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FINAL REPORT

Consumption of Seafood and Wildgame Contaminated with Mercury Brunswick, Glynn County, Georgia

Glynn County Health Department

July 1999

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Agency for Toxic Substances and Disease Registry
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U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY
ATLANTA, GA

CONSUMPTION OF SEAFOOD AND WILDGAME CONTAMINATED WITH MERCURY, BRUNSWICK, GLYNN COUNTY, GEORGIA

SUBMITTED BY

HAZARDOUS WASTE PROGRAM
ENVIRONMENTAL HEALTH SECTION
GLYNN COUNTY HEALTH DEPARTMENT
BRUNSWICK, GEORGIA

JULY 1999

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ABSTRACT

Seafood sampling results from the Turtle River and its tributaries in Glynn County, Georgia raised concerns that the consumption of mercury-contaminated seafood and wildgame from these areas could result in adverse health effects. Seafood from Purvis Creek, Gibson Creek, and the Turtle River between Georgia Highway 303 and channel marker 9 had the highest levels of mercury contamination based on data from Georgia Department of Natural Resources fish sampling surveys. This community-based study compared residents who may have been exposed to mercury by consuming seafood and wildgame from these waters (target group) to residents who reported that they had not consumed seafood and wildgame from these waters (comparison group).

The objectives of this study were: 1) to compare the prevalence of self-reported symptoms and illnesses between target and comparison group participants; 2) to determine seafood and wildgame consumption levels among study participants and assess the accuracy of these self-reported consumption levels; 3) to provide a basis for developing sound recommendations for seafood consumption advisories to the community; and 4) to assess individuals for evidence of mercury exposure using biological evidence (24-hour urine creatinine clearance test).

Results from this study indicate a higher potential exposure of the target group to mercury-contaminated seafood and wildgame. Urine mercury concentrations, however, were below the reference level in all study participants. There were statistically significant differences in several self-reported neurological symptoms between the two groups. Some differences were found between the two groups in self-reported illnesses, but none were statistically significant.

Analysis of the data showed that study participants generally under-estimated their amount of seafood consumption on the interviewer-administered questionnaire when compared to the amount they reported actually consuming as measured by the two-week dietary diary. Despite this finding, seafood comprised a smaller proportion of protein in study participants' diet than anticipated.

The majority of the target group participants do not harvest seafood in the advisory area. Of the eight participants who reported fishing in the restricted area, seven stated that they were aware of the advisory. Overall, the current risk-based seafood consumption guidelines are protective for the general public because evaluation of the amounts of seafood consumed on a per meal basis during the two week dietary diary showed that individuals did not eat more than values used by Georgia Department of Natural Resources in calculating the consumption guidelines.

Ongoing monitoring of mercury levels in seafood and other wildlife in the area is recommended, as well as ongoing public education concerning consumption of mercury-contaminated seafood.

INTRODUCTION

The Linden Chemical and Plastics (LCP) Company Ross Road site in the city of Brunswick, Georgia is located on 550 acres along the Turtle River and adjacent to tidal creeks and marshlands (Site map, Appendix A). From 1957 to 1994, the facility produced chlorine, sodium hydroxide, and muriatic acid by electrolysis of sodium chloride using mercury cells (1).

The site borders extensive tidal marshes, across which a causeway was constructed to carry a sewer allowing discharge of treated process wastewater into Purvis Creek, which flows into the Turtle River, which in turn flows into the Atlantic Ocean. Inspection showed that the sewer was not being used; instead, highly contaminated wastewater was being discharged directly into the tidal marshes (1).

Because of the shallow water depth along the coast in this area, the tidal action did not carry the contaminated wastewater far out into the deeper waters. This resulted in a heavy concentration of contaminants in the marshes and inlets off Purvis Creek as the heavy metals settled into the lower water strata. The marshlands are home to many species of seafood, including shrimp and crab, and several species of fish commonly eaten by local fishermen such as red and black drum, spotted sea trout, mullet, sheepshead, and croaker. Some local hunters also harvest clapper rails and deer from these marshlands.

Elevated levels of mercury were detected in soil, sediment, crab, and oyster samples collected from the LCP site and nearby areas of the Turtle River and its tributaries. Consequently, the Georgia Department of Natural Resources (GDNR) imposed a commercial fishing and seafood harvesting ban and issued a seafood consumption advisory for Purvis Creek, parts of Gibson Creek and the Turtle River. The LCP facility ceased operations on February 1, 1994 and emergency removal of hazardous waste was begun by the U. S. Environmental Protection Agency (EPA) under Superfund.

Given the high levels of mercury found in some seafood samples in the area, there was great concern that bioaccumulation of these toxic substances over the years may have serious adverse health effects on persons who have been eating seafood from this area over a long period of time. According to community informants, quite a few people have continued to fish in the posted areas. The Glynn Environmental Coalition, a local activist group, expressed concern that individuals in coastal Georgia consume far more seafood than the levels used to determine whether or not consumption of mercury-contaminated seafood poses a likely health threat, and that these individuals may be at substantial risk.

Community leaders requested that the Agency for Toxic Substances and Disease Registry (ATSDR) conduct a health consultation at the LCP site. The consultation concluded that there was a past and possibly a current and future health hazard at the site. These hazards included the possible

exposure of residents to unsafe levels of mercury prior to the seafood consumption advisory and ongoing exposure to mercury-contaminated seafood because of noncompliance or lack of awareness of the existing advisory. In response to the community's concerns, the Glynn County Health Department (GCHD) and ATSDR initiated a community-based exploratory study of local fishers and their seafood consumption habits in the fall of 1995.

OBJECTIVES

The following objectives were designed to address the concerns of the community as well as help develop an information base for providing guidance for safe seafood consumption and effective risk communication strategies:

1. Compare the prevalence of self-reported symptoms and illnesses of individuals who consumed seafood from the seafood consumption advisory area of the Turtle River and its tributaries to the prevalence of the same self-reported symptoms and illnesses among individuals who did not consume seafood from the area of interest.

2. Determine seafood and wildgame consumption levels among local residents and assess the accuracy of self-reporting of consumption levels.

3. Provide a basis for developing sound recommendations for seafood consumption advisories for the community.

4. Assess individuals for mercury exposure using biological evidence (24-hour urine creatinine clearance test).

BACKGROUND

The LCP site has been in use since 1917 when Atlantic Richfield Company (ARCO) began operating an oil refinery on the property. From 1937 to 1950, an oil-fired power generating facility was operated on portions of the site by Georgia Power Company. In 1941, Dixie Paints and Varnish Company operated a paint manufacturing facility on 10.5 acres of the property. The entire 550 acres was sold in 1955 to Allied Chemical (now Allied Signal) which manufactured chemicals for the pulp and paper industry until 1979. The most recent owner was the LCP Company which took over the Allied Signal chemical manufacturing process.

The facility operated with a permit to discharge treated waste into the adjacent waterways. In 1991, the Hanlin Group, parent company of LCP, filed for Chapter 11 bankruptcy. In 1993, the firm was notified by GDNR of significant violations that would result in revocation of the permit unless corrected. Allied Signal, a former owner of the property, tendered an offer to purchase, which it subsequently withdrew. GDNR then requested that the EPA begin cleanup under the

Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA or Superfund). The U.S. Justice Department ordered the plant closed and operations ceased on February 1, 1994. In June 1996, the site was placed on the EPA's National Priorities List (NPL) after Georgia's Governor used the state's one-time-only "Silver Bullet," an opportunity each state is granted to hasten cleanup and remediation activities at a selected hazardous waste site.

SITE CHARACTERIZATION

The EPA found mercury, polychlorinated biphenyls (PCBs), heavy metals such as cadmium and lead, and various caustic chemicals at the LCP site. Prior to emergency removal of approximately 415,000 pounds of mercury during 1995 and 1996, mercury contamination was especially widespread at the plant including building structures, impoundments, debris, surface soils, surface water, sediments, and ground water. A causeway had been constructed by LCP across the tidal marshlands to carry a sewer allowing discharge of treated process wastewater into Purvis Creek which flows into the Turtle River, which in turn flows into the Atlantic Ocean (Appendix A). Inspection showed that the sewer was not being used; instead, highly contaminated wastewater was being discharged directly into the tidal marshlands.

About 400 acres of the site are considered marshland. The entire area of coastal rivers and tidal creeks are heavily influenced by tides averaging nine feet. Because of the shallow water depth along the coast in this area, the tidal action had not carried the contaminated waste far out into the deeper waters, resulting in an especially heavy concentration of contaminants in the marshes and tributaries of Purvis Creek as the heavy metals settled into the lower water strata. The marshlands and tidal creeks are home to many species of seafood including shrimp, which spawn in the shallow coastal waters and live there for several years before moving offshore. Several species of fish commonly eaten by local fishers such as red and black drum, spotted sea trout, mullet, sheepshead, and croaker, as well as shrimp and blue crab are found in abundance in the shallow coastal waters.

SEAFOOD CHARACTERIZATION

Low mercury concentrations are routinely found in fish and shellfish (2). Sampling by GDNR in December 1991 found mercury in crabs and oysters in Purvis Creek, a tributary to the Turtle River near the LCP facility, that exceeded the Food and Drug Administration (FDA) action level of 1 part per million (ppm) (3). FDA action levels were used prior to 1995 in developing seafood consumption advisories. In 1992 four species of fish, blue crab, and shrimp were sampled from the Turtle River immediately adjacent to the LCP site (between the Georgia Highway 303 bridge and channel marker 9). Concentrations of mercury found in most samples were much higher than the FDA action level, ranging from 2.4 ppm in shrimp in Purvis Creek, to 4.0 ppm and 6.5 ppm in fish and crabs in the Turtle River. All analyses of seafood tissue mercury residues reported by GDNR were for total mercury in edible tissues.

In 1993 and again in 1995, shrimp, crab, and fish were collected by the GDNR in Purvis and Gibson Creeks as well as the Turtle River. Sampling results revealed that mercury concentrations for fish and shrimp were substantially lower than those in 1991 and 1992, with most samples less than FDA's 1 ppm action level. However, mercury concentrations in blue crab samples continued to exceed the FDA action level with some samples containing up to 1.99 ppm. All samples that exceeded the action level for mercury were collected either from Purvis and Gibson Creeks or sections of the Turtle River in close proximity to the LCP facility.

SEAFOOD CONSUMPTION ADVISORIES AND GUIDELINES

After reviewing the data collected in 1991, GDNR issued a precautionary advisory for the consumption of seafood harvested from Purvis Creek and portions of Gibson Creek and the Turtle River on March 18, 1992. Individuals were advised not to consume crab or other seafood harvested in Gibson Creek downstream from the Highway 303 bridge, in the Turtle River between the Highway 303 Bridge and channel marker No. 9 (about one mile), or in Purvis Creek or its tributaries. At that time, the GDNR closed this area to the commercial harvest of all seafood. GDNR also closed bait zones (areas for harvesting bait shrimp) in Gibson and Purvis Creeks as a precautionary measure. After further sampling a final advisory was issued in June 1993 warning against eating crabs, oysters, and other seafood from this area. The results of the 1993 study, which was conducted to further characterize seafood contamination upstream and downstream of the LCP site, showed no need to expand the seafood consumption advisory area.

In March 1995, the GDNR adopted a risk-based approach for evaluating seafood and freshwater fish with the goal of providing more detailed recommendations for people consuming fish and seafood which might be contaminated. The approach is based on the use of EPA's potency factors for carcinogens and reference doses for noncarcinogens. This approach allows current scientific information on toxicity to be incorporated into guidelines which acknowledge varying consumption rates for different groups of people, taking into account the amounts of contaminants present in the specific type of seafood. For example, recommendations may suggest limiting consumption by children due to their lower body weight, and by women of reproductive age due to potential harmful effects on the fetus. Risk-based guidelines were developed for the Turtle River after the results of the 1995 sampling study were compiled. They were released in the GDNR "1996 Guidelines for Eating Fish from Georgia Waters." As a result of the extensive amount of data collected in 1995 and the adoption of a risk-based approach, the area under consumption restrictions was extended to include 3 1/4 miles of the Turtle River and associated creeks and tributaries.

ADVERSE HEALTH EFFECTS RESULTING FROM EXPOSURE TO MERCURY

Mercury occurs naturally in the environment so everyone is exposed to very low levels of mercury in air, water, and food (2). People may also be exposed to mercury compounds from medicinal products, such as antiseptics or skin lightening creams that contain small amounts of mercury. Mercury spills in the home from such sources as thermometers or electrical switches may result in high exposures to mercury vapors released to the indoor air.

Background or natural levels of mercury have been measured in urban outdoor air, surface water and soil. The FDA has estimated that, on average, most people are exposed to about 3.5 micrograms (ug) of mercury per day in the food they eat.

Effects of sufficiently high levels of mercury on human health have been documented (4,5,6,7). Various disorders caused by exposure affect the nervous, renal, and reproductive systems (6,8,9). Repeated exposure to high levels of mercury over a long period of time can permanently damage the brain, kidneys, and developing fetuses. Short-term exposure to high levels will have similar health effects, but full recovery is more likely. Mercury is not believed to cause cancer in humans.

Many factors determine the nature and extent of potential adverse health effects including dose, duration, route or pathway of exposure, and simultaneous exposure to other chemicals, as well as individual characteristics including age, gender, existing illnesses or medical conditions, diet, and lifestyle factors such as alcohol use and nutritional deficiencies (2). Persons with existing liver, kidney, lung, or nerve disease may be especially sensitive to the toxic effects of mercury.

The form of mercury to which a person is exposed will also affect the severity of effects and the kind of health effects that may occur. People could have been exposed to three forms of mercury originating from the LCP site: methylmercury (also called organic mercury) in fish and shellfish, inorganic mercury salts in soil or dust, and metallic mercury vapor in air.

The greatest potential for exposure to mercury was most likely from fish and shellfish harvested from nearby contaminated waterways. Mercury was found at significant levels in fish and, to a lesser degree, shellfish from the area. Fish and shellfish eat smaller organisms that convert inorganic mercury to methylmercury. If individuals eat fish and shellfish contaminated with methylmercury they may exhibit effects similar to those from exposure to inorganic forms of mercury such as kidney damage, but are more likely to have nervous system effects. This is especially true of children born of mothers who were exposed to methylmercury during pregnancy. The central nervous system can show effects such as aberrant motor development and coordination or visual perception problems, or peripheral nervous system effects such as paresthesia.

BIOMARKERS USED TO IDENTIFY EXPOSURE TO MERCURY

Reliable and accurate tests are available to measure mercury levels in the human body. Blood, hair, and urine samples can be taken and tested in a laboratory. Blood tests are appropriate for analysis to measure exposure to organic mercury and can be used to accurately determine recent exposure to methylmercury. Measurement of mercury in hair samples can be used to confirm exposure for groups of people and may be used to provide a history of exposure to methylmercury that can be compared to known effect levels in studies of methylmercury in humans.

Urine specimens can also assess exposure to mercury. Urine mercury measurement is reliable and simple, and it provides rapid identification of individuals with elevated total (inorganic and methyl-) mercury levels (9). Although blood is better than urine for accurately estimating exposure to methylmercury, individuals with high, chronic methylmercury exposures may have elevated total mercury concentrations in urine. Because of the high concentrations of mercury measured in fish tissue sampling results in 1991 - 1993, it was assumed that total mercury concentrations would be elevated in the high exposure populations of fishers and that these elevated concentrations would be detected by urine mercury testing. Urinalysis is an appropriate measurement for initial screening when chronic exposure to high levels of mercury is suspected.

