 639-6304.
Agency for Toxic Substances and Disease Registry activities	_____	
	_____	

SECTION 3

IMPACTS OF LIMITING CONSUMPTION

3.1 Overview

There are positive and negative impacts of fish advisory programs which merit consideration when developing new programs or modifying existing ones. Options for limiting fish consumption are seriously considered only when sampling and analysis data indicate that fish consumers may be at risk. In addition to the obvious benefits of reducing health risks, there are other positive and negative impacts of fish advisories that may affect either the entire population or a subgroup of the population in an area. For example, posting fish advisories may be beneficial in educating people about the hazards of a water body, leading to less swimming, water use, and attention to the need for clean-up. Alternatively, posting may reduce the availability of fish as a dietary component or component of a traditional ceremony, and may jeopardize the livelihood of small businesses reliant on fishing activities. Under most circumstances, consumption advisories will have both positive and negative effects on individual consumers and their communities. These effects should be considered by decision-makers in developing a fish advisory program.

This section explores some of the potential impacts of various options for limiting fish consumption on groups and activities EXTERNAL to the governing body. Affected groups may include the target population or communities and individuals that serve them (e.g., fishing equipment stores). The impacts are, for the most part, site specific. Whether they should be a consideration in decision-making, and the extent of their impact, will depend on local conditions including the population, economy, social and cultural features, and other factors. Consequently, in reviewing this information the reader is urged to evaluate the information in light of the characteristics of the contaminated areas.

3.2 Nutrition

3.2.1 Basic Nutritional Needs

Fish consumption is generally beneficial because it provides a good source of protein and vitamins. Although fish composition varies, a 3.5 ounce fillet generally provides the nutrients listed in Table 3.1 (larger fillet may be consumed in practice).

The protein content of fish is high in relation to the fat content of most fish species (Anderson, et al, 1972). The nutritional components of fish will vary depending on the method of preparation, storage, and what portion of the fish is consumed and varies by species.

Table 3-1. Nutrient Values for 3.5 oz Fish Fillet

calories	98 - 236
protein	15 -29 grams
calcium	6 - 260 milligrams
potassium	190 - 414 milligrams
iron	0.7 - 2.2 milligrams
vitamin A	30 - 1050 I.U.
vitamin B:	
Thiamine	0.02 - 0.16 milligrams
Riboflavin	0.07 - 0.27 milligrams
Niacin	1.9 - 13.3 milligrams

Taken from Anderson et al., 1972. Table 1.

U.S. FDA has provided recommended dietary allowances for vitamins and minerals that can be compared to the above information to determine the contribution fish may make for various age groups and with different portion sizes (NRC, 1989). Although vitamin and mineral supplements are readily available at a relatively low cost, individuals who reduce their dietary intake of these essential nutrients from fish will not necessarily obtain supplements or consume other foods with these nutrients. More problematic is the access to high quality protein for many people with limited incomes. For some low income populations who rely on subsistence fishing for dietary protein, fish consumption is an essential part of their diet and an economic necessity.

3.2.2 Health Benefits of Fish Consumption

In addition to fulfilling basic nutritional needs, eating a diet rich in fish may also convey several health benefits. Restrictions in the amount or type of fish consumed may negatively impact the health of individuals who had been benefiting from fish consumption. Whether or not a negative impact will occur depends on what other foods are substituted for the fish. Substitutions may include other types of fish, or

non-fish sources of protein.

Impacts of restricted consumption depend on whether or not the consumers were benefiting from consuming fish in a manner that can or will not be replicated by other foods. The many human studies showing positive effects of fish consumption focus primarily on fish diets versus traditional western diets that may be high in salt, cholesterol, and saturated fats. The impact of switching from a fish-intensive diet to another "healthy" diet is less well understood. The following discussion identifies specific benefits that may be derived from fish or fish constituent (e.g., fish oil) consumption. When reviewing this information, risk managers may wish to consider the health status of target populations, their likely substitutions for fish, and how a fish advisory program can minimize the adverse impacts of fish consumption reductions.

Benefits of fish consumption have been identified in human epidemiological studies that compared the health status in fish consuming populations with those in populations consuming little or no fish. Many studies that identified these benefits have focused on the ingestion of fish oil; however, some have evaluated consumption of all edible portions of fish. The array of demonstrated benefits includes decreased cardiovascular disease, a reduction in blood pressure in hypertensive and non-hypertensive individuals, reduced risk of colon cancer and breast cancer, several benefits to diabetic patients, decreased pain from arthritis, and a decreased incidence of asthma attacks in asthmatics. In addition to epidemiological studies, animal research has also found associations between fish or fish oil and health benefits. The discussion below focuses on the findings of the human studies.

Cardiovascular Disease Reduction

More information is available on the association between fish and cardiovascular disease than between fish and other diseases. Studies have shown beneficial effects from eating fish oils, ranging from decreased coronary heart disease (CHD) mortality to decreases in blood pressure and decreased serum lipids.

Mortality from CHD has been shown to be low in many fish-eating populations and in clinical studies on the effects of eating fish and fish oils. Eskimo and Japanese populations who eat large amounts of fish have been shown to have low incidence of CHD and CHD mortality (Kromhout, 1993). These results may be due in part, however, to the relatively low amount of saturated fats in the diets of these populations. Saturated fats are considered a risk factor in CHD and a diet with low levels is associated with a lower than average risk of heart disease.

Prospective studies on the individual level are important to more accurately determine the correlation between fish consumption and CHD mortality. A 20-year prospective study on 852 men in the Netherlands found that CHD mortality (independent of other CHD risk factors) was inversely related to the amount of fish consumed (Kromhout, et al., 1985). Three other cohort studies showed similar results (Shekelle et al., 1985; Norell et al., 1986; Dolecek and Grandits, 1991). An intervention trial in Wales of 2,000 patients supports the results of the observational studies that have shown associations between fish consumption and reduced mortality (Burr et al., 1989). In this study, patients who were recovering from heart attacks and who ate at least two portions of fatty fish per week reduced their mortality by one third compared to patients who received advice on fat or fiber but did not consume fish biweekly. Other research in populations that generally consumed large amounts of fish, however, has demonstrated no association between fish consumption and mortality (Kromhout, 1993). This failure to find an association may be due to lack of a control group of individuals who do not consume fish.

Omega-3 fatty acids[1] have beneficial impacts on health, but the concentrations of these beneficial chemicals in fish tissue varies by fish species. Fish oil has been shown to reduce blood pressure (Kromhout, 1993), although the dose required for this effect has not been determined. In one study, mildly hypertensive men who received 50 ml fish oil (equivalent to 15 grams of omega-3 fatty acids) a day for four weeks had significantly lower blood pressure during the treatment period than they did at the beginning of the study (Knapp and Fitzgerald, 1989). Men who ingested either 39 grams omega-6 fatty acids from safflower oil, a mixture of oils representing the average U.S. diet, or a 10 ml dose of fish oil (omega-3 mg equivalent not provided) exhibited no decrease in blood pressure. The blood pressure of those receiving the high dose of fish oil returned to pre-study levels after the subjects stopped taking the oil. One study in which individuals ate fish in quantities that may represent normal daily intake values by the general population (1.2 grams of omega-3 fatty acids/day) showed that blood pressure was lowered after 8 months of the regimen (Simopoulos, 1991). Changes in physiology related to hypertension have also been noted in human studies. Twenty patients who had high levels of fatty acids at the outset of the study were given a diet containing fish oil, which consisted of about 20 to 30 percent of each patient's diet. Over the four-week diet, the patients exhibited decreases in cholesterol, fatty acid, and very low-density lipoprotein levels (Phillipson, et al., 1985). Several other clinical studies have shown fish oils to lower serum lipids (Dattilo, 1992).

Diabetic Symptom Reduction

[1] Omega-3 fatty acids are found in fish oil.

Recent evidence suggests that fish oil may benefit diabetic patients. Ingestion of cod-liver oil for eight weeks by diabetic patients resulted in a variety of effects: decreased permeability of blood vessels to macromolecules such as lipoproteins, reduced blood pressure, increased amount of high density lipoproteins, and decreased amounts of very-low density lipoproteins and triglycerides (Jensen et al., 1989). In contrast, olive oil resulted in no significant decrease in either blood pressure or blood vessel permeability, and the subjects' levels of very-low density lipoproteins and triglycerides increased. The decreased vascular permeability seen in the patients eating fish oil may prove beneficial because it prevents the progression of diabetic nephropathy by decreasing permeability to albumin. Long-term studies need to be undertaken to determine whether this mechanism actually occurs. Other studies on insulin-dependent and non-insulin-dependent diabetes patients have shown small increases in blood glucose, glycosylated hemoglobin, plasma total cholesterol, LDL cholesterol, and serum apo B associated with fish oil ingestion (Simopoulos, 1991).

Arthritic Symptom Reduction

McVeigh (1990) reviewed research on the effects of fish oil on arthritic patients. In one study of 49 patients, those given fish oil for six months had decreased morning stiffness, pain, and fatigue. The effects were dose related, with higher doses of fish oil resulting in greater improvement. These results are corroborated by other studies demonstrating similar beneficial effects to arthritic patients ingesting omega-3 fatty acids from fish oil (McVeigh, 1990).

