

**A Social and Economic Analysis of the Recreational Fisheries  
in Mississippi Flood Control Reservoirs**



**Final Report**

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# Introduction

Four large flood-control reservoirs (FCR) in north-central Mississippi, including Arkabutla, Sardis, Enid, and Grenada provide major fisheries to anglers in Mississippi and surrounding states. The U.S. Army Corps of Engineers (USACE) estimated that annual visitation to these reservoirs top 10-15 million visitor days. Recently termed the “Arc of Slabs” by In-Fisherman magazine, these reservoirs have been receiving an increased amount of effort from non-resident and non-local Mississippi anglers in recent years because of their notoriety as producers of large white and black crappie. Nevertheless, despite the large amount of visitation, research into the social and economic aspects of reservoir use has been limited. This study was initiated to determine trip characteristics, trip expenditures and resultant economic impacts, and attitudes of anglers about fishing the reservoir and possible changes to the management regime at Sardis and Grenada Lakes, the two most used reservoirs. This research should help local government, businesses, and regulatory agencies identify its constituents and their needs and desires, as well as determine the economic benefits that fishing trips have on the local and state economies, including job development.

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# Objectives

The primary goals of this study were to assess economic impacts to the local (counties adjacent to reservoirs) and state economies, angler support for changes in the management regime, and to evaluate current survey methodology designed to measure angler catch and effort. To achieve these goals we collected selected social, economic, and catch per effort information from recreational anglers contacted at the study reservoirs. Specific objectives were to:

- 1) determine fishing trip expenditures from resident and non-resident anglers and resultant economic impacts to local and state economies,
- 2) determine demographic profiles, angler trip origins, their species preferences, participation patterns, and their attitudes towards existing and proposed management regulations of the recreational fisheries,
- 3) identify the most efficient survey methodology for estimating catch rates, total catch, and total effort; the latter being needed to extrapolate trip expenditures to the entire angler population.

# Methods

## General Research Plan

Anglers were contacted as they exited the study reservoirs. At first contact, anglers were interviewed to obtain information about catch and effort during the ongoing outing. A self-administered mail questionnaire was sent to a randomly selected sample of anglers identified during onsite surveys. Estimates of total visitation (effort) were obtained to determine total expenditures and total catch. This study focused on Sardis and Grenada Lakes. The procedures outlined below were applied to Sardis Lake from March 2006 through February 2007, and administered at Grenada Lake from March 2007 through February 2008.

## Research Plan Components

### *Effort and catch per effort estimation*

Fishing effort is a measure of the use of the resource by anglers, and catch per effort is a measure of angler success. Estimates of effort were needed to extrapolate expenditure data to the population to assess the economic impact of the recreational fishery, and along with catch per effort, were used to estimate catch and harvest. Estimates of fishing effort and catch per effort were made over 12-month periods, through on-site surveys including roving and access creel surveys. Both of these survey types were considered because the roving survey was traditionally applied to the study reservoirs, and the access survey was the standard method elsewhere in waters managed by MDWFP. The two surveys were conducted independently to identify the most precise and least expensive procedure for estimating effort and catch.

### *Roving surveys (Existing survey conducted by MDWFP personnel)*

To estimate fishing effort, roving surveys made instantaneous counts of fishing parties according to reservoir section and sampling periods stratified according to months, and to week and weekend days. Eight sampling periods were selected at random within each month, four in week days and four in weekend days. The number of sampling periods was reduced in December-February due to reduced fishing effort. Sections were established spatially over the reservoirs based on the area that could be traversed over a 1-h period in a boat at safe speed. Each period consisted of 4 hours, with 2 or 3 periods within a day depending on length of the day (i.e., time of the year). Angler usage probabilities for sections and periods were estimated through previous aerial surveys or through in-lake instantaneous counts. Randomly selected parties encountered during the roving survey were interviewed to record party size, hours fished, and selected characteristics of the catch. Estimates of total effort were expanded using the product of mean party size, instantaneous count, and period length (hours) according to the probabilities associated with section, period, and week-day type. Catch per effort were estimated as the mean of ratios (Pollock et al. 1997), where effort represented the hours fished during an incomplete fishing trip. Total daily catch was estimated as the product of total effort and catch per effort and expanded to a monthly basis.

### *Access surveys*

The access surveys made independent estimates of catch per effort and effort, and the product estimated total catch. Catch per effort was estimated as the ratio of means by surveying anglers exiting access sites selected at random from longitudinal strata (upper, middle, and lower) within Sardis Lake. Sampling was stratified according to four quarters (Dec-Feb, Mar-May, Jun-Aug, Sep-Nov). The number of interviews was predetermined based on historical variability of catch per effort values, a 20% desired precision, and a 90% confidence. Interviews were divided roughly evenly over 24 sampling periods selected at random within each season, twelve in week days and twelve in weekend days, and approximately evenly distributed within each lake geographical stratum. Interviews recorded party size, hours fished, and selected characteristics of the catch; interviewees were also promptly informed about the economic study, given an information flyer, and asked for their cooperation.

Effort was estimated as the product of mean trip length, mean party size, and number of trips. Trip length and party size were recorded during the access creel survey. Number of trips was estimated through counts of boat trailers and bank parties at access sites surrounding the reservoirs. Instantaneous counts were made by visiting access sites by land during 24 sampling periods selected at random within each season, twelve in week days and twelve in weekend days, and approximately evenly distributed within each lake geographical stratum. The number of access points visited varied according to water-level. Total daily effort for each geographical stratum was estimated as the product of recorded trips and day length (hours). Additionally, methods for estimating effort based on compressions in pneumatic tubes (administered by USACE) or newly developed micro-magnetic sensors were investigated (TRAFx Research, Ltd., Alberta, Canada).

### ***Selecting participants for the social and economic study***

In addition to collecting catch and effort data, creel clerks asked one participant from each fishing party to be a part of a follow-up angler survey. Specifically, creel clerks told members of the fishing party that MSU was conducting an angler survey, and they needed responses from one randomly selected member from each group. Creel clerks then asked for the party member with the most recent birthday and presented that angler with an information flier with the specifics of the study. If the angler agreed, the creel clerk obtained name and address information as well as supplemental characteristics of their current trip. In case of guided trips (asked at start of interview), only customers were selected. Supplemental information included trip origin, whether it was a guided trip, phone number, and gender.

### ***Supplemental sampling days***

Typically, creel surveys do not intercept enough angler parties to make sufficiently precise social and economic estimates. The two primary groups for social and economic research are non-residents and resident anglers. To achieve a 5% margin of error on population estimates, 384 anglers must return completed questionnaires after their trips. Based on historical information, we expected a 65-75% response rate on the follow-up questionnaire. Nevertheless, based on angler and hunter surveys conducted in Mississippi by the principal investigator, response rates may be as low as 50% overall. Therefore, we had hoped to collect name and address information from roughly 800 resident and 800 non-resident anglers to achieve the desired level of precision. To achieve a sufficient number of anglers, 8-12 supplemental sampling days (6-h days at one ramp devoted solely to selecting participants) were conducted each quarter. The number of supplemental sampling days selected per quarter depended on projected number of contacts identified quarterly during access surveys.

### ***Mail Questionnaire***

A self administered mail questionnaire was jointly developed by MSU and MDWFP to collect information on each angler's fishing activity (days of participation, years of fishing, species preferences, and attitudes about fishing and management tools), and demographic information. Information regarding the trip during which they were intercepted included distance traveled to the lake, length of trip, species sought, whom they fished with, expenditures, willingness-to-pay more for their trip, and attitudes toward current and proposed management scenarios.

The mail survey was sent via first class mail. This was followed with a postcard reminder (day 10), and second (day 21) and third (day 35) mailings as necessary. At day 49, a final hand stamped letter and questionnaire were sent to non-respondent following the Tailored Design Method (Dillman 2000). Rather than conducting one survey at the end of the creel year, the mailing process was conducted quarterly to cover each of the four sampling seasons. Mail surveys were conducted in March, June, September, and January. This four wave mailing schedule was essential to reducing the effects of recall bias on expenditure items.

The names and address files collected from the creel surveys and supplemental surveys were produced by the project technician after each creel at MSU. Each wave of survey materials were assembled by the Human Dimensions and Conservation Law Enforcement Laboratory and mailed by MSU. Respondents

returned surveys to MSU where they were logged in and processed. Undeliverables were investigated immediately and re-mailed if possible to ensure each person sampled received all survey mailings with an equal opportunity to respond. A nonresponse check was made following procedures developed by Fisher (1996). Data were coded, checked, and verified during data entry at MSU.

### *Economic Analysis*

Economic impacts of fishing were generated from a statewide model using Impact Analysis for Planning (IMPLAN) software. The most current model of the Mississippi economy (2007) was used to perform the analysis. IMPLAN software used economic data from an area of interest (e.g., Mississippi and local area) to construct a model of its economy. Expenditures made in-state on behalf of fishing activity in the study lakes were then organized into final demands on state (and local) industries and businesses. An IMPLAN model of the state was built to generate direct and secondary impacts resulting from in-state participant expenditures. Direct impacts included sales, salaries, wages, and jobs created by the initial purchases of participants that were retained by the state economy in the operation of its businesses. Secondary impacts were composed of indirect and induced impacts. Indirect impacts were created through purchases made by directly impacted business or individuals with supporting businesses in the state economy. These impacts included the same categories as direct impacts. Induced impacts embodied purchases by employees within direct and indirect impacted sectors that generate sales, salaries, wages, and jobs. Leakages (expenditures leaving the state to purchase goods or services) occurred and were taken into account.

Resident and non-resident expenditures made in-state were used to measure economic impacts produced by fishing activity in the study lakes. As a cautionary note, some researchers have discounted using all resident expenditures to derive in-state impacts. However, this study reported on all resident expenditures as they translated into impacts with the understanding that they should, in all likelihood, be reduced in part. This was accomplished by determining the percentage of expenditures made by resident anglers that would have resulted in out-of-state fishing expenditures if the study lake was unavailable to them. Multipliers obtained from the analysis were used to assess economic impact relationships within the state and local economy. Type II multipliers, which were the total sales output for the region divided by the direct sales, were examined in this task.

# Results & Discussion by Objective

## Objectives 1 & 2 - Summary of Creel & Mail Survey Procedures

### Sardis Lake

- Access point creel surveys were conducted at Sardis Lake on 96 randomly selected days at randomly selected ramps from March 2006 through February 2007. An additional 24 days were spent at randomly selected ramps to solely collect name and addresses.
- A total of 512 fishing parties were encountered at Sardis Lake (415 of which were creel interviews, and 97 of which were name collection interviews). One person was randomly selected from each party to participate in the follow-up mail survey. Nevertheless, because we encountered 70 repeat anglers and 6 refused to participate in the study on-site, only 436 names and addresses were collected. Despite the large number of days sampled, we fell far short of the goal to collect name and address information from 800 resident and 800 non-resident anglers. This was most likely due to recreational boat fishing effort being less than anticipated at the reservoir during 2006-07 because of abnormally low water levels, and that effort was concentrated in spring months.
- Of the 436 individuals recruited to be in the study, 260 (60%) were from Mississippi and 176 (40%) were from out-of-state. Most (74%) non-residents were from Tennessee. Other nonresidents came primarily from Missouri (8%), Arkansas (6%) and Illinois (6%).
- A mail questionnaire was developed in consultation with MDWFP fisheries personnel which addressed trip characteristics, expenditures, and selected managerial issues. Each of 436 individuals recruited from the study received a mail questionnaire within 1-3 months of their trip. Of the 436 individuals, 331 returned useable questionnaires, 6 were non-deliverable, and 3 refused to complete the questionnaire. Therefore, effective response rate for the survey was 77.5%.

### Grenada Lake

- Access point creel surveys were conducted at Grenada Lake on 95 randomly selected days at randomly selected ramps from March 2007 through February 2008. An additional 34 days were spent at randomly selected boat ramps to solely collect name and addresses.
- A total of 614 fishing parties were encountered at Grenada Lake (399 of which were creel interviews and 215 were name collection interviews). One person was randomly selected from each party to participate in the follow-up mail survey. Nevertheless, because we encountered 80 repeat anglers and 53 refused to participate in the study on-site, only 481 names and addresses were collected. Despite the large number of days sampled, we fell far short of the goal to collect name and address information from 800 resident and 800 non-resident anglers. This was most likely due to recreational boat fishing effort being less than anticipated at the reservoir during 2007-08 because of abnormally low water levels, and that effort was concentrated in the spring months.
- Of the 614 fishing parties intercepted in the study, 514 (84%) were from Mississippi and 100 (16%) were from out-of-state. Missourians were the largest percentage of non-resident anglers at 5%, followed by Tennessee anglers (3%), Illinois anglers (3%), and 29 (5%) of anglers from combined states not listed above.
- A mail questionnaire was developed in consultation with MDWFP fisheries personnel which addressed trip characteristics, expenditures, and selected managerial issues. Each of the 481 individuals recruited from the study received a mail questionnaire within 1-3 months of their trip. Of the 481 individuals, 345 returned useable questionnaires, 12 were non-deliverable, and 3 refused to complete the questionnaire. Therefore, effective response rate for the survey was 74.0%.

## **Objective 1 – Sardis Lake Economics**

### **Methods**

#### ***Expenditures***

Mean in-region (i.e., Mississippi, 3-counties) expenditure profiles (U.S. currency spent/angler/activity day) were derived for Sardis Lake. The survey collected expense data by specific expenditure categories to align them with the appropriate industrial or business sector in the modeled economy of the region (e.g., the cost of sleeping accommodations with hotel and lodging places). All trip-related expenses were divided by the number of people indicated on the survey form and by the number of trip days. An adjustment was also made for other key destinations engaged in during the trip. Long-term expenses were divided by the number of days of use for the item during the season and then by the number of people indicated on the survey form. Several non-capital expense items, such as fishing licenses were divided by the number of activity days during the season (i.e., fishing licenses by number of days the individual would fish during the season).

#### ***Economic Impact Analysis***

In-region expenditure profiles, coupled with respective attendance figures in activity days, enabled the economic impact analysis. Economic impacts of expenditures from fishing and associated trip activities were generated from both a statewide and 3-county (i.e., Panola, Marshall, Lafayette) model using Impact Analysis for Planning (IMPLAN) software. The most current model of the Mississippi economy (2007) was used to perform these analyses. IMPLAN software uses economic data from an area of interest (e.g., Mississippi and various county combinations) to construct a model of an economy. Expenditures made in-state, or in the three counties, on behalf of fishing activity in Sardis Lake and associated trip activities were then organized into final demands on state and 3-county industries and businesses. IMPLAN models of the state and 3-county economies were built to generate direct and secondary impacts resulting from in-state participant expenditures and 3-county expenditures, respectively. Direct impacts included sales, salaries, wages, and jobs created by the initial purchases of participants that were retained by the state and 3-county economies in the operation of their businesses. Secondary impacts were composed of indirect and induced impacts. Indirect impacts were created through purchases made by directly impacted business or individuals with supporting businesses in the state and 3-county economies. These impacts included the same categories as direct impacts. Induced impacts embodied purchases by employees within direct and indirect impacted sectors that generated sales, salaries, wages, and jobs.

Multipliers obtained from the analyses were used to assess economic impact relationships within the state and local economy. Social Accounting Matrix (SAM) Type II multipliers, which are the total sales output for the state or 3-county region divided by their respective direct sales, were examined in this project.

### **Results**

#### ***Expenditures and Activity Days***

Resident and non-resident expenditure profiles were developed from reported expenditures for Sardis Lake trip-related items and equipment for both the State and 3-county analyses. The State analysis included expenditures made in the 3-county region and elsewhere in Mississippi. The 3-county analysis included expenditures made only in the 3-county region. Average expenditures incurred for various trip-related goods and services for residents (n = 168) and non-residents (n = 120) per day in Mississippi during the 2006/2007 season were \$49.44/angler/day (Tables 1 and 2) and \$45.79/ angler/day, respectively (Tables 3 and 4). Average expenditures incurred for equipment and other long-term items for residents (n = 168) and non-residents (n = 120) in Mississippi during the 2006/2007 season were \$112.00/angler /day (Tables 5 and 6) and \$111.35/ angler/day (Tables 7 and 8), respectively. Average expenditures incurred for various trip-related goods and services for residents (n = 168) and non-residents (n = 120) per day in the 3-county region during the 2006/2007 season were \$34.46/angler/day (Table 2) and \$37.42/ angler/day (Table 4), respectively. Average expenditures incurred for equipment and other long-term items for residents (n =



168) and non-residents (n = 120) in Mississippi during the 2006/2007 season were \$30.34/angler /day (Table 5) and \$20.21/angler/day, respectively (Table 7). Activity days for state residents and non-residents to the 3-county region during the 2006/2007 season were determined to be 54,168 and 37,643, respectively (Table 9).

### ***Economic Impact Analysis***

The overall economic impact from Sardis Lake fishing expenditures were derived from resident and non-resident expenditure profiles and activity days collected from survey data for the State and then the 3-county region. On the state level for the 2006/2007 fishing season, the total sales impact was \$23.36 million (2007 dollars), supporting 283 full and part-time jobs (Table 10). The SAM multiplier for this analysis was 1.52. Meaning that for every dollar spent in the state on fishing related expenditures at Sardis Lake there was an economic impact return of \$1.52. On the 3-county level for the 2006/2007 fishing season, the total sales impact was \$7.1 million (2007 dollars), supporting 127 full and part-time jobs (Table 11). The SAM multiplier for this analysis was 1.41. Meaning that for every dollar spent in the state on fishing related expenditures at Sardis Lake there was an economic impact return of \$1.41.

For the State-level analysis, the manufacturing sector had the highest sales impact (\$13.73 million) and included fishing equipment, clothes, food, and boating expenses. The manufacturing sector supplied the largest portion of the value-added (\$6.24 million) to the State. Value-added impacts includes employee compensation, proprietary income (e.g., income by the self-employed), other property income (e.g., interest), and indirect business taxes (e.g., sales, excise, and property taxes) (Olson and Lindall 2000). The services sector had the second largest total sales impact and value-added in the State, estimated at \$8.07 million and \$4.24 million, respectively. This group included retail sales and hotel, lodging, and other accommodation expenses.

For the 3-county analysis, the manufacturing sector also had the highest sales impact (\$3.68 million) and included fishing equipment, clothes, food, and boating expenses. The manufacturing group supplied the largest portion of the value-added (\$2.28 million) to the 3-county region. Again, the services sector had the second largest total sales impact and value-added in 3-county region, estimated at \$4.20 million and \$2.28 million, respectively. This group included retail sales and hotel, lodging, and other accommodation expenses.

### **Discussion**

Resident and non-resident expenditures made in-state and in the three counties were used to measure economic impacts produced by fishing activity and other activities associated with trips to Sardis Lake. As a cautionary note, some researchers have discounted using all resident expenditures to derive economy impacts because it is felt that resident expenditures are merely recycling dollars in an economy. However, this study reported on all resident expenditures as they translated into impacts with the understanding that they could potentially be reduced in part. Results presented clearly showed the support for both economies from resident expenditures. Specifically, residents indicated that they would spend 47.5% of the money they did at Sardis Lake out-of-state if the opportunity to fish Sardis Lake didn't exist.

In general, many goods and services were purchased by non-resident anglers outside the State, prior to their trip, which could have been purchased within the State. Purchases of goods and services are commonly made prior to a trip simply for convenience, time constraints, or price. Nevertheless, some purchases were most likely made outside the Mississippi and the 3-county region because these items were not available in the area or anglers may not be able to locate certain items. For non-residents, expenditures made outside the state could potentially be equipment, lodging, food, and transportation. Items for residents that are difficult to locate could be equipment purchases. Local businesses could likely provide a share of these items along with other outdoor-related services and amenities. For example, non-residents on multi-day trips commonly purchase lodging outside the State or 3-county region. With an increase of lodging within an increase in economic impacts would occur.

Economic multipliers derived from this study were used to explain the region and State's and 3-county's ability to absorb and use in-region angler-related activity participant expenditures. Multiplier size may be related to the areal size of a region's economy because value-added within a region has the potential to increase as its geographic area increases and, more than likely, a smaller proportion of expenditures are purchased outside the region (Loomis and Walsh 1997). Also, the extent of development within an economy is a factor in multiplier size. The absence of certain purchases was reflected in the multipliers. As expected, the 3-county multiplier would be lower than that for the State analysis. However, multipliers of 1.41 and 1.52, respectively, are on the low end of those typical for recreation expenditure multipliers that have usually ranged from 1.5 to 2.7 in the United States (Loomis and Walsh 1997).

While the economic impacts from fishing at Sardis Lake may seem limited relative to the State and 3-county economic impacts (\$154.3 billion and \$3.9 billion in 2007 dollars, respectively), they are still an important component of the economic base. For the 3-county region, 127 full and part-time jobs is an important contribution for a region that supported less than 50,000 jobs in 2007. In conclusion, fishing is but one of many activities on the Lake and collectively all recreational activities, in addition to the role used by the U.S. Army Corps of Engineers for impoundments, make this Lake a vital economic, social and ecological component of the quality of life in this part of the State.

Table 1. Resident average daily trip expenditures spent within 30 miles of Sardis Reservoir.