The 24-hour urine mercury creatinine clearance test was selected because it can be used successfully with individuals of all ages and generally has a higher acceptance and compliance rate than blood testing since it is a simple, non-invasive test. In order to obtain adequate participation in this study, the urine mercury test was chosen to alleviate concerns that individuals might have about having their blood drawn.

METHODS

STUDY DESIGN RATIONALE

A cross-sectional study was selected to determine the health status and direct evidence of exposure of a target group of individuals who consumed seafood from the Turtle River and its tributaries in Glynn County. This target group was compared to a comparison group of individuals from the same general geographical area who did not consume seafood from the area of interest. The data collection was conducted over a period of one calendar year to take into account any seasonal variations in seafood consumption.

In order to ensure that all types of seafood consumers were included, three groups of possibly exposed individuals were targeted: commercial, subsistence, and recreational fishers. Commercial fishers are individuals who fish for the purpose of selling seafood and who obtain seafood through the use of commercial gear. Subsistence fishers catch seafood as their main source of dietary protein. Recreational fishers fish for sport, recreation, or hobby; neither their livelihood nor diet is dependent on seafood they catch. It was assumed that these three groups of fishers and their families were likely to be heavy seafood consumers, and therefore at highest risk for exposure to mercury-contaminated seafood.

SELECTION OF TARGET AND COMPARISON GROUPS

Selection of the target group was limited to individuals who met the following criteria: a) consumed or caught seafood from the Turtle River or its tributaries in Glynn County; b) lived in Glynn County for at least the last two consecutive years prior to the study; and c) had not been employed at the LCP site since 1956, in order to exclude individuals who may have had occupational

exposure to mercury. The comparison group was selected using the same last two criteria; however, they had not consumed or caught seafood from the Turtle River or its tributaries in Glynn County. Participation in all phases of the study was voluntary.

DATA COLLECTION

Data were collected from study participants from May 1996 - April 1997 in four consecutive phases: 1) a screening survey; 2) an interviewer-administered questionnaire; 3) a dietary diary; and 4) a biological specimen (urine) for laboratory analysis. In order to verify responses and reduce recall bias, questions that were quite similar were asked in different ways in several of the data collection documents. The instruments used in each of the first three phases were field tested and revised as needed prior to the study data collection to ensure ease and accuracy of response.

Screening Survey

A screening survey (Appendix B) was administered to assess each individual's eligibility for participation. All individuals were asked questions regarding seafood consumption, fishing/hunting habits from the Turtle River and its tributaries, Glynn County residency, and LCP site employment history.

In an effort to recruit 400 target group participants, a total of 6200 screening surveys were distributed to local schools, businesses, agencies, industries, community groups, churches, and professional and civic organizations. Residents in private homes in the target geographical areas were contacted by door-to-door canvassing, and screening surveys were left at the homes of those who could not be contacted during the door-to-door canvassing. GCHD staff distributed surveys at fishing piers, bridges, boat ramps, businesses, and homes adjacent to affected waterways, fish camps, bait and tackle shops, and throughout the local commercial seafood industry. The screening survey was published in the local newspapers, as well as in the GCHD Hazardous Waste Site Newsletter, on several occasions with instructions on submitting the completed survey for enrollment. Television and radio coverage was used extensively throughout the recruitment period.

The comparison group was recruited by first administering the screening survey to all persons contacted from lists of 1200 households on mainland Glynn County and Blythe Island. This list was randomly generated from public records of residential addresses and published telephone numbers. In an effort to recruit 200 comparison group participants, these 1200 households were contacted via letter and telephone. Initially, a randomly generated list of 600 households was produced by the GCHD Management Information Systems (MIS) Unit from the Glynn County Solid Waste Department's record of households that receive public trash removal service. Those with published phone numbers were contacted by phone and asked to participate, and those without published phone numbers were mailed letters requesting their participation. Due to low participation enrollment from letter correspondence (0.9% success rate), 600 listed telephone numbers were randomly generated by Survey Sampling, Inc. from the most current public telephone listings. These households were contacted by telephone to recruit participants for the comparison group.

Interviewer-Administered Questionnaire

The study questionnaire (Appendix C) was adapted from those used in the ATSDR American Samoa and Florida Everglades studies of seafood consumption and the ATSDR general questionnaire. All answers were self-reported. The questionnaire was divided into sections regarding demographic information, tobacco use and alcohol consumption, prior and current symptoms and illnesses, occupational and other potential sources of mercury exposure, and seafood consumption and fishing/hunting habits.

All interviewers were instructed in the proper administration of the questionnaire and confidentiality of the information obtained. Interviewers were not informed of study hypotheses in order to avoid bias. The trainers monitored their performance during mock data collection using role-playing exercises.

Dietary Diary

After the questionnaire was administered, interviewers gave each study participant detailed instructions for completing the dietary diary. An abbreviated version of the National Fisheries Institute's draft dietary diary, which is currently undergoing standardization, was used (Appendix D). The dietary diary was used to assess the accuracy of self-reported seafood consumption levels recorded in the study questionnaire.

Study participants were asked to record their daily protein consumption from animal sources, including beef, pork, poultry, seafood, and wildgame, the origin of the seafood/wildgame consumed and accurate estimation of portion size of specific types of food for two consecutive weeks. The current day's dietary intake was entered by the interviewers as the first day of the two-week period, to serve as an example for study participants to follow on subsequent days. The study participant contacted the GCHD when s/he had completed the diary, and either took the diary to GCHD clinic, or project staff retrieved it. When the diary was returned, the interviewer instructed the study participant in proper collection of the biological specimen.

Biological Specimens

After completing the dietary diary, all target group participants were asked to submit a urine sample, and 50% of comparison group participants were asked to do so. Each participant was given verbal instructions for urine collection and was provided with a specimen container and written instructions. Urine specimens were either packed in ice and taken to the GCHD clinic by the study participant or the participant refrigerated the specimen, contacted the GCHD and it was then picked up by project staff and taken in refrigerated receptacles to the Doctor's Laboratory, Inc., Brunswick office. Urine specimens were then shipped to Doctor's Laboratory, Inc. in Valdosta, GA for analysis using standard laboratory analysis protocol. The reporting limit for mercury in urine is 0.5 *u*g/L. Anyone with a urine mercury concentration above the reference level of 20 *u*g Hg/g creatinine would be referred to a physician for further evaluation.

DATA ENTRY AND MANAGEMENT

GCHD staff entered the responses from the screening survey, questionnaire, dietary survey, and urinalysis laboratory results into EPI INFO 6.34 (10) data files. The coded forms were checked for completeness and accuracy. The data were edited for coding and keystroke errors using range and internal consistency checks. Inconsistent data were checked against the original responses.

DATA ANALYSIS

EPI INFO and SAS (11) statistical software were used for data analysis. The target and comparison groups were compared using analytic techniques appropriate for cross-sectional study designs. Univariate analyses generated descriptive statistics to characterize data in both the target and comparison groups. The Chi-square test was used to compare categorical variables such as demographic characteristics and symptoms while an odds ratio (OR) and 95% confidence interval (CI) were used to determine the association between reporting of specific illnesses. Odds ratios and p-values were not generated where less than five persons reported having a specific illness because results were too small for meaningful statistical analysis. Logistic regression analyses were conducted for statistically significant symptoms controlling for age, gender, smoking, alcohol consumption and whether the individual consumed seafood from the contaminated area or not. A test result was considered statistically significant if the p-value was less than 0.05. Missing data were not included in the analyses and therefore not reported in the tables.

RESULTS

This study addressed several issues and incorporated several data collection documents. In order to present the vast amount of information gathered during this study in a concise manner, the results are divided into five major sections: 1) enrollment rates; 2) questionnaire data; 3) dietary diary results; 4) development of seafood consumption advisories; and 5) biomarker results.

SECTION I: ENROLLMENT RATES

Target Group

The number of individuals who consumed seafood or wildgame from the advisory area was unknown. In order to reach all potentially affected individuals, 6200 screening surveys were distributed throughout the community. Of the 337 screening surveys returned, 282 met the target group participation criteria. Of these 282 eligible residents, 214 (76%) were interviewed, 156 (55%) completed a dietary diary, and 139 (49%) provided urine samples (Table 1). Three of the target area participants interviewed were discovered not to have met the inclusion criteria and were not included in further data analysis, resulting in 211 records for analysis.

Comparison Group

Lists of households on mainland Glynn County and Blythe Island were randomly generated from public records of residential addresses and published telephone numbers. Of the 1200 addresses and phone numbers contacted, 122 residents were eligible and agreed to participate as members of the comparison group. No further demographic or consumption data were collected from those who were not interviewed. Of the 122 eligible respondents, 106 (87%) were interviewed, 87 (71%) completed a dietary diary, and 12 (10%) provided urine samples (Table 1). One participant was not included in further analyses because s/he did not meet the inclusion criteria. A total of 105 comparison group records were analyzed.

SECTION II: QUESTIONNAIRE

Demographic Characteristics

Target and comparison group participants were not statistically different with regard to gender, age, race, and education distributions (Table 2). The target group participants ranged in age from 3 to 84 years (mean 47.7 years) while in the comparison population the age range was 6 to 87 years (mean 47.7 years). In the target group 52% of the participants were males and 48% were females. The comparison group had 49% males and 51% females. Both groups were predominately white (target group 94%; comparison group 88%). African Americans comprised 4% of the target group and 10% of the comparison group; race was not recorded for 2% of each group.

Target and comparison group participants were also similar in their educational levels. Approximately 40% of both groups had a high school education (target 42%; comparison 45%) or had attended some form of higher education including community college, technical school, four-year college or graduate school (target 41%; comparison 42%).

There were differences between the target and comparison groups in regard to household income and years living in Glynn County. Many participants did not record their annual household income (41% in the target group and 28% in the comparison group). Of those reporting income, the target population had a lower proportion of participants reporting an annual household income of $35,000 or more (25%) than did the comparison group (47%). A greater proportion of target group participants had resided in Glynn County for 20 years or more than comparison group participants (75% and 46% respectively). The mean number of years of residency in Glynn County for the target population was 33.7 years compared to 23.8 years in the comparison group.

Self-Reported Symptoms

Of the 11 questions assessing each participant's symptom history in the past two years (Table 3), six symptoms were higher in the target group than in the comparison group, and these increases were statistically significant with a 0.05 confidence level (lightheadedness, difficulty concentrating, trouble remembering, problems retaining reading/conversations, irritability, and sleep changes). Approximately one-third of target group participants (36%) and 61% of comparison group participants reported having none of the symptoms in the past two years. In both the target and comparison groups, 11% reported having one symptom in the past two years while 14% of the target

group participants and 11% of the comparison group participants reported having had two symptoms in the past two years. In the target group, 15% of the participants reported having six or more symptoms in the past two years while only 4% of the comparison group reported having six or more symptoms. All responses were self-reported and not verified by medical records.

Differences in the percentage of people reporting certain symptoms between the target and comparison groups might be due to differences other than their possible exposure to harmful substances in the environment. To control for differences between the two groups in alcohol consumption, smoking, age and gender, logistical regression statistical models were generated which took into consideration these other personal factors. The results from this more sophisticated statistical analysis were consistent with those from the simpler analysis (Table 4). In other words, even after adjusting for differences in alcohol consumption, smoking, age and gender, persons from the target group were more likely to report lightheadedness, difficulty concentrating, trouble remembering, irritability, depression and sleep changes than persons from the comparison group.

Self-Reported Illnesses

Crude analysis of the 18 separate questions assessing each participant's illness history (Table 5) showed that five had odds ratios greater than 1.0 (loss of consciousness/head injury, kidney infections, bladder infections, gallstones, and diabetes), indicating a higher occurrence of self-reported illness in the target group. One question had an odds ratio less than 1.0 (thyroid disease), indicating a lower occurrence of the illness in the target group. One question had an odds ratio of approximately one (kidney stones), indicating that the odds between the two groups was approximately equal. Odds ratios ranged from 0.71 to 1.73, and none were statistically significant. Insufficient numbers of responses were obtained for eleven illnesses, precluding calculation of odds ratios: brain tumor, seizures, kidney failure, kidney disease, bladder disease, mental retardation, cerebral palsy, stroke, alcoholism, encephalitis/meningitis, and Parkinson's disease. However, elevations in seizures and bladder disease were suggested in the target group. Illness questions were answered based on whether a participant had ever been hospitalized for or had been diagnosed by a physician as having a specific illness. All responses were self-reported and not verified by medical records.

Three questions regarding behavioral problems, developmental delays, and learning problems were asked regarding children 15 years or younger. Insufficient numbers of responses were obtained for all three questions, precluding calculation of an odds ratio.

Reproductive Outcomes

Data were evaluated for responses to seven questions asked of women over 12 years of age relating to reproductive outcomes including: history of miscarriage, stillbirth, premature labor, low birth weight baby, reproductive system disease, endometriosis, and hysterectomy (Table 6). Of these self-reported reproductive outcomes, odds ratios were not calculated for three which had an insufficient number of responses (stillbirths, low birth weight baby, and endometriosis). Three had odds ratios greater than 1.0 (premature labor, reproductive system disease/surgery, and hysterectomy), and one had an odds ratio less than 1.0 (miscarriage), indicating a lower occurrence in the target group. Odds ratios ranged from 0.88 to 2.49. None reached statistical significance.

Female respondents over 12 years of age were also asked if they were currently pregnant and the total number of times they had been pregnant (Table 6). Less than five percent of target group women were currently pregnant and none of the comparison group were. The majority of female respondents in both the target and comparison groups who were over 12 years of age reported that they had been pregnant at least once (88% and 98% respectively), and approximately one-third of women in both groups reported that they had been pregnant four or more times (32% and 30% respectively). There was no statistically significant difference between the two groups in the number of times a woman had been pregnant at least once.

Females over age 12 were asked if they ever had difficulty conceiving (Table 6). The odds ratio of less than 1.0 (OR 0.86, 95% CI 0.28-2.71) indicates a lower occurrence in the target group. There was not a statistically significant difference between the two groups.

Seafood/Wildgame Consumption and Acquisition

During the questionnaire interview, target and comparison group participants were also asked questions regarding their seafood/wildgame consumption in the past month and in the past six months.

Past Month

The majority of participants in both the target and comparison groups reported eating seafood in the last month (92% and 87%, respectively; Table 7). In the last month, 82 (39%) of target group participants reported catching local seafood or wildgame, while eight (8%) of the comparison group participants reported doing so. Nearly three-quarters (71%) the comparison group reported buying seafood or wildgame in the last month, compared to 56% in the target group.

When asked how often they ate seafood in the last month, 77 (36%) of target group participants who responded stated they had eaten seafood less than once a week, 80 (38%) ate seafood about once a week, and 37 (18%) ate seafood more than once a week (Table 8). Of the comparison group participants who responded to this same question, 44 (42%) said that in the last month they ate seafood less than once a week, 33 (31%) said they ate seafood about once a week, and 11 (11%) said they ate seafood more than once a week.

