ALABAMA POWER COMPANY

BIRMINGHAM, ALABAMA

MARTIN HYDROELECTRIC PROJECT

FERC NO. 349

STUDY PLAN 6 – STRIPED BASS TELEMETRY STUDY

NOVEMBER 2008

Prepared by:

ALABAMA POWER

A SOUTHERN COMPANY

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TABLE OF CONTENTS

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1.0 GOALS AND OBJECTIVES OF STUDY

The Alabama Department of Conservation and Natural Resources (ADCNR) currently stocks Gulf-strain striped bass (*Morone saxatilis*) in Lake Martin. The ADCNR would like to understand the relationship of project operation and potential impact to striped bass habitat in Lake Martin. If such a relationship is present, the ADCNR would like to determine ways to predict periods of impact and limit their overall effects on the stocks of adult Gulf-strain striped bass in the lake.

The objectives of this study are:

1. Determine the depths, temperatures, and dissolved oxygen concentrations used by adult striped bass in Lake Martin during summer and identify those locations.
2. Determine the approximate volume of suitable striped bass habitat present in Lake Martin during summer and examine possible factors (pollution, hydrology, project operation, etc.) that may affect this volume.
3. Determine the hooking mortality and behavior of adult striped bass angled during summer in Lake Martin.

2.0 RELEVANT RESOURCE MANAGEMENT GOALS

The ADCNR maintains a population of Gulf-strain striped bass in Lake Martin to create a unique inland recreational fishery and as a source of brood stock for striped bass stocking in the Gulf Coast drainages. Understanding the potential effect on the striped bass fishery is important for future management practices.

3.0 BACKGROUND AND EXISTING INFORMATION

Indiscriminant stocking of striped bass in the United States over the past 40 years have made it difficult to maintain a “pure strain” in the wild. The ADCNR maintains the Gulf-strain of striped bass in Lake Martin and is concerned with the “die-off” events of striped bass that are sporadically observed on Lake Martin during the summer and early fall. They are concerned that there is limited thermal refuge (cool temperatures/high dissolved oxygen) for striped bass in the lake and that there may be a relationship between project operation/generation and striped bass “die off” events. The ADCNR believes the turbine withdrawals may pull directly from the metalimnion and deplete the cool water/high dissolved oxygen layers of the lake which serve as a thermal refuge, especially for large adult fish.

According to studies in the southeast, adult striped bass prefer dissolved oxygen (DO) levels greater than 2 mg/l and temperatures less than 25°C (Isley, 2002; Moss, 2007; Hill, 1989; Francis-Floyd, 2002). Current information for Lake Martin (ADEM, 2005; APC, 2006), demonstrates the lake stratifies during the hot summer months, which restricts striped bass to the cooler water deeper in the lake. With the onset of stratification during the early summer, DO levels in the hypolimnion and metalimnion decrease due to anaerobic activity and reduced circulation and contact with the atmosphere. The layer of preferred habitat for striped bass naturally grows smaller as stratification intensifies until lake turnover in the fall destratifies the lake. It is believed that as the layers of water with ideal temperature and DO decreases, striped bass become overcrowded or at times have to sacrifice or choose between temperatures below 25°C and/or DO greater than 2mg/l. In marginal habitats with lower DO levels or higher temperatures, striped bass can become sluggish, feed less, or develop bacterial infections that can lead to increased mortality rates.

In addition to the studies cited above, the ADCNR cited a report by Dr. Steve Miranda (University of Mississippi) which reported that larger adult striped bass have a tendency to sink (not float) to the bottom of lakes upon death. This observation could potentially distort the number of die-offs and the number of fish involved with each die off reported in the past. They also cited a new study from Smith Lake that deals with the interaction (overlap of diets – competition) of largemouth, stripers, and spotted bass, which may provide beneficial information.

4.0 PROJECT NEXUS

The study would determine if existing project operation actually impacts striped bass thermal refuge areas during the summer and fall periods of the year. Recreational angling mortality may also have an impact of the striped bass populations.

5.0 STUDY AREA AND STUDY SITES

The study area for this issue would include the main body and two major arms (Kowaliga and Tallapoosa) of Lake Martin.

6.0 PROPOSED METHODOLOGY

6.1 <u>Field Study Methodology</u>

APC proposes to perform a striped bass telemetry study and a striped bass angling mortality study to address the objectives identified in Section 1. These two studies will be performed by Dr. Steven Sammons and Auburn University. The methodologies proposed by Dr. Sammons are listed in Attachment A.

