



**GUIDELINES FOR WRITING A SRAC PRE-PROPOSAL**  
**Comprehensive Method**  
*Updated April 16, 2019*

**General Instructions:**

Type the project proposal double-spaced using any standard 12 pt. typeface using the guidelines below. The completed proposal should contain the following elements:

- 1) A cover sheet with project summary
- 2) The project narrative
- 3) Vita for each participating scientist
- 4) Budgets pages consisting of budgets for each institution and an overall budget page for the entire project.

Send an electronic copy (Word) of your proposal to the SRAC Director as email attachment to jimmy.avery@msstate.edu.

**Proposal Format:**

- 1) Cover Sheet with Project Summary (Page 1)

This page should include the following: a) title of the project; b) the name, institution, address, phone number, and email address of the lead scientist; c) a list of cooperating scientists and their corresponding institutions; and d) a Project Summary of 250 words or less. The Project Summary must be self-contained and describe the overall project goals and the approaches to meet the project objectives. The summary should clearly indicate the nature of collaboration among the various participants.

- 2) Project Narrative (start on new page)

The Project Narrative should not exceed 12 double-spaced pages. The Narrative should contain the following items:

- a) Objectives: Restate the project objectives as stated in the Request for Pre-Proposals.
- b) Procedures: The procedures or methodology to be applied to the proposed effort should be explicitly stated and directly linked to the project objectives. This section should include but not necessarily be limited to a description of the proposed investigations and/or experiments; techniques to be employed, including their feasibility; kinds of results expected; means by which data will be analyzed or interpreted; pitfalls which

might be encountered; and limitations to proposed procedures. Also see the description of desired project components under “Experimental Approach” in the *Request for Pre-proposals* for additional considerations that you should address in this section.

- c) **Institutional Units Involved:** To meet the criterion for a regional project, the pre-proposal must include collaboration from scientists in two or more states or territories in the Southern Region (Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, Oklahoma, Puerto Rico, South Carolina, Tennessee, Texas, U.S. Virgin Islands, and Virginia). Identify each institutional unit contributing to the project. Clearly define the roles and responsibilities of each institutional unit of the project team and point out the nature of collaboration. Where possible, show how the work will be conducted in a truly collaborative fashion rather than simply as a division of labor.
- d) **Project Timetable:** The proposal should outline all important phases as a function of time, year by year, for the entire project, including periods beyond the grant funding period.
- e) **Logic Model:** All proposals must include a Logic Model that clarifies the linkages between investments and activities, outputs, and expected outcomes of the funded project. This addition is intended to help rationalize a project and facilitate stronger focus and reporting on expected outcomes or notable accomplishments. If you have submitted either a USDA AFRI or US EPA grant recently, you already have experience in Logic Model development. The USDA NIFA Generic Logic Model can be accessed at: [http://www.nifa.usda.gov/business/reporting/part/gen\\_logic\\_model.pdf](http://www.nifa.usda.gov/business/reporting/part/gen_logic_model.pdf). Logic Model information and training is available at the University of Wisconsin Extension Logic Model Information and Training website (<http://www.uwex.edu/ces/pdande/evaluation/evallogicmodel.html>) or the US EPA Logic Model Training website (<http://www.epa.gov/evaluate/lm-training/>). Typically this page will be in landscape mode due the nature of the model development.
- f) **Duplication of Research Statement:** To address the important issues of potential duplication of research, ensuring efficient and effective use of federal funds, and to facilitate new knowledge beyond the current state of science, all proposals must include a statement that indicates that relevant federal aquaculture-related research databases were accessed and reviewed. This is to ensure that the proposed project does not duplicate any previously funded research and that the proposed work is original research.

Therefore, pre-proposals should include a statement stating that “...relevant federal databases that include funded aquaculture-related research were accessed and reviewed including: the USDA Research, Education, and Economics Information System (REEIS); national and state Sea Grant programs and funded project databases; the National Sea Grant Library, and the USDA Regional Aquaculture Centers’ websites. These databases were accessed to search for and review any projects that are related to or the same as the research project proposed herein does not duplicate any previously funded projects found in these databases, and that the proposed work is original research.”

Relevant aquaculture-related research databases include:

USDA REEIS: <http://www.reeis.usda.gov/>

USDA Regional Aquaculture Centers:

- Northeastern Regional Aquaculture Center: <http://www.nrac.umd.edu/>
- Southern Regional Aquaculture Center: <http://www.srac.msstate.edu>
- North Central Regional Aquaculture Center: [www.ncrac.org](http://www.ncrac.org)
- Western Regional Aquaculture Center: <http://www.fish.washington.edu/wrac>
- Center for Tropical and Subtropical Aquaculture: <http://www.ctsa.org>

NOAA/Sea Grant Projects:

- Search Projects: <http://seagrant.noaa.gov/WhatWeDo/SearchProjects.aspx>
- State Programs: <http://www.seagrant.noaa.gov/other/programsdirectors.html>
- National Sea Grant College Program: <http://www.seagrant.noaa.gov>
- National Sea Grant Library: <http://nsgd.gso.uri.edu>

Also, you may also want to consider searching Google Scholar for information relevant to the subject of interest: <http://scholar.google.com>

### 3) Vitae

Include a one-page vita for each participating scientists. Use the attached format.

### 4) Budget pages

A one-page budget proposal for the overall project should be prepared. The overall budget must be followed by separate budgets for each participating institution. Use the Budget pages provided. **NOTE:** Indirect costs or tuition remission are not allowed. Contracts are awarded on a 12-month basis so there is no carryover from year to year for those on contract. Accountability of expenditures and distribution of funds to participants will be the responsibility of each participating institution.

Salaries of hard-funded faculty with a 12-month appointment who will be serving as principal and co-investigators are not allowed and should be considered as institutional contributions. Salary is allowed for soft-funded positions (faculty, Post-docs, research associates, GRAs, etc) and summer salary for PIs or CO-PIs on 9-month appointments.

#### *Budget Justifications*

**Equipment Purchases.** Equipment purchases will be allowed when 1) the project is a high priority to industry development or problem-solving, 2) the equipment is essential for the success and accomplishment of specific research objectives, 3) the equipment has a useful life beyond the project for long-term benefits for the institution's capacity for research as well as contributions to industry development, and 4) the equipment is of a specialized nature and would not normally be expected to be in University inventory. SRAC grant funds for

research and extension projects may not be used for office equipment and furnishings, air-conditioning, standard computers, or other general purpose equipment. A separate page for this justification should be attached to the budget.

**Travel:** All proposals must contain strong justification for any travel outside of the region or not directly required for field work or project team collaboration. The travel should be directly linked to the funded project and deemed supportive of the specific objectives of the regional project. This justification should be included in the budget summary. The use of electronic communication tools other than travel is encouraged when feasible to reduce travel costs and time.

Attending a national conference to “Present findings”, “Gather background information”, or “To meet with other project participants” will have to pass additional scrutiny in today’s audit-sensitive environment. Certainly, making scientific presentations on SRAC funded projects at national meetings is encouraged. However, it can hardly be justified early in the project when data is still incomplete or when multiple project participants want to present on the same subject. If an investigator is using SRAC funds, then there should be an accepted abstract or agenda item based on work generated by SRAC funding. Travel will be reimbursed for only one presenter.

