**EVALUATE PHASE II PRODUCTION OF BLUEGILL SUNFISH COMPARING A LEAST-COST DIET UTILIZED IN THE PHASE I VERIFICATION STUDY COMPARED TO AN "INDUSTRY STANDARD" FOR ONE PRODUCTION CYCLE**

**Chairperson:** Charles E. Hicks, Lincoln University of Missouri

**Industry Advisory Council Liaison:** Paula J. Moore

**Extension Liaison:** Charles E. Hicks, Lincoln University of Missouri

**Funding Request:** $75,000

**Duration:** 1 year (September 1, 2012 – August 31, 2013)

**Objectives:**

1. Using consistent protocols, evaluate/determine performance of age-2 bluegill fed the diet (41% protein/<8.3% lipid) previously developed by a NCRAC funded project compared to an "industry standard" diet used in the on-going project at two distinct latitude location in ponds for one growing season.

2. Coordinate dissemination of project results with the NCRAC Technical Committee/Extension Subcommittee. The expected deliverable will be a technical bulletin containing such detailed information as growth, production parameters, size composition, and survival using data collected over grow out to market size; i.e., the first year from the on-going project plus this year's project.

**Proposed Budgets:**

| Institution | Principal Investigators | Objectives | Year 1 | Total |
|---|---|---|---|---|
| Lincoln University of Missouri | Charles E. Hicks<br>James E. Wetzel | 1 & 2 | $35,475 | $35,475 |
| Purdue University | Paul B. Brown<br>Robert A. Rode | 1 & 2 | $3,050 | $3,050 |
| University of Wisconsin - Stevens Point | Christopher F. Hartleb | 1 & 2 | $36,475 | $36,475 |
| | | **Totals** | $75,000 | $75,000 |

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## JUSTIFICATION

Growth in the North Central Region's (NCR) aquaculture industry mirrors, and is driven by, broader U.S. and worldwide changes in the seafood industry. Aquaculture continues to be the fastest-growing animal-food-producing sector, with per capita supply from aquaculture increasing from 0.70 kg (1.54 lb) in 1970 to 7.80 kg (17.16 lb) in 2008, an average annual growth rate of 6.6% (FAO 2009). The most recent estimate shows that almost 40% of the fish and seafood consumed by humans is from aquaculture. However, domestic aquaculture production has remained about the same for the last five years (NMFS 2009). 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 evolving.

For a fish species to be suitable for aquaculture production on a true commercial scale it needs to meet both marketing and biological criteria (Weber and Riordan 1976). Within the NCR of the U.S., sunfish are recognized as highly desirable fish species for recreational and food markets (Hushak 1993; Morris and Mischke 2003). The term "sunfish" refers to any of 30 species now included in the Centrarchidae family (Pflieger 1975). According to Brunson and Morris (2000), interest is growing in producing sunfish for human consumption due to the fact that bluegill and redear sunfish as well as sunfish hybrids have good flavor and texture, low-fat flesh, and good storage qualities. Morris et al. (2002) developed a sunfish culture manual that summarizes the current level of knowledge for culturing various species of sunfish within the Midwest and observed that bluegill exhibited the traits necessary to become a commercially viable and marketable aquaculture product. However, a need exists to develop techniques to efficiently produce a food-sized sunfish within a reasonable time period for economic benefits.

Bluegill and sunfish hybrids have desirable characteristics for commercial aquaculture production. McLarney (1987) reports that bluegill have good to excellent flavor and slightly soft texture, which makes them acceptable to a large number of consumers. However, the sunfish aquaculture industry is relatively new and spread throughout the United States. There is little information available on the production, marketing, and economics for these species. According to Morris and Mischke (2003) there are an estimated 485 producers of sunfish nationally. Approximately 250 sunfish producers are within the NCR. The most commonly produced sunfish is the bluegill. Hybrid sunfish are also raised by approximately 25% of the producers. Approximately 75% of the producers utilize sport fish markets for selling their products. These include recreational pond and lake stocking and fee fishing enterprises. Some producers are also raising food fish and utilizing other niche markets for selling their product.

