

# SRI International



PB94109543



September 24, 1980

SEAFOOD CONSUMPTION DATA ANALYSIS

Final Report

Submitted by:

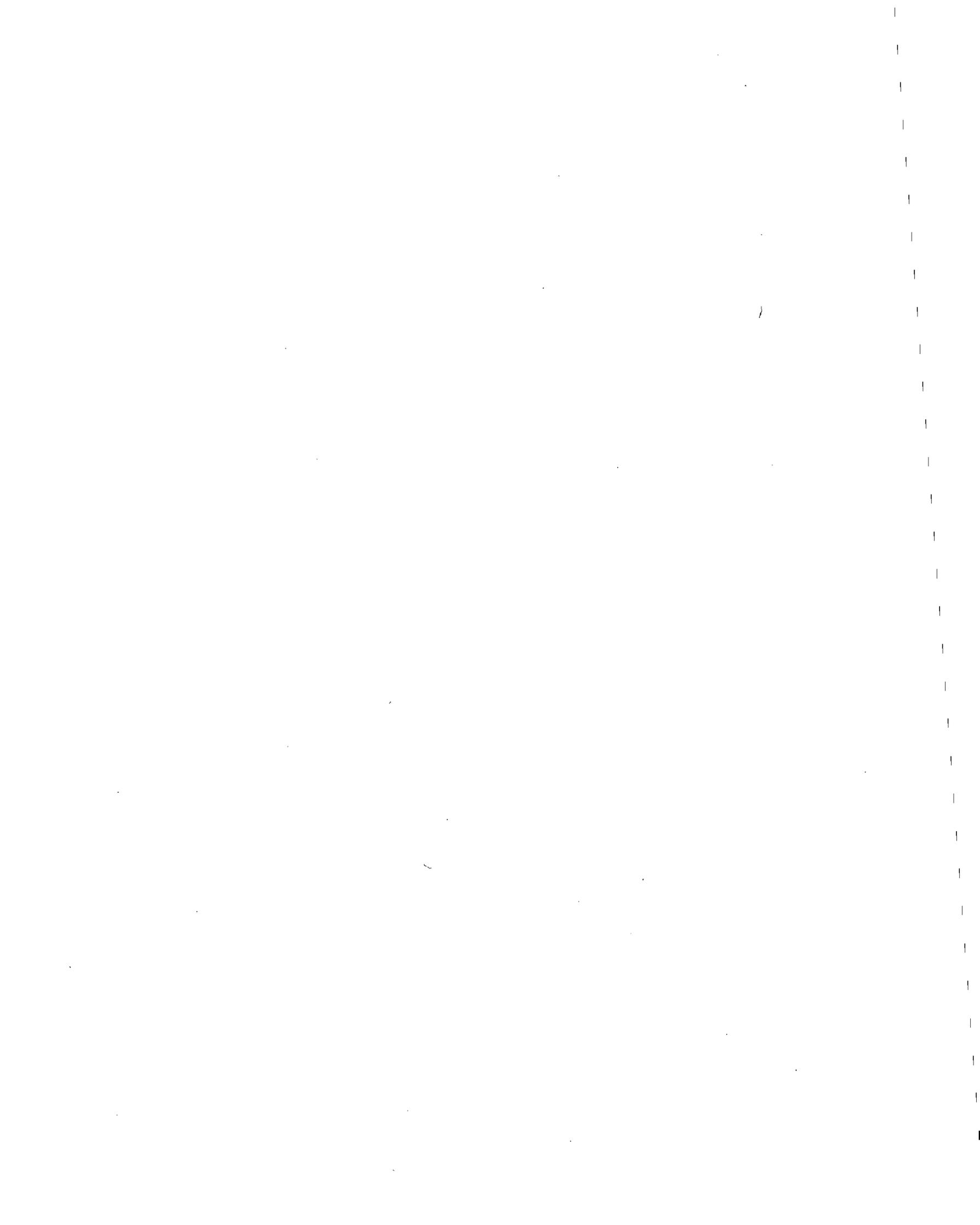
Harold Javitz  
Manager, Statistical Analysis Department

Prepared for:

Henry D. Kahn (WH-586)  
Environmental Protection Agency  
Office of Water Regulations and Standards  
401 M Street S. W.  
Washington, D.C. 20460

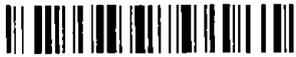
Task 11, EPA Contract 68-01-3887

Reproduced by:  
National Technical Information Service  
U. S. Department of Commerce  
Springfield, VA 22161



REPORT DOCUMENTATION PAGE

Form Approved  
 OMB No 0704 0188



PB94-109543

2. REPORT DATE  
 Sept. 1980

3. REPORT TYPE AND DATES COVERED

4. TITLE AND SUBTITLE  
 Seafood Consumption  
 Data Analysis

5. FUNDING NUMBERS

6. AUTHOR(S)

8. PERFORMING ORGANIZATION  
 REPORT NUMBER

7. AUTHOR(S) ORGANIZATION NAME(S) AND ADDRESS(ES)  
 U.S. Environmental Protection Agency  
 Office of Water  
 401 M St., SW  
 Washington, DC 20460

10. SPONSORING / MONITORING  
 AGENCY REPORT NUMBER

no number

12. DISTRIBUTION CODE

This report summarizes the findings of a literature search conducted by SRI International to identify sources of information on per capita fish consumption in the United States and an analysis of data tapes pertaining to a survey of fish consumption conducted by NPD Research.

seafood, fish, consumption

15. NUMBER OF PAGES

46

16. PRICE CODE

17. SECURITY CLASSIFICATION  
 OF REPORT

unclassified

18. SECURITY CLASSIFICATION  
 OF THIS PAGE

unclassified

19. SECURITY CLASSIFICATION  
 OF ABSTRACT

unclassified

20. LIMITATION OF ABSTRACT

unlimited

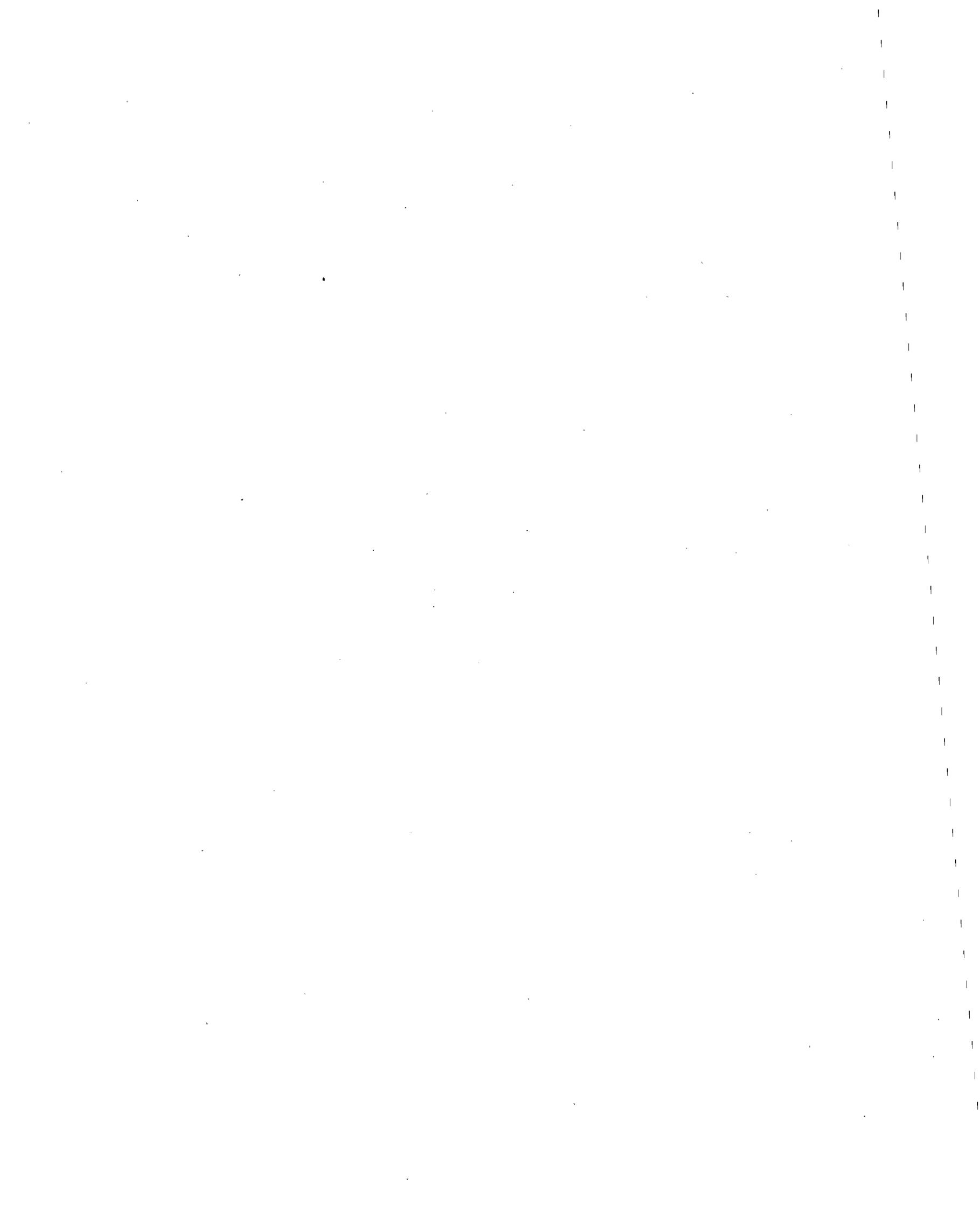
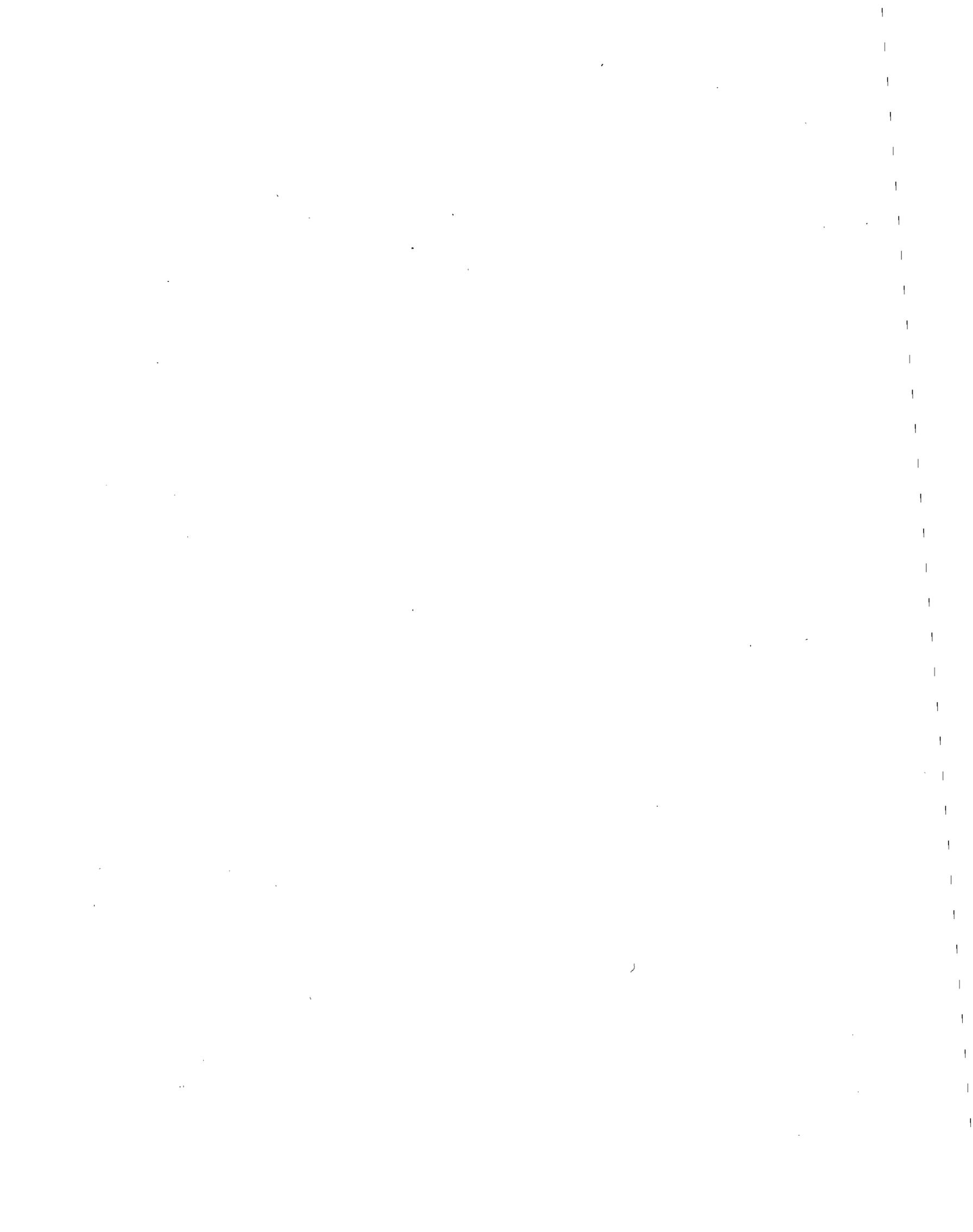