**VITA** (centered at top)

*(skip one line)*

**Name**, Address, Phone, Fax, E-mail

*(skip one line)*

**EDUCATION**

*(skip one line)*

B.S. (year, major, institution,)

M.S. (year, major, institution,)

Ph.D. (year, major, institution,)

*(skip one line)*

**EMPLOYMENT**

*(skip one line)*

List each position held on a separate line from most recent to oldest

*(skip one line)*

**SCIENTIFIC AND PROFESSIONAL ORGANIZATIONS**

*(skip one line)*

List each organization on a separate line

*(skip one line)*

**SELECTED PUBLICATIONS**

*(skip one line)*

List several recent publications (from most recent to oldest) relevant to the subject area of the project. Skip one line between each citation.

## Proposed Budget for the Regional Project

### TITLE OF THE REGIONAL PROJECT

Institution:				<b>Year 1</b>	<b>Year 2</b>	<b>Year 3</b>	<b>Total</b>
Scientist name:							
<b>Salaries and Wages</b>	CSREES-FUNDED WORK MONTHS						
1. No. Of Senior Personnel	Calendar	Academic	Summer				
a. ___ (Co)-PD(s)							
b. ___ Senior Associates							
2. No. of Other Personnel (Non-Faculty)							
a. ___ Research Associates/Postdoctorates							
b. ___ Other Professionals							
c. ___ Paraprofessionals							
d. ___ Graduate Students							
e. ___ Prebaccalaureate Students							
f. ___ Secretarial-Clerical							
g. ___ Technical, Shop and Other							
<b>Total Salaries and Wages</b>							
Fringe Benefits (If charged as Direct Costs)							
<b>Total Salaries, Wages, and Fringe Benefits</b>							
Nonexpendable Equipment (Attach justification. List items and dollar amounts for each item.)							
Materials and Supplies							
Travel (Attach justification.)							
Publication Costs/Page Charges							
All Other Direct Costs							
<b>Total Direct Costs</b>							
<b>Total Amount of This Request</b>							

*(Example: Comprehensive Method)*

**Project Title:** Split-Pond Aquaculture Systems: Design Refinements for Catfish Production and Evaluation for Culturing Other Species

**Lead Scientist:** Craig S. Tucker  
USDA-ARS Catfish Genetics Research Unit  
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Email: [craig.tucker@ars.usda.gov](mailto:craig.tucker@ars.usda.gov)

**Cooperators:** USDA-ARS Catfish Genetics Research Unit, Stoneville, MS  
Travis Brown  
E.L. Torrans  
USDA-ARS Natural Products Utilization Research Unit, Oxford, MS  
Kevin Schrader  
Mississippi State University, MS  
Charles Mischke  
Auburn University, AL  
Claude Boyd  
Gregory Whitis  
University of Arkansas at Pine Bluff, AR  
Jeonghwan Park  
Nathan Stone

**Project Summary:**

Split ponds consist of a fish-holding basin connected to a larger waste-treatment basin by conveyance structures through which water is circulated using high-volume pumps. Although rapidly adopted by catfish farmers, system design varies greatly among current users. The apparent success of split ponds for growing catfish has also generated interest in the possibility of culturing baitfish. Researchers at four institutions will collaborate to determine the best split pond designs for catfish and baitfish aquaculture. Engineering performance models for five high-volume pumps used in catfish split ponds will be developed. Commercial-scale systems using these pumps will then be evaluated for fish performance, water quality, and flavor quality. Additional studies will be conducted to determine the effect of dissolved oxygen management in the waste-treatment section on system water quality, fish flavor quality, and fish production. Studies will also be conducted to determine the best split pond design for growing baitfish. Priority design issues (fish barriers to prevent fish escape and the ratio of fish culture to waste-treatment area) will be studied to arrive at the best configuration. Results of this project will be distributed to aquaculturists through refereed journal publications, articles in trade journals, conferences, and a Southern Regional Aquaculture Center fact sheet.

## PROJECT NARRATIVE

### Objectives:

- 1) Evaluate split pond designs for catfish aquaculture.
  - a) Evaluate four split-pond pumping systems at commercial scale (USDA-ARS Stoneville, USDA-ARS Oxford, and Mississippi State University)
  - b) Improve pumping efficiency of paddlewheel pumps for split ponds (University of Arkansas at Pine Bluff)
  - c) Evaluate effects of whole-pond aeration on split-pond performance (Auburn University and USDA-ARS Oxford)
  
- 2) Evaluate split ponds for culture of warmwater species of commercial value other than catfish.
  - a) Evaluate existing split-pond designs for baitfish aquaculture (University of Arkansas at Pine Bluff)
  - b) Develop engineering design criteria for baitfish aquaculture (University of Arkansas at Pine Bluff)

### Procedures:

#### **Objective 1. Evaluate split pond designs for catfish aquaculture**

Split-ponds have been rapidly adopted in commercial catfish farming yet basic design and system components vary greatly among current systems. Two project subobjectives are to evaluate and refine pumping systems either in common use or currently considered for use in commercial split ponds. The third project subobjective is to evaluate the impact whole-pond aeration on water quality and fish production in split ponds. Outcomes of work on this objective will allow catfish farmers to make informed design and operating choices when building and using split ponds.

#### ***Subobjective 1a. Evaluate four split-pond pumping systems at commercial scale (USDA-ARS Stoneville, USDA-ARS Oxford, and Mississippi State University)***

This subobjective will evaluate fish performance, water quality, and fish flavor quality in split ponds with four pumping systems for recirculating water between the fish-holding section and the waste-treatment sections of split ponds.

Four, 7-acre earthen ponds at the National Warmwater Aquaculture Center at Stoneville, Mississippi will be modified into split ponds by constructing an earthen levee to divide ponds into a fish-holding section (approximately 20% of total pond area) and a waste-treatment section (80% of pond area). Four pumping systems will be installed: a) slow-turning paddlewheel, b)



fast-turning paddlewheel, c) high-speed screw-type pump, and d) high-speed axial flow turbine pump. Pump-performance curves will be developed by changing pump operational parameters (pump speed, paddle depth-of-submergence, etc) and assessing power usage and water pumping rate. Based on outcome of these tests, optimum pump operational parameters will be used throughout the fish culture evaluations.

Four, 10-hp paddlewheel aerators will be installed in the fish sections of each pond. Aerators will be operated at night or as needed to maintain dissolved oxygen concentrations in the fish-holding section above 3 mg/L. Pumping systems will be operated during daytime or as needed when dissolved oxygen concentrations in the waste-treatment section is above 3 mg/L. Aerators and pumps will be controlled by continuous dissolved oxygen monitoring and control systems deployed in each pond.

