EVALUATION OF THE NEWLY-DEVELOPED, LEAST-COST EXPERIMENTAL DIET FOR BLUEGILL AT COMMERCIAL DENSITIES IN PONDS AT TWO OR MORE FACILITIES IN THE NORTH CENTRAL REGION

Chairperson Joseph E. Morris, Iowa State University

Industry Advisory Council Liaison: Paula J. Moore, Neelyville, Missouri

Extension Liaison: Charles E. Hicks, Lincoln University

Funding Request: $124,400

Duration: 2 years (September 1, 2010 - August 31, 2012)

Objectives:

1. Using as consistent protocols as possible across locations, evaluate/determine performance of recently-developed NCRAC least-cost juvenile (3" minimum total length) bluegill diet versus an "industry standard" diet at two distinct latitude locations at standard pond stocking densities for one growing season. Stocking densities to be determined by the investigator(s) and producer(s).

2. Coordinate dissemination of project results with the NCRAC Technical Committee/Extension Subcommittee.

Proposed Budgets:

Institution	Principal Investigators	Objec-tives	Year 1	Year 2	Total
Iowa State University	Joseph E. Morris & Richard D. Clayton	1 & 2	$13,623	$29,577	$43,200
Lincoln University	Charles E. Hicks & James E. Wetzel	1 & 2	$13,827	$36,173	$50,000
Purdue University	Paul B. Brown & Robert A. Rode	1 & 2	$15,913	$15,287	$31,200
		Total	$43,363	$81,037	$124,400

TABLE OF CONTENTS

JUSTIFICATION

Growth in the North Central Region's (NCR) aquaculture industry mirrors, and is driven by, broader U.S. and worldwide transitions in the seafood industry. The percentage of seafood from wild fisheries is near or above its sustainable capacity and a steadily increasing percentage of seafood in the world comes from aquaculture, which accounted for this growth from 2000 to 2002 (FAO 2004). Currently, almost 40% of the fish and seafood consumed by humans is from aquaculture (NMFS 2007). Aquaculture-related business in the NCR continues to be an "emerging" industry in that selection of appropriate species and associated culture practices including feed selection is ongoing.

As with any animal industry, feed costs can be a considerable component. It is a known fact that feeds often account for ≥50% of the variable costs in aquaculture budgets. To reduce these variable costs there have been numerous research efforts in the NCR as well as the nation addressing the possible uses of lower-cost foodstuffs, e.g., vegetable or animal by-product protein.

Clearly, a substantial need exists to reduce these costs and develop more nutritionally adequate diets for established as well as emerging aquaculture species in the NCR. Although significant insights have come from these efforts, no diets yielding advantages beyond those offered by existing practical diets have resulted, in terms of growth performance, cost, or improved fish health, for any NCR culture species. The aim of the proposed study is to evaluate a diet for juvenile northern bluegill (*Lepomis macrochirus macrochirus*) that is significantly less costly than currently available diets for sunfish, while yielding a growth rate that is at least equal to an industry standard sunfish diet. Such a diet formulation is now available to the NCR as the result of a recently funded North Central Regional Aquaculture Center (NCRAC) project (see http://www.ncrac.org/FundedProjects/Nutrition2.htm) developed by Robert Hayward (University of Missouri-Columbia). The formulation now needs to be evaluated by comparing its performance against an "industry standard" diet in a commercial production pond setting.

RELATED CURRENT AND PREVIOUS WORK

Although many sunfish species, i.e., bluegill, have been cultured since the early 1900s, there is a limited amount of information available for culturists producing for the food fish market. Expansion of sunfish aquaculture is limited by the lack of proven, profitable, and sustainable production technologies. Sunfish have historically been cultured in ponds with the primary forages being natural organisms, e.g., zooplankton and benthic organisms. However, these natural food sources can be quickly depleted at the high fish densities typical of commercial culture conditions. Therefore, producers should consider using formulated diets to supplement, if not replace, natural prey to enhance growth in high density sunfish pond production. Feed selection for sunfish has been a continuum from using a basic trout/salmon diet to refined diets using purified ingredients. Much of the general guidelines for feed selection for sunfish is based on Tidwell et al. (1992) who suggested that using higher protein feeds (35% or greater) may improve growth and production potential of hybrid sunfish (green sunfish [*Lepomis cyanellus*] female × bluegill male). Both bluegill and hybrid sunfish grow best when fed diets containing at least 10% dietary lipid in the form of fish oil and the dietary phosphorus requirement of hybrid sunfish is <0.5% of the dry diet (NCRAC 1999). Twibell et al. (2003) reported higher weight gain and feed efficiency values in both juvenile bluegill and hybrid bluegill fed diets formulated for trout compared to diets formulated for channel catfish.

In a recent study, Masagounder et al. (2009) determined digestibility of several ingredients fed to bluegill using individual test feedstuffs at 98% of the diet. Apparent crude protein digestibility and apparent amino acid availability values were high from all test feedstuffs, with soybean meal (SBM) and poultry by-product meal (PBM) among the highest. Given that SBM and PBM are two of the more common feedstuffs available in the NCR and are serving as the basis for fish meal free diets in other NCRAC-funded studies at Purdue University (Purdue), the potential of using alternative ingredients appears good.

Fish growth rates can be described by several indices including instantaneous specific growth rate (SGR) (Ricker 1975; Busacker et al. 1990). The food conversion ratio (FCR) is a ratio expressing the number of

units of feed required for one unit of production (live weight) by a fish. To date, the majority of sunfish studies, involving both measurements of SGR and FCR, have dealt with hybrid sunfish.

Tidwell et al. (1992) and Webster et al. (1992) reported SGR values of 1.98 and 2.6, respectively. Both studies used small fish (3.0-5.0 g [0.1-0.2 oz]). Webster et al. (1997) reported lower SGR values for larger fish (>20.0 g [0.7 oz]). An SGR value of 0.37 was reported for large fish stocked in ponds for the summer growing season (Tidwell et al. 1994). Webster et al. (1992) reported FCR values of 3.72 and 3.87 at 32% and 38% crude protein, respectively. Webster et al. (1997) reported slightly higher FCR values for larger fish (>20.0 g [0.7 oz]). High FCR values were reported for large fish stocked in ponds for the summer growing season (Tidwell et al. 1994). Hicks et al. (2009) reported SGR and FCR values for northern bluegill tested in tanks and ponds as 1.21 and 1.25, respectively, for tanks and 0.39 and 2.37, respectively, for ponds. Owing to the generally superior SGR and FCR results found by Hicks et al. (2009), the same diet (sinking Nelson and Sons, Silvercup® finfish diet) used in that study will serve as the reference diet in this proposed trial. It is relatively safe to assume that SGR values for sunfish will increase with genetic modification as well as with improved feed formulations for those taxa.