**(RESIDENT DAILY LOCAL)**

| <b>Expenditure Item</b>                            | <b>Percent of anglers with an expenditure on an item</b> | <b>Average amount spent per day per angler (only with expenditure)</b> | <b>Average amount spent per day per angler (all)</b> |
|----------------------------------------------------|----------------------------------------------------------|------------------------------------------------------------------------|------------------------------------------------------|
| <b>Transportation</b>                              |                                                          |                                                                        |                                                      |
| Automobile, boat gas/oil                           | 74.4                                                     | 19.78                                                                  | 14.72                                                |
| Rental vehicle                                     | 0.0                                                      | 0.00                                                                   | 0.00                                                 |
| Airfare                                            | 0.0                                                      | 0.00                                                                   | 0.00                                                 |
| <b>Lodging</b>                                     |                                                          |                                                                        |                                                      |
| Lodging at state park hotels or cabins             | 0.6                                                      | 150.00                                                                 | 0.89                                                 |
| Lodging at hotel or motel                          | 0.6                                                      | 10.00                                                                  | 0.06                                                 |
| Public or private campground fees                  | 3.6                                                      | 3.03                                                                   | 0.11                                                 |
| Vacation home rental                               | 0.6                                                      | 11.11                                                                  | 0.07                                                 |
| <b>Food and beverages</b>                          |                                                          |                                                                        |                                                      |
| Restaurant or take-out meals                       | 25.0                                                     | 10.21                                                                  | 2.55                                                 |
| Groceries, ice, and non-alcoholic beverages        | 64.9                                                     | 8.50                                                                   | 5.51                                                 |
| Adult beverages                                    | 11.3                                                     | 6.83                                                                   | 0.77                                                 |
| Propane and/or cooking fuel                        | 1.2                                                      | 0.79                                                                   | 0.01                                                 |
| <b>Other shopping, services, and entertainment</b> |                                                          |                                                                        |                                                      |
| Fishing license                                    | 25.6                                                     | 12.77                                                                  | 3.27                                                 |
| Boat launch/daily use fees                         | 50.6                                                     | 6.15                                                                   | 3.11                                                 |
| Bait & tackle                                      | 50.0                                                     | 6.79                                                                   | 3.39                                                 |
| Boat & equipment rental                            | 0.0                                                      | 0.00                                                                   | 0.00                                                 |
| Fish guide fees                                    | 0.0                                                      | 0.00                                                                   | 0.00                                                 |
| Taxidermy                                          | 0.0                                                      | 0.00                                                                   | 0.00                                                 |
| Casinos, movies, other entertainment               | 0.0                                                      | 0.00                                                                   | 0.00                                                 |
| Other                                              | 0.0                                                      | 0.00                                                                   | 0.00                                                 |
| <b>TOTAL</b>                                       |                                                          |                                                                        | <b>\$ 34.46</b>                                      |

Table 2. Resident average daily trip expenditures elsewhere in Mississippi on Sardis Reservoir trip.

**(RESIDENT DAILY NON-LOCAL)**

| <b>Expenditure Item</b>                            | <b>Percent of anglers with an expenditure on an item</b> | <b>Average amount spent per day per angler (only with expenditure)</b> | <b>Average amount spent per day per angler (all)</b> |
|----------------------------------------------------|----------------------------------------------------------|------------------------------------------------------------------------|------------------------------------------------------|
| <b>Transportation</b>                              |                                                          |                                                                        |                                                      |
| Automobile, boat gas/oil                           | 23.8                                                     | 34.51                                                                  | 8.22                                                 |
| Rental vehicle                                     | 0.0                                                      | 0.00                                                                   | 0.00                                                 |
| Airfare                                            | 0.0                                                      | 0.00                                                                   | 0.00                                                 |
| <b>Lodging</b>                                     |                                                          |                                                                        |                                                      |
| Lodging at state park hotels or cabins             | 1.2                                                      | 52.50                                                                  | 0.63                                                 |
| Lodging at hotel or motel                          | 0.6                                                      | 37.50                                                                  | 0.22                                                 |
| Public or private campground fees                  | 0.0                                                      | 0.00                                                                   | 0.00                                                 |
| Vacation home rental                               | 0.0                                                      | 0.00                                                                   | 0.00                                                 |
| <b>Food and beverages</b>                          |                                                          |                                                                        |                                                      |
| Restaurant or take-out meals                       | 3.0                                                      | 25.80                                                                  | 0.77                                                 |
| Groceries, ice, and non-alcoholic beverages        | 13.7                                                     | 6.28                                                                   | 0.86                                                 |
| Adult beverages                                    | 2.4                                                      | 10.67                                                                  | 0.25                                                 |
| Propane and/or cooking fuel                        | 0.0                                                      | 0.00                                                                   | 0.00                                                 |
| <b>Other shopping, services, and entertainment</b> |                                                          |                                                                        |                                                      |
| Fishing license                                    | 7.7                                                      | 16.29                                                                  | 1.26                                                 |
| Boat launch/daily use fees                         | 8.9                                                      | 6.43                                                                   | 0.57                                                 |
| Bait & tackle                                      | 9.5                                                      | 9.67                                                                   | 0.92                                                 |
| Boat & equipment rental                            | 0.6                                                      | 15.00                                                                  | 0.09                                                 |
| Fish guide fees                                    | 0.0                                                      | 0.00                                                                   | 0.00                                                 |
| Taxidermy                                          | 0.0                                                      | 0.00                                                                   | 0.00                                                 |
| Casinos, movies, other entertainment               | 0.6                                                      | 200.00                                                                 | 1.19                                                 |
| Other                                              | 0.0                                                      | 0.00                                                                   | 0.00                                                 |
| <b>TOTAL</b>                                       |                                                          |                                                                        | <b>\$ 14.98</b>                                      |

Table 3. Non-resident average daily trip expenditures spent within 30 miles of Sardis Reservoir.

**(NON-RESIDENT DAILY LOCAL)**

| <b>Expenditure Item</b>                            | <b>Percent of anglers with an expenditure on an item</b> | <b>Average amount spent per day per angler (only with expenditure)</b> | <b>Average amount spent per day per angler (all)</b> |
|----------------------------------------------------|----------------------------------------------------------|------------------------------------------------------------------------|------------------------------------------------------|
| <b>Transportation</b>                              |                                                          |                                                                        |                                                      |
| Automobile, boat gas/oil                           | 69.2                                                     | 16.52                                                                  | 11.43                                                |
| Rental vehicle                                     | 0.8                                                      | 1.25                                                                   | 0.01                                                 |
| Airfare                                            | 1.7                                                      | 32.29                                                                  | 0.54                                                 |
| <b>Lodging</b>                                     |                                                          |                                                                        |                                                      |
| Lodging at state park hotels or cabins             | 6.7                                                      | 24.62                                                                  | 1.64                                                 |
| Lodging at hotel or motel                          | 8.3                                                      | 21.27                                                                  | 1.77                                                 |
| Public or private campground fees                  | 7.5                                                      | 10.57                                                                  | 0.79                                                 |
| Vacation home rental                               | 2.5                                                      | 10.26                                                                  | 0.26                                                 |
| <b>Food and beverages</b>                          |                                                          |                                                                        |                                                      |
| Restaurant or take-out meals                       | 54.2                                                     | 7.16                                                                   | 3.88                                                 |
| Groceries, ice, and non-alcoholic beverages        | 65.0                                                     | 6.17                                                                   | 4.01                                                 |
| Adult beverages                                    | 17.5                                                     | 3.96                                                                   | 0.69                                                 |
| Propane and/or cooking fuel                        | 4.2                                                      | 1.14                                                                   | 0.05                                                 |
| <b>Other shopping, services, and entertainment</b> |                                                          |                                                                        |                                                      |
| Fishing license                                    | 45.8                                                     | 16.56                                                                  | 7.59                                                 |
| Boat launch/daily use fees                         | 64.2                                                     | 2.67                                                                   | 1.72                                                 |
| Bait & tackle                                      | 58.3                                                     | 5.02                                                                   | 2.93                                                 |
| Boat & equipment rental                            | 0.0                                                      | 0.00                                                                   | 0.00                                                 |
| Fish guide fees                                    | 0.0                                                      | 0.00                                                                   | 0.00                                                 |
| Taxidermy                                          | 0.0                                                      | 0.00                                                                   | 0.00                                                 |
| Casinos, movies, other entertainment               | 0.0                                                      | 0.00                                                                   | 0.00                                                 |
| Other                                              | 1.7                                                      | 7.61                                                                   | 0.13                                                 |
| <b>TOTAL</b>                                       |                                                          |                                                                        | <b>\$ 37.42</b>                                      |

Table 4. Non-resident average daily trip expenditures elsewhere in Mississippi on Sardis Reservoir trip.

**(NON-RESIDENT DAILY NON-LOCAL)**

| <b>Expenditure Item</b>                            | <b>Percent of anglers with an expenditure on an item</b> | <b>Average amount spent per day per angler (only with expenditure)</b> | <b>Average amount spent per day per angler (all)</b> |
|----------------------------------------------------|----------------------------------------------------------|------------------------------------------------------------------------|------------------------------------------------------|
| <b>Transportation</b>                              |                                                          |                                                                        |                                                      |
| Automobile, boat gas/oil                           | 17.5                                                     | 23.07                                                                  | 4.04                                                 |
| Rental vehicle                                     | 0.0                                                      | 0.00                                                                   | 0.00                                                 |
| Airfare                                            | 0.0                                                      | 0.00                                                                   | 0.00                                                 |
| <b>Lodging</b>                                     |                                                          |                                                                        |                                                      |
| Lodging at state park hotels or cabins             | 0.0                                                      | 0.00                                                                   | 0.00                                                 |
| Lodging at hotel or motel                          | 0.8                                                      | 75.00                                                                  | 0.63                                                 |
| Public or private campground fees                  | 0.8                                                      | 2.82                                                                   | 0.02                                                 |
| Vacation home rental                               | 0.0                                                      | 0.00                                                                   | 0.00                                                 |
| <b>Food and beverages</b>                          |                                                          |                                                                        |                                                      |
| Restaurant or take-out meals                       | 8.3                                                      | 11.45                                                                  | 0.95                                                 |
| Groceries, ice, and non-alcoholic beverages        | 10.0                                                     | 8.83                                                                   | 0.88                                                 |
| Adult beverages                                    | 3.3                                                      | 3.51                                                                   | 0.12                                                 |
| Propane and/or cooking fuel                        | 0.0                                                      | 0.00                                                                   | 0.00                                                 |
| <b>Other shopping, services, and entertainment</b> |                                                          |                                                                        |                                                      |
| Fishing license                                    | 1.7                                                      | 27.08                                                                  | 0.45                                                 |
| Boat launch/daily use fees                         | 5.0                                                      | 6.08                                                                   | 0.30                                                 |
| Bait & tackle                                      | 4.2                                                      | 23.42                                                                  | 0.98                                                 |
| Boat & equipment rental                            | 0.0                                                      | 0.00                                                                   | 0.00                                                 |
| Fish guide fees                                    | 0.0                                                      | 0.00                                                                   | 0.00                                                 |
| Taxidermy                                          | 0.0                                                      | 0.00                                                                   | 0.00                                                 |
| Casinos, movies, other entertainment               | 0.0                                                      | 0.00                                                                   | 0.00                                                 |
| Other                                              | 0.0                                                      | 0.00                                                                   | 0.00                                                 |
| <b>TOTAL</b>                                       |                                                          |                                                                        | <b>\$ 8.37</b>                                       |

Table 5. Average daily cost incurred for various goods by residents in the local area on a typical fishing trip to Sardis Reservoir from March 2006 to February 2007.

**(RESIDENT LONG-TERM LOCAL)**

| <b>Expenditure Item</b>                          | <b>Percent of anglers with an expenditure on item (%)</b> | <b>Average amount spent per day per angler (only with expenditure)</b> | <b>Average amount spent per day per angler (all)</b> |
|--------------------------------------------------|-----------------------------------------------------------|------------------------------------------------------------------------|------------------------------------------------------|
| Second home, fishing camp, and maintenance       | 6.1                                                       | 362.39                                                                 | 21.96                                                |
| RV and associated maintenance                    | 0.0                                                       | 0.00                                                                   | 0.00                                                 |
| Boat, motor, trailer & associated maintenance    | 15.2                                                      | 48.57                                                                  | 7.36                                                 |
| Boat accessories (aeration systems, lights)      | 1.2                                                       | 6.50                                                                   | 0.08                                                 |
| Fishing tackle (nets, weights, hooks, lures)     | 9.7                                                       | 2.76                                                                   | 0.27                                                 |
| Electronic equipment (sonar, GPS, radio)         | 4.2                                                       | 5.18                                                                   | 0.22                                                 |
| Fishing rods and reels                           | 6.1                                                       | 3.35                                                                   | 0.20                                                 |
| Safety equipment (vests, extinguishers, flares)  | 1.2                                                       | 3.47                                                                   | 0.04                                                 |
| Filet knives, measuring boards, scales           | 3.0                                                       | 1.14                                                                   | 0.03                                                 |
| Coolers, thermoses, buckets                      | 5.5                                                       | 0.64                                                                   | 0.03                                                 |
| Other equipment (camera, binoculars, sunglasses) | 4.2                                                       | 0.44                                                                   | 0.02                                                 |
| Clothing (waders, vests, hats)                   | 4.2                                                       | 3.02                                                                   | 0.13                                                 |
| Other                                            | 0.0                                                       | 0.00                                                                   | 0.00                                                 |
| <b>TOTAL</b>                                     |                                                           |                                                                        | <b>\$ 30.34</b>                                      |

Table 6. Average daily cost incurred for various goods by residents in Mississippi on a typical fishing trip to Sardis Reservoir from March 2006 to February 2007.

**(RESIDENT LONG-TERM NON-LOCAL)**

| <b>Expenditure Item</b>                          | <b>Percent of anglers with an expenditure on item (%)</b> | <b>Average amount spent per day per angler (only with expenditure)</b> | <b>Average amount spent per day per angler (all)</b> |
|--------------------------------------------------|-----------------------------------------------------------|------------------------------------------------------------------------|------------------------------------------------------|
| Second home, fishing camp, and maintenance       | 10.3                                                      | 224.08                                                                 | 23.09                                                |
| RV and associated maintenance                    | 2.4                                                       | 231.75                                                                 | 5.62                                                 |
| Boat, motor, trailer & associated maintenance    | 57.0                                                      | 61.54                                                                  | 35.06                                                |
| Boat accessories (aeration systems, lights)      | 20.6                                                      | 27.22                                                                  | 5.61                                                 |
| Fishing tackle (nets, weights, hooks, lures)     | 70.3                                                      | 5.20                                                                   | 3.66                                                 |
| Electronic equipment (sonar, GPS, radio)         | 24.8                                                      | 8.67                                                                   | 2.16                                                 |
| Fishing rods and reels                           | 53.3                                                      | 5.69                                                                   | 3.03                                                 |
| Safety equipment (vests, extinguishers, flares)  | 20.7                                                      | 2.44                                                                   | 0.50                                                 |
| Filet knives, measuring boards, scales           | 29.1                                                      | 1.30                                                                   | 0.38                                                 |
| Coolers, thermoses, buckets                      | 30.9                                                      | 1.29                                                                   | 0.40                                                 |
| Other equipment (camera, binoculars, sunglasses) | 20.6                                                      | 3.77                                                                   | 0.78                                                 |
| Clothing (waders, vests, hats)                   | 23.6                                                      | 5.42                                                                   | 1.28                                                 |
| Other                                            | 1.8                                                       | 5.20                                                                   | 0.09                                                 |
| <b>TOTAL</b>                                     |                                                           |                                                                        | <b>\$ 81.66</b>                                      |



Table 7. Average daily cost incurred for various goods by non-residents in the local area on a typical fishing trip to Sardis Reservoir from March 2006 to February 2007.

**(NON-RESIDENTS LONG-TERM LOCAL)**

| <b>Expenditure Item</b>                          | <b>Percent of anglers with an expenditure on item (%)</b> | <b>Average amount spent per day per angler (only with expenditure)</b> | <b>Average amount spent per day per angler (all)</b> |
|--------------------------------------------------|-----------------------------------------------------------|------------------------------------------------------------------------|------------------------------------------------------|
| Second home, fishing camp, and maintenance       | 14.8                                                      | 72.97                                                                  | 10.79                                                |
| RV and associated maintenance                    | 2.6                                                       | 30.83                                                                  | 0.80                                                 |
| Boat, motor, trailer & associated maintenance    | 10.4                                                      | 11.00                                                                  | 1.15                                                 |
| Boat accessories (aeration systems, lights)      | 7.8                                                       | 13.57                                                                  | 1.06                                                 |
| Fishing tackle (nets, weights, hooks, lures)     | 15.7                                                      | 13.88                                                                  | 2.17                                                 |
| Electronic equipment (sonar, GPS, radio)         | 4.4                                                       | 26.53                                                                  | 1.15                                                 |
| Fishing rods and reels                           | 2.6                                                       | 24.72                                                                  | 0.64                                                 |
| Safety equipment (vests, extinguishers, flares)  | 3.5                                                       | 47.38                                                                  | 1.65                                                 |
| Filet knives, measuring boards, scales           | 4.4                                                       | 1.18                                                                   | 0.05                                                 |
| Coolers, thermoses, buckets                      | 4.4                                                       | 11.40                                                                  | 0.50                                                 |
| Other equipment (camera, binoculars, sunglasses) | 1.7                                                       | 2.46                                                                   | 0.04                                                 |
| Clothing (waders, vests, hats)                   | 3.5                                                       | 2.23                                                                   | 0.08                                                 |
| Other                                            | 0.9                                                       | 15.20                                                                  | 0.13                                                 |
| <b>TOTAL</b>                                     |                                                           |                                                                        | <b>\$ 20.21</b>                                      |

Table 8. Average daily cost incurred for various goods by non-residents in Mississippi on a typical fishing trip to Sardis Reservoir from March 2007 to February 2008.

**(NON-RESIDENTS LONG-TERM NON-LOCAL)**

| <b>Expenditure Item</b>                          | <b>Percent of anglers with an expenditure on item (%)</b> | <b>Average amount spent per day per angler (only with expenditure)</b> | <b>Average amount spent per day per angler (all)</b> |
|--------------------------------------------------|-----------------------------------------------------------|------------------------------------------------------------------------|------------------------------------------------------|
| Second home, fishing camp, and maintenance       | 23.5                                                      | 67.13                                                                  | 15.76                                                |
| RV and associated maintenance                    | 3.5                                                       | 23.31                                                                  | 0.81                                                 |
| Boat, motor, trailer & associated maintenance    | 23.5                                                      | 219.21                                                                 | 51.47                                                |
| Boat accessories (aeration systems, lights)      | 13.9                                                      | 14.33                                                                  | 1.99                                                 |
| Fishing tackle (nets, weights, hooks, lures)     | 46.1                                                      | 10.17                                                                  | 4.69                                                 |
| Electronic equipment (sonar, GPS, radio)         | 9.6                                                       | 43.53                                                                  | 4.16                                                 |
| Fishing rods and reels                           | 13.9                                                      | 35.03                                                                  | 4.87                                                 |
| Safety equipment (vests, extinguishers, flares)  | 9.6                                                       | 24.90                                                                  | 2.38                                                 |
| Filet knives, measuring boards, scales           | 11.3                                                      | 3.86                                                                   | 0.44                                                 |
| Coolers, thermoses, buckets                      | 10.4                                                      | 8.77                                                                   | 0.92                                                 |
| Other equipment (camera, binoculars, sunglasses) | 7.0                                                       | 7.62                                                                   | 0.53                                                 |
| Clothing (waders, vests, hats)                   | 9.6                                                       | 30.64                                                                  | 2.93                                                 |
| Other                                            | 3.5                                                       | 5.56                                                                   | 0.19                                                 |
| <b>TOTAL</b>                                     |                                                           |                                                                        | <b>\$ 91.14</b>                                      |

Table 9. Total number of fishing trips, average trip length, and total days of participation at Sardis Lake from March 1, 2006 to February 28, 2007; by residence location.

| <b>Residence Location</b> | <b>Total Number of Trips</b> | <b>Average Trip Length</b> | <b>Total Number of Man-Days Fishing</b> | <b>Total Number of Hours Fished</b> |
|---------------------------|------------------------------|----------------------------|-----------------------------------------|-------------------------------------|
| MS resident               | 45,140                       | 1.2                        | 54,168                                  | 270,840                             |
| Non-resident              | 10,174                       | 3.7                        | 37,643                                  | 188,215                             |
| Total                     | 55,314                       | -----                      | 91,811                                  | 459,055                             |

Table 10. Total economic impacts based on state-wide expenditures from resident and non-resident anglers fishing at Sardis Lake, Mississippi during the 2006/2007 fishing season (2007 dollars).

| Industry                 | Direct Impacts | Secondary Impacts | Total Sale Impacts | Value Added  | Employment # |
|--------------------------|----------------|-------------------|--------------------|--------------|--------------|
| AG, FORESTRY & FISHERIES | \$1,198        | \$110,763         | \$111,961          | \$49,785     | 1            |
| MINING                   | \$0            | \$499,059         | \$499,059          | \$307,711    | 3            |
| CONSTRUCTION             | \$0            | \$703             | \$703              | \$92         | 0            |
| MANUFACTURING            | \$9,333,182    | \$4,397,459       | \$13,730,641       | \$6,245,044  | 163          |
| TRANSP, COMM & UTILITIES | \$0            | \$434,824         | \$434,824          | \$216,956    | 4            |
| TRADE                    | \$0            | \$382,833         | \$382,833          | \$197,448    | 5            |
| F.I.R.E. <sup>a</sup>    | \$0            | \$129,123         | \$129,123          | \$63,286     | 3            |
| SERVICES                 | \$6,052,332    | \$2,027,145       | \$8,079,477        | \$4,242,441  | 105          |
|                          | \$15,386,712   | \$7,981,909       | \$23,368,621       | \$11,322,763 | 283          |

<sup>a</sup> Finance, insurance, and real-estate.

Table 11. Total economic impacts based on 3-county expenditures from resident and non-resident anglers fishing at Sardis Lake, Mississippi during the 2006/2007 fishing season (2007 dollars).

| Industry                 | Direct Impacts | Secondary Impacts | Total Sale Impacts | Value Added | Employment # |
|--------------------------|----------------|-------------------|--------------------|-------------|--------------|
| AG, FORESTRY & FISHERIES | \$0            | \$25,944          | \$25,944           | \$15,329    | 0            |
| MINING                   | \$0            | \$199,747         | \$199,747          | \$121,058   | 1            |
| CONSTRUCTION             | \$0            | \$0               | \$0                | \$0         | 0            |
| MANUFACTURING            | \$2,544,366    | \$1,136,889       | \$3,681,255        | \$2,283,181 | 62           |
| TRANSP, COMM & UTILITIES | \$0            | \$137,889         | \$137,889          | \$69,337    | 1            |
| TRADE                    | \$0            | \$105,759         | \$105,759          | \$53,072    | 2            |
| F.I.R.E. <sup>a</sup>    | \$0            | \$49,506          | \$49,506           | \$24,758    | 1            |
| SERVICES                 | \$3,427,201    | \$781,125         | \$4,208,326        | \$2,289,448 | 59           |
|                          | \$5,971,567    | \$2,436,859       | \$8,408,426        | \$4,856,183 | 127          |

<sup>a</sup> Finance, insurance, and real-estate.