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

Clearly, substantial need exists to reduce costs and develop nutritionally adequate diets for established as well as emerging aquaculture species in the NCR. Although significant insights have come from these efforts, no diet formulations yielding advantages beyond those already existing have resulted, either in terms of growth performance, cost, or improved fish health, for any NCR cultured species. The proposed study will evaluate a diet for phase II (age-2) northern bluegill (*Lepomis macrochirus macrochirus*) that is significantly less costly than currently available diets used for sunfish, yielding a growth rate 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 is being evaluated for phase I (age-1) bluegill that are not expected to meet market size. An evaluation is needed to compare the same least cost diet against an "industry standard" diet in a commercial production pond setting for a second production season in order to reach market size.

## RELATED CURRENT AND PREVIOUS WORK

Although sunfish, i.e., bluegill, culture has been on-going from the early 1900s, available information is limited for culturists producing for the food fish market. Expansion of sunfish aquaculture needs proven, profitable, and sustainable production technologies. Historically sunfish have been cultured in ponds with the primary forages being natural organisms, e.g., zooplankton and benthic organisms. However, these natural food sources are depleted by high fish densities typical of commercial culture conditions. Therefore, producers should consider using formulated diets to replace the natural forage base to enhance growth in high density sunfish pond production. Feed selection for sunfish has ranged from using basic trout/salmon formulations to refined diets based on purified ingredients. Much of the general guidelines for feed selection for sunfish is based on Tidwell et al. (1992) suggesting higher protein feeds (35% or greater) improve growth and production potential of hybrid sunfish (green sunfish [*Lepomis cyanellus*] female × bluegill male). Both bluegill and hybrid sunfish grow best when fed formulated diets containing at least 10% dietary lipid in the form of fish oil and the dietary phosphorus requirement of hybrid sunfish need not exceed 0.5% of the dry diet (NCRAC 1999).

Recently, 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 feedstuffs tested, with soybean meal (SBM) and poultry by-product meal (PBM) among the highest. Because 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 is promising.

Fish growth rate indices can include 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. Both measures (SGR and FCR) are important for determination of production cost, although 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 fish (3.0–20.0 g; 0.1–0.7 oz) well below where most feed required for food fish production is realized. 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 larger hybrids stocked in ponds for the summer growing season (Tidwell et al. 1994). 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. Due to the generally superior SGR and FCR results found by Hicks et al. (2009), and its use in the on-going NCRAC project, the same diet (sinking Nelson and Sons, Silvercup® finfish diet) used will serve as the reference diet in this proposed trial.

The initial project “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” was conducted at Iowa State University (ISU), Purdue, and Lincoln University of Missouri (LU). Age-1 bluegills were stocked in randomly selected ponds (six) at each location at a density of 20,000/ha (8,000/acre) and were fed the two diets. The ponds were sampled June 28-29, 2011. Approximately 100 fish were sampled from each pond and individual lengths and weights were taken. However, due to high variability within samples, no differences in the performance of the two diets could be determined. The trial was continued until the middle of October 2011 when ponds were harvested and fish individually weighed and measured. Comparisons of the two diets were made and the results still showed no significant difference in the growth of age-0 bluegill over the course of the first seven months of growth. The fish were then overwintered in the ponds and will be utilized in the Phase II testing. A lack of difference in the growth of the bluegill fed the two diets during their first year could be indicative of nutritional completeness of both diets or could be an artifact of slow but consistent growth by young-aged bluegill. Phase II of this project will help to extend the growth cycle and provide clarity as to the effectiveness of the least-cost diet to provide better growth and survival of market-sized bluegill.

SGR values for sunfish will most likely increase with genetic modification through selection and enhanced culture methods that include feeds specifically formulated for sunfish. Additionally, studies investigating

different feed formulations and feeding regimens can also be critical to improving fish growth. A recent study of the effects feeding frequency on growth rates of juvenile hybrid sunfish showed food consumption and growth rates increased from one to three feedings per day with no further benefits provided by four daily feedings (Wang et al. 1998). However, no effect of feeding frequency was observed on FCR values.