Hybrid catfish (channel catfish x blue catfish) fingerlings will be stocked into each split pond in spring at 10,000 fish per acre (based on total pond area). Fish will be fed a commercial 28% protein feed to satiation once daily. Response variables will include fish growth measured monthly throughout the growing season, final fish survival, final fish production, feed conversion ratio, dissolved oxygen concentrations measured continuously, and water quality measured biweekly at the inflow and outflow of waste-treatment sections (total-ammonia nitrogen, nitrite, total nitrogen, chlorophyll a, phytoplankton community composition). Monthly samples of water and fish will be obtained for analysis of odorous compounds known to be associated with fish off-flavor. Fish samples will also be used in sensory analysis to determine flavor quality. The study will be conducted for three consecutive years and differences in fish production, water quality, and fish flavor will be determined using appropriate statistical tests.

***Subobjective 1b. Improve pumping efficiency of paddlewheel pumps for split ponds (University of Arkansas at Pine Bluff)***

A paddlewheel-type pump developed at the University of Arkansas at Pine Bluff has found wide commercial use in split ponds. However, pump design and commercial application need to be further refined and optimized to maximize water flow rate and minimize energy usage. Work in this subobjective will use engineering models to refine pump performance. Based on the engineering models, the existing UAPB water circulator will be retrofitted with a different type of paddle and tested in an experimental fish pond (the first and second years of the project) and a commercial catfish farm (the second and third years of the project). Because the rotation speed and submergence depth of paddles are key operational parameters, we will primarily estimate pumping performance with combinations of the parameters under experimental and commercial conditions.

On a commercial farm, it may be difficult to adjust the water depth to allow for different submergence depths of the paddles for the experimental purpose. Thus, intensive data collection will be conducted as natural changes of water depth occur with any ordinary management regime. The rotation speed of the water circulator will be adjusted using a variable speed controller. Basically, the water velocity will be measured in a sluiceway using an acoustic digital

Doppler velocity meter and that data will be used to calculate water flow rate. Water velocity data also will be used to estimate the actual slip factor. In addition, the power consumption of the water circulator will be measured using a digital ammeter and that data will be used to assess the actual drag force caused by a newly designed blade. We will calibrate the engineering models using the data empirically acquired from the experimental and the commercial research ponds. Through this procedure, we will establish standard performance models to predict water flow rate and power consumption of the paddle wheel type water circulator according to paddle wheel dimensions and operational parameters. These approaches and engineering models could support scientists and farmers by providing them with baseline information allowing for further improvement of water pumps for split ponds.

***Subobjective 1c. Evaluate effects of whole-pond aeration on split-pond performance (Auburn University and USDA-ARS Oxford)***

The original split pond concept involved no water quality management in the waste-treatment section of the system. As such dissolved oxygen concentrations commonly fall to near 0 mg/L each night during the summer growing season. Cycles of daily aerobic conditions and nightly anaerobic conditions are thought to be keys to efficient waste nitrogen processing, which is a distinguishing characteristic of split pond systems. It is thought that wide daily cycles of dissolved oxygen in the waste-treatment section allow ammonia derived from fish excretion or mineralization of dead phytoplankton to be nitrified during aerobic condition and then denitrified during anaerobic conditions.

However, allowing a large portion (80% or more) of the split-pond system to become anaerobic at night is viewed as wasteful by some farmers, and they may attempt some level of dissolved oxygen management in the waste-treatment section to allow fish culture—often with non-catfish species that can use natural food production to sustain growth. The economic impact of this practice is not know, but more important in the context of the proposed project, the effects of nightly aeration in the waste-treatment section on waste nitrogen processing and other water quality variables are unknown.

Work in the subobjective will be conducted on a commercial catfish farm in west Alabama. The farm has eight split-ponds, each with a fish-holding section of about 2 acres. Currently the waste treatment sections are not aerated. A single 10-hp floating, electric paddlewheel aerator will be placed in the waste treatment section of each of four ponds, while four ponds will not have additional aeration.

Response variables will include fish growth fish survival, fish production, feed conversion ratio, dissolved oxygen concentrations measured continuously, and water quality measured biweekly at the inflow and outflow of waste-treatment sections (total-ammonia nitrogen, nitrite, total nitrogen, chlorophyll a, phytoplankton community composition). Monthly samples of water and fish will be obtained for analysis of odorous compounds known to be associated with fish off-flavor. Fish samples will also be used in sensory analysis to determine flavor quality. The study will be conducted for three consecutive years and differences in fish production, water quality,

and fish flavor will be determined using appropriate statistical tests.

**Objective 2. Evaluate split ponds for culture of warmwater species of commercial value other than catfish.**

Previous split-pond research has focused on growing catfish as the primary crop. The apparent success of split ponds for growing catfish has generated interest in the possibility of culturing baitfish. However, suitability of the split pond for baitfish culture is unknown and considerable innovation may be needed to accommodate culture considerations unique to small fish species.

***Subobjective 2a. Evaluate existing split-pond designs for baitfish aquaculture (University of Arkansas at Pine Bluff)***

Harvesting costs and inventory control are major issues for baitfish producers, and farmers have expressed interest in the split-pond system. Research indicates that the fixed costs of baitfish production are relatively high, thus increasing yields through intensification (feed and aeration) will distribute these costs over more product, reducing the percent that fixed costs contribute towards break-even price. The split-pond production system confines fish to an aerated zone, feed is more easily distributed to all fish, and it is easier to grade or harvest fish. Concentrating fish also increases the feasibility of protective options such as overhead netting and fences. In addition (although limited data are available for baitfish species), favorable swimming speeds may increase fish growth.

Work on this subobjective will be conducted in six, 0.1-acre experimental split-ponds and six traditional ponds for this study. Split-ponds are partitioned into a fish-holding section (20% of total area) and a waste-treatment section. For proof of concept, fine mesh screening will be used to retain fish within the culture unit; concurrent research will develop a self-cleaning screening system for commercial ponds. Medium golden shiners will be stocked into split and traditional ponds at two densities (50,000 and 300,000 per acre), with three replicates per treatment. Water will be circulated 12 hours per day using a paddlewheel pump driven by a 0.25-hp gear motor; aeration will be provided the remaining 12 hours using 0.5-hp vertical pump aerators. Fish will be fed a commercial feed to apparent satiation and sampled at intervals to estimate weight and condition. Zooplankton populations in ponds will be sampled periodically to compare concentrations between systems. Water temperatures at three depths in the two systems will be recorded using thermographs. Total ammonia nitrogen, pH and Secchi depth will be monitored periodically. At harvest, yield, survival, growth and condition of fish will be determined. Production data will be analyzed using appropriate statistical analyses. This study will complement, but not duplicate, research on overwintering baitfish in split-ponds funded through USDA NIFA Evans-Allen Project No. ARX05040.

***Subobjective 2b. Develop engineering design criteria for baitfish aquaculture (University of Arkansas at Pine Bluff)***

*Design and testing a rotary screen fish barrier for baitfish aquaculture*

Interest in applying the split-pond system to species other than catfish has substantially increased. A major issue with using split ponds for small fish species is the need to prevent fish from escaping the fish-holding section. Barriers must reliably retain fish while allowing appropriate water flow. Small-mesh screens or barriers will be prone to fouling or clogging by debris moved along in the water flow needed to recirculate water between the two sections of the systems. Devices to retain fish must balance reliability, simplicity, resistance to clogging and ease of cleaning.

