Estimation of Daily Per Capita Freshwater Fish Consumption of Alabama Anglers

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Executive Summary

A statewide freshwater fish consumption survey of anglers was conducted from August 1992 - July 1993. Anglers were interviewed on-site at the ends of their fishing trips at 23 tailwater and 6 reservoir locations representing 11 river drainages in Alabama. The objective of the survey was to estimate daily per capita consumption of fish harvested from Alabama rivers and reservoirs by anglers.

The survey was stratified by season. Daily per capita consumption (C_{daily}) was derived from each interview using two methods: one method used the actual harvests of fish where anglers identified the fish to be consumed at the next meal in conjunction with a dressing method for each fish (the Harvest Method); the second method used a visual representation (the surface of the palm side of the open hand) for a typical 4-oz serving (the 4-oz Serving Method).

The sample size for the Harvest Method was 563 anglers and the sample size for the 4-oz Serving Method was 1,313 anglers. Annual estimates of daily per capita consumption (C_{annual}) were 43 g/d and 46 g/d for the Harvest and 4-oz Serving Methods, respectively, using all meals of fish harvested from rivers and reservoirs in Alabama. If only meals of fish harvested from the sample locations were considered, then estimates of C_{annual} dropped to 33 g/d and 30 g/d for the two methods, respectively. Seasonal estimates were lowest in the spring (30-34 g/d) and highest in the summer (53-57 g/d). These seasonal differences were statistically significant ($p < .05$).

Estimates of C_{annual} were not found to differ across major ethnic groups (black and white), but did change with respect to ages and incomes of anglers. The lowest estimates of daily consumption were associated with anglers between 20 and 30 years old (16 g/d), and with black anglers whose annual family incomes were greater than $40,000 (14 g/d). The highest estimates of consumption were associated with people older than 50 years (76 g/d), and with black anglers whose annual incomes were less than $15,000 (63 g/d).

The estimate of C_{annual} for freshwater anglers from this study using the 4-oz Serving Method (46 g/d) was twice as high as that estimated by the Alabama Department of Public Health (ADPH) phone survey (24 g/d). Both the average serving size and the frequency of eating fish meals were higher from the on-site ADEM study. The serving size difference alone accounted for the difference between the two estimates of C_{annual}. Reasons for the serving size discrepancy likely resided in differences between the visual standards used to represent a 4-oz serving size. It also is likely that real differences existed between the angler populations surveyed.

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List of Abbreviations

ADPH	Alabama Department of Public Health
ADEM	Alabama Department of Environmental Management
ANOVA	analysis of variance
C_{daily}	daily per capita freshwater fish consumption
$C_{drainage}$	estimate of mean daily per capita consumption for a particular river drainage
$C_{seasonal}$	seasonal estimate of daily per capita freshwater fish consumption
C_{annual}	annual estimate of daily per capita freshwater fish consumption
cm	centimeter
d	days
EPA	United States Environmental Protection Agency
F	females
FAA	Department of Fisheries and Allied Aquacultures, Auburn University
FIMS	Fishery Information Management Systems, Inc.
g	grams
g/d	grams per day
kg	kilograms
lbs	pounds
m	number of meals in previous month (30 d) when fish were served
mm	millimeters
M	males
MBW	mean body weight
N or n	sample size
q	number of people eating fish at the next meal
p	probability level for test statistics
s	number of servings of fish eaten at a meal
SE_{annual}	standard error of annual estimates
$SE_{seasonal}$	standard error of seasonal estimates
spp.	species
RSE	relative standard error
TL	total length of fish
$V_{seasonal}$	variance of $C_{seasonal}$
Wt	weight
$Wt_{dressed}$	reduce weight of harvested fish based on dress-out percentages
$Wt_{seasonal}$	Weighting factor for annual means and standard errors using the proportions of interviews and seasonal time periods for each season

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Introduction

Many variables are factored into the derivation of water quality standards and allowable industrial source discharges. These variables include: the toxicity and carcinogenicity of compounds; the capacity of the compound to bioaccumulate; and a human exposure factor (EPA, 1989). Ingestion of freshwater fish is considered to be a significant avenue of human exposure to certain toxic compounds released into surface waters (Rifkin and LaKind, 1991). The human exposure factor is based on the average body weight of people, and the daily per capita consumption rate of fish, over an average lifespan of 70 years. The Environmental Protection Agency (EPA) uses an estimated level of fish consumption of 6.5 g/d for the general population and 20 g/d for the freshwater recreational and subsistence angling public (EPA, 1989). An average person in the general population is considered to be 70 kg (EPA, 1989).

The Alabama Department of Environmental Management (ADEM) is involved in establishing statewide water quality criteria. As part of the process of evaluating current criteria, a state-wide freshwater fish consumption survey was conducted to determine the daily per capita consumption (g/d) by the recreational and subsistence angling public. This state-wide freshwater fish consumption survey was conducted by Fishery Information Management Systems (FIMS) in cooperation with the Department of Fisheries and Allied Aquacultures (FAA) at Auburn University.

Anglers catch a variety of fish species and employ various fish cleaning methods. Depending on the species, Osterhaug et al. (1963) and

Stansby and Olcott (1976), reported edible portion yields of 20 to 40% of fish body weight for commercially caught and filleted fin fish. The EPA (1989) recommended that weights of harvested fish be reduced by 70% (30% dress-out weight) to give weights of edible portions for consumption studies. These values are generally applied to all fish species and dressing methods.

It is logical that dress-out percentages of fish depend on body shape and dress-out method. To augment the fish consumption survey, a study was conducted to determine differences in dress-out percentages among fish species and dressing methods. The total weight of each harvested fish was reduced by the dress-out percent, yielding the edible portion of the fish remaining after preparation for cooking.

The only other study that has estimated daily per capita consumption of freshwater fish by Alabama anglers was a telephone survey conducted by the Alabama Department of Public Health (ADPH) from July - October, 1991. That study targeted the general population of Alabama, but also provided estimates of per capita consumption of anglers (Hughes and Woernle, 1992).

The objective of the ADEM survey reported on in this document was to determine mean daily per capita consumption of freshwater fish caught from Alabama rivers by Alabama anglers. Additionally, estimates of mean daily per captia consumption were determined seasonally by sample sites and by river drainages, and also for various demographic groups. Annual estimates of mean daily per capita consumption were compared to those of the ADPH telephone survey.

Methods

Survey Design

The survey was conducted from August 1992 - July 1993. Sampling days were selected within each of four seasonal blocks defined as: fall (August 1 to November 30, 1992), winter (December 1, 1992 to February 20, 1993), spring (February 21 to May 8, 1993), and summer (May 9 to July 30, 1993). This survey design allowed estimation of daily per capita freshwater fish consumption rates (C_{daily}) for each season.

Each study site was surveyed once, for two consecutive days, within each of the four seasonal blocks. The two consecutive days were either Friday and Saturday or Sunday and Monday. The two-day sample periods were randomly assigned to study sites within each season. This approach minimized day-type bias and maximized the potential for intercepting the most anglers, given that a large proportion of fishing occurs on weekends. Sampling was conducted from sunrise to sunset on the days chosen at each site.

Study Sites

Past river-angler surveys at tailwater sites on the Tallapoosa and Coosa Rivers in Alabama (FIMS, 1989 and 1993) have indicated that the majority (75% to 80%) of the fishing occurred in the immediate tailwater areas below the dams. Thus, to intercept the most anglers in a cost effective manner, sampling was conducted mostly in tailwaters. Twenty-three (23) study sites distributed across Alabama were sampled (Figure 1). These sites represented 22 tailwaters, 7 reservoirs, and 11 river drainages in Alabama (Tables 1 and 5).

Field Procedures

The majority of the dams had either fishing piers or boat launching ramps below the dams where anglers gained access to the tailwaters. For reservoirs, a single landing was identified that would likely yield the most interviews based on access-use information collected from local fishery-related businesses. Each tailwater or reservoir sample required one clerk. Anglers were intercepted and interviewed at access points at the completion of their fishing trips. This intercept method (completed trip) assured that all fish harvested were enumerated. The interview schedule used for this survey is shown in Appendix A.

Two methods were used to estimate C_{daily}: (1) Anglers with harvested fish were asked if they planned to consume their fish that day (Question 3). If the answer was "yes", then C_{daily} was calculated for that interview using the quantity of fish that would be eaten at the next meal as specified by the interviewee. This method will be termed the 'Harvest Method'. The harvest was enumerated by species, measured for total length (TL) in mm, and weighed in grams (g). Weights were measured using tubular hanging scales with various metric capacities and gradations; (2) For all anglers who indicated that they consumed fish from the study site, the number of 4-oz servings typically eaten at a meal was determined by equating the entire surface (palm side) of the flat, open hand to a single 4-oz serving. This is standard nutritional protocol when conducting dietary recall surveys (Crayton, 1990). The interviewer presented the palm-side of the open hand to the respondent when this question (#7) was asked. This gave the angler a visual frame of reference for the serving size being addressed. This method will be termed the '4-oz Serving Method'.

A chart was presented to the anglers (Figure 2) which depicted six (A - F) different fish cleaning methods. As an angler's harvested fish were weighed and measured, the angler was asked to identify the cleaning method that would be used for specific fish to be consumed at the next meal. Anglers also were asked if they would remove the belly fat tissue and skin, as indicated on the chart.

Demographic information on age, gender, town, county and state of residence, and family income, were collected during the interview. Additionally, body weights were requested of all anglers to corroborate values currently used by ADEM for risk assessment.

Determination of Fish Dress-Out Percentages

The total weight of a fish is not 100% edible flesh. When fish are prepared for cooking, the inedible portions are removed and discarded. Thus, dress-out percentages, or the amount of the total weight remaining after cleaning, must be determined for individual species and cleaning methods to accurately estimate C_{daily} from harvest data. The objectives of the dress-out study were: 1) to assess the differences in dress-out percentages among Alabama freshwater fish species most commonly harvested and consumed by anglers; and 2) to assess differences among dressing methods.

Twenty (20) species of commonly caught Alabama freshwater sportfish were collected using hook-and-line, electrofishing, gillnets and trap nets. Fish were collected from Yates Reservoir on the Tallapoosa River, Jordan Dam Tailrace and Weiss Reservoir on the Coosa River, and two private farm ponds located in Lee and Montgomery counties in Alabama. These fish were collected during the months of July - September, 1993.

The length ranges of fish collected approximated the length ranges of fish harvested by anglers interviewed during the survey (see length frequency distributions of fish harvested in Appendix C). Table 2 lists the common names of species collected for the dress-out study, with sample sizes and mean dress-out percentages for each cleaning method.

Fish were iced down upon collection and later frozen whole for several days while additional fish were collected. Fish were then thawed and processed in the following manner: the species, length and weight were recorded for individual fish. Then, each fish was subjected to a dress-out process which was incremental in nature using the six fish cleaning methods, A - F, illustrated in Figure 2. There were so few fish that were dressed using Method D (steaking), that steaking was not considered in the experiment. The experimental process was slightly different with catfish, which do not have scales, relative to the other scaled fish evaluated in the study.

For fish with scales, cleaning Method A was accomplished by first simply eviscerating the fish (drawn) and secondly removing the body fat. An incision was made from the anus to the pectoral girdle for evisceration. Each fish was weighed after all viscera were removed and again after the body fat was removed.

The next step, Method B, entailed scaling the fish and removal of the head. The scales were removed by scrapping a metal fish scaler along the surface of the fish in a tail to head motion. The body of the fish without the head and scales was weighed.

Scaled fish then were subjected to Methods E and F. First, the fillets were removed with the skin and rib bones remaining (Method F). Secondly, the skin and rib bone sections were removed from the fillets (Method E). After each step in the dressing sequence, the weight of the

edible portion was recorded.

Method C weights were derived by placing the carcass, fillets, skin, and fins back on the scale together, at the end of the dress-out process.

Catfish were processed like scaled fish for Method A. Then the skin was removed, because removal of the skin is easier with the head still on. The head and fins were then cut from the body and the body was weighed to give the dress-out weight for Method C. The fins and skin were then weighted with the body to derive weights for Method B. Fillets then were taken and the rib bones were removed to give Method E dress-out weights. Method F weights were derived by adding the rib bone and skin weights back to the fillet weight from Method E.

At the end of the cleaning processes for both scaled and unscaled fish, the head, spine and rib bone sections remained. These parts were wrapped in aluminum foil and placed in an autoclave for 6 to 12 minutes at a temperature of 210° C, which enabled the inedible bones to be and weighed separately. These inedible weights were subtracted from the weights derived from Methods A and B to give final edible weights. Only the head bones were subtracted from Method C weights, and only the ribs from Method E weights.

It should be noted that there were species of fish that anglers identified for consumption during interviews that could not be conveniently collected for the dress-out experiment. To derive dress-out weights for these fish based on the cleaning methods specified by the respondents, the harvest weights of individual fish were multiplied by the mean dress-out percentage for the appropriate cleaning method, calculated from all 268 fish representing the species listed in Table 2.

The mean dress-out percentage for each cleaning method is given at the bottom of Table 2.

Estimation of Daily Per Capita Fish Consumption (C_{daily})

The first four questions on the interview schedule were: 1) "Have you kept any fish that you caught today?", 2) "Do you eat the fish that you catch from this location?", 3A) "Have you caught enough fish today for a family meal?", and 3D) "Will you eat these fish today?" (Appendix A). Anglers who answered "yes" to these questions were used to calculate C_{daily} using the Harvest Method. Anglers who indicated that they did not consume fish from the study site (a "no" response to question 2) were given a C_{daily} of 0 g/d and included in the calculation of mean daily per capita consumption.

The calculation used to determine C_{daily} from each interview using the Harvest Method was:

$$C_{daily} = \frac{\left(\frac{\sum Wt_{dressed}}{q}\right) m}{30d}, \qquad \text{Equation (1)}$$

where,

$\Sigma\ Wt_{dressed}$ = the sum of the dressed weight of fish harvested in grams that would be eaten for a meal later that day;

q = the number of people who would eat those fish at the meal;

m = the number of meals eaten during the last month when fish were served; and

30 d = average number of days in a month to convert to a daily rate.

Equation (1) was applied to both the number of meals eaten in the past month of fish caught at that landing or study site only (site meals), and the number of meals eaten in the past month of fish caught from the sample site plus all other lakes and rivers in Alabama (all meals), not including farm ponds. In our calculations, it was assumed that meal sizes based on measuring fish harvested from the study sites would be representative of meal sizes composed of fish harvested from other lakes and rivers.

Only interviews of anglers who indicated that they consumed fish from the study site were used in the 4-oz Serving Method. Anglers who indicated that they had not consumed fish over the past month were given a C_{daily} of 0 g/d and included in the calculation. The 4-oz Serving Method included anglers who consumed fish from the sample site, but who did not harvest any fish during that trip. These anglers could not be included in the calculation of C_{daily} using the Harvest Method.

For the 4-oz Serving Method, the number of 4-oz portions of fish eaten per meal, as indicated by the respondent, was converted to gram equivalents, and C_{daily} was calculated for each interview using the following equation:

$$C_{daily} = \frac{(g)\,(s)\,(m)}{30d}\ , \qquad \text{Equation (2)}$$

where,

g = gram equivalent of a single 4-oz serving (113.4 g);

s = number of 4-oz servings of fish (palm side of the open hand) eaten at a meal;

m = the number of meals eaten in the last month when fish was served; and

30 d = average number of days per month to convert to a daily rate.

Equation (2), like Equation (1), was applied to sample site meals, and also to all meals comprised of fish caught from Alabama lakes and rivers.