## **Objective 1 – Grenada Lake Economics**

### **Methods**

#### ***Expenditures***

Mean in-region (i.e., Mississippi, 3-counties) expenditure profiles (U.S. currency spent/angler/activity day) were derived for Grenada Lake. The survey collected expense data by specific expenditure categories to align them with the appropriate industrial or business sector in the modeled economy of the region (e.g., the cost of sleeping accommodations with hotel and lodging places). All trip-related expenses were divided by the number of people indicated on the survey form and by the number of trip days. An adjustment was also made for other key destinations engaged in during the trip. Long-term expenses were divided by the number of days of use for the item during the season and then by the number of people indicated on the survey form. Several non-capital expense items, such as fishing licenses were divided by the number of activity days during the season (i.e., fishing licenses by number of days the individual would fish during the season).

#### ***Economic Impact Analysis***

In-region expenditure profiles, coupled with respective attendance figures in activity days, enabled the economic impact analysis. Economic impacts of expenditures from fishing and associated trip activities were generated from both a statewide and 3-county (i.e., Grenada, Yalobusha, Calhoun) model using Impact Analysis for Planning (IMPLAN) software. The most current model of the Mississippi economy (2006) was used to perform these analyses. IMPLAN software uses economic data from an area of interest (e.g., Mississippi and various county combinations) to construct a model of an economy. Expenditures made in-state, or in the three counties, on behalf of fishing activity in Grenada Lake and associated trip activities were then organized into final demands on state and 3-county industries and businesses. IMPLAN models of the state and 3-county economies were built to generate direct and secondary impacts resulting from in-state participant expenditures and 3-county expenditures, respectively. Direct impacts included sales, salaries, wages, and jobs created by the initial purchases of participants that were retained by the state and 3-county economies in the operation of their businesses. Secondary impacts were composed of indirect and induced impacts. Indirect impacts were created through purchases made by directly impacted business or individuals with supporting businesses in the state and 3-county economies. These impacts included the same categories as direct impacts. Induced impacts embodied purchases by employees within direct and indirect impacted sectors that generated sales, salaries, wages, and jobs.

Multipliers obtained from the analyses were used to assess economic impact relationships within the state and local economy. Social Accounting Matrix (SAM) Type II multipliers, which are the total sales output for the state or 3-county region divided by their respective direct sales, were examined in this project.

### **Results**

#### ***Expenditures and Activity Days***

Resident and non-resident expenditure profiles were developed from reported expenditures for Grenada Lake trip-related items and equipment for both the State and 3-county analyses (Tables 12-20). The State analysis included expenditures made in the 3-county region and elsewhere in Mississippi. The 3-county analysis included expenditures made only in the 3-county region. Average expenditures incurred for various trip-related goods and services for residents (n = 274) and non-residents (n = 61) per day in Mississippi during the 2006/2007 season were \$60.25/angler/day (Tables 12 and 13) and \$57.59/angler/day (Tables 14 and 15), respectively. Average expenditures incurred for equipment and other long-term items for residents (n = 274) and non-residents (n = 61) in Mississippi during the 2007/2008 season were \$121.69/angler/day (Tables 16 and 17) and \$61.12/angler/day (Tables 18 and 19), respectively. Average expenditures incurred for various trip-related goods and services for residents (n = 274) and non-residents (n = 61) per day in the 3-county region during the 2007/2008 season were \$51.95/angler/day (Table 12) and \$53.82/angler/day (Table 14), respectively. Average expenditures incurred for equipment

and other long-term items for residents (n = 274) and non-residents (n = 61) in the 3-county region during the 2007/2008 season were \$30.65/angler /day (Table 16) and \$11.48/angler/day (Table 18), respectively. Activity days for state residents and non-residents to the 3-county regions during the 2007/2008 season were determined to be 37,289 and 8,747, respectively (Table 20).

### ***Economic Impact Analysis***

The overall economic impact from Grenada Lake fishing expenditures were derived from resident and non-resident expenditure profiles and activity days collected from survey data for the State and then the 3-county region. On the state level for the 2007/2008 fishing season, the total sales impact was \$11.77 million (2007 dollars), supporting 192 full and part-time jobs (Table 21). The SAM multiplier for this analysis was 1.46. Meaning that for every dollar spent in the state on fishing related expenditures at Sardis Lake there was an economic impact return of \$1.46. On the 3-county level for the 2007/2008 fishing season, the total sales impact was \$4.97 million (2007 dollars), supporting 106 full and part-time jobs (Table 22). The SAM multiplier for this analysis was 1.32. Meaning that for every dollar spent in the state on fishing related expenditures at Grenada Lake there was an economic impact return of \$1.32.

For the State-level analysis, the manufacturing sector had the highest sales impact (\$6.58 million) and included fishing equipment, clothes, food, and boating expenses. The manufacturing sector supplied the largest portion of the value-added (\$3.38 million) to the State. Value-added impacts includes employee compensation, proprietary income (e.g., income by the self-employed), other property income (e.g., interest), and indirect business taxes (e.g., sales, excise, and property taxes) (Olson and Lindall 2000). The services sector had the second largest total sales impact and value-added in the State, estimated at \$4.49 million and \$2.18 million, respectively. This group included retail sales and hotel, lodging, and other accommodation expenses.

For the 3-county analysis, the manufacturing sector also had the highest sales impact (\$2.51 million) and included fishing equipment, clothes, food, and boating expenses. The manufacturing group supplied the largest portion of the value-added (\$1.45 million) to the 3-county region. Again, the services sector had the second largest total sales impact and value-added in 3-county region, estimated at \$2.24 million and \$1.08 million, respectively. This group included retail sales and hotel, lodging, and other accommodation expenses.

### **Discussion**

Resident and non-resident expenditures made in-state and in the three counties were used to measure economic impacts produced by fishing activity and other activities associated with trips to Grenada Lake. As a cautionary note, some researchers have discounted using all resident expenditures to derive economy impacts because it is felt that resident expenditures are merely recycling dollars in an economy. However, this study reported on all resident expenditures as they translated into impacts with the understanding that they could potentially be reduced in part. Results presented clearly showed the support for both economies from resident expenditures. Specifically, residents indicated that they would spend 26.5% of the money they did at Grenada Lake out-of-state if the opportunity to fish Grenada Lake didn't exist.

In general, many goods and services were purchased by non-resident anglers outside the State, prior to their trip, which could have been purchased within the State. Purchases of goods and services are commonly made prior to a trip simply for convenience, time constraints, or price. Nevertheless, some purchases were most likely made outside the Mississippi and the 3-county region because these items were not available in the area or anglers may not be able to locate certain items. For non-residents, expenditures made outside the state could potentially be equipment, lodging, food, and transportation. Items for residents that are difficult to locate could be equipment purchases. Local businesses could likely provide a share of these items along with other outdoor-related services and amenities. For example, non-residents on multi-day trips commonly purchase lodging outside the State or 3-county region. With an increase of lodging within an increase in economic impacts would occur.

Economic multipliers derived from this study were used to explain the region and State's and 3-county's ability to absorb and use in-region angler-related activity participant expenditures. Multiplier size may be related to the areal size of a region's economy because value-added within a region has the potential to increase as its geographic area increases and, more than likely, a smaller proportion of expenditures are purchased outside the region (Loomis and Walsh 1997). Also, the extent of development within an economy is a factor in multiplier size. The absence of certain purchases was reflected in the multipliers. As expected, the 3-county multiplier would be lower than that for the State analysis. However, multipliers of 1.46 and 1.32, respectively, are on the low end of those typical for recreation expenditure multipliers that have usually ranged from 1.5 to 2.7 in the United States (Loomis and Walsh 1997).

While the economic impacts from fishing at Grenada Lake may seem limited relative to the State and 3-county economic impacts (\$154.3 billion and \$3.9 billion in 2007 dollars, respectively), they are still an important component of the economic base. For the 3-county region, 106 full and part-time jobs is an important contribution for a region that supported less than 50,000 jobs in 2007. In conclusion, fishing is but one of many activities on the Lake and collectively all recreational activities, in addition to the role used by the U.S. Army Corps of Engineers for impoundments, make this Lake a vital economic, social and ecological component of the quality of life in this part of the State.



Table 12. Resident average daily trip expenditures spent within 30 miles of Grenada Reservoir.

**(RESIDENTS DAILY LOCAL)**

| <b>Expenditure Item</b>                            | <b>Percent of anglers with an expenditure on an item</b> | <b>Average amount spent per day per angler (only with expenditure)</b> | <b>Average amount spent per day per angler (all)</b> |
|----------------------------------------------------|----------------------------------------------------------|------------------------------------------------------------------------|------------------------------------------------------|
| <b>Transportation</b>                              |                                                          |                                                                        |                                                      |
| Automobile, boat gas/oil                           | 79.8                                                     | 19.35                                                                  | 15.45                                                |
| Rental vehicle                                     | 0.0                                                      | 0.00                                                                   | 0.00                                                 |
| Airfare                                            | 0.0                                                      | 0.00                                                                   | 0.00                                                 |
| <b>Lodging</b>                                     |                                                          |                                                                        |                                                      |
| Lodging at state park hotels or cabins             | 0.4                                                      | 2.22                                                                   | 0.01                                                 |
| Lodging at hotel or motel                          | 0.4                                                      | 16.67                                                                  | 0.07                                                 |
| Public or private campground fees                  | 4.2                                                      | 129.36                                                                 | 5.44                                                 |
| Vacation home rental                               | 1.3                                                      | 17.17                                                                  | 0.22                                                 |
| <b>Food and beverages</b>                          |                                                          |                                                                        |                                                      |
| Restaurant or take-out meals                       | 14.7                                                     | 8.73                                                                   | 1.28                                                 |
| Groceries, ice, and non-alcoholic beverages        | 68.1                                                     | 10.42                                                                  | 7.09                                                 |
| Adult beverages                                    | 14.7                                                     | 5.74                                                                   | 0.84                                                 |
| Propane and/or cooking fuel                        | 3.8                                                      | 2.04                                                                   | 0.08                                                 |
| <b>Other shopping, services, and entertainment</b> |                                                          |                                                                        |                                                      |
| Fishing license                                    | 26.9                                                     | 26.18                                                                  | 7.04                                                 |
| Boat launch/daily use fees                         | 39.5                                                     | 7.47                                                                   | 2.95                                                 |
| Bait & tackle                                      | 51.3                                                     | 20.02                                                                  | 10.26                                                |
| Boat & equipment rental                            | 0.0                                                      | 0.00                                                                   | 0.00                                                 |
| Fish guide fees                                    | 0.0                                                      | 0.00                                                                   | 0.00                                                 |
| Taxidermy                                          | 0.0                                                      | 0.00                                                                   | 0.00                                                 |
| Casinos, movies, other entertainment               | 1.3                                                      | 38.33                                                                  | 0.48                                                 |
| Other                                              | 1.7                                                      | 43.72                                                                  | 0.73                                                 |
| <b>TOTAL</b>                                       |                                                          |                                                                        | <b>\$51.95</b>                                       |

Table 13. Resident average daily trip expenditures elsewhere in Mississippi.

**(RESIDENTS DAILY NON-LOCAL)**

| <b>Expenditure Item</b>                            | <b>Percent of anglers with an expenditure on an item</b> | <b>Average amount spent per day per angler (only with expenditure)</b> | <b>Average amount spent per day per angler (all)</b> |
|----------------------------------------------------|----------------------------------------------------------|------------------------------------------------------------------------|------------------------------------------------------|
| <b>Transportation</b>                              |                                                          |                                                                        |                                                      |
| Automobile, boat gas/oil                           | 15.1                                                     | 26.27                                                                  | 3.97                                                 |
| Rental vehicle                                     | 0.0                                                      | 0.00                                                                   | 0.00                                                 |
| Airfare                                            | 0.0                                                      | 0.00                                                                   | 0.00                                                 |
| <b>Lodging</b>                                     |                                                          |                                                                        |                                                      |
| Lodging at state park hotels or cabins             | 1.3                                                      | 63.85                                                                  | 0.80                                                 |
| Lodging at hotel or motel                          | 0.0                                                      | 0.00                                                                   | 0.00                                                 |
| Public or private campground fees                  | 0.4                                                      | 12.00                                                                  | 0.05                                                 |
| Vacation home rental                               | 0.0                                                      | 0.00                                                                   | 0.00                                                 |
| <b>Food and beverages</b>                          |                                                          |                                                                        |                                                      |
| Restaurant or take-out meals                       | 2.5                                                      | 16.32                                                                  | 0.41                                                 |
| Groceries, ice, and non-alcoholic beverages        | 10.5                                                     | 9.49                                                                   | 1.00                                                 |
| Adult beverages                                    | 2.1                                                      | 8.08                                                                   | 0.17                                                 |
| Propane and/or cooking fuel                        | 0.8                                                      | 2.09                                                                   | 0.02                                                 |
| <b>Other shopping, services, and entertainment</b> |                                                          |                                                                        |                                                      |
| Fishing license                                    | 3.8                                                      | 16.72                                                                  | 0.63                                                 |
| Boat launch/daily use fees                         | 2.5                                                      | 11.83                                                                  | 0.30                                                 |
| Bait & tackle                                      | 7.1                                                      | 12.56                                                                  | 0.90                                                 |
| Boat & equipment rental                            | 0.4                                                      | 8.00                                                                   | 0.03                                                 |
| Fish guide fees                                    | 0.0                                                      | 0.00                                                                   | 0.00                                                 |
| Taxidermy                                          | 0.0                                                      | 0.00                                                                   | 0.00                                                 |
| Casinos, movies, other entertainment               | 0.0                                                      | 0.00                                                                   | 0.00                                                 |
| Other                                              | 0.4                                                      | 4.80                                                                   | 0.02                                                 |
| <b>TOTAL</b>                                       |                                                          |                                                                        | <b>\$8.30</b>                                        |

Table 14. Non-resident average daily trip expenditures spent within 30 miles of Grenada Reservoir.

**(NON-RESIDENTS DAILY LOCAL)**

| <b>Expenditure Item</b>                            | <b>Percent of anglers with an expenditure on an item</b> | <b>Average amount spent per day per angler (only with expenditure)</b> | <b>Average amount spent per day per angler (all)</b> |
|----------------------------------------------------|----------------------------------------------------------|------------------------------------------------------------------------|------------------------------------------------------|
| <b>Transportation</b>                              |                                                          |                                                                        |                                                      |
| Automobile, boat gas/oil                           | 90.0                                                     | 13.15                                                                  | 11.84                                                |
| Rental vehicle                                     | 0.0                                                      | 0.00                                                                   | 0.00                                                 |
| Airfare                                            | 0.0                                                      | 0.00                                                                   | 0.00                                                 |
| <b>Lodging</b>                                     |                                                          |                                                                        |                                                      |
| Lodging at state park hotels or cabins             | 23.3                                                     | 27.54                                                                  | 6.43                                                 |
| Lodging at hotel or motel                          | 40.0                                                     | 24.06                                                                  | 9.63                                                 |
| Public or private campground fees                  | 11.7                                                     | 6.06                                                                   | 0.71                                                 |
| Vacation home rental                               | 1.7                                                      | 22.2                                                                   | 0.37                                                 |
| <b>Food and beverages</b>                          |                                                          |                                                                        |                                                      |
| Restaurant or take-out meals                       | 75.0                                                     | 10.26                                                                  | 7.70                                                 |
| Groceries, ice, and non-alcoholic beverages        | 80.0                                                     | 7.41                                                                   | 5.92                                                 |
| Adult beverages                                    | 26.7                                                     | 3.96                                                                   | 1.06                                                 |
| Propane and/or cooking fuel                        | 6.7                                                      | 2.03                                                                   | 0.14                                                 |
| <b>Other shopping, services, and entertainment</b> |                                                          |                                                                        |                                                      |
| Fishing license                                    | 80.0                                                     | 5.36                                                                   | 4.29                                                 |
| Boat launch/daily use fees                         | 36.7                                                     | 1.14                                                                   | 0.42                                                 |
| Bait & tackle                                      | 68.3                                                     | 4.29                                                                   | 2.93                                                 |
| Boat & equipment rental                            | 0.0                                                      | 0.00                                                                   | 0.00                                                 |
| Fish guide fees                                    | 3.3                                                      | 60.83                                                                  | 2.03                                                 |
| Taxidermy                                          | 0.0                                                      | 0.00                                                                   | 0.00                                                 |
| Casinos, movies, other entertainment               | 3.3                                                      | 6.79                                                                   | 0.23                                                 |
| Other                                              | 1.7                                                      | 7.41                                                                   | 0.12                                                 |
| <b>TOTAL</b>                                       |                                                          |                                                                        | <b>\$53.82</b>                                       |

Table 15. Non-resident average daily trip expenditures elsewhere in Mississippi.

**(NON-RESIDENTS DAILY NON-LOCAL)**

| <b>Expenditure Item</b>                            | <b>Percent of anglers with an expenditure on an item</b> | <b>Average amount spent per day per angler (only with expenditure)</b> | <b>Average amount spent per day per angler (all)</b> |
|----------------------------------------------------|----------------------------------------------------------|------------------------------------------------------------------------|------------------------------------------------------|
| <b>Transportation</b>                              |                                                          |                                                                        |                                                      |
| Automobile, boat gas/oil                           | 31.7                                                     | 7.02                                                                   | 2.22                                                 |
| Rental vehicle                                     | 0.0                                                      | 0.00                                                                   | 0.00                                                 |
| Airfare                                            | 0.0                                                      | 0.00                                                                   | 0.00                                                 |
| <b>Lodging</b>                                     |                                                          |                                                                        |                                                      |
| Lodging at state park hotels or cabins             | 0.0                                                      | 0.00                                                                   | 0.00                                                 |
| Lodging at hotel or motel                          | 1.7                                                      | 7.22                                                                   | 0.12                                                 |
| Public or private campground fees                  | 3.3                                                      | 2.55                                                                   | 0.09                                                 |
| Vacation home rental                               | 0.0                                                      | 0.00                                                                   | 0.00                                                 |
| <b>Food and beverages</b>                          |                                                          |                                                                        |                                                      |
| Restaurant or take-out meals                       | 16.7                                                     | 3.37                                                                   | 0.56                                                 |
| Groceries, ice, and non-alcoholic beverages        | 5.0                                                      | 1.60                                                                   | 0.08                                                 |
| Adult beverages                                    | 1.7                                                      | 0.60                                                                   | 0.01                                                 |
| Propane and/or cooking fuel                        | 0.0                                                      | 0.00                                                                   | 0.00                                                 |
| <b>Other shopping, services, and entertainment</b> |                                                          |                                                                        |                                                      |
| Fishing license                                    | 3.3                                                      | 14.97                                                                  | 0.50                                                 |
| Boat launch/daily use fees                         | 5.0                                                      | 1.83                                                                   | 0.09                                                 |
| Bait & tackle                                      | 3.3                                                      | 0.69                                                                   | 0.03                                                 |
| Boat & equipment rental                            | 0.0                                                      | 0.00                                                                   | 0.00                                                 |
| Fish guide fees                                    | 0.0                                                      | 0.00                                                                   | 0.00                                                 |
| Taxidermy                                          | 0.0                                                      | 0.00                                                                   | 0.00                                                 |
| Casinos, movies, other entertainment               | 1.7                                                      | 3.65                                                                   | 0.06                                                 |
| Other                                              | 1.7                                                      | 0.54                                                                   | 0.01                                                 |
| <b>TOTAL</b>                                       |                                                          |                                                                        | <b>\$3.77</b>                                        |

Table 16. Average daily cost incurred for various goods by residents in the local area on a typical fishing trip to Grenada Reservoir from March 2007 to February 2008.

**(RESIDENTS LONG-TERM LOCAL)**

| <b>Expenditure Item</b>                          | <b>Percent of anglers with an expenditure on item (%)</b> | <b>Average amount spent per day per angler (only with expenditure)</b> | <b>Average amount spent per day per angler (all)</b> |
|--------------------------------------------------|-----------------------------------------------------------|------------------------------------------------------------------------|------------------------------------------------------|
| Second home, fishing camp, and maintenance       | 2.5                                                       | 832.38                                                                 | 20.81                                                |
| RV and associated maintenance                    | 1.7                                                       | 64.83                                                                  | 1.08                                                 |
| Boat, motor, trailer & associated maintenance    | 20.0                                                      | 25.62                                                                  | 5.12                                                 |
| Boat accessories (aeration systems, lights)      | 6.3                                                       | 1.29                                                                   | 0.08                                                 |
| Fishing tackle (nets, weights, hooks, lures)     | 27.9                                                      | 4.17                                                                   | 1.16                                                 |
| Electronic equipment (sonar, GPS, radio)         | 2.5                                                       | 7.96                                                                   | 0.20                                                 |
| Fishing rods and reels                           | 20.8                                                      | 4.45                                                                   | 0.93                                                 |
| Safety equipment (vests, extinguishers, flares)  | 5.8                                                       | 2.65                                                                   | 0.15                                                 |
| Filet knives, measuring boards, scales           | 10.8                                                      | 1.29                                                                   | 0.14                                                 |
| Coolers, thermoses, buckets                      | 14.2                                                      | 1.27                                                                   | 0.18                                                 |
| Other equipment (camera, binoculars, sunglasses) | 6.7                                                       | 1.64                                                                   | 0.11                                                 |
| Clothing (waders, vests, hats)                   | 11.3                                                      | 5.87                                                                   | 0.66                                                 |
| Other                                            | 0.4                                                       | 6.00                                                                   | 0.03                                                 |
| <b>TOTAL</b>                                     |                                                           |                                                                        | <b>\$30.65</b>                                       |

Table 17. Average daily cost incurred for various goods by residents in Mississippi on a typical fishing trip to Grenada Reservoir from March 2007 to February 2008.