TABLE OF CONTENTS

I	Introduction . . . . .	1
II	Summary of Data Sources . . . . .	2
III	NMFS Balance Sheets on Commercially Caught Seafood . . . . .	3
IV	The USDA Food Consumption Surveys. . . . .	7
V	The 1969-1970 Market Facts Survey. . . . .	10
VI	Recreationally Caught Fish . . . . .	14
VII	The 1973-1974 NPD Fish Consumption Survey. . . . .	18
VIII	Conclusions . . . . .	35

APPENDICES

A.	Characterization of the NPD Sample of Fish Consumers . . . . .	41
----	--	----



## I INTRODUCTION

↙ The U.S. Environmental Protection Agency (EPA) is required by the Clean Water Act (as amended) and the June 1976 NRDC/EPA Settlement Agreement to set water quality criteria for 65 toxic priority pollutants. The effort to determine criteria requires the analysis of large quantities of data dealing with the effects of toxic substances on aquatic organisms and humans. To determine these criteria, it is necessary to quantify human exposure through fish<sup>2</sup> consumption and drinking water intake.<sup>3</sup>

Human exposure through fish consumption is a function of the bio-concentration factors of the different species and kinds of fish (e.g., saltwater pisces, freshwater pisces, crustaceans, and molluscs) and the quantities of these foods consumed in the United States. Estimates of fish consumption may be obtained directly from surveys of the food consumption of households and individuals, or indirectly by measurement of fish production (commercial and sport fishing), imports, and inventory changes.

This report summarizes the findings of

- A literature search conducted by SRI International to identify sources of information on per capita fish consumption in the United States; *and*
- An analysis of data tapes pertaining to a survey of fish consumption conducted by NPD Research.

In addition to referencing the sources of data on fish consumption, this report discusses the types of data available from each source, the per capita fish consumption estimates derived from the sources, and the apparent validity and usefulness of the data for quantifying human exposure to toxic substances through fish consumption.

\*Unless otherwise noted, the term "fish" is used throughout this report to refer to any animal living in freshwater or saltwater that can be classified as Pisces, Mollusca, or Crustacea. Amphibians, mammals and reptiles that dwell in the water are specifically excluded. The term "seafood" refers to any fish caught in saltwater.

## II SUMMARY OF DATA SOURCES

Four main sources of fish consumption statistics that were applicable to quantifying fish consumption in the United States emerged from the literature review:

- Balance sheets for commercially processed seafood computed by the National Marine Fisheries Service (NMFS).
- The 1965-1966 and 1977-1978 National Food Consumption Surveys conducted for the U.S. Department of Agriculture (USDA).
- A 1969-1970 survey of fish consumption conducted for the NMFS by Market Facts Inc.
- A 1973-1974 survey of fish consumption conducted for the Tuna Research Institute by NPD Research (formerly National Purchase Diary).

These sources were the only ones that met the minimum requirement of being statistically projectable to the U.S. population or sizable segments thereof.

The remaining chapters of this report are devoted to an examination of these four data sources and the problems in estimating the consumption of recreationally caught fish, as follows:

- Chapter III discusses the NMFS balance sheets
- Chapter IV discusses the USDA Food Consumption Surveys
- Chapter V discusses the Market Facts survey
- Chapter VI discusses the consumption of recreationally caught fish
- Chapter VII discusses the NPD survey and the results of tabulations performed by SRI on the NPD data.

Conclusions on the adequacy of current data to estimate fish consumption and the magnitude of fish consumption are presented in Chapter VIII. The demographic characteristics of the NPD sample of fish consumers is presented in Appendix A.

### III NMFS BALANCE SHEET ON COMMERCIALLY CAUGHT SEAFOOD

The most frequently cited source of seafood statistics is the balance sheet on commercially caught or processed seafood maintained by the National Marine Fisheries Service, National Oceanic and Atmospheric Administration, U.S. Department of Commerce. The NMFS issues Fishery Market News Reports tri-weekly, including data such as landings, ex-vessel auction prices, fish wholesale prices, market receipts, cold storage holdings, and imports. These data, as well as data on commercial fishery processing, canning, and curing are aggregated for the previous 24 months in the publication, Food Fish: Market Review and Outlook.

The preliminary data are corrected and all summary data are presented in the yearly Fisheries of the United States, which covers the prior 10 years at the minimum. Fishery Statistics of the United States is the final annual statistical digest on the nation's commercial fisheries and is more detailed than Fisheries of the United States.

In addition to the above-mentioned reports, the NMFS also publishes Shellfish Market Review, Food Fish Market Review, and Fish Meal and Oil Market Review. These reports, each published several times per year, provide descriptions and analyses of economic factors affecting fishery market products. There are reviews of market trends, both historical and recent, and an outlook for the near future. Statistical tables are presented for landings, production, imports, inventories, supplies, apparent consumption, and prices. Basic Economic Indicators are statistical reports that present demand indicators and projections, U.S. fishery-related employment, biological stock assessment, U.S. production and trade, and other economic indicators according to species.

### Per Capita Consumption Formula

In the NMFS balance sheets, per capita civilian consumption of commercial seafood during monthly and yearly periods is computed using the formula:

$$\text{Per capita consumption} = \frac{P + I + BI - E - MP - EI}{CP}$$

where

- P denotes U.S. production of seafood during the period
- I denotes imports of seafood during the period
- BI denotes U.S. seafood inventories at the beginning of the period
- E denotes U.S. exports during the period
- MP denotes military purchases of seafood during the period
- EI denotes U.S. seafood inventories at the end of the period
- CP denotes the U.S. civilian population size at the middle of the period (as measured by the U.S. Bureau of the Census).

All figures used in the formula are on an edible weight basis. Per capita consumption is available for fresh and frozen, canned, cured, and total seafood, as well as for selected species (fresh and frozen cod, flounder, haddock, halibut, ocean perch, and turbot; and canned salmon, sardines, and tuna).

### Methodology

Details of the methodology used by the NMFS to compile its balance sheet on seafood consumption are succinctly explained by the USDA (April 1972). Salient details are

- U.S. production includes Alaska and Hawaii since 1960.
- U.S. production of canned seafood includes Puerto Rico and American Samoa since 1954.
- Information on stocks of cured seafood have generally been inadequate, although the situation has improved over the years.
- The data are adjusted to eliminate duplication caused by domestic production of canned and cured products from fresh and frozen seafood (including imports).

### Limitations

There are a few major limitations and caveats to the use of the NMFS balance sheet statistics. First, the statistics refer only to consumption of marine fish entering commercial channels. Therefore the statistics do not include the consumption of freshwater fish (whether recreationally caught\* or commercially grown and harvested), recreationally caught saltwater fish, or commercially caught fish sold in roadside stands.