Mean values of C_{daily} were calculated on a seasonal basis ($C_{seasonal}$) by pooling the interviews from all sample sites within each season. This estimate was considered to be a seasonal state-wide average. Within seasons, a mean C_{daily} was calculated across interviews for major river drainages ($C_{drainage}$). The study sites were grouped into 11 drainages (Tables 1 and 5) and then interviews were pooled across the grouped study sites within each drainage.

The annual consumption rate (C_{annual}) for Alabama anglers in the sample was calculated by taking a weighted mean of the seasonal per capita consumption rates across the four seasonal time periods. Variances and relative standard errors (RSE) were calculated by taking a weighted variance across seasonal time periods. Weighting factors were based on the fraction of the total number of interviews taken each season (W1), and on the fraction of the total year represented by each season (W2). The following equation was used to calculate C_{annual}:

$$C_{annual} = \sum (Wt_{seasonal})(C_{seasonal}) \quad , \qquad \text{Equation (3)}$$

where,

$Wt_{seasonal}$ = the weighting factor for a particular season
= (W1)(W2)/Σ(W1)(W2), where the summation is over the 4 seasons; and

$C_{seasonal}$ = the mean of C_{daily} for a particular season.

The standard error of C_{annual} was calculated as:

$$SE_{annual} = \left(\sum (Wt_{seasonal})^2 (V_{seasonal})\right)^{\frac{1}{2}}, \qquad \text{Equation (4)}$$

where,

$Wt_{seasonal}$ = seasonal weighting factor as defined above; and

$V_{seasonal}$ = the variance of $C_{seasonal}$.

The Statistical Analysis System (SAS 1992) was used for data manipulation and statistical analyses. Comparisons were made among the estimated freshwater fish consumption rates by seasons, river drainages, ethnic groups, age groups, family income categories, and body weight categories using analysis of variance (ANOVA) and the Student-Newman-Keul test for differences among means. A Student's t-test for two independent samples was used to compare mean values of C_{daily} between the Harvest and the 4-oz Serving Methods.

Avidity bias, or the bias associated with repeated interviews of the same anglers, was addressed by first identifying those interviews with the same town, county and state of residence, and the same income, age group, gender, and body weight. It was assumed that when two interviews had the same responses to all of these variables over the two consecutive days at any given sampling site, that it was very likely that the same individual had been interviewed twice. When repeated interviews of the same angler were identified, the dress-out weight of harvested fish, the number of people likely to eat those fish, and the number of meals eaten, were averaged across the two interviews of the particular angler, to provide a single estimate of C_{daily} for that angler.

The mathematical procedure described above corrected for seasonal avidity bias associated with repeated interviews within sites, which would be the most likely source of this type of error. In all, only twenty-three repeat interviews were identified. This equated to 4% of

the 563 interviews used in the calculation of C_{daily} with the Harvest Method, and 1.8% of the 1,303 interviews used for the calculation of C_{daily} with the 4-oz Serving Method. Given the survey design, it was extremely unlikely that the same individual would be interviewed within a season at two different sample sites. Thus, seasonal avidity bias was not a severe issue using the on-site sampling approach applied in this study.

Repeated interviews over different seasons would not cause avidity bias because estimates of per capita consumption were stratified seasonally, so that the values derived from each interview based on the questions asked, only applied to that particular season. Thus, for example, if the same individual consumed fish over two seasons, and happened to be interviewed in both seasons, then the value of C_{daily} derived from the first interview would influence one estimate of $C_{seasonal}$, and the value of C_{daily} derived from the second interview would influence another estimate of $C_{seasonal}$ from a different season. Since each $C_{seasonal}$ only contributes a certain amount to C_{annual} (based on $Wt_{seasonal}$ as defined in Equation (3)), repeat interviews of the same individual across seasons do not constitute repeat sample values of C_{annual}, as they would in a mail or telephone survey. Thus, using an on-site, seasonally-stratified survey, if the same person happened to be interviewed in all seasons, then that person would end up contributing one full replication to the estimate of C_{annual}, not four replications, as might be presumed.

Results and Discussion

Sample Sizes

The total number of anglers interviewed during the entire study period was 1,586. The number of anglers interviewed during each season was 363 during the fall, 224 during the winter, 511 during the spring, and 488 during the summer. The number of anglers who indicated that they ate fish from the sample sites was 1,313, or 83% of the anglers interviewed. All of these anglers (1,313) were used in the calculations of mean estimates of C_{daily} based on the 4-oz Serving Method. There were 563 anglers who answered "yes" to the first four questions of the interview schedule and thus were eligible for inclusion in the calculations of mean estimates of C_{daily} based on the Harvest Method.

Seventeen (17) percent of the anglers interviewed during the study said that they did not eat fish from the sample sites. Of this 17%, the reasons given for not consuming fish were: 'fear of pollution or contaminated fish' (24%), 'don't eat fish' (23%), 'practiced catch and release fishing for conservation purposes' (21%), and 'first time fishing at that site' (10%). The remainder of the responses (22%) ranged from 'poor taste of the fish', to 'not liking to clean fish'. Only one angler indicated that he did not eat freshwater fish caught at that location due to a fish consumption advisory issued earlier.

Dress-out Percentages

Dress-out percentages for each fish species and cleaning method (Figure 2) used in the dress-out study are given in Table 2. It is apparent that dress-out percentages varied depending on the dress-out technique employed. Table 3 shows the percentages of fish that were

dressed using the different methods presented to anglers. Most of the sunfish were dressed whole (Methods A and B) and dress-out percentages were between 50 and 75% (Table 2). Most bass were filleted (Methods E and F), and dress-out percentages ranged from 30 to 48%. Catfish mostly were dressed using Method C and dress-out percentages ranged from 41 to 45%. Obviously, accurate calculation of edible portions of various fish species from harvest data must take into account the particular dressing method used. Current EPA recommendations do not address these differences.

Annual Estimates of Daily Per Capita Fish Consumption (C_{annual})

Estimates of C_{annual} using the Harvest Method were 32.6 g/d (N=563, RSE=10%) for meals eaten from study sites only, and 43.1 g/d (N=563, RSE=9%), for meals eaten from study sites plus other lakes and rivers in Alabama. The 95% confidence intervals for these estimates were 25.9 to 39.3 g/d, and 35.3 to 50.9 g/d, respectively.

Estimates of C_{annual} using the 4-oz Serving Method were 30.3 g/d (N=1,303, RSE=6%) using meals eaten from study sites only, and 45.8 g/d (N=1,311, RSE=5%), for meals eaten from study sites plus other lakes and rivers in Alabama. The 95% confidence intervals for these estimates were, 23.5 to 37.1 g/d, and 40.9 to 50.7 g/d, respectively.

When the entire sample was pooled such that C_{annual} was not calculated by taking a weighted mean of $C_{seasonal}$, but rather by taking a mean over all 1,303 interviews available for the 4-oz Serving Method, then the estimate of C_{annual} was 44.8 g/d. The median of the distribution was 22.7 g/d and the 75th percentile value was 56.7 g/d. The mode of the distribution was 0.0 g/d (28% of the sample), which represented

respondents who did not eat any meals of fish over the month previous to the interview. Secondary modes which represented 41% of the distribution occurred between 10 and 49 g/d.

There was no significant difference ($p > .05$) between the estimates of C_{annual} derived from the Harvest Method and the 4-oz Serving Method. This was the case whether C_{annual} was based only on study site meals, or on all meals (Table 4). There was a significant difference ($p < .05$) between estimates of C_{annual} based on site meals vs. all meals, as might be expected, whether C_{annual} was estimated using the Harvest Method or the 4-oz Serving Method (Table 4). Meals eaten with fish harvested from the sample sites represented only 40% of all meals eaten with fish caught from rivers and reservoirs in Alabama.

These results imply that the Harvest Method and the 4-oz Serving Method provided estimates of C_{annual} that corroborated one another. The significant difference between C_{annual} based on site meals vs. all meals indicates that the values based only on study site meals underestimate the true per capita consumption rate of all freshwater fish by anglers.

The mean number of people who ate fish at each meal was 3.9 (N=1,313, RSE=3%), and the mean number of 4-oz servings of fish consumed per meal was 3.7 (N=1,313, RSE=2%).

Seasonal Estimates of Daily Per Capita Fish Consumption ($C_{seasonal}$)

Estimates of $C_{seasonal}$ are shown in Table 4. Spring consistently had the lowest consumption rate across all categories analyzed. The highest consumption rates were consistently obtained in the summer. Only three of the estimates of $C_{seasonal}$ given in Table 4 (all based on the Harvest

Method) had RSEs greater than 20%. In general, the precision of $C_{seasonal}$ was better using the 4-oz Serving Method (RSEs < 12%).

No statistical differences ($p > .05$) were found among estimates of $C_{seasonal}$ using the Harvest Method, even though summer estimates were nearly two times higher than the estimates from the other seasons (Table 4). For the 4-oz Serving Method, $C_{seasonal}$ was statistically different ($p < .05$) between the spring and summer (Table 4).

The frequency of eating fish meals was lowest in the spring (3.9 meals/month) and highest during the summer (4.8 meals/month), reflecting the differences in $C_{seasonal}$. The small number of interviews in the winter contributed to the higher variability of those estimates (Table 4).

River Drainage Estimates of Daily Per Capita Fish Consumption ($C_{drainage}$)

Estimates of $C_{drainage}$ for all 11 river drainages are shown in Table 5. There were no significant differences among the 11 river drainages using either the Harvest Method or the 4-oz Serving Method. The variability of $C_{drainage}$ using the 4-oz Serving Method was less than when using the Harvest Method (Table 5).

Tables B1 - B2 give mean values of C_{daily} from each individual sample site on a seasonal basis, based on the Harvest Method. Tables B3 - B4 give the same information for the 4-oz Serving Method. The variability of site estimates of C_{daily} was high for both estimation methods. The small number of interviews, and the variable characteristics of the harvests of anglers, were the most important factors contributing to these high site variances.

Species Composition of Harvested Fish

Anglers harvested and consumed 34 different species of fish from the study sites during the study period. Table 6 lists the common and scientific names of all fish species enumerated in the harvests of anglers during this study. Field personnel weighed and measured a total of 2,579 individual fish. The total weight of these fish was 3,029 kg.

Table 7 lists the number and total weight for each species of fish harvested by anglers during the study period. The composition of harvested fish that potentially would be consumed at a meal, as indicated by the respondents, is shown in Figure 3. Channel catfish was the most common species harvested and consumed (15%). Largemouth bass and bluegill sunfish were second (11% each), and blue catfish (10%) was third. When similar species were grouped, the catfishes were dominant (29%), followed by black bass (17%), crappie (15%), sunfish (16%), and Morone spp. (13%). The remainder of the groups contributed less than 10% (Figure 4). Appendix C contains length frequency distributions for each species measured in the harvests of anglers during this study.

Demographic Characteristics of Anglers

Anglers from 14 states were interviewed during this study. Eighty-eight (88) percent of the anglers interviewed were from Alabama, representing 61 out of the 67 possible counties in the state. No out-of-state anglers were used in the previously discussed estimates of mean daily consumption rates.

Eighty-eight (88) percent of the anglers sampled were males and 12% were females. Fifty-five (55) percent of the anglers interviewed were between the ages of 30 and 50 years old; 17% were less than 30 years old and 28% were greater than 50. Body weights for male anglers ranged from

122 to 197 lbs with a mean of 182 lbs (83 kg). Women anglers ranged from 94 to 157 lbs, with a mean of 136 lbs (62 kg). Given the ratio of males and females in the sample, the mean body weight of an average angler interviewed was 177 lbs (80 kg). Table 8 gives the age distribution of people interviewed, and mean body weights for genders.

The percentages of anglers grouped into ethnic categories was comparable to the 1990 Alabama population census. Seventy-nine (79) percent of interviewed anglers were white, 18% were black, and less than 1% were native American, Asian American or Latin American. Two (2) percent of the angler parties interviewed were composed of individuals of different races.

The annual family income categories used in the study, and the percentages of anglers interviewed in each category, are shown in Table 9. The majority of anglers (78%) had annual family incomes above $15,000. Twenty-two (22) percent of the interviewed anglers could be classified as living in poverty (less than $15,000 annually for a family of 4). The modal annual income range of $20,000 - $25,000 was similar to that of the ADPH telephone fish consumption survey (Hughes and Woernle 1992).

Estimates of C_{annual} for Socio-Demographic Groups

Estimates of C_{annual} based on the 4-oz Serving Method using all fish meals tended to increase with age. Anglers less than 20 years old were not well represented in the sample (n = 8). Anglers between 20 and 30 years old consumed 16 g/d, anglers between 30 and 50 years old consumed 39 g/d, and anglers older than 50 years consumed 76 g/d. Eighty-three (83) percent of the anglers interviewed were older than 30 years. There

was no relationship between body weight and daily consumption rate of freshwater fish for anglers in the sample.

Estimates of C_{annual} for ethnic groups are presented in Table 10. The two most important ethnic groups were blacks and whites. For the estimation of C_{annual} using the Harvest Method, the composition of the sample was 21% black and 78% white. For the 4-oz Serving Method, sample composition was 20% black and 79% white. There were no statistical differences in C_{annual} between the two major ethnic groups for either estimation method (Table 10).

Trends emerged when ethnic groups and income levels were considered together (Table 11). In general, there were observable trends in C_{annual} across income categories for both blacks and whites. If annual incomes are categorized into poverty level incomes (< \$15,000), middle level incomes (≥ \$15,000 and ≤ \$40,000), and upper level incomes (> \$40,000), then, using the 4-oz Serving Method, estimates of C_{annual} for blacks dropped from 60 g/d for poverty income families, to 15 g/d for upper income families. Using the Harvest Method, trends were similar, and estimates of C_{annual} dropped from 66 g/d for poverty level families, to 12 g/d for upper income families. Estimates of C_{annual} for middle income black families were intermediate to those cited above (Table 11).

Trends in C_{annual} were not as clear across income categories for whites. Using the Harvest Method, C_{annual} dropped from 54 g/d for poverty income families, to 33 g/d for upper income families. The estimate for middle income families was intermediate at 48 g/d. Using the 4-oz Serving Method, C_{annual} dropped slightly from 41 g/d for poverty level families, to 35 g/d for upper income families (Table 11).

Averaging the results from the two estimation methods, there was a

tendency for upper income white anglers to eat roughly 70% as much fish as poverty level white anglers, whereas upper income black anglers ate only about 20% as much fish as poverty level black anglers.

Comparison Between C_{annual} from the ADPH and the Current ADEM Survey

The ADPH phone survey estimated C_{annual} for the general population, as well as for freshwater anglers (Hughes and Woernle 1992). In the ADPH survey, an angler was defined as anyone who fished at least one time during the previous year. The ADPH survey estimated C_{annual} to be 18.4 g/d for freshwater fish consumers, and 23.7 g/d for freshwater anglers. The estimate of C_{annual} for freshwater anglers from the ADEM survey based on the 4-oz Serving Method using all meals of fish eaten from Alabama lakes and rivers was 45.8 g/d. This estimate was two times higher than the corresponding ADPH value.

The two primary variables involved in the estimation of C_{daily} for each interview from both surveys were the number of 4-oz servings and the frequency of eating meals when fish were served (Equation 2). The visual frame of reference for the 4-oz serving size differed, however, between the surveys. The ADPH survey used the size of a clenched fist, whereas this study used the size of the palm side of a flat, open hand. In the ADPH phone survey, a respondent would have to look at the size of his or her fist, whereas in the current ADEM survey, interviewers showed the respondents the serving size by holding out their hands (note that all interviewers for the ADEM survey were males).