Asthmatic Symptom Reduction

Nine asthmatic patients treated with fish oil lipid capsules had significantly fewer asthmatic episodes than eight patients taking placebos (Arm et al., 1989). It has been suggested that fish oil may confer anti-inflammatory effects, which leads to the observed decreases the severity of symptoms in both arthritic and asthmatic patients.

Cancer Risk Reduction

The protective effects of eating fish may extend to reducing the risk of getting certain cancers. A study of 88,751 nurses found that those nurses with a daily consumption of fish or chicken had lower risk of getting colon cancer than those with a lower consumption rate (Willett et al., 1990). Other research has shown that fish may reduce the risk of breast, colon, pancreas, and prostate cancers (Simopoulos, 1991).

The research described above indicates that fish may convey significant health benefits for those with certain medical conditions, as well as the general population. Some health experts believe that the health benefits outweigh the risks associated with fish contaminants (e.g., Kimbrough, 1991). EPA is not indicating an acceptance of or agreement with the study results by reporting these studies. Agencies may wish to review the studies in more detail to determine the applicability of their results to the risk management process.

There is not yet sufficient information to determine precisely what levels of fish consumption are associated with specific health benefits. However, the positive benefits of fish consumption may be considered when evaluating the trade-offs between various risk management options. An evaluation of the benefits and risks of fish consumption, which may include careful consideration the levels of contamination, risks associated with contaminants, potential benefits to fish consumers, and the availability of alternative economically feasible food supplies and their associated risks.

It would also be useful to have information regarding the health risks associated with alternative forms of protein that would replace the fish formerly consumed by fishers who alter their dietary habits based on advisories. Information exists on many of the pesticides, preservatives, and drugs used in the production, processing, and preservation of meats, dairy products and vegetarian alternatives. Conversely, no comprehensive data exist on the overall risks and benefits associated with these products. It is beyond the scope of this document to evaluate such risks. When establishing fish advisories risk managers may wish to consider that alternatives to fish also may be associated with risks.

Under ideal circumstances, contaminants in fish will be eliminated through better environmental controls. Until that time, regulatory limits and advisories based on an evaluation of risks and benefits should provide the fish consumer with sufficient information to reap the benefits of eating fish while avoiding unsafe exposures to contaminants.

3.3 Cultural and Societal Impacts

While decision-makers often focus on the risks and benefits of various policy decisions or the feasibility and cost of programs, affected populations often perceive decisions and programs from the point of view of impacts on their lives or

effects on their communities.[2] To be appropriately designed and effective, risk evaluations and programs to reduce risk must take into consideration the needs and perceptions of the community being exposed. These impacts should also be considered when decision-makers are evaluating trade-offs between different program options and establishing consumption limits.

In most cases there will be trade-offs for individuals and communities if restrictions in fish consumption are advised. This section provides a discussion of potential impacts on social and cultural aspects of individuals and communities. The information obtained in this section was obtained primarily from discussions with members of Native American, Asian American, African American, and Hispanic communities and sport and urban fishers groups. State and federal workgroup members with information on cultural impacts were also consulted. Formal surveys were not conducted for this document; consequently, the information provided represents a summary of what was learned through conversations with a range of individuals and does not reflect a representative sampling of fisher groups or government agencies. Readers are urged to submit information for future revisions to EPA's Fish Contamination Program.

3.3.1 Traditional Activities

Fishing and fish consumption are a part of the traditional activities of many groups. These range from Native Americans who employ fish in religious and secular ceremonies to urban fishers who engage in sport fishing activities during specific seasons as a part of their social activities. The importance of these activities to the communities and participants is significant and cannot be quantified in the same way that risks or dollars lost on tourism are quantified. The value of these activities to individuals and groups may vary from something that is a pleasant intermittent pastime to an essential part of a long-standing culture and personal identity. The effects of imposing fishing restrictions on individuals and groups merit evaluation prior to taking any significant action.

The cultural and spiritual practices of subsistence fishers may be affected by fishing advisories. One population most affected are Native Americans, where traditions have been built around fishing and sharing the catch for centuries (EPA, 1994b). Native American groups have used fish in their traditional religious activities over

[2] Communities in this context refers to a group of people who share similar cultural patterns and who consider themselves to be member of the same societal group. A community may be a tribe, ethnic group, small town or part of a city. Subpopulations within the community may be identified to obtain groups who have similar activities, susceptibilities and needs.

many centuries. While the wide diversity of beliefs among the hundreds of tribes in the United States makes generalizations regarding their beliefs inappropriate, nature plays a large role in the religious beliefs and activities of many tribes. Those tribes near large waterbodies, such as the Great Lakes and Atlantic and Pacific Oceans, have often used particular types of fish to symbolize characteristics or ideas. The fish are used in ceremonial meals, and the catching of fish may also be a part of the traditional activities.

The Columbia River Inter-Tribal Fish Commission (CRITFC), composed of four tribes that fish along the Columbia River Basin, has been involved in evaluating fish contamination and its various impacts on the tribes. In their report on the results of their studies, they preceded all technical information with a statement under tribal health:

> "Fish is not just a major food source for tribal members, it is the essence of the tribes' cultural, economic and spiritual well-being."

(CRITFC, 1994).

Such a statement placed in a position of prominence in the report indicates the importance of fish to these tribes.

Many tribal affiliates have explained that at least two of the options for limiting the consumption of contaminated fish, outright bans and catch and release programs, would be completely inconsistent with the cultures relying on fishing for subsistence and cultural sense of self (Watanabe, 1994; Kmiecik, 1994; Coombs, 1994; Cole, 1994; Dellinger, 1994; Walker, 1994). To those who are a part of a culture defined by the societal relationship to fishing (and providing for themselves) and concepts of efficient living, fish advisories are especially troubling. Restrictions on fishing rights have also been perceived by some individuals as passing the negative impacts of contaminated waters from the polluters who should be responsible for cleaning the waters to socio-economically disadvantaged communities or clusters of individuals with little political clout. Fishing represents the integration of family with community responsibility. Families spend time together fishing, and communities try to maintain interests in the harvests and management of both anadromous and resident fishes. These acts and that of preparing fish for use when the fishing season slows down and the anadromous fish have left provides a sense of community (Cole, 1994; Coombs, 1994).

For many of these tribes that rely on fishing as a major part of their economic and nutritional base, fishing advisories are an apparent sign of disrespect to their

communities and cultures. They perceive the message that those responsible for the unhealthy water contaminant levels are not required to clean the water to a level that is safe to consume the fish, and are viewed by the external decision-makers (i.e., government) to be more important than the individuals that choose to supplement their diets with fish (Watanabe, 1994; Cole, 1994).

Specific ceremonial uses of fish, such as the First Fish ceremonies to celebrate the first fish of the seasons, are vital to the maintenance of cultures living off the land and water. Such ceremonies may require consuming parts of the fish not typically consumed, or having everyone who is present consume parts of the fish, including nursing mothers and children. For example, the First Fish ceremony among the tribes of northern California includes the consumption of the entire fish while returning the bones back to the river (Coombs, 1993; Walker, 1994). The Objibwa (Chippewa) of the upper Great Lakes region, another community that depends upon fish as a food source and an important economic base, have a well documented history of fishing cultures, including subsistence and commercial fishing. Extra fish are distributed among crew members and the extended family for labor compensation as part of cultural ritual and tradition (Dellinger, 1993).

People for Community Recovery, an African American urban community organization in Chicago, has raised up additional concerns. Many of the waterways in urban stretches are not visibly posted with any advisories, although advisories have been released for those areas by the State. These areas are used by numerous subsistence fishers who supply fish to their immediate and extended families and supplement their incomes by selling the fish they catch to the local community. These fishers often do not pick up the sportsfisher guides available (typically via fish license distributors) and may be unaware of the potential health hazards from eating fish from these waters. Consequently, these particular fishers are unlikely to know the particulars of the fish advisories released by the State, and the consumers are even more unlikely to have been informed of the health advisories. Fish bans or catch and release recommendations may not be a realistic risk management option in these communities, and enforcement would be extremely difficult. The current practice of no postings, however, has left many urban fishers feeling that their health is being compromised because they are not considered to be a valued part of the community.

Posting as much information as possible in a brief format, including types and quantities of fish that are safe to eat, is most important to them. Two main concerns that affect urban African American populations in this area, which could be addressed through fish advisory and local community programs, are the existence of informal fish markets and communication of safe preparation techniques. In both of these instances, the individuals eating the fish may not have been made aware

of which types and quantities of fish are safe to eat. Although many African Americans have been switching to cooking methods that reduce the amount of fat, the preferred method is still frying a skin-on fillet or deep frying the whole gutted fish. Of the preferred fish to consume, several species are bottom fish such as catfish and buffalo fish, although increasingly many of these are farm raised. These individuals typically require the fish as a part of their diet and as a supplemental or primary form of income necessary for their family (Williams, 1994). Although advisory information may not change all of the fishers' behavior, the information will allow them to make their own informed decisions.