The exclusion of freshwater fish from the commercial catch statistics results in an underestimation of total commercial catch of approximately 2.2% (USDA, 1975). Also, when ex-vessel prices for fish are very low, commercial fishermen (particularly those harvesting shellfish) sometimes set up roadside stands and market directly to the public. Officials of the Resources Statistics Division of the NMFS have informed SRI in telephone conversations that in a year when the economy causes weak wholesale prices, 2% to 3% of the U.S. commercial catch may be sold outside of regular commercial channels.

Second, the statistics do not include any adjustment for spoilage or waste, either in transportation, retail storage, or in home storage and preparation.

Third, the statistics may only be used to estimate the average U.S. consumption of seafood. The data are not sufficiently detailed to estimate regional or statewide consumption, percentiles of consumption, or mean consumption by demographic factors.

Table 1 summarizes the U.S. per capita civilian consumption of seafood for the years 1960 through 1978, as cited in NMFS publication, Fisheries of the United States, 1978 (April 1979).

\*Under the category of recreationally caught fish we include legal and illegal catches, regardless of whether the primary motivation of the fisherman is recreation or supplementing the household food supply. Estimates of the consumption of recreationally caught fish are discussed in Chapter VI of this report.

Table 1  
 U.S. ANNUAL PER CAPITA CIVILIAN CONSUMPTION OF  
 COMMERCIALY PROCESSED SEAFOOD 1960 - 1978

<u>Year</u>	<u>Per Capita Consumption (edible lb./year)</u>			<u>Total</u>
	<u>Fresh and Frozen</u>	<u>Canned</u>	<u>Cured</u>	
1960	5.7	4.0	0.6	10.3
1961	5.9	4.3	0.5	10.7
1962	5.8	4.3	0.5	10.6
1963	5.8	4.4	0.5	10.7
1964	5.9	4.1	0.5	10.5
1965	6.0	4.3	0.5	10.8
1966	6.1	4.3	0.5	10.9
1967	5.8	4.3	0.5	10.6
1968	6.2	4.3	0.5	11.0
1969	6.6	4.2	0.4	11.2
1970	6.9	4.5	0.4	11.8
1971	6.7	4.3	0.5	11.5
1972	7.2	4.9	0.4	12.5
1973	7.5	5.0	0.4	12.9
1974	7.0	4.8	0.4	12.2
1975	7.6	4.3	0.4	12.3
1976*	8.2	4.3	0.5	13.0
1977*	7.8	4.6	0.4	12.8
1978*	7.9	5.0	0.5	13.4

\* Preliminary data subject to revision

Source: NMFS, Fisheries of the United States, 1978 (April 1979)

*10.67 22/11/80*

## VI THE USDA FOOD CONSUMPTION SURVEYS

Approximately once every 10 years the USDA conducts a survey of food consumption. The last two surveys were completed in 1965-1966 and 1977-1978, and the data from the 1965-1966 survey has been published (USDA, January 1972). The data from the 1977-1978 survey was not available when this report was written, but should be available by mid-1980.

### The 1977-1978 USDA Survey

In conversations with the USDA, SRI ascertained the general procedures of the 1977-1978 survey. The survey encompassed 15,000 households and was conducted over a 1-year period. The survey was nationwide; weights were computed to balance the sample against census-defined controls.

The survey method was semi-recall, i.e., households were asked to keep records (such as slips from grocery stores, notes on backs of envelopes) before the interview and were then asked about their food consumption on the previous 7 days. The household did not record food eaten outside the home. Because 7-day recall may be quite inaccurate, record keeping could be spotty, and meals eaten outside the home were not recorded, we do not believe that these data on household fish consumption will prove particularly useful.

On the other hand, more satisfactory data was gathered on individuals within the household. All of the individuals in the household who were less than 20 years of age or over 60 years of age and half of the individuals who were between 20 and 60 years of age were interviewed. The interview technique was part recall and part diary. On the day of the interview the individual was asked questions concerning the food that had been eaten on that day and on the preceding day. The interviewees then maintained a diary for the rest of the interview day and the following day. The survey of individuals ascertained how much food was eaten both inside and outside the home. When these data are available they will constitute the most up-to-date source of information on fish consumption.

### The 1965-1966 USDA Survey

The 1965-1966 USDA Survey encompassed approximately 15,000 households and 14,500 individuals. The household survey recorded "food available for consumption" including plate waste, food fed to pets, and inedible portions (e.g., head, shell, fins, tail) if brought into the kitchen. Meals away from home were counted but not described, and adjustments were made to account for food eaten away from home, assuming that food in an average meal eaten away was equivalent to food in an average meal at home. Household food consumption was recorded for 7 days using recall. For reasons previously described we do not believe the data on household fish consumption are particularly useful.

The individual survey was conducted only during April, May, and June of 1965. The recall method was used for the day (midnight to midnight) preceding the interview. Food intake recorded was food actually eaten both at home and away from home. The results of the individual survey are presented in Table 2. We caution that the sample size is rather small (approximately 500 person-months), and is not distributed uniformly over the year. In addition, fish in mixtures (e.g., stews, soups, salads, pot pies, and plate dinners) are not included in Table 2. Fish in mixtures was included by the USDA in a broader undifferentiated category of meat, poultry, and fish in mixtures.

Table 2  
 FISH CONSUMPTION ACCORDING TO  
 THE 1965 USDA SURVEY OF INDIVIDUALS

<u>Sex</u>	<u>Age (in years)</u>	<u>Average Quantity of Fish (in lb. per year)</u>
Male and Female	Under 1 year	0.0
	1 - 2	2.4
	3 - 5	4.0
	6 - 8	5.6
Male	9 - 11	6.4
	12 - 14	8.0
	15 - 17	8.0
	18 - 19	10.5
	20 - 34	11.3
	35 - 54	10.5
	55 - 64	14.5
	65 - 74	8.8
75 years and older	11.3	
Female	9 - 11	6.4
	12 - 14	6.4
	15 - 17	7.2
	18 - 19	7.2
	20 - 34	7.2
	35 - 54	10.5
	55 - 64	7.2
	65 - 74	6.4
75 years and older	7.2	

Source: USDA, January 1972

## V THE 1969-1970 MARKET FACTS SURVEY

### Sample and Types of Data

Commencing in February 1969, Market Facts Inc. of Chicago, Illinois, under contract to the NMFS, carried out a 1-year survey of fish consumption patterns of 1,586 U.S. households with a total of 4,864 persons. The participants were selected at random from a large panel designed to parallel census data for the United States with respect to population density, degree of urbanization, geographic region, household income, and age. The head of each household completed a diary of fish purchases twice monthly for 12 months. These diaries reported purchases of fish products by item and weight, numbers of fish meals eaten away from home by item, and the number of meals consumed at home prepared from sport fish by species.\* Data on the fish consumption of the individual members of the family were not available; individual consumption was estimated by dividing the total household consumption by the number of household members.

### Uses of the Survey

Estimates of fish consumption were developed by NMFS using the Market Facts survey. Detailed breakdowns of mean fish consumption by various demographic variables and species can be found in two NMFS publications (Nash, April 1971; Miller and Nash, June 1971). Table 2, obtained from these sources, shows that total fish consumption was highest among Jews and Blacks.

The two NMFS publications do not explain in detail how the quantities of consumed fish were computed for consumer entries of fish combined with other ingredients (e.g., breaded fish sticks, clam chowder) or fish eaten away from home (e.g., seafood plate, fishburger). The comments and some

---

\*The NMFS publications are not consistent on whether the consumption estimates included gamefish. The article by Finch (1973) claims that gamefish consumption was accounted for; the 1978 NMFS publication Report on the Chance of U.S. Seafood Consumers Exceeding the Current Acceptable Daily Intake for Mercury and Recommended Regulatory Controls states that gamefish consumption was excluded.

of the tables in the NMFS publications lead us to believe that the weight of other ingredients may have been counted as fish and that an unsophisticated method of dealing with meals eaten away from home may have been employed. In addition, we do not know the sample sizes for the various classes of consumers in Table 3.

The Market Facts survey was later used by the NMFS in the MECCA project (Model for the Estimation of the Consumption of Contaminants from Aquatic Foods). In that project the levels of mercury in 52 kinds of fish were specified. The frequency distribution of human ingestion of mercury from fish was computed by 1) multiplying the level of mercury for each kind of fish by the prorated amount of that fish consumed by the individual, and 2) summing the mercury ingestion of the individual over the 52 kinds of fish. In the MECCA project, conversion factors were used to estimate fish consumption from the survey diary entries. For example, 13% of the canned weight of clam chowder and 50% of the frozen weight of breaded fish sticks were assumed to be seafood, and shrimp cocktails served at restaurants were assumed to contain 1.50 ounces of shrimp.

The methodology employed in the MECCA study appeared to be well suited to satisfying the EPA's objective of establishing water quality criteria that would safeguard human health, even though individual consumption was rather crudely calculated. Consequently we inquired as to the availability of the data. We were told that the data base was essentially irretrievable and that attempts a few years earlier to reconstruct the data base had failed. We were unable to locate any individual who thought that the data base could be salvaged.