There was a significant difference ($p < .05$) between the surveys in the number of 4-oz servings consumed at a meal. The ADPH survey estimated 1.8 servings (N=176, SE=0.08) and the current ADEM study

estimated 3.7 serving per meal (N=1,313, SE=0.06). This difference, by itself, explains the discrepancy between the two estimates of C_{annual}. It appears that even though a clinched fist and the palm side of an open hand were both equated to a single 4-oz serving, people tended to perceive the clinched fist to represent a larger mass of fish, and thus responded with a lower number of servings per meal.

To clarify the issue of converting from a physical shape to a single 4-oz serving of fish flesh, we bought fish fillets of various thicknesses (different species of fish) that were about the size of the entire surface of the palm side of an open male hand, using hands from 3 males to gage the appropriate fillet size. The sizes of the fillets, then, represented the visual image presented to anglers in the on-site ADEM survey.

Six fillets were used, 2 thin fillets, 2 medium fillets, and 2 thick fillets. The thin fillets were about one-third the thickness of the male hands, the medium fillets were about two-thirds, and the thick fillets were slightly thicker than the male hands. Mean fillet weights were taken by weighing each of the 6 fillets and then combining the weights into groups of threes, one fillet weight from each thickness category. Different groups of threes were used so that 4 means were generated. Mean weights per fillet ranged from 4.5 - 5.5 oz.

Given that it was possible for an angler to misinterpret the presentation of the open hand, as described for the ADEM survey, to mean just the palm of the hand without the fingers, palm-sized fillets were cut from the larger hand-sized fillets weighed above. The palm-sized fillets were cut to fit the palms of the three male hands used to gage the sizes of the cuts. The same process of taking mean weights described

above was used for the palm-sized fillets. The mean weight per fillet ranged from 3.0 - 3.5 oz. The mean fillet weight across both visual representations was 4.0 oz.

To determine fish flesh weights associated with the sizes of male and female fists, which would be the visual standards used in the ADPH survey (depending on whether a male or female answered the phone), the fillets used above were cut into small chunks that could be molded into fist-sized balls. Three females each made one ball, and three males did the same. The mean weight of a serving based on the size of a female fist was 4.5 oz, and the mean weight based on the size of a male fist was 8.5 oz.

The sex ratio of anglers was not reported in the ADPH survey (Hughes and Woernle, 1992). It is likely that anglers would be dominated by males, as per the current ADEM study, where 88% of the anglers interviewed were males. If the sex ratio from the ADEM study is applied to anglers from the ADPH study in order to calculate a single serving size for a clinched fist, then the mean weight of a fist of fish flesh, or one serving, comes to 8 oz. This implies that the ADPH estimate of C_{annual} for anglers of 24 g/d likely should be doubled, given that a fist was equated to a 4-oz serving, or one-half of the true weight. This adjustment would bring the ADPH value to 48 g/d which essentially is equal to the estimate of 46 g/d from the on-site ADEM survey.

The frequency of meals eaten is the other key variable in Equation (2) influencing estimates of daily per capita consumption. The ADPH survey question that dealt with this was stated such that the anglers needed to recall the average number of meals of fish eaten per week over the entire year. For comparison to the current study, this weekly mean

was converted to a monthly value. The average frequency of eating freshwater fish meals estimated by the ADPH study was 3.8 meals per month, and that estimated by the current ADEM study was 4.4 meals per month, or 16% more than ADPH respondents. This difference, then, also would partially contribute to the discrepancy between the estimates of C_{annual} from the two surveys.

It also certainly is possible that the angler populations identified in the two surveys were different. The ADPH survey identified anyone who had fished at least once in the past year as an angler. Thus, many people likely were included as anglers that did very little fishing over the course of a year. The current ADEM study, however, intercepted anglers who were engaged in fishing at the study sites, and it is likely that, on-the-average, this angler population did more fishing annually than did the population in the ADPH survey. It is expected to some degree, then, that the frequency of eating fish would be higher, and that the size of servings might be larger, for the individuals targeted with the ADEM study.

Conclusions

The results of this survey indicate that the mean daily per capita freshwater fish consumption of the angling public is higher than that recommended by the EPA (20 g/d). Annual estimates of mean daily per capita consumption (C_{annual}) for anglers from the current ADEM study were 43 g/d for the Harvest Method and 46 g/d for the 4-oz Serving Method, respectively. These two estimates of C_{annual} corroborated one another.

If estimates of C_{annual} are based only on the meals of fish caught at the study sites (primarily river tailwater areas just below dams), then estimates of C_{annual} dropped to 33 g/d using the Harvest Method, and to 30 g/d using the 4-oz Serving Method. Again, the estimates from the two methods corroborated one another.

Mean values of daily per capita freshwater fish consumption varied across seasons (Table 4), river drainages (Table 5), study sites (Tables B1 - B4), and various socio-demographic groupings (Tables 10 and 11), as previously discussed. Based on average values of C_{annual} from the Harvest Method and the 4-oz Serving Method using all meals of fish caught in Alabama rivers and reservoirs, the lowest estimates of daily consumption were associated with anglers between 20 and 30 years old (16 g/d), and with black anglers whose annual family incomes were greater than $40,000 (14 g/d). The highest estimates of consumption were associated with people older than 50 years (76 g/d), and with black anglers whose annual family incomes were less than $15,000 (63 g/d). There are daily consumption rates in the tables in this report that are higher and lower than the extremes summarized here, but those values are associated with very small segments of the sample of anglers surveyed.

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Table 1. List of the 23 selected study sites for the Alabama freshwater fish consumption survey (August 1992 - July 1993). The seven reservoirs sampled also are indicated.

	Study Sites	River Drainage
1	Wheeler Dam & Reservoir	Tennessee River
2	Guntersville Dam	Tennessee River
3	Lewis Smith Dam	Mulberry River
4	Warrior Dam	Black Warrior River
5	Holt Dam & Reservoir	Black Warrior River
6	Coffeeville Dam	Tombigbee River
7	Demopolis Dam	Tombigbee River
8	Aliceville Dam	Tombigbee River
9	Tombigbee Landing at Jackson	Tombigbee River
10	Claiborne Dam	Alabama River
11	Millers Ferry Dam & Reservoir	Alabama River
12	Jones Bluff Dam	Alabama River
13	Powder Magazine at Montgomery	Alabama River
14	Lay Reservoir	Coosa River
15	Logan Martin Dam	Coosa River
16	Weiss Dam & Reservoir	Coosa River
17	Harris Dam	Tallapoosa River
18	Thurlow/Yates Reservoir Complex	Tallapoosa River
19	Harding Dam & Reservoir	Chattahoochee River
20	Columbia Dam	Chattahoochee River
21	Landing on Pea River at Elba	Pea River
22	The Bear Creek Impoundment	Bear Creek
23	River Landing in Mobile Delta	Mobile River

Table 2. Dress-out percentages for each species and dressing method used in the dress-out study. Cleaning methods are shown in Figure 2.

Species	n	Cleaning Methods A	B	C	D	E	F
Bluegill sunfish	23	.69	.49	.40	.49	.24	.41
Redear sunfish	8	.71	.50	.40	.50	.27	.43
Redbreast sunfish	3	.75	.50	.40	.50	.24	.41
Warmouth sunfish	5	.69	.51	.40	.51	.26	.42
Largemouth bass	27	.69	.52	.40	.52	.30	.45
Spotted bass	4	.72	.57	.40	.57	.33	.49
White bass	5	.72	.55	.40	.55	.32	.47
Striped bass	7	.69	.55	.40	.55	.32	.48
Hybrid striped bass	16	.74	.57	.40	.57	.32	.48
Black crappie	37	.72	.56	.40	.56	.32	.48
White crappie	12	.74	.59	.40	.59	.32	.51
Channel catfish	38	.70	.59	.44	.59	.30	.38
Blue catfish	10	.71	.57	.45	.58	.30	.38
White catfish	12	.71	.54	.41	.54	.28	.37
Bullhead catfish	10	.65	.53	.41	.53	.27	.35
Freshwater drum	12	.69	.51	.40	.51	.27	.44
Common carp	7	.67	.54	.40	.54	.25	.44
Blacktail redhorse	14	.74	.57	.40	.60	.29	.48
Smallmouth buffalo	10	.74	.59	.40	.59	.30	.49
Spotted sucker	8	.75	.61	.40	.61	.28	.52
Mean Dress-out %	268	.70	.50	.40	.50	.30	.45

Table 3. Percentages of fish species cleaned (Figure 2) as indicated by anglers during the study period (July 1992 -August 1993).

Species	Cleaning Methods					
	A	B	C	D	E	F
Bluegill sunfish	5	80	10	0	5	0
Redear sunfish	5	80	4	0	11	0
Redbreast sunfish	0	100	0	0	0	0
Green sunfish	0	100	0	0	0	0
Longear sunfish	0	100	0	0	0	0
Warmouth sunfish	11	89	0	0	0	0
Rock bass	0	0	0	0	100	0
Largemouth bass	0	14	2	0	69	15
Spotted bass	0	6	0	0	81	13
Smallmouth bass	0	2	0	0	98	0
White bass	0	34	2	0	55	9
Striped bass	5	30	5	0	50	10
Hybrid Striped bass	0	15	3	0	78	4
Yellow bass	0	36	11	0	53	0
Black crappie	0	18	1	0	73	8
White crappie	1	32	1	0	61	5
Channel catfish	0	4	63	2	23	8
Blue catfish	0	2	61	2	28	6
Flathead catfish	0	0	46	2	52	0
White catfish	0	0	94	0	6	0
Brown bullhead	0	11	83	0	0	6
Black bullhead	0	53	35	0	12	0
Yellow bullhead	0	0	100	0	0	0
Sauger	0	1	1	0	89	9
Yellow perch	67	0	0	0	33	0
Freshwater drum	12	39	13	0	25	11
Rainbow trout	59	32	0	0	9	0
Longnose gar	0	0	100	0	0	0
Common carp	0	20	0	0	80	0
American eel	0	0	100	0	0	0
Chain pickerel *	0	0	0	100	0	0
Blacktail redhorse *	100	0	0	0	0	0
Smallmouth buffalo	0	50	0	0	50	0
Spotted sucker *	0	100	0	0	0	0

* depicts species where only 1 or 2 fish were enumerated in anglers' harvests.

Table 4. Estimates of $C_{seasonal}$ (g/d) of Alabama anglers (August 1992 - July 1993). Estimates are given for the Harvest and 4-oz Serving Methods for both site meals and all meals. The numbers of interviewed anglers (N) are shown and the relative standard errors (%) are given in parentheses.

Harvest Method

Season	Site Meals N	Site Meals Mean		All Meals N	All Meals Mean	
Fall	130	29.7	(17.8)	130	43.4	(17.6)
Winter	56	26.2	(27.5)	56	34.2	(23.8)
Spring	185	21.5	(20.9)	185	29.3	(16.8)
Summer	192	46.7	(16.9)	192	57.0	(14.6)

4-oz Serving Method

Season	Site Meals N	Site Meals Mean		All Meals N	All Meals Mean	
Fall	303	32.0	(11.7)	303	49.4	(11.0)
Winter	177	30.8	(11.4)	177	43.9	(10.1)
Spring	411	20.5	(8.7)*	414	33.6	(7.5)*
Summer	412	36.4	(9.6)*	417	53.0	(9.7)*

* denotes statistical differences ($p < .05$) among seasonal means within site categories.

Table 5. Estimates of $C_{drainage}$ (g/d) for Alabama anglers (August 1992 - July 1993) for each river drainage in the study area. Estimates are given for the Harvest and 4-oz Serving Methods for both site meals and all meals. Relative standard errors (%) are shown in parantheses.

Harvest Method

	People at meal		Site Meals		All Meals	
Drainage	N	Mean	N	Mean	N	Mean
Alabama	70	4.2 (7)	63	37.9 (45)	63	44.1 (40)
Bear Creek	22	3.4 (7)	21	12.0 (34)	21	22.6 (28)
Black Warrior	43	3.8 (7)	9	34.9 (25)	39	56.0 (20)
Chattahoochee	48	4.2 (11)	47	30.2 (28)	47	37.8 (23)
Coosa	138	4.6 (6)	129	27.4 (27)	129	35.3 (23)
Mobile	37	4.5 (12)	25	45.1 (26)	25	66.6 (31)
Mulberry River	13	5.2 (25)	11	12.7 (45)	11	17.0 (36)
Pea	7	3.6 (8)	5	3.4 (100)	5	5.2 (59)
Tallapoosa	30	4.1 (10)	27	28.7 (30)	27	36.6 (26)
Tennesse	108	4.5 (10)	97	32.4 (23)	97	48.2 (20)
Tombigbee	97	5.1 (11)	87	44.7 (21)	87	49.5 (19)

4-oz Serving Method

	Number of 4-oz Servings		Site Meals		All Meals	
River	N	Mean	N	Mean	N	Mean
Alabama	139	3.4 (5)	139	29.7 (19)	139	42.8 (21)
Bear Creek	46	3.8 (9)	46	14.2 (24)	46	27.1 (26)
Black Warrior	99	4.0 (6)	98	33.8 (17)	99	56.0 (13)
Chattahoochee	140	4.0 (7)	139	30.7 (24)	140	46.6 (17)
Coosa	259	3.6 (4)	256	23.7 (13)	259	40.0 (17)
Mobile	65	3.9 (6)	65	40.8 (19)	65	54.5 (15)
Mulberry River	28	3.5 (12)	27	13.4 (35)	27	42.0 (26)
Pea	18	4.6 (10)	18	12.0 (56)	18	35.9 (34)
Tallapoosa	80	3.8 (6)	77	28.8 (19)	79	43.9 (17)
Tennessee	210	3.9 (4)	210	35.8 (12)	210	50.9 (10)
Tombigbee	166	3.6 (4)	165	37.1 (10)	166	47.0 (10)

Table 6. Common and scientific names of fish harvested by anglers during the study period (August 1992 - July 1993).

Common Name	*Scientific Name*
Black Bass	
Largemouth bass	*Micropterus salmoides*
Smallmouth bass	*Micropterus dolomieui*
Spotted bass	*Micropterus punctulatus*
Catfish	
Black bullhead	*Ictalurus melas*
Blue catfish	*Ictalurus furcatus*
Brown bullhead	*Ictalurus nebulosus*
Channel catfish	*Ictalurus punctatus*
Flathead catfish	*Pylodictis olivaris*
White catfish	*Ictalurus catus*
Yellow bullhead	*Ictalurus natalis*
Crappie	
Black crappie	*Pomoxis nigromaculatus*
White crappie	*Pomoxis annularis*
Freshwater drum	*Aplodinotus grunniens*
Morone	
Hybrid striped bass	*M. chrysops x M. saxatilis*
Striped bass	*Morone saxatilis*
White bass	*Morone chrysops*
Yellow bass	*Morone mississippiensis*
Other	
American eel	*Anguilla rostrata*
Blacktail redhorse	*Moxostima poecilurum*
Chain pickerel	*Esox niger*
Common carp	*Cyprinus carpio*
Longnose gar	*Lepisosteus osseus*
Smallmouth buffalo	*Ictiobus bubalus*
Spotted sucker	*Minytrema melanops*
Perch	
Sauger	*Stizostedion canadense*
Yellow perch	*Perca flavescens*
Rainbow trout	*Oncorhynchus mykiss*
Sunfish	
Bluegill sunfish	*Lepomis macrochirus*
Green sunfish	*Lepomis cyanellus*
Longear sunfish	*Lepomis megalotis*
Redbreast sunfish	*Lepomis auritus*
Redear sunfish	*Lepomis microlophus*
Rock bass	*Ambloplites rupestris*
Warmouth sunfish	*Chaenobryttus gulosus*

Table 7. Number and total weight for each species of fish measured in anglers' harvests during the study period (August 1992-July 1993). Unidentified species were weighed and placed in the appropriate taxonomic group.