**(RESIDENTS LONG-TERM NON-LOCAL)**

| <b>Expenditure Item</b>                          | <b>Percent of anglers with an expenditure on item (%)</b> | <b>Average amount spent per day per angler (only with expenditure)</b> | <b>Average amount spent per day per angler (all)</b> |
|--------------------------------------------------|-----------------------------------------------------------|------------------------------------------------------------------------|------------------------------------------------------|
| Second home, fishing camp, and maintenance       | 5.0                                                       | 499.90                                                                 | 24.99                                                |
| RV and associated maintenance                    | 6.7                                                       | 200.66                                                                 | 13.38                                                |
| Boat, motor, trailer & associated maintenance    | 53.3                                                      | 48.29                                                                  | 25.75                                                |
| Boat accessories (aeration systems, lights)      | 22.9                                                      | 8.11                                                                   | 1.86                                                 |
| Fishing tackle (nets, weights, hooks, lures)     | 65.8                                                      | 4.34                                                                   | 2.86                                                 |
| Electronic equipment (sonar, GPS, radio)         | 17.5                                                      | 11.32                                                                  | 1.98                                                 |
| Fishing rods and reels                           | 51.7                                                      | 5.88                                                                   | 3.04                                                 |
| Safety equipment (vests, extinguishers, flares)  | 21.7                                                      | 3.45                                                                   | 0.75                                                 |
| Filet knives, measuring boards, scales           | 32.9                                                      | 2.01                                                                   | 0.66                                                 |
| Coolers, thermoses, buckets                      | 35.0                                                      | 1.61                                                                   | 0.57                                                 |
| Other equipment (camera, binoculars, sunglasses) | 20.8                                                      | 3.68                                                                   | 0.77                                                 |
| Clothing (waders, vests, hats)                   | 27.9                                                      | 5.56                                                                   | 1.55                                                 |
| Other                                            | 2.1                                                       | 618.01                                                                 | 12.88                                                |
| <b>TOTAL</b>                                     |                                                           |                                                                        | <b>\$91.04</b>                                       |

Table 18. Average daily cost incurred for various goods by non-residents in the local area on a typical fishing trip to Grenada Reservoir from March 2007 to February 2008.

**(NON-RESIDENTS LONG-TERM LOCAL)**

| <b>Expenditure Item</b>                          | <b>Percent of anglers with an expenditure on item (%)</b> | <b>Average amount spent per day per angler (only with expenditure)</b> | <b>Average amount spent per day per angler (all)</b> |
|--------------------------------------------------|-----------------------------------------------------------|------------------------------------------------------------------------|------------------------------------------------------|
| Second home, fishing camp, and maintenance       | 1.9                                                       | 100.00                                                                 | 1.92                                                 |
| RV and associated maintenance                    | 1.9                                                       | 5.25                                                                   | 0.10                                                 |
| Boat, motor, trailer & associated maintenance    | 9.6                                                       | 12.40                                                                  | 1.19                                                 |
| Boat accessories (aeration systems, lights)      | 1.9                                                       | 79.00                                                                  | 1.52                                                 |
| Fishing tackle (nets, weights, hooks, lures)     | 19.2                                                      | 26.45                                                                  | 5.09                                                 |
| Electronic equipment (sonar, GPS, radio)         | 0.0                                                       | 0.00                                                                   | 0.00                                                 |
| Fishing rods and reels                           | 5.8                                                       | 7.81                                                                   | 0.45                                                 |
| Safety equipment (vests, extinguishers, flares)  | 0.0                                                       | 0.00                                                                   | 0.00                                                 |
| Filet knives, measuring boards, scales           | 0.0                                                       | 0.00                                                                   | 0.00                                                 |
| Coolers, thermoses, buckets                      | 1.9                                                       | 12.00                                                                  | 0.23                                                 |
| Other equipment (camera, binoculars, sunglasses) | 1.9                                                       | 1.24                                                                   | 0.02                                                 |
| Clothing (waders, vests, hats)                   | 1.9                                                       | 50.00                                                                  | 0.96                                                 |
| Other                                            | 0.0                                                       | 0.00                                                                   | 0.00                                                 |
| <b>TOTAL</b>                                     |                                                           |                                                                        | <b>\$11.48</b>                                       |

Table 19. Average daily cost incurred for various goods by non-residents in Mississippi on a typical fishing trip to Grenada Reservoir from March 2007 to February 2008.

**(NON-RESIDENTS LONG-TERM NON-LOCAL)**

| <b>Expenditure Item</b>                          | <b>Percent of anglers with an expenditure on item (%)</b> | <b>Average amount spent per day per angler (only with expenditure)</b> | <b>Average amount spent per day per angler (all)</b> |
|--------------------------------------------------|-----------------------------------------------------------|------------------------------------------------------------------------|------------------------------------------------------|
| Second home, fishing camp, and maintenance       | 9.6                                                       | 59.28                                                                  | 5.70                                                 |
| RV and associated maintenance                    | 3.8                                                       | 3.13                                                                   | 0.12                                                 |
| Boat, motor, trailer & associated maintenance    | 21.2                                                      | 37.84                                                                  | 8.01                                                 |
| Boat accessories (aeration systems, lights)      | 7.7                                                       | 37.65                                                                  | 2.90                                                 |
| Fishing tackle (nets, weights, hooks, lures)     | 36.5                                                      | 19.18                                                                  | 7.01                                                 |
| Electronic equipment (sonar, GPS, radio)         | 3.8                                                       | 88.89                                                                  | 3.42                                                 |
| Fishing rods and reels                           | 19.2                                                      | 22.99                                                                  | 4.42                                                 |
| Safety equipment (vests, extinguishers, flares)  | 1.9                                                       | 22.22                                                                  | 0.43                                                 |
| Filet knives, measuring boards, scales           | 7.7                                                       | 3.78                                                                   | 0.29                                                 |
| Coolers, thermoses, buckets                      | 9.6                                                       | 7.55                                                                   | 0.73                                                 |
| Other equipment (camera, binoculars, sunglasses) | 3.8                                                       | 3.95                                                                   | 0.15                                                 |
| Clothing (waders, vests, hats)                   | 9.6                                                       | 21.19                                                                  | 2.04                                                 |
| Other                                            | 1.9                                                       | 750.00                                                                 | 14.42                                                |
| <b>TOTAL</b>                                     |                                                           |                                                                        | <b>\$49.64</b>                                       |



Table 20. Total number of fishing trips, average trip length, and total days of participation at Grenada Reservoir from March 1, 2007 to February 29, 2008; by residence location.

| <b>Residence Location</b> | <b>Total Number of Trips</b> | <b>Average Trip Length</b> | <b>Total Number of Man-Days Fishing</b> | <b>Total Number of Hours Fished</b> |
|---------------------------|------------------------------|----------------------------|-----------------------------------------|-------------------------------------|
| MS resident               | 31,074                       | 1.2                        | 37,289                                  | 190,176                             |
| Non-resident              | 2,133                        | 4.1                        | 8,747                                   | 44,609                              |
| Total                     | 33,207                       | -----                      | 46,036                                  | 234,785                             |

Table 21. Total economic impacts based on state-wide expenditures from resident and non-resident anglers fishing at Grenada Lake, Mississippi during the 2007/2008 fishing season (2007 dollars).

| Industry                 | Direct Impacts | Secondary Impacts | Total Sale Impacts | Value Added | Employment # |
|--------------------------|----------------|-------------------|--------------------|-------------|--------------|
| AG, FORESTRY & FISHERIES | \$684          | \$66,960          | \$67,644           | \$33,676    | 0            |
| MINING                   | \$0            | \$225,637         | \$225,637          | \$127,966   | 1            |
| CONSTRUCTION             | \$0            | \$358             | \$358              | \$47        | 0            |
| MANUFACTURING            | \$4,605,824    | \$1,975,135       | \$6,580,959        | \$3,388,892 | 105          |
| TRANSP, COMM & UTILITIES | \$18,129       | \$177,777         | \$195,906          | \$97,568    | 2            |
| TRADE                    | \$0            | \$147,090         | \$147,090          | \$81,262    | 2            |
| F.I.R.E. <sup>a</sup>    | \$0            | \$63,773          | \$63,773           | \$30,333    | 1            |
| SERVICES                 | \$3,423,073    | \$1,069,092       | \$4,492,165        | \$2,188,495 | 80           |
|                          | \$8,047,710    | \$3,725,822       | \$11,773,532       | \$5,948,239 | 192          |

<sup>a</sup>Finance, insurance, and real-estate.

Table 22. Total economic impacts based on 3-county (Grenada, Yalobusha, Calhoun) expenditures from resident and non-resident anglers fishing at Grenada Lake, Mississippi during the 2007/2008 fishing season (2007 dollars).

| Industry                 | Direct Impacts | Secondary Impacts | Total Sale Impacts | Value Added | Employment # |
|--------------------------|----------------|-------------------|--------------------|-------------|--------------|
| AG, FORESTRY & FISHERIES | \$674          | \$28,952          | \$29,626           | \$17,967    | 0            |
| MINING                   | \$0            | \$76,806          | \$76,806           | \$35,160    | 1            |
| CONSTRUCTION             | \$0            | \$0               | \$0                | \$0         | 0            |
| MANUFACTURING            | \$1,946,848    | \$570,309         | \$2,517,157        | \$1,451,169 | 50           |
| TRANSP, COMM & UTILITIES | \$18,129       | \$49,970          | \$68,099           | \$33,380    | 1            |
| TRADE                    | \$0            | \$20,269          | \$20,269           | \$14,383    | 1            |
| F.I.R.E.                 | \$0            | \$24,979          | \$24,979           | \$11,550    | 1            |
| SERVICES                 | \$1,808,414    | \$433,275         | \$2,241,689        | \$1,085,391 | 54           |
|                          | \$3,774,065    | \$1,204,560       | \$4,978,625        | \$2,649,000 | 106          |

<sup>a</sup>Finance, insurance, and real-estate.

## Objective 2 - Sardis Lake Angler Survey Executive Summary

### DEMOGRAPHICS

#### Overall

- Ninety-six percent (96%) of anglers were male and the average age was 53 years.
- The median household income was \$60,000 – \$69,999.
- Angler's median education level was a high school diploma.
- Ninety-four percent (94%) were White or Anglo, 4% were Black or African American, and less than 1% was Native American or Alaskan Native, Asian or a Pacific Islander, or Hispanic or Latino.

#### Mississippi Residents

- Ninety-seven percent (97%) of resident anglers were male and the average age was just under 53 years.
- The median household income was \$50,000 - \$59,999.
- Resident angler's median education level was a high school diploma.
- Ninety-six percent (96%) of resident anglers were White or Anglo, almost 3% were Black or African American, and less than 1% was either Native American or Alaskan Native, or Asian or Pacific Islander.

#### Non-Residents

- Ninety-five percent (95%) of non-resident anglers were male and the average age was 54 years.
- The median household income was \$70,000 - \$79,999.
- Non-resident angler's median education level was at least one year of college.
- Ninety-two percent (92%) of non-resident anglers were White or Anglo, almost 6% were Black or African American, and less than 1% was Native American or Alaskan Native, Asian or a Pacific Islander, or Hispanic or Latino.

### GENERAL FISHING ACTIVITY AND EXPERIENCE

#### Overall

- Anglers spent an average of 45 days fishing in lakes, 5 days fishing in ponds, 5 days fishing in rivers and streams, and less than 1 day fishing saltwater (within the previous twelve months).
- On average, anglers had 40 years of freshwater fishing experience.
- Seventy percent (70%) believe they were equally skilled in their fishing ability compared to other anglers. Twenty-four percent (24%) think they were more skilled and 6% think they were less skilled than other anglers.
- Sixteen percent (16%) of Sardis Lake anglers were members of a fishing club or organization.
- Sixteen percent (16%) participated in fishing tournaments; those who participated fished an average of 6 freshwater tournaments in Mississippi and 2 freshwater tournaments outside of Mississippi.
- The most fished for freshwater species was crappie as indicated by 70% of anglers; 20% fished for black bass, 7% for catfish, 1% for sunfish, and less than 1% indicated they fished for walleye, temperate bass, trout, or other species.
- Thirty-two percent (32%) of anglers indicated they fished with family and friends together the most often, followed by friends (26%), family (22%), alone (18%), and 2% of anglers fished with club members.
- Fishing ranked as the most important activity when compared to other outdoor activities by 67% of anglers, 28% consider fishing their second most important outdoor activity, 3% consider fishing as their third most important outdoor activity, and 2% could not provide a ranking for fishing.

#### Mississippi Residents

- Anglers spent an average of 52 days fishing in lakes, 5 days fishing in ponds, 5 days fishing in rivers and streams, and less than 1 day fishing saltwater (within the previous twelve months).
- On average, resident anglers had 40 years of freshwater fishing experience.

- Seventy-one percent (71%) believe they were equally skilled in their fishing ability compared to other anglers. Twenty-two percent (22%) think they were more skilled and 7% think they were less skilled than other anglers.
- Eighteen percent (18%) of Sardis Lake resident anglers were members of a fishing club or organization.
- Eighteen percent (18%) participated in fishing tournaments; those who participated fished an average of 8 freshwater tournaments in Mississippi and 1 freshwater tournament outside of Mississippi.
- Resident angler's most fished for freshwater species was crappie as indicated by 67%; 22% fished for black bass, 10% for catfish, and 1% fished for sunfishes.
- Thirty-three percent (33%) of anglers indicated they fished with family and friends together the most often, followed by family (26%), friends (21%), alone (17%), and 3% of anglers fished with club members.
- Fishing ranked as the most important activity when compared to other outdoor activities by 67% of anglers, 30% consider fishing their second most important outdoor activity, 2% consider fishing as their third most important outdoor activity, and less than 1% could not provide a ranking for fishing.

### **Non-Residents**

- Anglers spent an average of 36 days fishing in lakes, 5 days fishing in ponds, 5 days fishing in rivers and streams, and less than 1 day fishing saltwater (within the previous twelve months).
- On average, non-resident anglers had 41 years of freshwater fishing experience.
- Sixty-nine percent (69%) believe they were equally skilled in their fishing ability compared to other anglers. Twenty-seven percent (27%) think they were more skilled and 4% think they were less skilled than other anglers.
- Only 14% of Sardis Lake non-resident anglers were members of a fishing club or organization.
- Fourteen percent (14%) participated in fishing tournaments; those who participated fished an average of 5 freshwater tournaments in Mississippi and 3 freshwater tournaments outside of Mississippi.
- Non-resident angler's most fished for freshwater species was crappie as indicated by 75%; 19% fished for black bass, 3% for catfish, 2% fished for sunfishes, and 1% fished for walleye.
- Thirty-three percent (33%) of non-resident anglers indicated they fished with friends the most often, followed by family and friends together (30%), alone (19%), family (16%), and 2% of anglers fished with club members.
- Fishing ranked as the most important activity when compared to other outdoor activities by 68% of non-resident anglers, 25% consider fishing their second most important outdoor activity, 4% consider fishing as their third most important outdoor activity, and less than 3% could not provide a ranking for fishing.

## **ANGLERS PREVIOUS SARDIS LAKE FISHING ACTIVITY AND EXPERIENCES**

### **Overall**

- Eight-eight percent (88%) of anglers have fished at Enid Reservoir, 85% have fished at Arkabutla Reservoir, and 70% have fished at Grenada Lake Reservoir.
- On average, anglers have 24 years of fishing experience at Sardis Lake; in the previous twelve months, they spent an average of 35 days fishing at Sardis Lake.
- Forty-five percent (45%) believe the quality of fishing for their primary targeted species has declined compared to their previous fishing experiences at Sardis Lake. Thirty-eight percent (38%) believe fishing quality has stayed the same and 17% said fishing quality declined.
- Only 34% of anglers participated in fishing tournaments at Sardis Lake; the average number of bass tournaments they participated in was 2, they participated in less than 1 crappie tournament and less than 1 tournament for any other species.

### **Mississippi Residents**

- Ninety-three percent (93%) of resident anglers have fished at Enid Reservoir, 83% have fished at Arkabutla Reservoir, and 85% have fished at Grenada Lake Reservoir.
- On average, anglers have 26 years of fishing experience at Sardis Lake; in the previous twelve months, they spent an average of 42 days fishing at Sardis Lake.
- Forty-eight percent (48%) of resident anglers believe the quality of fishing for their primary targeted species has declined compared to their previous fishing experiences at Sardis Lake. Thirty-three percent (33%) believe fishing quality has stayed the same and 19% said fishing quality declined.
- Only 36% of resident anglers participated in fishing tournaments at Sardis Lake; the average number of bass tournaments they participated in was 2, they participated in less than 1 crappie tournament and less than 1 tournament for any other species.

### **Non-Residents**

- Eighty percent (80%) of non-resident anglers have fished at Enid Reservoir, 87% have fished at Arkabutla Reservoir, and 45% have fished at Grenada Lake Reservoir.
- On average, non-resident anglers have 21 years of fishing experience at Sardis Lake; in the previous twelve months, they spent an average of 25 days fishing at Sardis Lake.
- Forty-one percent (41%) believe the quality of fishing for their primary targeted species has declined compared to their previous fishing experiences at Sardis Lake. Forty-four percent (44%) believe fishing quality has stayed the same and 15% said fishing quality declined.
- Only 30% of non-resident anglers participated in fishing tournaments at Sardis Lake; the average number of bass tournaments they participated in was 2 and they participated in less than 1 crappie tournament and less than 1 tournament for any other species.

## **TRIP CHARACTERISTICS**

### **Overall**

- Fifty-seven percent (57%) of anglers resided in Mississippi at the time of the survey, 32% in Tennessee, 3% in Arkansas, less than 3% in Missouri, 2% in Illinois, and the remaining 1% were from other states (AL, IN, KY, NV, CO, NE, and WA).
- The average trip length was 2.7 days on the trip they were intercepted by the creel technicians and the average distance traveled was 68.4 miles (one-way).
- Ninety-eight percent (98%) of anglers indicated that fishing at Sardis Lake was the primary purpose of their trip and spent an average of 2.2 days fishing on their trip.
- Only about 3% of anglers intercepted indicated it was their first trip they had made to Sardis Lake.
- Thirty-four percent (34%) of anglers were fishing with friends on their trip, 29% with family, 21% alone, 16% with family and friends, and less than 1% with club or business associates.
- Anglers indicated they fished with 2 people on their trip and paid for at most 2 people on average.
- Ninety-nine percent (99%) of anglers indicated they did not use a guide on their trip; less than 4% were pre-fishing for a tournament.
- Ninety-nine percent (99%) indicated they did not use “yo-yo’s”.
- Seventy-nine percent (79%) indicated a first preference for catching crappie, then black bass (11%), catfish (8%), temperate bass (1%), and less than 1% preferred to catch other species.

### **Mississippi Residents**

- The average trip length was 1.3 days on the trip they were intercepted by the creel technicians and the average distance traveled was 37.0 miles (one-way).
- Ninety-eight percent (98%) of anglers indicated that fishing at Sardis Lake was the primary purpose of their trip and spent an average of 1.4 days fishing on their trip.
- Only 0.6% of resident anglers intercepted indicated it was their first trip they had made to Sardis Lake.
- Thirty-four percent (34%) of anglers were fishing with friends on their trip, 31% with family, 22% alone, 12% with family and friends, and less than 1% with club or business associates.

- Anglers indicated they fished with 2 people on their trip and paid for at most 2 people on average.
- Ninety-nine percent (99%) of resident anglers indicated they did not use a guide on their trip; more than 4% were pre-fishing for a tournament.
- Ninety-nine percent (99%) indicated they did not use “yo-yo’s”.
- Seventy-five percent (75%) indicated a first preference for catching crappie, then black bass (13%), catfish (11%), temperate bass (1%), and less than 1% preferred to catch other species.

#### **Non-Residents**

- The average trip length was 4.7 days on the trip they were intercepted by the creel technicians and the average distance traveled was 111.0 miles (one-way).
- Ninety-seven percent (97%) of anglers indicated that fishing at Sardis Lake was the primary purpose of their trip and spent an average of 3.4 days fishing on their trip.
- Only about 6% of non-resident anglers intercepted indicated it was their first trip they had made to Sardis Lake.
- Thirty-eight percent (38%) of anglers were fishing with friends on their trip, 21% with family, 20% with family and friends, 20% alone, and less than 1% with club or business associates.
- Anglers indicated they fished with 3 people on their trip and paid for at most 2 people on average.
- Ninety-nine percent (99%) of non-resident anglers indicated they did not use a guide on their trip; 3% were pre-fishing for a tournament.
- Ninety-nine percent (99%) indicated they did not use “yo-yo’s”.
- Eighty-five percent (85%) indicated a first preference for catching crappie, then black bass (8%), catfish (5%), and 2% preferred temperate bass.

### **ATTITUDES TOWARD CATCHING AND KEEPING FISH**

#### **Overall**

- Eighty-one percent (81%) of anglers indicated they usually eat the fish they caught.
- About 72% of anglers agreed that “the more fish they caught, the happier I am”.
- Fifty-seven percent (57%) of anglers agreed that a better fishing trip was one in which they caught bigger fish.
- Even if no fish were caught, fewer than 57% of anglers agreed a fishing trip could still be considered successful.
- Over 55% of anglers liked to fish where they knew they would have a chance to catch a “trophy fish”.
- About 54% of anglers agreed that a successful trip was one in which many fish were caught.
- Fifty-three percent (53%) of anglers agreed that when they went fishing, they were not satisfied until they caught something.
- More than 50% of anglers agreed that they were happiest with their fishing trip if they at least caught the daily bag limit.
- Nearly half of anglers indicated they would not go fishing if they thought they were not going to catch any fish.
- Seventy-three percent (73%) of anglers disagreed with the statement that “they wanted to keep all the fish they caught”.
- About 54% of anglers disagreed with the statement “when I go fishing, I’m just as happy if I don’t catch a fish”.

#### **Mississippi Residents**

- Seventy-eight percent (78%) of resident anglers indicated they usually eat the fish they caught.
- About 73% of anglers agreed that “the more fish they caught, the happier I am”.
- Sixty-one percent (61%) of anglers agreed that a better fishing trip was one in which they caught bigger fish.
- Even if no fish were caught, 60% of resident anglers agreed a fishing trip could still be considered successful.