In light of these studies a need exists to measure the effectiveness of these new feeds 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. The on-going trial using age-1 bluegill is unlikely to yield desired harvest size fish, therefore a second production season is needed.

## ANTICIPATED BENEFITS

Results garnered from this project will provide the aquaculture industry with relevant field-tested information related to the culture of age-2 bluegills using least cost experimental diets. Project results will be coordinated with the NCRAC Technical Committee/Extension Subcommittee to provide deliverables such as technical bulletins containing such detailed information as growth, production parameters, size composition, and survival using data collected over grow out to market size; i.e., the first year from the on-going project plus this year's project.

## OBJECTIVES

1. Using consistent protocols, evaluate performance of age-2 bluegill fed the diet (41% protein/<8.3% lipid) previously developed by a NCRAC funded project compared to an "industry standard" diet used in the on-going project at two distinct latitude location in ponds for one growing season.

2. Coordinate dissemination of project results with the NCRAC Technical Committee/Extension Subcommittee. The expected deliverable will be a technical bulletin containing such detailed information as growth, production parameters, size composition, and survival using data collected over grow out to market size; i.e., the first year from the on-going project plus this year's project.

## PROCEDURES

### Evaluate Performance of Age-2 Bluegill Fed Previously Developed Diet Compared to Industry Standard (Objective 1)

Main Project

Researchers from two NCR universities, LU and the University of Wisconsin-Stevens Point (UW-Stevens Point) will seek to compare age-2 bluegill production at densities of 7,674 sunfish/ha (2,800/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 between the two locations. The standard diet is a commercial trout chow and the test diet is the open formula diet (Appendix 1) developed by Robert Hayward, University of Missouri-Columbia. Earthen ponds at LU and UW-Stevens Point (0.10-ha; 0.25-acre) will be used for part or all of the study described below.

*Stocking Trial Ponds (April 2012)*—Age-1 bluegill from the on-going project will be overwintered in ponds through age-2 (April 2012) prior to transfer to raceways for grading, counting, and preparation for transport to trial ponds. After a 48-hr period to recover from transfer, a random sample of 200 fish from each pond/raceway will be weighed in aggregate to estimate average weight for populations of each pond. Ponds at both locations will be drained and allowed to dry over-winter. All ponds will be filled with well water in early spring and ponds at both locations will be stocked at 7,674 sunfish/ha (2,800/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 (700 sunfish/pond). Great care will be taken to ensure trial ponds within a site are stocked with similar numbers and equal size distribution of fish from each hatchery pond. Due to poor survival over the winter, fish from Purdue University will be combined/transported with the fish at UW-Stevens Point in order to stock at the densities cited.

*Feeding Trial (April 2012 through October 2012)*—The day following stocking of fish into production ponds, feeding will commence with applications twice daily except once on Saturday and none on Sunday for the duration of a 180-day feeding trial scheduled to end October 2012; 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 3–4 feeding rings (1.52 m (59.30 in) diameter) per pond to limit the loss of food on windy days and to decrease possible establishment of feeding hierarchies.

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 measured at the beginning, 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. Percent yield will be calculated and compared among sunfish fed the two diets. 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 and analyzed to obtain an initial cost of production.

*Statistical Analyses*—A completely randomized block design will be used; two sites: LU and UW-Stevens Point (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 and percent 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.

**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 provided using Web-based technologies, fact sheets, workshops, and/or technical bulletins. The expected deliverables will be technical bulletins containing such detailed information as growth, production parameters such as percent yield, size composition, and survival using data collected over grow out to market size; i.e., the first year from the on-going project plus this year's project.

## FACILITIES

*LU*—Six 0.10-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 raceways with a diffuser powered by a regenerative blower serving as backup. 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. [Latitude 38° 34' 36" N]

*UW-Stevens Point*—Six 0.10 ha (0.25-acre) earthen ponds available to the UW-Stevens Point Northern Aquaculture Demonstration Facility (NADF) in Bayfield, Wisconsin will be used for the pond culture.