Of the 79 target group respondents who caught local seafood or wildgame, 38 (48%) reported doing so less than once a week in the last month, 25 (32%) reported catching local seafood or wildgame about once a week in the last month, and 16 (20%) reported catching local seafood or wildgame more than once a week in the last month (Table 8). Eight participants from the comparison group responded to this question: 5 stated they caught local seafood or wildgame less than once a week in the last month, 2 caught local seafood or wildgame about once a week, and 1 caught local seafood or wildgame more than once a week.

Over half (57%, n=66) of the target group respondents who reported buying seafood or wildgame in the past month bought it less than once a week, while 38 (33%) stated they bought seafood or wildgame about once a week and 12 (10%) said they bought seafood or wildgame more

than once a week in the last month (Table 8). The comparison population was very similar in their buying habits. Of those who reported buying seafood or wildgame in the past month, 43 (57%) reported buying it less than once a week, 25 (33%) bought seafood or wildgame about once a week, and 7 (9%) bought seafood or wildgame more than once a week.

Six Months

The majority of participants in both the target and comparison groups reported eating seafood in the last six months (99% and 92%, respectively; Table 9). In the last six months 113 (54%) of target group participants reported catching local seafood or wildgame, while 10% of comparison group participants reported doing so. In the last six months the majority of both groups reported buying seafood or wildgame (target group 74%, comparison group 79%).

Of those who responded to the question of how often they ate seafood in the last six months, 21 (16%) of target group participants stated they had eaten seafood less than once a month, 51 (25%) ate seafood about once a month, and 131 (65%) ate seafood more than once a month (Table 10). Of the comparison group participants who responded to this same question, one-fifth (22%, n=21) said that they had eaten seafood less than once a month in the last six months, 29 (30%) said they ate seafood about once a month, and 47 (48%) said they ate seafood more than once a month.

Of the 109 target group respondents who caught local seafood or wildgame in the past six months, 21 (19%) reported doing so less than once a month, 26 (24%) reported catching local seafood or wildgame about once a month, and 62 (57%) reported catching local seafood or wildgame more than once a month (Table 10). Ten participants from the comparison group responded to this question. Eight stated they caught local seafood or wildgame less than once a month in the last six months, 1 caught local seafood or wildgame about once a month, and 1 caught local seafood or wildgame more than once a month.

Of the 151 target group respondents who reported buying seafood or wildgame in the last six months nearly one-third (31%, n=47) bought seafood or wildgame less than once a month, while 39 (26%) stated they bought seafood or wildgame about once a month, and 65 (43%) said they bought seafood or wildgame more than once a month (Table 10). The comparison population was very similar in its buying habits for the past six months. Twenty-five (30%) reported buying seafood or wildgame less than once a month, 24 (29%) bought seafood or wildgame about once a month, and 34 (41%) bought seafood or wildgame more than once a month.

Seafood and Wildgame Harvesting Locations

Target group participants were selected for this study if they consumed or caught seafood or wildgame from the Turtle River or its tributaries. In order to determine fishing habits of these respondents, a map of the area was shown to each participant and s/he was asked to show where the local seafood or wildgame had been caught.

Past Month

Of the 78 target group participants who had caught local seafood or wildgame in the past month, 10% stated that they had fished in the restricted area of Purvis Creek and Turtle River between Highway 303 and channel marker 9, and Gibson Creek below Highway 303 (Table 11).

Another 10% stated that they fished on Blythe Island, including South Brunswick River, while 4% fished in Yellow Bluff Creek and 1% fished in Gibson Creek above Highway 303. The majority (74%) of target group participants stated that they had fished in other areas, which included Altamaha River, Buffalo River, Jekyll Island, Hampton Creek, Satilla River, and St. Simon's Island.

Past Six Months

Of the 98 target group participants who had caught local seafood or wildgame in the past six months and who also responded to questions regarding harvest location, 5% responded they had fished in the restricted area, 9% fished near Blythe Island, 2% in Yellow Bluff Creek and 3% in Academy Creek/East River (Table 11). The majority of target group participants (81%) stated that they had fished in other areas, which included Altamaha River, Buffalo River, Jekyll Island, Hampton Creek, Satilla River, South Brunswick River, and St. Simon's Island.

Advisory Compliance

Since target group participants had consumed or caught seafood from the Turtle River or its tributaries, they were also asked questions regarding their compliance with the fishing restrictions that have been in place since 1992 (Table 12). Of the 211 target group participants, 51%, (n=108) reported catching seafood or wildgame from the Turtle River restricted area in the last five years. These same individuals were also asked when they had caught seafood or wildgame in the restricted area. Thirty-six percent (n=39) caught seafood or wildgame in 1995, 17% (n=18) in 1994, 28% (n=30) in 1993, and 9% (n=10) in 1992. Approximately one-half of these individuals (53%, n=57) reported catching seafood or wildgame more than once a month from the restricted area, 13% (n=14) caught seafood or wildgame about once a month, and 29% (n=31) caught seafood or wildgame less than once a month.

The majority of target group participants (90%) stated they knew about the advisory that was in place for part of the Turtle River, Purvis Creek, and Gibson Creek. While only two-thirds (65%) of these individuals reported changing their fishing habits or the amount or types of seafood that they ate from that area, the reason most of them (95%) said they changed their habits was due to the advisory. The majority of target group participants (81%) stated that they were concerned about contamination of seafood from the advisory area.

SECTION III: DIETARY DIARY

After an individual had completed the interview-administered questionnaire, s/he was given a two-week dietary diary for recording daily protein consumption, including beef, pork, poultry, seafood, and wildgame. Also recorded in this diary was whether the food was bought or caught and an estimation of the portion size of specific types of food. Information regarding location was recorded if food was classified as being caught.

The majority of the target and comparison group participants (74%, n=156; 83%, n=87, respectively; Table 13) who were interviewed completed a dietary diary. The dietary diary was conducted over a period of ten months with the majority (69%) of target group participants completing the diary during the summer, 20% during the winter, 10% during the fall, and less than one percent during the spring. For the comparison group, 22% completed the dietary diary during the summer, 46% during the spring, and 32% during the winter. The two groups were similar in

gender, age, and race distributions. The target group participants who completed the dietary diary ranged in age from 3 to 84 years (mean 49.1 years), while in the comparison population the age range was 6 to 87 years (mean 46.9 years). Of the target area participants completing the diary, 50% were male and 50% were female; in the comparison group participants, 48% were male and 52% were female. In both groups, the majority of the individuals were white (94% of target; 92% comparison). The demographics of those completing the dietary diary were similar to those enrolled in the study who completed the questionnaire.

When asked in the dietary diary if they participated in local fishing and/or hunting activities, the majority of target group participants (68%) reported that they did so, and approximately one-fifth (19%) of comparison group participants reported participating in such activities (Table 13). Of the 101 (65%) target group participants who self-reported which type of fisher they were, 97 (96%) classified themselves as recreational fishers, three were commercial (3%), and one was a subsistence fisher (1%). For comparison group fishers (n=16), 15 participants classified themselves as recreational fishers (94%) and one as a subsistence fisher (6%).

For both the target and comparison groups, beef made up approximately one-third of their total dietary protein (Table 14). Pork was a slightly larger source of dietary protein for the comparison group (29%) than the target group (25%), as was protein from poultry (comparison group 25%, target group 23%). In the target group seafood made up 18% of dietary protein; in the comparison group 13% of dietary protein was from seafood. Less than 5% of dietary protein in both the target and comparison groups was from wildgame (3% and 1%, respectively).

The majority of target and comparison group participants recorded eating seafood during the two weeks they completed the dietary diary (92%, n=144 and 78%, n=68 respectively). In both the target and comparison groups, nearly one-third of participants recorded eating one or two seafood meals during the two-week period (31% and 33%, respectively). One-third of target group participants recorded eating three or four seafood meals during the two-week period, compared to one-quarter of comparison group participants. Nearly one-third (29%) of target group participants recorded eating five or more seafood meals in the two-week period, and one-fifth of comparison group participants reported eating that many seafood meals. The average number of seafood meals eaten per week was 1.7 in the target group, while the comparison group mean was 1.3 meals per week. Shellfish and fish other than locally caught made up more meals than did locally caught fish or prepared seafood for participants in both the target and comparison groups.

For the two groups combined, a total of 772 seafood meals were consumed during collection of the dietary diary (Table 15). The majority of these seafood and wildgame meals (68%) were purchased from local merchants, dockside vendors, private fishers, fast food restaurants, restaurants, chain or local grocery stores or other establishments. Chain or local groceries and fast food restaurants comprised the majority (78%) of those seafood and wildgame meals bought and therefore were assumed not to contain excessive amounts of mercury. The type of seafood meals (including caught, bought, and prepared seafood) eaten most often by both target and comparison group participants was shrimp (45%, 41%) followed by tuna (14%, 17%). Other types of seafood eaten by both target and comparison group participants included trout (10%, 6%), crab (8%, 6%), catfish (5%, 8%), salmon (4%, 7%), flounder (4%, 4%), oysters (3%, 5%), clams (3%, 4%) and whiting (3%, 3%). All other types of seafood meals eaten by both groups during the collection of the dietary diary comprised less than 2% each of the total amount of seafood meals eaten.

Of the 250 meals of locally caught seafood and wildgame consumed by target group participants during the two-week dietary diary period, approximately 14% (34) were taken from the advisory area (Table 16). The types of seafood that participants reported catching in this area included shrimp, trout, crab, flounder, sea trout, bass, and whiting. Target group participants also reported eating venison caught from the advisory area. The majority (71%) of meals that target group participants caught and ate were caught in local fishing areas other than the advisory area, and 15% of locally caught seafood or wildgame meals were caught from the Blythe Island area.

SECTION IV: DEVELOPING RECOMMENDATIONS FOR SEAFOOD CONSUMPTION ADVISORIES

Seafood consumption advisories are based on the frequency of consumption of seafood collected in the advisory area and the toxicity of chemicals found in seafood. Rarely is site-specific information available on seafood consumption patterns, and considerable professional judgment must be used in selecting intake values for seafood. Concentrations of chemicals of concern have been and continue to be extensively measured in local fish and seafood in the area. Toxicity information is available from agencies, such as the EPA or ATSDR, to evaluate potential for toxicity. However, as a result of the general lack of information on local consumption patterns, considerable uncertainty exists as to the protectiveness of site-specific seafood consumption advisories.

This study examined reported seafood consumption during several time periods in an area where seafood had been sampled for mercury contamination. Self-reported consumption levels were ascertained during the interviewer-administered questionnaire phase of the study, and actual consumption levels were recorded during the dietary diary phase. These results, along with measured mercury levels in seafood, were compared to consumption guidelines currently in place to determine if the guidelines were protective.

In order to assess the accuracy of self-reported seafood consumption levels, data from the questionnaire and the dietary diary were compared in two different ways: 1) self-classification in the questionnaire and mean percentage of seafood in diet measured in grams and 2) frequency of meals consumed per week as reported in the questionnaire and actual frequency of meals consumed in the dietary diary.

Study participants were asked in the interviewer-administered questionnaire to describe their level of seafood consumption on a scale ranging from "none", "a little", "moderate", and "a lot". Responses from both target and comparison group participants were compared to the amount of seafood they reported consuming during the two-week dietary diary (Table 17). Comparison group respondents, who stated that they ate no seafood, reported eating seafood in the dietary diary and actually had a higher mean percentage of their diet from seafood than the comparison group respondents who stated they consumed "a little" seafood (20% vs. 17%). Target group respondents who said they consumed "a little" had nearly the same mean percentage of their diet from seafood as comparison group participants who stated that they consumed "a little" seafood (16% of diet vs. 17%). Comparison group respondents who stated that they ate a "moderate" amount of seafood had the same mean percentage of their diet from seafood than did target group participants who stated they consumed a moderate amount of seafood (18%). Target group respondents who said they consumed "a lot" of seafood had a slightly higher mean percentage of their diet from seafood than did comparison group participants who stated that they consumed "a lot" of seafood (27% vs. 24%).

Past month seafood consumption levels reported by participants in the questionnaire were also compared with consumption levels recorded in the dietary diary (Table 18). In both the target and comparison groups, there was a high degree of agreement between the questionnaire and dietary diary among those who stated they ate seafood less than once a week (target 67%, 10 of 15; comparison 77%, 10 of 13). There was less agreement between the questionnaire and the dietary diary in both groups regarding their seafood consumption if they stated they ate one meal a week (target 36%, 8 of 22; comparison 42%, 5 of 12) or if they stated they ate more than one meal a week (target 25%, 24 of 98; comparison 14%, 5 of 37).

Overall, both target and comparison group participants were less accurate in reporting their seafood consumption as consumption levels increased, based on their responses to the questionnaire compared to the dietary diary. These findings were generally consistent in both groups, indicating that quantifying and recording seafood consumption in the dietary diary on the day it was eaten provided a more useful picture of actual seafood consumption than retrospective recall.

An important factor in determining the basis for seafood advisories is the potential for variability in meal sizes of individuals. When calculating its consumption guidelines, GDNR accounts for variation in meal size by using a range from 4 oz. to 8 oz. Evaluation of the amounts consumed on a per meal basis during the two week dietary diary showed that individuals did not eat more than values used by GDNR in calcula ing the consumption guidelines. It should be noted that if meal sizes frequently exceed this range, GDNR consumption guidelines may not be sufficiently protective.

SECTION V: BIOMARKER RESULTS

In the target group, 137 (65%) of the individuals who completed the interview provided urine samples, while only 12 (11%) of comparison group individuals provided urine samples. The reporting limit for urine mercury from the laboratory was 0.5 *u*g/L. All results less than the reporting limit were reported as zero. Urine test results were reported as corrected (*u*g Hg/g of creatinine) values to avoid spurious results due to variation in urine output.

None of the urine mercury results in either group exceeded the established reference level of 20.0 *u*g Hg/g creatinine. Urine mercury test results in the target group ranged from 0.0 *u*g Hg/g creatinine to 19.4 *u*g Hg/g creatinine, with a mean of 0.886 *u*g Hg/g creatinine. The majority of target group individuals who provided a urine sample (63%, n=86) had a urine mercury concentration below the detection limit (Table 19). Of the 37% (n=51) individuals from the target group who had a urine mercury concentration above the detection limit, only one had a concentration above 10 *u*g Hg/g creatinine. None of the comparison group had urine mercury concentrations greater than 2.0 *u*g Hg/g creatinine.

DISCUSSION

The techniques used to recruit participants into the target group yielded reasonable certainty that a high proportion of affected individuals were contacted. However, many individuals contacted to be part of the comparison group were unwilling to participate in the study. Therefore, the recruitment of the comparison group was less than optimal.

The analysis of eleven self-reported health symptoms in the past two years showed that for six of these symptoms there were statistically significant differences between the two groups. Participants in the target group were more likely to report lightheadedness, difficulty concentrating, trouble remembering, irritability, depression, and sleep changes. However, for each symptom the majority of both target and comparison group participants reported not having the symptom. The reasons for the statistically significant differences are unclear. However, some of these differences might be attributed to interviewer bias and/or recall bias. All urine mercury concentrations were below the reference level.