Even when advisories are posted, fishers may ignore the warnings. The Hudson River Sloop Clearwater (HRSC) environmental group conducted a survey of individuals who supplement their diet and income with fish from the Hudson. An ad-hoc interview of individuals fishing the river after the survey found that some anglers think the fishing advisories are "a big fairy tale." There is a strong belief among some fishers that if the fish "look okay", or if fishers are "still alive," then no problems exist (HRSC, 1994). Such beliefs are a testament to the need for advisory postings that first are available to everyone and, more importantly, are explained clearly so that individuals who are purchasing or receiving fish can make educated decisions about the quantity to consume.

Sport fishers also form an informal community that may provide support and essential relaxation for those who participate. For many this activity may be their primary hobby and their outlet to escape the stresses of everyday life. For many, fishing is a social activity. Even non-fishers participate in the festival-like atmosphere that surrounds some fishing periods, such as the smelt runs in Chicago. Other subpopulations where fishing and/or fish consumption are an important part of the culture and traditions include some Asian American communities, and long-time subsistence and commercial fishing communities such as Chesapeake Bay fishers (EPA, 1994b).

Many people have participated in sports fishing activities over their lifetimes and it is not uncommon to see many generations spending time together fishing. As with Native American impacts, the importance of fishing to sports fishers and to their communities should be considered carefully when evaluating fish advisory actions. Cultural and spiritual values are extremely difficult to quantify. Nonetheless, states should consider the effect that restricting a fishery will have on these values when deciding whether or not to issue a fish advisory.

Although the value of traditional activities to communities cannot be quantified in dollars, the importance of fishing and fish consumption to these communities may be great. A high value may be placed on the ability to fish in traditional fishing

areas and to obtain food from nature. Both direct restrictions of fishing and less intrusive fish advisories may also have strong implications for communities with respect to the degradation of lands and waters that they hold sacred. For these groups in particular, remediation of contaminated waters and fish may be an especially high goal. In some cases, moving the fishing grounds to other locations or limiting fish consumption to minimize risk may seem far less appropriate than it would seem to fishers with differing attachments to the land. The cultural implications of programs should be considered carefully in designing risk reduction programs. Input from targeted populations may be especially important in cases where traditional ways will be disrupted by such programs.

Supplement A in Volume II has a detailed discussion of some specific groups of subsistence fishers' dietary patterns. It also provides information regarding the importance of fish both as a food source and in their cultural lives. This section should be consulted for additional information on the topic.

3.3.2 Dietary Patterns

Nutritional advantages of fish consumption were discussed in an earlier section, but specific health benefits are not the only issue related to dietary restrictions such as fish advisories. In many cultures within the U.S., particularly Asian American and Native American groups, fish consumption is a long-standing tradition, with recipes passed from generation to generation. Other groups also have dietary traditions making extensive use of fish. As noted above, fish are an important component of the diet of many urban and rural poor, as well as those who fish for sport rather than economic necessity. Restrictions in fish consumption may provide a hardship to those who have spent years cooking in familiar ways. It may be difficult or impossible to substitute ingredients for fish, and the taste may not be palatable to those accustomed to traditional fish dishes.

If substitutions are made for fish, the replacements may be less healthy (see the health benefits section, 3.2) and may not be financially practical for subsistence fishers. Many alternative western foods are higher in saturated fats, salt, and other undesirable components. Considering the potential impacts on the dietary patterns of targeted populations is encouraged in developing fish advisory programs.

3.3.3 Use Taking and Mobility

People who have property that has traditionally entitled them to fish may suffer significant negative impacts from fish advisories (commercial issues are discussed in the following section). These individuals may be owners of property where they have carried out recreational or subsistence fishing, or tribal members with treaty

rights to waterbodies. Such people may feel that restrictions, particularly involuntary restrictions, on fishing are an infringement on their property rights. Native American groups have characterized such activities as use taking in a legal sense.

Fishers who have the option of using alternate waterbodies without advisories (or with less stringent advisories) are not affected in the same way as those who have specific rights regarding shore line or water property. Aside from any commercial valuation, property owners may feel that the value of their property to themselves is severely diminished if the fish are contaminated to an extent requiring fish advisories.

3.4 Economic Impacts of Fishing Advisories

States should keep in mind that the imposition of fish advisories may result in various social costs. For example, fish advisories may decrease the values of properties abutting affected waterbodies used for fishing. The cost of obtaining food containing high quality protein may increase for subsistence fishers who must find alternative protein sources. The magnitude of these costs will depend on the species of fish affected, the degree of fishing (sport and subsistence) taking place before or after the advisory, the quantity of fish tissue consumption allowed post-advisory, and the effect of ingesting contaminated fish tissue on sensitive subpopulations such as children. These social costs can be defined as the negative impact of fish advisories on human society. When evaluating whether or not to issue a fish advisory, however, these social costs must be weighed against the social benefit of reducing adverse effects to human health.

In general, social costs and benefits can take several forms. They can include impacts on goods and services with clearly defined markets such as commercial fisheries. Alternatively, they can include impacts on items that society cares about but are not traded on markets such as contaminant-free water. Finally, other social costs and benefits may have components that can be valued through market transactions and other components for which a dollar value is cannot be set by the marketplace. Adverse health effects are a good example of this situation. While health effects can lead to losses in productivity and wages that are easily monetized, they will also lead to pain and suffering, which are more difficult to value.

This section focuses on the three categories of social costs and benefits associated with fish advisories. These categories are:

- **Costs Associated with Fishing** -- includes potential economic losses to the recreational fishing industry, costs to anglers, price increases of protein sources for subsistence fishers, and diminished cultural values.

- **Costs Associated with Property Values** -- includes potential losses in land value to land owners abutting a river reach where a fish advisory is in effect.

- **Health Benefits from Contaminant Reductions** -- includes potential benefits of reductions in contamination of fish ingested by recreational and subsistence fishers and their families.

This section is not intended to provide in-depth guidance on how to estimate social and economic costs and benefits, nor should it be viewed as inclusive of all possible social costs and benefits associated with fish advisories. Rather, it is intended to give states an idea of the types of costs and benefits they should consider and how they might be estimated in the development of fish advisories. In addition, some examples of possible costs and benefits are provided. Note that the values presented in this section can not necessarily be applied to a particular situation without further data collection and analysis. Because fish advisories are site-specific, analyses of costs and benefits should be carried out on a case-by-case basis.

3.4.1. Methods for Estimating Costs Resulting from Fish Advisories

Recreational, subsistence, and cultural values must be considered when evaluating the economic and social costs associated with fish advisories. Each of these values could be reduced significantly due to the imposition of a fish advisory. To estimate the loss to each of these categories, the value derived by each must first be established. While the market value for commercially caught fish (i.e. price/lb) is easily established, fully capturing the cost of non-market goods such as recreational and subsistence fishing is more complex and difficult. Several approaches can be used to estimate values for non-market goods including but not limited to the travel cost, contingent valuation, and expenditure methods. These methods are summarized briefly below:

Travel Cost Method

The travel cost method (TCM) uses information on the costs that people incur to travel to and use a particular site to estimate a demand curve for that site. The method assumes that people who live X miles from a recreation site and who face time and travel costs in getting to the site would use the site just as frequently as people X + h miles from the site when faced with an admission fee to the site equal

to the additional time and travel costs associated with the distance h. From this assumption and observations regarding the frequency of use of different groups, a demand curve for the site can be traced out. The demand curve is then used to estimate the "consumer surplus" associated with the use of the site: in other words, the value that consumers receive from the site over and above the costs that they incur in using it. Consumer surplus is an estimate of the net benefits of the resource to the people using that resource. For example, if the resource is a recreational fishing site, the method can be used to value the recreational fishing experience (EPA, 1994b).

Contingent Valuation

In the contingent valuation (CV) method, surveys are conducted to elicit individuals' willingness-to-pay (WTP) for a particular good, such as a fishery or clean water. CV is more broadly applicable than TCM. Like the TCM, it can be used to estimate consumer surplus associated with recreational fisheries, but it can also be used to estimate less tangible values such as how much people care about a clean environment.

Expenditure Method

This method estimates the value of a non-market good based on total expenditures related to that good. For example, in the case of recreational fishing, total trip expenditures and equipment expenditures can be used to estimate the value of fishing to the angler. Although expenditures are an indicator of the value of the fishing experience, they do not reflect the net benefit associated with the experience (i.e., consumer surplus) as do the TCM and CV methods. If a fishery were to be shut down, recreational fishers would recoup what they would have spent on travel, equipment and other items. Their consumer surplus, however, would be lost. Although consumer surplus is a better measure of the economic value of recreational fisheries than simply expenditures, both are presented in this guidance document because states may be able to estimate expenditures more readily than they are able to undertake a TCM or CV analysis.

States may want to undertake more than one type of analysis as a check for consistency between the results of different methodologies. States should be careful not to double count fishing values, however, by adding the results of individual analyses.