- Over 56% of anglers liked to fish where they knew they would have a chance to catch a “trophy fish”.
- About 53% of anglers agreed that a successful trip was one in which many fish were caught.
- Fifty-one percent (51%) of anglers agreed that when they went fishing, they were not satisfied until they caught something.
- More than 48% of anglers agreed that they were happiest with their fishing trip if they at least caught the daily bag limit.
- Slightly less than 48% of resident anglers indicated they would not go fishing if they thought they were not going to catch any fish.
- Seventy-two percent (72%) of resident anglers disagreed with the statement that “they wanted to keep all the fish they caught”.
- About 52% of anglers disagreed with the statement “when I go fishing, I’m just as happy if I don’t catch a fish”.

### **Non-Residents**

- Eighty-six percent (86%) of non-resident anglers indicated they usually eat the fish they caught.
- About 71% of anglers agreed that “the more fish they caught, the happier I am”.
- Fifty-two percent (52%) of anglers agreed that a better fishing trip was one in which they caught bigger fish.
- Even if no fish were caught, 53% of non-resident anglers agreed a fishing trip could still be considered successful.
- Over 54% of anglers liked to fish where they knew they would have a chance to catch a “trophy fish”.
- About 55% of anglers agreed that a successful trip was one in which many fish were caught.
- Fifty-seven percent (57%) of anglers agreed that when they went fishing, they were not satisfied until they caught something.
- More than 48% of anglers agreed that they were happiest with their fishing trip if they at least caught the daily bag limit.
- Half of the non-resident anglers indicated they would not go fishing if they thought they were not going to catch any fish.
- Seventy-five percent (75%) of non-resident anglers disagreed with the statement that “they wanted to keep all the fish they caught”.
- About 56% of anglers disagreed with the statement “when I go fishing, I’m just as happy if I don’t catch a fish”.

## **TRIP SATISFACTION**

### **Overall**

- Eighty-four percent (84%) of anglers thoroughly enjoyed their trip and 75% believed the facilities met their needs for their trip.
- Over 70% of anglers agreed that they would like to fish more lakes like Sardis Lake and 68% felt their fishing trip was well worth the money they spent to fish.
- Most anglers (87%) disagreed with the statement “I caught what I consider a ‘trophy’ on this trip”.
- Over half of anglers disagreed with the statement “I caught more fish than I expected on this trip”.
- About 48% of anglers said they were extremely or very satisfied with their trip; 33% were moderately satisfied, and 19% felt not at all or slightly satisfied with their trip.

### **Mississippi Residents**

- Eighty-five percent (85%) of anglers thoroughly enjoyed their trip and 73% believed the facilities met their needs for their trip.
- Over 67% of anglers agreed that they would like to fish more lakes like Sardis Lake and 68% felt their fishing trip was well worth the money they spent to fish.
- Most anglers (85%) disagreed with the statement “I caught what I consider a ‘trophy’ on this trip”.



- Fifty-seven percent (57%) of anglers disagreed with the statement “I caught more fish than I expected on this trip”.
- About 43% of resident anglers said they were extremely or very satisfied with their trip; 37% were moderately satisfied, and 20% felt not at all or slightly satisfied with their trip.

#### **Non-Residents**

- Eighty-three percent (83%) of non-resident anglers thoroughly enjoyed their trip and 79% believed the facilities met their needs for their trip.
- Over 75% of anglers agreed that they would like to fish more lakes like Sardis Lake and 68% felt their fishing trip was well worth the money they spent to fish.
- Most anglers (90%) disagreed with the statement “I caught what I consider a ‘trophy’ on this trip”.
- Almost half (46%) of anglers disagreed with the statement “I caught more fish than I expected on this trip”.
- About 54% of anglers said they were extremely or very satisfied with their trip; 27% were moderately satisfied, and 19% felt not at all or slightly satisfied with their trip.

### **FISHING TOURNAMENT ATTITUDES**

#### **Overall**

- Many anglers (42%) were neutral about the idea of organized fishing tournaments at Sardis Lake; 36% supported or strongly supported the idea of organized fishing tournaments at Sardis Lake while 22% were opposed to or strongly opposed to tournaments at Sardis Lake.
- Forty-one percent (41%) were neutral to the idea of organized fishing tournaments at Sardis Lake that offer large cash prizes; 33% supported or strongly supported the idea of tournaments with large cash prizes; 27% were opposed or strongly opposed to the idea of tournaments with large cash prizes.
- Seventy-one percent (71%) of anglers supported or strongly supported fishing tournaments at Sardis Lake that required that fish be released alive. Twenty-one percent (21%) were neutral about the live-release tournaments and 8% were opposed or strongly opposed to live-release tournaments.
- Nearly 73% were opposed or strongly opposed to fishing tournaments at Sardis Lake that do not require that fish be released alive. Twenty-three percent (23%) were neutral and the remaining 4% supported or strongly supported the non-live-release tournaments.

#### **Mississippi Residents**

- Resident anglers (38%) were neutral about the idea of organized fishing tournaments at Sardis Lake; 40% supported or strongly supported the idea of organized fishing tournaments at Sardis Lake while 22% were opposed to or strongly opposed to tournaments at Sardis Lake.
- Many anglers (39%) were neutral to the idea of organized fishing tournaments at Sardis Lake that offer large cash prizes; 37% supported or strongly supported the idea of tournaments with large cash prizes; 24% were opposed or strongly opposed to the idea of tournaments with large cash prizes.
- Seventy-two percent (72%) of anglers supported or strongly supported fishing tournaments at Sardis Lake that required that fish be released alive. Nineteen percent (19%) were neutral about the live-release tournaments and 9% were opposed or strongly opposed to live-release tournaments.
- Nearly 74% were opposed or strongly opposed to fishing tournaments at Sardis Lake that do not require that fish be released alive. Twenty-three percent (22%) were neutral and the remaining 4% supported or strongly supported the non-live-release tournaments.

### **Non-Residents**

- Non-resident anglers (47%) were neutral about the idea of organized fishing tournaments at Sardis Lake; 30% supported or strongly supported the idea of organized fishing tournaments at Sardis Lake while 23% were opposed to or strongly opposed to tournaments at Sardis Lake.
- Many non-resident anglers (43%) were neutral to the idea of organized fishing tournaments at Sardis Lake that offer large cash prizes; 27% supported or strongly supported the idea of tournaments with large cash prizes; 30% were opposed or strongly opposed to the idea of tournaments with large cash prizes.
- Seventy percent (70%) supported or strongly supported fishing tournaments at Sardis Lake that required that fish be released alive. Twenty-three percent (22%) were neutral about the live-release tournaments and 8% were opposed or strongly opposed to live-release tournaments.
- Nearly 71% were opposed or strongly opposed to fishing tournaments at Sardis Lake that do not require that fish be released alive. Twenty-four percent (24%) were neutral and the remaining 5% supported or strongly supported the non-live-release tournaments.

## **CURRENT REGULATIONS AT SARDIS LAKE**

### **Overall**

- In general, 89% of anglers were in support of the current 10 inch minimum size limit on crappie and 80% of anglers supported or strongly supported the current 30 bag limit on crappie.
- Thirty percent (30%) of anglers held a neutral attitude about the current unlimited bag limit for white bass, while 63% supported or strongly supported the unlimited bag limit.
- The current regulation that states that “yo-yo’s” be attended during daylight hours only was supported or strongly supported by 56% of anglers.
- Forty-seven percent (47%) of anglers supported or strongly supported the unlimited bag limit for catfishes. Additionally, 40% felt neutral about the unlimited bag limit regulation for catfishes.
- Forty-four percent (44%) of anglers supported or strongly supported the current transport limit of 7 daily bag limits per species; 32% opposed or strongly opposed the transport limit.
- Forty-one percent (41%) opposed or strongly opposed the lack of a possession limit on fish, 37% were neutral, and the remaining 22% supported or strongly supported the lack of a possession limit.

### **Mississippi Residents**

- In general, 88% of anglers were in support of the current 10 inch minimum size limit on crappie and 76% of anglers supported or strongly supported the current 30 bag limit on crappie.
- Twenty-five percent (25%) of anglers held a neutral attitude about the current unlimited bag limit for white bass, while 68% supported or strongly supported the unlimited bag limit.
- The current regulation that states that “yo-yo’s” be attended during daylight hours only was supported or strongly supported by 59% of anglers.
- Forty-seven percent (47%) of anglers supported or strongly supported the unlimited bag limit for catfishes. Additionally, 39% felt neutral about the unlimited bag limit regulation for catfishes.
- Thirty-nine percent (39%) of resident anglers supported or strongly supported the current transport limit of 7 daily bag limits per species; 40% were opposed or strongly opposed to the transport limit.
- Half of resident anglers were opposed or strongly opposed to the lack of a possession limit on fish, 32% were neutral, and the remaining 18% supported or strongly supported the lack of a possession limit.

### **Non-Residents**

- In general, 91% of non-resident anglers were in support of the current 10 inch minimum size limit on crappie and 86% supported or strongly supported the current 30 bag limit on crappie.
- Thirty-seven percent (37%) of anglers held a neutral attitude about the current unlimited bag limit for white bass, while 57% supported or strongly supported the unlimited bag limit.
- The current regulation that states that “yo-yo’s” be attended during daylight hours only was supported or strongly supported by 52% of anglers.

- Forty-seven percent (47%) of anglers supported or strongly supported the unlimited bag limit for catfishes. Additionally, 42% felt neutral about the unlimited bag limit regulation for catfishes.
- Over half (52%) of non-resident anglers supported or strongly supported the current transport limit of 7 daily bag limits per species.
- Thirty-one percent (31%) opposed or strongly opposed the lack of a possession limit on fish, 44% were neutral, and the remaining 25% supported or strongly supported the lack of a possession limit.

## **BLACK BASS REGULATIONS AT SARDIS LAKE**

### **Overall**

- Almost 68% of anglers supported or strongly supported the current 7 fish daily bag limit on black bass only of which 3 can be over 20 inches.
- Over half of anglers (55%) indicated their support for the current 16-20 inch slot-length on black bass.
- When asked about possible changes to the black bass regulations, nearly 63% of anglers opposed or were strongly opposed to removing the current 16-20 inch slot-length limit and returning to a 10 fish daily bag limit with no size limit.
- Exactly 60% of anglers opposed or were strongly opposed to removing the current 16-20 inch slot-length limit on black bass and returning to a 7 fish daily bag limit with no size limit.
- Forty-eight percent (48%) were opposed or strongly opposed to removing the current 16-20 inch slot-length limit on black bass and returning to a 5 fish daily bag limit with no size limit.

### **Mississippi Residents**

- Over 67% of anglers supported or strongly supported the current 7 fish daily bag limit on black bass only of which 3 can be over 20 inches.
- Over half of anglers (53%) indicated their support for the current 16-20 inch slot-length on black bass.
- When asked about possible changes to the black bass regulations, nearly 61% of anglers opposed or were strongly opposed to removing the current 16-20 inch slot-length limit and returning to a 10 fish daily bag limit with no size limit.
- Sixty-one percent (61%) of anglers opposed or were strongly opposed to removing the current 16-20 inch slot-length limit on black bass and returning to a 7 fish daily bag limit with no size limit.
- Forty-seven percent (47%) were opposed or strongly opposed to removing the current 16-20 inch slot-length limit on black bass and returning to a 5 fish daily bag limit with no size limit.

### **Non-Residents**

- Almost 68% of non-resident anglers supported or strongly supported the current 7 fish daily bag limit on black bass only of which 3 can be over 20 inches.
- Fifty-nine percent (59%) indicated their support for the current 16-20 inch slot-length on black bass.
- When asked about possible changes to the black bass regulations, 68% opposed or were strongly opposed to removing the current 16-20 inch slot-length limit and returning to a 10 fish daily bag limit with no size limit.
- Fifty-nine percent (59%) of anglers opposed or were strongly opposed to removing the current 16-20 inch slot-length limit on black bass and returning to a 7 fish daily bag limit with no size limit.
- Half of non-resident anglers were opposed or strongly opposed to removing the current 16-20 inch slot-length limit on black bass and returning to a 5 fish daily bag limit with no size limit.

## **CRAPPIE FISHING METHODS**

### **Overall**

- When asked which fishing method crappie fishermen used, half of anglers used both trolling and poling, 39% used only the poling method, and trollers accounted for the remaining 11%.

- The method used most often (56%) was trolling. The poling method was used by the other 44% of crappie anglers.
- Even though it wasn't used as often, 64% of crappie anglers preferred to fish for crappie by poling. Thirty-six percent (36%) preferred the trolling method.
- On average, trollers fished with seven fishing poles.

### **Mississippi Residents**

- When asked which fishing method crappie fishermen used, 42% of resident anglers used both trolling and poling, 46% used only the poling method, and trollers accounted for the remaining 12%.
- The method used most often (56%) was trolling. The poling method was used by the other 44% of crappie anglers.
- Even though it wasn't used as often, 61% of crappie anglers preferred to fish for crappie by poling. Thirty-nine percent (39%) preferred the trolling method.
- On average, resident trollers fished with 8 fishing poles.

### **Non-Residents**

- When asked which fishing method crappie fishermen used, 60% of non-resident anglers used both trolling and poling, 30% used only the poling method, and trollers accounted for the remaining 10%.
- The method used most often (55%) was trolling. The poling method was used by the other 45% of crappie anglers.
- Even though it wasn't used as often, 66% of crappie anglers preferred to fish for crappie by poling. Thirty-four percent (34%) preferred the trolling method.
- On average, non-resident trollers fished with six fishing poles.

## **PROPOSED CRAPPIE REGULATIONS**

### **Overall**

- Fifty-eight percent (58%) of anglers supported or strongly supported banning the use of yo-yo's for crappie fishing; 26% were neutral and the remaining 16% were opposed or strongly opposed to banning yo-yo's.
- Seventy-four percent (74%) of anglers opposed or strongly opposed a change in regulation that would lower the bag limit on crappie to 15 fish per day; 55% were opposed to lowering the bag limit to 20 fish per day; 36% were opposed to lowering the bag limit to 25 fish per day.
- In fact, 48% of anglers supported or strongly supported changing the bag limit on crappie to 25 fish per day.
- Sixty percent (60%) of anglers were opposed or strongly opposed to increasing the minimum size limit on crappie to 12 inches; only 29% were opposed or strongly opposed to an 11 inch minimum. Conversely, 41% of anglers supported or strongly supported an 11 inch minimum length on crappie. Only 23% supported or strongly supported the 12 inch minimum length.
- Seventy percent (70%) of anglers supported or strongly supported implementing some sort of pole limit for each angler. Nine percent (9%) were neutral; 21% did not want some sort of pole limit.
- When asked if anglers would support implementing a 4-pole limit per angler regulation, 45% of anglers were opposed or strongly opposed. Sixteen percent (16%) of anglers were neutral; 39% were supportive of a 4-pole limit.
- When asked if anglers would support implementing a 3-pole limit per angler regulation, fewer than 53% of anglers were opposed or strongly opposed. Nineteen percent (19%) were neutral; 28% were supportive of a 3-pole limit.
- Only 55% of anglers opposed or strongly opposed a 2-pole limit per angler regulation. Overall, about 31% of anglers supported or strongly supported the 2-pole limit. Fourteen percent (14%) were neutral.
- Sixty-eight percent (68%) were opposed or strongly opposed to a 1-pole limit per angler regulation. Fifteen percent (15%) felt neutral and 17% were supportive or strongly supportive of a 1-pole limit per angler.

### **Mississippi Residents**

- Sixty-one percent (61%) of resident anglers supported or strongly supported banning the use of yo-yo's for crappie fishing; 24% were neutral and the remaining 15% were opposed or strongly opposed to banning yo-yo's.
- Sixty-seven percent (67%) were opposed or strongly opposed to a change in regulation that would lower the bag limit on crappie to 15 fish per day; 55% were opposed to lowering the bag limit to 20 fish per day; 38% were opposed to lowering the bag limit to 25 fish per day.
- In fact, 47% supported or strongly supported changing the bag limit on crappie to 25 fish per day.
- Fifty-five percent (55%) of resident anglers were opposed or strongly opposed to increasing the minimum size limit on crappie to 12 inches; only 38% were opposed or strongly opposed to an 11 inch minimum. Conversely, 41% of anglers supported or strongly supported an 11 inch minimum length on crappie. Only 27% supported or strongly supported the 12 inch minimum length.
- Seventy-two percent (72%) of anglers supported or strongly supported implementing some sort of pole limit for each angler. Nine percent (9%) were neutral; Nineteen percent (19%) did not want some sort of pole limit.
- When asked if anglers would support implementing a 4-pole limit per angler regulation, 47% of anglers were opposed or strongly opposed. Sixteen percent (15%) of anglers were neutral; 38% were supportive of a 4-pole limit.
- When asked if anglers would support implementing a 3-pole limit per angler regulation, fewer than 53% of anglers were opposed or strongly opposed. Twenty-one percent (21%) were neutral; 26% were supportive of a 3-pole limit.
- Half of resident anglers were opposed or strongly opposed to a 2-pole limit per angler regulation; 34% of anglers supported or strongly supported the 2-pole limit. Sixteen percent (16%) were neutral.
- Sixty-one percent (61%) were opposed or strongly opposed to a 1-pole limit per angler regulation. Sixteen percent (16%) felt neutral and 23% were supportive or strongly supportive of a 1-pole limit per angler.

### **Non-Residents**

- Fifty-five percent (55%) of non-resident anglers supported or strongly supported banning the use of yo-yo's for crappie fishing; 28% were neutral and the remaining 17% were opposed or strongly opposed to banning yo-yo's.
- Eighty-two percent (82%) of anglers opposed or strongly opposed a change in regulation that would lower the bag limit on crappie to 15 fish per day; 56% were opposed to lowering the bag limit to 20 fish per day; 35% were opposed to lowering the bag limit to 25 fish per day.
- In fact, 50% of non-resident anglers supported or strongly supported changing the bag limit on crappie to 25 fish per day.
- Sixty-seven percent (67%) of anglers were opposed or strongly opposed to increasing the minimum size limit on crappie to 12 inches; 40% were opposed or strongly opposed to an 11 inch minimum. Conversely, 39% of anglers supported or strongly supported an 11 inch minimum length on crappie. Only 18% supported or strongly supported the 12 inch minimum length.
- Sixty-six percent (66%) of anglers supported or strongly supported implementing some sort of pole limit for each angler. Eleven percent (11%) were neutral; 23% did not want some sort of pole limit.
- When asked if anglers would support implementing a 4-pole limit per angler regulation, 43% were opposed or strongly opposed. Eighteen percent (18%) of anglers were neutral; 42% were supportive of a 4-pole limit.
- When asked if anglers would support implementing a 3-pole limit per angler regulation, 53% of anglers were opposed or strongly opposed. Seventeen percent (17%) were neutral; 30% were supportive of a 3-pole limit.
- Sixty-two percent (62%) of anglers opposed or strongly opposed a 2-pole limit per angler regulation; 26% supported or strongly supported the 2-pole limit. Twelve percent (12%) felt neutral.

- Seventy-six percent (76%) were opposed or strongly opposed to a 1-pole limit per angler regulation; 14% felt neutral and 10% were supportive or strongly supportive of a 1-pole limit per angler.

## **SURVEY LOGISTICS**

### **Overall**

- All but one mail questionnaire (out of 323 total) was completed by the person to whom it was addressed.
- Overall, 63% of people provided open-ended comments on the back page of the mail questionnaire.
- The effective response rate was 76.4 %, with 331 returned, useable mail questionnaires, 6 undeliverable questionnaires, and a total of 439 participants.

### **Mississippi Residents**

- Sixty-seven percent (67%) of resident anglers provided open-ended comments on the back page of the mail questionnaire.

### **Non-Residents**

- Fifty-seven percent (57%) of non-resident anglers provided open-ended comments on the back page of the mail questionnaire.

## Objective 2 – Grenada Lake Angler Survey Executive Summary

### DEMOGRAPHICS

#### Overall

- Grenada Reservoir anglers were primarily white (97%) males (99%). Their average age was 52 years and their median household income level was \$50,000-\$59,999. About 49% completed high school and over 48% had completed some college coursework.
- Eighty-two percent (82%) of anglers resided in Mississippi at the time of the survey, 7% in Missouri, 4% in Tennessee, 3% in Illinois, less than 2% in Arkansas, and the remaining 2% were from other states (AL, IN, KY, KS, LA, NC, and OH).

#### Mississippi Residents

- Residents were primarily white (97%) males (99%). Their average age was 52 years and their median household income level was \$50,000-\$59,999. Fifty percent (50%) completed high school and almost 48% had completed some college coursework.

#### Non-Residents

- All non-residents were white (100%) and 98% were males. Their average age was 54 years and their median household income level was \$70,000-\$79,999. Forty-four percent (44%) completed high school and almost 55% had completed some college coursework.

### GENERAL FISHING ACTIVITY AND EXPERIENCE

#### Overall

- Grenada Reservoir anglers spent on average 42 days fishing in lakes, 6 days fishing in ponds, 5 days fishing in rivers and streams, and less than 1 day fishing in saltwater (in the previous 12 months); they have on average 41 years of freshwater fishing experience.
- Sixty-six percent (66%) believed they were equally skilled in their fishing ability compared to other anglers. Twenty-five percent (25%) thought they were more skilled and 9% thought they were less skilled than other anglers.
- Thirteen percent (13%) were members of a fishing club or organization and 13% participated in fishing tournaments. Those who participated in tournaments competed in an average of 5 freshwater tournaments in Mississippi and 1 freshwater tournament outside of Mississippi.
- The most fished for freshwater species was crappie as indicated by 78% of anglers; the second most fished for freshwater species was catfish by 29% of anglers. Thirty-five percent (35%) also indicated catfish as their third freshwater species preference.
- Twenty-seven percent (27%) of anglers indicated they fished alone most often, followed by fishing with friends (25%), family (24%), family and friends together (21%), and the remaining 3% fished with club members or business associates.
- Fishing ranked as the most important activity when compared to other outdoor activities by 64% of anglers; 32% consider fishing their second most important outdoor activity. Three percent (3%) consider fishing as their third most important outdoor activity and 1% could not provide a ranking for fishing.
- Forty-five percent (45%) had fished at Enid Reservoir; 31% had fished at Sardis Reservoir and 14% had fished at Arkabutla Reservoir.