Ponds can be filled using well water and drained completely with built in standpipes. Fiberglass raceways (*N* = 6; volume 1,136-L [300-gal]) are available for use during sorting and enumeration of sunfish. Counter current gas exchange columns aerate water prior to entering raceways with a diffuser powered by a regenerative blower serving as backup for aeration in both raceways and ponds. A low humidity, temperature-controlled facility is available for feed storage. A fully equipped water analysis laboratory is located at the NADF. [Latitude 44$^{o}$ 15' 42" N]

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Webster, C.D., L.G. Tiu, and J.H. Tidwell. 1997. Growth and body composition of juvenile hybrid bluegill *Lepomis cyanellus* × *L. macrochirus* fed practical diets containing various percentages of protein. Journal of the World Aquaculture Society 28:230-240.

Webster, C.D., J.H. Tidwell, L.S. Goodgame, J.A. Clark, and D.H. Yancy. 1992. Effects of protein level on growth and body composition of hybrid sunfish (*Lepomis cyanellus* × *L. macrochirus*) reared in ponds. Transactions of the Kentucky Academy of Science 53:97-100.

## PROJECT LEADERS

| State | Name/Institution | Area of Specialization |
|---|---|---|
| **Indiana** | Paul B. Brown<br>Purdue University | Fish Culture/Fish Nutrition |
| | Robert A. Rode<br>Purdue University | Fish Culture |
| **Missouri** | Charles E. Hicks<br>Lincoln University of Missouri | Fish Culture/RAS |
| | James E. Wetzel<br>Lincoln University of Missouri | Fish Culture/Fish Nutrition/Genetics |
| **Wisconsin** | Christopher F. Hartleb<br>University of Wisconsin-Stevens Point | Fish Culture/Fish Biology |

## PARTICIPATING INSTITUTIONS AND CO-PRINCIPAL INVESTIGATORS

**Lincoln University of Missouri**
Charles E. Hicks
James E. Wetzel

**Purdue University**
Paul B. Brown
Robert A. Rode

**University of Wisconsin-Stevens Point**
Christopher F. Hartleb

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, MO 65101

PROJECT DIRECTOR(S)
Charles E. Hicks and 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** | 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 | | | | $17,280 | | | |
| f. ___ Secretarial-Clerical | | | | | | | |
| g. ___ Technical, Shop and Other | | | | | | | |
| **Total Salaries and Wages** → | | | | $17,280 | | | |
| B. Fringe Benefits (If charged as Direct Costs) | | | | $1,728 | | | |
| **C. Total Salaries, Wages, and Fringe Benefits (A plus B)** → | | | | $19,008 | | | |
| D. Nonexpendable Equipment (Attach supporting data. List items and dollar amounts for each item.) | | | | | | | |
| E. Materials and Supplies | | | | $12,980 | | | |
| 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)** → | | | | $35,475 | | | |
| **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) → | | | | $35,475 | | | |
| **N. Other** → | | | | | | | |
| **O. Total Amount of This Request** → | | | | $35,475 | | | |

**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 LINCOLN UNIVERSITY OF MISSOURI**

**(Hicks and Wetzel)**

**Objectives 1 & 2**

**A. Salaries, Wages.** 1.5 pre-baccalaureate students @ $9.00/hour for a 1,280 work year, total = 1,920 hr ($17,280).

**B. Fringe Benefits.** Fringe benefit rate for pre-baccalaureate students is 10% ($1,728).

**E. Materials and Supplies**. Fish feed, 530 lb. gain/pond, (start fish size 0.22 lb-ending weight 0.75 = gain/fish 0.53 lb × 1,000 fish = 530 lb. Estimate 1.5 conversions = 795 lb feed/pond. Total feed 795 × 6 ponds = 4,770 lb feed @ $0.70/lb = $3,339. Shipping and freight costs for feed estimated at $0.60/lb = $2,862. Other supplies include chemicals for water quality analysis ($1,724); five placement ¾ hp floating aerators with 100 ft cords each @ $892 ($4,460); and one hanging load cell scale for weighing fish ($595).