Static window screens have been used to retain baitfish in the small experimental baitfish split ponds but are unsuitable for commercial use because they easily foul. Work under this subobjective will focus on developing an effective and practical design of rotary screen fish barriers for commercial split ponds to retain small fish.

Screen filtering is a commonly used method in the wastewater industries and has been adopted in recirculating aquaculture systems for the separation of liquids and solids. Rotary screen filters have been used for decades in aquaculture industries and, in recent years, they have been more commonly installed in commercial farms. These devices consist of a rotating drum or disc covered with a fine mesh screen through which the culture water passes. Inorganic and organic particles captured on the mesh are separated by backwashing or scraping to a waste collection trough. Although rotary screen filters are primarily used to remove solids, they could be an effective method for retaining small fish in the split ponds while providing a cost-effective solution to the need for continuous cleaning. Initial work will involve consideration of engineering and hydraulic factors, such as the desirable mesh size to retain the fish, the characteristics of the influent, the maximum flow rate, the allowable head losses, the porosity of the screen, and the rotation speed.

Based on engineering considerations, a prototype of the rotary screen barrier will be built and tested in an experimental baitfish pond in the first and second years of the project to prove the concept and observe any problems for commercial application. Through this proof-of-concept study, barriers will be refined for the commercial application.

*Contribution of natural foods in split ponds to golden shiner production*

Split-pond systems, by excluding fish from the majority of the pond volume, should provide a zooplankton refuge and possibly increase secondary productivity overall through constant cropping of a portion of zooplankton biomass. This subobjective will be to compare zooplankton communities in experimental split-pond systems and traditional ponds to determine the relative abundance of natural foods. Water samples will be collected from four locations within each of the 12 ponds (six traditional and six split-ponds) daily for 5 days. Zooplankton biomass and

counts will provide estimates of standing crop and relative growth rates of zooplankton in the traditional and split-ponds will be compared by determining RNA/DNA ratios with flow cytometry. Appropriate statistical analyses will be used to determine differences in zooplankton communities between split-ponds and traditional ponds.

*Developing culture to waste treatment unit ratio design criteria for golden shiners.*

The current split-pond design confines fish to 15-20% of the pond area. Reducing the ratio of culture to waste treatment area would facilitate fish management and reduce costs of predator exclusion. However, reducing the culture area increases fish density and necessitates an increased water flow rate to replenish dissolved oxygen and natural foods. Design criteria will be developed based on the response of fish to water flow rate and density. Researchers at the University of Arkansas at Pine Bluff will conduct two experiments to determine the effects of 1) fish density, and 2) water flow rate, on the growth and physiology of golden shiners. Each 10-wk study will use a common experimental protocol, except as indicated.

Twelve aerated, temperature-controlled flow tanks will be used for each experiment, and collimeters will be used to induce laminar flow. Twenty-five golden shiners will be stocked into each tank for each study. Water flow will be interrupted during the time of feeding to provide fish in the different treatments with equal feeding opportunity. Fish will be fed a commercial diet once daily to satiation and uneaten pellets will be collected. In the density experiment, fish will be raised at three densities with four replicates. Water flow velocity will be maintained at 1.5 body lengths per second. In the water velocity experiment, fish will be stocked at one density and exposed to three water velocities (1, 1.5, and 2 body lengths per second) with four replicates. Feeding, water quality monitoring, harvest protocol, and analysis will be the same as in the density study. At the completion of each 10-wk study, fish in each replicate will be subjected to a stress test. Whole body cortisol will be measured for 4 fish chosen at random per treatment group. Survival will be recorded across all treatment groups and replicates. Individual weight and total length of the fish will be recorded. Appropriate statistical analyses will be used to determine differences in response variables between densities and swimming speeds.

**Cooperation and Institutions Involved:**

*USDA-ARS Stoneville and Mississippi State University:*

Federal and university investigators at the National Warmwater Aquaculture Center (NWAC) in Stoneville, MS, will conduct engineering performance tests of four high-volume pumps and will construct split ponds using the four pump types. They will evaluate fish performance and water quality in the four commercial scale ponds over the three-year life of the project. Investigators at NWAC will collaborate with UAPB researchers to coordinate pump performance-testing protocols.

*Auburn University:*

Auburn investigators will collaborate with a commercial fish farmer in Alabama to determine the effects of nightly aeration in the waste-treatment section of split ponds on waste nitrogen processing and other water quality variables.

*USDA-ARS Oxford:*

The USDA-ARS investigator at Oxford will be responsible for sampling and analysis of water and fish for compounds responsible for catfish off-flavor. Sampling will be conducted from ponds at the Mississippi and Alabama research sites.

*University of Arkansas at Pine Bluff (UAPB):*

Investigators from UAPB will be responsible for developing engineering models to refine paddlewheel pump performance and testing of improved designs in an experimental fish pond and a commercial catfish farm. Investigators at UAPB will collaborate with NWAC researchers to coordinate pump performance-testing protocols. UAPB investigators will also evaluate split ponds for baitfish aquaculture and develop improved fish barriers and fundamental design features to address unique issues in baitfish culture.

**Project Timetable:**

*Subobjective 1a. Evaluate four split-pond pumping systems at commercial scale (USDA-ARS Stoneville, USDA-ARS Oxford, and Mississippi State University)*

Construct four commercial scale split ponds	Oct 2013-Jan 2014
Pump performance testing	Jan 2014-Mar 2014
Year 1 pond study	Mar 2014-Oct 2014
Year 2 pond study	Mar 2015-Oct 2015
Year 3 pond study	Mar 2016-Oct 2016

*Subobjective 1b. Improve pumping efficiency of paddlewheel pumps for split ponds (University of Arkansas at Pine Bluff)*

Engineering model development	Oct 2013-Mar 2014
Year 1 pond study of refined design	Mar 2014-Oct 2014
Year 2 pond study of refined design	Mar 2015-Oct 2015
Year 3 pond study of refined design	Mar 2016-Oct 2016

*Subobjective 1c. Evaluate effects of whole-pond aeration on split-pond performance (Auburn University and USDA-ARS Oxford)*

Year 1 pond study	Mar 2014-Oct 2014
Year 2 pond study	Mar 2015-Oct 2015
Year 3 pond study	Mar 2016-Oct 2016

*Subobjective 2a. Evaluate existing split-pond designs for baitfish aquaculture (University of Arkansas at Pine Bluff)*

Year 1 pond evaluation	Mar 2014-Oct 2014
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*Subobjective 2b. Develop engineering design criteria for baitfish aquaculture (University of Arkansas at Pine Bluff)*

Rotary screen engineering model development	Oct 2013-Mar 2014
Year 1 pond study of rotary screen	Feb 2014-Oct 2014
Year 2 pond study of rotary screen	Apr 2015-Oct 2015
Year 3 pond study of rotary screen	Apr 2016-Oct 2016
Assessment of natural food contribution	Apr 2014-Aug 2014
Evaluate system component ratios	Oct 2014-Apr 2015

**Logic Model for the USDA/NIFA Southern Regional Aquaculture Center Project: Split-pond Aquaculture Systems: Design Refinements for Catfish Production and Evaluation for Culturing Other Species**

**Situation:** Split ponds are a new, high-intensity pond aquaculture system that has been rapidly adopted by progressive catfish farmers. However, optimum engineering design is unknown and the usefulness of the system for non-catfish species has not been studied.