In addition to studies investigating different feed formulations, feeding frequency can also be critical to improving fish growth. A recent study of the effects of daily feeding frequency on growth rates of juvenile hybrid sunfish showed that food consumption and growth rates increased from one to three daily feedings, but no further with four daily feedings (Wang et al. 1998). However, there was no effect of daily feeding frequency on FCR values.

In light of these past studies there is now a need to measure the effectiveness of the new diet (Table 1) against a base commercial diet often used by current sunfish producers in the NCR. To be relevant to actual culture practices, these new studies must include direct comparisons under actual field conditions. In the final NCRAC report from Rob Hayward (University of Missouri-Columbia) on the earlier bluegill diet study, this new diet reduces whole-body lipid deposition by 25-33% of the high energy trout diets being used as standards. Hayward also noted in the same report that the ingredient costs for this new diet is estimated at $478/ton compared to costs for the commercial diet at $1,100/ton; additional costs are expected for the final diet to be used in this experiment because it will be produced in a small quantity. The overall cost of this diet should drop when produced in larger quantities.

Table 1. Formulation of a least-cost diet developed for juvenile bluegill. Source: Rob Hayward, University of Missouri-Columbia.

Ingredients[Source]	Price*		Amount (percent by weight)
	$/metric ton	$/ton	
Porcine meat and bone meal[1]	270.07	245.00	38.01
Soybean meal[2]	336.21	305.00	36.99
Corn gluten meal[3]	518.09	470.00	15.29
Corn[4]	142.45	129.23	3.60
Fish Oil[5]	1477.10	1,340.00	4.00
Lecithin[6]	4,188.79	3,800.00	0.30
Dicalcium phosphate	11,023.12	10,000.00	0.20
Vitamin premix[7]	11,023.12	10,000.00	1.00
Vitamin C	1,543.24	1,400.00	0.07
Choline chloride	1,543.24	1,400.00	0.14
Mineral mix[7]	1,543.24	1,40.00	0.10
Binder[8]	2,314.86	2,100.00	0.30
			100.00

*Prices in $/ton of porcine meat and bone meal, soybean meal, corn gluten meal, and corn are average values for the price of those ingredients for the first week of every month from the period January 2008 to December 2009 as reported in the weekly newspaper “Feedstuffs.” The prices in $/ton of other ingredients are those charged by the respective sources when this diet was prepared.

[1]American Midwest Distributors, LLC, Kansas City, Missouri.

[2]ADM Soybean Meal Plant, Mexico, Missouri.
[3]Grain Processing Corporation, Muscatine, Iowa.
[4]Bourn Feed, Columbia, Missouri.
[5]Refined Menhaden Oil (Virginia Prime Gold), Omega Protein, Inc., Houston, Texas.
[6]Archer Daniels Midland Company, Decatur, Illinois.
[7]Nelson's Silvercup Fish Feed, Nelson & Sons, Inc., Murray, Utah.
[8]Ultra-Bond™, Uniscope, Inc., Johnstown, Colorado.

ANTICIPATED BENEFITS

Results garnered from this research will provide the aquaculture industry with relevant field-tested information related to the culture of bluegills using least cost experimental diets.

OBJECTIVES

1. Using as consistent protocols as possible across locations, evaluate/determine performance of recently-developed NCRAC least-cost juvenile (3" minimum total length) bluegill diet versus an "industry standard" diet at two distinct latitude locations at standard pond stocking densities for one growing season.
2. Coordinate dissemination of project results with the NCRAC Technical Committee/Extension Subcommittee.

PROCEDURES

Evaluate/Determine Performance of Recently Developed NCRAC Bluegill Diet (Objective 1)

Researchers from three NCR universities, Iowa State University (ISU), Lincoln University of Missouri (LU), and Purdue University (Purdue), will seek to compare Age-1 bluegill production at densities of 247,000/ha (10,000/acre) using two diets, the recently developed open formula versus an industry standard diet (40% crude protein and 10% lipids); both diets being produced by one common facility and distributed among the three locations. The standard diet is a commercial trout chow and the test diet is the open formula diet developed by Robert Hayward, University of Missouri-Columbia. Earthen ponds at LU and Purdue (0.10-ha [0.25-acre]) and ISU (0.08-ha [0.20-acre]) will be used for part or all of the study described below.

A single cohort of stocker fingerlings will be produced for the pond production phase using several single-mated northern bluegill pairs (local Missouri stock) as brood stock as two sites, LU and ISU. Ponds will be managed for intensive sunfish fingerling production with a targeted yield of 10,000 fingerlings/pond (50% survival) with an average total length of 7.6 cm (3.0 in) yielding adequate numbers for distribution to the three culture sites.

Founding and Rearing of Stock (April–October 2010)

Prior to the initiation of the funded project, LU staff will condition monosex groups of adult northern bluegill and select brood fish (N = 216; 72 males and 144 females). Half of the brood fish (36 males and 72 females) will be sent to ISU by late May 2010. In June, fish will be spawned in a minimum of four hatchery ponds per location. Each pond will have a net pen allowing confinement of brood fish and easy observation of breeding activity. A group of 6 males and 12 females will be placed into each net pen. Four broods per net pen will be selected such that four sires (males) and at least as many dams (females) are represented by offspring from each breeding group. In the following 2-week interval, a single cohort of offspring will be collected and brood fish removed; nests and net pens will also be removed. Broods will then be reared in the culture ponds from which they were initially collected. All ponds will be managed for optimal fish production following pond fertilization practices and management for sunfish fingerling production (Piper et al. 1982; Morris and Clayton 2009) through fall 2010. Targeted yield is

10,000 fingerlings/pond (total ≥40,000) with an average total length of 7.6 cm (3.0 in). LU will over-winter fish in ponds used for fingerling production and ISU will, if needed, transfer fish to an indoor recirculating aquaculture system to continue growth.

Stocking Trial Ponds (April 2011)

Fingerlings will be harvested and fish from a pond will be transferred to a raceway for grading, counting, and preparation for transport to trial ponds. After a 48-h period to recover from harvest, a random sample of 200 fish from each pond/raceway will be weighed in aggregate to estimate average weight for populations of each pond. All ponds at the three locations will be stocked at ~30,000/ha (12,000/acre). A standardized number of fish from each raceway will then be individually counted into each of six fish hauling compartments until all hauling compartments have enough fingerlings (randomized mix of four stocks) to stock into trial ponds (3,000 fish/pond at LU and Purdue and 2,400 fish/pond at ISU). Great care will be taken to ensure trial ponds within a site are stocked with similar numbers and size distribution of fish from each hatchery pond. Limitation of hauling capacity may require both LU and ISU to supply fish for Purdue ponds.