Loss of consciousness/head injury, kidney infections, bladder infections, gallstones, and diabetes were reported more often in the target group than in the comparison group; however, none reached statistical significance. Those in the target group reporting loss of consciousness/head injury were predominantly men, while those in the comparison group were predominately older women. The majority of kidney infections, bladder infections, and gallstones reported by target and comparison group participants were reported by women. In the U.S., the majority of individuals with kidney infections, bladder infections, and gallstones are predominately older women. Diabetes was also reported more often in the target group than the comparison group. All but five of the individuals reporting having diabetes were individuals more than 50 years of age; the other five were in their thirties and forties. This pattern is consistent with national data. Additional analysis was conducted that focused on the children that participated in this study. However, the results from this analysis were not included in the report due to reasons of confidentiality. The analysis included examining individual urine mercury concentrations for all children, along with consumption amounts and questionnaire data, to determine if follow-up would be needed. Urine mercury levels of all children were quite low and we did not see an increase in reporting of symptoms or diseases, or reporting of consumption of seafood from the restricted area.

Results from both the questionnaire and the two-week dietary survey provide insight into the amount of seafood eaten by Glynn County residents. Results from the questionnaire indicate that approximately three-quarters of both target and comparison group respondents reported eating seafood once a week or less. The dietary diary analysis shows that respondents actually consumed more seafood meals than they stated in the questionnaire. Results from the dietary diary show that people in both groups consume between 1.5 and 2 seafood meals per week. However, more than half of that amount consisted of shellfish and/or fish which was not locally caught. In addition, shrimp was reportedly eaten most often, and analyses showed less mercury contamination in shrimp than in crab, which had the highest mercury levels, but were seldom eaten by study participants. Fish held intermediate rank in both contamination and consumption. The data from both the questionnaire and the dietary survey suggest that for most of the population, an intake rate based on a consumption pattern of one meal per week or less should be protective. Initial discussions with local fishers and other residents indicated that consumption rates were higher than actually reported by the study participants. This finding is significant in light of the fact that seafood consumption was expected to be higher in this part of coastal Georgia, where seafood is plentiful, and fishing is a popular past-time.

Approximately 10% of the target group reported continuing to catch and consume seafood or wildgame from areas where severe restrictions (a "do not eat" advisory) currently exist. When asked questions regarding compliance with fishing restrictions since 1992, responses indicated that larger numbers of respondents harvested seafood and wildgame from advisory areas recently (1995) than in earlier years (1992, 1993, and 1994). This trend of increasing consumption in the restricted area may be related to the change from a simple advisory ("do not eat") from 1992 through 1994, to

a more complex and descriptive approach instituted in 1995 and published in the 1996 GDNR risk-based consumption guidelines, where recommendations are made for many species of seafood on a meal per week or month basis. Of the target group participants who said they fished in the advisory area (Purvis Creek, Gibson Creek, Turtle River between Hwy. 303 and channel marker 9) in the past month (n=8), seven said they were aware of a health advisory that restricts consumption of certain species of seafood.

Preliminary information collected during the planning phase of this study suggested that local fish consumers were continuing to consume fish with high concentrations of mercury, so urine mercury tests were used as a noninvasive screening tool. Even though a blood test is a better indicator of exposure to methylmercury, 10% to 30% of organic mercury may be excreted in the urine (1), and chronic exposures to large amounts of methylmercury would likely be indicated by elevated urine mercury. In the target and comparison groups, there were no urine mercury concentrations greater the 20 *u*g Hg/g creatinine. These concentrations are well below concentrations that have been associated with mercury toxicity (50-100 *u*g Hg/g creatinine) from inorganic mercury, and suggest that individuals monitored in this study had not been highly exposed recently to inorganic or organic mercury.

STUDY STRENGTHS AND LIMITATIONS

Strengths

Recruitment of the target group participants was thorough and comprehensive. All media (press, radio, and television) were used throughout the process. Screening surveys were made available at numerous locations, such as convenience stores, fishing outfitters, and docks and marinas. Contacts were asked to inform others who might be interested and eligible. The number of exposed individuals who were eligible but chose not to participate, though unknown, is thought to be small.

The study used trained interviewers and a central data collection site. The study included a biomarker test for gathering objective data for valid comparisons. Questions about illnesses were designed to reduce the possibility of recall bias by asking the participants to report illnesses which had been diagnosed by a health care provider.

This study afforded an opportunity to examine reported seafood consumption in an area where mercury-contaminated seafood had been sampled, thus providing site-specific information which is seldom available. The dietary diary provided precise quantification of protein consumption and information on primary sources of protein in the respondents' diet, and detailed questions about fishing and hunting habits provided information as to amount, frequency, and species of seafood and wildgame consumed by study participants. This considerably strengthened confidence in the methodology used for developing the seafood intake values for the GDNR guidelines.

Although considerable professional judgment must always be used in selecting intake values for seafood, comparison of results with the GDNR consumption guidelines which had been in place over a period of years, gave confirmation of the appropriateness of the intake values used to develop these guidelines.

Throughout the study, a Study Advisory Group (SAG) comprised of representatives from community-based organizations, local government, commercial and recreational fishers, and other residents provided valuable input into recruitment of participants, fishing locations, and other matters critical to the successful conduct of a community-based study. Members helped recruit participants and inform residents about the study by presentations to local churches, civic associations, and fisher/hunter organizations. They also publicized the study informally through personal contacts.

Limitations

The study design was complicated by lack of definitive data on the number of exposed individuals. Consultations with knowledgeable residents and long-time area fishers were useful in determining probable fishing habits and developing an estimate of the upper number of individuals likely to have consumed mercury-contaminated seafood. Therefore, the study population involved an unknown but well-informed estimate of the types and numbers of fishers to be targeted for the study. The discussions with the informants also yielded suggestions for the most efficacious recruitment techniques. Other than the list of popular fishing locations used initially to recruit participants, no sampling frame was available. Recruitment was, therefore, not random, potentially introducing sampling bias. Although extensive efforts were made to recruit potential participants at all fishing locations as well as times, the field recruitment methods may have resulted in recruitment of participants who were the most accessible. Also, participation was voluntary, and monetary incentives were offered to those who completed the dietary diary; nevertheless, the incentives may not have been sufficient to persuade some individuals to participate.

Recruitment of the comparison group proved to be quite difficult. People were not enthusiastic about participating in the study despite efforts to explain the importance of adequate participation of community respondents to the results to the study. Although extensive efforts were made to obtain adequate representation of individuals of the general community, limitations in time, staff, and funding prevented further recruitment efforts within the time frame of the study.

Current consumption of seafood from the area falling under the GDNR seafood consumption guidelines was used as a surrogate of exposure. Whether the seafood actually consumed was mercury contaminated was not known. In addition, consumption of seafood from the restricted area may have occurred before this study was conducted. The urine mercury test measured current mercury levels in individuals, therefore past exposure would not have been detected.

Recall bias may have affected recollections of seafood and wildgame consumption, other mercury exposures, and fishing/hunting locations since these responses could not be validated. Although there was no independent measure of where seafood/wildgame were caught, a map of the area of interest was used to assist participants' recall of the areas in which they fished/hunted. Recall bias might have affected relationships between individual consumption levels and recall factors; however, there was no evidence to suggest that recall bias occurred more often in the target group than in the comparison group or vice versa. Any effect would therefore have been expected to be equally distributed between the groups.

The possibility of recall bias also exists due to the self-reporting of symptoms and diseases that were not independently verified by a check of physician or hospital records. However, questions about diseases were worded to reduce recall bias by requesting that participants report only diseases diagnosed by a health care provider.

CONCLUSIONS

1. Participants in the target group reported a higher number of statistically significant symptoms compared with participants in the comparison group.

2. Respondents generally under-estimated their amount of seafood consumption as reported in the questionnaire when compared to the amount they reported actually consuming as measured by the two-week dietary diary.

3. Seafood comprised a smaller proportion of protein in study participants' diets than anticipated.

4. The current GDNR risk-based seafood consumption guidelines are protective for the general public because individuals are not consuming more seafood per meal than values used in calculating the consumption guidelines.

5. The majority of study participants do not fish in the restricted area; the few that do, however, state that they are aware of the advisory.

6. All study participants had urine mercury concentration levels below the reference level of 20 *u*g Hg/g creatinine.

7. There is evidence that the target group consumed seafood from the restricted area, without evidence of high mercury burden.

RECOMMENDATIONS

1. Continue public education regarding the hazards of consuming mercury-contaminated seafood with a focus on pregnant and nursing women, children, the elderly, and those with compromised immune systems.

2. Continue monitoring of mercury levels in fish, shellfish, and other wildgame to ensure that the GDNR "Guidelines for Eating Fish from Georgia Waters" are appropriate.

3. Evaluate the feasibility of expanding the distribution area of the GDNR "Guidelines for Eating Fish from Georgia Waters".

4. Evaluate the feasibility of developing a fact sheet (based on the GDNR "Guidelines for Eating Fish from Georgia Waters") specific for fishing areas in Glynn County to be made available where fishing licenses are sold.

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TABLES

Table 1: Participation Rates for Target and Comparison Populations, Seafood Consumption Study, Brunswick, Georgia, 1996

	Target Group	Comparison Group
Screening Survey	282	122
Questionnaire	214 (76%)	106 (87%)
Dietary Diary	156 (55%)	87 (71%)
Urine Sample	139 (49%)	12 (10%)

Table 2: Demographic and other Characteristics of Target and Comparison Populations, Seafood Consumption Study, Brunswick, Georgia, 1996

Characteristics	Target Group (n=211)		Comparison Group (n=105)		X^2 Degrees of Freedom (p-value)
	Number	Percent	Number	Percent	
Gender					0.23
Male	110	52	51	49	1
Female	101	48	54	51	(0.60)
Age					
< 10 years	12	6	5	5	
10-19 years	12	6	10	10	9.28
20-29 years	20	9	7	7	6
30-39 years	33	15	12	11	(0.16)
40-49 years	31	15	13	12	
50-59 years	25	12	24	23	
60 and over	78	37	34	32	
Race					
White	197	94	92	88	4.59
African American	9	4	11	10	2
Other/unknown	5	2	2	2	(0.10)
Education (Individual)					
Elementary school	29	14	12	11	
High school	88	42	47	45	4.57
Comm coll/technical	23	11	7	7	5
4 year college	59	28	31	29	(0.47)
Graduate school	5	2	6	6	
None/refused	7	3	2	2	
Household Income					
<$15,000	28	13	6	6	16.90
$15,000-34,999	43	21	20	19	3
≥$35,000	53	25	49	47	**(0.00)**
Refused/Unknown	87	41	30	28	
Years living in Glynn Co.					
<10 years	25	12	30	29	26.53
10-19 years	27	13	26	25	4
20-29 years	39	18	14	13	**(0.00)**
30-39 years	44	21	11	10	
40+ years	76	36	24	23	

Bold type indicates statistical significance.

Table 3: Self-Reported Symptoms of Target and Comparison Populations, Seafood Consumption Study, Brunswick, Georgia, 1996

Symptom	Target Group (n=211)		Comparison Group (n=105)		χ^2 d.f. (p-value)*
	Number	Percent**	Number	Percent**	
Lightheadedness/dizzy					
None	140	67	84	80	10.84
Little	33	16	16	15	4
Moderate	17	8	3	3	**(0.03)**
Frequent	15	7	2	2	
A lot	5	2	0	0	
Difficulty concentrating					
None	156	74	94	89	12.32
Little	18	8	6	6	4
Moderate	14	7	3	3	**(0.01)**
Frequent	14	7	2	2	
A lot	9	4	0	0	
Confusion					
None	189	90	102	99	8.87
Little	9	4	0	0	4
Moderate	9	4	1	1	(0.06)
Frequent	2	1	0	0	
A lot	1	1	0	0	
Trouble remembering					
None	128	61	89	85	20.23
Little	38	18	11	10	4
Moderate	20	10	1	1	**(0.00)**
Frequent	18	9	3	3	
A lot	5	2	1	1	
Difficulty w/ phone #'s					
None	194	93	104	99	5.15
Little	12	5	1	1	3
Moderate	1	1	0	0	(0.16)
Frequent	1	1	0	0	
A lot	0	0	0	0	
Problems retaining reading/conversations					
None	180	86	103	98	11.54
Little	14	7	1	1	4
Moderate	7	3	1	1	**(0.02)**
Frequent	6	3	0	0	
A lot	2	1	0	0	
Irritability					
None	140	67	85	81	9.65
Little	31	15	12	11	4
Moderate	16	7	4	4	**(0.05)**
Frequent	12	6	4	4	
A lot	10	5	0	0	

Bold type indicates statistical significance.
* Fisher's exact
** Percentages based on number of valid responses

Table 3: Self-Reported Symptoms of Target and Comparison Populations, Seafood Consumption Study, Brunswick, Georgia, 1996 (Continued)

Symptom	Target Group (n=211)		Comparison Group (n=105)		χ^2 d.f. (p-value)*
	Number	Percent**	Number	Percent**	
Depression					
None	160	76	94	89	8.98
Little	22	11	6	6	4
Moderate	12	6	3	3	(0.06)
Frequent	13	6	1	1	
A lot	3	1	1	1	
Sleep changes					
None	157	75	91	86	9.50
Little	13	6	6	6	4
Moderate	20	10	7	7	**(0.05)**
Frequent	7	3	1	1	
A lot	12	6	0	0	
Clumsiness					
None	169	81	95	90	5.60
Little	20	10	5	5	4
Moderate	13	6	2	2	(0.23)
Frequent	5	2	2	2	
A lot	2	1	1	1	
Difficulty grasping					
None	172	82	92	88	3.47
Little	14	7	3	3	4
Moderate	12	6	7	7	(0.48)
Frequent	5	2	2	1	
A lot	6	3	1	1	

Bold type indicates statistical significance.
* Fisher's exact
** Percentages based on number of valid responses

Table 4: Logistic Regression Models* for Selected Self-reported Symptoms of Target and Comparison Group Populations, Seafood Consumption Study, Brunswick, Georgia, 1996

Symptom	Beta (Target Group)	Standard Error	Odds Ratio	p-value
Lightheadedness / dizzy	0.79	0.29	2.2	0.007
Difficulty concentrating	1.10	0.36	3.0	0.002
Trouble remembering	1.33	0.32	3.8	0.0001
Irritability	0.70	0.29	2.0	0.017
Depression	1.04	0.37	2.8	0.0051
Sleep changes	0.82	0.34	2.3	0.017

* Model is adjusted for the following covariates: alcohol consumption, smoking, gender, and age.