Inputs	Outputs		Outcomes -- Impact		
	Activities	Participation	Short	Medium	Long
<p>Coordinated, collaborative regional research project.</p> <p>Nine research and extension faculty.</p> <p>Two institutional aquaculture research facilities.</p> <p>One private, commercial aquaculture facility.</p> <p>Specialized pumps, aerators, fish barriers, and oxygen monitoring equipment</p> <p>Supplies for water quality analyses.</p> <p>Funds for graduate students and technical assistance</p> <p>Travel funds</p>	<p>Compare catfish production, water quality, and fish flavor quality in split ponds with four pumping systems</p> <p>Optimize existing paddlewheel pump design and evaluate catfish production, water quality, and fish flavor quality in split ponds with new pump design</p> <p>Evaluate effects of additional aeration of split ponds on catfish production, water quality, and fish flavor quality.</p> <p>Evaluate the potential of split ponds for baitfish aquaculture.</p> <p>Develop novel fish barriers and design parameters for split ponds used in baitfish aquaculture.</p>	<p>Nine research and extension faculty at two universities and two USDA-ARS research units.</p> <p>Additional research and extension faculty at participating institutions.</p> <p>Commercial catfish and baitfish farmers.</p>	<p>New knowledge of split pond function and usefulness in catfish and baitfish aquaculture</p> <p>Improved designs of split ponds.</p> <p>Recommendations for improved designs</p> <p>Research and extension publications.</p> <p>Research and extension workshops.</p>	<p>Adoption of new split pond designs by progressive catfish and baitfish farmers.</p> <p>Improved production economics for catfish and baitfish farmers.</p>	<p>Increased adoption of new split pond designs by catfish and baitfish farmers.</p> <p>Improved production brings stability or growth to catfish and baitfish industries.</p> <p>Initial evaluation of split ponds for other pond fish aquaculture.</p>

**Assumptions:** Split ponds can increase pondfish production and are easier to manage than traditional ponds. Improved designs will further increase production potential.

**External Factors:** Economics of split pond aquaculture will depend on input costs, fish prices, and market conditions. Adoption of split ponds will depend on stability of catfish and baitfish industries.



**Duplication of Research:**

Split ponds are new production systems initially developed by researchers involved in this study. As such, investigators are fully aware of all current research involving this system as well as all commercial application. The subject of this study is novel, original, and similar research is not being currently conducted or planned. This was verified by various on-line searches, including the REEIS portal and the NOAA funding database. On-line searches identified several past or present projects involving split ponds for catfish aquaculture. All studies identified in on-line searches involve participants in the proposed project and do not duplicate the proposed work.

## VITA

### **Craig S. Tucker**

USDA-ARS Catfish Genetics Research Unit, P.O. Box 38, Stoneville, Mississippi 38776

Phone: 662-686-3597, E-mail: craig.tucker@ars.usda.gov

### EDUCATION

B.S.            1974   California State University, Humboldt  
M.S.            1976   Auburn University  
Ph.D.           1978   Auburn University

### EMPLOYMENT

2012-present   Research Leader, USDA-ARS Catfish Genetics Research Unit  
2001–2012     Director, National Warmwater Aquaculture Center, Mississippi State University  
1997–2012     Director, USDA-NIFA Southern Regional Aquaculture Center  
1990–2012     Research Professor, Mississippi State University  
1985–1990     Associate Fishery Biologist, Mississippi State University  
1980–1985     Assistant Fishery Biologist Mississippi State University  
1978–1980     Post-Doctoral Investigator, Woods Hole Oceanographic Institution

### SCIENTIFIC AND PROFESSIONAL ORGANIZATIONS

World Aquaculture Society  
Phi Kappa Phi  
Sigma Xi  
Gamma Sigma Delta

### SELECTED PUBLICATIONS

Brown, T.W. and C.S. Tucker. 2013. Pumping performance of a slow-rotating paddlewheel for split-pond aquaculture systems. *North American Journal of Aquaculture* 75:153-158.

Mishra, S., D.R. Mishra, Z. Lee, and C.S. Tucker. 2013. Quantifying cyanobacterial phycocyanin concentration in turbid productive waters: a quasi-analytical approach. *Remote Sensing of the Environment* 133:141-151.

Brune, D.E., C.S. Tucker, M. Massingill, and J. Chappell. 2012 Partitioned aquaculture systems. Pages 308-342 in “Aquaculture Production Methods,” J. Tidwell (editor). Wiley-Blackwell Publishing, Ames, Iowa.

## VITA

### **Travis Waldemar Brown**

USDA-ARS Catfish Genetics Research Unit, P.O. Box 38, Stoneville, Mississippi 38776  
Phone: 662-686-3591, E-mail: [travis.brown@ars.usda.gov](mailto:travis.brown@ars.usda.gov)

### EDUCATION

B.S. 2004 University North Carolina Wilmington  
M.Aq. 2007 Auburn University  
Ph.D. 2010 Auburn University

### EMPLOYMENT

2010-present Research Fish Biologist, USDA-ARS CGRU, Stoneville, MS  
2005-2010 Graduate Research Associate, Auburn University  
2007-2008 Agriculture Program Assistant II, Auburn University  
2005-2005 Research Assistant, University North Carolina Wilmington  
2000-2005 Aquaculture Instructor, Brunswick Community College, NC  
1999-2001 Assistant Manager, Carolina Perch Company, Winnabow, NC

### SCIENTIFIC AND PROFESSIONAL ORGANIZATIONS (partial list)

Alabama Catfish Producers Association  
Catfish Farmers of America  
Phi Theta Kappa  
Texas Aquaculture Association  
World Aquaculture Society (U.S. Chapter of WAS)

### SELECTED PUBLICATIONS

Brown T.W. and C.S. Tucker. 2013. Pumping performance of a slow-rotating paddlewheel for split-pond aquaculture systems. *North American Journal of Aquaculture* 75:153-158.

Brown T.W., C.E. Boyd, and J.A. Chappell. 2012. Approximate water and chemical budgets for an experimental, in-pond raceway system. *Journal of the World Aquaculture Society* 43:526-537.

Brown TW, J.A. Chappell, and C.E. Boyd. 2011. A commercial-scale, in-pond raceway System for ictalurid catfish production. *Aquacultural Engineering* 44:72-79.

Brown T.W. and J.A. Chappell 2011. Experimental commercial-scale, in-pond raceway System piques farmers' interest in west AL. *Aquaculture North America* 2(5):8-9.