6.2 Data Analysis

A report of the Telemetry study and the Angling Mortality study will be prepared and discussed with the MIG 1. Information from these studies will be compared with pollution sources, project operations (turbine operations - machine hours), or other potential impact sources will be compared to identify recommendations for addressing impacts (if applicable) to the striped bass fishery.

7.0 CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE

This study employs generally accepted practices for evaluating fish distributions and stock assessments at hydroelectric projects. The study methodology was recommended by the ADCNR and Auburn University and is consistent with generally accepted fishery sampling principles and practices.

8.0 PRODUCTS

Data and analyses from this study will be included in periodic reports to the MIG 1 during the study phase. A draft report of the field study results will be distributed to the MIG 1 for review and comment within 6 to 8 months of completion of the field study. A final report will be provided as part of the draft license application that will include raw data in tabular form, maps of sample sites, conditions during sampling, and an analysis of striped bass distribution in relation to lake water quality parameters and project operation.

9.0 SCHEDULE

This schedule is draft and APC intends to develop a formal schedule with MIG 1 members upon final FERC approval of the study.

APC files Final Study Plan ....November 2008
MIG 1 Consultation ....January 2009 – December 2010
Fish Collection and Tagging...February 2009
Fish Tracking and collection of water quality data....... February – November 2009
Anticipated FERC Approval .... May 2009
Angling Mortality Study...August – September 2009
Review data and finalize report on field studies.............................December 2009
Draft Report .... June 2010
Final Report .... September 2010

10.0 LEVEL OF EFFORT AND COST

APC estimates the cost of consulting on the study plan, collecting the fisheries data, analyses, and developing a draft and final report is approximately $200,000 based on the level of field studies to be performed.

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ATTACHMENT A

ADULT STRIPED BASS HABITAT USE AND THE EFFECTS OF CATCH AND RELEASE ANGLING DURING THE SUMMER IN LAKE MARTIN, ALABAMA

A PROPOSAL SUBMITTED TO ALABAMA POWER COMPANY

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September 8, 2008

ADULT STRIPED BASS HABITAT USE AND THE EFFECTS OF CATCH AND RELEASE ANGLING DURING THE SUMMER IN LAKE MARTIN, ALABAMA

A PROPOSAL SUBMITTED TO ALABAMA POWER COMPANY

Originally restricted to marine and estuarine systems, striped bass *Morone saxatilis* have become important sportfish in many reservoir systems across the southeastern U.S. (Coutant 1987; Jackson and Hightower 2001; Young and Isely 2002). Striped bass are active, pelagic piscivores that commonly reach a large size (> 10 kg) and prey on other pelagic fishes such as clupeids (Axon and Whitehurst 1985). However, many populations of striped bass are limited by the amount of cool, oxygenated water found in reservoir systems during summer (Coutant 1985; Young and Isely 2002; Bettoli 2005). Summer mortality of adult striped bass (≥ 5 kg) has been linked to poor environmental conditions that lead to lower body condition, increased disease, and ultimately death (Coutant 1985; Matthews 1985; Moss 1985; Braschler et al. 1989). Summer mortality of striped bass is more severe in larger fish, since temperature preference and thermal tolerance typically decreases as the fish age (Coutant 1985; Matthews 1985). Thus, availability of suitable summertime water temperature and dissolved oxygen concentrations are likely the most important limiting factors governing the ability of a reservoir to support a trophy fishery for striped bass (Axon and Whitehurst 1985).

Temperatures exceeding 25 C and dissolved oxygen concentrations below 2 mg/L are unusable habitat for adult striped bass (Coutant and Carroll 1980; Coutant 1985). Field studies of telemetered striped bass have shown that adult fish commonly use waters that are < 20 C and have dissolved oxygen concentrations ≥ 4 mg/L (Coutant 1985; Bettoli 2005). When these temperatures and dissolved oxygen levels are readily available, striped bass will range widely while feeding on pelagic prey (Bettoli 2005; Moss et al. 2005). However, as summer progresses and water temperatures warm, striped bass are commonly restricted to narrow bands of Carroll 1980; Combs and Peltz 1982; Moss 1985; Hampton et al. 1988; Braschler et al. 1989; Wilkerson and Fisher 1997; Moss et al. 2005). Striped bass can persist in suboptimal conditions for periods up to 4-5 weeks (Hampton et al. 1988; Jackson and Hightower 2001; Young and Isely 2001). However, if conditions worsen or persist longer, striped bass typically suffer large die-offs, typically composed of larger individuals (Coutant 1985; Matthews 1985). Thus, abundant cool oxygenated zones of water in summer are vital for successful trophy fisheries of striped bass in southeastern reservoirs.