Feeding Trial (April 2011—October 2011)

The day following stocking of fish into production ponds, hand feeding will commence with applications twice daily except Saturday (once) and Sunday (none) for the duration of a 180-day feeding trial scheduled to end October 2011; the actual culture period will depend on climatic conditions. All sites will be harvested after similar culture duration. Fish will be fed to apparent satiation (amount they can consume in 15 min) using feeding rings (diameter 1.5 m [5.0 ft]) to limit the loss of food on windy days; not all feed will be placed into the rings. A semi-floating diet will be used for assessment of feeding activities. Feed applications will be adjusted to at least 2% to the maximum of 4% of biomass daily using the estimated fish biomass based on monthly fish samples. In the event sinking diets are used, fish will be fed 2% minimum body weight/day rather than to satiation.

Fish samples will be captured by seine and measured at 28-day intervals for estimation of growth rate. Early morning dissolved oxygen and temperature and afternoon pH and total ammonia nitrogen (NH_3-N) will be monitored twice weekly unless low levels approach critical culture limits that require daily measurements. Total alkalinity and hardness levels will be measure at the start, middle, and end of the study. Twice weekly measures of NH_3-N, nitrite (NO_2-N), and nitrate (NO_3-N) will be made using samples taken from each pond at dawn. Fish will be harvested by seining followed by hand picking of stranded fish during draining. At the end of the culture season, a representative randomly selected sample (N = 100+) from each pond will be dressed for fillets with weights taken for whole body, gilled, and gutted carcass, fillet, viscera, and liver. A subsample of randomly selected fillets (N = 20) will be homogenized prior to proximate composition analysis. Proximate composition will be made of four replicates from each subsample (AOAC 2000). Although not a funded component of this study, production costs and associated outputs will be estimated to obtain an initial cost of production.

Statistical Analyses

A completely randomized block design will be used; three sites, LU, ISU, and Purdue (blocks), two diets at each site (treatments), and three ponds per treatment per location (replicates). Individual ponds will be used as experimental units and variation among ponds will be nested in treatments and used as the experimental error to test significance in initial and final weight, SGR, gross yield (kg/ha), dress-out percentages, and survival. Tissue analysis of a randomized sample from each pond will be sent to an external lab to determine proximate analysis.

Statistical Analysis for Secondary Project. Production average for each brood within a common tank will serve as a replicate within each diet/source population.

Outreach (Objective 2)

Information from all facets of this project will be provided to the extension liaison whereby regular research updates to the aquaculture industry will be done using Web-based technologies, fact sheets, workshops, and/or technical bulletins.

FACILITIES

ISU

Six 0.08-ha (0.2-acre) earthen ponds located north of the ISU campus will be used for the pond culture phase. A low humidity, temperature-controlled facility is available for feed storage. A fully equipped water analysis laboratory is located on campus; it is equipped with spectrophotometers, pH meters, glassware, fume hood, and reagent storage.

One wet lab is located on the ISU campus. The 37 m^2 (400 ft^2) culture facility is equipped for flow through or recycle with twelve 1,000-L (264-gal) round tanks. The water supply is city tap water that has been dechlorinated, pH adjusted, and temperature controlled.

LU

Six 0.1-ha (0.25-acre) earthen ponds located on the George Washington Carver Memorial Farm southeast of Jefferson City, Missouri, will be used for the pond culture phases. Ponds can be filled using well water and drained completely with built in standpipes. Fiberglass raceways (*N* = 6; volume = 1,136-L [300-gal]) under roof are plumbed in parallel with water supplied by a well capable of exchanging the entire volume hourly. Counter current gas exchange columns aerate water prior to entering a raceway with a diffuser powered by regenerative blower serving as backup. Two recirculating aquaculture systems, each with six 795-L (210-gal) culture tanks, bead filter, and submerged media biofilter, are housed in a temperature/photoperiod controlled indoor facility. Setups for handling all aspects of feeding (brine hatchery, belt feeders) early life stage sunfish are in place. A walk in refrigerator is available for feed storage. A fully equipped water analysis and proximate composition analysis laboratory are available on the main campus.

Purdue

Six 0.1-ha (0.25-acre) earthen ponds located at the Purdue University Aquaculture Research Lab will be used for pond rearing in the summer of 2011. Feed will be stored in an adjacent storage facility and water quality measure analyzed in the lab next door.

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PROJECT LEADERS

State	Name/Institution	Area of Specialization
Illinois	Paul B. Brown Purdue University	Fish Culture/Fish Nutrition
	Robert A. Rode Purdue University	Fish Culture
Iowa	Richard D. Clayton Iowa State University	Fish Culture/RAS
	Joseph E. Morris Iowa State University	Fish Culture/Pond Management
Missouri	Charles E. Hicks Lincoln University of Missouri	Fish Culture/RAS
	James E. Wetzel Lincoln University of Missouri	Fish Culture/Fish Nutrition/Genetics

PARTICIPATING INSTITUTIONS AND PRINCIPAL INVESTIGATORS

Iowa State University (ISU)
Joseph E. Morris
Richard D. Clayton

Lincoln University (LU)
Charles E. Hicks
James E. Wetzel

Purdue University (Purdue)
Paul B. Brown
Robert A. Rode

PROPOSED ACTIVITIES FOR IOWA STATE UNIVERSITY

(Morris and Clayton)

Major Actions for Each Objective

1. Using as consistent protocols as possible across locations, evaluate/determine performance of recently-developed NCRAC least-cost juvenile (3" minimum total length) bluegill diet versus an "industry standard" diet at two distinct latitude locations at standard pond stocking densities for one growing season. Stocking densities to be determined by the investigators.
    a. Serve as supplement/backup to LU in production of age-1 bluegills
    b. Serve as one of three study sites for feed study
        i. Assess efficacy of open-formula diet on fish production

2. Coordinate dissemination of project results with the NCRAC Technical Committee/Extension Subcommittee.
    a. Supply data to LU for summarization to aquaculture community

UNITED STATES DEPARTMENT OF AGRICULTURE
COOPERATIVE STATE RESEARCH, EDUCATION, AND EXTENSION SERVICE

OMB Approved 0524-0039
Expires 03/31/2004

BUDGET

ORGANIZATION AND ADDRESS
Department of Natural Resource Ecology and Management
Iowa State University, Ames, IA 50011-3221