## VITA

### **Eugene Leslie Torrans**

USDA-ARS Catfish Genetics Reserach Unit, P.O. Box 38, Stoneville, Mississippi 38776

Phone: 662-686-5460, E-mail: les.torrans@ars.usda.gov

### EDUCATION

B.S. 1969 Michigan State University

Ph.D. 1980 University of Oklahoma

### EMPLOYMENT

1999-present Research Fishery Biologist, USDA-ARS, Stoneville, MS

1998 Night Oxygen Man, Watermark Farms, Faunsdale, AL

1989-95 Laboratory Director, Southeastern Fish Cultural Laboratory, Marion, AL

1980-88 Associate Professor, University of Arkansas at Pine Bluff

1973-77 Manager, Sooner Fish Farm, Washington, OK

1969-73 Peace Corps Volunteer, United Republic of Cameroon,

### SCIENTIFIC AND PROFESSIONAL ORGANIZATIONS

American Fisheries Society (Fish Culture Section)

World Aquaculture Society (U.S. Chapter)

Catfish Farmers of America

Catfish Farmers of Mississippi

### SELECTED PUBLICATIONS

Torrans, E.L. and B. Ott. 2012. Impact of minimum dissolved oxygen concentration on growout performance of blue catfish with comparison to channel catfish. *North American Journal of Aquaculture*, in press.

Torrans, E. L. 2008. Production responses of channel catfish to minimum daily dissolved oxygen concentrations in earthen ponds. *North American Journal of Aquaculture* 50(4):371-381.

Torrans, E.L. and J. Steeby. 2008. Effects of dissolved oxygen concentration on oxygen consumption and development of channel catfish eggs and fry: implications for hatchery management. *North American Journal of Aquaculture* 70(3): 286-295.

Torrans, E.L. 2005. Effect of oxygen management on culture performance of channel catfish in earthen ponds. *North American Journal of Aquaculture* 67:275-288.

## VITA

### **Charles C. Mischke**

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### EDUCATION

B.S.            1993    Mississippi State University  
M.S.            1995    Iowa State University  
Ph.D.          1999    Iowa State University

### EMPLOYMENT

2009-present    Research Professor, Mississippi State University  
2004-2009      Associate Research Professor, Mississippi State University  
1999-2004      Assistant Research Professor, Mississippi State University  
1999            Editor/Writer, North Central Regional Aquaculture Center, Iowa State University

### SCIENTIFIC AND PROFESSIONAL ORGANIZATIONS

US Freshwater Prawn & Shrimp Growers Association  
Catfish Farmers of America  
World Aquaculture Society  
U. S. Aquaculture Society  
American Fisheries Society  
Southern Division American Fisheries Society  
American Fisheries Society Fish Culture Section  
Phi Kappa Phi  
Gamma Sigma Delta.

### SELECTED PUBLICATIONS

Mischke, C. C. Editor. 2012. Aquaculture Pond Fertilization: Impacts of nutrient input on production. John Wiley & Sons, Inc., Ames, Iowa.

Mischke, C. C. and N. Chatakondi. 2012. Effects of abrupt pH increases on survival of different ages of young channel catfish and hybrid catfish. North American Journal of Aquaculture 74:160-163.

Mischke, C. C., C. S. Tucker, M. H. Li. 2012. Channel catfish polyculture with fathead minnows or threadfin shad: effects on pond plankton communities and catfish fillet flavor, color, and fatty acid composition. Journal of the World Aquaculture Society 43:208-217.

## VITA

### **Claude E. Boyd**

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### EDUCATION

B.S.            1962    Mississippi State University  
M.S.            1963    Mississippi State University  
Ph.D.           1966    Auburn University.

### EMPLOYMENT

1966-1967    Aquatic Biologist, Federal Water Pollution Control Administration  
1967-1968    Assistant Professor, Auburn University, 1967  
1968-1970    Ecologist, University of Georgia/Savannah River Ecology laboratory  
1971-1977    Associate Professor, Auburn University  
1977-present Professor

### SCIENTIFIC AND PROFESSIONAL ORGANIZATIONS

Phi Kappa Phi  
World Aquaculture Society  
Fellow, American Association for the Advancement of Science  
Academy of Fellows, Auburn University College of Agriculture

### SELECTED PUBLICATIONS

Boyd, C.E., C.W. Wood, P.L. Chaney, and J.F. Queiroz. 2010. Role of aquaculture pond sediments in sequestration of annual global carbon emissions. *Environmental Pollution* 158:2537-2540.

Chainark, S. and C.E. Boyd. 2010. Evaluation of a meter for testing potassium concentration in low-salinity aquaculture ponds. *Journal of the World Aquaculture Society* 41:102-106.

Boyd, C.E., C.S. Tucker, and R. Viriyatum. 2011. Interpretation of pH, acidity, and alkalinity in aquaculture and fisheries. *North American Journal of Aquaculture* 73(4):403-408.

Brown, T., C.E. Boyd, and J. Chappell. 2012. Approximate water and chemical budgets for an experimental, in-pond raceway system. *Journal of the World Aquaculture Society* 43:526-537.

## VITA

### Gregory N. Whitis

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### EDUCATION

B.S.            1980   Iowa State University  
M.Aq.         1983   Auburn University

### EMPLOYMENT

1987-present   Extension Aquaculturist, Alabama Cooperative Extension System  
1985-1987      Farm Manager, Pearce Catfish Farms, Browns, Alabama  
1981-1983      Research Technician, Auburn University

### SCIENTIFIC AND PROFESSIONAL ORGANIZATIONS

World Aquaculture Society  
Catfish Farmers of America  
Alabama Fisheries Society

### SELECTED PUBLICATIONS

Roy, L., G. Whitis and G. Walton. 2012 demonstration of blue crab culture in inland low-salinity waters of west Alabama. *North American Journal of Aquaculture*, 74:453-456.

Boyd, C.E., J. Queiroz, G. Whitis, B. Hulcher and B. Hemstreet. 2003. Best management practices for channel catfish farming in Alabama. Special Report 1. Alabama Agricultural Experiment Station.

Whitis, G.N. 2002. Watershed fish production ponds: guide to site selection and construction. SRAC Publication No.102.

Engle, C. and G. Whitis. 2000. Economics of catfish production in watershed ponds. Arkansas Cooperative Extension.

Boyd, C.E., J. Queiroz, K. Lee, M. Rowan, G. Whitis and A. Gross. Environmental assessment of channel catfish *Ictalurus punctatus* farming in Alabama. *Journal of the World Aquaculture Society* 31:511-544.

## VITA

### Kevin K. Schrader

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### EDUCATION

B.S. 1986 Auburn University  
Ph.D. 1995 Auburn University

### EMPLOYMENT

1996-97 Post-Doctoral Associate, Mississippi State University  
1997-present Research Microbiologist, USDA-ARS, Oxford, MS

### SCIENTIFIC AND PROFESSIONAL ORGANIZATIONS

World Aquaculture Society, member

### SELECTED PUBLICATIONS

Schrader, K.K., M.Q. de Regt, P.D. Tidwell, C.S. Tucker, and S.O. Duke. 1998. Compounds with selective toxicity towards the off-flavor metabolite producing cyanobacterium *Oscillatoria* cf. *chalybea*. *Aquaculture* 163:85-99.