Table 3

## FISH CONSUMPTION ESTIMATES FROM THE MARKET FACTS SURVEY

<u>Demographic Characteristics</u>	<u>Mean Per Capita Consumption (lb./year)</u>				
	<u>Fresh and Frozen Finfish</u>	<u>Canned Fish</u>	<u>Fresh and Frozen Shellfish</u>	<u>Specialty Items</u>	<u>Total Fish</u>
<b>Race</b>					
Black	11.426	7.544	3.003	1.081	23.054
White	3.947	5.163	1.731	1.423	12.264
Other	3.945	5.245	5.800	1.110	16.100
Not specified	1.851	2.907	0.821	1.750	7.329
<b>Religion</b>					
Catholic	3.981	5.280	2.193	1.607	13.061
Jewish	10.087	10.081	2.230	4.856	27.254
Protestant	4.142	5.105	1.662	1.413	12.322
Other	5.959	4.851	2.846	1.794	15.450
Not specified	0.705	1.435	0.405	0.615	3.160
<b>Income per capita</b>					
Under \$1,000	4.605	4.836	0.820	0.709	10.970
\$1,000 - \$1,999	4.375	5.125	1.784	1.284	12.568
\$2,000 - \$2,499	2.823	4.178	0.975	1.253	9.229
\$2,500 - \$2,999	4.723	5.662	2.455	1.183	14.023
\$3,000 - \$3,499	4.791	4.613	1.949	1.669	13.022
\$3,500 and over	3.892	5.030	2.030	1.706	12.658
<b>Occupation</b>					
Professional and semiprofessional	3.419	3.719	1.311	0.988	9.437
Proprietors, managers	3.521	4.903	1.612	1.393	11.429
Clerical and sales	4.432	5.515	2.266	1.846	14.059
Craftsmen, foremen	3.760	5.199	1.970	1.353	12.282
Head operatives	3.946	4.149	1.335	0.724	10.154
Others	6.535	7.745	2.159	1.990	18.429

Table 3 (Concluded)

<u>Demographic Characteristics</u>	<u>Mean Per Capita Consumption (lb./year)</u>				
	<u>Fresh and Frozen Finfish</u>	<u>Canned Fish</u>	<u>Fresh and Frozen Shellfish</u>	<u>Specialty Items</u>	<u>Total Fish</u>
<u>Education</u>					
Less than 4 years high school	5.833	7.244	2.102	1.629	16.808
Less than 4 years college	6.999	5.135	1.916	1.545	15.595
College graduate	3.676	3.975	1.558	1.109	10.318
Not specified	5.015	3.924	0.648	1.263	10.850
<u>Region</u>					
New England	5.802	5.677	4.164	1.966	17.609
Middle Atlantic	4.648	5.657	2.031	1.958	14.294
East North Central	3.506	4.168	1.193	1.177	10.044
West North Central	2.454	4.159	0.631	0.638	7.882
South Atlantic	5.375	5.293	2.197	1.355	14.220
East South Central	7.491	6.778	1.911	1.057	17.237
West South Central	8.630	5.513	1.634	0.778	16.555
Mountain	3.712	6.545	2.201	1.781	14.239
Pacific	4.433	5.926	1.712	1.887	13.958
<u>Total per capita</u>	4.922	5.318	1.819	1.420	13.479

---

Source: Nash, 1971

## VI RECREATIONALLY CAUGHT FISH

There appears to be general agreement in the published literature that a substantial portion of the total U.S. fish consumption is obtained from recreationally caught fish. However, the statistics on this source of fish are poorly documented, scanty, and generally not well suited to estimating consumption. For example, most of the literature concerns data such as the number of recreational fisherman, days spent fishing, and pounds of fish eggs and fingerlings distributed to streams and lakes.

Potentially the best source of data on the consumption of recreationally caught fish is the NPD survey (discussed in Chapter VII). However the NMFS removed all information concerning whether consumed fish were commercially or recreationally caught in their data-cleaning operation. Consequently, use of the NPD data to estimate the consumption of recreationally caught fish would involve retrieval of the original NPD data tapes and a painstaking reconstruction of the NMFS data-cleaning decision process.

### Unsubstantiated Estimates of the Consumption of Recreationally Caught Fish

In a supplement to Agricultural Economic Report #138, the USDA (1976) estimates the yearly consumption of fish from 1960-1976, including "game fish." In the same document the USDA presents the NMFS balance sheet data for marine commercial fisheries. Presumably the difference between these two consumption figures represents the consumption of recreationally caught fish. It is not clear whether the total fish consumption includes commercially grown and harvested freshwater fish (e.g., trout, channel catfish, and crayfish) or commercially caught fish sold in roadside stands. If so, then the fish consumption from recreationally caught fish would be overestimated. The method used by the USDA to derive the yearly consumption estimates is not documented.

The fish consumption estimates are presented in Table 4. These figures generally agree with a footnote on page 75 of the Fisheries of the United States (1978) stating that per capita consumption of recreationally caught fish since 1970 is estimated to be between 3 and 4 pounds of edible meat per year.

Table 4  
ESTIMATED YEARLY FISH CONSUMPTION PER CAPITA

Year	Total Fish Consumption Including Game Fish <sup>a</sup>	Fish Consumption From Marine Commercial Fisheries <sup>b</sup>	Fish Consumption From Recreationally Caught Fish <sup>c</sup>
1960	13.7	10.3	3.4
1961	14.0	10.7	3.3
1962	13.8	10.6	3.2
1963	14.0	10.7	3.3
1964	13.8	10.5	3.3
1965	14.2	10.8	3.4
1966	14.4	10.9	3.5
1967	14.2	10.6	3.6
1968	14.8	11.0	3.8
1969	15.1	11.2	3.9
1970	15.8	11.8	4.0
1971	15.6	11.5	4.1
1972	16.6	12.5	4.1
1973	17.1	12.9	4.2
1974	16.4	12.2	4.2
1975	16.5	12.2 <sup>e</sup>	4.3
1976 <sup>d</sup>	17.2	12.9 <sup>e</sup>	4.3

<sup>a</sup> Per capita consumption, "retail weight equivalent"

<sup>d</sup> Preliminary

<sup>b</sup> From NMFS balance sheet data

<sup>e</sup> Revised at later date by NMFS; see Table 1 for corrected consumption estimates.

<sup>c</sup> Obtained by subtraction

Source: USDA, "Agriculture Economic Report #138," 1976

### NMFS Surveys of Recreationally Caught Fish

In Fisheries of the United States (1978), the NMFS summarizes the results of 1960, 1965, and 1970 NMFS saltwater angling surveys conducted through the Bureau of the Census as supplements to the national surveys of fishing and hunting. However, these surveys were not entirely satisfactory—recreational catches of shell fish were not included, the 1-year recall period introduced memory bias, Hawaii was not included, and only the round weight of fish caught (rather than the edible weight brought ashore) was estimated. Recreational catches of finfish for 1960, 1965, and 1970 were estimated to be 1.380, 1.474 and 1.577 billion pounds respectively.

The document also summarizes the results of a 1974 regional survey of the Northeastern Coastal U.S. and a 1975 regional survey of the South Atlantic and Gulf states. Those regional surveys overcame many of the previous methodological deficiencies. A detailed questionnaire was sent to respondents every 2 months and statistics on recreationally caught shellfish were gathered. Finfish and shellfish were measured on a round weight basis (including shells). The NMFS was not completely content with the methodology utilized, however, and contracted a private firm to develop an improved questionnaire and sampling scheme.

On November 1, 1978, NMFS began a new 1-year Marine Recreational Fisheries Survey using the revised methodology. Results from the survey are scheduled to be available in early 1980. Although the Pacific Coast states of California, Oregon, and Washington are not included in the survey, a 1-year survey on the Pacific Coast was scheduled to begin in July 1979. A series of annual surveys of saltwater marine (but not freshwater) recreational fisheries is planned.

## VII THE 1973-1974 NPD FISH CONSUMPTION SURVEY

The most reliable source of data on human fish consumption appears to be the survey conducted during 1973 and 1974 by NPD Research Inc., a market research and consulting firm that specializes in the analysis of consumer purchasing behavior as recorded in monthly diaries. That survey was funded by the Tuna Research Institute (TRI) as part of a study of tuna consumption.

Later, the National Marine Fisheries Service (NMFS) received permission from TRI to obtain the data. The data were used in a paper titled "Human Exposure to Polychlorinated Biphenyls and Polybrominated Biphenyls," by F. Cordle, et. al. (1978), in which it was reported that the average U.S. resident consumed 18.7 grams per day of fish. This figure was cited by the EPA in their "Water Quality Criteria Request for Comments" appearing in the March 15, 1979 edition of the Federal Register.

After the date of the data calculations for the Cordle paper, the NMFS and personnel from the FDA, USDA, and TRI conducted an intensive effort to identify and correct errors in the NPD data base. Substantial numbers of errors were found, which invalidated the consumption figures presented in Cordle's paper. A corrected data base was employed by the NMFS in a report on the chance of U.S. seafood customers exceeding the acceptable daily intake for mercury. However, that report provided estimate of mercury intake rather than fish consumption. Under EPA directive, SRI obtained a copy of the cleaned data base and performed the data tabulations necessary to estimate human fish consumption.\*

### Description of the NPD Survey

The NPD survey was conducted from September 1973 through August 1974. The sample comprised 6980 families who were participating in NPD's syndicated national purchase diary panel, 2400 additional families

\*SRI gratefully acknowledges the assistance of Mrs. Betty Hackley of the NMFS in securing a copy of the NPD data tape and in providing information concerning the survey.

where the female head was under 35, and 210 additional Black families. The national panel is recruited and maintained in order to be approximately representative of the U.S. population over a number of census-defined controls (state within census region, in/out of Standard Metropolitan Statistical Areas (SMSA), family size, income, presence and age of children, race, and age of housewife). The additional families were drawn from NPD's 35 local test markets and were not geographically balanced. Out of the 9,590 families sampled, approximately 7,662 families (25,165 individuals) completed the questionnaire. This constitutes an 80% response rate, which is usually considered to be acceptable in sample surveys. To provide a projectable sample, the respondents were weighted on the following demographic characteristics:

- Census region (New England, Middle Atlantic, East North Central, West North Central, South Atlantic, East South Central, West South Central, Mountain, and Pacific).
- Household size (2, 3-4, 5 and over).\*
- Age of housewife (under 35, 35-44, 45-54, 55 and over).
- Income (under \$5,000, \$5,000-\$7,999, \$8,000-\$19,999, \$20,000 and over).
- Market size (out of SMSA, SMSA under 1 million, SMSA between 1.0 and 2.5 million, SMSA over 2.5 million).

The usage questionnaire was administered to one-twelfth of the sample during each of the 12 months of the survey. The usage questionnaire appears to have gathered all of the relevant data required to estimate fish consumption. Each family was identified by a number that has been cross-referenced to a demographic tape including the following information:

---

\* The apparent exclusion from the sample of households with only one member constitutes a possible source of bias.

income, census division, SMSA size, race, age, sex and relationship of household members, and employment status, age, marital status, and education of female and male heads.

In the usage survey the family recorded the date of any meal containing fish, the type of fish (species), the packaging of the fish (canned, frozen, fresh, dried, or smoked, or eaten out), whether fresh fish was recreationally caught or commercially purchased, the amount of fish prepared for the meal\*, the number of servings consumed by each family member and any guests, and the amount of fish not consumed during the meal. Meals eaten both at home and away from home were recorded.