PROJECT DIRECTOR(S)
Joseph E. Morris & Richard D. Clayton

USDA AWARD NO. **Year 1: Objectives 1 & 2**

	CSREES FUNDED WORK MONTHS			Duration Proposed Months: 12 **Funds Requested by Proposer**	Duration Proposed Months: ____ **Funds Approved by CSREES** (If different)	Non-Federal Proposed Cost-Sharing/ Matching Funds (If required)	Non-federal Cost-Sharing/ Matching Funds Approved by CSREES (If Different)
A. Salaries and Wages	Calendar	Academic	Summer				
1. No. of Senior Personnel							
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. _1_ Prebaccalaureate Students				$5,000			
f. ___ Secretarial-Clerical							
g. ___ Technical, Shop and Other							
Total Salaries and Wages →							
B. Fringe Benefits (If charged as Direct Costs)							
C. Total Salaries, Wages, and Fringe Benefits (A plus B) →				$5,000			
D. Nonexpendable Equipment (Attach supporting data. List items and dollar amounts for each item.)							
E. Materials and Supplies				$8,123			
F. Travel				$ 500			
G. Publication Costs/Page Charges							
H. Computer (ADPE) Costs							
I. Student Assistance/Support (Scholarships/fellowships, stipends/tuition, cost of education, etc. Attach list of items and dollar amounts for each item.)							
J. All Other Direct Costs (In budget narrative, list items and dollar amounts and provide supporting data for each item.)							
K. Total Direct Costs (C through I) →				$13,623			
L. F&A/Indirect Costs. (If applicable, specify rate(s) and base(s) for on/off campus activity. Where both are involved, identify itemized costs in on/off campus bases.)							
M. Total Direct and F&A/Indirect Costs (J plus K) →				$13,623			
N. Other →							
O. Total Amount of This Request →				$13,623			

P. Carryover -- (If Applicable) . . . . . **Federal Funds: $** **Non-Federal funds: $** **Total $**

Q. Cost Sharing/Matching (Breakdown of total amounts shown in line O)		
Cash (both Applicant and Third Party) →		
Non-Cash Contributions (both Applicant and Third Party) →		

NAME AND TITLE (Type or print)	**SIGNATURE** (required for revised budget only)	**DATE**
Project Director		
Authorized Organizational Representative		
Signature (for optional use)		

According to the Paperwork Reduction Act of 1995, an agency may not conduct or sponsor, and a person is not required to respond to a collection of information unless it displays a valid OMB control number. The valid OMB control number for this information collection is 0524-0039. The time required to complete this information collection is estimated to average 1.00 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing the reviewing the collection of information.

Form CSREES-2004 (12/2000)

UNITED STATES DEPARTMENT OF AGRICULTURE
COOPERATIVE STATE RESEARCH, EDUCATION, AND EXTENSION SERVICE

OMB Approved 0524-0039
Expires 03/31/2004

BUDGET

ORGANIZATION AND ADDRESS
Department of Natural Resource Ecology and Management
Iowa State University, Ames, IA 50011-3221

PROJECT DIRECTOR(S)
Joseph E. Morris & Richard D. Clayton

USDA AWARD NO. **Year 2: Objectives 1 & 2**

	CSREES FUNDED WORK MONTHS			Duration Proposed Months: 12 Funds Requested by Proposer	Duration Proposed Months: ____ Funds Approved by CSREES (If different)	Non-Federal Proposed Cost-Sharing/ Matching Funds (If required)	Non-federal Cost-Sharing/ Matching Funds Approved by CSREES (If Different)
A. Salaries and Wages	Calendar	Academic	Summer				
1. No. of Senior Personnel							
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. _2_ Prebaccalaureate Students				$12,000			
f. ___ Secretarial-Clerical							
g. ___ Technical, Shop and Other							
Total Salaries and Wages →				$12,000			
B. Fringe Benefits (If charged as Direct Costs)							
C. Total Salaries, Wages, and Fringe Benefits (A plus B) →				$12,000			
D. Nonexpendable Equipment (Attach supporting data. List items and dollar amounts for each item.)							
E. Materials and Supplies				$7,177			
F. Travel				$7,400			
G. Publication Costs/Page Charges							
H. Computer (ADPE) Costs							
I. Student Assistance/Support (Scholarships/fellowships, stipends/tuition, cost of education, etc. Attach list of items and dollar amounts for each item.)							
J. All Other Direct Costs (In budget narrative, list items and dollar amounts and provide supporting data for each item.)				$3,000			
K. Total Direct Costs (C through I) →				$29,577			
L. F&A/Indirect Costs. (If applicable, specify rate(s) and base(s) for on/off campus activity. Where both are involved, identify itemized costs in on/off campus bases.)							
M. Total Direct and F&A/Indirect Costs (J plus K) →				$29,577			
N. Other →							
O. Total Amount of This Request →				$29,577			

P. Carryover -- (If Applicable) . . . . . **Federal Funds: $** **Non-Federal funds: $** **Total $**

Q. Cost Sharing/Matching (Breakdown of total amounts shown in line O)		
Cash (both Applicant and Third Party) →		
Non-Cash Contributions (both Applicant and Third Party) →		

NAME AND TITLE (Type or print)	**SIGNATURE** (required for revised budget only)	**DATE**
Project Director		
Authorized Organizational Representative		
Signature (for optional use)		

According to the Paperwork Reduction Act of 1995, an agency may not conduct or sponsor, and a person is not required to respond to a collection of information unless it displays a valid OMB control number. The valid OMB control number for this information collection is 0524-0039. The time required to complete this information collection is estimated to average 1.00 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing the reviewing the collection of information.

Form CSREES-2004 (12/2000)

BUDGET EXPLANATION FOR IOWA STATE UNIVERSITY

(Clayton and Morris)

Objectives 1 & 2

A. Salaries and, Wages. Year 1: One prebaccalaureate student @ $8/hour for 625 hours ($5,000). Year 2: Two prebaccalaureate students @ $8/hour for 1,500 hours ($12,000).

E. Materials and Supplies. Year 1: Six ½-hp pond aerators, $1,000 each ($6,000); brood stock feed ($550); fry diet ($73); fish feeders to be used in RAS ($2,123). Year 2: Control diet ($1,650); treatment diet ($4,500).

F. Travel. Year 1: Movement of brood stock from Missouri to Iowa ($500). Year 2: Deliver fish to Purdue and partial support for travel, lodging, and meals to attend regional and national conferences at locations to be determined ($7,400)

J. All Other Direct Costs. Year 2: Proximate analysis of 36 samples × $32/sample ($1,152); fatty acid profile of 36 samples × $30/sample ($1080); amino acid profile (feed) of 12 samples × $64/sample ($768).