#### Mississippi Residents

- Residents spent on average 42 days fishing in lakes, 6 days fishing in ponds, 5 days fishing in rivers and streams, and less than 1 day fishing in saltwater (in the previous 12 months); they have on average 41 years of freshwater fishing experience.
- Sixty-seven percent (67%) believed they were equally skilled in their fishing ability compared to other anglers. Twenty-four percent (24%) thought they were more skilled and 9% thought they were less skilled than other anglers.

- Ten percent (10%) were members of a fishing club or organization and 9% participated in fishing tournaments. Those who participated in tournaments competed in an average of 5 freshwater tournaments in Mississippi and 1 freshwater tournament outside of Mississippi.
- The most fished for freshwater species was crappie as indicated by 78% of residents; the second most fished for freshwater species was catfish by 32% of anglers. Sunfish and catfish were tied at 34% of residents reporting those as their third freshwater species preference.
- Thirty percent (30%) of anglers indicated they fished alone most often, followed by fishing with family (27%), friends (22%), family and friends together (19%), and the remaining 2% fished with club members or business associates.
- Fishing ranked as the most important activity when compared to other outdoor activities by 63% of anglers; 34% consider fishing their second most important outdoor activity. Two percent (2%) consider fishing as their third most important outdoor activity and 1% could not provide a ranking for fishing.
- Forty-eight percent (48%) had fished at Enid Reservoir; 31% had fished at Sardis Reservoir and 12% had fished at Arkabutla Reservoir.

### **Non-Residents**

- Non-residents spent on average 45 days fishing in lakes, 3 days fishing in ponds, 7 days fishing in rivers and streams, and less than 1 day fishing in saltwater (in the previous 12 months); they have on average 41 years of freshwater fishing experience.
- Fifty-nine percent (59%) believed they were equally skilled in their fishing ability compared to other anglers. Thirty-one percent (31%) thought they were more skilled and 10% thought they were less skilled than other anglers.
- Twenty-six percent (26%) were members of a fishing club or organization and 31% participated in fishing tournaments. Those who participated in tournaments competed in an average of 2 freshwater tournaments in Mississippi and nearly 8 freshwater tournaments outside of Mississippi.
- The most fished for freshwater species was crappie as indicated by 77% of non-residents; the second most fished for freshwater species was sunfish by 28% of anglers. Catfish was the third freshwater species preferred by 39% of non-residents.
- Thirty-eight percent (38%) indicated they fished with friends most often, followed by fishing with family and friends together (30%), alone (15%), family (13%), and the remaining 4% fished with club members.
- Fishing ranked as the most important activity when compared to other outdoor activities by 68% of anglers; 27% consider fishing their second most important outdoor activity. Five percent (5%) consider fishing as their third most important outdoor activity.
- Only 30% of non-residents had fished at Enid Reservoir; 28% had fished at Sardis Reservoir and 23% had fished at Arkabutla Reservoir.

## **TRIP ACTIVITY AND CHARACTERISTICS**

### **Overall**

- The average trip length was 1.7 days on the trip they were intercepted by the creel technicians and the average distance traveled was 48 miles (one-way).
- Ninety-six percent (96%) of anglers indicated fishing at Grenada Reservoir was the primary purpose of their trip and they spent an average of 1.4 days fishing on their trip.
- Only about 8% of anglers intercepted indicated it was their first trip they had made to Grenada Reservoir.
- Less than 30% of anglers were fishing with family on their trip, 29% with friends, 29% alone, 11% with family and friends together, and the remaining 1% fished with club members or business associates.
- Anglers indicated they fished with 2 people on their trip and paid for at most 1 person on average.
- Less than 1% indicated they used a guide on their trip and 3% were pre-fishing for a tournament.
- No anglers (0%) used yo-yo's on their trip.



- Eighty-seven percent (87%) indicated crappie as their primary target species on their trip. The second preferred target species was catfish (37%) and the third target species was also catfish according to 35% of Grenada Reservoir anglers.

### **Mississippi Residents**

- The average trip length was 1 day on the trip they were intercepted by the creel technicians and the average distance traveled was 33 miles (one-way).
- Ninety-six percent (96%) of residents indicated fishing at Grenada Reservoir was the primary purpose of their trip and they spent an average of 1 day fishing on their trip.
- Only about 2% of anglers intercepted indicated it was their first trip they had made to Grenada Reservoir.
- Thirty-four percent (34%) of anglers were fishing alone on their trip, 32% fished with family, 24% with friends, 9% with family and friends together, and the remaining 1% fished with club members.
- Anglers indicated they fished with 2 people on their trip and paid for at most 1 person on average.
- No residents (0%) used a guide on their trip and less than 2% were pre-fishing for a tournament.
- No anglers (0%) used yo-yo's on their trip.
- Eighty-six percent (86%) indicated crappie as their primary target species on their trip. The second preferred target species was catfish (39%); catfish and sunfish were tied (32%) as the third target species by resident anglers.

### **Non-Residents**

- The average trip length was 7.5 days on the trip they were intercepted by the creel technicians and the average distance traveled was 332 miles (one-way).
- Ninety-seven percent (97%) of anglers indicated fishing at Grenada Reservoir was the primary purpose of their trip and they spent an average of 4 days fishing on their trip.
- Thirty-four percent (34%) of non-residents indicated it was their first trip to Grenada Reservoir.
- Fifty-two percent (52%) of non-residents fished with friends on their trip; 18% fished with family, 18% with family and friends together, 8% alone, and the remaining 4% fished with business associates or others.
- Non-residents indicated they fished with almost 3 people on average on their trip and paid for almost 2 people.
- Three percent (3%) indicated they used a guide on their trip and 11% were pre-fishing for a tournament.
- No anglers (0%) used yo-yo's on their trip.
- An overwhelming percent of non-residents (95%) were targeting crappie on their trip. The second target species by non-residents was black bass (36%) and 57% indicated catfish as their third species target.

## **TRIP SATISFACTION**

### **Overall**

- The majority of anglers (74%) “thoroughly enjoyed their trip” and 63% “would like to fish more lakes like this one.”
- Over 57% of anglers agreed “the fishing trip was well worth the money spent to take this trip” and 58% agreed the fishing facilities met their needs for their trip.
- The majority (73%) indicated they did not catch what they considered a trophy fish on their trip; 62% indicated they did not catch more fish than expected on their trip.
- Thirty-six percent (36%) were moderately satisfied with their trip. Thirty-five percent (35%) were very or extremely satisfied and only 29% were slightly or not at all satisfied with their trip.

### **Mississippi Residents**

- The majority of residents (74%) “thoroughly enjoyed their trip” and 60% “would like to fish more lakes like this one.”

- Over 59% of anglers agreed “the fishing trip was well worth the money spent to take this trip” and 56% agreed the fishing facilities met their needs for their trip.
- The majority (75%) indicated they did not catch what they considered a trophy fish on their trip; 64% indicated they did not catch more fish than expected on their trip.
- Thirty-six percent (36%) were moderately satisfied with their trip. Thirty-three percent (33%) were very or extremely satisfied and only 31% were slightly or not at all satisfied with their trip.

#### **Non-Residents**

- The majority of non-residents (77%) “thoroughly enjoyed their trip” and 77% “would like to fish more lakes like this one.”
- Over 48% of anglers agreed “the fishing trip was well worth the money spent to take this trip” and 66% agreed the fishing facilities met their needs for their trip.
- Most (66%) indicated they did not catch what they considered a trophy fish on their trip; 55% indicated they did not catch more fish than expected on their trip.
- Thirty-four percent (34%) were moderately satisfied with their trip. Forty-four percent (44%) were very or extremely satisfied and only 22% were slightly or not at all satisfied with their trip.

### **FISHING ACTIVITY, ATTITUDES, AND PREFERENCES**

#### **Overall**

- On average, anglers have 28 years of fishing experience at Grenada Reservoir; in the previous 12 months, they spent an average of 32 days fishing at Grenada Reservoir.
- Sixty-nine percent (69%) believed the quality of fishing for their primary target species declined compared to their previous fishing experiences at Grenada Reservoir. Twenty-four percent (24%) believed the fishing quality has stayed the same and only 6% felt the quality has improved.
- Eighty-nine percent (89%) agreed or strongly agreed with “I usually eat the fish I catch.”
- Sixty-eight percent (68%) agreed or strongly agreed with “the more fish I catch, the happier I am” and 68% also agreed or strongly agreed they like to fish where they know they have a chance at catching a trophy fish.
- Overall, 63% of anglers agreed or strongly agreed with “the bigger the fish I catch, the better the fishing trip” and 55% wouldn’t go fishing if they thought they wouldn’t catch any fish.
- Seventy percent (70%) disagreed or strongly disagreed with “I want to keep all the fish I catch.”
- Most (64%) disagreed or strongly disagreed with the statement “when I go fishing, I’m just as happy if I don’t catch a fish.”

#### **Mississippi Residents**

- On average, residents have 29 years of fishing experience at Grenada Reservoir; in the previous 12 months, they spent an average of 33 days fishing at Grenada Reservoir.
- Seventy-five percent (75%) believed the quality of fishing for their primary target species declined compared to their previous fishing experiences at Grenada Reservoir. Nineteen percent (19%) believed the fishing quality has stayed the same and only 7% felt the quality has improved.
- Ninety-one percent of residents (91%) agreed or strongly agreed with “I usually eat the fish I catch.”
- Sixty-eight percent (68%) agreed or strongly agreed with “the more fish I catch, the happier I am” and 64% also agreed or strongly agreed they like to fish where they know they have a chance at catching a trophy fish.
- Fifty-nine percent (59%) agreed or strongly agreed with “the bigger the fish I catch, the better the fishing trip” and 56% wouldn’t go fishing if they thought they wouldn’t catch any fish.
- Sixty-nine percent (69%) of residents disagreed or strongly disagreed with the statement “I want to keep all the fish I catch.”
- Most (64%) disagreed or strongly disagreed with the statement “when I go fishing, I’m just as happy if I don’t catch a fish.”

### **Non-Residents**

- On average, non-residents have 7 years of fishing experience at Grenada Reservoir; in the previous 12 months, they spent an average of 8 days fishing at Grenada Reservoir.
- Thirty-three percent (33%) believed the quality of fishing for their primary target species declined compared to their previous fishing experiences at Grenada Reservoir. Sixty-two percent (62%) believed the fishing quality has stayed the same and only 5% felt the quality has improved.
- Eighty-one percent of non-residents (81%) agreed or strongly agreed with “I usually eat the fish I catch.”
- Sixty-eight percent (68%) agreed or strongly agreed with “the more fish I catch, the happier I am” and 82% agreed or strongly agreed they like to fish where they know they have a chance at catching a trophy fish.
- Seventy-eight percent (78%) agreed or strongly agreed with “the bigger the fish I catch, the better the fishing trip” and 52% wouldn’t go fishing if they thought they wouldn’t catch any fish.
- Seventy-six percent (76%) of non-residents disagreed or strongly disagreed with the statement “I want to keep all the fish I catch.”
- Most (64%) disagreed or strongly disagreed with the statement “when I go fishing, I’m just as happy if I don’t catch a fish.”

## **TOURNAMENT ACTIVITY, SUPPORT/OPPOSITION, AND PARTICIPATION**

### **Overall**

- Nearly 16% of anglers participated in fishing tournaments at Grenada Reservoir. Of those, they participated (on average) in 2 crappie tournaments and 1 bass tournament.
- A plurality of anglers (41%) was opposed or strongly opposed to the idea of organized fishing tournaments at Grenada Reservoir; 37% were neutral and 22% supported or strongly supported tournaments.
- Forty-four percent (44%) were opposed or strongly opposed to the idea of organized fishing tournaments at Grenada Reservoir that offer large cash prizes; 34% were neutral and 22% supported or strongly supported cash prize tournaments.
- Most anglers (72%) were opposed or strongly opposed tournaments at Grenada Reservoir that did not require fish be released alive; 23% were neutral and only 5% supported or strongly supported this type of tournament.
- Sixty-one percent (61%) supported or strongly supported tournaments at Grenada Reservoir that required fish be released alive; 26% were neutral and 13% were opposed or strongly opposed to this type of tournament.

### **Mississippi Residents**

- Fifteen percent (15%) of residents participated in fishing tournaments at Grenada Reservoir. Of those, they participated (on average) in 2 crappie tournaments and 1 bass tournament.
- A plurality of residents (45%) were opposed or strongly opposed to the idea of organized fishing tournaments at Grenada Reservoir; 34% were neutral and 21% supported or strongly supported tournaments.
- Forty-nine percent (49%) were opposed or strongly opposed to the idea of organized fishing tournaments at Grenada Reservoir that offer large cash prizes; 32% were neutral and 19% supported or strongly supported cash prize tournaments.
- Most anglers (71%) were opposed or strongly opposed tournaments at Grenada Reservoir that did not require fish be released alive; 24% were neutral and only 5% supported or strongly supported this type of tournament.
- Fifty-eight percent (58%) supported or strongly supported tournaments at Grenada Reservoir that required fish be released alive; 27% were neutral and 15% were opposed or strongly opposed to this type of tournament.

### **Non-Residents**

- Eighteen percent (18%) of anglers participated in fishing tournaments at Grenada Reservoir. Of those, they participated (on average) in 2 crappie tournaments and 1 bass tournament.

- Twenty-three percent (23%) of non-residents were opposed or strongly opposed to the idea of organized fishing tournaments at Grenada Reservoir; 50% were neutral and 27% supported or strongly supported tournaments.
- Twenty-six percent (26%) were opposed or strongly opposed to the idea of organized fishing tournaments at Grenada Reservoir that offer large cash prizes; 42% were neutral and 32% supported or strongly supported cash prize tournaments.
- Most non-residents (77%) were opposed or strongly opposed tournaments at Grenada Reservoir that did not require fish be released alive; 20% were neutral and only 3% supported or strongly supported this type of tournament.
- Seventy-four percent (74%) supported or strongly supported tournaments at Grenada Reservoir that required fish be released alive; 20% were neutral and 6% were opposed or strongly opposed to this type of tournament.

### **ATTITUDES ABOUT CURRENT MANAGEMENT REGULATIONS**

From March 2007 to August 2007, there was a 12 inch minimum size limit on crappie with a 30 crappie bag limit and each angler was allowed to keep up to 5 crappie under 12 inches; a 3 pole per angler limit was also in place.

Effective August 6, 2007, the 12 inch minimum size limit on crappie was still in place but the bag limit was reduced to 20 crappie and no crappie less than 12 inches could be retained; the 3 pole limit remained in place. Any anglers intercepted after August 6, 2007 received a modified version of the mail questionnaire which asked for angler support/opposition for the new regulations and any references to the previous regulations were removed.

#### **Overall**

- Most anglers (74%) supported or strongly supported the 12 inch minimum size limit on crappie and 69% supported or strongly supported the 30 fish bag limit on crappie.
- Fifty-four percent (54%) supported or strongly supported the 5 fish under 12 inches bag limit on crappie; 64% supported or strongly supported the 3 pole per angler limit.
- Sixty-four percent (64%) supported or strongly supported the 20 fish bag limit on crappie.
- A plurality of anglers (47%) supported or strongly supported the unlimited bag limit for catfishes and 55% supported or strongly supported the unlimited bag limit for white bass.
- Nearly half (48%) supported or strongly supported the regulation that states yo-yo's be attended during daylight hours only; 39% were neutral.
- Thirty-nine percent (39%) supported or strongly supported the transport limit of 7 daily bag limits per species and 33% remained neutral.
- Nearly 42% opposed or strongly opposed the lack of a possession limit on fish and 37% remained neutral to this regulation.

#### **Mississippi Residents**

- Most residents (74%) supported or strongly supported the 12 inch minimum size limit on crappie and 70% supported or strongly supported the 30 fish bag limit on crappie.
- Fifty-one percent (51%) supported or strongly supported the 5 fish under 12 inches bag limit on crappie; 64% supported or strongly supported the 3 pole per angler limit.
- Sixty-nine percent (69%) supported or strongly supported the 20 fish bag limit on crappie.
- Half (50%) of residents supported or strongly supported the unlimited bag limit for catfishes and 58% supported or strongly supported the unlimited bag limit for white bass.
- Half (50%) supported or strongly supported the regulation that states yo-yo's be attended during daylight hours only; 36% were neutral.
- Thirty-nine percent (39%) supported or strongly supported the transport limit of 7 daily bag limits per species and 30% remained neutral.
- Nearly 44% opposed or strongly opposed the lack of a possession limit on fish and 33% remained neutral to this regulation.

### **Non-Residents**

- Most non-residents (76%) supported or strongly supported the 12 inch minimum size limit on crappie and 63% supported or strongly supported the 30 fish bag limit on crappie.
- Sixty-nine percent (69%) supported or strongly supported the 5 fish under 12 inches bag limit on crappie; 65% supported or strongly supported the 3 pole per angler limit.
- Thirty-six percent (36%) supported or strongly supported the 20 fish bag limit on crappie; 28% were neutral and 36% opposed or strongly opposed the 20 bag limit.
- Sixty percent (60%) of non-residents were neutral to the unlimited bag limit for catfishes and 32% supported or strongly supported it. Fifty-seven percent (57%) were neutral to the unlimited bag limit for white bass and 40% supported or strongly supported it.
- Over half (53%) were neutral to the regulation that states yo-yo's be attended during daylight hours only; 36% supported or strongly supported that regulation.
- Almost half (49%) remained neutral to the transport limit of 7 daily bag limits per species; 36% supported or strongly supported the transport limit.
- Fifty-four percent (54%) were neutral to the lack of a possession limit on fish while 33% were opposed or strongly opposed; 13% supported or strongly supported the lack of a possession limit.

## **PREFERENCES OF GRENADA RESERVOIR BLACK BASS ANGLERS**

### **Overall**

- A plurality of anglers (42%) was neutral to the current 7 fish daily bag limit on black bass; 39% supported or strongly supported the 7 fish bag limit. The remaining 19% opposed or strongly opposed it.
- Again, anglers were neutral (44%) to the proposed regulation to change to a 5 fish daily bag limit on black bass. Thirty-six percent (36%) supported or strongly supported the proposed regulation and the remaining 20% opposed or strongly opposed it.

### **Mississippi Residents**

- Forty-three percent (43%) of residents were neutral to the current 7 fish daily bag limit on black bass; 38% supported or strongly supported the 7 fish bag limit. Nineteen percent (19%) of residents opposed or strongly opposed it.
- Residents were neutral (44%) to the proposed regulation to change to a 5 fish daily bag limit on black bass. Thirty-six percent (36%) supported or strongly supported the proposed regulation and the remaining 20% opposed or strongly opposed it.

### **Non-Residents**

- Forty percent (40%) of non-residents were neutral to the current 7 fish daily bag limit on black bass; 40% strongly supported the 7 fish bag limit. Twenty percent (20%) of non-residents opposed it.
- Half (50%) of non-residents were neutral to the proposed regulation to change to a 5 fish daily bag limit on black bass. Twenty-five percent (25%) supported the proposed regulation and the remaining 25% opposed it.

## PREFERENCES OF GRENADA RESERVOIR CRAPPIE ANGLERS

### Overall

- When asked which fishing method crappie fishermen used, 31% indicated both trolling and poling. The majority (66%) used the poling method and trollers accounted for the remaining 3%.
- The method used most often (66%) was poling. The other 34% of anglers fished by trolling.
- The majority (73%) reported poling as their preferred crappie fishing method. Twenty-seven percent (27%) preferred the trolling method.
- On average, trollers fished with 4 poles.
- Fifty-six percent (56%) of anglers supported or strongly supported banning the use of yo-yo's for crappie fishing; 27% were neutral and the remaining 17% were opposed or strongly opposed to banning yo-yo's.
- The plurality of anglers (45%) supported or strongly supported a change in regulation that would lower the bag limit on crappie to 25 fish per day; 22% were neutral to this proposed regulation change and 33% opposed or strongly opposed it.
- When asked about lowering the bag limit on crappie to 20 fish per day, 41% opposed or strongly opposed that regulation change but 41% supported or strongly supported it. The other 18% were neutral.
- Over half (55%) opposed or strongly opposed reducing the bag limit on crappie to 15 fish per day. Eighteen percent (18%) were neutral and 27% were supportive of that proposed regulation change.
- Most anglers (70%) were opposed or strongly opposed to reducing the bag limit on crappie to 10 fish per day; 20% were neutral and 10% supported or strongly supported it.
- Overall, over half (54%) of anglers were opposed or strongly opposed to reducing the bag limit on crappie at all.
- Fifty-six percent (56%) of anglers opposed or strongly opposed implementing a 4-pole limit for each angler.
- Forty-five percent (45%) supported or strongly supported a 2-pole limit restriction; 37% were opposed or strongly opposed.
- Forty-one percent (41%) supported or strongly supported a 1-pole limit restriction; 38% were opposed or strongly opposed.
- When asked about eliminating pole restrictions altogether, 79% were opposed or strongly opposed to that proposed regulation.
- Anglers indicated 3 poles (per person) was the ideal number of poles that should be allowed at Grenada Reservoir.

### Mississippi Residents

- When asked which fishing method crappie fishermen used, 27% indicated both trolling and poling. The majority (72%) used the poling method and trollers accounted for the remaining 1%.
- The method used most often (74%) was poling. The other 26% of anglers fished by trolling.
- The majority (77%) reported poling as their preferred crappie fishing method. Twenty-three percent (23%) preferred the trolling method.
- On average, trollers fished with 4 poles.
- Fifty-four percent (54%) of residents supported or strongly supported banning the use of yo-yo's for crappie fishing; 26% were neutral and the remaining 20% were opposed or strongly opposed to banning yo-yo's.
- The plurality of residents (43%) supported or strongly supported a change in regulation that would lower the bag limit on crappie to 25 fish per day; 19% were neutral to this proposed regulation change and 38% opposed or strongly opposed it.
- When asked about lowering the bag limit on crappie to 20 fish per day, 41% opposed or strongly opposed that regulation change and 41% supported or strongly supported it. The other 18% were neutral.
- Fifty-nine percent of residents (59%) opposed or strongly opposed reducing the bag limit on crappie to 15 fish per day. Fifteen percent (15%) were neutral and 26% were supportive of that proposed regulation change.