3.4.2 Recreational Fishing and Tourism

To estimate recreational fishing values, states may want to use one of the

methodologies listed above. To undertake these analyses, states will need to collect information including but not limited to: numbers of fishing days per site per year, distances traveled by anglers per recreational fishing site, and recreational fishing-related expenditures per angler per site. States that wish to estimate fishing values using these approaches should contact the Office of Water in their EPA Region or at Headquarters as well as economics departments at state universities for further assistance. If conducting such analyses is not possible, states should at least qualitatively describe the possible impacts to recreational fishing of issuing a fish advisory.

Studies of economic value of recreational fishing have been conducted in many sites throughout the US over the past 30 years. To assist states, Table 3-2 summarizes and compares examples of reported recreational fishing day values based on travel cost methods, contingent valuation methods or expenditures. In 1991, freshwater fishers took an average of 13 trips each and fished an average of 14 days each (United States Fish and Wildlife Service (FWS), 1993). During this period, fishers spent an average of $596 each on trip and equipment expenditures, or approximately $41 per fishing day (FWS, 1993). These expenditures where divided between items such as: food, lodging, transportation, rods, reels, tackle boxes, camping equipment, boats, fishing licenses, and fishing magazines.

For the purpose of this comparison, all values have been normalized to 1992 dollars. For example, the $41 average expenditures per day in 1991 becomes $42 per day in 1992. As Table 3-2 indicates, the fishing day values range from $16 to $69 per day, with a mean of about $38 per day.

Table 3-2. Examples of Values Reported for Recreational Fishing

Type of Value	Value (1992$)	Source
Mean benefit/day of anadromous fishing	$67	Walsh et al. 1988 (in EPA 1993b)
Mean benefit/day of warm-water fishing	$24	Walsh et al. 1988 (in EPA 1993b)
Mean benefit/day of cold-water fishing	$38	Walsh et al. 1988 (in EPA 1993b)
Average value of a fishing day for trout, including resource costs (travel cost methods)	$23-35	Vaughan & Russell 1982
Average value of a fishing day for trout, including resource costs (contingent valuation method)	$31	Charbonneau & Hay 1978 (in Vaughan & Russell 1982)
Average value of a fishing day for catfish, including resource costs (travel cost method)	$16-23	Vaughan & Russell 1982
Average value of a fishing day for catfish, including resource costs (contingent valuation method)	$22	Charbonneau & Hay 1978 (in Vaughan & Russell 1982)
Total expenditures (including memberships, magazines, etc.) per day for sportfishing in general	$48	FWS 1993
Trip and equipment expenditures per day for sport fishing in general	$42	FWS 1993

The information provided in Table 3-2 should not be considered to be representative of all recreational fisheries. These values, therefore, should not simply be applied to a river reach where a fish advisory is under consideration. Rather, these values are meant to illustrate the relative value of certain types of fisheries and expenditures made on fishing in the US.

States may also want to develop their own approaches to estimating recreational fishing values, particularly where time and budget are limiting constraints. For example, the Arkansas Game and Fish Commission estimated the loss of fishing expenditures due to mercury-related fish consumption advisories based on decreases in fishing license purchases in counties where mercury advisories were issued. The decrease in licenses was multiplied by the average number of trips an angler takes per year, and by the average per-trip expenditures (EPA, 1994b).

States should also keep in mind that recreational fishers may have alternative sites that they would visit if a fish advisory were issued on a particular river reach. As such, the value assumed to be lost due to a fish advisory must be adjusted to account for the value (probably lower, or the fishers would be fishing there in the first place) of the substitute site. Similarly, anglers may just catch and release fish from waterbodies with advisories in effect, which would also have the effect of lowering the value of the fishing experience. Finally, states should consider the probability that some fishers may ignore the advisory, presumably resulting in increased health costs.

3.4.3 Subsistence Fishing and Food Costs

The impact of fish advisories to subsistence anglers may be more significant than to recreational anglers due to higher fishing days and consumption rates. This value, however, is not captured in the available recreational or commercial fisheries data. Because subsistence fishers and their families may rely on the fish they catch as their primary protein source, states should consider the cost to subsistence fishers and their families to switch to a more expensive protein source. As a rough approximation, states will need to estimate an average cost difference between fish and alternative protein sources and apply this difference to an estimate of kg/day consumed per person. In addition, states should consider the extent to which nutritional value is simply lost if substitute foods are not purchased.

3.4.4 Costs Associated with Property Values

Society places a premium on certain amenities associated with property (e.g. size of lot, proximity to waterfront, scenic views, etc) evidenced by price differentials among properties with varying degrees of these amenities. Where an amenity is

degraded, landowners are likely to experience a reduction in their property value. As such, owners of land adjacent to waterbodies where fish advisories are in effect may experience a decline in property value. One common approach to evaluating the impact of changes in a particular attribute to total value is the hedonic price technique. This technique is a method for estimating the implicit price of the characteristics differentiating closely related products in a product class. Hedonic pricing is based on the observation that a market good can be represented as a bundle of characteristics that describe the good; for example, a house can be described in terms of lot size, square footage of the house, number of rooms, proximity to an amenity such as waterfront, and any other number of features. In principle, if there are enough models with different combinations of features, an implicit price relationship can be estimated giving the price of any model as a function of its various characteristics. For example, by observing how the selling price of the house varies with, say, proximity to waterfront, the implicit value of proximity to waterfront can be determined (Freeman, 1979). If the quality of the water in a waterbody is degraded to the point where a fish advisory is issued, the implicit value of the proximity to waterfront variable is expected to decrease[3].

States should consider this cost as part of the total cost when establishing fish advisories. States may want to describe potential rather than quantified impacts to property values, however, since using the hedonic price technique requires detailed time series and cross-sectional data on property values and attributes and regression analysis.

3.4.5 Benefits Associated with Health Advisories

Although fish advisories will create costs, they may result in monetary benefits in the form of reduced adverse health effects to society. As such, it is important for agencies to consider both potential costs and benefits when issuing fish advisories. Consumption of contaminated fish can cause health problems, particularly for sensitive subpopulations. For example, infants are more susceptible to certain pollutants, (e.g., mercury, lead) than adults. In addition, populations that consume more fish than the general population (e.g., sport fishers, subsistence fishers, and their families) may be at greater risk. Establishing fish advisories should therefore reduce these adverse health effects; however, this has not been scientifically established. States should also keep in mind that, to the extent that these groups are not aware of fishing advisories or are unwilling to observe them, the benefits of issuing a fish advisory may be minimized.

[3] Other effects that influence changes in total value would have to be addressed in any analysis undertaken by states.

Cost of Illness Approach

To estimate the benefits of fish advisories, risk managers should first consider the economic impact of adverse health effects. Where adverse health effects are avoided due to a fish advisory, this impact can then be considered a benefit of the fish advisory. There are two methods for measuring the economic value of health effects. One, the "cost-of-illness" (COI) approach, measures the effects of illness that are directly observed in the marketplace, such as lost wages and medical costs. To use COI, states would have to collect data on the number of individuals, by subpopulation, expected to require a particular type of medical care, the medical cost of each treatment scenario, and the expected lost wages per affected individual. For an example of the COI approach, states can refer to an EPA document titled *The Medical Costs of Five Illnesses Related to Exposure to Pollutants* (EPA, 1992d).

Willingness to Pay Approach

The second approach measures the total value of health effects by estimating an individual's willingness-to-pay (WTP) to avoid them. The WTP approach should include the cost of illness, but also includes other less tangible costs such as pain and suffering. This approach provides a more complete estimate of the economic value of health effects than does the COI approach, but it is more difficult to use because costs such as pain and suffering are not valued in the marketplace. Two methods can be used to measure WTP. In the first, the contingent valuation (CV) method, surveys are conducted to elicit people's willingness to pay to avoid a particular health effect such as cancer. In the second, information available on the monetary tradeoffs people make between income and health risks is used. For example, people in occupations with a higher risk of death than other occupations generally command a higher wage, all other factors being equal. Similarly, people pay for items such as car air bags that reduce the risk of death. Dividing the wage premium for a risky job, or the cost of risk-reducing products, by the change in risk yields an estimate of the "value of a statistical life." This value represents an aggregation of small changes in risk across a population, rather than the value of the life of a particular individual (EPA, 1994b).

Life Valuation

The literature on the value of a statistical life is well developed. Based on a survey of this literature, values can range from $2 million to $10 million (1992 dollars) (EPA, 1989; Violette and Chestnut, 1983, 1986). These values, however, will be useful to states only in cases where fish advisories are expected to avoid fatal effects (such as cancer) associated with the consumption of contaminated fish.

Where fatal effects are possible, an estimate can be made of the number of deaths expected.

Illness Valuation

Some limited information is available on the value of nonfatal effects like nonfatal injuries, bronchitis, hospital visits, and respiratory symptom days. These effects, however, may not be relevant to the types of health effects typical of fish consumption. Other effects, such as decreased IQ can result in costs to society and other opportunity costs that states may choose to incorporate into their assessments. States interested in pursuing either the COI or WTP approach should contact the Office of Water at EPA Headquarters in Washington, D.C., as well as economics departments at state universities for further assistance.