Table 5: Crude Odds Ratios (ORs) for Self-Reported Illnesses of Target and Comparison Populations, Seafood Consumption Study, Brunswick, Georgia, 1996

Illness	Target Group (n=211)	Comparison Group (n=105)	OR (95% C.I.)	p-value
Loss of consciousness/head injury				
Yes	23	7	1.73	0.30
No	186	98	(0.67-4.65)	
Brain tumor				
Yes	3	1	---	---
No	206	104		
Seizures				
Yes	8	2	---	---
No	201	103		
Kidney infections				
Yes	31	13	1.23	0.68
No	178	92	(0.58-2.64)	
Kidney stones				
Yes	18	9	1.01	0.84
No	191	96	(0.41-2.54)	
Kidney failure				
Yes	3	1	---	---
No	206	104		
Kidney disease				
Yes	5	3	---	---
No	204	102		
Bladder infections				
Yes	56	26	1.11	0.80
No	153	79	(0.62-1.99)	
Bladder disease				
Yes	11	3	---	---
No	198	102		
Gallstones				
Yes	16	6	1.37	0.69
No	193	99	(0.48-4.09)	
Mental retardation				
Yes	1	1	---	---
No	208	104		
Cerebral palsy				
Yes	0	1	---	---
No	209	104		
Diabetes				
Yes	17	7	1.25	0.64
No	191	98	(0.46-3.47)	
Stroke				
Yes	4	4	---	---
No	205	101		

Table 5: Crude Odds Ratios (ORs) for Self-Reported Illnesses of Target and Comparison Populations, Seafood Consumption Study, Brunswick, Georgia, 1996 (Continued)

Illness	Target Group (n=211)	Comparison Group (n=105)	OR (95% C.I.)	p-value
Thyroid				
Yes	16	11	0.71	0.40
No	193	94	(0.29-1.72)	
Alcoholism				
Yes	4	4	----	----
No	204	101		
Encephalitis / meningitis				
Yes	2	1	----	----
No	206	104		
Parkinson's disease				
Yes	0	2	----	----
No	208	103		
Children Only (15 years or younger)				
Behavioral problems				
Yes	4	0	----	----
No	10	9		
Developmental delays				
Yes	1	0	----	----
No	13	9		
Learning problems				
Yes	4	0	----	----
No	10	9		

Table 6: Crude Odds Ratios for Self-Reported Reproductive Problems of Target and Comparison Populations, Seafood Consumption Study, Brunswick, Georgia, 1996

Reproductive Problems Females > 12 Years	Target Group	Comparison Group	OR (95% C.I.)	p-value
Miscarriage				
Yes	25	17	0.88	0.88
No	52	31	(0.38-2.03)	
Stillbirths				
Yes	5	2	----	----
No	72	47		
Premature labor				
Yes	17	5	2.49	0.14
No	60	44	(0.78-8.50)	
Low birthweight baby				
Yes	9	4	----	----
No	68	45		
Reproductive system disease / surgery				
Yes	35	14	1.56	0.32
No	56	35	(0.69-3.57)	
Endometriosis				
Yes	13	4	----	----
No	78	45		
Hysterectomy				
Yes	47	19	1.69	0.20
No	44	30	(0.78-3.66)	
Are you pregnant now?				
Yes	3	0	----	----
No	78	50		
Total number of times pregnant				
0	11	1		
1	9	4		
2	22	18		0.22
3	18	12		
4+	28	15		
Difficulty conceiving				
Yes	11	7	0.86	0.98
No	75	41	(0.28-2.71)	

Table 7: Patterns of Eating, Catching, and Buying Seafood and Wildgame for the Past Month among Target and Comparison Group Populations, Seafood Consumption Study, Brunswick, Georgia, 1996

Question	Target Group (n=211)		Comparison Group (n=105)	
	Number	Percent	Number	Percent
Ate seafood in past month				
Yes	194	92	89	87
No	16	8	13	13
Caught local* seafood/wildgame in past month				
Yes	82	39	8	8
No	126	61	97	92
Bought seafood in past month				
Yes	118	56	75	71
No	93	44	30	29

* For the target group, "local seafood/wildgame" refers to seafood or wildgame that was caught locally including, the advisory area; for the comparison group, "local seafood/wildgame" refers to seafood or wildgame that was caught locally but not in the advisory area.

Table 8: Frequency of Seafood and Wildgame Consumption* During Past Month among Target and Comparison Group Populations, Seafood Consumption Study, Brunswick, Georgia, 1996

Question	Target Group (n=211)		Comparison Group (n=105)	
	Number	Percent	Number	Percent
Frequency of seafood consumption in past month				
< once a week	77	36	44	42
about once a week	80	38	33	31
> once a week	37	18	11	11
Other/missing	17	8	17	16
Frequency of harvesting local** seafood/wildgame in past month				
< once a week	38	18	5	5
about once a week	25	12	2	2
> once a week	16	8	1	1
Other/missing	132	62	97	92
Frequency of buying local** seafood/wildgame in past month				
< once a week	66	31	43	41
about once a week	38	18	25	24
> once a week	12	6	7	7
Other/missing	95	45	30	28

* Includes both caught and bought seafood

** For the target group, "local seafood/wildgame" refers to seafood or wildgame that was caught locally, including the advisory area; for the comparison group, "local seafood/wildgame" refers to seafood or wildgame that was caught locally but not in the advisory area.

Table 9: Patterns of Eating, Catching, and Buying Seafood and Wildgame for the Past Six Months among Target and Comparison Group Populations, Seafood Consumption Study, Brunswick, Georgia, 1996

Question	Target Group (n=211)		Comparison Group (n=105)	
	Number	Percent	Number	Percent
Ate seafood in last six months				
Yes	205	99	97	92
No	2	1	8	8
Caught local* seafood/wildgame in last six months				
Yes	113	54	10	10
No	96	46	95	90
Bought seafood in last six months				
Yes	156	74	83	79
No	54	26	22	21

* For the target group, "local seafood/wildgame" refers to seafood or wildgame that was caught locally including, the advisory area; for the comparison group, "local seafood/wildgame" refers to seafood or wildgame that was caught locally but not in the advisory area.

Table 10: Frequency of Seafood and Wildgame Consumption* During Past Six Months among Target and Comparison Group Populations, Seafood Consumption Study, Brunswick, Georgia, 1996

Question	Target Group (n=211)		Comparison Group (n=105)	
	Number	Percent	Number	Percent
Frequency of seafood consumption in past six months				
< once a month	21	10	21	20
about once a month	51	24	29	27
> once a month	131	62	47	45
Other/missing	8	4	8	8
Frequency of harvesting local seafood/wildgame in past six months				
< once a month	21	10	8	8
about once a month	26	12	1	1
> once a month	62	30	1	1
Other/missing	102	48	95	90
Frequency of buying local** seafood /wildgame in past six months				
< once a month	47	22	25	24
about once a month	39	19	24	23
> once a month	65	31	34	32
Other/missing	60	28	22	21

* includes both caught and bought seafood

** For the target group, "local seafood/wildgame" refers to seafood or wildgame that was caught locally including, the advisory area; for the comparison group, "local seafood/wildgame" refers to seafood or wildgame that was caught locally but not in the advisory area.

Table 11: Seafood and Wildgame Harvesting Locations among Target Group Participants, Seafood Consumption Study, Brunswick, Georgia, 1996

Question	Target Group			
	Past month n=78	Percent	Past 6 months n=98	Percent
Locations:				
Blythe Island	8	10	9	9
Yellow Bluff Creek	3	4	2	2
Academy Creek/East R	0	0	3	3
Purvis Creek	0	0	0	0
Turtle River (Hwy 303)	7	9	5	5
Gibson Creek below 303	1	1	0	0
Gibson Creek above 303	1	1	0	0
Other	58	74	79	81

Table 12: Advisory Compliance among Target Group Participants, Seafood Consumption Study, Brunswick, Georgia, 1996

Question	Target
Caught seafood/wildgame from the Turtle River Advisory Area in the last 5 years	
Yes	108
No	97
Missing	6
Year caught seafood /wildgame from the Advisory Area	
1995	39
1994	18
1993	30
1992	10
Missing	11
Frequency of catching seafood/wildgame from the Advisory Area during past 5 years	
< once a month	31
about once a month	14
> once a month	57
Missing	6
Knew that there was an Advisory for part of Turtle River, Purvis and Gibson Creeks	
Yes	190
No	15
Don't know	4
Changed fishing habits or amount or types of seafood eaten from Advisory Area	
Yes	136
No	57
Don't know	4
Change in fishing habits or amount or types of seafood eaten due to Advisory	
Yes	129
No	6
Concerned about the contamination of seafood from the Advisory Area	
Yes	170
No	31
Don't know	8

Table 13: Demographic and other Characteristics of Target and Comparison Populations Who Completed the Dietary Diary Section of the Seafood Consumption Study, Brunswick, Georgia, 1996

Characteristics	Target Group (n=156)		Comparison Group (n=87)		X^2 Degrees of Freedom (p-value)
	Number	Percent	Number	Percent	
Gender					0.02
Male	78	50	42	48	1
Female	78	50	45	52	(0.90)
Age					
< 10 years	6	4	5	6	
10-19 years	10	6	8	9	5.48
20-29 years	10	6	7	8	6
30-39 years	25	16	11	13	(0.48)
40-49 years	27	17	9	10	
50-59 years	21	14	18	21	
60 and over	57	37	29	33	
Race					
White	147	94	80	92	0.52
African American	6	4	5	6	2
Other/unknown	3	2	2	2	(0.77)
Participation in local fishing/hunting activities					48.25
Yes	101	68	16	19	1
No	48	32	67	81	(0.00)
Type of fisher/hunter					
Commercial	3	3	0	0	2.72
Subsistence	1	1	1	6	2
Recreational	97	96	15	94	(0.26)

Table 14: Source of Dietary Protein in Target and Comparison Group Populations, Seafood Consumption Study, Brunswick, Georgia, 1996

Protein Source*	Target Group Mean % (Range)	Comparison Group Mean % (Range)
Beef	31 (0 - 86)	33 (0 - 85)
Pork	25 (0 - 65)	29 (0 - 60)
Poultry	23 (0 - 65)	25 (0 - 63)
Seafood	18 (0 - 80)	13 (0 - 100)
Game	3 (0 - 32)	1 (0 - 21)

* Consumption measured in grams for each participant

Table 15: Type of Seafood Meals Consumed* During the Two-Week Dietary Diary among Target and Comparison Group Participants, Seafood Consumption Study, Brunswick, Georgia, 1996

Seafood Type	Target Group		Comparison Group		Total
	Number	Percent	Number	Percent	
Shrimp	196	45	69	41	265
Tuna	59	14	29	17	88
Trout	45	10	10	6	55
Crab	35	8	10	6	45
Catfish	20	5	13	8	33
Salmon	18	4	12	7	30
Flounder	19	4	7	4	26
Oysters	14	3	9	5	23
Clams	12	3	6	4	18
Whiting	14	3	5	2	19
All others	118	21**	52	23**	170
Total	550	100.0	222	100.0	772

* Includes both caught and bought seafood
** All other types of seafood meals made up < 2% each of total

Table 16: Type and Location of Caught Seafood and Wildgame Meals Consumed During the Two-Week Dietary Diary among Target Group Participants, Seafood Consumption Study, Brunswick, Georgia, 1996

Type*	Advisory Area	Blythe Island	Other Local	Total
Shrimp	8	5	64	77
Trout	7	11	22	40
Crab	1	12	11	24
Flounder	2	5	8	15
Spotted Sea Trout	4	3	5	12
Bass	2	0	6	8
Whiting	3	0	4	7
Venison	4	1	15	20
All Other Species	3	0	44	47
Total	34	37	179	250

* Includes only caught seafood and wildgame

Table 17: Seafood Consumption Levels (Questionnaire) Compared to Actual Consumption Levels (Dietary Diary), Seafood Consumption Study, Brunswick, Georgia, 1996

Questionnaire Response	Target Group (n=144)			Comparison Group (n=68)		
	Dietary Diary			Dietary Diary		
	n	Mean (%)*	Range*	n	Mean (%)*	Range*
None	n/a	n/a	n/a	2	20	5-34
A little	38	16	0-50	34	17	2-100
Moderate	77	18	1-50	24	18	5-42
A lot	29	27	3-80	8	24	15-37

* measured percentage of diet from seafood

Table 18: Agreement of Seafood Consumption as reported in the Questionnaire and the Dietary Diary, Target and Comparison Group Participants, Seafood Consumption Study, Brunswick, Georgia, 1996

	Target Group (n=135)				Comparison Group (n=74)			
Questionnaire	Dietary Diary				Dietary Diary			
	< 1 week	1 week	> 1 week	Total	< 1 week	1 week	> 1 week	Total
< 1 week	*10*	12	28	58	*10*	7	13	30
1 week	4	*8*	46	58	3	*5*	19	27
> 1 week	1	2	*24*	29	0	0	*5*	5
Total	15	22	98	145	13	12	37	62

Italic type indicates areas of agreement

Table 19: Characteristics of Target Group Population by Urine Mercury Concentrations, Seafood Consumption Study, Brunswick, Georgia, 1996

Variable	Population		Hg < Reporting Limit*		Hg > Reporting Limit*	
	Number	Percent	Number	Percent	Number	Percent
Total	137	100	86	63	51	37
Age Group						
< 20	11	8	9	11	2	4
20-29	7	5	3	3	4	8
30-39	22	16	16	19	6	12
40-49	22	16	9	10	13	25
50-59	19	14	13	15	6	12
60+	56	41	36	42	20	39
Gender						
Female	67	49	45	52	22	43
Male	70	51	41	48	29	57
Residence in Glynn County						
< 10 years	13	9	6	7	7	14
10-19 years	18	13	15	17	3	6
20-29 years	26	19	15	17	11	22
30-39 years	29	21	17	20	12	23
40-49 years	20	15	10	12	10	20
50+ years	31	23	23	27	8	15

* The reporting limit for mercury in urine from the laboratory is 0.5 *ug*/L.