Group and Species	Number	Weight (kg)
Black Bass (mixed Bass)		4.80
Largemouth bass	274	171.47
Smallmouth bass	43	38.69
Spotted bass	124	89.90
Catfish (mixed Catfish)		256.42
Blue catfish	272	436.12
Black bullhead	15	19.15
Brown bullhead	18	10.20
Channel catfish	387	726.66
Flathead catfish	39	107.17
White catfish	25	6.81
Yellow bullhead	1	1.15
Crappies (mixed Crappie)		174.65
Black crappie	143	119.76
White crappie	233	88.99
Freshwater drum	130	144.85
Morone (mixed Morone spp.)		29.63
White bass	46	20.59
Striped bass	78	140.92
Hybrid striped bass	168	215.96
Yellow bass	37	11.85
Other		
American eel	2	0.53
Blacktail redhorse	1	1.05
Chain pickerel	2	0.99
Common carp	7	32.25
Longnose gar	4	13.80
Smallmouth buffalo	1	8.95
Spotted sucker	1	0.36
Perch		
Sauger	95	45.43
Yellow perch	4	0.38
Rainbow trout	23	4.72
Sunfish (mixed Sunfish)		13.20
Bluegill sunfish	280	77.34
Green sunfish	11	0.96
Longear sunfish	21	0.98
Redbreast sunfish	16	0.75
Redear sunfish	71	10.75
Rock bass	1	0.16
Warmouth sunfish	6	0.52

Table 8. Age groups, gender (M or F), number, and mean body weight (MBW) in pounds (lbs) of anglers interviewed during the (July 1992 - August 1993). Relative standard errors of MBW are included in parentheses (%).

	Age Groups											
	< 20		20-29		30-39		40-49		50-59		≥60	
	M	F	M	F	M	F	M	F	M	F	M	F
Number	233	30	31	49	491	57	484	47	257	26	235	36
MBW	122 (3)	94 (7)	184 (1)	131 (3)	189 (1)	141 (2)	197 (1)	148 (3)	195 (1)	157 (4)	179 (1)	142 (2)

Table 9. The percentage of anglers interviewed in each annual family income category during the study period (August 1992 - July 1993).

Income Category	Annual Family Income	Number	Percent
A	≤ $ 5,000	51	4
B	$ 5,001 - $ 10,000	79	6
C	$ 10,001 - $ 15,000	146	12
D	$ 15,001 - $ 20,000	150	12
E	$ 20,001 - $ 25,000	333	27
F	$ 25,001 - $ 30,000	134	11
G	$ 30,001 - $ 40,000	111	9
H	$ 40,001 - $ 50,000	112	9
I	> $ 50,001	112	9
J	No Response	9	1

Table 10. Estimates of C_{annual} (g/d) of Alabama anglers (August 1992 - July 1993) for each ethnic group. Relative standard errors (%) are shown in parantheses.

Harvest Method

Ethnic Group	Site Meals N	Site Meals Mean	All Meals N	All Meals Mean
Asian	2	74.7 (97)	2	74.7 (97)
Black	113	35.4 (23)	113	49.6 (20)
Latin	2	0 (.)	2	0 (.)
Native American	0	0 (.)	0	. (.)
White	413	33.9 (9)	413	48.6 (12)

4-oz Serving Method

Ethnic Group	Site Meals N	Site Meals Mean	All Meals N	All Meals Mean
Asian	3	44.1 (79)	3	44.1 (79)
Black	232	33.4 (14)	232	50.7 (11)
Latin	2	0 (.)	2	0 (.)
Native American	2	22.7 (99)	2	22.7 (99)
White	925	29.4 (6)	925	49.7 (6)

Table 11. Estimates of C_{annual} (g/d) for each ethnic group of Alabama anglers (August 1992 - July 1993) for each income category as determined using the Harvest and 4-oz Serving Methods.

Ethnic Group	Income Category	Number	Harvest Method	4-oz Serving Method
Asian	E	1	2.2	15.1
	G	2	147.2	113.4
Black	A	15	138.9	101.7
	B	10	28.4	64.8
	C	18	30.8	42.1
	D	17	57.5	38.0
	E	16	58.4	44.8
	F	6	40.6	56.0
	G	7	40.7	45.4
	H	4	15.1	21.4
	I	2	11.0	7.6
	J	3	20.8	11.3
Latin	C	2	0	0
Native	E	1	.	22.7
	H	1	.	0
White	A	7	44.4	48.2
	B	19	82.0	48.0
	C	48	51.5	45.2
	D	44	84.3	55.3
	E	108	48.1	57.0
	F	35	32.6	51.0
	G	26	28.1	37.0
	H	35	23.6	32.0
	I	20	113.4	44.6
	J	1	5.6	20.2

Note: There were 105 interviews with missing ethnic group entries or groups with a combination of more than one ethnic group in the fishing party.

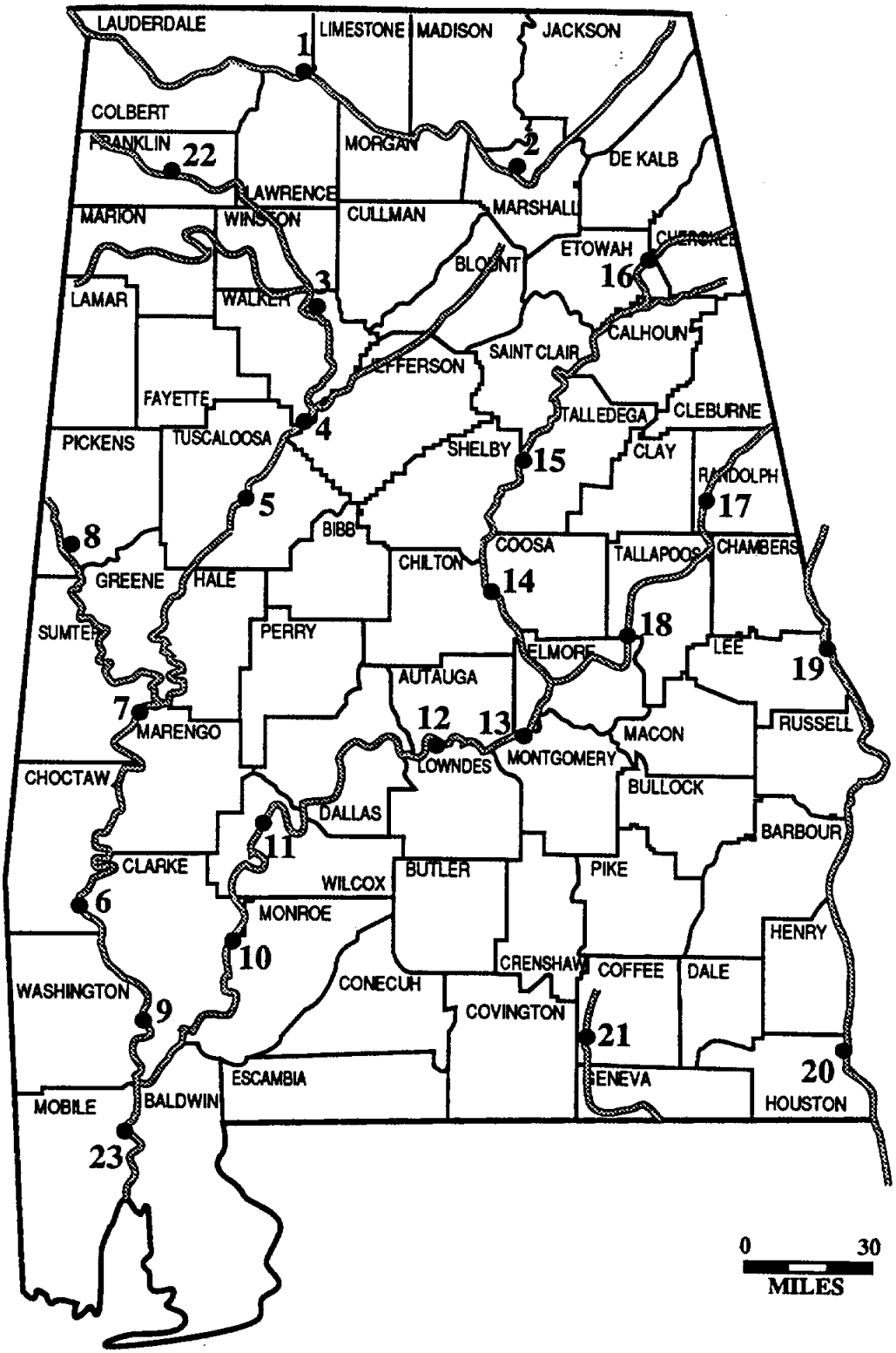
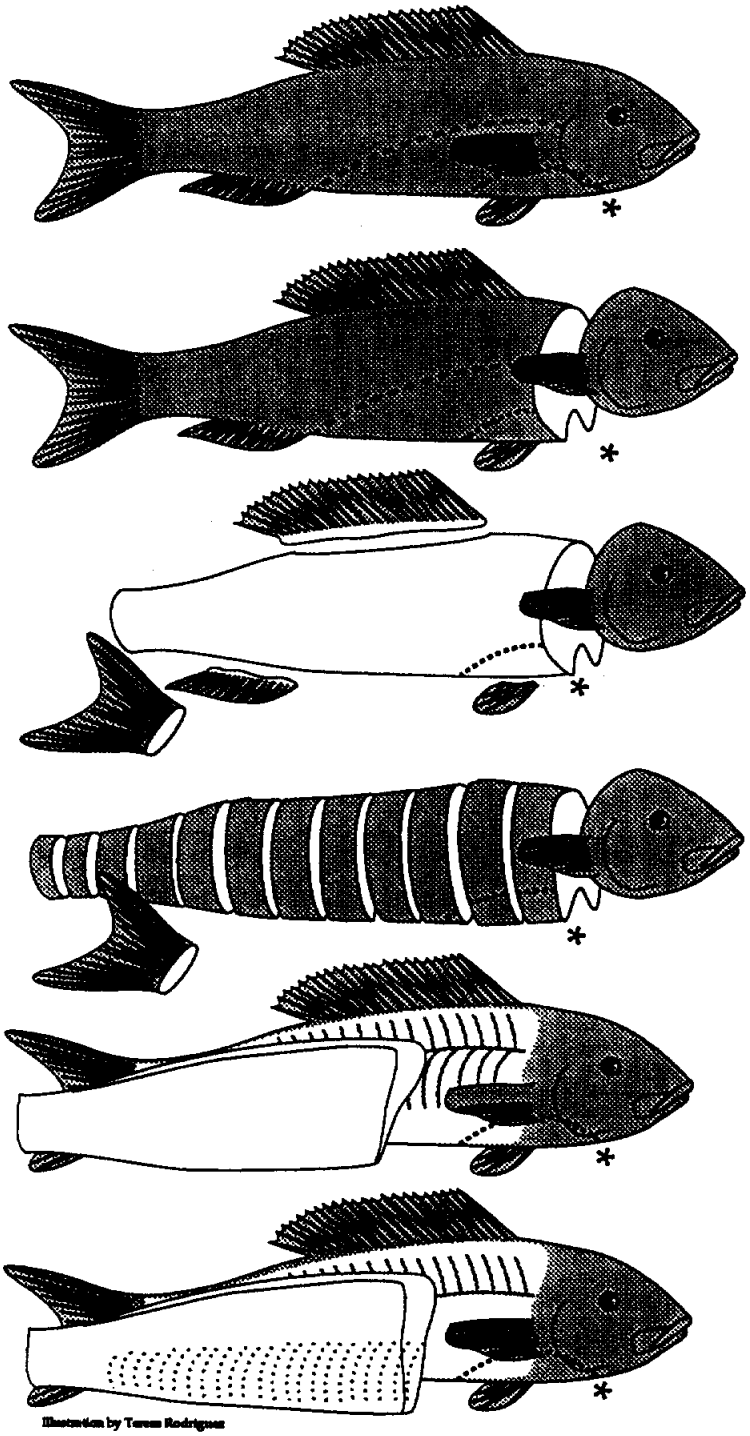


Figure 1. Map of Alabama showing the locations of the 23 study sites for the freshwater fish consumption survey (August 1992 - July 1993).

Fish Cleaning Methods



A ___Whole fish - gutted only (drawn)
*Belly fat removed
Yes___ No___

B ___Whole fish - gutted, scaled head off
*Belly fat removed
Yes___ No___

C ___Whole fish - skinned- head off
*Belly fat removed
Yes___ No___

D ___Fish steaks, or
fish steaks and fillets
*Belly fat removed
Yes___ No___

E ___Fillet without rib bones
w/skin ___ or w/o skin ____
*Belly fat removed
Yes___ No___

F ___Fillet with rib bones
w/skin ___ or w/o skin ____
*Belly fat removed
Yes___ No___

Figure 2. Different fish cleaning methods that anglers were asked to choose from during the Alabama Freshwater Fish Consumption Survey, (July 1992 - August 1993).

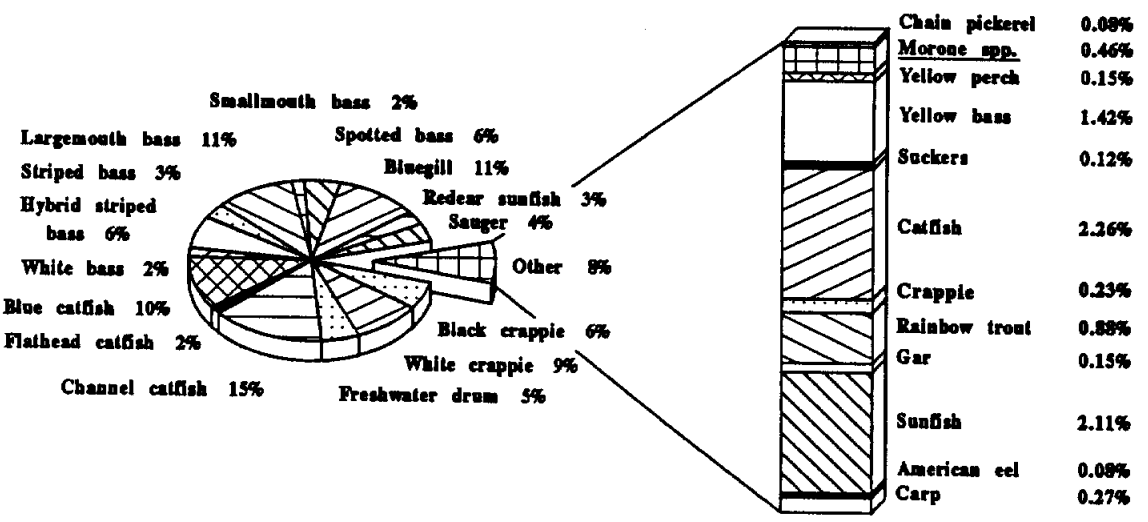


Figure 3. Species composition (% by numbers) of fish harvested by anglers during the study period (August 1992 - July 1993).