3.5 Legal and Treaty Rights

The legal and treaty rights of individuals and groups with respect to land and activities can have a direct bearing on the authority of agencies to act regarding fish contamination. Interference or alteration of these rights may also be a significant consideration when evaluating program impacts. To the extent possible, fish advisory programs should be designed to minimize negative impacts on the rights of both the populations at risk and any other persons who have rights with respect to the waterbodies and land under consideration. Consequently, legal and treaty rights must be evaluated and interpreted when developing fish advisory programs. More detailed information on the legal aspects of this issue are beyond the scope of this document. State, federal, local, and tribal laws may govern in this area and it may be advisable to obtain legal counsel when such issues arise.

3.6. Summary

Numerous impacts of fish advisory programs on individuals, communities and local economies are possible. A brief overview of some categories of these impacts has been provided in this section. Risk managers and policy makers are encouraged to discuss various options for controlling fish consumption with community members and leaders to obtain a comprehensive understanding of the impacts likely to occur as a result of the options under consideration. This type of information gathering will also be an opportunity to discuss various aspects of risk and fish contamination. Such discussions provide a mechanism for educating both policy makers and community members regarding the issues surrounding fish contamination problems and potential resolutions. Readers are encouraged to review Volume IV: Risk

Communication regarding various aspects of communicating risks to the public.

The various fish advisory options, discussed in Section 2, have varying potentials for impacting community relations, tourism, property values, individual actions, traditional practices, and health. The extent of these impacts will depend on specific characteristics of the populations affected by fish advisories and the nature of the fish advisory program. Consequently, local information, combined with specific plans regarding fish advisories, are needed to evaluate the relative advantages and disadvantages of various options. Table 3-3 provides a template for entering information regarding impacts of limiting consumption. This template is similar to the one provided in Section 2, allowing risk managers to enter critical information to be used to compare various options. The options discussed in this section are all listed in the template; however, the risk manager may choose to consider only some of these options or may add other others which are not listed.

Risk managers may elect to enter some indicator of impacts in the various cells (e.g., low, moderate, high), estimated costs (where applicable), number of people affected, or some other method of indicating the magnitude of an impact. The type of information entered will depend on what data is available and what would prove most useful to the decision-making process. Although information is not likely to be available on the costing of benefits resulting from reduced illness associated with contaminant exposure, the column is provided for the reader's convenience.

Table 3-3. Template for the Impacts of Risk Management Options

Risk Management Options		Nutrition	Cultural Impacts		Economic Impacts			Benefits of Health Advisories[4]
			Traditional Activities	Dietary Patterns	Recreational Fishing & Tourism	Subsistence Fishing & Food Costs	Property Values	
No action								
Fish consumption advisory	General guidance							
	Quantitative Guidance							
Catch and release	Voluntary							
	Mandatory							
Fishing ban	Voluntary							
	Mandatory							

[4] Benefits are associated with reduced risks. These can be determined from risk assessment results (see Table 2-9) and from associated health information provided in Volume II. Entries may consist of quantitative information, such as the number of people who will not be at risk as a result of a program, or qualitative indicators of effects. Risk managers may also want to add a column for corresponding reductions in the benefits of fish consumption (as discussed at the beginning of this section).

SECTION 4.

DECISION-MAKING REGARDING FISH ADVISORY OPTIONS

4.1. Overview

This section contains a discussion of methods for comparing the characteristics of various management options to select the most appropriate options and levels of protection based on program goals, available resources, and local conditions. A discussion of both data organization and decision-making, as well as one of qualitative comparisons of risk, organizational features, and impacts are presented. Also addressed are decisions required for program design. The focus of this section is on qualitative comparisons among options, although the use of quantitative information is encouraged. Many factors, such as cultural and other social impacts, cannot be quantified, or easily compared to quantitative risk or economic data.

Templates are provided that can be used by risk managers to organize information on option characteristics. These templates utilize information discussed in other sections of this volume (e.g., risk levels, options). Issues related to prioritizing impacts are discussed along with methods for program evaluation and modification.

4.2. Qualitative Comparisons of Health Risks and Options Impacts

The information discussed in other sections and volumes should be used to evaluate overall advantages and disadvantages of various program options. The information includes:

- organizational impacts including feasibility and efficacy (Section 2),
- societal impacts including nutritional, cultural, and economic impacts (Section 3), and
- population risk characterization (Supplement B in Volume II).

The information can also be used to prioritize activities. It is suggested that the planning and evaluations for fish advisories be carried out on a site-specific basis whenever feasible. As discussed previously, local population characteristics and impacts on local traditions and economies may vary considerably from one area to another.

Various types of information are required for decision-making. Some may be of a quantitative nature (e.g., risks associated with current consumption patterns, the estimated costs of various program activities, staffing requirements, impacts on property values). The quantitative values may be best estimates; however, this type of predictive information often contains significant uncertainty and should be considered accordingly. Most information collected for a fish advisory program will likely be of a qualitative nature (e.g., potential cultural impacts on targeted populations, nutritional impacts).

Some form of risk characterization is also assumed to have been generated, although it may not be precise and should be considered a rough estimate even when detailed analyses have been carried out. (Risk characterization is discussed in Supplement B.) Federal risk assessment methods were designed primarily to provide a means to establish exposure limits (e.g., for drinking water standards) and generate protective rather than predictive estimates. Consequently, the risk estimates should be considered an indication of maximum risk rather than a precise predictor of actual risk. As discussed previously, risk reduction through implementation of fish advisory programs are characterized as "benefits" for purposes of discussing advantages and disadvantages of various options. Benefits are those cases or people who would have been affected that were not affected as a result of reductions in their consumption of contaminated fish.

A wide variety of risk management options have been considered in this document. The selection of which options to consider for inclusion in a fish advisory program is a critical decision. Risk managers may have wide latitude in establishing fish advisory programs or they may be operating under a specific set of constraints regarding their options for reducing fish-related risks. Restricting access to waterbodies or banning fishing may not be an option in areas where no regulatory authority is held by the overseeing fish contamination problems. (In most areas, however, the health department will have authority to restrict access in cases where a clear and present danger to the public exists.)

Significant constraints on program options may also be imposed by budgetary or other conditions. Because the options have differing potentials for reducing risk, restricting options may affect a program's risk reduction potential significantly. The full spectrum of risk management options should be considered prior to selecting

a particular subset of activities. This approach enables risk managers to review the advantages and disadvantages of all possibilities with other interested parties, so that the final decisions may be considered objective and fully thought through.

Table 4-1 provides a template for organizing information on the various impacts, resource needs, and benefits of program options. This template provides only a small amount of space for information entry in any category. Indicators of effect may be used instead of long narrative descriptions; alternatively, risk managers may use this template as a model to modify according to their needs. Information should be organized by water body and/or targeted population. One set of data could be generated for each subpopulation, allowing decisions to be made more easily on a site-specific basis. This method is recommended because the characteristics of each group may differ.

Restriction of fish consumption involves tradeoffs with respect to health, recreation, economics, community and traditional activities, and personal interests and other perceived benefits of fish consumption. Risk managers are encouraged to consider all risks and impacts in some way; however, managers may elect to focus on one or a few of the potential risks or impacts. The types of options and the degree of restrictiveness than a fish advisory program recommends will depend, in part, on the way in which various population groups and their risks are evaluated and upon the impacts considered most important. Decisions regarding how risks and impacts are prioritized and balanced will have a pronounced effect on fish advisory programs. Involvement of all affected parties in the evaluation and decision-making process is highly recommended.

4.3. Selection of Options

Risk managers, in concert with other policy makers, scientific and health advisors, and community members, will recommend the most appropriate options for dealing with fish contamination. In large programs, such as state programs, an array of options may be chosen corresponding to specific

Table 4-1. Information Summary on Organizational Factors, Impacts and Benefits: Template[1]

Risk Management Options	Feasibility			Efficacy		Nutrition	Cultural Impacts		Economic Impacts	Health Benefits	
	Staff	Funds	Reg. Auth.	Education	Risk Reduction		Traditional Activities	Diet		Non-Cancer	Cancer
No action											
Fish advisories											
General											
Quantitative											
Catch and release											
Voluntary											
Mandatory											
Fish ban											
Voluntary											
Mandatory											

[1] This template is for entry of information in any form which is useful to risk managers. This may be descriptive or quantal information, such as high, medium and low, or quantitative information such as number of staff required, costs of programs, etc. It is not anticipated that governing bodies will have detailed information on all categories included; however, this template may be used to organize the inforamtion which has been collected.

contamination characteristics, risk, targeted populations, and resources. It is assumed in this document that most decisions will involve the use of general or quantitative fish advisories in areas where contamination is known to exist at levels posing significant population risks. As discussed in Section 2, however, determining what level of risk is significant is an agency decision, and will affect the scope and nature of fish advisory programs.