Oxygen is a non-renewable resource in the cool, deep waters of reservoirs during summer, and availability of this vital summertime habitat for adult striped bass can be governed by several factors. Hydropower generation provides abnormally cool water downstream of the dam (possibly providing a thermal refuge for fishes in that system), while depleting the lower strata of waters in the reservoir behind the dam (Cole and Hannan 1990). Increases in nutrient inputs either from upstream sources or from lakeshore development will increase the depletion of dissolved oxygen from the lower water strata through increased respiration and decay (Coutant 1987). Obviously, all of these factors can and often do occur simultaneously, thus affecting the volume of available summertime habitat in hard to predict ways. Coutant (1987) stated that water resource managers should specifically identify the water temperatures and dissolved oxygen concentrations required by the species of interest in each water body. Zones that meet the requirements of these species should be quantified and maintained, especially when these zones are constricted during critical periods. To date, little attempt has been made to quantify the available summer habitat of striped bass in reservoir systems, or to examine how reservoir Angling mortality can also be an important component of striped bass total annual mortality. Hooking mortality of freshwater fishes, including striped bass, is often greater during summer months when water temperatures are high (Tomasso et al. 1996; Wilde et al. 2000). Striped bass show signs of physiological stress when angled; often these effects are greater during summer, leading to greater mortality (Tomasso et al. 1996). Millard et al. (2005) found that striped bass in the Hudson River, NY, experienced a higher rate of catch and release mortality when temperatures were $\geq$ 16 C. Summer water temperatures in southeastern reservoirs are commonly greater than 25 C, and often approach lethal temperatures for adult striped bass (Coutant 1985; Bettoli and Osborne 1998). Studies have found catch and release mortality of angled striped bass is commonly reported to be 50-80% during the summer in southeastern reservoirs (Bettioli and Osborne 1998; Wilde et al. 2000; Bettinger et al. 2005). Tomasso et al. (1996) reported that the normal physiology of striped bass was severely disturbed during capture by hook and line, and that the degree of disturbance was greater during the summer. Summer mortality of striped bass is likely increased in reservoir systems where availability of suitable summer habitat is low, where striped bass are crowded and likely malnourished (Coutant 1985).

Lake Martin is a large (16,188 ha) oligo-mesotrophic tributary storage reservoir on the Tallapoosa River in east-central Alabama. Reaching depths in excess of 45 m, Lake Martin typically stratifies by late April and remains strongly stratified until November in most years (D. Bayne, Auburn University, personal communication). Since 1978, Gulf-strain striped bass have been stocked into Lake Martin on an annual basis by Alabama Department of Conservation and bass developed, with anglers catching numerous fish > 10 kg annually (N. Nichols, ADCNR, personal communication). However, during years subsequent to the development of this fishery, periodic summer mortalities of adult striped bass have been observed on Lake Martin (Alabama Power Company [APC] 2008). The most recent of these mortalities occurred in late August to mid September in 1991, 1994, and 2001, typically occurred in the lower section of the reservoirs near the dam, and consisted primarily of fish > 5 kg (J. Lochamy, APC, personal communication). The causes of these mortalities are not known but are most likely related to availability of summer habitat for adult striped bass (APC 2008). Angling pressure for these fish is also high during summer in the lower reservoir, but it is not known what affect these activities may have on the observed summer mortalities of striped bass in Lake Martin (N. Nichols, ADCNR, personal communication).

OBJECTIVES

1) Determine depths, temperatures, and dissolved oxygen concentrations used by adult striped bass in Lake Martin during summer.
2) Determine the approximate volume of suitable striped bass habitat present in Lake Martin during summer and examine possible factors affecting this volume.
3) Determine the hooking mortality and behavior of adult striped bass angled during summer in Lake Martin.