- Most residents (69%) were opposed or strongly opposed to reducing the bag limit on crappie to 10 fish per day; 20% were neutral and 11% supported or strongly supported it.
- Overall, over half (53%) of residents were opposed or strongly opposed to reducing the bag limit on crappie at all.
- Sixty percent (60%) opposed or strongly opposed implementing a 4-pole limit for each angler.
- Nearly half (48%) supported or strongly supported a 2-pole limit restriction; 39% were opposed or strongly opposed.
- Forty-seven percent (47%) supported or strongly supported a 1-pole limit restriction; 32% were opposed or strongly opposed.
- When asked about eliminating pole restrictions altogether, 83% were opposed or strongly opposed to that proposed regulation.
- Residents indicated 3 poles (per person) was the ideal number of poles that should be allowed at Grenada Reservoir.

### **Non-Residents**

- When asked which fishing method crappie fishermen used, 46% indicated both trolling and poling. Forty-two percent (42%) used the poling method and trollers accounted for the remaining 42%.
- The method used most often (54%) was trolling. The other 46% of anglers fished by poling.
- The majority (64%) reported poling as their preferred crappie fishing method and 36% preferred the trolling method.
- On average, trollers fished with 4 poles.
- Sixty percent (60%) of non-residents supported or strongly supported banning the use of yo-yo's for crappie fishing; 32% were neutral and the remaining 8% were opposed or strongly opposed to banning yo-yo's.
- Over half of non-residents (52%) supported or strongly supported a change in regulation that would lower the bag limit on crappie to 25 fish per day; 30% were neutral to this proposed regulation change and 18% opposed or strongly opposed it.
- When asked about lowering the bag limit on crappie to 20 fish per day, 40% supported or strongly supported it but 38% were opposed or strongly opposed it. The other 22% were neutral.
- Forty-three percent (43%) opposed or strongly opposed reducing the bag limit on crappie to 15 fish per day. Thirty-two percent (32%) were supportive of that proposed regulation change and 25% were neutral.
- The majority of non-residents (77%) were opposed or strongly opposed to reducing the bag limit on crappie to 10 fish per day; 15% were neutral and 8% supported or strongly supported it.
- Overall, 61% of non-residents were opposed or strongly opposed to reducing the bag limit on crappie at all.
- Forty-three percent (43%) opposed or strongly opposed implementing a 4-pole limit for each angler.
- Thirty-four percent (34%) of non-residents supported or strongly supported a 2-pole limit restriction; 34% were neutral and 32% opposed or strongly opposed that regulation.
- Sixty percent (60%) opposed or strongly opposed a 1-pole limit restriction.
- When asked about eliminating pole restrictions altogether, 64% were opposed or strongly opposed to that proposed regulation.
- Non-residents indicated 3 poles (per person) was the ideal number of poles that should be allowed at Grenada Reservoir.

## **SURVEY LOGISTICS**

### **Overall**

- Ninety-nine percent (99%) mail questionnaires were completed by the person to whom it was addressed.
- Overall, 66% provided open-ended comments on the back page of the mail questionnaire.
- The effective response rate was 73.6 %, with 345 returned, useable mail questionnaires, and a total of 614 participants in the study.

### **Mississippi Residents**

- Sixty-eight percent (68%) of residents provided open-ended comments on the back page of the mail questionnaire.

### **Non-Residents**

- Fifty-seven percent (57%) of non-residents provided open-ended comments on the back page of the mail questionnaire.



## **Objective 3 – Creel Survey Comparisons at Sardis and Grenada Lakes**

The goals of this part of the study were to (1) estimate total fishing effort, and (2) compare three survey designs to determine if they provided similar estimates of total effort. Two surveys also provided estimates of catch per effort, which along with total effort, estimate total catch. Discrepancies in estimates of total catch could then be due to differences in estimates of effort, catch per effort, or both. Conversely, concurring estimates of total catch could be obtained with conflicting estimates of effort and catch per effort. Therefore, our comparisons of survey designs focused exclusively on effort and catch per effort; similarities in total catch can be inferred if effort and catch per effort agree between surveys.

The effort and catch per effort surveys consisted of concurrent study designs that extended from 1 March 2006 through 28 February 2007 in Sardis Reservoir, and 1 March 2007 through 29 February 2008 in Sardis Reservoir. Design 1 represented a roving creel that estimated effort (hours) and catch per effort by intercepting anglers while they were fishing. Design 2 represented a combination of an access survey with an instantaneous boat-trailer count at access points. In design 2, the boat-trailer count estimated effort (hours) and the access survey estimated catch per effort. Designs 1 and 2 provided independent estimates of the boat-based fisheries; the bank-based fisheries represent less than 10% of the effort in Sardis Reservoir and were disregarded. Design 3 involved a traffic count survey that estimated effort in terms of number of visits rather than hours. The 12-month time frame was stratified into four quarters including March-May, June-August, September-November, and December-February. Weekdays and weekend days represented additional day-type strata. Holidays included all designated U.S. federal holidays and were treated as weekend days.

### **Design 1**

This design involved a roving creel survey that utilized a non-uniform probability sampling survey patterned after Malvestuto et al. (1978), which is equivalent to the roving-roving design described by Pollock et al. (1994). The surveys were implemented by MDWFP staff. A sampling day was divided into 4-h time blocks including three time blocks in March-November spanning a 12-h sampling day, and two time blocks in December-February spanning an 8-h sampling day. Spatially, the Sardis Reservoir was divided into five geographical strata of roughly equal areas, and Grenada Reservoir into three geographical strata. Sampling probabilities for the day and spatial strata were proportional to the amount of fishing expected in each stratum. Sampling probabilities were estimated monthly through aerial counts made in 1989.

Sampling on the water body was comprised of two components, interviews and counts. The direction (right or left) in which the survey clerk circled the reservoir section was chosen at random. Interviews were made by intercepting anglers encountered while conducting a circuit of the spatial strata. When boat density was high, interceptions were selected with systematic random sampling (i.e., every  $n$  boat). The information recorded during each interview included number of anglers in the boat, time spent fishing estimated based on the angler's recollection, species caught, and counts of harvested fish according to species. In contrast with Malvestuto et al. (1978), counts and interviews were conducted concurrently rather than separately; these two count methods were suggested as equivalent (personal communication between S. Malvestuto and K. Meals, MDWFP).

The manpower available allowed 80 sampling units in each reservoir. Each quarter was allocated 24 sampling units (12 week days and 12 weekend days), except for the December-February quarter that was allocated 8 sampling units (4 week days and 4 weekend days) because fishing effort was expected to be lower.

**Angler effort.**—With design 1 the data collected were expanded to estimate angler effort in terms of angler trips as follows:

(1) For a given sampling unit the angler count (including all anglers in the party) was multiplied by 4 (i.e., 4 h contained within the unit) to give an estimate of the total hours ( $h_{psiq}$ ) spent during the  $p^{\text{th}}$  sampling period,  $s^{\text{th}}$  reservoir section,  $i^{\text{th}}$  day,  $w^{\text{th}}$  day type strata, and the  $q^{\text{th}}$  quarter.

(2) Total effort spent on the entire reservoir during the entire fishing day,  $H_{iwq}$ , was calculated as:

$$H_{iwq} = h_{psiq}/p_p p_s \quad (1)$$

where  $p_p$  = the sampling probability associated with the particular sampling period and  $p_s$  = the sampling probability associated with the particular reservoir section.

(3) The mean effort for each day-type stratum in each quarter,  $H_{wq}$ , i.e., a mean daily effort for weekdays and weekends was calculated as:

$$H_{wq} = \sum H_{iwq} / n_{wq}$$

where  $n_{wq}$  = the number of days sampled within the  $w^{\text{th}}$  stratum in the  $q^{\text{th}}$  quarter .

(4) The variance of each  $H_{wq}$ ,  $v(H_{wq})$ , was calculated as:

$$v(H_{wq}) = \frac{\sum H_{iwq}^2 - (\sum H_{iwq})^2 / n_{wq}}{n_{wq} - 1}$$

(5) The mean daily effort per quarter,  $H_q$ , was estimated as:

$$H_q = \sum N_{wq} H_{wq} / N_q$$

where  $N_{wq}$  = the total number of days within the  $w^{\text{th}}$  stratum and  $q^{\text{th}}$  quarter, and  $N_q$  = the total number of days within the quarter.

(6) The variance of  $H_q$ ,  $v(H_q)$ , was calculated as:

$$v(H_q) = \sum W_{wq}^2 v_{wq} / n_{wq} - \sum W_{wq} v_{wq} / N_q$$

where  $W_{wq}$  = the stratum weight ( $N_{wq}/N_q$ ). The square root of the variance represented the standard error ( $se_q$ ) of  $H_q$ .

**Catch per effort.**-- With design 1 the data collected were expanded to estimate catch per effort as follows:

(1) The mean catch per hour for the  $i^{\text{th}}$  sampling day,  $w^{\text{th}}$  day type, and  $q^{\text{th}}$  quarter,  $CPH_{iwq}$ , was computed as the mean of ratios:

$$CPH_{iwq} = \frac{\sum (C_{jiwq} / H_{jiwq})}{n_{iwq}}$$

where  $C_{jiwq}$  = the total catch by the  $j^{\text{th}}$  party interviewed in the  $i^{\text{th}}$  sampling day,  $w^{\text{th}}$  day type, and  $q^{\text{th}}$  quarter;  $H_{jiwq}$  the hours fished by the  $j^{\text{th}}$  party interviewed in the  $i^{\text{th}}$  sampling day, in the  $w^{\text{th}}$  day type strata, and the  $q^{\text{th}}$  quarter; and  $n_{iwq}$  the total number of parties interviewed in the  $i^{\text{th}}$  sampling day, in the  $w^{\text{th}}$  day type strata, and the  $q^{\text{th}}$  quarter. Hours fished was computed as the product of number of anglers in the party and number of hours fished by the party. This estimate of catch per hour was assumed to represent the entire day during which the sample was taken.

(2) The mean catch per hour for each day type stratum in each quarter,  $CPH_{wq}$ , i.e., a mean catch per hour for weekdays and weekends was calculated as:

$$CPH_{wq} = \sum CPH_{iwq} / n_{wq}$$

where  $n_{wq}$  = the number of days sampled with the  $w^{\text{th}}$  stratum in the  $q^{\text{th}}$  quarter.

(3) The variance of each  $CPH_{wq}$ ,  $v(CPH_{wq})$ , was calculated as:

$$v(CPH_{wq}) = \frac{\sum CPH_{iwq}^2 - (\sum CPH_{iwq})^2 / n_{wq}}{n_{wq} - 1}$$

(4) The mean daily catch per hour for each quarter,  $CPH_q$ , was estimated as:

$$CPH_q = \sum N_{wq} CPH_{wq} / N_q$$

where  $N_{wq}$  = the total hours of effort within the  $w^{\text{th}}$  day type stratum in the  $q^{\text{th}}$  quarter, and  $N_q$  = the total hours of effort within the  $q^{\text{th}}$  quarter.

(5) The variance of  $CPH_q$ ,  $v(CPH_q)$ , was calculated as:

$$v(CPH_q) = \sum W_{wq}^2 v_{wq} / n_{wq} - \sum W_{wq} v_{wq} / N_q$$

where  $W_{wq}$  = the stratum weight ( $N_{wq}/N_q$ ), and  $n_{wq}$  is the number of anglers sampled within the  $w^{\text{th}}$  day type stratum and the  $q^{\text{th}}$  quarter. The square root of the variance represented the standard error ( $se_q$ ) of  $CPH_q$ .

## Design 2

This design involved an access creel survey alongside boat-trailer counts. The shorelines of each reservoir were each divided into three segments of roughly equal lengths, and all access points were identified within each segment. Our personnel resources allowed us to sample one segment per sampling day. Within a sampling day, a segment was selected at random, and a 6-h access survey was conducted between 1000 and 1600 hours at a randomly selected access point within the segment. Either before, during, or after the access survey, selected at random, the survey clerk drove throughout the segment and visited each access point within the segment. At each access point the clerk counted the number of boat trailers present, and promptly continued to the next access point in the route. In all, 12 public access points were included in the Sardis Reservoir survey and 15 in the Grenada Reservoir survey, but because of annual water level fluctuations not all access were available year round.

A critical aspect of this type of survey is being able to separate boating for fishing from boating for other

recreational activities. We observed that boaters often segregated temporally and spatially. Boating during certain times of the year (e.g., winter, early spring, late fall) represented almost exclusively fishing effort, with the remaining periods requiring more careful scrutiny. Spatially, large boat ramps near major access highways attracted the most non-fishing boaters, with certain ramps (e.g., near stump fields, off the beaten path) attracting exclusively fishers. Trucks parked near the bank or in boat ramps, without a trailer and with the tailgate down, almost always represented a small johnboat user. The type of trailer also helped identify boaters, with jet-ski trailers being small, with singular guard rails, and often pulled by a passenger car. Similarly, large trailers with V-shaped frame often towed ski boats. Moreover, the type of gear showing in the back of vehicles often revealed the recreation activity being pursued. These clues were considered collectively to make a judgment call about the recreational activity pursued. Comparisons between the percentages of fishing boats exiting access areas (estimated by clerks posted at boat ramps) with the percentage of fishing boats (estimated with the indicators listed above) confirmed that our estimates were reasonably accurate (within 10% of actual counts).

Anglers were interviewed as they exited the reservoir after a completed fishing trip. When angler density was high, interviews were selected with systematic random sampling (i.e., every  $n$  party). The information recorded during each interview included number of anglers in the party, time spent fishing (i.e., time of interview minus time trip started estimated based on the angler's recollection, discounting any time not spent fishing as identified by the interviewee), species and number of fish caught and released, and counts of harvested fish according to species. The manpower available allowed 102 sampling units. Each quarter was allocated 30 sampling units (15 week days and 15 weekend days), except for the December-February quarter that was allocated 12 sampling units (6 week days and 6 weekend days) because we expected fishing effort to decrease.

The effort estimates made with design 2 represent total boat hours. To estimate total angler hours, effort estimates must be multiplied by the mean size of angler parties. Therefore, estimates of angler hours include two sources of variability: that associated with estimates of boat counts and that associated with estimates of party size. Party size was estimated during the access creel survey and estimates multiplied by boat-trailer counts; variance of the products were estimated with the method proposed by Goodman (1960).

This type of survey has not been described in the literature. Although it involves interviewing and counting anglers at access sites, it is different from the access-access design described by Pollock et al. (1994), and therefore we refer to it as a modified access-access survey. This survey may seem similar to the bus-route survey (Pollock et al. 1994), but they are different. The bus-route survey requires that the survey clerk remains at each ramp in the route for a fixed amount of time to make boat-trailer counts and to interview anglers exiting the ramp. In the present survey, the survey clerk stayed at the ramp only long enough to make boat-trailer counts, and anglers were interviewed at a boat ramp randomly selected within the count segment.

**Angler effort.**-- Using this sampling scheme where the year was stratified into quarters, the quarter into week days and weekend days, and the reservoir into segments, trailer counts were expanded as follow:

(1) For a given sampling unit the trailer counts were added across access sites within the reservoir segments sampled, and multiplied by the number of daylight hours on the sampling day (sunrise/sunset; U.S. Naval Observatory 2007) to give an estimate of the total boat-hours ( $B_{iswq}$ ) expended during the  $i^{\text{th}}$  day, in the  $s^{\text{th}}$  segment, in the  $w^{\text{th}}$  day type strata, and the  $q^{\text{th}}$  quarter.

(2) The mean number of total boat-hours,  $B_{swq}$ , was computed for each segment according to day-type strata and quarter as:

$$B_{swq} = \sum B_{iswq} / n_{swq}$$

where  $n_{swq}$  = the total number of days sampled in the  $s^{\text{th}}$  segment, in the  $w^{\text{th}}$  day-type strata, and the  $q^{\text{th}}$  quarter.

(3) The variance of each  $B_{swq}$ ,  $v(B_{swq})$ , was calculated as:

$$v(B_{swq}) = \frac{\sum B_{iswq}^2 - (\sum B_{iswq})^2 / n_{swq}}{n_{swq} - 1}$$

(4) The mean daily total boat-hours,  $B_{wq}$ , and variance,  $v(B_{wq})$ , for the reservoir in each day-type strata and quarter were estimated as:

$$B_{wq} = \sum B_{swq}, \text{ and}$$

$$v(B_{wq}) = \sum v(B_{swq})$$

(7) The mean daily total boat effort per quarter,  $B_q$ , was estimated as:

$$B_q = \sum N_{wq} B_{wq} / N_q$$

where  $N_{wq}$  = the total number of days within the  $w^{\text{th}}$  day-type stratum in the  $q^{\text{th}}$  quarter, and  $N_q$  = the total number of days within the  $q^{\text{th}}$  quarter.

(8) The variance of  $B_q$ ,  $v(B_q)$ , was calculated as:

$$v(B_q) = \sum W_{wq}^2 v_{wq} / n_{wq} - \sum W_{wq} v_{wq} / N_q$$

where  $W_{wq}$  = the stratum weight ( $N_{wq}/N_q$ ), and  $n_{wq}$  is the number of days sampled within the  $w^{\text{th}}$  day type stratum and the  $q^{\text{th}}$  quarter. The square root of the variance represented the standard error ( $se_q$ ) of  $B_q$ .

(9) The mean party sizes,  $P_{iwq}$ , required to estimate angler effort from boat effort were estimated for the  $i^{\text{th}}$  sampling day,  $w^{\text{th}}$  day type, and  $q^{\text{th}}$  quarter was as:

$$P_{iwq} = \frac{\sum P_{jiwq}}{n_{iwq}}$$

where  $P_{jiwq}$  = the size of the  $j^{\text{th}}$  party interviewed in the  $i^{\text{th}}$  sampling day,  $w^{\text{th}}$  day type, and  $q^{\text{th}}$  quarter; and  $n_{iwq}$  the total number of parties interviewed in the  $i^{\text{th}}$  sampling day, in the  $w^{\text{th}}$  day type strata, and the  $q^{\text{th}}$  quarter.

(10) The mean party size for each day type stratum in each quarter,  $P_{wq}$ , i.e., a mean party size for week

days and weekend days was calculated as:

$$P_{wq} = \sum P_{iwq} / n_{wq}$$

where  $n_{wq}$  = the number of days sampled with the  $w^{\text{th}}$  stratum in the  $q^{\text{th}}$  quarter .

(11) The variance of each  $P_{wq}$ ,  $v(P_{wq})$ , was calculated as:

$$v(P_{wq}) = \frac{\sum P_{iwq}^2 - (\sum P_{iwq})^2 / n_{wq}}{n_{wq} - 1}$$

(12) The mean daily party size for each quarter,  $P_q$ , was estimated as:

$$P_q = \sum N_{wq} P_{wq} / N_q$$

where  $N_{wq}$  = the total number of days within the  $w^{\text{th}}$  day type stratum in the  $q^{\text{th}}$  quarter, and  $N_q$  = the total number of days within the  $q^{\text{th}}$  quarter.

(13) The variance of  $P_q$ ,  $v(P_q)$ , was calculated as:

$$v(P_q) = \sum W_{wq}^2 v_{wq} / n_{wq} - \sum W_{wq} v_{wq} / N_q$$

where  $W_{wq}$  = the stratum weight ( $N_{wq}/N_q$ ), and  $n_{wq}$  is the number of days sampled within the  $w^{\text{th}}$  day type stratum and the  $q^{\text{th}}$  quarter.

(14) The product of trailer counts and party size estimated angler hours,  $H_q$ , as:

$$H_q = B_q P_q$$

(15) and the variance of  $H_q$ ,  $v(B_q P_q)$ , was estimated as (Goodman 1960):

$$v(B_q P_q) = B_q^2 v(P_q) + P_q^2 v(B_q) - v(P_q) v(B_q)$$

The square root of this variance represented the standard error ( $se_q$ ) of  $H_q$  .

**Catch per effort.**-- With design 2 the average catch per hour was estimated according to quarters as follows:

(1) The mean catch per hour,  $CPH_{iwq}$ , for the  $i^{\text{th}}$  sampling day,  $w^{\text{th}}$  day type, and  $q^{\text{th}}$  quarter was computed as the ratio of means:

$$CPH_{iwq} = C_{iwq} / H_{iwq}$$

where  $C_{iwq}$  = the total catch by all anglers interviewed in the  $i^{\text{th}}$  sampling day,  $w^{\text{th}}$  day type, and  $q^{\text{th}}$  quarter, and  $H_{iwq}$  the total hours fished by the parties interviewed in the  $i^{\text{th}}$  sampling day, in the  $w^{\text{th}}$  day type strata, and the  $q^{\text{th}}$  quarter. Hours fished was computed as the product of number of anglers in the party and number of hours fished by the party. This was considered an estimate of catch per hour for the entire day during which the sample was taken.

The rest of the computations are the same as those given for estimating catch per effort with design 1, item 2.

### Design 3

The USCOE conducts traffic counts in the study reservoirs to estimate visitation by recreationists, including anglers. These counts are made 24 h per day, 365 days per year with automatic traffic meters that use pneumatic tubes stretched across roadways to count axles. Counts are made at entrances and egress roadways into recreational areas such as parks, camping facilities, boat ramps, and other attractions. The survey is focused on estimation all type of recreation visits, not just fishing. Therefore, the pneumatic counters are strategically located to count all visitors to the reservoir, and may not be positioned at sites where fishing visitation would be estimated most efficiently. Axle counts are converted to number of visitors. Numbers of visitors are partitioned into different resource uses including recreational fishing. The loadings to make these conversions are developed for each counter through repeated onsite surveys that observe traffic patterns to manually classify counts and calibrate pneumatic compressions, and concurrent interviews of visitors to determine the purpose of their visit.

Traffic counters associated with 12 access sites in Sardis Reservoir and 15 access sites in Grenada Reservoir were included. These access sites corresponded to those included in design 2. The counters were operated and maintained by the USCOE, who provided us with visitor counts and the loadings necessary to convert visitors to anglers according to access point (unpublished data provided by S. Franco, USCOE). Traffic counters estimate number of anglers and boat anglers visiting the reservoir, but not angler-hours of effort. To estimate total angler hours, angler counts may be combined with estimates of trip length obtained from angler interviews.