The selection of appropriate fish advisory options is obviously a critical decision (as defined in Section 1) in program development. While this appears to be the most important decision, it usually will be based upon information gathered regarding individual or community risk levels and characteristics. This information, in turn is dependent on previous decisions regarding consumption rates, sampling and analysis, risk value selection, target population identification, evaluation of non-fish exposures, and consideration of impacts. These factors have been discussed in previous sections of this document and are summarized in Table 1-1. Because all previous decisions contribute to the basis for option selection and determination of protection levels, it is suggested that risk managers review these initial decisions prior to making the final decisions discussed in this chapter.

It is useful to evaluate whether previous decisions were health conservative or not; whether they took into account all or some of the population; whether they focused on average, high end, or bounding exposure and risk values; and other factors. Such information can be used when evaluating options and advisory levels to arrive at appropriate choices. If conservative assumptions were used in previous decisions, there may be less concern that compliance with advisories be strictly adhered to. Alternatively, if average values were used and sensitive populations were not targeted, non-compliance with advisories could have significantly greater adverse effects.

In selecting specific fish advisory options, risk managers may want to consider carefully which strategies are likely to be most effective for the populations which are to be served. This group is typically made up of several populations near various waterbodies and may require separate evaluation of each case. Information on the likelihood that a group will benefit from a particular approach can be inferred from the data collected on cultural, economic, and nutritional impacts. In addition, any other anecdotal or local information with a bearing on this type of decision should be considered. Such decisions are not necessarily based solely on objective data, and may require a familiarity with and sensitivity to the targeted population.

Practical considerations regarding sample quantitation limits are also relevant. Some contaminants may not be quantifiable at levels which are as low as those

indicated as optimal by health risk data. For example, quantifying the concentrations may not be possible at levels yielding a cancer risk of one in one million. This practical constraint may be important in establishing a realistic advisory. In some cases it may necessitate the acceptance of a higher level of risk than would be chosen based solely on health considerations. Flexibility in the program design will allow for modifications in advisories over time in keeping with more sensitive assays likely to be developed in the future.

Risk managers may elect to base option selection largely on risk. An example of this type of approach follows:

- A governing body could elect to take no action when cancer risks were less than one in one million and the concentrations were significantly less than the RfDs for non-carcinogens.

- General advisories could be developed when cancer risk levels were in the range of one in one hundred thousand to one in one million and the RfDs were not exceeded but were approached.

- Quantitative advisories could be developed for carcinogens with risk levels greater than one in ten thousand but less than one in one thousand and when the RfDs were exceeded by a factor of up to ten.

- Fishing bans and/or catch and release programs (either voluntary or involuntary) could be used when cancer risks exceeded on in one thousand and RfDs were exceeded by a factor greater than 10.

This tiered approach provides a spectrum of activities to deal with negligible to serious risks. This is only an example; risk managers may decide to structure their programs quite differently. Decisions should be made in the context of previous decisions and include considerations of whether previous decisions were sufficiently health conservative. As discussed throughout this document, decisions should also take into consideration the characteristics and needs of local affected communities.

The tiered approach is an overall strategy that may be applicable to all areas within a governing body's jurisdiction. It is risk-based and its application to specific waterbodies and populations requires risk information. Consequently, risk calculations may be carried out (see Supplement B in Volume II) requiring contamination data, consumption patterns, risk values, and body weight data. Table 4-2 provides a template that risk managers may use to organize

Table 4-2. Tiered Approach to Fish Advisories	
Risk Level	Option
Cancer	
Non-Cancer	
Other Considerations	

information for a tiered approach to risk reduction. Note that both cancer risk and non-cancer risk entry cells are provided. The advantages and disadvantages of selecting various values for the parameters used in this table are discussed throughout this text.

This approach is especially sensitive to decisions regarding consumption patterns and risk values. Contamination data are obtained through sampling and so not subject to alterations. Body weight data, while important, will usually not alter final results significantly. For example, the use of a 60 kg body weight for women will result in an "allowable" level of contamination which is only 15 percent lower than that for a 70 kg man. Approaches based on children's body weights may have a more substantial impact. Consumption patterns may vary widely within and among populations. The rate of 6.5 g per day is less than one tenth that observed in many studies of subsistence fishers, some of whom consume considerably more than 100 grams per day. For example, a recently completed study in the Great Lakes found that the average fisher consumed 360 grams per day (GLIFWC, 1994). Selecting a consumption rate is therefore a critical factor in establishing where fish advisories are needed and the nature of the advisory programs. It may be advisable to develop criteria based on different consumption rates for populations with widely varying consumption patterns.

Risk values are also a critical parameter in making decisions regarding advisory programs. Supplement B discusses the importance of selecting an appropriate health endpoint (e.g., developmental, systemic, non-carcinogenic) and its potentially significant impact on the level of contamination considered to pose unacceptable risks. As the discussions of individual chemical contaminants in Volume II demonstrate, many contaminants are associated with numerous different types of toxicity that may be exhibited at different levels of exposure. Recent developmental toxicity, neurotoxicity, or immunotoxicity data may indicate that risk occurs at lower levels of exposure than those indicated by previous liver and kidney toxicity studies. (The organ that is most sensitive will vary by chemical.) The use of the most sensitive endpoint will result in a more conservative approach to health protection.

Carcinogenic toxicity has in the past often yielded the most health-conservative exposure limits, especially when coupled with a low level of "acceptable" risk such as one in one million. Decision-makers may elect to choose a non-cancer health endpoint or a less stringent level of acceptable risk. For some chemicals there may be alternatives to choose from regarding risk endpoints and values varying by

orders of magnitude. The decisions will affect the scope and nature of a fish advisory program and the level of protection afforded the public substantially. Careful consideration of the advantages and disadvantages of the decisions regarding risk parameters is strongly encouraged.

Table 4-2 contains separate entry areas for other considerations that decision-makers may feel are important. These may include specific concerns regarding special sensitivities or types of effects that risk managers may feel justify an alternative approach. An example of this might be when new toxicity data become available. Under these circumstances, risk assessors may provide a new analysis that is used in developing fish advisories. An example is provided by mercury, which has been carefully evaluated by some states and subsequently stringent guidance was developed. Evidence of mercury toxicity is provided in human studies and causes serious effects in offspring of exposed women and exposed infants, as discussed in Volume II. These factors have led some risk managers to approach this chemical more aggressively than other contaminants. Risk managers may also elect to address other developmental toxins with greater conservatism due to concerns regarding exposures of pregnant women. Significant toxicity data gaps, the existence of known highly sensitive individuals in a population, or other predisposing factors such as poor nutritional status may lead risk managers to vary their options selections.

4.4. Levels of Protection

When fish advisories are considered necessary, risk managers will determine the level of protection in a fish advisory to be afforded targeted populations. Risk managers may choose from various risk values (e.g., RfDs and cancer potencies, locally generated values) to establish consumption limits. These values will result in consumption limits varying by orders of magnitude, especially when cancer-based and non-cancer-based values are compared. In addition, targeted "acceptable" risk levels are used in setting limits for carcinogens. Decisions regarding risk values can have a substantial impact on consumption limitation policies and on potential risks to the population.
This is discussed in some detail in Supplement B of Volume II.

The consumption limits, listed in Volume II, provide different levels of protection from carcinogenic risk, ranging from one in ten thousand to one in one million upper bound lifetime likelihood of cancer. Consumption limits corresponding to these different risk levels in risk multiples of 10 are provided; however, the methodology to calculate consumption limits for other risk levels is also described, and can be used when appropriate. Cancer risks are evaluated based upon an assumed

relationship between exposure and lifetime risk as defined in the cancer potency values for each target analyte. Risk managers determine what level of risk is acceptable (e.g., one in ten thousand, one in one million), which enables them to identify a particular exposure level as acceptable. The acceptable level of risk can be determined by the needs and goals of the target population, the decision-makers, other affected parties, or, under ideal circumstances, by joint discussions between the various impacted groups and agency staff.

Consumption limits based on non-carcinogenic effects typically use an RfD or other benchmark approach to determine a "safe" exposure level. The potential for non-carcinogenic effects can be evaluated by comparing exposures quantitatively to a Reference Dose (RfD) or some other benchmark of a "safe" exposure level (Supplement B in Volume II). Volume II provides the RfDs developed by EPA, along with a summary of toxicological information for the 23 target analytes. It also includes discussions of recent study results for most analytes regarding developmental, neurological and other types of toxicity. As discussed in Volume II, risk assessors may elect to use the EPA RfDs or review of the toxicological literature and develop their own exposure limits, based upon which values they consider most appropriate for their target populations. In some cases, more than one value may be selected for various subgroups of the population (e.g., children, women of reproductive age).

Table 4-3 provides a template to be used to list the selected values for contaminants in a particular waterbody, or which are of concern to a particular population. If a population fishes from more than one waterbody it may be advisable to include all chemical exposures in one evaluation so that similarly acting chemicals can be identified. The template includes entry areas for a variety of population subgroups and for various body weights of children. Risk managers may decide to refine their advisories to this level, or may determine that one general advisory is sufficient.