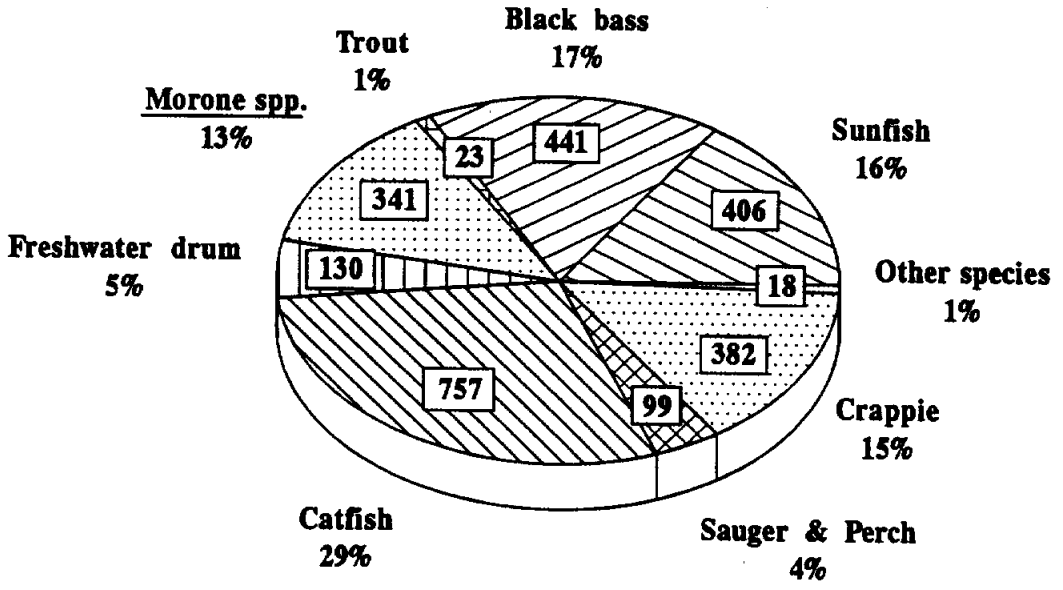


Figure 4. Grouped species composition (% by numbers) of fish harvested by anglers during the study period (August 1992 - July 1993).

Appendix A

Alabama State-Wide Freshwater
Fish Consumption Survey Interview Schedule

Alabama State-Wide Freshwater
Fish Consumption Survey (Interview Schedule)

I am conducting a fresh water fish consumption survey in the State of Alabama. May I take a few minutes of your time to ask some questions about your fishing trip and measure the fish that you have kept?

Date and Location

Month ___ Day ___ Year _____ System _____ Interview #____ Time:_____

Fish Consumption Related Questions

1. Have you kept any fish that you have caught today?
(Circle response)

Yes **No**

2A. Do you eat fish that you catch from this location?
(Circle response)

Yes

IF NO TO #1 & YES TO #2 GO TO QUESTION NUMBER

5A.

No : then

2B. why? _____ (Code:_____),

2C. and what do you do with them?
_____ (Code:_____)

5B.

3A. Have you caught enough fish today for a family meal?
(Circle response)

Yes

No : then

3B. How many more fish like the ones you've caught do you need to make a meal?
_____ (enter a number of additional fish needed).

3C. Will you freeze these fish until you have caught enough to make a meal?

Yes **No**
GO TO QUESTION NUMBER 3E

3D. Will you eat these fish today?
(Circle response)

Yes

No

3E. When do you think that you will eat these fish?

_____ *(Code:_____)*
GO TO NEXT QUESTION

4A. How many other people will eat these fish with you?

_____ *(enter number of people that will consume these fish)*

4B. How will these fish be cooked? _____ *(Code:_____)*

5A. *How many meals have you eaten over the past month with fish you've caught here?* _____

5B. *How many meals have you eaten over the past month with fish you've caught in other lakes or rivers in Alabama?* _____

5C. How many meals have you eaten over the past month with fish you've caught in farm ponds in Alabama? _____

Month ___ Day ___ Year _____ System _____ Interview #____

These next few questions are about the way you prepare and cook your fish and how important they are to you.

6A. Do you clean your own fish? (Circle response)

Yes No

6B. Who does?_____ (Code: _____)

7. A serving of fish consists of approximately 4 ounces. This would be about the size of the palm of your hand. How many servings of fish do you usually eat per meal? _____

Short Form Ends Here (with species information)

---

8. How important to your family meals are the fish that you catch here or in other Alabama lakes and rivers? Are they:

(1)not important (2)somewhat important (3)important (4)very important ?

9. Are the fish you catch here or in other Alabama Lakes and Rivers important in reducing your family food expenses? Are they:

(1)not important (2)somewhat important (3)important (4)very important ?

10. What will you eat today for your next family meal (main course) if you don't eat fish caught here?

_____ (Code: _____)

11. Have you ever heard of a health advisory warning against consuming fish caught here? Yes_____ No____

12. Do you know of any place in Alabama where a health advisory warning against consuming fish has been issued? Yes_____ No_____

If yes, where_____

(Code: _____)

13. Would you eat fish from this location if there was a health advisory warning against consuming fish caught here? Yes____ No____

14. Who do you feel should be responsible for the protection of Alabama's water resources? _____

(Code: _____)

Month ___ Day ___ Year _____ System _____ Interview #_____

There are many hazards or risks in our daily lives. These next few questions will help us determine the angling publics' views concerning the risks associated with the fish that you catch and eat for your family meals.

Out of all your daily activities, what is most dangerous to you?_____
(Code: _____)

Please respond to the following statements, on a scale of 1 to 5, 1 meaning that you strongly disagree, 3 meaning undecided and 5 meaning that you strongly agree.

	SD	D	U	A	SA
15. Public angencies have exaggerated the risk of eating fish caught in Alabama lakes & rivers.	1	2	3	4	5
16. Adequate information is available about the safety of eating fish from Alabama lakes & rivers.	1	2	3	4	5
17. People need to worry about chemicals in the fish they eat from Alabama lakes and rivers.	1	2	3	4	5
18. Larger fish are more hazardous to eat than small ones.	1	2	3	4	5
19. Bottom-feeding fish like Catfish and Bullheads are more hazardous to eat than other fish like Crappie & Bream.	1	2	3	4	5
20. Most of Alabama's Lakes and Rivers are free of pollution.	1	2	3	4	5
21. State agencies need to take a more aggresive approach to protect Alabama's lakes and rivers.	1	2	3	4	5

Demographics

22. What time did you begin fishing today_____?

23. How many other people are fishing with you today?
_____ *(enter the total number of anglers in party; including interviewee)*

24. Race: *(enter number of anglers in party that are in each race)*
_____ (B) Afro-American
_____ (A) Asian-American
_____ (C) Euro-American
_____ (H) Hispanic-American
_____ (N) Native-American

25. Ages and Body weight of Anglers: *(enter number of anglers in party that are within each age category)*
Ages
_____< 20 _____20-29 _____30-39 _____40-49 _____50-59 _____ ≥ 60

Do you mind if I ask you how much you and your fishing companions weigh? *(circle the anglers gender)*

_____ M F _____ M F _____ M F _____ M F _____ M F _____ M F

_____ M F _____ M F _____ M F _____ M F _____ M F _____ M F

26. What State _____, County _____, and Town _____ do you live in?

27. How much money did you spend on todays fishing trip on:

Gas: $_____ Food & Drinks: $_____ Bait: $_____

28. Would you please tell me which one of these categories your yearly family income falls in. _____

Month ___ Day ___ Year _____ System _____ Interview #____

Alabama State-Wide Freshwater
Fish Consumption Survey (Harvest Sheet)

All fish are to be identified, measured, and weighed. Ask the angler to indicate which fish will be consumed the next time fish are eaten for a family meal.

Species	Number	Length (cm)	Weight (grams)	To be Consumed Yes No	Cleaning Method
					- -
					- -
					- -
					- -
					- -
					- -
					- -
					- -
					- -
					- -
					- -
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					- -
					- -
					- -
					- -
					- -

Appendix B

Alabama State-Wide Freshwater Fish Consumption Survey

Site Specific and Seasonal Estimates of C_{daily}

Table B1. Number (N), mean, and relative standard errors (%) of per capita fish consumption (C_{daily}) based on the Harvest Method and number of fish meals eaten only from the sample site in the previous 30 days during the study period (July 1992 - August 1993).

	Seasonal Blocks											
	Fall 1992			Winter 1993			Spring 1993			Summer 1993		
Study Sites	N	MEAN		N	MEAN		N	MEAN		N	MEAN	
Wheeler reservoir	0	.	.	1	6.9	.	7	9.0	(52)	4	39.4	(93)
Wheeler dam	26	42.9	(38)	2	2.1	(100)	11	21.2	(44)	28	37.9	(42)
Guntersville	6	3.8	(73)	9	23.4	(32)	5	8.0	(62)	10	45.3	(78)
Lewis Smith	4	5.3	(84)	5	22.3	(50)	2	3.5	(100)	0	.	.
Warrior	2	76.9	(100)	5	57.2	(56)	3	55.1	(92)	14	30.2	(44)
Holt reservoir	0	.	.	0	.	.	2	3.2	(100)	4	54.4	(55)
Holt dam	3	4.4	(73)	0	.	.	5	17.8	(64)	1	7.0	.
Coffeeville	6	85.3	(75)	2	0.2	(100)	0	.	.	8	56.8	(60)
Demopolis	7	54.3	(28)	0	.	.	3	51.5	(43)	13	14.6	(45)
Aliceville	10	29.7	(41)	.	.	.	16	23.0	(23)	6	15.6	(60)
Jackson	0	.	.	2	247.1	(28)	7	16.7	(40)	7	120.6	(65)
Claiborne	3	58.5	(83)	2	37.3	(100)	2	23.8	(42)	12	138.0	(61)
Millers Ferry res.	0	.	.	0	.	.	7	6.8	(80)	1	24.9	.
Millers Ferry dam	2	0	.	0	.	.	6	5.8	(57)	3	9.7	(100)
Jones Bluff	5	24.2	(88)	2	5.1	(100)	6	7.0	(51)	3	37.7	(91)
Powder Magazine	3	0.6	(100)	1	0	.	2	2.1	(100)	3	2.7	(70)
Lay reservoir	4	4.5	(70)	3	32.5	(41)	17	8.6	(42)	2	0	.
Logan Martin	7	6.3	(47)	3	3.8	(100)	24	32.7	(28)	9	87.8	(61)
Weiss dam	0	.	.	10	3.9	(64)	26	9.3	(38)	0	.	.
Weiss reservoir	4	9.4	(100)	3	8.5	(49)	14	84.9	(62)	3	35.3	(62)
Harris dam	0	.	.	0	.	.	1	0	.	2	55.2	(96)
Thurlow reservoir	2	5.2	(28)	0	.	.	0	.	.	3	0	.
Yates reservoir	1	0	.	0	.	.	1	53.3	.	17	35.3	(34)
Harding reservoir	2	68.0	(36)	1	4.4	.	5	9.5	(100)	5	14.4	(57)
Harding dam	8	8.6	(90)	1	0	.	4	4.0	(100)	3	97.8	(100)
Columbia dam	2	9.8	(100)	3	30.6	(69)	3	24.3	(50)	10	59.9	(39)
Pea river	2	8.4	(100)	0	.	.	3	0	.	0	.	.
Bear Creek reservoir	8	15.9	(59)	1	0	.	3	8.6	(100)	9	11.1	(38)
Mt. Vernon landing	13	44.0	(34)	0	.	.	0	.	.	12	46.2	(40)

Table B2. Number (N), mean, and relative standard errors (%) of per capita fish consumption (C_{daily}) using the Harvest Method and number of fish meals eaten from all other rivers and reservoirs in Alabama in the previous 30 days during the study period (July 1992 - August 1993).

	Seasonal Blocks											
	Fall 1992			Winter 1993			Spring 1993			Summer 1993		
Study Sites	N	MEAN		N	MEAN		N	MEAN		N	MEAN	
Wheeler reservoir	0	.	.	1	6.9	.	7	19.7	(41)	4	39.4	(93)
Wheeler dam	26	68.0	(36)	2	5.0	(15)	11	48.7	(44)	28	54.0	(35)
Guntersville dam	6	4.7	(57)	9	35.0	(34)	5	13.1	(42)	10	45.0	(78)
Lewis Smith dam	4	9.6	(36)	5	28.3	(41)	2	3.5	(100)	0	0	.
Warrior dam	2	76.9	(100)	5	88.5	(55)	3	68.0	(93)	14	59.0	(30)
Holt reservoir	0	.	.	0	.	.	2	28.9	(100)	4	70.5	(33)
Holt dam	3	20.7	(35)	0	.	.	5	28.9	(74)	1	7.0	.
Coffeeville dam	6	85.3	(75)	2	0.2	(100)	0	0	.	8	58.0	(58)
Demopolis dam	7	58.6	(31)	0	.	.	3	51.5	(43)	13	27.6	(30)
Aliceville dam	10	38.1	(43)	.	.	.	16	23.9	(23)	6	21.0	(59)
Jackson ramp	0	.	.	2	247.1	(28)	7	24.3	(36)	7	124.8	(62)
Claiborne dam	3	110.3	(91)	2	37.3	(100)	2	23.8	(42)	12	150.1	(57)
Millers Ferry res.	0	.	.	0	.	.	7	7.5	(73)	1	24.9	.
Millers Ferry dam	2	0	.	0	.	.	6	10.0	(58)	3	9.7	(100)
Jones Bluff dam	5	26.4	(83)	2	32.0	(38)	6	10.4	(48)	3	46.3	(86)
Powder Magazine ramp	3	1.3	(50)	1	0	.	2	2.1	(100)	3	2.7	(70)
Lay reservoir	4	4.5	(70)	3	32.5	(41)	17	9.8	(43)	2	0	.
Logan Martin dam	7	6.3	(47)	3	11.0	(58)	24	47.0	(27)	9	116.0	(59)
Weiss dam	0	.	.	10	9.9	(49)	26	12.8	(36)	0	0	.
Weiss reservoir	4	12.0	(74)	3	10.3	(58)	14	94.0	(55)	3	60.3	(76)
Harris dam	0	.	.	0	.	.	1	0	.	2	66.1	(97)
Thurlow reservoir	2	14.0	(20)	0	.	.	0	0	.	3	0	.
Yates reservoir	1	10.3	.	0	.	.	1	96.0	.	17	43.5	(29)
Harding reservoir	2	68.0	(36)	1	4.4	.	5	24.7	(87)	5	24.3	(66)
Harding dam	8	21.0	(49)	1	0	.	4	11.8	(47)	3	97.8	(100)
Columbia dam	2	24.4	(100)	3	30.6	(69)	3	36.7	(1)	10	63.0	(38)
Pea River	2	9.6	(74)	0	.	.	3	2.2	(76)	0	0	.
Bear Creek reservoir	8	35.1	(42)	1	0	.	3	8.6	(100)	9	19.0	(26)
Mt. Vernon ramp	13	81.0	(44)	0	0	.	0	0	.	12	51.2	(35)

Table B3. Number (N), mean, and relative standard errors (%) of per capita fish consumption (C_{daily}) based on the 4-oz Method and number of fish meals eaten from only the sample site in the previous 30 days during the study period (July 1992 - August 1993).