Objective 1: In late February 2009, 30 striped bass $\geq$ 4.5 kg will be collected using electrofishing and long lines baited with goldfish *Crassius auratus* (Moss et al. 2005). These fish will be implanted with 25-g radio tags (Advanced Telemetry Systems, Inc., model F1850) and 22-g ultrasonic tags (Sonotronics, Inc., model CTT-83-3I) following the procedures of Maceina et al. (1999). This tag size follows the recommendation of Winter (1996) of not implanting a tag greater than 2% of body weight in order that behavior and movement will not be affected. The radio tags have a life expectancy of 1086 d and will be fitted with a mortality sensor. If these tags are motionless for at least 24 h due to death or expulsion, then the signal rate will increase from 50 to 100 pulses per second. The ultrasonic tags have a life expectancy of 36 months and are temperature sensitive; transmitted pulses will be dependent on the surrounding temperature (Bettoli and Osborne 1998). The relationship between pulse rate and water temperature will be modeled for each tag to ensure the correct temperature is determined.

Fish will be tracked approximately every 14 d beginning two weeks after tag insertion, to allow fish time to recover from surgery. From mid-May until the end of September, fish will be located once a week to identify summer habitat use. Thereafter, fish will again be located once every two weeks until the following summer. During this summer period, fish will be tracked over a 24-h period - once in late May, and twice a month thereafter through September for a total of nine 24-h tracking periods. During those tracking events, 12 fish will be selected randomly and found every 4 hours for 24 hours to assess diel movements and habitat changes. During each tracking period, the precise location (within 5 m) of each fish will be mapped using real-time differential corrected GPS. Water depth will be recorded, along with the pulse rate from the encompassing the general area where the fish were found in order to identify the depths and dissolved oxygen concentrations fish were utilizing when located. Daily movements will be calculated for each fish by dividing the distance moved between locations by the amount of time elapsed (in d) between locations (Wilkerson and Fisher 1997; Sammons et al. 2003). Fish movements will be compared among four seasons, defined by water temperatures (Wilkerson and Fisher 1997; Sammons et al. 2003). Water temperatures, dissolved oxygen concentrations, and depths used by telemetered fish will be compared among seasons using ANOVA (Wilkerson and Fisher 1997; Young and Isely 2002; Bettoli 2005). Significance for all statistical tests will be set at $P \leq 0.10$.

Objective 2: Temperature and dissolved oxygen profiles will be collected every 2 weeks from June-September in a grid pattern in the lower third of Lake Martin. Profiles will be taken approximately every 2 km throughout the main river channel section of the lake and in large embayments within 20 km of the dam (e.g., Blue and Kowaliga creeks). Profile locations will be mapped using real-time differential corrected G.P.S. units and entered into GIS software for analysis. Summer striped bass habitat will be initially defined as water temperatures $\leq$ 21 C and dissolved oxygen concentrations $\geq$ 4 mg/L (Coutant 1985), and will be modified pending results of the telemetry study in Objective 1. Spatial Analyst tools in ArcGIS 9.1 (ESRI, Inc., Redlands, CA, 92373) will be used to extrapolate water quality data between profiles by performing a series of interpolations using a combination of linear algebra and kringing to create depth layers using point data (i.e., the profile stations). This information will be used to estimate the volume data going back as far as possible will be obtained from Alabama Department of Environmental Management and APC, and this data will be analyzed using GIS to estimate striped bass habitat volume in past summers. If possible, water quality data such as chl-a or phosphorus concentrations will be obtained for Lake Martin and used to assess changes in nutrient concentrations through time. Further analyses will seek to explain annual variations in the volume of striped bass habitat as a function of hydrological factors (discharge and inflow) during the year.

Objective 3: Striped bass will be angled from the lower section of Lake Martin during the summer 2009. Professional fishing guides or local anglers with experience fishing for striped bass in Lake Martin will accompany us on the majority of our sampling trips. Striped bass will be angled using typical methods used by striped bass anglers during summer on Lake Martin. Landing times and handling times will be recorded for each fish caught, as well as surface temperature, air temperature, and terminal gears (Bettoli and Osborne 1998). We will attempt to land fish quickly to minimize physiological stress caused by angling (Tomasso et al. 1996). Only striped bass ≥ 1 kg will be retained for these experiments; smaller fish will be released immediately. Striped bass ≥ 1 kg will be measured (total length) and placed into a foam-lined cooler containing untreated lake water. Hooks embedded in the pharynx or gills, or otherwise judged too difficult to remove, will be cut; if a live bait is swallowed, the line will be cut. Striped bass will be tagged with a retrievable ultrasonic tag and float assembly as described in Osborne and be fitted with cylindrical acrylic float that exerts approximately 8 g of positive buoyancy; the total length of this assembly will not exceed 300 mm and have a cross-sectional area of approximately 2 cm^2. Each float will be pressure-tested by lowering them to a depth of at least 30 m and leaving them on an anchor rope overnight (Osborne and Bettoli 1995). Tags will be attached to each fish using synthetic absorbable suture; the assembly will be attached to the dorsal musculature anterior to the dorsal fin so that it will lie along the upper flank of each fish. In each case, total tagging time should be ≤ 2 minutes (Bettoli and Osborne 1998).