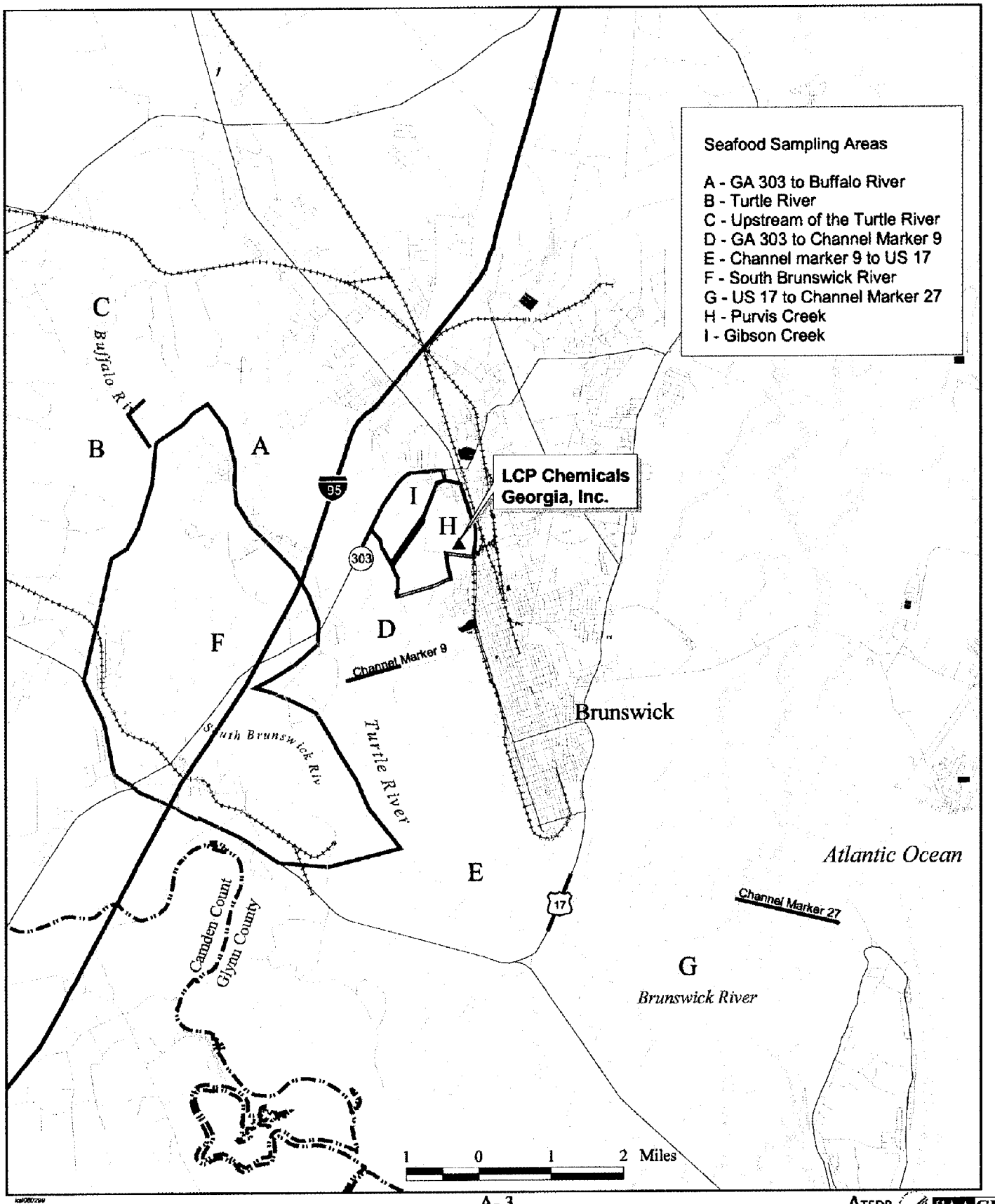
APPENDICES

Appendix A- Map of the LCP Area, Including Turtle River and its Tributaries

Brunswick, Georgia

Seafood Sampling Areas

Glynn County, GA



ATSDR SAAGIS

Appendix B- Screening Survey

SCREENING SURVEY FOR PARTICIPATION

This questionnaire is voluntary and confidential. We are conducting a study in response to significant community concerns regarding the safety of eating locally caught seafood. Please circle your answer.

1. Have you lived in Glynn County since at least January 1, 1994?

Yes No

If you answered NO, please turn this form over and go to number 8. If you answered Yes, please continue.

2. Have you ever worked at LCP Chemicals or Allied Signal (formerly Allied Chemical) in Brunswick?

Yes No

If you answered Yes, please turn this form over and go to number 8. If you answered NO, please continue.

3. What is your age? _____

4. Have you ever FISHED or harvested seafood from the Turtle River or its tributaries in Glynn County? (see attached map)

Yes No

5. Have you ever EATEN seafood taken from the Turtle River or its tributaries in Glynn County? (see attached map)

Yes No

6. Would you be interested in participating in a study of seafood consumption in this area?

Yes No

7. Please let us know when it would be convenient for us to contact you for an interview.

_____ Time _____ Date _____ Location

Please provide the following information so we may contact you:

Name_____ # in Household_____

Address_____

_____

Phone Number_____

If you do not wish to participate, could you please give us a reason why?

_____

_____

8. **If you would like more information about this study, please check all of the following that apply:**

_____ Please add me to the mailing list to receive the Glynn County Health Department's Quarterly Hazardous Waste Site Newsletter.

_____ I am concerned about local community environmental issues and would be willing to serve on a Community Advisory Panel.

9. **Please provide the following contact information (please print neatly):**

Name_____

Address_____

_____

Phone Number_____

Thank you for participating. Please return this questionnaire to:

Hazardous Waste Program
Glynn County Health Department
1716 Ellis St.
Brunswick, GA 31520

Call the Hazardous Waste Program office at 264-3236 for more information.

Thank you for your help today.

Appendix C- Study Questionnaire

PARTICIPANT I.D. #: SC _____

Time Interview Began: _ _ : _ _ AM/PM Date: ___/ ___ /___

INSTRUCTIONS: IF 5 - 12 YRS OLD; PARENT/GUARDIAN ANSWERS
IF 13 - 17 YRS OLD; CHILD ANSWERS (with parent present)
IF 18 OR OLDER; PARTICIPANT ANSWERS

SECTION I: DEMOGRAPHICS/PERSONAL

To begin, I would like to ask you a few questions about yourself. You can refuse to answer any question, but please answer all questions you choose to answer as truthfully and completely as possible.

1.1 What is your (SUBJECT's) full name? (Please print clearly)

First _____

Middle _____

Last _____

1.2 What is your (SUBJECT's) current street address?

_____ _____
Number Street Apt.

_____ _____
City State

_____
Zip Code

1.2.1 Your (SUBJECT's) mailing address (if different from above):

_____

_____

1.3 What are the telephone numbers where you (SUBJECT) can be reached?

(__ __ __) - __ __ __ - __ __ __ __ (Home)

(__ __ __) - __ __ __ - __ __ __ __ (Work)

PARTICIPANT I.D. #: SC _____

Time Interview Began: _ _ : _ _ AM/PM Date: ___/ ___ /___

1.4 Is there a phone where **you (SUBJECT)** can be reached?

1 = Has phone
2 = No phone **(If NO, go to 1.5)**
8 = Refused to answer
9 = Don't know

1.4.1 In the event that we need to contact **you (SUBJECT)** by telephone, when is a good time to call?

3 = Morning
4 = Afternoon
5 = Evening
6 = Weekend
10 = Anytime

1.5 Relationship of adult to **SUBJECT:**

1 = Self
2 = Spouse
3 = Parent
4 = Child
5 = Other relative
6 = Legal guardian
10 = Other, specify _____

1.6 What is **your (SUBJECT's)** date of birth?

__ __/__ __/__ __ (mm/dd/yr)

1.6.1 What is **your (SUBJECT's)** age now? _____ years

1.7 **Interviewer: INQUIRE/DETERMINE GENDER OF SUBJECT**

1 = Male
2 = Female

1.8 Which of the following best describes **your (SUBJECT's)** race?
(Interviewer: READ THE LIST)

1 = African-American
2 = White
3 = Asian
4 = Native American
5 = Hispanic
6 = Pacific Islander
10 = Other
8 = Refused to answer
9 = Don't Know

1.9 How many years have **you (SUBJECT)** lived in Glynn County?

_____ years

PARTICIPANT I.D. #: SC _____

SECTION II: RESIDENCE

Now, I would like to ask you some questions about the home you (SUBJECT) live in. (Where Subject has lived most of the time in the past 2 years.) Circle applicable answer.

2.1 What year was the house that **you (SUBJECT)** live in built? (oldest part)

1 = Prior to 1900
2 = 1900 - 1925
3 = 1926 - 1950
4 = 1951 - 1975
5 = 1976 - 1990
6 = 1991 - Present
8 = Refused to answer
9 = Don't know

2.2 How long have **you (SUBJECT)** lived in this house? (continuously)

__ __ (years)
8 = Refused to answer
9 = Don't know

2.3 What type of water pipes does the home contain?

1 = Lead
2 = Plastic/PVC
3 = Galvanized steel
4 = Copper
5 = Iron
10 = Other (specify) _____
8 = Refused to answer
9 = Don't know

What type of water does **your (SUBJECT's)** household normally use MOST for: **(read A followed by choices, then read B and choices)**

	A) 2.4 Drinking	B) 2.5 Cooking
Choices		
Private Well	1	1
Community Well	2	2
Purchased Bottled	3	3
City (Municipal)	4	4
Cistern	5	5
Other _____	10	10
Refused to Answer	8	8
Don't Know	9	9

2.6 Has any part of **your (SUBJECT's)** house been repainted, sanded, or refinished within the past year?

1 = Yes
2 = No
8 = Refused to Answer
9 = Don't Know

PARTICIPANT I.D. #: SC _____

2.7 How many people are permanent residents of this household?

__ __ Number of permanent residents
8 = Refused to answer
9 = Don't know

SECTION III: TOBACCO / ALCOHOL

The next few questions concern smoking and alcohol consumption.

3.1 Do you (SUBJECT) smoke tobacco now?

1 = Yes **(GO TO 3.1.2)**
2 = No
8 = Refused to answer
9 = Don't know

3.1.1. Did you (SUBJECT) smoke and have since quit?

1 = Yes
2 = No **(GO TO 3.3)**
8 = Refused to answer
9 = Don't know

3.1.2 How many years total did/have you (SUBJECT) smoked?

__ __ years

On average, how much do/did you (SUBJECT) smoke?

3.2.1	__ __ Cigarettes	per ___	1 = day
3.2.2	__ __ Cigars	per ___	2 = week
3.2.3	__ __ Bowls	per ___	3 = month
			4 = year

3.3 Do you (SUBJECT) drink alcoholic beverages (including beer, wine or wine coolers, liquor or moonshine?

1 = Yes **(GO TO 3.4.2)**
2 = No
8 = Refused to answer
9 = Don't know

3.3.1 Did you (SUBJECT) drink alcohol and have since quit?

1 = Yes
2 = No **(GO TO 4.1)**
8 = Refused to answer
9 = Don't know

3.3.2 How many years total did/have **you (SUBJECT)** been drinking alcohol?

__ __ years

3.4.1 On the average, how many drinks do/did **you (SUBJECT)** have? (1 DRINK = 1 BEER, 1 SHOT LIQUOR, 1 GLASS WINE/COOLER)

__ __ Drinks per ___ 1 = day
2 = week
3 = month
4 = year

SECTION IV: HEALTH HISTORY

The next few questions are about your (SUBJECT'S) health history.

4.1 Have **you (SUBJECT)** ever been hospitalized for or has a doctor ever told you (SUBJECT) that **you (HE/SHE)** have any of the following conditions or diseases:

		YES	NO	RA	DK
a)	Loss of Consciousness/Head Injury	1	2	8	9
b)	Brain Tumor	1	2	8	9
c)	Seizures	1	2	8	9
d)	Kidney Infections	1	2	8	9
e)	Kidney Stones	1	2	8	9
f)	Kidney Failure	1	2	8	9
g)	Kidney Disease	1	2	8	9
h)	Bladder Infections	1	2	8	9
i)	Bladder Disease	1	2	8	9
j)	Gallstones	1	2	8	9
k)	Mental Retardation	1	2	8	9
l)	Cerebral Palsy	1	2	8	9
m)	Diabetes	1	2	8	9
n)	Stroke	1	2	8	9
o)	Thyroid Problems	1	2	8	9
p)	Diagnosis of Alcoholism	1	2	8	9
q)	Encephalitis or Meningitis	1	2	8	9
r)	Parkinson's Disease				
For Children Only					
aa)	Behavioral Problems	1	2	8	9
bb)	Developmental Delays	1	2	8	9
cc)	Learning Problems	1	2	8	9

4.2 Please identify, and describe the frequency of the following symptoms **you (SUBJECT)** may have experienced over the past 2 years.

		None	Little	Moderate	Frequent	A Lot	RA	DK
a)	Lightheadedness/Dizzy	1	2	3	4	5	8	9
b)	Difficulty Concentrating	1	2	3	4	5	8	9
c)	Confusion/Disorientation	1	2	3	4	5	8	9
d)	Trouble Remembering	1	2	3	4	5	8	9
e)	Difficulty looking up and dialing phone #'s	1	2	3	4	5	8	9
f)	Hard to understand or retain meaning reading/ conversations	1	2	3	4	5	8	9
g)	Irritability	1	2	3	4	5	8	9
h)	Depression	1	2	3	4	5	8	9
i)	Sleep Changes	1	2	3	4	5	8	9
j)	Clumsiness/Loss of Balance	1	2	3	4	5	8	9
k)	Difficulty moving fingers or grasping/tremor	1	2	3	4	5	8	9

4.3 **[If female subject, > than 12 years old]** Do **you (SUBJECT)** have a history of any of the following problems:

		YES	NO	RA	DK
a)	Miscarriage	1	2	8	9
b)	Stillbirths	1	2	8	9
c)	Premature labor	1	2	8	9
d)	Low birthweight baby	1	2	8	9
e)	Reproductive system disease/surgery	1	2	8	9
f)	Endometriosis	1	2	8	9
g)	Hysterectomy	1	2	8	9

4.4 Have **you (SUBJECT)** ever experienced difficulty conceiving?

1 = Yes
2 = No
8 = Refused to answer
9 = Don't know

THE FOLLOWING TWO QUESTIONS ARE FOR FEMALES 12 YEARS OF AGE AND OLDER. FOR ALL OTHERS, GO TO QUESTION 4.7

The next two questions are about pregnancy.

4.5 Are **you (SUBJECT)** pregnant now?

1 = Yes
2 = No
8 = Refused to answer
9 = Don't know

4.6 What is the **total** number of times in **your (SUBJECT's)** life that you **(SUBJECT)** have been pregnant? Count current pregnancy if pregnant now, and count all other pregnancies including livebirths, stillbirths, miscarriages, or abortions.

__ __ Total pregnancies in lifetime
8 = Refused to answer
9 = Don't know

4.7 Do **you (SUBJECT)** take any medicines regularly?

1 = Yes
2 = No
8 = Refused to answer
9 = Don't know

If yes, please tell me about all prescription and over-the-counter medicines that **you (SUBJECT)** take regularly.

	Name of Medicine	Reason for Taking
a)		
b)		
c)		
d)		
e)		

Please explain any health-related problems **you (SUBJECT)** have had and when:

_____

_____

_____

_____

_____

4.8 May we review the medical records in the treating doctor's office?
1 = Yes
2 = No
8 = Refused to answer
9 = Don't know

PARTICIPANT I.D. #: SC _____

SECTION V: DIETARY

Now I'd like to ask you some questions about your (SUBJECT'S) diet and food preparation at home.

5.1 When food or drinks are prepared, served or stored, are they often placed in **clay pottery or ceramic** dishes?

1 = Yes
2 = No
8 = Refused to answer
9 = Don't know

5.2 When food or drinks are prepared, served or stored, are they often placed in **copper or pewter** dishes or containers?

1 = Yes
2 = No
8 = Refused to answer
9 = Don't know

5.3 When food is stored or put away, is it sometimes **stored in the original can after being opened?**

1 = Yes
2 = No
8 = Refused to answer
9 = Don't know

THE NEXT QUESTION IS FOR CHILDREN 5 - 12 YEARS OLD.
FOR ALL OTHERS, GO TO QUESTION 6.1

5.4 Sometimes children put things in their mouth other than food. How often does **(CHILD'S NAME)** put things other than food in his/her mouth?

1 = None
2 = A little
3 = Moderate
4 = A lot
8 = Refused to answer
9 = Don't know
IF YES, SPECIFY _____

SECTION VI: SEAFOOD

The next series of questions are about eating fish and seafood, including fresh fish, frozen fish, canned fish or shellfish and wild game.