PROPOSED ACTIVITIES FOR LINCOLN UNIVERSITY

(Hicks and Wetzel)

Objectives 1 & 2

Major Actions for Each Objective

1. Using as consistent protocols as possible across locations, evaluate/determine performance of recently-developed NCRAC least-cost juvenile (3" minimum total length) bluegill diet versus an "industry standard" diet at two distinct latitude locations at standard pond stocking densities for one growing season. Stocking densities to be determined by the investigators.
    a. Acquire brood stock for distribution to ISU
    b. Serve as primary production site for age-1 bluegills
    c. Serve as one of three study sites for feed study
        i. Assess efficacy of open-formula diet on fish production

2. Coordinate dissemination of project results with the NCRAC Technical Committee/Extension Subcommittee.
    a. Provide summarization to the aquaculture community

UNITED STATES DEPARTMENT OF AGRICULTURE
COOPERATIVE STATE RESEARCH, EDUCATION, AND EXTENSION SERVICE

OMB Approved 0524-0039
Expires 03/31/2004

BUDGET

ORGANIZATION AND ADDRESS
Lincoln University of Missouri
Jefferson City, Missouri 65101

PROJECT DIRECTOR(S)
Charles E. Hicks & James E. Wetzel

USDA AWARD NO. **Year 1: Objectives 1 & 2**

	CSREES FUNDED WORK MONTHS			Duration Proposed Months: 12 Funds Requested by Proposer	Duration Proposed Months: ____ Funds Approved by CSREES (If different)	Non-Federal Proposed Cost-Sharing/ Matching Funds (If required)	Non-federal Cost-Sharing/ Matching Funds Approved by CSREES (If Different)
A. Salaries and Wages							
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. _2_ Prebaccalaureate Students				$9,866			
f. ___ Secretarial-Clerical							
g. ___ Technical, Shop and Other							
Total Salaries and Wages →				$9,866			
B. Fringe Benefits (If charged as Direct Costs)							
C. Total Salaries, Wages, and Fringe Benefits (A plus B) →				$9,866			
D. Nonexpendable Equipment (Attach supporting data. List items and dollar amounts for each item.)							
E. Materials and Supplies				$3,641			
F. Travel				$ 320			
G. Publication Costs/Page Charges							
H. Computer (ADPE) Costs							
I. Student Assistance/Support (Scholarships/fellowships, stipends/tuition, cost of education, etc. Attach list of items and dollar amounts for each item.)							
J. All Other Direct Costs (In budget narrative, list items and dollar amounts and provide supporting data for each item.)							
K. Total Direct Costs (C through I) →				$13,827			
L. F&A/Indirect Costs. (If applicable, specify rate(s) and base(s) for on/off campus activity. Where both are involved, identify itemized costs in on/off campus bases.)							
M. Total Direct and F&A/Indirect Costs (J plus K) →				$13,827			
N. Other →							
O. Total Amount of This Request →				$13,827			

P. Carryover -- (If Applicable) . . . . . **Federal Funds: $** **Non-Federal funds: $** **Total $**

Q. Cost Sharing/Matching (Breakdown of total amounts shown in line O)		
Cash (both Applicant and Third Party) →		
Non-Cash Contributions (both Applicant and Third Party) →		

NAME AND TITLE (Type or print)	**SIGNATURE** (required for revised budget only)	**DATE**
Project Director		
Authorized Organizational Representative		
Signature (for optional use)		

Form CSREES-2004 (12/2000)

UNITED STATES DEPARTMENT OF AGRICULTURE
COOPERATIVE STATE RESEARCH, EDUCATION, AND EXTENSION SERVICE

OMB Approved 0524-0039
Expires 03/31/2004

BUDGET

ORGANIZATION AND ADDRESS
Lincoln University of Missouri
Jefferson City, Missouri 65101

PROJECT DIRECTOR(S)
Charles E. Hicks & James E. Wetzel

USDA AWARD NO. **Year 2: Objectives 1 & 2**

	CSREES FUNDED WORK MONTHS			Duration Proposed Months: 12 **Funds Requested by Proposer**	Duration Proposed Months: ____ **Funds Approved by CSREES** (If different)	Non-Federal Proposed Cost-Sharing/ Matching Funds (If required)	Non-federal Cost-Sharing/ Matching Funds Approved by CSREES (If Different)
A. Salaries and Wages	Calendar	Academic	Summer				
1. No. of Senior Personnel							
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. _2_ Prebaccalaureate Students				$17,512			
f. ___ Secretarial-Clerical							
g. ___ Technical, Shop and Other							
Total Salaries and Wages →				$17,512			
B. Fringe Benefits (If charged as Direct Costs)							
C. Total Salaries, Wages, and Fringe Benefits (A plus B) →				$17,512			
D. Nonexpendable Equipment (Attach supporting data. List items and dollar amounts for each item.)							
E. Materials and Supplies				$11,307			
F. Travel				$4,342			
G. Publication Costs/Page Charges							
H. Computer (ADPE) Costs							
I. Student Assistance/Support (Scholarships/fellowships, stipends/tuition, cost of education, etc. Attach list of items and dollar amounts for each item.)							
J. All Other Direct Costs (In budget narrative, list items and dollar amounts and provide supporting data for each item.)				$3,012			
K. Total Direct Costs (C through I) →				$36,173			
L. F&A/Indirect Costs. (If applicable, specify rate(s) and base(s) for on/off campus activity. Where both are involved, identify itemized costs in on/off campus bases.)							
M. Total Direct and F&A/Indirect Costs (J plus K) →				$36,173			
N. Other →							
O. Total Amount of This Request →				$36,173			

P. Carryover -- (If Applicable) . . . . . **Federal Funds: $** **Non-Federal funds: $** **Total $**

Q. Cost Sharing/Matching (Breakdown of total amounts shown in line O)		
Cash (both Applicant and Third Party) →		
Non-Cash Contributions (both Applicant and Third Party) →		

NAME AND TITLE (Type or print)	**SIGNATURE** (required for revised budget only)	**DATE**
Project Director		
Authorized Organizational Representative		
Signature (for optional use)		

Form CSREES-2004 (12/2000)

BUDGET EXPLANATION FOR LINCOLN UNIVERSITY OF MISSOURI

(Hicks and Wetzel)

Objectives 1 & 2

A. Salaries and Wages. Year 1: Two prebaccalaureate students @ $8.10/hour for 609 hours ($9,866). Year 2: Two prebaccalaureate students @$8.10/hour for 1081 hours ($17,512).

E. Materials and Supplies. Year 1: 1 scales (balance) ($1,175); dissolved oxygen meter ($1,045); fertilizer ($100); alfalfa meal ($311); conditioning feed for brood fish ($110); brine shrimp ($420); fry starter ($150); floating trout diet ($330). Year 2: Water quality analysis supplies ($260); control diet ($1,355); treatment diet ($3,697); seine ($195); PIT tags ($5,800).

F. Travel. Year 1: Transport brood stock to ISU and Purdue ($320). Year 2: Transportation to ISU and Purdue ($1,234); partial support for travel, lodging, and meals to attend regional and national conferences at locations to be determined ($3,108).

J. All Other Direct Costs. Year 2: Proximate analysis of 36 samples × $32/sample ($1,152); fatty acid profile of 36 samples × $30/sample ($1,080); amino acid profile (feed) of 12 samples × $65/sample ($780).