The NPD survey appears to have been well conducted, although the level of documentation currently available is not sufficient to verify that assertion. We have only been able to obtain documentary fragments from NPD and NMFS—a page of the questionnaire apparently pasted up for presentation purposes, a list of the codes used on the data tapes, verbal explanations, recollections, etc. In particular, the documentation does not include a copy of the questionnaire, the procedures used to reduce the questionnaire responses to the NPD data tape format, and the conversion factors used to calculate fish consumption from respondent entries (especially important with respect to breaded fish, canned fish, or fish mixed with other ingredients where the packaged weight will tend to overestimate the fish content).

#### Computer Processing of the NPD Data

One of the primary objectives of this study has been the calculation of statistics on fish consumption using the NPD data base. Early in the

---

\* For fresh fish, the weight was recorded in ounces and may have included the weight of the head and tail. For frozen fish, the weight was recorded in packaged ounces, and it was noted whether the fish was breaded or combined with other ingredients (e.g., TV dinners). For canned fish, the weight was recorded in packaged ounces and it was noted whether the fish was canned in water, oil, or with other ingredients (e.g., soups).

study, the EPA secured a tape of the NPD data base (NTIS #PB-283-726), prepared by the NMFS, and forwarded it to SRI for processing. The tape contained an I.D. for each individual panelist, the state of residence, sex and age, and an entry for each of 100 species (species type, average serving size in grams, and number of servings eaten in the month of survey).

Preliminary runs on this tape revealed substantial discrepancies with the documentation accompanying the tape and published results based upon the survey. We contacted the NMFS to attempt to resolve these discrepancies and were informed that the tape we had obtained contained many errors. A corrected version of the data tape was supplied to NTIS on approximately June 1978. We ordered the corrected tape from NTIS (#PB-294-725) and received it in January 1980. That data tape contained data only for fish consumers--the NMFS had deleted all individuals who did not consume fish in the month of the survey from the data tape.\* The NTIS tape contained data on 24,652 fish consumers who represent, on a weighted basis, 94.0% of all U.S. residents (according to a tabulation performed by NPD Research). A complete demographics tape was received from NPD Research in mid-February, 1980, after an earlier tape had been returned because it lacked sample weights. The corrected data tape from NTIS and the demographics tape from NPD were merged at SRI. The combined data base was used in the data tabulations presented in this section (which shows percentiles of monthly fish consumption for the U.S. population of fish consumers and for segments of that population as defined by various demographic variables).

#### Data Tabulations

The data tabulations that we performed included the calculation of the mean and the 95th percentile of monthly fish consumption for U.S. fish consumers (14.3 grams/day and 41.7 grams/day respectively) and for various segments of that population defined by demographic variables.

The tabulations (means, percentiles, and percentages) were performed on a weighted basis. In computing mean consumption, each person contributes to the mean in proportion to his assigned survey weight. For example, suppose that we have selected  $N$  respondents from the survey sample who have weights  $W_1, W_2, \dots, W_N$  and monthly fish consumption  $C_1, C_2, \dots, C_N$ . Here  $N$  may be all respondents, or all respondents who belong

---

\*We have been informed by NPD Research that demographic data on respondents who did not eat fish is irretrievable.

to a certain demographic category (e.g., females between 20 and 29 years of age). The mean fish consumption of these N respondents is computed using the formula

$$\text{mean consumption} = \frac{\sum_{i=1}^N W_i C_i}{\sum_{i=1}^N W_i}$$

If all of the weights  $W_i$  were equal, this formula would simplify to the usual unweighted mean

$$\frac{\sum_{i=1}^N C_i}{N}$$

However, the weights are generally unequal. One may consider the weight  $W_i$  as being the number of U.S. fish consumers represented by the i-th survey respondent and the sum of all of the weights as being the (average) number of U.S. fish consumers during 1973-1974. The mean consumption figures in this section of the report can be multiplied by 0.94 to extrapolate to the population of all U.S. residents.

The 95th percentile of fish consumption was also computed on a weighted basis, without invoking any distributional assumptions. For example, suppose that we have selected a subset of N respondents from the survey sample who have weights  $W_1, W_2, \dots, W_N$  and monthly fish consumption  $C_1, C_2, \dots, C_N$ , and further suppose that the individuals in the subset have been ordered so that  $C_1 \leq C_2 \leq \dots \leq C_N$ . The 95th percentile of fish consumption for these N respondents is defined as the consumption of that individual (say the j-th person) such that:

- (1) the sum of the weights of the individuals in the subset with consumption less than the j-th person is less than 95% of the total weight of the subset (e.g.,  $\sum_{i=1}^{j-1} W_i < (0.95) \sum_{i=1}^N W_i$ ).

- (2) the sum of the weights of the individuals in the subset with consumption no larger than the  $j$ -th person's is 95% or more of the total weight of the subset (e.g.,  $\sum_{i=1}^j W_i \geq (0.95) \sum_{i=1}^N W_i$ ).

We note that the 95th percentile of fish consumption among fish consumers corresponds to the 95.3 percentile of fish consumption among the entire population of fish consumers and nonconsumers.\*

Tables 5 through 12 display SRI's tabulations of fish consumption from the cleared NPD data base, as follows:

- Table 5 contains estimates of mean fish consumption and the 95th percentile of consumption for segments of the U.S. fish consuming population defined by race, sex, age, census region, community type, occupation of male head of household, education of male head of household, family size, and family income.
- Table 6 contains estimates of the percentage of females who consume specified amounts of fish (e.g., 0.0-5.0 grams/day, 5.1-10.0 grams/day, etc.). These percentages are calculated for respondents in 10-year age categories.
- Table 7 contains information for males corresponding to the information in Table 6.
- Table 8 contains mean fish consumption and the 95th percentile of consumption by sex and age category.
- Table 9 contains the mean consumption of fish by species-like categories.
- Tables 10 and 11 contain estimates of mean fish consumption and 95th percentile of consumption for females by age category and certain demographic variables (e.g., race, census region and community type). Tables 12 and 13 contain the corresponding information for males.

---

\*The 95.3 percent figure is derived as follows: Let  $x$  be the 95th percentile of fish consumption among fish consumers. Then 5 percent of the fish consumers eat more than  $x$  grams of fish per day. That is, for every 94 fish consumers there are  $(.05)(94)=4.7$  persons who eat more than  $x$  grams per day. According to the NPD survey, 94 percent of U.S. residents are fish consumers, so that there are 100 U.S. residents for every 94 fish consumers. Consequently 4.7 persons per 100 U.S. residents eat more than  $x$  grams per day. This implies that  $x$  is the 95.3 percentile of fish consumption among U.S. residents.

Table 5

## FISH CONSUMPTION BY DEMOGRAPHIC VARIABLES\*

<u>Demographic Category</u>	<u>Mean Consumption</u>	<u>Upper 95th Percentile</u>
<u>Race</u>		
Caucasian	14.2	41.2
Black	16.0	45.2
Oriental	21.0	67.3
Other	13.2	29.4
<u>Sex</u>		
Female	13.2	38.4
Male	15.6	44.8
<u>Age (years)</u>		
0- 9	6.2	16.5
10-19	10.1	26.8
20-29	14.5	38.3
30-39	15.8	42.9
40-49	17.4	48.1
50-59	20.9	53.4
60-69	21.7	55.4
70+	13.3	39.8
<u>Census Region</u>		
New England	16.3	46.5
Middle Atlantic	16.2	47.8
East North Central	12.9	36.9
West North Central	12.0	35.2
South Atlantic	15.2	44.1
East South Central	13.0	38.4
West South Central	14.4	43.6
Mountain	12.1	32.1
Pacific	14.2	39.6

\* The calculations in this table are based upon the respondents to the NPD survey who consumed fish in the month of the survey. The NPD Research estimates that these respondents represent, on a weighted basis, 94.0% of the population of U.S. residents.

Table 5 (continued)\*

<u>Demographic Category</u>		
<u>Community Type</u>	<u>Mean Consumption</u>	<u>Upper 95th Percentile</u>
Outside central city, 250K - 500K	12.2	32.1
Central city, 250K - 500K	14.1	40.5
Rural, non-SMSA	13.0	38.3
Central city, 2M or more	19.0	55.6
Outside central city, 2M or more	15.9	47.3
Central city, 1M - 2M	15.4	41.7
Outside central city, 1M - 2M	14.5	41.5
Central city, 500K - 1M	14.2	41.0
Outside central city, 500K - 1M	14.0	39.7
Central city, 50K - 250K	13.8	43.4
Outside central city, 50K - 250K	11.3	31.7
Other urban	13.5	39.2
 <u>Occupation of Male Head of Household</u>		
Retired, unemployed, military, student	16.7	46.7
Laborers	11.2	31.4
Farm foremen, laborers	12.7	43.4
Professionals	14.7	42.2
Proprietors, managers, officials	14.6	43.4
Clerical	14.6	42.5
Sales	14.7	41.7
Craftsmen, foremen (skilled)	13.1	37.7
Operative (semi-skilled)	12.4	37.4
Private household worker	10.7	19.3
Service workers	15.2	45.0
Farm owners, managers	13.3	33.8
 <u>Education of Male Head of Household</u>		
Grade school	15.4	47.4
Some high school	14.1	41.8
Graduated high school	13.7	39.6
Some college	14.6	41.7
Graduated college	14.6	42.2

\* The calculations in this table are based upon the respondents to the NPD survey who consumed fish in the month of the survey. The NPD Research estimates that these respondents represent, on a weighted basis, 94.0% of the population of U.S. residents.