Following transmitter attachment, each fish will be released into the lake. The suture material will decay in approximately 3 weeks; once free of the fish the tag assembly should float to the surface where it can be retrieved during normal tracking activities or by anglers and boaters (Bettoli and Osborne 1998). Additionally, each assembly will be clearly marked "REWARD" and a $35 reward will be paid to increase rate of return from anglers if they find the tag (Osborne and Bettoli 1995). Similar to the activities described in Objective 1, the relationship between pulse rate and temperature will be modeled for each tag to accurately describe the temperature and depth used by each fish. Tagged fish will be located on three consecutive days following their release, then once in each of the following time intervals following release: 5-7, 7-10, 10-14, 14-21 days for a minimum total of seven locations per fish. When tagged fish are relocated, tag number, pulse interval, and tag location will be recorded. Fish that show no movement and whose tag pulse interval are consistent with the temperature at the reservoir bottom will be considered dead (Bettoli and Osborne 1998).

Once per month short-term post release behavior of striped bass will be observed. Each then every ½ hour for 2 additional hours, and once more > 5 hours post release for a total of 2930 observations for each fish. For each fish located, pulse rate interval and locations will be recorded, and temperature and depth of the stratum the fish occupied will be calculated.

Logistic regression will be used to test the relation between survival rate and landing time, handling time, water temperature, air temperature, total length of the fish, and gear (Bettoli and Osborne 1998). Relations between gear type (artificial lures vs. live bait) and survival rates of striped bass will be examined each month using the chi-square statistic (SAS Institute 2002). Student's t-test will be used to examine whether striped bass that survived differed from those that did not in terms of their mean length, landing time, handling time, water temperature, and air temperature at time of capture. Significance of all statistical analyses will be set at $P \leq 0.10$.

EXPECTED BENEFITS

Results from this study will allow biologists with ADCNR and APC to better understand dynamics of the striped bass population in Lake Martin. Data from the telemetry portion of the study will identify habitat use (water temperature, dissolved oxygen concentrations, and depth) of striped bass in Lake Martin, especially during the critical summer season. Results from the profile data and GIS analyses will allow biologists to evaluate the quantity of this preferred habitat in summer and draw conclusions about the degree of crowding and stress the striped bass population is subjected to in Lake Martin. Further, this portion of the study may serve as a template to direct future efforts of the managing agencies to quantify available summertime striped bass habitat in the reservoir. Analyses of factors that may influence availability of critically influence striped bass management in Lake Martin.

Results from the hooking mortality portion of the study will allow biologists to evaluate the current fishery for striped bass in Lake Martin. This study will identify critical periods during summer when hooking mortality may be high, leading to a decline in large fish if the fishery gains in popularity and experiences an increase in angling effort in the future. Furthermore, this study will evaluate whether the quantity of summer habitat interacts in any way with summer hooking mortality. Results from all three phases of this proposed study may be used by fisheries biologists to identify critical periods during summer when striped bass may be more vulnerable to summer mortality, whether by a lack of quality habitat, high angling mortality, or both.

February 2009	Collect and tag 30 adult striped bass $\geq$ 5 kg with radio and ultrasonic tags, tracking begins 2 weeks after tagging
March-mid May 09	Tracking of tagged striped bass, once every other week
mid-late May 2009	Weekly tracking begins, first 24-hr tracking
June-September 2009	Temperature-dissolved oxygen profiles are taken biweekly, angling study, 24-hr tracking twice a month, weekly telemetry
October 2009	Tracking of striped bass goes back to biweekly, data analysis begins
November 2009	Tracking continues, data analysis complete
December 2009	Initial report due to APC by end of the month, tracking continues ? Possibly another round of everything we did in 2009?

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