	Seasonal Blocks											
	Fall 1992			Winter 1993			Spring 1993			Summer 1993		
Sample Sites	N	MEAN		N	MEAN		N	MEAN		N	MEAN	
Wheeler reservoir	13	10.8	(42)	5	5.3	(100)	28	13.4	(33)	17	29.4	(44)
Wheeler dam	37	40.1	(19)	12	50.1	(38)	29	20.6	(42)	42	40.3	(37)
Guntersville	25	30.0	(30)	31	40.4	(21)	10	20.8	(50)	24	38.7	(39)
Lewis Smith	11	7.0	(47)	5	38.6	(32)	9	10.1	(100)	2	1.9	(100)
Warrior	3	27.0	(52)	8	27.2	(51)	5	66.5	(36)	20	29.9	(29)
Holt reservoir	0	.	.	1	0	.	10	23.1	(81)	22	40.9	(44)
Holt dam	10	30.0	(53)	6	32.8	(74)	10	24.9	(42)	3	68.0	(92)
Coffeeville	6	46.0	(31)	2	15.0	(100)	0	.	.	10	52.2	(31)
Demopolis	7	63.0	(35)	0	.	.	7	36.7	(43)	19	33.4	(28)
Aliceville	19	36.0	(28)	.	.	.	44	32.5	(23)	16	27.4	(36)
Tombigbee @ Jackson	0	.	.	9	52.4	(42)	13	28.2	(32)	15	45.1	(35)
Claiborne	11	68.0	(74)	5	30.2	(73)	3	20.8	(51)	18	33.0	(50)
Millers Ferry res.	3	22.7	(50)	3	65.5	(89)	12	18.3	(47)	2	60.5	(50)
Millers Ferry dam	3	7.6	(100)	0	.	.	9	43.7	(41)	6	66.1	(70)
Jones Bluff	11	28.2	(44)	3	27.7	(51)	17	14.5	(34)	10	20.4	(55)
Powder Magazine	6	5.0	(46)	5	12.6	(69)	7	13.5	(52)	5	26.5	(31)
Lay reservoir	9	14.3	(46)	4	19.8	(49)	30	16.3	(28)	15	15.1	(47)
Logan Martin	25	37.0	(30)	14	22.7	(56)	49	21.7	(24)	12	98.6	(41)
Weiss dam	11	11.7	(46)	8	29.0	(47)	30	12.6	(28)	7	0	.
Weiss reservoir	2	0	.	15	22.7	(43)	19	19.3	(44)	6	33.6	(51)
Harris dam	3	25.2	(53)	6	57.7	(62)	4	36.9	(73)	6	48.5	(40)
Thurlow reservoir	5	15.1	(35)	6	56.7	(61)	0	.	.	9	13.9	(73)
Yates reservoir	6	2.5	(100)	0	.	.	2	81.3	(63)	33	29.3	(30)
Harding reservoir	10	17.0	(41)	7	25.9	(93)	19	13.1	(57)	15	42.3	(73)
Harding dam	16	67.6	(65)	7	26.5	(59)	7	2.2	(100)	11	16.2	(35)
Columbia dam	9	44.5	(40)	6	22.0	(50)	18	17.2	(38)	14	52.1	(60)
Pea river	4	22.7	(100)	9	4.2	(80)	10	0	.	4	31.2	(58)
Bear Creek reservoir	15	11.8	(48)	5	43.8	(43)	7	11.3	(72)	15	23.8	(31)
Mt. Vernon landing	23	44.3	(28)	0	.	.	3	0	.	34	41.6	(28)

Table B4. Number (N), mean, and relative standard errors (%) of per capita fish consumption (C_{daily}) using the 4-oz Method and number of fish meals eaten from all other rivers and reservoirs in Alabama in the previous 30 days during the study period (July 1992 - August 1993).

	Seasonal Blocks											
	Fall 1992			Winter 1993			Spring 1993			Summer 1993		
	N	MEAN		N	MEAN		N	MEAN		N	MEAN	
Systems												
Wheeler reservoir	13	18.3	(33)	5	9.8	(51)	28	31.0	(28)	17	40.5	(32)
Wheeler dam	37	51.1	(16)	12	54.5	(34)	29	38.2	(35)	42	49.8	(36)
Guntersville dam	25	51.7	(28)	31	61.0	(16)	10	34.4	(41)	24	58.9	(28)
Lewis Smith dam	11	53.6	(43)	5	55.2	(40)	9	18.1	(55)	2	52.9	(29)
Warrior dam	3	34.0	(51)	8	47.0	(42)	5	79.4	(35)	20	59.2	(21)
Holt reservoir	0	.	.	1	0	.	10	61.2	(62)	22	60.3	(30)
Holt dam	10	60.1	(48)	6	36.5	(66)	10	43.1	(35)	4	74.7	(60)
Coffeeville dam	6	46.0	(31)	2	15.1	(100)	0	.	.	10	67.3	(29)
Demopolis dam	7	69.1	(40)	0	.	.	7	36.7	(43)	19	49.3	(31)
Aliceville dam	19	41.2	(26)	.	.	.	44	36.3	(21)	17	38.7	(38)
Jackson ramp	0	.	.	7	58.9	(37)	13	43.9	(27)	15	75.3	(26)
Claiborne dam	11	120.6	(84)	5	30.2	(73)	3	20.8	(51)	18	41.3	(40)
Millers Ferry res.	3	47.9	(29)	3	95.8	(69)	12	31.8	(40)	2	60.5	(50)
Millers Ferry dam	3	7.6	(100)	0	.	.	9	51.2	(36)	6	66.1	(70)
Jones Bluff dam	11	36.4	(46)	3	68.0	(23)	17	22.0	(30)	10	36.7	(35)
Powder Magazine ramp	6	13.9	(27)	5	26.5	(41)	7	20.5	(33)	5	26.5	(31)
Lay reservoir	9	16.8	(38)	4	19.8	(49)	32	27.9	(24)	15	18.9	(44)
Logan Martin dam	25	50.8	(36)	14	35.1	(46)	49	34.8	(22)	12	223.3	(55)
Weiss dam	11	22.0	(38)	15	33.3	(32)	19	38.4	(30)	8	15.1	(73)
Weiss reservoir	2	22.7	(100)	8	36.1	(38)	30	21.2	(21)	6	40.9	(46)
Harris dam	3	25.2	(53)	6	97.0	(74)	4	51.0	(67)	8	39.2	(40)
Thurlow reservoir	5	35.5	(30)	3	17.6	(62)	0	.	.	9	27.7	(39)
Yates reservoir	6	10.1	(74)	0	.	.	2	134.2	(77)	33	44.9	(20)
Harding reservoir	10	43.5	(37)	7	38.3	(82)	20	24.9	(42)	15	52.4	(59)
Harding dam	16	83.4	(53)	7	52.4	(36)	7	14.0	(58)	11	22.7	(30)
Columbia dam	9	74.3	(27)	6	23.3	(46)	18	44.5	(42)	14	62.9	(49)
Pea River	4	32.1	(63)	0	.	.	10	16.3	(32)	4	88.8	(48)
Bear Creek reservoir	15	40.3	(48)	9	10.1	(40)	7	11.3	(72)	15	31.5	(22)
Mt. Vernon ramp	23	66.5	(23)	5	43.8	(43)	3	25.2	(100)	34	50.6	(23)

Appendix C

Alabama State-Wide Freshwater

Fish Consumption Survey

Length Frequency Distributions of Fish Measured During the Study Period.

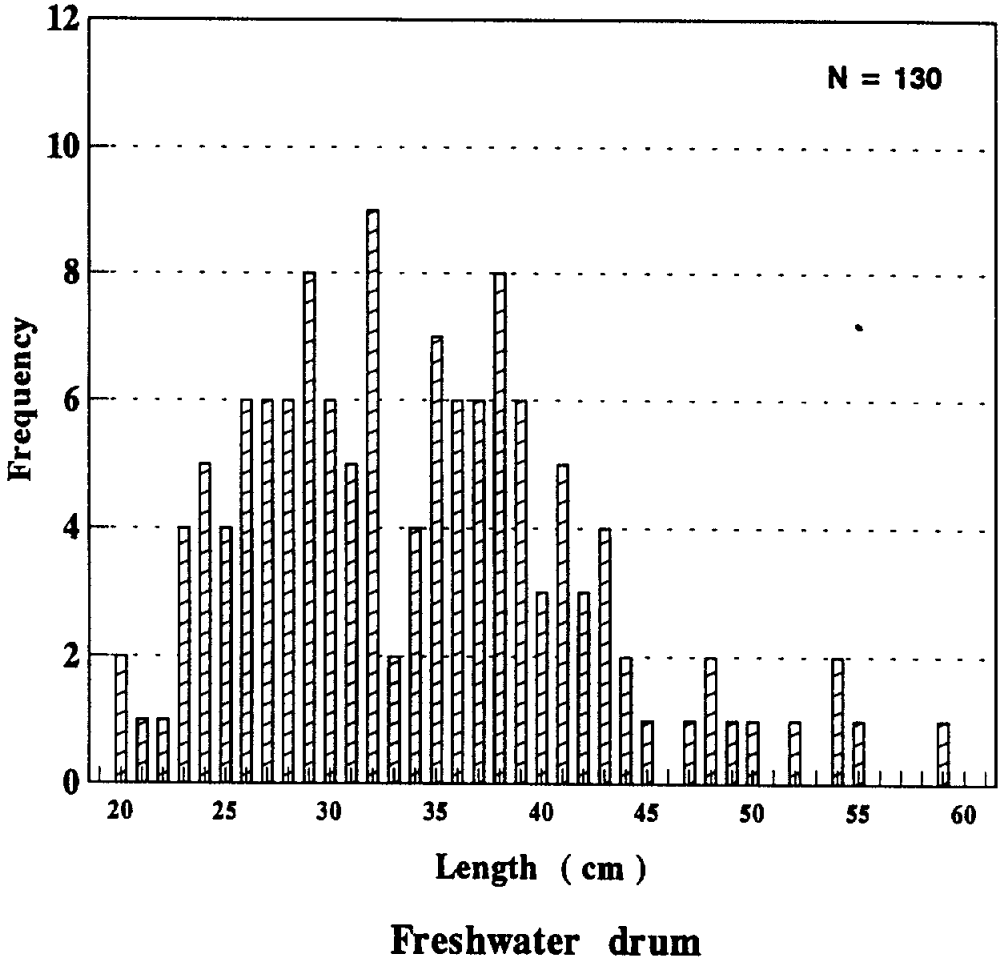
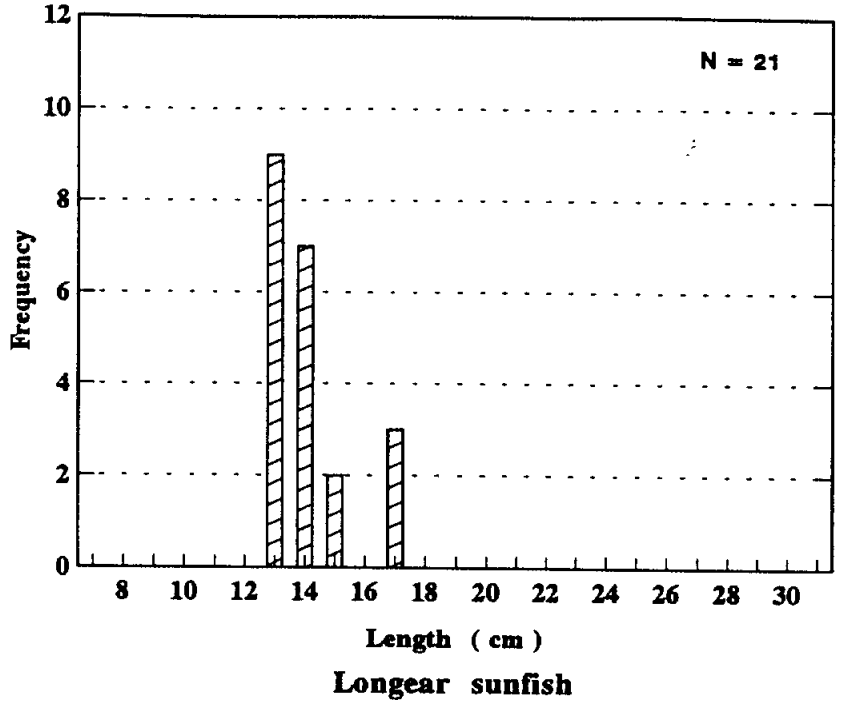


Figure C1. Length frequency of freshwater drum measured during the study period (August 1992 - July 1993).



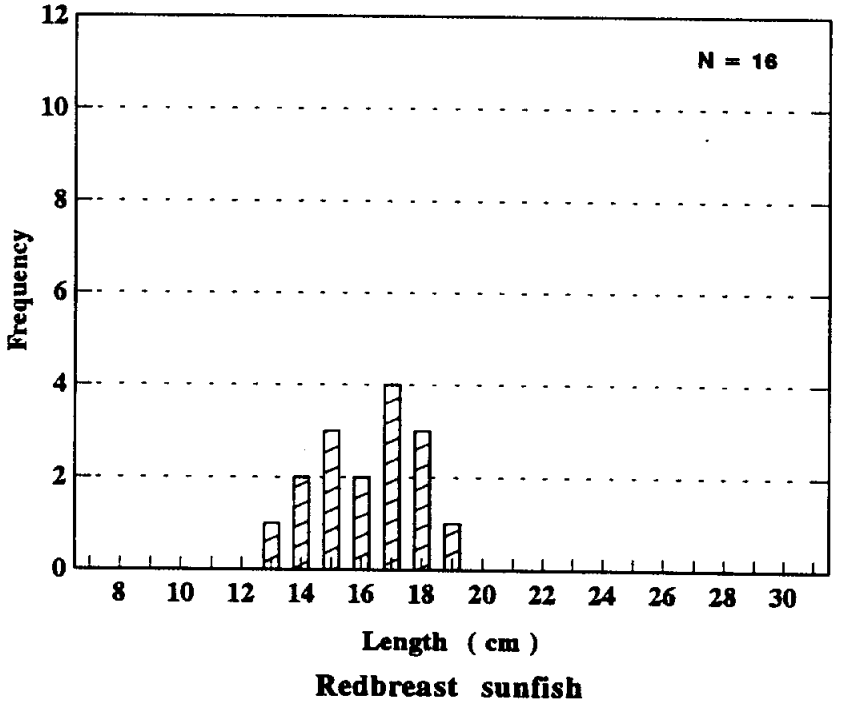
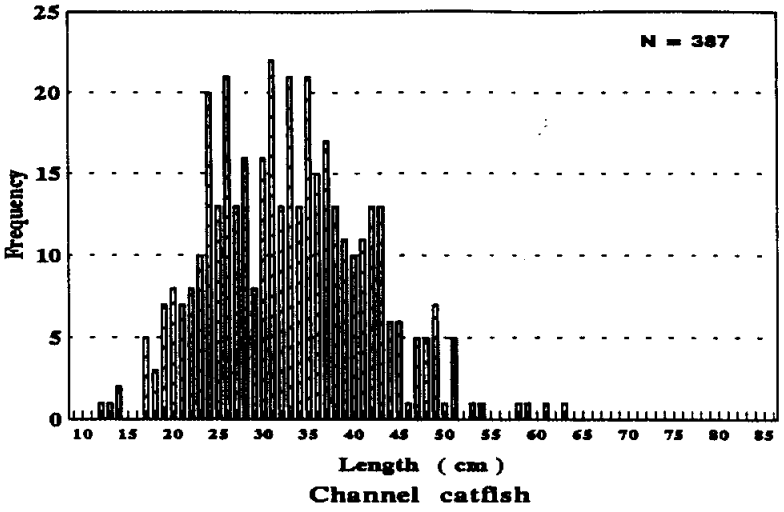
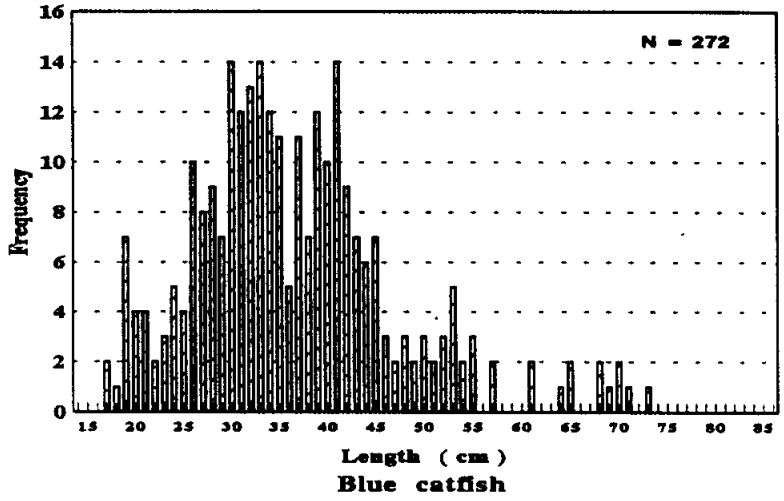


Figure C2. Length frequency of longear and redbreast sunfish measured during the study period (August 1992 - July 1993).