Table 5 (concluded) \*

<u>Demographic Category</u>	<u>Mean Consumption</u>	<u>Upper 95th Percentile</u>
<u>Family Size</u>		
Two members	18.3	49.4
Three members	15.5	45.5
Four members	12.6	35.8
Five members	11.5	32.2
Six members	11.3	35.2
Seven members	12.1	38.2
Eight members	11.2	30.2
Nine members	12.5	36.5
Ten members	12.6	35.1
Eleven members	8.1	16.9
Twelve or more members	11.9	34.7
<u>Family Income</u>		
20K or more	16.7	49.0
15K - 19,999	15.1	41.6
13K - 14,999	14.0	40.7
12K - 12,999	14.3	42.2
11K - 11,999	13.1	38.0
10K - 10,999	13.7	38.3
9K - 9,999	12.9	36.9
8K - 8,999	13.9	40.7
7K - 7,999	12.6	39.5
5K - 6,999	13.2	38.4
3K - 4,999	14.5	44.6
under 3K	14.3	37.1

\* The calculations in this table are based upon the respondents to the NPD survey who consumed fish in the month of the survey. The NPD Research estimates that these respondents represent, on a weighted basis, 94.0% of the population of U.S. residents.

Table 6

## DISTRIBUTION OF FISH CONSUMPTION FOR FEMALES BY AGE\*

Age (years)	Consumption Category (gr/day)										
	0-5	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40-45	45-50	over
0-9	5.1	10.1	15.1	20.1	25.1	30.1	37.6	47.6	60.1	0.0	0.0
10-19	26.8	11.0	3.7	1.0	1.1	0.7	0.3	0.0	0.0	0.0	0.0
20-29	31.4	15.4	6.9	3.5	2.4	1.2	0.7	0.2	0.4	0.0	0.0
30-39	26.1	20.4	11.8	6.7	3.5	4.4	2.2	0.9	0.9	0.0	0.0
40-49	23.6	18.0	12.7	8.3	4.8	3.8	2.8	1.9	1.7	0.1	0.1
50-59	21.9	20.7	13.2	9.3	4.5	4.6	2.8	3.4	2.1	0.2	0.2
60-69	17.4	16.8	15.5	10.5	8.5	6.8	5.2	4.2	2.0	0.2	0.2
70+	16.9	20.6	15.9	9.1	9.2	6.0	6.1	2.4	2.1	0.2	0.2
Overall	22.1	12.3	9.7	5.2	2.9	2.6	1.2	0.8	1.2	0.1	0.1
	24.0	16.8	10.7	6.4	4.3	3.5	2.4	1.6	1.2	0.1	0.1

\*The percentage of females in an age bracket who consume, on average, a specified amount (grams) of fish per day.

The calculations in this table are based upon the respondents to the NPD survey who consumed fish in the month of the survey. The NPD Research estimates that these respondents represent, on a weighted basis, 94.0% of the population of U.S. residents.

Table 7

## DISTRIBUTION OF FISH CONSUMPTION FOR MALES BY AGE\*

Age (years)	Consumption Category (gr/day)											
	0-0	5.1	10.1	15.1	20.1	25.1	30.1	35.1	40.1	45.1	50.1	over
	-5.0	-10.0	-15.0	-20.0	-25.0	-30.0	-35.0	-40.0	-45.0	-50.0	-55.0	-60.0
0-9	52.1	30.1	11.9	3.1	1.2	0.6	0.7	0.1	0.1	0.2	0.1	0.0
10-19	27.8	29.3	19.0	10.4	6.0	3.2	1.7	1.7	1.7	0.4	0.5	0.0
20-29	16.7	22.9	19.6	14.5	8.8	6.2	4.4	3.1	3.1	1.9	1.9	0.1
30-39	16.6	21.2	19.2	13.2	9.5	7.3	5.2	3.2	3.2	2.4	2.2	0.0
40-49	11.9	22.3	18.6	14.7	8.4	8.5	5.3	5.2	5.2	3.3	1.7	0.1
50-59	9.9	15.2	15.4	14.4	10.4	9.7	8.7	7.6	7.6	4.3	4.1	0.2
60-69	7.4	15.0	15.6	12.8	11.4	8.5	9.9	8.3	8.3	5.5	5.5	0.2
70+	24.5	21.7	15.7	9.9	9.8	5.3	5.4	3.1	3.1	1.7	2.8	0.1
Overall	22.6	23.1	17.0	11.3	7.7	5.7	4.6	3.6	3.6	2.2	2.1	0.1

\* The percentage of males in an age bracket who consume, on average, a specified amount (grams) of fish per day.

The calculations in this table are based upon the respondents to the NPD survey who consumed fish in the month of the survey. The NPD Research estimates that these respondents represent, on a weighted basis, 94.0% of the population of U.S. residents.

Table 8  
 AVERAGE AND 95th PERCENTILE OF FISH  
 CONSUMPTION (GR/DAY) BY SEX AND AGE\*

	<u>All Fish</u>		
	<u>Age (years)</u>	<u>Mean</u>	Upper <u>95th Percentile</u>
Female	0 - 9	6.1	17.3
	10 - 19	9.0	25.0
	20 - 29	13.4	34.5
	30 - 39	14.9	41.8
	40 - 49	16.7	49.6
	50 - 59	19.5	50.1
	60 - 69	19.0	46.3
	70+	10.7	31.7
Male	0 - 9	6.3	15.8
	10 - 19	11.2	29.1
	20 - 29	16.1	43.7
	30 - 39	17.0	45.6
	40 - 49	18.2	47.7
	50 - 59	22.8	57.5
	60 - 69	24.4	61.1
	70+	15.8	45.7
Overall		14.3	41.7

---

\*The calculations in this table are based upon the respondents to the NPD survey who consumed fish in the month of the survey. The NPD Research estimates that these respondents represent, on a weighted basis, 94.0% of the population of U.S. residents.

Table 9

## MEAN FISH CONSUMPTION BY "SPECIES" \*

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

\*The calculations in this table are based upon the respondents to the NPD survey who consumed fish in the month of the survey. The NPD Research estimates that these respondents represent, on a weighted basis, 94.0% of the population of U.S. residents.

Table 10

## AVERAGE FISH CONSUMPTION (GR/DAY) FOR FEMALES\*

Demographic Category	Age (years)							
	0-9	10-19	20-29	30-39	40-49	50-59	60-69	70+
<b>Race</b>								
Caucasian	6.0	8.7	12.9	14.7	16.5	19.3	19.0	10.7
Black	8.5	10.9	20.7	16.5	20.5	24.4	19.5	12.9
Oriental	9.1	24.0	17.4	27.7	22.5	28.4	8.3	--
Other	8.4	11.7	14.2	26.3	10.9	22.5	17.3	6.8
<b>Census Region</b>								
New England	7.2	9.8	14.0	15.8	20.8	24.1	22.1	12.7
Middle Atlantic	6.2	10.0	14.0	17.3	18.7	21.7	22.9	11.2
East North Central	5.9	8.0	12.9	14.2	14.8	17.9	16.8	10.1
West North Central	5.0	7.5	12.0	13.6	13.8	16.8	17.2	8.9
South Atlantic	6.2	9.0	14.1	14.4	18.9	21.3	18.8	11.4
East South Central	6.1	7.8	13.4	13.7	15.2	15.5	19.4	12.4
West South Central	6.4	11.2	13.3	16.7	17.6	17.6	16.8	11.7
Mountain	5.9	9.0	12.9	13.1	13.3	15.3	15.8	12.1
Pacific	6.4	8.7	13.5	13.6	15.2	20.3	18.5	9.2
<b>Community Type</b>								
Outside Central City 250K-500K	5.2	8.6	12.1	14.0	20.5	14.8	17.0	8.9
Central City 250K-500K	7.0	7.0	12.6	15.6	13.3	21.9	18.0	11.2
Rural, non-SMSA	5.5	7.7	11.9	13.2	14.2	15.2	18.1	11.5
Central City, 2M or more	9.0	11.7	17.5	17.0	21.7	26.7	22.7	11.1
Outside Central City, 2M or more	6.8	11.4	16.3	16.9	20.1	20.4	18.5	10.4
Central City 1M-2M	6.8	9.3	13.5	17.0	16.8	24.6	23.7	12.1
Outside Central City 1M-2M	6.3	8.7	12.9	13.7	14.7	20.7	22.7	11.2
Central City 500K-1M	6.2	9.6	13.3	17.4	14.8	20.3	18.3	9.8
Outside Central City 500K-1M	6.2	9.2	13.2	14.3	18.6	20.0	18.9	9.9
Central City 50K-250K	5.5	7.5	14.9	16.3	16.1	15.3	18.4	9.7
Outside Central City 50K-250K	3.8	5.2	12.7	12.8	11.0	16.9	15.8	9.8
Other urban	5.9	8.7	12.4	13.7	15.3	17.9	17.4	10.8

\* The calculations in this table are based upon the respondents to the NPD survey who consumed fish in the month of the survey. The NPD Research estimates that these respondents represent, on a weighted basis, 94.0% of the population of U.S. residents.

Table 11

## 95TH PERCENTILE OF FISH CONSUMPTION (GR/DAY) FOR FEMALES \*

Demographic Category	Age (years)							
	0-9	10-19	20-29	30-39	40-49	50-59	60-69	70+
<b>Race</b>								
Caucasian	16.5	23.7	33.5	41.1	40.1	49.3	46.3	31.7
Black	23.4	29.2	55.6	44.4	53.3	55.1	38.5	24.9
Oriental	17.6	74.5	42.5	135.9	151.6	55.1	10.8	--
Other	19.6	35.9	56.7	119.6	24.6	26.5	17.3	15.4
<b>Census Region</b>								
New England	18.9	23.5	31.3	40.2	46.8	55.9	60.3	30.8
Middle Atlantic	15.2	27.2	34.2	54.2	50.2	54.4	62.3	39.3
East North Central	21.5	20.9	34.1	42.2	46.6	49.4	38.7	30.2
West North Central	12.4	21.6	34.3	36.8	39.5	46.0	39.1	25.0
South Atlantic	15.8	23.7	36.0	39.7	52.6	52.4	42.6	32.9
East South Central	15.3	20.0	33.1	35.2	43.9	38.4	48.7	26.5
West South Central	16.8	31.9	31.6	48.4	54.9	44.5	46.3	10.2
Mountain	18.8	25.9	37.6	30.8	34.1	50.1	42.8	41.6
Pacific	18.4	20.7	38.4	31.6	46.5	46.0	46.2	23.9
<b>Community Type</b>								
Outside Central City 250K-500K	13.5	23.1	31.9	28.1	89.1	36.4	41.8	25.1
Central City 250K-500K	19.1	19.0	34.9	40.8	46.1	58.9	46.3	38.4
Rural, non-SMSA	14.5	21.9	30.4	41.8	38.8	39.7	48.9	35.4
Central City, 2M or more	30.8	34.3	50.6	42.2	54.5	64.2	52.9	54.1
Outside Central City, 2M or more	17.5	31.3	41.8	48.6	61.5	50.3	46.1	33.6
Central City 1M-2M	20.6	25.3	32.5	53.6	40.5	52.5	50.2	34.1
Outside Central City 1M-2M	17.6	21.1	37.6	37.2	34.9	46.0	42.7	34.2
Central City 500K-1M	15.4	26.2	32.9	48.4	35.3	50.0	44.6	24.4
Outside Central City 500K-1M	18.5	23.0	33.8	41.1	50.8	56.2	64.6	30.2
Central City 50K-250K	14.5	21.8	36.2	53.7	44.5	43.1	38.7	30.8
Outside Central City 50K-250K	12.3	14.6	25.9	28.7	34.1	33.1	38.4	31.7
Other urban	17.2	26.7	33.1	35.2	46.6	48.6	48.7	30.5

\* The calculations in this table are based upon the respondents to the NPD survey who consumed fish in the month of the survey. The NPD Research estimates that these respondents represent, on a weighted basis, 94.0% of the population of U.S. residents.