Schrader, K.K., C.S. Tucker, M.Q. de Regt, and S.K. Kingsbury. 2000. Evaluation of limnocorrals for studying the effects of phytotoxic compounds on plankton and water chemistry in aquaculture ponds. *Journal of the World Aquaculture Society* 31:403-415.

Schrader, K.K., N.P.D. Nanayakkara, C.S. Tucker, A.M. Rimando, M. Ganzera, and B.T. Schaneberg. 2003. Novel derivatives of 9,10-anthraquinone are selective algicides against the musty-odor cyanobacterium *Oscillatoria perornata*. *Applied and Environmental Microbiology* 69:5319-5327.

Schrader, K.K., A.M. Rimando, C.S. Tucker, J. Glinski, S.J. Cutler, and H.G. Cutler. 2004. Evaluation of the natural product SeaKleen for controlling the musty-odor producing cyanobacterium *Oscillatoria perornata* in catfish ponds. *North American Journal of Aquaculture* 66:20-28.

A.M. Rimando and K.K. Schrader (eds). 2003. *Off-flavors in Aquaculture*. ACS Symposium Series 848; American Chemical Society, Washington, D.C.



## VITA

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### EDUCATION

B.A. 1998 Pukyong National University, Korea  
M.S. 2000 Pukyong National University  
Ph.D. 2005 Pukyong National University

### EMPLOYMENT

2012-present Assistant Professor, University of Arkansas at Pine Bluff  
2008-2012 Post-Doctoral Research Associate, North Carolina State University  
2002-2008 Adjunct Professor, Gangwon Provincial College, Korea

### SCIENTIFIC AND PROFESSIONAL ORGANIZATIONS

World Aquaculture Society  
Aquacultural Engineering Society  
Korean Aquaculture Society

### SELECTED PUBLICATIONS

Park, J., Y. Kim, P. K. Kim, and H. V. Daniels. 2011. Effects of two different ozone doses on seawater recirculating systems for black sea bream *Acanthopagrus schlegelii* (Bleeker): Removal of solids and bacteria by foam fractionation. *Aquacultural Engineering* 44:19-24.

Oh, S.Y., R. S. Kang, J. G. Myoung, C. K. Kim, J. Park, and H. V. Daniels. 2010. Effect of ration size restriction on compensatory growth and proximate composition of dark-banded rockfish, *Sebastes inermis*. *Journal of the World Aquaculture Society* 41:923-930.

Park, J., H. B. Kim, P. K. Kim, and J. Y. Jo. 2009. Feces production and ammonia excretion of pacific abalone, *Haliotis discus hannai*, fed kelp, *Laminaria japonicus*, in relation to water temperature and shell length. *Journal of the World Aquaculture Society* 40: 207-21.

Park, J., H. Y. Kim, P. K. Kim, and J. Y. Jo. 2008. The growth of disk abablone, *Haliotis discus hannai*, according to the culture density in a pilot scale recirculating aquaculture system with baffled culture tank. *Aquacultural Engineering* 38:161-170.

## VITA

### **Nathan M. Stone**

Aquaculture/Fisheries Center, University of Arkansas at Pine Bluff, Mail Slot 4912, Pine Bluff, AR 71601, Phone: (870) 575-8138, E-mail: nstone@uaex.edu

### EDUCATION

B.S.	1974	Cornell University
M.S.	1981	Auburn University
Ph.D.	1988	Auburn University

### EMPLOYMENT

1988-Present	Extension Fisheries Specialist, University of Arkansas at Pine Bluff
1985-1988	Graduate Research Assistant, Auburn University
1984 - 1985	Visiting Professor, University of Panama
1982 - 1983	Visiting Professor, Universidad Centroamericana, Managua, Nicaragua

### SCIENTIFIC AND PROFESSIONAL ORGANIZATIONS

World Aquaculture Society  
American Fisheries Society  
North American Lake Management Society

### SELECTED PUBLICATIONS

Stone, N. 2012. Baitfish pond fertilization. Pages 217-233 in C. C. Mischke, editor. Aquaculture pond fertilization: impacts of nutrient input on production. John Wiley & Sons, Hoboken, Jersey.

Clemment, T., and N. Stone. 2010. Golden shiner egg production during a spawning season. North American Journal of Aquaculture 72:272-277.

Melandri, M., N. Stone and R. Lochmann. 2008. Effects of temperature on the growth of golden shiners in aquaria. North American Journal of Aquaculture 70:452-458.

Stone, N., A. Goodwin, R. Lochmann, H. Phillips, C. Engle and H. Thomforde. 2005. Baitfish culture. Pages 607 – 643 in A. M. Kelly and J. Silverstein, editors. Aquaculture in the 21<sup>st</sup> Century. American Fisheries Society, Symposium 46, Bethesda, Maryland.

Stone, N. and M. Rowan. 1998. Ineffectiveness of water circulation for golden shiner *Notemigonus crysoleucas* production in ponds. Journal of the World Aquaculture Society 29:510-517.

**Proposed Budget for the Regional Project:**

Split-pond Aquaculture Systems: Design Refinements for Catfish Production and Evaluation for  
Culturing Other Species

Institutions: USDA-ARS (Stoneville and Oxford), Mississippi State University, Auburn University, and the University of Arkansas at Pine Bluff

Scientist's names: C. Tucker, T. Brown, E.L. Torrans, C. Mischke, C. Boyd, G. Whitis, K. Schrader, J. Park, and N. Stone.

	Year 1	Year 2	Year 3	Total
Salaries and Wages				
Research Associate-Postdoctoral				
Other professional				
Graduate students	17,220	18,081	18,985	54,286
Prebaccalaureate Students				
Secretarial-Clerical				
Technical, Shop and Other	25,507	25,780	15,959	67,246
Fringe Benefits (if charged as Direct Costs)	3,175	3,199	3,224	9,598
Total Salaries, Wages and Fringe Benefits	45,902	47,060	38,168	131,130
Non-Expendable Equipment	119,050			119,050
Material and Supplies	72,193	61,170	19,475	152,838
Travel within Region	5,594	5,594	4,894	16,082
Publication Costs/Page Charges			900	
All other Direct Costs (Contractual Service)				
Total (for each year and cumulative)	242,739	113,824	63,437	420,000

**Proposed Budget for the Regional Project:**

Split-pond Aquaculture Systems: Design Refinements for Catfish Production and Evaluation for  
Culturing Other Species

Institution: USDA-ARS, Catfish Genetics Research Unit (Stoneville, MS)

Scientist's names: C. Tucker, T. Brown, E.L. Torrans

	Year 1	Year 2	Year 3	Total
Salaries and Wages				
Research Associate-Postdoctoral				
Other professional				
Graduate students				
Prebaccalaureate Students				
Secretarial-Clerical				
Technical, Shop and Other				
Fringe Benefits (if charged as Direct Costs)				
Total Salaries, Wages and Fringe Benefits				
Non-Expendable Equipment	27,600			27,600
Material and Supplies	5,000	1,000	1,000	7,000
Travel within Region				
Publication Costs/Page Charges				
All other Direct Costs (Contractual Service)				
Total (for each year and cumulative)	32,600	1,000	1,000	34,600

## **BUDGET JUSTIFICATION: Non-Expendable Equipment**

USDA-ARS, Catfish Genetics Research Unit (Stoneville, MS)

*In-Situ Dissolved Oxygen Monitoring and Control System*                      6@\$4,600 = \$27,600

Remote, continuous dissolved oxygen monitoring is essential to split pond operation. Remote monitoring and control systems control the function of pumps for recirculating water between the two pond sections and control aeration in the fish-holding section. This equipment is specialized and not common to inventory. Expenditures on this equipment meets the requirements as an allowable expense for SRAC projects: 1) the project is a high priority to industry because split-pond aquaculture has been rapidly adopted by the catfish industry; 2) the equipment is essential for accomplishment of research objective, 3) the equipment has a useful life beyond the project for long-term benefits for the institution's capacity for research as well as contributions to industry development, and 4) the equipment is of a specialized nature and is not normally on Agency inventory.