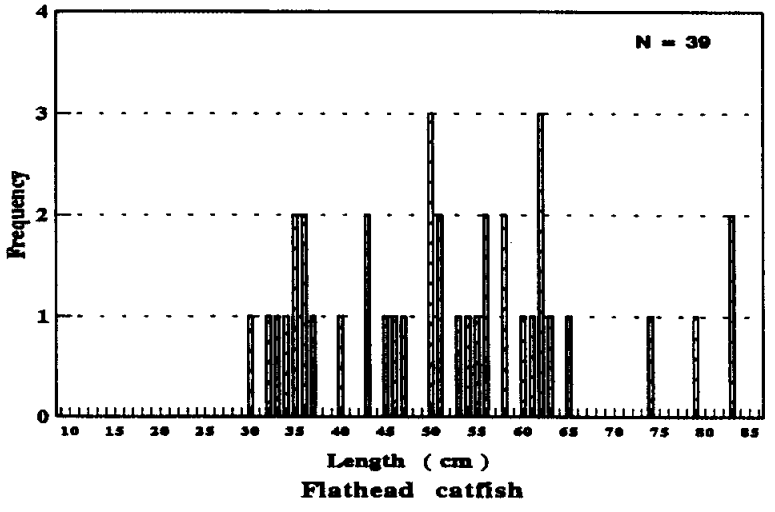
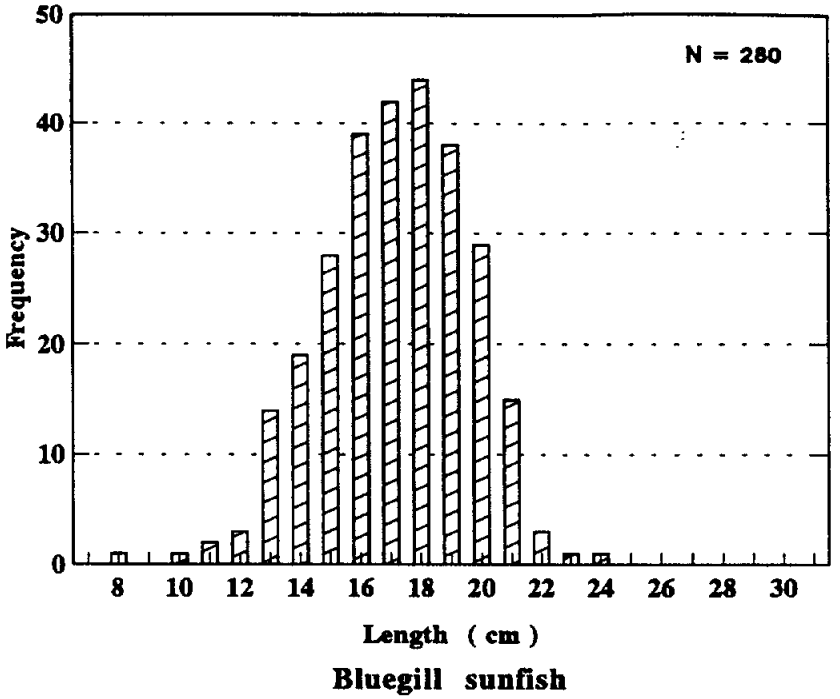


Figure C3. Length frequency of channel, blue and flathead catfish measured during the study period (August 1992 - July 1993).



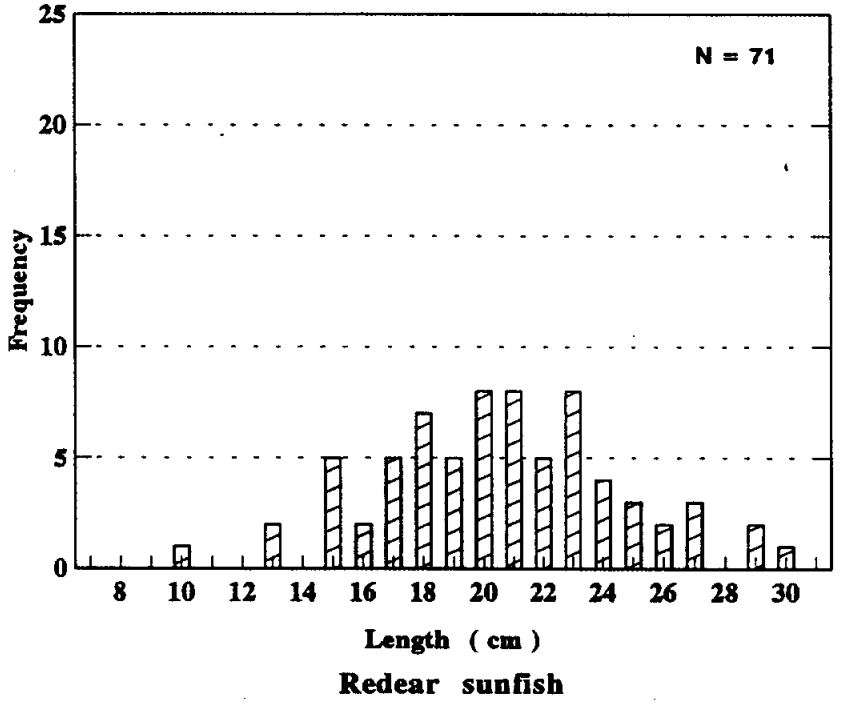


Figure C4. Length frequency of bluegill and redear sunfish measured during the study period (August 1992 - July 1993).

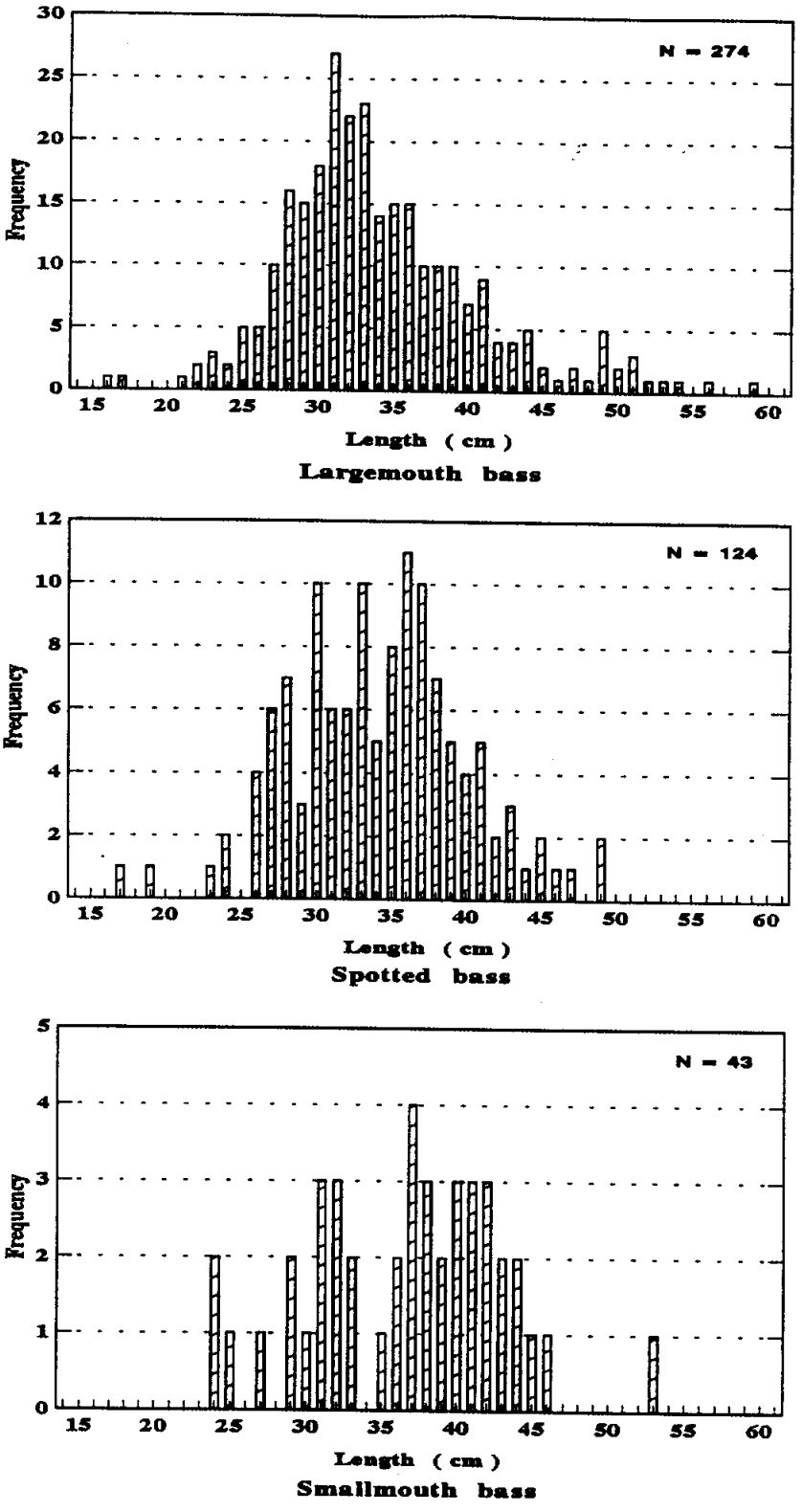
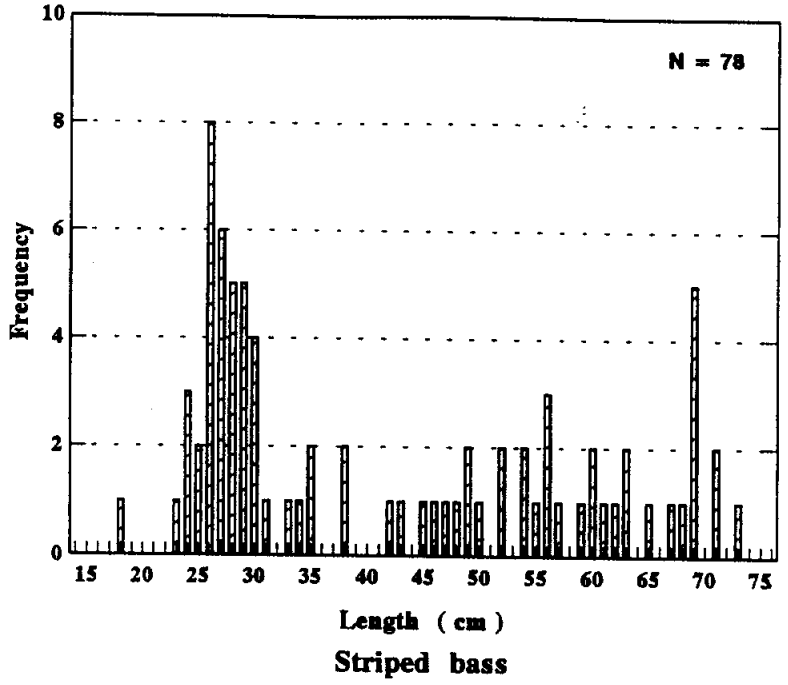


Figure C5. Length frequency of largemouth, spotted, and smallmouth bass measured during the study period (August 1992 - July 1993).



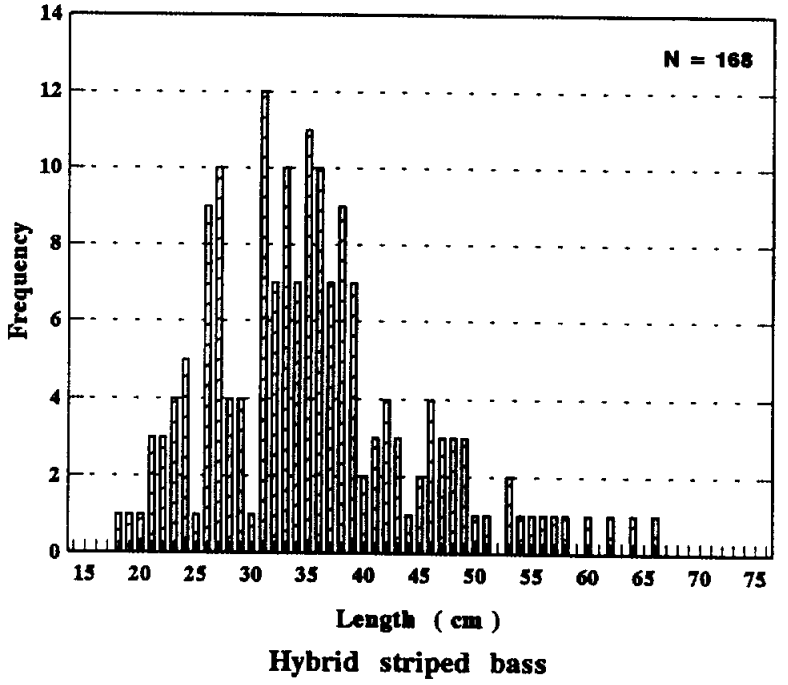


Figure C6. Length frequency of striped and hybrid striped bass measured during the study period (August 1992 - July 1993).

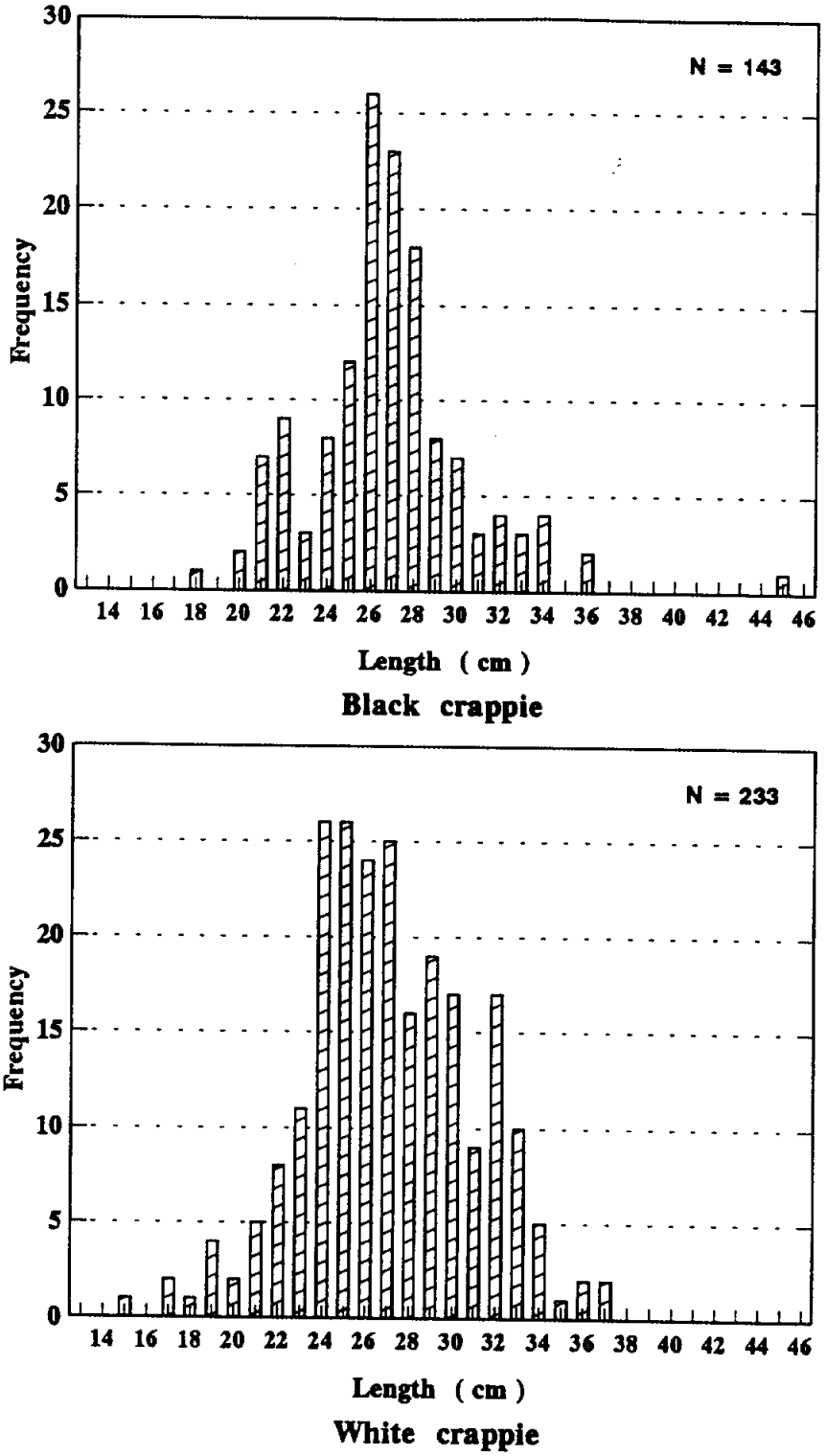


Figure C7. Length frequency of black and white crappie measured during the study period (August 1992 - July 1993).