**J. All Other Direct Costs**. Proximate analysis of 36 samples @ $35/sample ($1,260); 36 fatty acid profile samples @ $35/sample ($1,260); and 12 amino acid profile (feed) samples @ $80/sample ($967).

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 and 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** | 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 | | | | $1,000 | | | |
| 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)** → | | | | $1,000 | | | |
| D. Nonexpendable Equipment (Attach supporting data. List items and dollar amounts for each item.) | | | | | | | |
| E. Materials and Supplies | | | | $ 100 | | | |
| F. Travel | | | | $1,500 | | | |
| 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.) | | | | $ 450 | | | |
| **K. Total Direct Costs (C through I)** → | | | | $3,050 | | | |
| **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) → | | | | $3,050 | | | |
| **N. Other** → | | | | | | | |
| **O. Total Amount of This Request** → | | | | $3,050 | | | |

**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.** $1,000 for a prebaccalaureate student to feed, harvest, and transport fish to Wisconsin.

**E. Materials and Supplies.** Maintenance fish feed until fish are harvested and hauled to Wisconsin ($100).

**F. Travel**. Transportation of fish to the University of Wisconsin-Stevens Point ($1,500).

**J. All Other Direct Costs**. Fish health and VHS testing required before fish can be transported from Indiana to Wisconsin ($450).

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

OMB Approved 0524-0039
Expires 03/31/2004

# BUDGET

ORGANIZATION AND ADDRESS
University of Wisconsin-Stevens Point, Northern Aquaculture Demonstration Facility
800 Reserve Street, Stevens Point, WI 54481

PROJECT DIRECTOR(S)
Christopher F. Hartleb

**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. 1 (Co)-PD(s) | | | 0.1 | $2,342 | | | |
| 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. 1 Technical, Shop and Other | | | | $11,440 | | | |
| **Total Salaries and Wages** → | | | | $13,782 | | | |
| B. Fringe Benefits (If charged as Direct Costs) | | | | $5,801 | | | |
| **C. Total Salaries, Wages, and Fringe Benefits (A plus B)** → | | | | $19,583 | | | |
| D. Nonexpendable Equipment (Attach supporting data. List items and dollar amounts for each item.) | | | | | | | |
| E. Materials and Supplies | | | | $9,705 | | | |
| F. Travel | | | | $2,500 | | | |
| 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.) | | | | $4,687 | | | |
| **K. Total Direct Costs (C through I)** → | | | | $36,475 | | | |
| **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) → | | | | $36,475 | | | |
| **N. Other** → | | | | | | | |
| **O. Total Amount of This Request** → | | | | $36,475 | | | |

**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 UNIVERSITY OF WISCONSIN-STEVENS POINT**

**(Hartleb)**

**Objectives 1 & 2**

**A. Salaries, Wages.** Portion of summer salary for PI, who is on a nine-month faculty appointment, to cover 90 hours/year to supervise project and limited term employee (LTE) ($2,342). Salary for LTE (technical) to assist PI in research (11.00/hour ×1,040 hours/year = $11,440).

**B. Fringe benefits**. 48.4% for PI (faculty) and 40.8% for LTE.

**E. Materials and Supplies.** Control diet - Nelson and Son Inc., Silvercup Floating Trout Diet (40% CP: 10% Fat) ($2,500); treatment diet - Least Cost Bluegill Fingerling Diet ($4,500); six fish feeders (feeding rings) ($400); and water chemistry reagents (dissolved oxygen, pH, total ammonia nitrogen, alkalinity, hardness, nitrite, nitrate) ($2,305).

**F. Travel**. Travel from university (Stevens Point) to fish culture ponds for fish sampling and water chemistry analysis; partial support for travel, lodging, and meals to attend regional and national conferences at locations to be determined.