PROPOSED ACTIVITIES FOR PURDUE UNIVERSITY

(Brown and Rode)

Major Actions for Each Objective

1. Using as consistent protocols as possible across locations, evaluate/determine performance of recently-developed NCRAC least-cost juvenile (3" minimum total length) bluegill diet versus an "industry standard" diet at two distinct latitude locations at standard pond stocking densities for one growing season. Stocking densities to be determined by the investigators.
    a. Serve as one of three study sites for feed study
        i. Assess efficacy of open-formula diet on fish production
        ii. Develop economic analysis of study results.

2. Coordinate dissemination of project results with the NCRAC Technical Committee/Extension Subcommittee.
    a. Provide information to LU for summarization to the aquaculture community

UNITED STATES DEPARTMENT OF AGRICULTURE
COOPERATIVE STATE RESEARCH, EDUCATION, AND EXTENSION SERVICE

OMB Approved 0524-0039
Expires 03/31/2004

BUDGET

ORGANIZATION AND ADDRESS
Purdue University
715 West State Street, West Lafayette, IN 47907-2061

PROJECT DIRECTOR(S)
Paul B. Brown & Robert A. Rode

USDA AWARD NO. **Year 1: Objectives 1 & 2**

	CSREES FUNDED WORK MONTHS			Duration Proposed Months: 12 **Funds Requested by Proposer**	Duration Proposed Months: ____ **Funds Approved by CSREES** (If different)	Non-Federal Proposed Cost-Sharing/ Matching Funds (If required)	Non-federal Cost-Sharing/ Matching Funds Approved by CSREES (If Different)
A. Salaries and Wages							
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. 2 Prebaccalaureate Students				$5,000			
f. ___ Secretarial-Clerical							
g. ___ Technical, Shop and Other							
Total Salaries and Wages →				$5,000			
B. Fringe Benefits (If charged as Direct Costs)							
C. Total Salaries, Wages, and Fringe Benefits (A plus B) →				$5,000			
D. Nonexpendable Equipment (Attach supporting data. List items and dollar amounts for each item.)							
E. Materials and Supplies				$10,913			
F. Travel							
G. Publication Costs/Page Charges							
H. Computer (ADPE) Costs							
I. Student Assistance/Support (Scholarships/fellowships, stipends/tuition, cost of education, etc. Attach list of items and dollar amounts for each item.)							
J. All Other Direct Costs (In budget narrative, list items and dollar amounts and provide supporting data for each item.)							
K. Total Direct Costs (C through I) →				$15,913			
L. F&A/Indirect Costs. (If applicable, specify rate(s) and base(s) for on/off campus activity. Where both are involved, identify itemized costs in on/off campus bases.)							
M. Total Direct and F&A/Indirect Costs (J plus K) →				$15,913			
N. Other →							
O. Total Amount of This Request →				$15,913			

P. Carryover -- (If Applicable) . . . . . **Federal Funds: $** **Non-Federal funds: $** **Total $**

Q. Cost Sharing/Matching (Breakdown of total amounts shown in line O)		
Cash (both Applicant and Third Party) →		
Non-Cash Contributions (both Applicant and Third Party) →		

NAME AND TITLE (Type or print)	**SIGNATURE** (required for revised budget only)	**DATE**
Project Director		
Authorized Organizational Representative		
Signature (for optional use)		

Form CSREES-2004 (12/2000)

UNITED STATES DEPARTMENT OF AGRICULTURE
COOPERATIVE STATE RESEARCH, EDUCATION, AND EXTENSION SERVICE

OMB Approved 0524-0039
Expires 03/31/2004

BUDGET

ORGANIZATION AND ADDRESS
Purdue University
715 West State Street, West Lafayette, IN 47907-2061

PROJECT DIRECTOR(S)
Paul B. Brown & Robert A. Rode

USDA AWARD NO. **Year 2: Objectives 1 & 2**

	CSREES FUNDED WORK MONTHS			Duration Proposed Months: 12 **Funds Requested by Proposer**	Duration Proposed Months: ____ **Funds Approved by CSREES** (If different)	Non-Federal Proposed Cost-Sharing/ Matching Funds (If required)	Non-federal Cost-Sharing/ Matching Funds Approved by CSREES (If Different)
A. Salaries and Wages	Calendar	Academic	Summer				
1. No. of Senior Personnel							
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. _2_ Prebaccalaureate Students				$5,000			
f. ___ Secretarial-Clerical							
g. ___ Technical, Shop and Other							
Total Salaries and Wages →				$5,000			
B. Fringe Benefits (If charged as Direct Costs)							
C. Total Salaries, Wages, and Fringe Benefits (A plus B) →				$5,000			
D. Nonexpendable Equipment (Attach supporting data. List items and dollar amounts for each item.)							
E. Materials and Supplies				$6,800			
F. Travel							
G. Publication Costs/Page Charges							
H. Computer (ADPE) Costs							
I. Student Assistance/Support (Scholarships/fellowships, stipends/tuition, cost of education, etc. Attach list of items and dollar amounts for each item.)							
J. All Other Direct Costs (In budget narrative, list items and dollar amounts and provide supporting data for each item.)				$3,487			
K. Total Direct Costs (C through I) →				$15,287			
L. F&A/Indirect Costs. (If applicable, specify rate(s) and base(s) for on/off campus activity. Where both are involved, identify itemized costs in on/off campus bases.)							
M. Total Direct and F&A/Indirect Costs (J plus K) →				$15,287			
N. Other →							
O. Total Amount of This Request →				$15,287			

P. Carryover -- (If Applicable) . . . . . **Federal Funds: $** **Non-Federal funds: $** **Total $**

Q. Cost Sharing/Matching (Breakdown of total amounts shown in line O)		
Cash (both Applicant and Third Party) →		
Non-Cash Contributions (both Applicant and Third Party) →		

NAME AND TITLE (Type or print)	**SIGNATURE** (required for revised budget only)	**DATE**
Project Director		
Authorized Organizational Representative		
Signature (for optional use)		

Form CSREES-2004 (12/2000)

BUDGET EXPLANATION FOR PURDUE UNIVERSITY

(Brown and Rode)

Objectives 1 & 2

A. Salaries and Wages. Year 1: Two prebaccalaureate students @ $7.25/hour for 690 hours ($5,000). Year 2: Two prebaccalaureate students @$7.25/hour for 690 hours ($5,000).

E. Materials and Supplies. Year 1: Three ½ hp pond aerators ($1,000); water quality analysis supplies ($380); control diet ($1,650); treatment diet ($4,500); seine ($570); feed rings ($813).

F. Travel. Year 2: partial support for travel, lodging, and meals to attend regional and national conferences at locations to be determined for two people @ $3,400 per individual ($6,800).