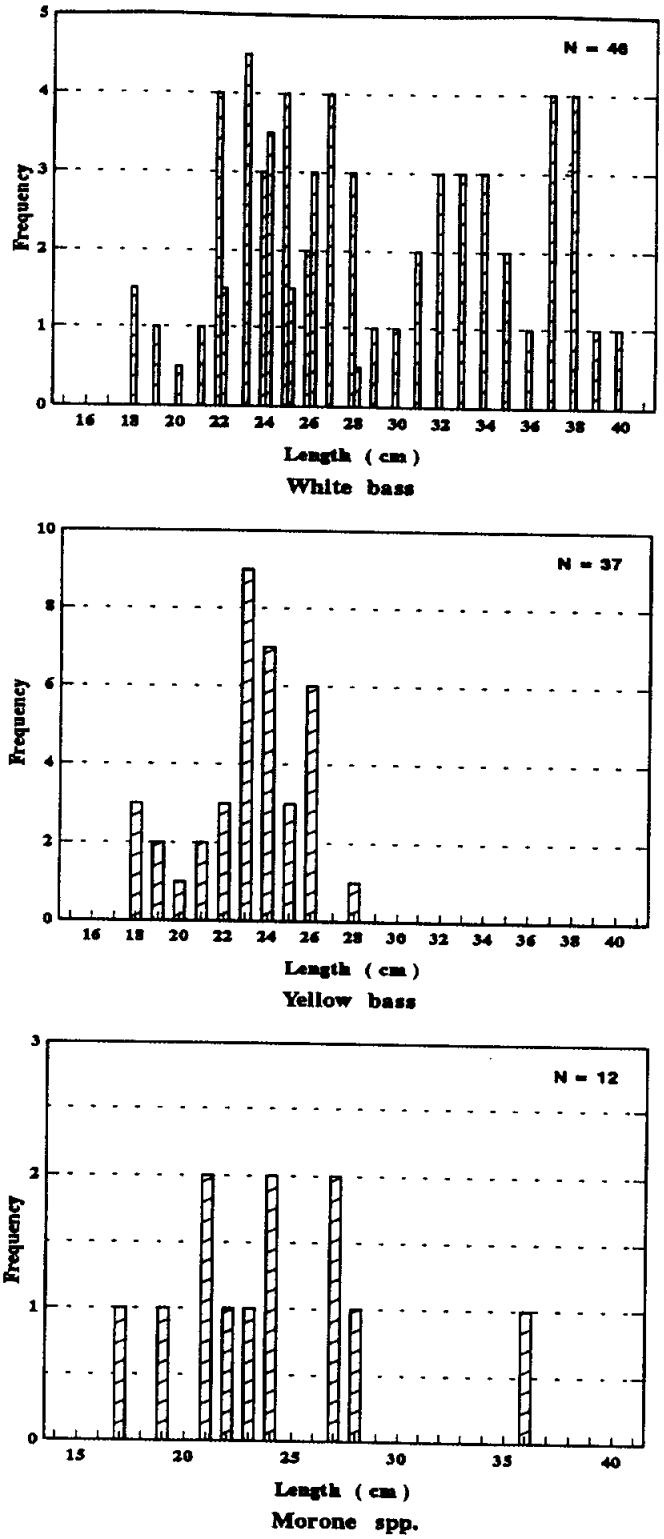
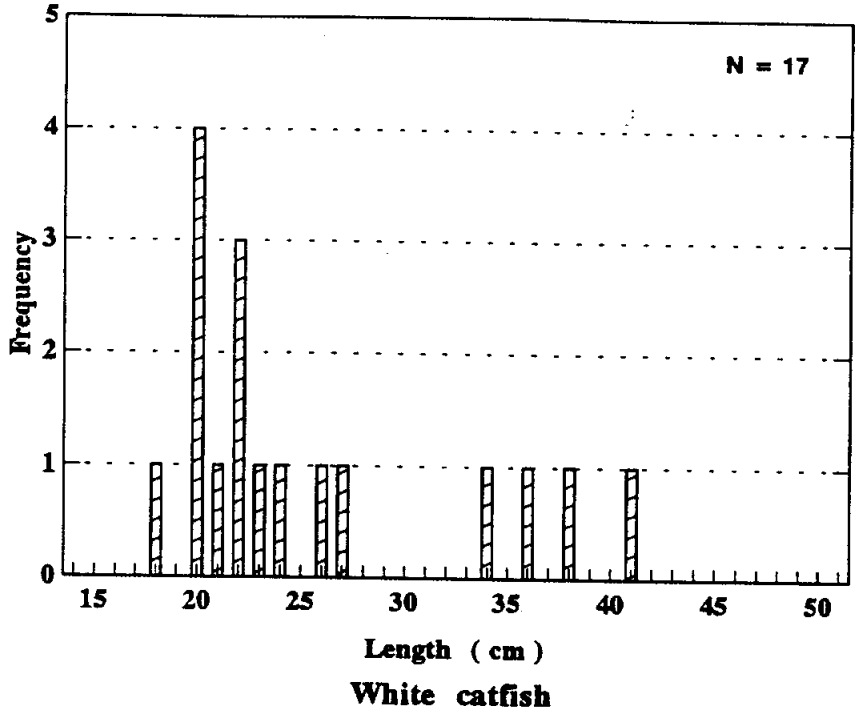


Figure C8. Length frequency of white bass, yellow bass, and Morone species measured during the study period (August 1992 - July 1993).



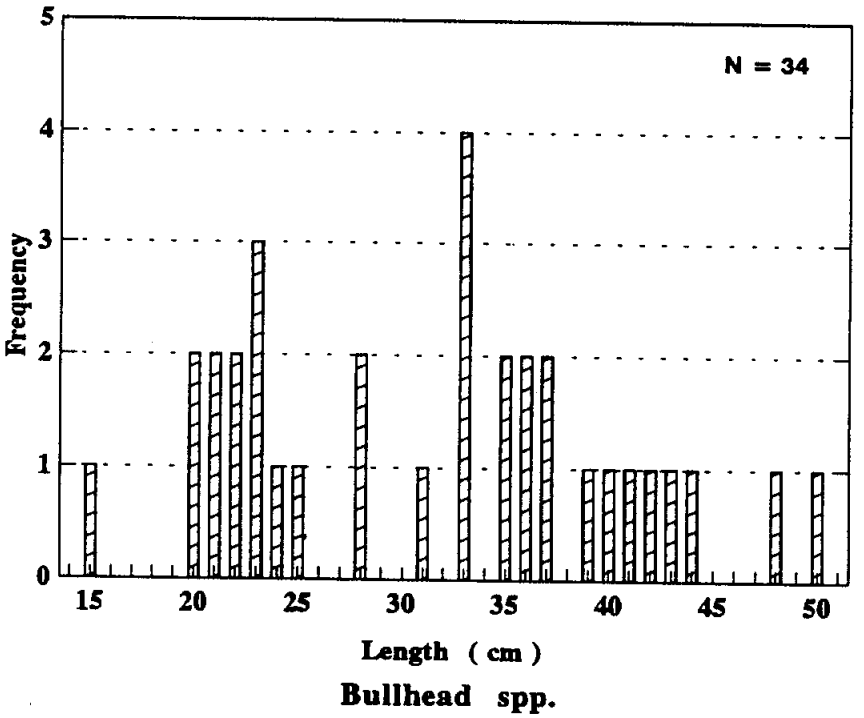


Figure C9. Length frequency of white and bullhead catfish measured during the study period (August 1992 - July 1993).

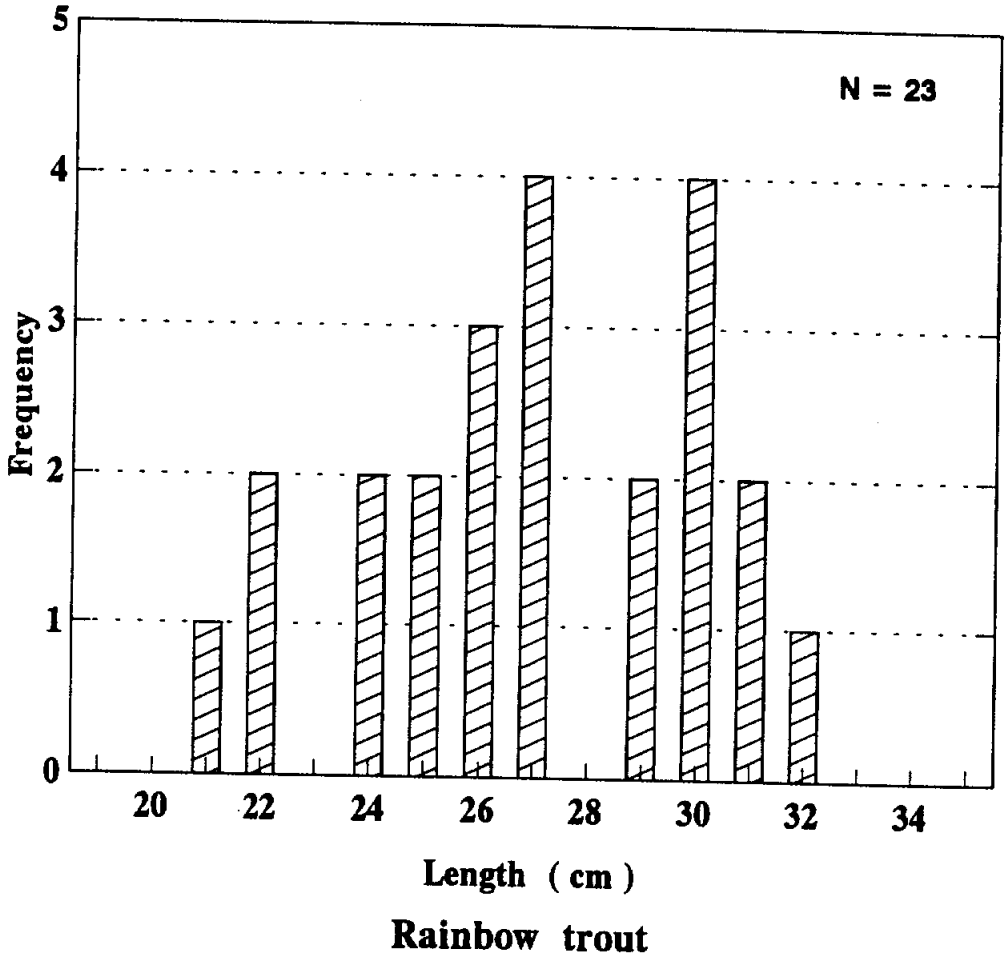


Figure C10. Length frequency of rainbow trout measured during the study period (August 1992 - July 1993).

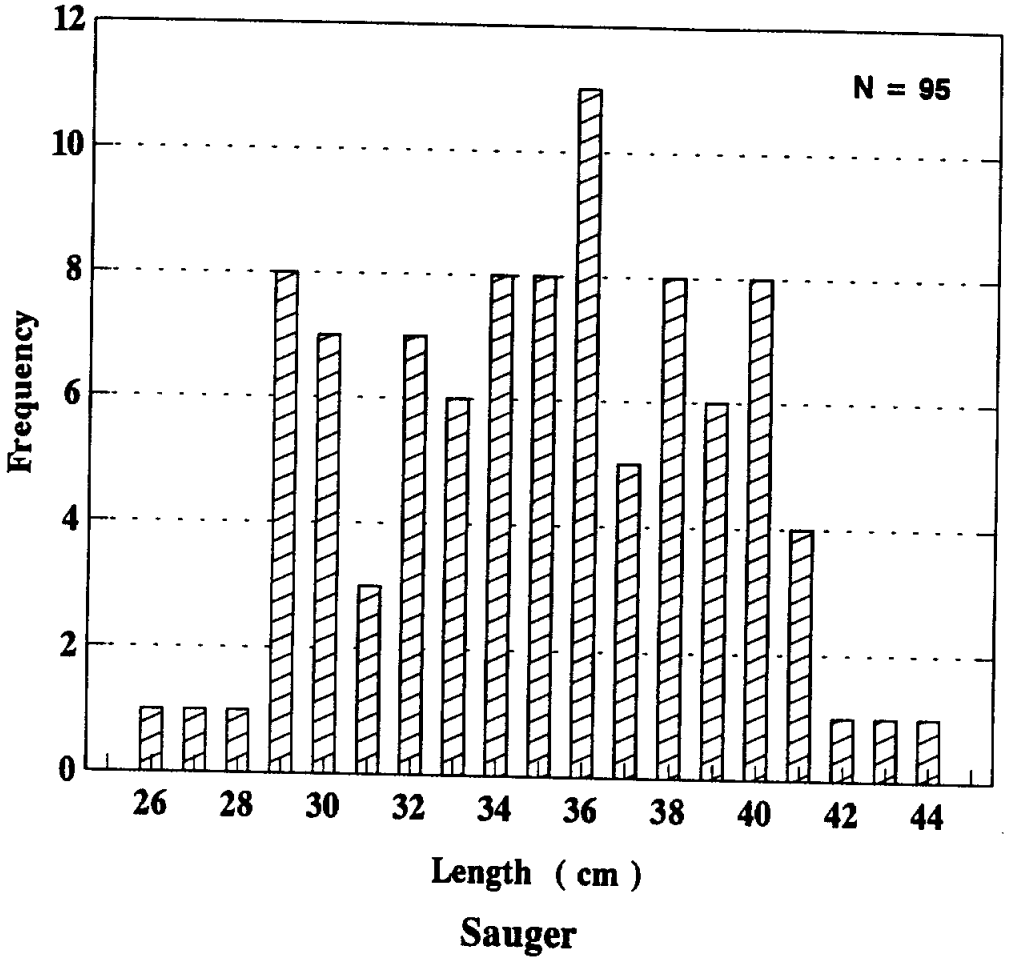


Figure C11. Length frequency of sauger measured during the study period (August 1992 - July 1993).