6.1 How would you describe **your (SUBJECT's)** level of seafood consumption?

1 = None **(GO TO 6.3)**
2 = A little
3 = Moderate
4 = A lot
8 = Refused to answer
9 = Don't know

PARTICIPANT I.D. #: SC _____

6.2 Did **you (SUBJECT) EAT** fish, shellfish, or other seafood in the **last month?**

1 = Yes
2 = No **(GO TO 6.3)**
8 = Refused to answer
9 = Don't know

6.2.1 Which of the following best describes how often **you (SUBJECT) ATE** fish: fresh, frozen, canned fish or shellfish, **last month?**

1 = Less than once a week. **(GO TO 6.3)**
2 = About once a week. **(GO TO 6.3)**
3 = More than once a week.
8 = Refused to answer
9 = Don't know

6.3 Did **you (SUBJECT) CATCH LOCAL** fish, shellfish, or other wildlife in the **last month?**

1 = Yes
2 = No **(GO TO 6.4)**
8 = Refused to answer
9 = Don't know

6.3.1 Which of the following best describes how often **you (SUBJECT) CAUGHT LOCAL** fish, shellfish, or other wildlife in the **last month?**

1 = Less than once a week. **(GO TO 6.3.3)**
2 = About once a week. **(GO TO 6.3.3)**
3 = More than once a week.
8 = Refused to answer
9 = Don't know

Now I would like to determine where **you (SUBJECT) USUALLY CAUGHT LOCAL** seafood. Please use the list to identify where **you (SUBJECT)** usually **CAUGHT** the seafood.

6.3.2 Where did **you (SUBJECT)** usually **CATCH LOCAL** fish **last month?**

1 = Blythe Island
2 = Yellow Bluff Creek
3 = Academy Creek/East River
4 = Purvis Creek
5 = Turtle River between Hwy. 303 and mile marker 9
6 = Gibson Creek below Hwy. 303
7 = Gibson Creek above Hwy. 303
10 = Other, please specify _____
8 = Refused to answer
9 = Don't know

PARTICIPANT I.D. #: SC _____

6.4 Was fish or shellfish **BOUGHT** to be eaten by members of the household **last month**?

1 = Yes
2 = No **(GO TO 6.5)**
8 = Refused to answer
9 = Don't know

6.4.1 Which of the following best describes how often **you (SUBJECT) BOUGHT** fish, shellfish, or other wildlife in the **last month**?

1 = Less than once a week.
2 = About once a week.
3 = More than once a week.
8 = Refused to answer
9 = Don't know

6.4.2 Where was fish usually **BOUGHT** to be eaten by members of the household **last month**?

1 = Local fish market/Roadside stand
2 = Dockside
3 = Private fisherman
4 = Fast food
5 = Restaurant
6 = Chain grocery store
7 = Local grocer
10 = Other, please specify _____
8 = Refused to answer
9 = Don't know

6.5 Now I would like to ask a few questions similar to the questions just asked to determine how often **you (SUBJECT) ATE** fish during the **last 6 months**. Have **you (SUBJECT) EATEN** any fresh, frozen, or canned fish in the **last 6 months**?

1 = Yes
2 = No **(GO TO 6.6)**
8 = Refused to answer
9 = Don't know

6.5.1 Which of the following best describes how often **you (SUBJECT) ATE** fish: fresh, frozen, canned fish or shellfish in the **last 6 months**?

1 = Less than once a month.
2 = About once a month.
3 = More than once a month.
8 = Refused to answer
9 = Don't know

PARTICIPANT I.D. #: SC _____

6.6 Did you (SUBJECT) **CATCH LOCAL** fish, shellfish, or wildlife in the last **6 months**?

1 = Yes
2 = No **(GO TO 6.7)**
8 = Refused to answer
9 = Don't know

6.6.1 Which of the following best describes how often you (SUBJECT) **CAUGHT LOCAL** fish, shellfish, or other wildlife in the last **6 months**?

1 = Less than once a month.
2 = About once a month.
3 = More than once a month.
8 = Refused to answer
9 = Don't know

6.6.2 Where did you (SUBJECT) usually **CATCH LOCAL** fish in the last **6 months**?

1 = Blythe Island
2 = Yellow Bluff Creek
3 = Academy Creek/East River
4 = Purvis Creek
5 = Turtle River between Hwy. 303 and mile marker 9
6 = Gibson Creek below Hwy. 303
7 = Gibson Creek above Hwy. 303
10 = Other, please specify _____
8 = Refused to answer
9 = Don't know

6.7 Was fish or shellfish **BOUGHT** to be eaten by members of the household in the last **6 months**?

1 = Yes
2 = No **(GO TO 6.8)**
8 = Refused to answer
9 = Don't know

6.7.1 Which of the following best describes how often you (SUBJECT) **BOUGHT** fish, shellfish, or other wildlife in the last **6 months**?

1 = Less than once a month.
2 = About once a month.
3 = More than once a month.
8 = Refused to answer
9 = Don't know

6.7.2 Where was fish, shellfish usually **BOUGHT** to be eaten by members of the household in the **last 6 months?**

1 = Local fish market/roadside stand
2 = Dockside
3 = Private fisherman
4 = Fast food
5 = Restaurant
6 = Chain grocery store
7 = Local grocer
10 = Other, please specify _____
8 = Refused to answer
9 = Don't know

6.8 Did you (SUBJECT) **CATCH LOCAL** fish, shellfis, or wildlife from the Turtle River advisory area in the **last 5 years?**

1 = Yes
2 = No (GO TO 6.9)
8 = Refused to answer
9 = Don't know

6.8.1 When did **you (SUBJECT)** last **CATCH LOCAL** fish, shellfish, or wild game from the Turtle River advisory area?

1 = 1995
2 = 1994
3 = 1993
4 = 1992

6.8.2 Which of the following best describes how often **you (SUBJECT) CAUGHT LOCAL** fish, shellfish, or other wildlife from the Turtle River advisory area during the **last 5 years?**

1 = Less than once a month.
2 = About once a month.
3 = More than once a month.
8 = Refused to answer
9 = Don't know

6.8.3 Where did **you (SUBJECT)** usually **CATCH LOCAL** fish in the last **5 years?**

1 = Blythe Island
2 = Yellow Bluff Creek
3 = Academy Creek/East River
4 = Purvis Creek
5 = Turtle River between Hwy. 303 and mile marker 9
6 = Gibson Creek below Hwy. 303
7 = Gibson Creek above Hwy. 303
10 = Other, please specify _____
8 = Refused to answer
9 = Don't know

6.9 If a piece of sliced bread represents 1 portion of fish, about how many portions this size would **you (SUBJECT)** usually eat in an average meal?

__ __.__ portions (e.g. 0.5 = 1/2 slice, 1.0 = 1 slice, 2.0, 3.5, etc.)

6.10 How often do **you (SUBJECT)** usually gut and clean fish before eating?

1 = Never
2 = Seldom
3 = Sometimes
4 = Often
8 = Refused to answer
9 = Don't know

SECTION VII: HOBBIES/OCCUPATIONS

The next set of questions are about jobs YOU (SUBJECT) and persons in your (SUBJECT's) home may have or have had.

7.1 Have **you (SUBJECT)** ever worked in the seafood industry?

1 = Yes
2 = No **(GO TO 7.2)**
8 = Refused to answer
9 = Don't know

7.1 What types of seafood industry-related work did **you (SUBJECT)** do?

		YES	NO
a)	Catching/Sorting Seafood	1	2
b)	Cleaning Seafood	1	2
c)	Packaging Seafood	1	2
d)	Soldering Cans	1	2
e)	Transportation/Handling	1	2
f)	Clerical/Administration	1	2
g)	Other	1	2

IF OTHER, specify:_____

7.1.2 How long did/have **you (SUBJECT)** worked in the seafood industry? (3 months = .25 yrs; 6 months = .50 yrs; 9 months = .75 yrs.)

__ __ Years
88 = Refused to answer
99 = Don't know

7.1.3 Do **you (SUBJECT)** work in the seafood industry now?

1 = Yes
2 = No
8 = Refused to answer
9 = Don't know

7.2 Have **ANY** members of **your (SUBJECT's)** household, not including yourself **(SUBJECT)**, worked in the seafood industry?

1 = Yes
2 = No (GO TO 7.3)
8 = Refused to answer
9 = Don't know

7.2 What type of seafood processing or fishing related work have OTHER household members done?

		YES	NO
a)	Catching/Sorting Seafood	1	2
b)	Cleaning Seafood	1	2
c)	Packaging Seafood	1	2
d)	Soldering Cans	1	2
e)	Transportation/Handling	1	2
f)	Clerical/Administration	1	2
g)	Other	1	2

IF OTHER, specify: _____

7.2.2 How long did/have they worked in the seafood industry? (3 months = .25 yrs; 6 months = .50 yrs; 9 months = .75 yrs.)
__ __ Years
88 = Refused to answer
99 = Don't know

7.2.3 Do they work in the seafood industry now?

1 = Yes
2 = No
8 = Refused to answer
9 = Don't know

7.3 What is the name of the place where **you (SUBJECT)** work, or have worked most recently?

_____

7.3.1 How long have **you (SUBJECT)** worked (did you work) there, in years? **(3 months = 0.25, 6 months = 0.5, 9 months = 0.75)**

__ __ . __ __ years **(if 00 skip to 8.1)**

Now I'd like to ask about your (SUBJECT's) two most recent jobs, starting with your present/most recent job listed above. (Unemployed, disabled, retired or homemaker should be entered.)

a. What is/was **your (SUBJECT's)** job title?
b. What type of industry is/was this?
c. How long have/did **you (SUBJECT)** work there?

TITLE	TYPE INDUSTRY	FROM	TO
_____	_____	__ __/__ __	__ __/__ __
_____	_____	__ __/__ __	__ __/__ __
		(mo./yr.)	(mo./yr.)

7.4.1 What is the job title **you (SUBJECT)** have had **most** of the time **you (HE/SHE)** have worked in the last 90 days?

_____

7.4.2 What is the job title **you (SUBJECT)** have had **most** of the time **you (HE/SHE)** have worked in the last 5 years?

_____

SECTION VIII: HOUSEHOLD MEMBERS' WORK/HOBBIES

Now I'd like to ask you some questions about the work and hobbies of yourself (SUBJECT) and persons living in your (SUBJECT's) home.

8.1 In the last year have **you (SUBJECT)** done any painting, soldering, welding, machinist work, or radiator repair as a hobby?

1 = Yes
2 = No
8 = Refused to answer
9 = Don't know

8.1.1 In the last year have ANY OTHER members of **your (SUBJECT's)** household, not including **yourself (SUBJECT)**, done any painting, soldering, welding, machinist work, or radiator repair as a hobby?

1 = Yes
2 = No
8 = Refused to answer
9 = Don't know

8.2 In the last year have **you (SUBJECT)** worked on a job as a painter, solderer, welder, machinist, or repaired radiators?

1 = Yes
2 = No
8 = Refused to answer
9 = Don't know

8.2.1 In the last year have any members of **your (SUBJECT's)** household, not including **yourself (SUBJECT)**, worked on a job as a painter, solderer, welder, machinist, or repaired radiators?

1 = Yes
2 = No
8 = Refused to answer
9 = Don't know

PARTICIPANT I.D. #: SC _____

SECTION IX: HEALTH ADVISORY

The next section asks general questions regarding the Health Advisory.

9.1 Did **you (SUBJECT)** know that there is a **Health Advisory** for part of Turtle River, Purvis Creek and Gibson Creek because of contamination that advises people not to eat seafood from that area?

1 = Yes
2 = No
8 = Refused to answer
9 = Don't know

9.2 Have **you (SUBJECT)** changed **your (SUBJECT's)** fishing habits or the amount or types of fish that **you (SUBJECT)** eat from that area?

1 = Yes
2 = No **(GO TO 9.4)**
8 = Refused to answer
9 = Don't know

9.3 Was this due to the **Health Advisory**?

1 = Yes
2 = No
8 = Refused to answer
9 = Don't know

What other reasons have changed these habits?

_____

9.4 Are **you (SUBJECT)** concerned about contamination of fish from the closure area of Turtle River, Purvis and Gibson Creeks?

1 = Yes
2 = No **(GO TO 10.1)**
8 = Refused to answer
9 = Don't know

What contaminants are **you (SUBJECT)** concerned about from the closure area?

_____

PARTICIPANT I.D. #: SC _____

SECTION X: DEMOGRAPHICS

The next two questions are for statistical purposes only.

10.1 Please tell me which of the following income groups best describes your (SUBJECT's) total household income before taxes:

1 = Less than $5,000 per year
2 = $5,000 to $9,999 per year
3 = $10,000 to $14,999 per year
4 = $15,000 to $24,999 per year
5 = $25,000 to $34,999 per year
6 = $35,000 to $49,999 per year
7 = $50,000 to 74,999 per year
8 = Refused to answer
9 = Don't know
10 = More than $75,000 per year

10.2 What is the highest year of education you (SUBJECT) have completed? (Circle one)

No Schooling	777
Elementary Schooling	1 2 3 4 5 6 7 8
High School	9 10 11 12
Technical/Trade School	513 514
Junior or Community College	613 614
Four Year College or University	13 14 15 16
Graduate School or Higher	17
Refused to Answer	888
Don't Know	999

10.3 Have you ever seen this questionnaire before today's interview?

1 = Yes
2 = No
8 = Refused to answer
9 = Don't Know

****

THIS IS THE END OF THE INTERVIEW. DO YOU HAVE ANY QUESTIONS?

(Give them a copy of the Daily Dietary Diary and continue with Dietary Interviewer's Protocol.)

THANK YOU FOR YOUR ASSISTANCE! (Provide appropriate incentive.)

****

TIME INTERVIEW ENDED: _ _:_ _ AM/PM INTERVIEWER'S ID NUMBER: __ __

Appendix D- Dietary Diary

DIETARY S 'VEY CHART

Please print clearly the name of each person in your household on the blank line in the top row of boxes, beginning with the oldest member of the household, and ending with the youngest member of the household. Then answer these questions about each person in your household.

		Name of Person 1	Name of Person 2	Name of Person 3	Name of Person 4	Name of Person 5	Name of Person 6
1.	Birthday (mm/dd/yy)	___/___/___	___/___/___	___/___/___	___/___/___	___/___/___	___/___/___
2.	Gender (Male/Female)	____ Male ____ Female	____ Male ____ Female	____ Male ____ Female	____ Male ____ Female	____ Male ____ Female	____ Male ____ Female
3.	Height (Feet/Inches)	____ Feet ____ Inches	____ Feet ____ Inches	____ Feet ____ Inches	____ Feet ____ Inches	____ Feet ____ Inches	____ Feet ____ Inches
4.	Weight (Pounds)	____ Pounds	____ Pounds	____ Pounds	____ Pounds	____ Pounds	____ Pounds
5.	Relation to Person 1 * (See below)	_____	_____	_____	_____	_____	_____
6.	Does he/she participate in local fishing/hunting activities?	____ Yes ____ No	____ Yes ____ No	____ Yes ____ No	____ Yes ____ No	____ Yes ____ No	____ Yes ____ No
7.	If YES to question 6, what type of fisher/hunter does he/she consider themself? **/* (See below)	____ Commercial ____ Subsistence ____ Recreational	____ Commercial ____ Subsistence ____ Recreational	____ Commercial ____ Subsistence ____ Recreational	____ Commercial ____ Subsistence ____ Recreational	____ Commercial ____ Subsistence ____ Recreational	____ Commercial ____ Subsistence ____ Recreational

* Relationship to person 1:

1. Self
2. Spouse
3. Parent
4. Child
5. Other Relative
6. Legal Guardian
10. Other

** Definitions of types of fishers.

Commercial Fishing: fishing for the purpose of sale; the sale or offering for sale of fish by the person taking such fish, or fishing or taking fish through the use of commercial gear. The commercial fisher operates a minimum of 120 times per year.