Table 12

## AVERAGE FISH CONSUMPTION (GR/DAY) FOR MALES\*

Demographic Category	Age (years)							
	0-9	10-19	20-29	30-39	40-49	50-59	60-69	70+
<u>Race</u>								
Caucasian	6.1	11.1	15.8	16.9	17.9	22.7	24.3	15.8
Black	7.9	12.7	20.7	18.1	22.2	24.5	26.7	15.4
Oriental	13.8	12.9	17.0	24.8	34.0	24.6	46.3	20.8
Other	7.3	10.7	19.5	13.1	15.5	12.2	30.0	12.7
<u>Census Region</u>								
New England	6.3	13.7	18.6	17.4	19.9	27.3	32.7	17.4
Middle Atlantic	6.7	11.5	17.0	19.8	19.9	26.4	28.7	17.1
East North Central	6.3	10.1	14.2	14.7	15.1	20.3	21.6	16.0
West North Central	5.0	9.7	13.3	12.2	15.2	22.1	20.4	13.3
South Atlantic	6.3	11.4	16.6	18.5	21.1	22.3	25.4	17.5
East South Atlantic	7.1	8.2	16.0	14.7	15.2	17.3	23.7	14.9
West South Central	6.7	12.9	19.1	19.2	18.9	18.3	19.9	16.0
Mountain	5.3	11.4	14.4	15.4	15.4	18.5	17.3	13.3
Pacific	6.1	10.7	16.7	17.0	20.0	25.8	24.6	13.4
<u>Community Type</u>								
Outside Central City 250K-500K	5.1	8.0	13.5	13.1	16.8	18.6	19.5	14.0
Central City 250K-500K	6.1	12.0	13.7	18.9	15.4	23.5	27.6	15.3
Rural, non-SMSA	5.9	10.1	16.3	16.2	17.8	19.1	21.1	16.3
Central City, 2M or more	8.4	11.9	18.3	20.2	19.2	28.9	32.1	18.6
Outside Central City, 2M or more	6.7	12.1	16.2	17.9	19.8	24.6	25.4	15.9
Central City, 1M-2M	7.7	12.6	16.8	19.3	19.7	22.8	22.9	18.2
Outside Central City, 1M-2M	6.6	11.8	17.4	14.7	18.3	24.5	31.0	13.8
Central City 500K-1M	5.8	12.8	15.6	18.1	19.2	24.2	22.6	15.7
Outside Central City, 500K-1M	6.4	10.9	17.6	15.3	19.9	23.9	22.8	15.9
Central City, 50K-250K	5.1	10.0	15.0	19.0	22.7	17.6	23.3	13.2
Outside Central City, 50K-250K	5.6	9.7	12.2	13.2	11.9	17.4	20.6	14.3
Other urban	6.1	11.1	16.0	18.0	16.4	21.6	22.9	15.0

\* The calculations in this table are based upon the respondents to the NPD survey who consumed fish in the month of the survey. The NPD Research estimates that these respondents represent, on a weighted basis, 94.0% of the population of U.S. residents.

Table i3

## 95TH PERCENTILE OF FISH CONSUMPTION (GR/DAY) FOR MALES\*

Demographic Category	Age (years)							
	0-9	10-19	20-29	30-39	40-49	50-59	60-69	70+
<b>Race</b>								
Caucasian	15.2	28.8	39.9	45.6	46.6	55.6	61.1	45.3
Black	25.1	33.2	57.0	40.6	50.6	63.3	63.0	47.8
Oriental	52.8	40.2	37.7	108.9	171.6	67.3	82.2	49.0
Other	17.4	29.2	86.4	31.4	16.8	28.1	30.0	20.7
<b>Census Region</b>								
New England	12.7	41.2	55.9	47.6	54.6	57.8	75.3	60.2
Middle Atlantic	18.0	30.1	55.0	55.4	49.0	63.3	81.4	50.9
East North Central	16.5	25.3	35.7	34.8	35.4	48.0	60.9	46.9
West North Central	12.6	23.7	37.3	32.6	35.6	59.9	57.1	37.1
South Atlantic	15.4	29.6	37.8	48.2	57.6	58.4	59.7	44.6
East South Central	16.9	23.8	41.6	42.3	42.3	33.1	62.7	44.9
West South Central	21.3	39.2	50.7	48.6	52.0	54.1	57.3	45.2
Mountain	12.6	26.3	31.8	38.8	31.3	55.4	41.3	39.4
Pacific	14.9	26.0	42.7	39.3	49.4	60.2	56.4	45.7
<b>Community Type</b>								
Outside Central City, 250K-500K	14.2	20.9	45.0	35.5	44.1	36.5	52.4	35.0
Central City, 250K-500K	14.9	36.6	28.2	38.0	39.4	59.5	53.2	39.4
Rural, non-SMSA	13.8	24.9	45.0	50.1	47.6	56.9	53.8	48.5
Central City, 2M or more	35.3	29.1	64.7	48.1	49.0	74.1	82.6	55.8
Outside Central City, 2M or more	14.9	31.2	41.9	54.2	54.4	65.3	72.9	44.6
Central City, 1M-2M	25.1	31.3	41.5	53.3	48.5	52.1	57.6	42.2
Outside Central City, 1M-2M	18.3	28.9	46.7	36.7	42.5	60.2	64.7	38.6
Central City, 500K-1M	15.2	35.5	37.0	44.9	50.1	63.1	55.1	48.9
Outside Central City 500K-1M	16.4	27.7	51.2	36.2	57.7	57.7	51.2	48.2
Central City, 50K-250K	10.9	43.6	35.3	50.8	55.5	50.7	55.5	56.4
Outside Central City, 50K-250K	12.2	29.1	54.4	35.1	27.8	39.1	43.1	36.2
Other urban	15.2	25.9	39.2	48.0	42.1	48.9	63.0	49.9

\* The calculations in this table are based upon the respondents to the NPD survey who consumed fish in the month of the survey. The NPD Research estimates that these respondents represent, on a weighted basis, 94.0% of the population of U.S. residents.

## VIII CONCLUSIONS

This investigation of human fish consumption was motivated by the requirement that the EPA establish water quality criteria for 65 priority pollutants. To set these criteria, the EPA developed a methodology that considered the intake via fish and water consumption of the pollutants that were suspected of being carcinogenic. Consequently, it was necessary for the EPA to estimate human fish consumption. A mean fish consumption figure, which appeared in the Cordle paper (1978) and was derived from an NPD survey data base, was adopted by the EPA as an interim measure. This investigation was initiated to validate that estimate.

In this report we have discussed at some length the estimates of fish consumption that can be developed from the balance sheets for commercially processed fish computed by the NMFS, the National Food Consumption Surveys conducted for the USDA, the Market Facts Survey, and the NPD Survey.

The balance sheets computed by the NMFS were discussed in Section III. The balance sheets may only be used to estimate mean seafood consumption for the U.S. population. There are numerous shortcomings to the data: freshwater and recreationally caught fish are excluded, commercially caught fish sold in roadside stands are excluded, and there is no adjustment for spoilage or waste. The USDA combines the NMFS balance sheet data with their own unsubstantiated estimate of recreationally caught fish. The USDA estimates of fish consumption appear in Table 4. For the years 1973 through 1976, the estimates of average fish consumption are 21.2, 20.3, 20.4 and 21.3 grams/day respectively.

The USDA National Food Consumption Surveys were discussed in Section IV. The 1977-1978 survey promises to provide data on fish consumption, but the USDA data tabulations were not completed at the time of the preparation of this report. The results of the 1965 - 1966 survey concerning the fish consumption of individuals are presented in Table 2. That table presents average fish consumption by sex and age categories. We note, however, that these fish consumption figures may be underestimates for two reasons. First, the consumption figures do not include fish in mixtures. Second, fish consumption increased approximately 18% between 1965 - 1966 and 1975 - 1976. In addition, we caution that the sample size for this portion of the survey was rather small (500 person-months) and all interviews were conducted in April, May, and June of 1965, rather than over an entire year.

The 1969 - 1970 Market Facts survey was discussed in Section V. Although that survey is 10 years old and there is conflicting evidence concerning whether consumption estimates included gamefish, we believe that the survey results are quite useful in estimating mean consumption. Because individual consumption was obtained by dividing total household consumption by the number of household members, the Market Facts survey results should not be used to estimate percentiles of fish consumption, nor consumption by age and sex categories. Table 3 presents the results of that survey, with mean fish consumption broken down by demographic characteristics. We note that average fish consumption was computed to be 16.8 grams/day and that Jews and Blacks had significantly higher mean fish consumption figures of 33.9 grams/day and 28.7 grams/day, respectively. Unfortunately no further tabulations may be performed because the data base is no longer available.