Consumption limits are provided in Volume II and offer various options from which to choose. Consumption limits for children are based on one body weight in Volume II; however, methods for calculating consumption limits for other body weights are also provided in that volume. Adult consumption limits are based on a 70 kilogram body weight for the general population and for women. Risk assessors and managers may determine that their female population of reproductive age has a different average body weight, or that a lower than average body weight should be used to provide a more health conservative values. Methods for calculating new consumption limits (or modifying the limits provided in the tables listed in Volume II) are also provided.

Table 4-3. Template for the Summary of Advisory Levels

Contaminant	General Advisory	Basis	Women's Advisory	Basis	Children's Advisory			Basis	Other	Basis
					Body Weight	Body Weight	Body Weight			

Decisions regarding the establishment of fish intake limit levels are at the discretion of the agency issuing fish advisories. The federal agencies, including EPA and FDA, who provide information and support in this area, do not have regulatory authority over non-commercial fish. Agencies are encouraged to establish limits which are most appropriate for their target populations in the context of local needs and characteristics.

4.5. Level of Program Effort and Funding

As discussed in Section 2, programs utilizing similar options (e.g. quantitative fish advisories) may differ substantially due to differing levels of effort and funding. Financial constraints may be moderate or severe, depending on the financial circumstances of the agency. These constraints affect the manner in which options can be implemented and may be a consideration in selection of an option as discussed in Section 2. The level of program effort and funding is a critical decision which is often beyond the scope of the risk manager. Risk managers may wish to maximize the available resources through cooperative activities with other agencies carrying out similar work, community groups with similar goals, or health or environmental organizations having similar interests (this is briefly discussed in Section 3).

Discussions of organizational structures and staffing for fish advisory programs are beyond the scope of this document. There are numerous public management guidebooks, however, providing information on effective and efficient management structures and program design that could maximize the effectiveness of a fish advisory program regardless of its size (Gawthrop,1984; Koteen, 1989; Bryson, 1988 and 1992; Frederickson, 1980; Vasu, 1990; Campbell, 1988; Gilbert, 1983; Association for Public Policy Analysis and Management, 1982; Carr, 1990). Readers are urged to consult these sources, as well as states and other groups that have set up fish advisory programs, to identify approaches that can be used to meet their goals using available resources.

A significant consideration in evaluating the type of fish advisory program that can be set up using a particular resource allocation is the overall population to be served. This population is typically made up of several sub-populations near various waterbodies, that may have different consumption patterns, risks, and likelihood of compliance with advisories. Within the constraints imposed by available resources, risk managers must determine which groups are in the greatest need of services and how those groups will best be served. Moderate services may be provided to a larger number of groups, or especially high-risk groups may be targeted for intensive efforts. The utilization of all types of information previously

discussed in this document may be helpful in determining the best approach to this type of resource allocation problem. Consultation with affected parties is also encouraged, because they may have strategies for accessing other resources to address program goals.

4.6. Program Evaluation and Modification

When a fish advisory program is being designed or modified, risk managers may want to consider inclusion of a component that involves program evaluation and modification. These activities are often not considered in the initial planning of a program, but an efficacy review in a program can help managers determine how effective it is (who it is reaching, whether their behavior has changed, whether the target population wants additional information, etc) and how the program might be altered to better address its goals. This type of activity can be carried out informally through contacting local participants and members of the targeted population routinely, or may be more formally designed to sample effectiveness randomly through surveys or some other means.

Incorporating flexibility into fish advisory programs is important so that necessary modifications can be made both in the initial design and over time as needs change. The decision to include these elements in a program design is one the risk managers should consider carefully to provide for the long-range success of a fish advisory program. The decision to include these components in a fish advisory program is considered critical because it may have a substantial impact on a program's long-term success.

4.7. Summary

This section has provided methods for organizing and considering information regarding risk, organizational issues, and impacts of fish advisory options. Risk managers and others involved in the decision-making process may need to utilize information from a variety of sources to gain an overall sense of who needs to be served by fish advisory programs and how to best design a program. As with any public undertaking, all problems and issues cannot be anticipated. Consequently, program flexibility is necessary to ensure long-term effectiveness. By broadly considering the characteristics of the target populations, however, risk managers will be better able to design programs appropriately (this is also addressed in

Volume IV: Risk Communication). When decisions are made and programs are designed with participation from representatives of targeted populations, valuable insights into the community are gained and the opportunities for a successful program are increased.

The Agency recognizes that there is much valuable information that can be obtained through the experiences of people in the field who are working on the development of fish advisory programs. EPA welcomes contributions from these people. Future versions of this document will benefit from information which readers submit.

SECTION 5

LITERATURE CITED [1]

Anderson, L., M. Dibble, H. Mitchell, and H. Rynbergen. 1972. *Nutrition in Nursing.* Philadelphia, PA: Lippincott Co.

Arm, J.P., C.E. Horton, B.W. Spur, J-M. Mencia-Huerta, and T.H. Lee. 1989. The effects of dietary supplementation with fish oil lipids on the airways response to inhaled allergen in bronchial asthma. *Amer Rev Resp Dis,* Vol. 139(6).

Armbruster, G., Saunders, and Hayes. 1989. Effects of trimming and cooking by several methods on polychlorinated biphenyls (PCB) residues in bluefish. *J. Food Safety,* Vol.9.

Association for Public Policy Analysis and Management. 1982. *Research in Public Policy Analysis and Management*, Vol. 1-3.

Bero, Kathy. 1994. Lake Michigan Federation, Milwaukee, WI office. Personal communication with Abt Associates, May 24.

Bryson, J. 1988. *Strategic Planning for Public and Nonpublic Organizations*. San Francisco, CA: Jossey-Bass.

Bryson, J. 1992. *Leadership for the Common Good. Tackling Public Problems in a Shared-Power World*. San Francisco, CA: Jossey-Bass

Burr, J.L., J.F. Gilbert, R.M. Holliday, P.C. Elwood, A.M. Fehily, S. Rogers, P.M. Sweetnam, and N.M. Deadman. 1989. Effects of Changes in Fat, Fish, and Fibre Intakes on Death and Myocardial Reinfarction: Diet and Reinfarction Trial (DART). *The Lancet,* September 30.

[1] Article titles were not usually available for citations obtained from HSDB; consequently, page number, were included for those citations (only).

Campbell, C. and Peters, B. 1988. *Organizing Governance, Governing Organizations*. Pittsburgh, PA: University of Pittsburgh.

Carlson, G. 1994. Comments on Volume II of this series from the Missouri Department of Health, April 22.

Carr. D. 1991. *Excellence in Government: Total Quality Management in the 1990s*. Virginia: Cooper & Lybrand.

Columbia River Inter-Tribal Fish Commission. 1994. Summary of preliminary results, *A Fish Consumption Survey of the Umatilla, Nez Perce, Yakima and Warm Springs Tribes of the Columbia River Basin.*

Coombs, G. 1994. State of Washington, Department of Ecology. Personal communication with Abt Associates, September 21.

Cung, Josee. 1994. Minnesota Department of Natural Resources, South East Asian Outreach Project. Personal communication with Abt Associates, July 28.

Dattilo, A.M. 1992. Effects of omega-3 fatty acids on cardiovascular health. *J Cardiopul Rehab,* Vol. 12.

Dellenbarger, L., A. Schupp, and B. Kanjilal. 1993. *Seafood Consumption in Coastal Louisiana.* Louisiana Department of Environmental Quality.

Dellinger, J.A. 1994. School of Preventive Medicine, Medical College of Wisconsin. Personal Communication with Abt Associates, September 9.

Dolecek, T.A. and G. Grandits, 1991. Dietary polyunsaturated fatty acids and mortality in the Multiple Risk Factor Intervention Trial (MRFIT). *World Rev Nut and Diet,* Vol. 66. [Cited in Kromhout, 1993.]

Frederickson, G. 1980. *New Public Administration*. Montgomery, AL: University of Alabama Press.

Freeman, A. nd. *The Benefits of Environmental Improvement: Theory and Practice.* Cambridge, MA: John Hopkins University Press for Resources for the Future.

Gawthrop, L. 1984. *Public Sector Management, Systems and Ethics*. Bloomington, IN: Indiana University Press.

Gilbert, C., ed. 1983. *Implementing Governmental Change*. Beverly Hills, CA: Sage Publications.

Great Lakes Indian Fish and Wildlife Commission (GLIFWC). 1994. *Final Report on the 1993 Survey of Tribal Spearers: Mercury Concerns.* Odanah, WI: GLIFWC, April 20.

Habicht, H.F. Deputy Administrator, EPA. 1992. Memorandum: Guidance on Risk Characterization for Risk Managers and Risk Assessors, Washington, D.C.

Honstead, J.F., T.M. Beetle, and J.K. Soldat. 1971. *A Statistical Study of the Habits of Local Fishermen and Its Application to Evaluation of Environmental Dose.* Richland, WA: Battelle Pacific Northwest Laboratories. [Cited in Rupp, E. et al., 1980.]

Hudson River Sloop Clearwater (HRSC). 1993. *Survey of Urban Subsistence Fishers along the Hudson River.*

Humphrey, H.E.B. 1976. Cited in Michigan Sport Angles Fish Consumption Survey. Ann Arbor, MI: University of Michigan School of Natural Resources.