Subsistence Fishing: fishing for the purpose of providing dietary protein. Primarily due to low income factors, the supplementing of diet by catching and eating local seafood, (i.e. main meat source is fish and seafood, with only occasional, infrequent consumption of chicken, beef, pork, etc.) Additionally, these fishers, in some instances, fish in order to sell their catch for income. The subsistence fisher operates a maximum of 119 times per year and a minimum of 52 times per year.

Recreational Fishing: fishing for sport, relaxation or hobby; neither livelihood nor diet is dependent on seafood caught. Seafood caught may be kept for consumption, sale or released. The recreational angler fishes a maximum of 52 times per year and a minimum of 12 times per year.

DIRECTIONS FOR SEAFOOD AND WILD GAME

This set of directions is to be used for seafood and wild game, although seafood is used as the example. Please use these instructions to complete the charts for seafood and wild game.

Please use the same order of household members (oldest to youngest) as on the Dietary Survey Chart when completing the following diary pages.

Q. 1 Seafood today? Did any person in the household eat seafood today? If PERSON 1 ate seafood today, answer yes on the seafood chart, and continue with the following questions for the seafood chart. If the answer is no, continue with PERSON 2. If no one has eaten seafood today, check no for each person, and continue with the chart for wild game using these instructions, substituting wild game for seafood.

Q. 2 Meal: At what meal was this item eaten? Select one meal.

B = Breakfast
L = Lunch
D = Dinner
S = Snack

If more than one type of seafood was eaten during one meal, see Example #1. If seafood was eaten at more than one meal in a day, see Example #2. In both cases, select the item with the largest portion of seafood and record on the chart for that day. Then, please use the RECORD FOR ADDITIONAL SERVINGS at the end of the weekly diary, to record the additional items.

Example #1: tuna salad and shrimp cocktail for lunch; record tuna salad for lunch on the chart for seafood for that day, AND, record shrimp cocktail in RECORD FOR ADDITIONAL SERVINGS ALSO as lunch for that day.

Example #2: crab cakes for lunch and marsh hen with crab stuffing for dinner; record crab cake for lunch on the chart for seafood for that day, record marsh hen for dinner on the chart for wild game for the same day, AND, using the RECORD FOR ADDITIONAL SERVINGS, record crab as dinner, ALSO for that day.

Q. 3 Seafood type: What kind of seafood was eaten? Use FOOD ITEM CODE LIST to help identify the name of the type of seafood eaten. Write the name of the type of seafood (if known) in the upper box for Question 3. (Examples: Crab, spotted seatrout, dove, etc.)

Q. 4 Amount eaten: How much seafood was eaten? Please refer to the PORTION GUIDE.

Remember: If PERSON 3, for example, ate seafood more than once today, or if more than one type of seafood was eaten during one meal, please use the RECORD FOR ADDITIONAL SERVINGS to record the additional servings.

Q. 5 Where eaten: Where was the item eaten? Select "at home", or "away from home" for each person.

Q. 6 Where from: For bought seafood, where was the item purchased or obtained? Enter the code for where the item was obtained from the FOOD ITEM CODE LIST under the "BOUGHT FISH/GAME" heading.

For caught seafood, enter the code from the FOOD ITEM CODE LIST under the "CAUGHT FISH/GAME" heading.

Finally, if the seafood was caught, enter the date it was caught. If you do not know the exact date, please make your best guess.

Continue with the chart for wild game using these directions.

DATE____/____/____

BEEF

	Example	Person 1	Person 2	Person 3	Person 4	Person 5	Person 6
Q. 1 Beef today?	Yes X No ___	Yes ___ No ___	Yes ___ No ___	Yes ___ No ___	Yes ___ No ___	Yes ___ No ___	Yes ___ No ___
Q. 2 Meal	B ___ L ___ D X S ___	B ___ L ___ D ___ S ___	B ___ L ___ D ___ S ___	B ___ L ___ D ___ S ___	B ___ L ___ D ___ S ___	B ___ L ___ D ___ S ___	B ___ L ___ D ___ S ___
Q. 3 Beef type name	*STEAK*						
Q. 4 Amount eaten - See Portion Guide	*14*						
Q. 5 Where eaten?	Home X Away ___	Home ___ Away ___	Home ___ Away ___	Home ___ Away ___	Home ___ Away ___	Home ___ Away ___	Home ___ Away ___

POULTRY

	Example	Person 1	Person 2	Person 3	Person 4	Person 5	Person 6
Q. 1 Poultry today?	Yes ___ No X	Yes ___ No ___	Yes ___ No ___	Yes ___ No ___	Yes ___ No ___	Yes ___ No ___	Yes ___ No ___
Q. 2 Meal	B ___ L ___ D ___ S ___	B ___ L ___ D ___ S ___	B ___ L ___ D ___ S ___	B ___ L ___ D ___ S ___	B ___ L ___ D ___ S ___	B ___ L ___ D ___ S ___	B ___ L ___ D ___ S ___
Q. 3 Poultry type name							
Q. 4 Amount eaten - See Portion Guide							
Q. 5 Where eaten?	Home ___ Away ___	Home ___ Away ___	Home ___ Away ___	Home ___ Away ___	Home ___ Away ___	Home ___ Away ___	Home ___ Away ___

PORK

	Example	Person 1	Person 2	Person 3	Person 4	Person 5	Person 6
Q. 1 Pork today?	Yes X No ___	Yes ___ No ___	Yes ___ No ___	Yes ___ No ___	Yes ___ No ___	Yes ___ No ___	Yes ___ No ___
Q. 2 Meal	B X L ___ D ___ S ___	B ___ L ___ D ___ S ___	B ___ L ___ D ___ S ___	B ___ L ___ D ___ S ___	B ___ L ___ D ___ S ___	B ___ L ___ D ___ S ___	B ___ L ___ D ___ S ___
Q. 3 Pork type name	*BACON*						
Q. 4 Amount eaten - See Portion Guide	*25*						
Q. 5 Where eaten?	Home ___ Away X	Home ___ Away ___	Home ___ Away ___	Home ___ Away ___	Home ___ Away ___	Home ___ Away ___	Home ___ Away ___

DATE ___/___/___

SEAFOOD

	Example	Person 1	Person 2	Person 3	Person 4	Person 5	Person 6
Q. 1 Seafood today?	Yes _X_ No ___	Yes ___ No ___	Yes ___ No ___	Yes ___ No ___	Yes ___ No ___	Yes ___ No ___	Yes ___ No ___
Q. 2 Meal	B ___ L _X_ D ___ S ___	B ___ L ___ D ___ S ___	B ___ L ___ D ___ S ___	B ___ L ___ D ___ S ___	B ___ L ___ D ___ S ___	B ___ L ___ D ___ S ___	B ___ L ___ D ___ S ___
Q. 3 Seafood type name	*COD*						
Q. 4 Amount eaten - See Portion Guide	*105*						
Q. 5 Where eaten?	Home ___ Away _X_	Home ___ Away ___	Home ___ Away ___	Home ___ Away ___	Home ___ Away ___	Home ___ Away ___	Home ___ Away ___
Q. 6 Where from? - See Food Item Code List	Bought _5_ Caught ___	Bought ___ Caught ___	Bought ___ Caught ___	Bought ___ Caught ___	Bought ___ Caught ___	Bought ___ Caught ___	Bought ___ Caught ___
Date caught	___/___/___	___/___/___	___/___/___	___/___/___	___/___/___	___/___/___	___/___/___

WILD GAME

	Example	Person 1	Person 2	Person 3	Person 4	Person 5	Person 6
Q. 1 Wild game today?	Yes _X_ No ___	Yes ___ No ___	Yes ___ No ___	Yes ___ No ___	Yes ___ No ___	Yes ___ No ___	Yes ___ No ___
Q. 2 Meal	B ___ L ___ D _X_ S ___	B ___ L ___ D ___ S ___	B ___ L ___ D ___ S ___	B ___ L ___ D ___ S ___	B ___ L ___ D ___ S ___	B ___ L ___ D ___ S ___	B ___ L ___ D ___ S ___
Q. 3 Wild game type name	*CLAPPER RAIL*						
Q. 4 Amount eaten - See Portion Guide	*13*						
Q. 5 Where eaten?	Home _X_ Away ___	Home ___ Away ___	Home ___ Away ___	Home ___ Away ___	Home ___ Away ___	Home ___ Away ___	Home ___ Away ___
Q. 6 Where from? - See Food Item Code List	Bought ___ Caught _2_	Bought ___ Caught ___	Bought ___ Caught ___	Bought ___ Caught ___	Bought ___ Caught ___	Bought ___ Caught ___	Bought ___ Caught ___
Date caught	_7_/_10_/_96_	___/___/___	___/___/___	___/___/___	___/___/___	___/___/___	___/___/___

PORTION GUIDE CODE LIST

BEEF, POULTRY, PORK AND WILD GAME

Weight
Steaks, Roasts, Ham Chops, Ribs, Organ Meats

1 Ounce 11
3 Ounces 12
6 Ounces 13
8 Ounces 14
12 Ounces 15
1 Pound 16
1.5 Pounds 17
Other 90

Measurement
Casserole, Soup, Stew, Salad

1 Cup 18
3 Cups 19
6 Cups 20
1 Tablespoon 21
3 Tablespoons 22
6 Tablespoons 23
Other 91

Number/Size
Lunch Meat, Hot dogs, Sausages Bacon, Hamhocks

3 Small 24
3 Large 25
6 Small 26
6 Large 27
9 Small 28
9 Large 29
12 Small 30
12 Large 31
16 Small 32
16 Large 33
Other.....92
Other Beef, Poultry or Pork 93

SEAFOOD

Weight
Fish, Lobster, Crab Legs and Claws

1 Ounce 101
3 Ounces 102
6 Ounces 103
8 Ounces 104
12 Ounces 105
1 Pound 106
1.5 Pounds 107
Other 190

SEAFOOD (CONT.)

Measurement
Casserole, Soup, Stew, Salad

1 Cup 108
2 Cups 109
3 Cups 110
1 Tablespoon 111
3 Tablespoons 112
6 Tablespoons 113
Other 191

Number/Size
Shrimp*

3 Small 114
3 Medium 115
3 Large 116
3 Jumbo 117
6 Small 118
6 Medium 119
6 Large 120
6 Jumbo 121
9 Small 122
9 Medium 123
9 Large 124
9 Jumbo 125
12 Small 126
12 Medium 127
12 Large 128
12 Jumbo 129
16 Small 130
16 Medium 131
16 Large 132
16 Jumbo 133
Other 192

Number/Size
Oysters, Sardines, Herring, Scallops**

3 Small 134
3 Large 135
6 Small 136
6 Large 137
9 Small 138
9 Large 139
12 Small 140
12 Large 141
16 Small 142
16 Large 143
Other 193

SEAFOOD (CONT.)

Number/Size
Clams***

3 Small 144
3 Large 145
6 Small 146
6 Large 147
9 Small 148
9 Large 149
12 Small 150
12 Large 151
16 Small 152
16 Large 153
Other.....194

Number/Size
Crabs***

3 Small 154
3 Large 155
6 Small 156
6 Large 157
9 Small 158
9 Large 159
12 Small 160
12 Large 161
16 Small 162
16 Large 163
Other 195

Number/Size
Mussels, Squid, Fish Sticks

3 Small 164
3 Large 165
6 Small 166
6 Large 167
9 Small 168
9 Large 169
12 Small 170
12 Large 171
16 Small 172
16 Large 173
Other 196

* For Shrimp:
Small = 61 + count
Medium = 51-60 count
Large = 41- 50 count
Jumbo = 21-40 count

** For Scallops:
Small = bay scallops
Large = sea scallops

*** For Clams, Crabs
Small = Grade 3, 4
Large = Grade 1, 2

PORTION GUIDE

To determine the amount of food actually eaten by each person for Q. 4 on the DAILY RECORD, please follow these instructions. The amounts should be determined before the item is prepared and cooked (unless it was eaten raw or obtained already cooked).

Check the weights on the package label if you purchased the item.

Use the easiest method to estimate the amount eaten. For example:

* Weight in ounces (oz.) or pounds (lb.) of a steak, pork chop, lobster, fish fillet (etc.), or item from a can.

* Cup = eight (8) fluid ounces of chowder, casserole with meat, or stew, 1/2 Cup = thick soups, 1/4 Cup = thin soups.

* Number of level tablespoons (tbsp.) in each sandwich of turkey, ham, tuna (etc.) salad or serving of other meat or seafood salad, spread or dip.

* Number (no.) and size (small, medium, large, extra large) of shrimp, oysters, fish sticks, clams in sauce, or shrimp in casserole.

Then, enter the number of those units of the item eaten by each household member in the appropriate box for Q. 4. For example:

* 4, 5, 10 (etc.) ozs. or .25, 1, 2.5 (etc.) lbs.

* 1/2, 1, 2 1/4 (etc.) cups.

* 1, 2, 6 (etc.) tbsps.

* 5, 12 (etc.) large shrimp, oysters.

For dishes such as chowders or casseroles, by the number of shrimp, or the weight in pounds (lbs.) and ounces (ozs.) of meat used to prepare the dish by the number of portions CONSUMED to determine the amount or number eaten. MAKE THE PROPER ADJUSTMENT FOR SMALL EATERS SUCH AS CHILDREN. If one or more can or frozen package (etc.) was used, divide the stated weight of ALL cans/packages by the number of portions consumed.

FOR EXAMPLE:

For roast or fish fillet, divide the weight of the roast or fish by the number of persons who ate the dish.

For equal-sized servings from one pound of "51-60" count shrim2p,divide 55 (halfway between 51 and 60) by the number of persons who ate the shrimp.

For turkey salad or sandwiches: estimate the number of tablespoons of salad eaten. For tuna salad and sandwiches, divide the weight stated on the can by the number of portions eaten.

IF YOU HAVE ANY QUESTIONS AT ANY TIME, OR ARE UNSURE HOW TO ESTIMATE A PORTION SIZE, PLEASE CALL 264-3236 AND ASK FOR A HAZARDOUS WASTE PROGRAM STAFF MEMEBR.

REMEMBER:

* Record only the amount actually eaten, not the amount served. Example: threw away half a sandwich, count as half of above calculation.

* Adjust the portion size for children and other small portion eaters. Example: use half portions.

* Record the amount eaten in the box the person's name in the DAILY RECORD.

FOOD ITEM CODE LIST

BOUGHT FISH/GAME.....CODE

Local Fish Market/
Roadside Stand.....1
Dockside.....2
Private Fisher.....3
Fast Food Restaurant...4
Restaurant.....5
Chain Grocery Store....6
Local Grocer.....7
Other.....10

CAUGHT FISH/GAME.....CODE

Blythe Island.....1
Yellow Bluff Creek.....2
Academy Creek/E. River.3
Purvis Creek.....4
Turtle River between Hwy.
303 & chan. mark. 9..5
Gibson Creek below
Hwy. 303.....6
Gibson Creek above
Hwy. 303.....7
Other.....10