The 1973 - 1974 NPD survey was discussed in Section VII. The data from the survey appear to be the best currently available. Data tabulations performed by SRI on the corrected data base are presented in Tables 5 through 13. Those tables contain information that pertains only to fish consumers. Average fish consumption was 14.3 grams/day for males and females combined, with an average fish consumption of 13.2 grams/day for females and 15.6 grams/day for males. Average fish consumption among females reached 19.5 grams/day in the 50 - 59 years age category and among males reached 24.4 grams/day in the 60 - 69 years age category. Average fish consumption was also high among Orientals (21.0 grams/day) and residents in central cities with populations of 2 million or more (19.0 grams/day).

Tables 5, 6, 7, 8, 11 and 12 identify either a 95th percentile of daily consumption or a distribution of daily consumption. The daily consumption of an individual is estimated in turn by dividing his total monthly consumption by thirty days.\* It is informative to examine whether the same or a larger or smaller 95th percentile of daily consumption would have been obtained if each respondent had recorded a longer time period (e.g. a number of years) of fish consumption data. We believe that the upper percentiles of daily fish consumption derived from one month of data per respondent would be larger than the upper percentiles of daily consumption derived from more than one month of data per respondent, for the following reasons:

- Monthly fish consumption in the U.S. is relatively low (according to the NPD survey results only 0.94 lbs. are consumed each month) so that the presence or absence of a few fish dinners can result in a large percentage difference.
- Fish consumption is seasonally influenced (especially for sports fishermen). Consequently individual consumption may vary substantially from month to month.

These reasons induce greater variability in a daily consumption distribution derived from a month of data per respondent than in a daily consumption distribution derived from more than one month of data per respondent. It follows that the upper percentiles of daily consumption based on one month of data per respondent will be conservative.

---

\*The NPD data records do not contain an identifier for the month in which the survey questionnaire was completed, requiring the use of a nominal number of days per month. If a researcher wishes to assume a different nominal number of days per month, say 30.4 = 365/12, he may multiply the consumption figures derived from the NPD survey by  $.987 = 30/30.4$ .

The 95th percentiles of daily fish consumption are considerably higher than average fish consumption. For the entire population, the 95th percentile is estimated to be 41.7 grams/day and reaches 61.1 grams/day for males of ages 60 - 69 years, 67.3 grams/day for Orientals, and 55.6 grams/day for residents of central cities with populations of 2 million or more.

Because the amount of pollutant per gram of fish depends upon the species of fish (e.g., different species have different bioconcentration factors and percent lipid contents), the determination of the amount of the pollutant ingested by humans via fish consumption requires that the data tabulations be performed at a species level. Table 9 provides the mean consumption figures necessary to estimate the mean consumption of a pollutant via fish consumption. To derive the mean consumption by U.S. residents of a pollutant via the consumption of selected fish species, the following steps should be taken:

1. The mean consumption of each species should be multiplied by the appropriate bioconcentration factor and percent lipid content;
2. The products so derived should be summed over the species of interest; and
3. The sum should be multiplied by 0.94.

Unfortunately, the 95th percentile of the consumption of a pollutant via fish consumption cannot be so easily derived. To obtain the 95th percentile of the pollutant consumption, the consumption by each survey respondent of the pollutant via selected fish species must first be calculated. Subsequently, the 95th percentile of this distribution of individual pollutant consumptions can be derived using the algorithm described in Section VII (which explicitly accounts for the different weighting factors used to project the NPD sample).

## REFERENCES

In addition to the NMFS publications, two USDA references (April 1972 and 1976) pertain to the NMFS balance sheet of commercially processed marine fish consumption. The articles by Finch, Marasco, Nash, and Miller and Nash, relate to the 1969 Market Facts Survey. The 1973-1974 NPD Survey is mentioned in Cordle, et al. The 1965-1966 USDA Survey is discussed in Food and Nutrient Intake...(USDA, January 1972). The consumption of recreationally caught fish is discussed in Fisheries of the United States; and USDA's Food Consumption... provides an estimate of total fish consumption including "game fish."

Cordle, F., et al., "Human exposure to polychlorinated biphenyls and polybrominated biphenyls," Environmental and Health Perspectives, Vol. 24, p. 157-172, 1978.

Environmental Protection Agency, "Water Quality Criteria Request for Comments," Federal Register, Part V, Vol. 44, No. 52, p. 15926-15981, March 15, 1979.

Finch, R., "Effects of Regulatory Guidelines on the Intake of Mercury from Fish — the MECCA Project," NMFS, Fishery Bulletin, Vol. 71, No. 3, p. 615-626, 1973.

Marasco, R., "Food from the Sea: An Economic Perspective of the Seafood Market," American Journal of Agricultural Economics, Vol. 56, No. 5, December 1974.

Miller, M. M. and Nash, D. A., Regional and Other Related Aspects of Shellfish Consumption, Circular 361, National Marine Fisheries Service, Seattle, Washington, June 1971.

Nash, D. A., A Survey of Fish Purchases of Socio-Economic Characteristics, National Marine Fisheries Service, Seattle, Washington, COM-71-00647, Data Report 62, April 1971.

NMFS, Fisheries of the United States, U. S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Resource Statistics Division (Annual publication).

NMFS, Fishery Statistics of the United States, U. S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service (Annual publication).

NMFS, Food Fish: Market Review and Outlook (NOAA FFSOA 28), U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Industry and Consumer Services Division (Periodical).

NMFS, Report on the Chance of U.S. Seafood Consumers Exceeding the Current Acceptable Daily Intake for Mercury and Recommended Regulatory Controls, U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Office of Fisheries Development, Seafood Quality and Inspection Division, February 1978.

USDA, Food and Nutrient Intake of Individuals in the United States, Report #11 of the Household Food Consumption Survey 1965-1966, U.S. Department of Agriculture, Agricultural Research Service, January 1972.

USDA, Food Consumption, Prices and Expenditures, supplement to Agricultural Economic Report #138, U.S. Department of Agriculture, 1976.

USDA, "Major Statistical Series of the U.S. Department of Agriculture: How they are constructed and used. Volume 5: Consumption and Utilization of Agricultural Products," Agricultural Handbook No. 365, April 1972.

USDA, RPA: The Nation's Renewable Resources -- An Assessment, 1975, U. S. Department of Agriculture, 1977.

APPENDIX A

CHARACTERIZATION OF THE NPD SURVEY  
SAMPLE BY DEMOGRAPHIC CATEGORIES

Appendix A

CHARACTERIZATION OF THE NPD SURVEY  
SAMPLE BY DEMOGRAPHIC CATEGORIES

<u>Race</u>	Number of Respondents (Unweighted)	Percentage of Fish Consumers (Weighted)
Caucasian	23234	93.8%
Black	1126	5.1%
Oriental	155	0.6%
Other	135	0.5%
Missing	2	0.0%
 <u>Sex</u>		
Female	12608	51.1%
Male	11762	47.7%
Missing	282	1.2%
 <u>Age (years)</u>		
0- 9	3935	14.4%
10-19	3979	17.3%
20-29	3855	13.3%
30-39	3864	13.9%
40-49	2410	11.0%
50-59	2563	12.0%
60-69	1812	8.2%
70+	795	3.8%
Missing	1439	6.2%
 <u>Census Region</u>		
New England	1381	6.4%
Middle Atlantic	5292	17.7%
East North Central	4668	19.4%
West North Central	2436	7.8%
South Atlantic	3036	15.1%
East South Central	1157	6.3%
West South Central	2276	9.9%
Mountain	1080	4.3%
Pacific	3324	13.1%
Missing	2	0.0%

Appendix A (continued)

<u>Community Type</u>	<u>Number of Respondents (Unweighted)</u>	<u>Percentage of Fish Consumers (Weighted)</u>
Outside central city, 250 - 500K	1198	4.5%
Central city, 250K - 500	1376	4.9%
Rural, non-SMSA	4010	18.1%
Central city, 2M or more	1419	6.0%
Outside central city, 2M or more	2692	12.3%
Central city, 1M - 2M	2096	6.9%
Outside central city, 1M - 2M	2325	9.0%
Central city, 500K - 1M	2068	7.8%
Outside central city, 500K - 1M	2149	8.1%
Central city, 50K - 250K	812	3.3%
Outside central city, 50K - 250K	622	2.5%
Other urban	3833	16.6%
Missing	2	0.0%

Occupation of Male Head of Household

Retired, unemployed, military, student	2647	12.6%
Laborers	350	1.7%
Farm foremen, laborers	225	1.0%
Professionals	5118	20.0%
Proprietors, managers, officials	3937	16.3%
Clerical	1486	5.7%
Sales	1452	6.0%
Craftsmen, foremen (skilled)	3855	14.5%
Operative (semi-skilled)	3476	13.3%
Private household worker	20	0.1%
Service workers	1257	5.2%
Farm owners, managers	827	3.7%
Missing	2	

Education of Male Head of Household

No male head	985	5.0%
Grade school	1750	8.1%
Some high school	3167	14.1%
Graduated high school	7367	27.9%
Some college	5406	21.0%
Graduated college	5975	24.0%
Missing	2	0.0%

B295  
9

Appendix A (continued)

<u>Family Size</u>	<u>Number of Respondents (Unweighted)</u>	<u>Percentage of Fish Consumers (Weighted)</u>
One Member	20	0.1%
Two members	6051	26.0%
Three members	4978	18.5%
Four members	6185	22.4%
Five members	4008	17.9%
Six members	2086	9.4%
Seven members	771	3.6%
Eight members	318	1.2%
Nine members	143	0.6%
Ten members	23	0.1%
Eleven members	32	0.1%
Twelve or more members	35	0.2%
Missing	2	

Family Income

20K or more	2702	15.5%
15K - 19,999	3832	14.4%
13K - 14,999	2800	10.3%
12K - 12,999	2016	7.4%
11K - 11,999	2035	5.9%
10K - 10,999	2801	7.8%
9K - 9,999	1758	5.1%
8K - 8,999	1627	4.6%
7K - 7,999	1487	8.5%
5K - 6,999	1361	11.4%
3K - 4,999	1238	7.1%
under 3K	393	2.1%
Missing	2	0.0%