Javitz, H. 1980. *Seafood Consumption Data Analysis: Final Report.* EPA, SRI International, September 24.

Jensen, T., S. Stender, K. Goldstein, G. Holmer, and T. Deckert. 1989. Partial normalization by dietary cod-liver oil of increased microvascular albumin leakage in patients with insulin-dependent diabetes and albuminuria. *New Eng J of Med,* Vol. 321(23).

Johnson, Hazel. 1994. People for Community Development, Chicago, Ill. Personal communication with Abt Associates, May 3.

Kimbrough, R.D. 1991. Consumption of fish: benefits and perceived risk. *J of Tox and Env Health*, Vol. 33.

Kmiecik, N. 1994. Great Lakes Indian Fish and Wildlife Commission. Personal communication with Abt Associates, July 28, August 12.

Knapp, H.R. and G.A. Fitzgerald. 1989. The antihypertensive effects of fish oil. *New Eng J of Med*, Vol. 320(16).

Koteen, J. 1989. *Strategic Management in Public and Nonprofit Organizations*. New York, NY: Praeger.

Kromhout, D., E.B. Bosschieter, and C.dL. Coulander. 1985. The inverse relation between fish consumption and 20-year mortality from coronary heart disease. *New Eng J of Med*, Vol. 312(19).

Kromhout, D. 1993. Epidemiological aspects of fish in the diet. *Proc of Nutr Soc,* Vol. 52.

McVeigh, G. 1990. Arthritris and diet: a new look. *Prevention,* Vol. 42(10).

Minnesota Department of Health. 1992. *Minnesota Fish Consumption Advisory.* Minneapolis, MN, May.

Missouri Department of Health. 1993. Department of Health Releases Fish Consumption Advisory. News Release, May 19.

Missouri Department of Health. 1992. *1992 Fish Consumption Advisory* and associated press release. Jefferson City, MO, May.

National Academy of Sciences (NAS). 1983. *Risk Assessment in the Federal Government: Managing the Process.* Washington, D.C.: Committee on the Institutional Means for Assessment of Risks to Public Health, Commission on Life Sciences, National Research Council.

National Academy of Sciences (NAS). 1993. *Pesticides in the Diets of Infants and Children.* Committee on Pesticides in the Diets of Infants and Children, Board on Agriculture and Board on Environmental Studies and Toxicology, Commission on Life Sciences. Washington, D.C.: National Academy Press.

National Research Council (NRC). 1989. *Recommended Dietary Allowances. 10th Edition.* Washington, D.C.: National Academy Press.

New York State Deparment of Environmental Conservation (NY DEC). 1985. *Final Environmental Impact Statement for Policy on Contaminants in Fish.* Albany NY: DEC, October.

Norell, S.E., A. Ahlbom, M. Feychting, and N.L. Pedersen, 1986. Fish consumption and mortality from heart disease. *Brit Med J,* Vol. 293. [Cited in Kromhout, 1993.]

North Dakota State Department of Health and Consolidated Laboratories. 1992. News Release, April 6.

Pestana, Edith. 1994. Connecticut Commissioner's Office of the Department of Environmental Protection, Section of Environmental Justice. Personal communication with Abt Associates, May 18.

Phillipson, B.E., D.W. Rothrock, W.E. Connor, W.S. Harris, and D.R. Illingworth. 1985. Reduction of plasma lipids, lipoproteins, and apoproteins by dietary fish oils in patients with hypertriglyceridemia. *New Eng J of Med,* Vol. 312(19).

Puffer, H. 1981. C*onsumption Rates of Potentially Hazardous Marine Fish Caught in the Metropolitan Los Angeles Area*. EPA Grant #R807 120010.

Rupp, Elizabeth, F.L. Miller, and C.F. Baes III. 1979. Some Results of Recent Surveys of Fish and Shellfish Consumption by Age and Region of U.S. Residents. *Health Physics,* Vol. 39.

Richter, B.S., and R. Rondinelli. 1989. *The Relationship of Human Levels of Lead and Cadmium to the Consumption of Fish Caught In and Around Lake Coeur d'Alene,* Idaho. Final Report, Technical Assistance to the Idaho State Health Department and the Indian Health Service, Boise, ID.

Shekelle, R., L. Missell, O. Paul, and A. MacMillan-Schryock, 1985. Fish consumption and mortality from coronary heart disease. *New Eng J of Med,* Vol. 313:820. [Cited in Kromhout, 1993.]

Shubat, P. 1993a. *Draft Health Risk Assessment for the Consumption of Sport Fish Contaminated with Mercury, PCBs and TCDD.* Minneapolis, MN: Minnesota Department of Health, January.

Shubat, P. 1993b. Minnesota Department of Health. Conversation with Abt Associates. August 25.

Simopoulos, A.P., 1991. Omega-3 fatty acids in health and disease and in growth and development. *Amer J of Clin Nutr,* Vol. 54.

Swartzman, D. et al., eds. 1982. *Cost Benefit Analysis and Environmental Regulations: Politics, Ethics, and Methods.* Washington, DC: The Conservation Foundation.

U.S. EPA. 1989. *Monetized health benefits of regulating sewage sludge use and disposal.* Final report prepared by Abt Associates Inc. for the Office of Policy Analysis and Office Water Regulations and Standards, EPA, Washington DC.

U.S. EPA. 1992a. Guidelines for exposure assessment. U.S. EPA, *Federal Register,* 57(104): 22888, Washington D.C.

U.S. EPA. 1992b *National Study of Chemical Residues in Fish, Volumes I and II.* U.S. EPA, Office of Science and Technology, EPA 823-R-92-008a, Washington, D.C.

U.S. EPA. 1992c. *Consumption Surveys for Fish and Shellfish: A Review and Analysis of Survey Methods.* U.S. EPA, Office of Water, Washington, D.C.

U.S. EPA. 1992d. *The medical costs of five illnesses related to exposure to pollutants.* Final report prepared by Abt Associates Inc. for the Office of Pollution Prevention and Toxics. U.S. EPA, Washington, DC.

U.S. EPA. 1993a. *Guidance for Assessing Chemical Contamination Data for Use in Fish Advisories, Volume 1: Fish Sampling and Analysis.* U.S. EPA, Office of Science and Technology, Washington, D.C.

U.S. EPA. 1993b. *Regulatory Impact Assessment of Proposed Effluent Guidelines and NESHAP for the Pulp, Paper, and Paperboard Industry.* Engineering and Analysis Division. U.S. EPA, Office of Air Quality Planning and Standards.

U.S. EPA. 1994a. *Guidance for Assessing Chemical Contamination Data for Use in Fish Advisories, Volume II: Risk Assessment and Fish Consumption Limits,* Prepared by Abt Associates for the U.S. EPA Office of Water, Washington D.C.

U.S. EPA. 1994b. *"Social Costs of Mercury Pollution (Draft),"* Office of Air Quality Planning and Standards, US EPA, Research Triangle Park, NC April 19.

U.S. EPA. 1994c. *Guidance for Assessing Chemical Contamination Data for Use in Fish Advisories, Volume II: Risk Communication*, U.S. EPA Office of Water, Washington D.C.

U.S. Fish and Wildlife Service (FWS). 1993. *National Survey of Fishing, Hunting, and Wildlife Associated Recreation.* Washington, D.C

Vasu, M. and Stewart, D., 1990. *Organizational Behavior and Public Management*. New York, NY: M. Dekker.

Vaughan, W.J., Russell, C.S. 1982. Valuing a fishing day: An application of a systematic varying parameter model. *Land Econ,* Vol. 58.

Violette, D.M. and L.G. Chestnut. 1986. *Valuing Risks: New Information on the Willingness to Pay for Changes in Fatal Risks.* Report to US EPA, Washington, DC.

Violette, D.M. and L.G. Chestnut. 1983. *Valuing Reductions in Risk: a Review of the Empirical Estimates. Environmental Benefits Analysis Series.* EPA #230-05-83-003. US EPA, Washington, DC.

Walker, D. 1994. University of Colorado, Boulder, Department of Cultural Anthropology. Personal communication with Abt Associates, September 24.

Watanabe, Anne. 1993, 1994. Columbia River Intertribal Commission. Conversation with Abt Associates, October 15, 1993; August 1, 1994; September 27, 1994.

West, Patrick, et al. 1993. *1991-92 Michigan Sport Anglers Fish Consumption Study.* Final Report to the Michigan Great Lakes Protection Fund, Michigan Department of Natural Resources, Lansing, Michigan.

West, Patrick, et al. 1989. *Michigan Sport Anglers Fish Consumption.* Natural Resource Sociology Research Lab Technical Report #2. Ann Arbor, MI: University of Michigan School of Natural Resources.

Willett, W.C., M.J. Stampfer, G.A. Colditz, B.A. Rossner, and F.E. Speizer. 1990. Relation of meat, fat, and fiber intake to the risk of colon cancer in a prospective study among women. *New Eng J of Med,* Vol.323(24).

Williams, Orrin. 1994. People for Community Recovery, Chicago, IL. Personal communication with Abt Associates, September 27.