Total effort in terms of annual fishing trips to site  $s$  ( $T_s$ ) was estimated as:

$$T_s = \sum V_{qs} p_{qs}$$

where  $V_{qs}$  = total number of visitors recorded by the automatic counter at site  $s$  during the  $q$  quarter, and  $p_{qs}$  the fraction of visitors that are boat anglers at site  $s$  during the  $q$  quarter.

Total number of trips made by boat anglers to the reservoir for the year ( $T$ ) was estimated as

$$T = \sum T_s$$

No estimates of variance around  $T$  could be made because variance of  $V_{qs}$  and  $p_{qs}$  were not available. Total effort in terms of hours fished was estimated as the product of  $T$  and the average length of fishing trip recorded with design 2. Estimates of error were available for length of fishing trip but not for  $T$ ; thus, no attempt was made to provide confidence limits for  $T$ .

## Results

### Design 1

*Sardis Reservoir.*- In all, 3,361 boats were counted and 1,237 anglers assembled in 656 boating parties were interviewed in Sardis Reservoir. Length of incomplete fishing trips averaged 3.1 h. The estimated total effort in terms of hours fished varied among quarters, peaking in March-May and dropping to a low in December-February (Table 23). The March-May quarter received roughly three times the effort of the other quarters; relative to this 3-fold difference, differences among the three other quarters were small. Precision

of the estimated total effort, indicated by the relative standard error ( $100 \times SE/\text{mean}$ ), was highest for the March-May quarter, lower but adequate (i.e.,  $< 20\%$ ) in the two quarter between June and November, and lowest for the December-February quarter when relative standard error increased to  $45\%$ , likely due to reduced sample size. For the year, total effort was estimated at 593,088 angler-hours ( $SE = 107,658$ ).

Catch and harvest per hour varied quarterly (Table 24). Catch was highest in June-August (3.33 fish/h) and lowest in March-May (1.65 fish/h). Harvest was highest in December-February (1.98 fish/h) and lowest in March-May (1.08 fish/h). The rate of fish harvested to fish caught was more constant, ranging from 51 to 65%. The most abundant fish group in the catch was the crappies (Table 25), representing 83-92% of the catch depending on quarter.

*Grenada Reservoir.*- A total of 1,971 boats were counted and 659 anglers assembled in 382 boating parties were interviewed. Length of incomplete fishing trips averaged 4.2 h. Total fishing effort varied among quarters, peaking in March-May and dropping to a low in December-February (Table 23). The March-May quarter received roughly eight times the effort of the June-August and September-November quarters, and nearly twenty times the December-February effort. Precision of the estimated total effort was best in June-August and September-November (11-12%), larger than 20% in March-May, and unacceptable in December-February ( $>80\%$ ). For the year, total effort was estimated at 248,817 angler-hours ( $SE = 59,375$ ).

Catch and harvest per hour varied quarterly (Table 24). Catch was highest in June-August (2.57 fish/h) and lowest in December-February (0.44 fish/h). Harvest was lower but followed the same seasonal pattern. The rate of fish harvested to fish caught was ranged from 41 to 74%. The most abundant fish group in the catch were the crappies (Table 25), representing 42 to 88% of the catch depending on quarter.

## Design 2

*Sardis Reservoir.*- A total of 2,451 vehicles were counted, including 1,321 in March-May, 496 in June-August, 575 in September-November, and 59 in December-February. Expanded out for day-length and accounting for day-type strata these counts translated into 239,381 vehicle-hours, including 132,930 in March-May, 51,144 in June-August, 49,698 in September-November, and 5,609 in December-February. The access survey estimated the average party size was 1.94 in March-May, 1.92 in June-August, 1.87 in September-November, and 1.79 in December-February. Expanding vehicle-hours to angler hours as the product of vehicle counts and party size estimated total angler hours as 459,055 for the year, and 257,883 in March-May, 98,196 in June-August, 92,936 in September-November, and 10,039 in December-February (Table 23). Precision was adequate with relative standard errors scoring less than 20%, except in December-February.

Estimates of catch per hour and harvest per hour varied over quarters (Table 24). Catch was highest in March-May (4.19 fish/h), and lower the rest of the year but with little variation among quarters (2.55-2.66 fish/h). Harvest was also highest in March-May (2.69 fish/h) and lowest in June-August (1.27 fish/h). The rate of fish harvested to fish caught ranged from 49 to 74%. The most abundant fish group in the catch were the crappies (Table 25), representing 63 to 94% of the catch depending on quarter. Trip lengths in quarters 1-4 averaged 5.4, 5.9, 5.3, and 4.1 h, respectively, with an annual average of 5.0 h.

*Grenada Reservoir.*- A total of 1,720 vehicles were counted, including 1,276 in March-May, 168 in June-August, 208 in September-November, and 68 in December-February. Expanded out for day-length and accounting for day-type strata these counts translated into 138,765 vehicle-hours, including 107,984 in March-May, 12,250 in June-August, 15,981 in September-November, and 2,550 in December-February. The access survey estimated the average party size was 1.71 in March-May, 1.83 in June-August, 1.53 in September-November, and 1.28 in December-February. Expanding vehicle-hours to angler hours as the product of vehicle counts and party size estimated total angler hours as 234,785 for the year, and 184,652 in March-May, 22,418 in June-August, 24,451 in September-November, and 3,264 in December-February (Table 23). Precision as suggested by the relative standard errors was less than 10%, except in December-February when it was nearly 18%.



Estimates of catch per hour and harvest per hour were highly variable over quarters (Table 24). Catch was highest in June-August (3.13 fish/h), and lowest in December-February (0.70 fish/h). Harvest was also highest in June-August (2.22 fish/h) and lowest in December-February (0.01 fish/h). The rate of fish harvested to fish caught was highly variable ranging from 1 to 71%. The most abundant fish group in the catch were the crappies (Table 25), representing nearly 90% of the catch, except in the June-August quarter when they made up 41% of the catch and catfish 48%. Trip lengths in quarters 1-4 averaged 5.5, 4.9, 5.1, and 3.4 h, respectively, with an annual average of 5.3 h.

### Design 3

*Sardis Reservoir.*- The pneumatic counters system identified a total of 228,713 boat fishing trips to Sardis Reservoir (Table 23). In all, 89,797 of these trips occurred in March-May, 70,332 in June-August, 27,589 in September-November, and 40,805 in December-February. No estimates of error are available for these estimates because (1) they represent full counts, and (2) the error around loadings necessary to convert axle counts to visitors, and visitors to boat anglers were not available. Assuming an average annual trip length of 5.0 hours to Sardis Reservoir, estimated by design 2, the estimated number of annual fishing trips would convert into 1,143,565 fishing hours, which is roughly 2-2.5 times the estimate provided by designs 1 and 2.

*Grenada Reservoir.*- The counters identified a total of 186,097 fishing trips to Grenada Reservoir (Table 23). Of these, 94,461 occurred in March-May, 49,042 in June-August, 19,466 in September-November, and 23,128 in December-February. No estimates of error are available for these estimates for the two reasons stated above. Assuming an average annual trip length of 5.3 hours to Grenada Reservoir, estimated by design 2, the estimated number of annual fishing trips would convert into 986,314 fishing hours, which is roughly 4 times the estimate provided by designs 1 and 2.

## Discussion

Design 1 and 2 provided equivalent estimates of effort, although estimates were consistently lower for design 2. Design 2 provided estimates that were 23% lower in Sardis Reservoir and 6% lower in Grenada Reservoir. The December-February period was the most difficult to estimate because of low fishing effort and reduced sampling days, resulting in highly imprecise estimates. If this period is excluded from the computations of total effort, design 2 provided estimates that were 10% lower in Sardis Reservoir and 3% lower in Grenada Reservoir. Reasons for the discrepancies in estimates were not immediately obvious. Roving creels (i.e., design 1) may tend to overestimate effort if probabilities associated with counts (i.e.,  $p_p$  and  $p_s$  in equation 1) are inaccurate, or if during counts fishing boats are overestimated (i.e., fishing boat are not accurately distinguished from other vessels). Conversely, trailer counts may tend to underestimate effort if anglers are not accessing the lake through distinct access sites. Nevertheless, confidence limits provided by the two survey designs overlapped widely, indicating differences were not statistically significant for any quarter.

The relative standard error of effort estimates made with design 2 were consistently lower (i.e., higher precision) than those made with design 1. Some of the increased precision was due to more daily counts made with design 2 than with design 1. However, the increased precision was also due to increased consistency in the counts made with design 2 over those made with design 1. Relative standard deviation values, which are not affected by number of daily counts, were lower in nearly all quarters for design 2 than for design 1. Therefore, daily counts were generally more similar when counting trailers at boat ramps than when counting boats in the water.

Design 3 consistently overestimated boating fishing effort in reference to designs 1 and 2. Design 3 accounts for all fishing effort occurring during a 24-h period, whereas designs 1 and 2 include only daytime effort. Thus, higher estimates by design 3 were expected. However, the difference was too large to represent legitimate nighttime effort. We suspect the differences are partly due to positioning of the counters in areas that optimize measuring overall recreational visits but not necessarily accurately reflect

visitation by boat fishers. Another potential error source is the loadings used to convert axle counts to visitors and eventually to recreational fishing effort. The loadings we applied had not been updated in over 15 years, and is possible that they do not reflect current traffic and car-pooling (i.e., number of visitors/vehicle) patterns. Although counts made by these USCOE-operated traffic counters may provide functional estimates of recreational visits, they clearly do not adequately reflect fishing effort. Nevertheless, this methodology may be effective if traffic counters are installed at locations where they are likely to encounter primarily fishing-related traffic, and if conversion loadings are estimated at least every five years.

Catch rate estimates were not significantly different between designs 1 and 2, except in the March-May period. In March-May, catch rates estimated with design 1 were lower than those estimated with design 2, in both reservoirs. This discrepancy is troublesome considering that this period accounted for roughly 50% of the effort in Sardis Reservoir and 75% in Grenada Reservoir. The percentages of the catch that was harvested were similar for designs 1 and 2 (i.e., 65 and 64% at Sardis, and 74 and 69% at Grenada), suggesting recall bias (i.e., recollecting number of fish released) was not an issue. Thus, it is not clear what aspect(s) of the surveys caused the bias. This difference requires further attention to verify whether the discrepancies represent systematic departures due to methodological problems or simply random disagreement. In the interim, considering that design 2 represents a survey of completed trips, we suggest that its estimates are preferred over those of design 1 that represents a survey of incomplete trips.

The error structure of the three designs is affected by different terms in the estimation procedure. For design 1, the error term is affected by the variability of counts among sampling periods, and by the variability in the probabilities associated with counts (i.e.,  $p_p$  and  $p_s$  in equation 1). Traditionally, this latter error has been ignored (e.g., Malvestuto et al. 1978) and only the former error included in the computations, although day-to-day variability in  $p_p$  and  $p_s$  is potentially large and should be included because it is available from repeated aerial counts. These probabilities could vary greatly among years as a result of water level fluctuations that alter reservoir area and the distribution of fishing effort, as was the case in our study reservoirs. In these cases, it is important to emphasize estimation of probabilities at various water levels because applying a fix set of probabilities to surveys conducted in years with different water level is assured to produce inaccurate estimates. For design 2, the error term is affected by the variability of counts among sampling periods, potential error distinguishing the nature of recreational boating activity, possible undercount of boat anglers that do not access the lake through survey sites, and if estimating angler-hours rather than boat-hours, the variability in party size. Variability in party size is usually low, although site and fishery specific. Error associated with distinguishing the nature of boating has not been estimated, but is likely to vary seasonally as user-group participation fluctuate, being minimal in some periods when nearly all boating represents angling effort. Undercounting boat anglers that do not access the lake through sites included in the survey is likely to vary among reservoirs depending on local conditions, and among seasons if water levels fluctuate drastically and accessibility changes. For design 3, counts are absolute so variability in counts among sampling periods is eliminated. Nevertheless, there is error in the estimation of loadings needed to translate axle counts to number of visitors, and in the estimation of the percentage of visitors that pursue fishing opportunities. These loadings are akin to roving creel probabilities associated with sampling periods or sampling sections obtained with aerial surveys, in the sense that both are determined for a calendar year and applied to other years. These error sources are normally ignored in computations, but should be included because they are available from repeated surveys that calibrate pneumatic compressions through manually classified counts.

The three designs have various advantages and disadvantages for estimating effort, with varying effectiveness depending on the field situation. Design 1 has the advantages of precisely separating anglers from recreational boaters, and allowing counts of boat and bank anglers that do not access the lake through designated access points. Disadvantages of design 1 include the need for accurate aerial surveillance, or equivalent, to estimate probabilities associated with counts (i.e.,  $p_p$  and  $p_s$  in equation 1), difficulties in making in-water counts safely and accurately during adverse weather conditions (e.g., strong wind, lightning), and inability to provide estimates of nighttime effort. In direct contrast with design 1, design 2 has the advantages of providing effort estimates during incline weather condition and at anytime of the day or night, and does not require estimation of probabilities associated with counts (i.e.,  $p_p$  and  $p_s$ ). Nevertheless, design 2 may underestimate boat fishing effort if a large fraction of anglers are not accessing

the water at established access points, and underestimate bank fishing effort if anglers access the bank at points other than next to boat ramps. Also, design 2 requires that the survey clerk accurately separates fishing boats from other watercrafts by examining vehicles parked at a boat ramp. Designs 1 and 2 require equivalent levels of personnel time and fuel requirements, although design 2 precludes the need for a suitable boat, trailer, and associated maintenance. At this level, preference of one design over the other may depend on number of access points, their distribution over the reservoir, and the configuration of the network of roads connecting them. Design 3 automates counting and provides metering continuously through the day and year, so estimates represent absolute counts rather than samples. The major advantage of this design is that the capital and effort cost of these systems is relatively low and once set up, monitoring demands little effort except for inspection, maintenance, and periodic check ups to verify functioning and download counts. A major disadvantage is the need to calibrate through manually classified counts to obtain the adjustment loadings (i.e., percentage of traffic that represent boats), and this calibration must be done for each meter on a temporal basis (e.g., by time of day and time of year) to ensure continued accuracy of the data. Moreover, these meters often require frequent inspections and maintenance as a result of damage by vandals and from high traffic volumes. Meters operated by the USCOE are aimed at estimating total recreational visitors, and may only be reliable for estimating fishing effort in reservoirs where most of the visitation represents fishing.

We conclude that designs 1 and 2 are suitable for estimating fishing effort in the study reservoirs. Although design 3 did not provide reliable estimates, it may be effective if counters are distributed strategically so that they reflect primarily fishing traffic, but additional research is needed. The choice of design depends on many factors including local conditions, equipment and manpower availability, and whether simultaneous estimates of catch per effort are needed. In some cases, catch per effort surveys are already in place and adding the trailer counts described in design 2 or the pneumatic counts described in design 3 could expand the usefulness of the data.

Table 23. Total effort (hours fished or trip numbers), relative standard deviation (RSD = 100\*SD/total effort), and relative standard error (RSE = 100\*SE/total effort) estimated in Sardis Reservoir from March 2006 through February 2007, and Grenada Reservoir from March 2007 through February 2008, according to survey design. Estimates of error were not available for design 3.

|         | Design 1<br>(roving-roving) |       |      | Design 2<br>(modified access-access) |      |      | Design 3<br>(pneumatic counter) |
|---------|-----------------------------|-------|------|--------------------------------------|------|------|---------------------------------|
|         | Hours fished                | RSD   | RSE  | Hours fished                         | RSD  | RSE  | Trip numbers                    |
| Mar-May | 284,165                     | 44.8  | 11.4 | 257,883                              | 45.8 | 9.6  | 89,987                          |
| Jun-Aug | 112,378                     | 58.0  | 14.8 | 98,196                               | 38.1 | 9.3  | 70,332                          |
| Sep-Nov | 103,202                     | 64.8  | 16.0 | 92,936                               | 51.6 | 11.6 | 27,589                          |
| Dec-Feb | 93,343                      | 80.6  | 45.2 | 10,039                               | 61.6 | 32.7 | 40,805                          |
| All     | 593,088                     | 56.4  | 18.2 | 459,055                              | 45.5 | 10.4 | 228,713                         |
| Grenada |                             |       |      |                                      |      |      |                                 |
| Mar-May | 191,393                     | 89.8  | 23.7 | 184,652                              | 44.0 | 4.9  | 94,461                          |
| Jun-Aug | 23,237                      | 48.2  | 11.4 | 22,418                               | 33.3 | 4.0  | 49,042                          |
| Sep-Nov | 24,385                      | 48.4  | 12.0 | 24,451                               | 31.1 | 4.2  | 19,466                          |
| Dec-Feb | 9,802                       | 124.9 | 86.1 | 3,264                                | 73.2 | 13.8 | 23,128                          |
| All     | 248,817                     | 83.2  | 23.9 | 234,785                              | 42.1 | 4.9  | 186,097                         |

Table 24. Catch statistics for all species combined according to quarter and survey design (1 = roving-roving; 2 = modified access-access). N is the number of parties interviewed, and numbers in parentheses represent the SE and RSE, respectively.

| Quarter | Survey design | N   | Catch per hour  | Harvest per hour | Harvest/catch (%) |
|---------|---------------|-----|-----------------|------------------|-------------------|
| Sardis  |               |     |                 |                  |                   |
| Mar-May | 1             | 244 | 1.65 (0.13, 8)  | 1.08(0.09, 8)    | 65                |
|         | 2             | 119 | 4.19 (0.30, 7)  | 2.69 (0.19, 7)   | 64                |
| Jun-Aug | 1             | 188 | 3.33 (0.26, 8)  | 1.69 (0.14,8)    | 51                |
|         | 2             | 52  | 2.59 (0.39, 15) | 1.27 (0.23, 18)  | 49                |
| Sep-Nov | 1             | 182 | 2.03 (0.15, 7)  | 1.26 (0.09, 7)   | 62                |
|         | 2             | 119 | 2.55 (0.26, 10) | 1.67 (0.20,12)   | 65                |
| Dec-Feb | 1             | 42  | 3.08(0.23, 7)   | 1.80 (0.17, 9)   | 58                |
|         | 2             | 147 | 2.66 (0.36, 13) | 1.98 (0.30, 15)  | 74                |
| All     | 1             | 656 | 2.36 (0.11, 5)  | 1.36 (0.06, 4)   | 57                |
|         | 2             | 437 | 3.00 (0.17, 6)  | 1.97 (0.13, 7)   | 66                |
| Grenada |               |     |                 |                  |                   |
| Mar-May | 1             | 166 | 1.28 (0.12, 9)  | 0.95 (0.08, 8)   | 74                |
|         | 2             | 282 | 1.95 (0.11, 6)  | 1.35 (0.08, 6)   | 69                |
| Jun-Aug | 1             | 78  | 2.57 (0.39, 15) | 1.81 (0.33, 18)  | 70                |
|         | 2             | 46  | 3.13 (0.60, 19) | 2.22 (0.55, 25)  | 71                |
| Sep-Nov | 1             | 128 | 2.26 (0.16, 7)  | 1.10 (0.08, 7)   | 49                |
|         | 2             | 53  | 2.27 (0.31, 14) | 1.10 (0.15, 14)  | 48                |
| Dec-Feb | 1             | 11  | 0.44 (0.28, 64) | 0.18 (0.13, 72)  | 41                |
|         | 2             | 18  | 0.70 (0.31, 44) | 0.01 (0.01, 99)  | 1                 |
| All     | 1             | 383 | 1.87 (0.11, 6)  | 1.16 (0.08, 7)   | 62                |
|         | 2             | 399 | 2.08 (0.12, 6)  | 1.38 (0.09, 7)   | 65                |

Table 25. Catch per hour according to species group, quarter, and survey design (1 = roving-roving; 2 = modified access-access). Asterisks indicate catch per 10 hours.

| Species group      | Mar-May | Jun-Aug | Sep-Nov | Dec-Feb |
|--------------------|---------|---------|---------|---------|
| Sardis - Design 1  |         |         |         |         |
| Crappie            | 1.41    | 2.78    | 1.86    | 2.59    |
| Catfish            | 0.07    | 0.32    | 0.10    | 0.16    |
| Black bass         | 0.07    | 0.04    | 0.03    | 0.03    |
| Sunfish            | 0.01    | 0.05    | 0.01    | 0.00    |
| White bass         | 0.08    | 0.08    | 0.02    | 0.30    |
| All                | 1.65    | 3.33    | 2.03    | 3.08    |
| Sardis - Design 2  |         |         |         |         |
| Crappie            | 3.80    | 1.89    | 1.60    | 2.51    |
| Catfish            | 0.15    | 0.42    | 0.17    | 0.05    |
| Black bass         | 0.06    | 0.05    | 0.17    | 0.07    |
| Sunfish            | 0.01    | 0.17    | 0.00    | 0.00    |
| White bass         | 0.17    | 0.04    | 0.59    | 0.03    |
| All                | 4.19    | 2.59    | 2.55    | 2.66    |
| Grenada - Design 1 |         |         |         |         |
| Crappie            | 1.13    | 1.08    | 2.00    | 0.33    |
| Catfish            | 0.11    | 0.58    | 0.10    | 0.00    |
| Black bass         | 0.00    | 0.00    | 0.02    | 0.07    |
| Sunfish            | 0.00    | 0.00    | 0.00    | 0.00    |
| White bass         | 0.03    | 0.91    | 0.14    | 0.04    |
| All                | 1.28    | 2.57    | 2.26    | 0.44    |
| Grenada - Design 2 |         |         |         |         |
| Crappie            | 1.71    | 1.29    | 2.10    | 0.62    |
| Catfish            | 0.16    | 1.51    | 0.12    | 0.07    |
| Black bass         | 0.02*   | 0.05*   | 0.00*   | 0.00*   |
| Sunfish            | 0.00    | 0.00    | 0.00    | 0.00    |
| White bass         | 0.06    | 0.24    | 0.02    | 0.01    |
| All                | 1.95    | 3.13    | 2.27    | 0.70    |

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