**Proposed Budget for the Regional Project:**

Split-pond Aquaculture Systems: Design Refinements for Catfish Production and Evaluation for  
Culturing Other Species

Institutions: Mississippi State University, National Warmwater Aquaculture Center

Scientist's name: C. Mischke

	Year 1	Year 2	Year 3	Total
Salaries and Wages				
Research Associate-Postdoctoral				
Other professional				
Graduate students				
Prebaccalaureate Students				
Secretarial-Clerical				
Technical, Shop and Other				
Fringe Benefits (if charged as Direct Costs)				
Total Salaries, Wages and Fringe Benefits				
Non-Expendable Equipment	70,200			70,200
Material and Supplies	7,000	4,225	4,225	15,450
Travel within Region				
Publication Costs/Page Charges				
All other Direct Costs (Contractual Service)				
Total (for each year and cumulative)	77,200	4,225	4,225	85,650

**BUDGET JUSTIFICATION: Non-Expendable Equipment**

*Mississippi State University*

10-hp paddlewheel aerators	6@\$6,200 =	\$37,200
15-hp Flygt axial flow turbine pump	1@\$15,000 =	\$15,000
10-hp auger (screw) pump	1@\$7,500 =	\$7,500
Electrical enclosures with starters	3 @\$3,500=	\$10,500
Total		\$70,200

This project objective involves specialized new construction, using additional aeration and novel pumps. This equipment is specialized and not common to University inventory. Expenditures on this equipment meets the requirements as an allowable expense for SRAC projects: 1) the project is a high priority to industry because split-pond aquaculture has been rapidly adopted by the catfish industry; 2) the equipment is essential for accomplishment of research objective, 3) the equipment has a useful life beyond the project for long-term benefits for the institution's capacity for research as well as contributions to industry development, and 4) the equipment is of a specialized nature and is not normally on University inventory.

**Proposed Budget for the Regional Project:**

Split-pond Aquaculture Systems: Design Refinements for Catfish Production and Evaluation for  
Culturing Other Species

Institutions: Auburn University

Scientist's names: C. Boyd and G. Whitis

	Year 1	Year 2	Year 3	Total
Salaries and Wages				
Research Associate-Postdoctoral				
Other professional				
Graduate students	17,220	18,081	18,985	54,286
Prebaccalaureate Students				
Secretarial-Clerical				
Technical, Shop and Other	5,402	5,675	5,959	17,036
Fringe Benefits (if charged as Direct Costs)	475	499	524	1498
<b>Total Salaries, Wages and Fringe Benefits</b>	<b>23,097</b>	<b>24,255</b>	<b>25,468</b>	<b>72,820</b>
Non-Expendable Equipment	21,250			21,250
Material and Supplies	8,498	4,250	4,250	16,998
Travel within Region	3,894	3,894	3,894	11,682
Publication Costs/Page Charges				
All other Direct Costs (Contractual Service)				
<b>Total (for each year and cumulative)</b>	<b>56,739</b>	<b>32,399</b>	<b>33,612</b>	<b>122,750</b>



## BUDGET JUSTIFICATION: Non-Expendable Equipment

*Auburn University*

10-hp paddlewheel aerators	4@\$4,900 =	\$19,600
Spare 3-phase starter	1@\$650 =	\$650
Spare gearbox	1@\$1,000 =	\$1,000
Total		\$21,250

This project objective involves research conducted on a commercial farm. The farmer is being asked to add additional aeration to four ponds for purposes of completing this research. It is beyond reason to expect the farmer to spend private funds to aid this project and he will allow use of his farm only if the addition equipment is provided by Auburn University. This equipment is specialized and not common to University inventory, and must be purchased specifically for this project. Expenditures on this equipment meets the requirements as an allowable expense for SRAC projects: 1) the project is a high priority to industry because split-pond aquaculture has been rapidly adopted by the catfish industry; 2) the equipment is essential for accomplishment of research objective, 3) the equipment has a useful life beyond the project, will be retained by Auburn University after project completion, and will have long-term benefits for the institution's capacity for research as well as contributions to industry development, and 4) the equipment is of a specialized nature and is not normally on University inventory.

**Proposed Budget for the Regional Project:**

Split-pond Aquaculture Systems: Design Refinements for Catfish Production and Evaluation for  
Culturing Other Species

Institution: USDA-ARS, Natural Products Utilization Research Unit (Oxford, MS)

Scientist's names: K. Schrader

	Year 1	Year 2	Year 3	Total
Salaries and Wages				
Research Associate-Postdoctoral				
Other professional				
Graduate students				
Prebaccalaureate Students				
Secretarial-Clerical				
Technical, Shop and Other	10,105	10,105		20,210
Fringe Benefits (if charged as Direct Costs)				
Total Salaries, Wages and Fringe Benefits	10,105	10,105		20,210
Non-Expendable Equipment				
Material and Supplies	11,695	11,695		23,390
Travel within Region	700	700		1,400
Publication Costs/Page Charges				
All other Direct Costs (Contractual Service)				
Total (for each year and cumulative)	22,500	22,500		45,000

**Proposed Budget for the Regional Project:**

Split-pond Aquaculture Systems: Design Refinements for Catfish Production and Evaluation for  
Culturing Other Species

Institutions: University of Arkansas at Pine Bluff

Scientists names: J. Park and N. Stone.

	Year 1	Year 2	Year 3	Total
Salaries and Wages				
Research Associate-Postdoctoral				
Other professional				
Graduate students				
Prebaccalaureate Students				
Secretarial-Clerical				
Technical, Shop and Other	10,000	10,000	10,000	30,000
Fringe Benefits (if charged as Direct Costs)	2,700	2,700	2,700	8,100
Total Salaries, Wages and Fringe Benefits	12,700	12,700	12,700	38,100
Non-Expendable Equipment				
Material and Supplies	40,000	40,000	10,000	90,000
Travel within Region	1,000	1,000	1,000	3,000
Publication Costs/Page Charges			900	
All other Direct Costs (Contractual Service)				
Total (for each year and cumulative)	53,700	53,700	24,600	132,000