J. All Other Direct Costs. Year 2: Proximate analysis of 36 samples × $32/sample ($1,152); fatty acid profile of 36 samples × $30/sample ($1,080); amino acid profile (feed) of 12 samples × $65/sample ($780).

BUDGET SUMMARY FOR EACH YEAR FOR ALL PARTICIPATING INSTITUTIONS

Year 1

	ISU	LU	Purdue	Totals
Salaries and Wages	$5,000	$9,866	$5,000	$19,866
Fringe Benefits				
Total Salaries, Wages, and Fringe Benefits	$5,000	$9,866	$5,000	$19,866
Materials and Supplies	$8,123	$3,641	$10,913	$22,677
Travel	$ 500	$ 320		$ 820
All Other Direct Costs				
TOTAL PROJECT COSTS	$13,623	$13,827	$15,913	$43,363

Year 2

	ISU	LU	Purdue	Totals
Salaries and Wages	$12,000	$17,512	$5,000	$34,512
Fringe Benefits				
Total Salaries, Wages, and Fringe Benefits	$12,000	$17,512	$5,000	$34,512
Materials and Supplies	$7,177	$11,307	$6,800	$25,284
Travel	$7,400	$4,342		$11,742
All Other Direct Costs	$3,000	$3,012	$3,487	$9,499
TOTAL PROJECT COSTS	$29,577	$36,173	$15,287	$81,037

SCHEDULE FOR COMPLETION OF OBJECTIVES

Objective 1: Initiated in Year 1 and completed in Year 1.

Main Objective

2009	Fall – Collect/quarantine source population samples (ongoing project)
2009-2010	Winter – Mark and raise collected fingerlings
2010	Spring – Select P1s from samples, send half to ISU
2010	Summer and Fall – Found and rear broods in ponds (LU and ISU)
2010-2011	Fall/Winter/Spring – Found/rear/mark broods for secondary objective
2011	Spring – Grade/transport (LU and ISU) and stock into ponds
2011	Spring through Fall – Rear production fish to harvest (LU/ISU/PU)

Secondary Project/LU only

2010	Summer – select brood fish following founding of broods for main objective
2010-2011	Fall/Winter/Spring – Found/rear/mark broods for secondary objective
2011	Spring – Harvest marked fish and stock on top of main objective trial
2011	Spring through Fall – Rear to harvest
2011	Fall – Harvest – Sort from main objective fish using PIT tag reader

Objective 2: Initiated in Year 1 and completed in Year 2

LIST OF PRINCIPAL INVESTIGATORS

Paul B. Brown, Purdue University
Richard D. Clayton, Iowa State University
Charles E. Hicks, Lincoln University
Joseph E. Morris, Iowa State University
Robert A. Rode, Purdue University
James E. Wetzel, Lincoln University

VITA

Paul B. Brown
Purdue University
715 West State Street
West Lafayette, IN 47907-2061

Phone: (765) 494-4968
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E-mail: pb@purdue.edu

EDUCATION

B.S. University of Tennessee, 1980, Wildlife and Fisheries Sciences
M.S. University of Tennessee, 1983, Aquatic Animal Nutrition
Ph.D. Texas A&M University, 1987, Aquatic Animal Nutrition

POSITIONS

Professor (1997-present); Associate Professor (1993-1997); Assistant Professor (1989-1993), Aquaculture Nutrition, Purdue University

SCIENTIFIC AND PROFESSIONAL ORGANIZATIONS

American Society of Nutritional Sciences
World Aquaculture Society

SELECTED PUBLICATIONS

Gonzales, J. G., and P. B. Brown. 2007. Nutrient retention capabilities of Nile tilapia (*Oreochromis niloticus*) fed bio-regenerative life support system (BLSS) waste residue. Advances in Space Research 40:1725-1734.

Kasper, C. S., B. A. Watkins, and P. B. Brown. 2007. Evaluation of two soybean meals fed to yellow perch (*Perca flavescens*). Aquaculture Nutrition 13:431-438.

Gonzales, J. M., A. H. Hutson, M. E. Rosinski, P. B. Brown, Y. V. Wu, and T. F. Powless. 2007. Evaluation of fish meal-free diets for first feeding Nile tilapia, *Oreochromis niloticus*. Journal of Applied Aquaculture 19:89-99.

Kasper, C. S., and P. B. Brown. 2003. Growth improved in juvenile Nile tilapia fed phosphatidylcholine. North American Journal of Aquaculture 65:39-43.

Gould, N. L., M. M Glover, L. D. Davidson, and P. B. Brown. 2003. Dietary flavor additives influence consumption of feeds by yellow perch, *Perca flavescens*. Journal of the World Aquaculture Society 34:412-417.

Twibell, R. G., M. E. Griffin, B. Martin, J. Price, and P. B. Brown. 2003. Predicting dietary essential amino acid requirements for hybrid striped bass. Aquaculture Nutrition 9:373-382.

Kasper, C. K., M. R. White, and P. B. Brown. 2002. Betaine can replace choline in diets fed to juvenile Nile tilapia, *Oreochromis niloticus*. Aquaculture 205:119-126.

Twibell, R. G., B. A. Watkins, and P. B. Brown. 2001. Dietary conjugated linoleic acids and lipid source alter fatty acid composition of juvenile yellow perch, *Perca flavescens*. Journal of Nutrition 131:2322-2328.

Kasper, C. S., M. R. White, and P. B. Brown. 2000. Choline is required by tilapia when methionine is not in excess. Journal of Nutrition 130:238-242.

VITA

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Iowa State University
339 Science II
Ames, Iowa 50011-3221

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Fax: (515) 294-7874
E-mail: rclayton@iastate.edu

EDUCATION

B.S. Iowa State University, 1992, Fisheries and Wildlife Biology
M.S. Iowa State University, 2007, Fisheries Biology

POSITIONS

Extension Aquaculture Specialist/Ag Specialist II (2004-present) and Research Associate I (2003-2004), Iowa State University Department of Natural Resource Ecology and Management
Research Associate I (1997-2003), Iowa State University Department of Animal Nutrition and Growth
Research Associate (1992-1997), Iowa State University Department of Animal Ecology

SCIENTIFIC AND PROFESSIONAL ORGANIZATIONS

American Fisheries Society
Iowa Chapter of the American Fisheries Society
Iowa Aquaculture Association
Sigma Xi

SELECTED PUBLICATIONS

Mulligan, B., J. E. Morris, and R. D. Clayton. Accepted. Chironomid abundance and consumption by juvenile channel catfish in plastic-lined and earthen culture ponds. Aquaculture Research.

Kaatz, S., J. E. Morris, J. B. Rudacille, and R. D. Clayton. 2009. Origin of chironomid larvae in plastic-lined culture ponds: airborne or water supply? North American Journal of Aquaculture 72:107-110.

Bozwell, J. L., R. D. Clayton, and J. E. Morris. 2009. Use of hydrogen peroxide to improve golden shiner egg hatchability. North American Journal of Aquaculture 71:238-241.

Morris, J. E., and R. D. Clayton. 2009. Centrarchid aquaculture. Pages 293-311 *in* S. J. Cooke and D. P. Philipp, editors. Centrarchid fishes, Wiley-Blackwell, West Sussex, United Kingdom.

Rosauer, D. R., J. E. Morris, and R. D. Clayton. 2009. Role of compensatory growth in walleye fingerling production. North American Journal of Aquaculture 71:35-38.

Johnson, J. A., R. C. Summerfelt, and R. D. Clayton. 2008. Evaluation of replacement feeds for the Biokyowa Feed for larval walleye. North American Journal of Aquaculture 70:446-451.

Clayton, R. D., J. E. Morris, and R. C. Summerfelt. 2008. Comparison of soy and fish oil in practical diets for fingerling walleye. North American Journal of Aquaculture 70:171-174.

Morris, J. E., and R. D. Clayton. 2007. A benthic sampler for plastic-lined ponds. Journal of the World Aquaculture Society 38:318-321.

Summerfelt, R. C., and R. D. Clayton. 2007. Evaluation of open-formula grower diets for juvenile walleyes. North American Journal of Aquaculture 69:53-58.

Clayton, R. D., T. L. Stevenson, and R. C. Summerfelt. 1998. Fin erosion in intensively cultured walleyes and hybrid walleyes. Progressive Fish-Culturist 60(2):114-118.

VITA

Charles E. Hicks
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Lincoln University
Foster Hall, 904 Chestnut St.
Jefferson City, MO 65101

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FAX: (573) 635-2894
E-mail: hicksc@lincolnu.edu

EDUCATION

B.S. Utah State University, Biology
M.S. Utah State University, Fishery Biology

POSITIONS

Assistant Professor (2002-present), Lincoln University-Cooperative Research
Assist Fisheries and Wildlife Extension Specialist (2002-present), University of Missouri - Fisheries and Wildlife
Adjunct Staff (1997), Lincoln University
Aquaculture Specialist (1993-1998), Missouri Department of Agriculture
Director Technical Services, Genesis Aquaculture, Inc.
General Manager (19871989), South Florida Aquaculture Center, Inc., Florida City
Superintendent of Fish Hatcheries (1968-1987), Missouri Department of Conservation, Jefferson City
Supervisor of Hatcheries (1965-1968), Utah Division of Wildlife Resources, Salt Lake City
Biologist (1964-1965), Logan Experimental Fish Cultural Station Logan, Utah
Biologist, Fisheries Research Institute, University of Washington, Seattle

SCIENTIFIC AND PROFESSIONAL ORGANIZATIONS

American Fisheries Society
Fish Culture Section of the American Fisheries Society
Missouri Aquaculture Association

SELECTED PUBLICATIONS

Hicks, C. E., M. R. Ellersieck, and C. J. Borgwordt. 2009. Production methods of food sized bluegill sunfish (*Lepomis macrochirus)*. North American Journal of Aquaculture 71:52-58.

Pierce, R. A., R. S. Hayward, J. Parcell, and C. E. Hicks. 2007. Paddlefish Production: opportunities for Missouri Pond and Lake Owners. University of Missouri Extension Guide. University of Missouri, Columbia.

Graham, L. K., E. J. Hamilton, T. R. Russell, and C. E. Hicks. 1986. The culture of paddlefish—a review of methods. Pages 78-94 *in* J. . Dillard, L.K.Graham, and T.R. Russell, editors. The paddlefish: status, management and propagation. American Fisheries Society, North Central Division, Special Publication 7, Bethesda, Maryland.

VITA

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Department of Natural Resource Ecology and Management
Iowa State University
124 Science II
Ames, IA 50011-3221

Phone: (515) 294-4622
Fax: (515) 294-7874
E-mail: jemorris@iastate.edu

EDUCATION

B.S. Iowa State University, 1979, Fisheries and Wildlife Biology
M.S. Texas A&M University, 1982, Wildlife and Fisheries Sciences
Ph.D. Mississippi State University, 1988, Fisheries and Wildlife

POSITIONS

Fisheries and Aquaculture Specialist/Associate Professor (1995-present), Specialist/Assistant Professor (1988-present), Department of Natural Resource Ecology and Management, Iowa State University and Associate Director (1990-present), North Central Regional Aquaculture Center
Graduate Research Assistant (1986-1988), Mississippi State University
Aquaculture Manager (1982-1986), Stiles Farm Foundation
Graduate Research Assistant (1981-1982), and Research Technician I (1980-1981), Texas A&M University
Fisheries Biologist Aide (1979), Indiana Department of Natural Resources

SCIENTIFIC AND PROFESSIONAL ORGANIZATIONS

American Fisheries Society: Iowa Chapter; Education, Fish Culture, Early Life History, and Fish Management Sections
Iowa Aquaculture Association
World Aquaculture Society
Phi Kappa Phi
Sigma Xi

SELECTED PUBLICATIONS

Mulligan, B., J. E. Morris, and R. D. Clayton. Accepted. Chironomid abundance and consumption by juvenile channel catfish in plastic-lined and earthen culture ponds. Aquaculture Research.

Kaatz, S., J. E. Morris, J. B. Rudacille, and R. D. Clayton. 2009. Origin of chironomid larvae in plastic-lined culture ponds: airborne or water supply? North American Journal of Aquaculture 72:107-110.

Bozwell, J. L., R. D. Clayton, and J. E. Morris. 2009. Use of hydrogen peroxide to improve golden shiner egg hatchability. North American Journal of Aquaculture 71:238-241.

Clayton, R. D., and J. E. Morris. 2009 Habituation performance for two percids to formulated feed under turbid and clear water culture. Journal of Applied Aquaculture 21:151-159.

Morris, J. E., and R. D. Clayton. 2009. Centrarchid aquaculture. Pages 293-311 *in* S. J. Cooke and D. P. Philipp, editors. Centrarchid fishes, Wiley-Blackwell, West Sussex, United Kingdom.

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SELECTED PUBLICATIONS

Stone, N., C. Engle, and R. Rode. 1997. Costs of small-scale catfish production. Arkansas Cooperative Extension Service Publication FSA 9077-2.5M-7-97N, Little Rock.

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SELECTED PUBLICATIONS

Wetzel, J. E., C. S. Kasper, and C. C. Kohler. 2006. Comparison of pond production of phase-III sunshine bass fed 32-, 36-, and 40%-crude-protein diets with fixed energy: protein ratios. North American Journal of Aquaculture 68(3):264-270.

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