**J. All other Direct Costs.** Payment to professional fish transport company to haul age-1 bluegill from Iowa to Wisconsin ($1,000); import permit with fish health certification ($200); proximate analysis completed at external lab of 36 samples × $35/sample ($1,260); fatty acid profile 36 samples × $35/sample ($1,260); and 12 amino acid profile (feed) samples × $80/sample ($967).

**BUDGET SUMMARY FOR EACH YEAR FOR EACH PARTICIPATING INSTITUTIONS**

| | LU | Purdue | UW-Stevens Point | Totals |
|---|---|---|---|---|
| Salaries and Wages | $17,280 | $1,000 | $13,782 | $32,062 |
| Fringe Benefits | $1,728 | | $5,801 | $7,529 |
| Total Salaries, Wages, and Fringe Benefits | $19,008 | $1,000 | $19,583 | $39,591 |
| Materials and Supplies | $12,980 | $ 100 | $9,705 | $22,785 |
| Travel | | $1,500 | $2,500 | $4,000 |
| All Other Direct Costs | $3,487 | $ 450 | $4,687 | $8,624 |
| **TOTAL PROJECT COSTS** | **$35,475** | **$3,050** | **$36,475** | **$75,000** |

## SCHEDULE FOR COMPLETION OF OBJECTIVES

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

| Main Objective | |
|---|---|
| 2011 | Fall – Weigh and Measure Phase I fish and separate Phase II fish for winter placement |
| 2011-2012 | Winter – Monitor water quality of ponds with designated fish |
| 2012 | Spring – 2012 place 1,000 fish from Phase I study into selected ponds for summer feeding.<br>Fall – Weigh and measure fish and take selected samples for further analysis. |

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

## LIST OF PRINCIPAL INVESTIGATORS

**Christopher F. Hartleb,** University of Wisconsin-Stevens Point
**Charles E. Hicks,** Lincoln University of Missouri
**Paul B. Brown,** Purdue University
**Robert A. Rode,** Purdue University
**James E. Wetzel,** Lincoln University of Missouri

**VITA**

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

Phone: (765) 494-4968
Fax: (765) 496-2422
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); and 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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Department of Biology
University of Wisconsin-Stevens Point
800 Reserve Street
Stevens Point, WI 54481

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E-mail: chartleb@uwsp.edu

**EDUCATION**

B.S. Rensselaer Polytechnic Institute, 1990, Biology
M.S. University of New Hampshire, 1992, Zoology (Limnology)
Ph.D. University of Maine, Maine Coop. Fish & Wildlife Research Unit, 1996, Fisheries Biology

**POSITIONS**

Professor (2006-present); Associate Professor (2002-2006); Assistant Professor (1996-2002), Biology and Water Resources, Department of Biology and Co-Director, Northern Aquaculture Demonstration Facility (2006-present), University of Wisconsin-Stevens Point
Researcher Assistant (1992-1996), Maine Cooperative Fish & Wildlife Research Unit, University of Maine
Research Assistant (1990-1992), Lakes Fish Condition Program, University of New Hampshire
Research Assistant (1988-1990), Rensselaer Fresh Water Institute, Rensselaer Polytechnic Institute

**SCIENTIFIC AND PROFESSIONAL ORGANIZATIONS**

American Fisheries Society, Fish Culture & Education Sections
Wisconsin Aquaculture Industry Advisory Council
World Aquaculture Society/U.S. Aquaculture Society
Wisconsin Aquaculture Association

**SELECTED PUBLICATIONS**

Koehler, R.A., B. Sloss, and C.F. Hartleb. In preparation. Population distribution of North American yellow perch (*Perca flavescens*) analyzed with microsatellite loci.

Fischer, G.J., Hartleb, C.F., Held, J.A., Holmes, K., and J. Malison. 2009. Evaluation of brook trout in a coldwater recycle aquaculture system. Aquacultural Engineering 41:109-113.

Malison, J.A., and C.F Hartleb (eds.). 2005. A Manual of Best Management Practices for aquaculture in Wisconsin and the Great Lakes Region. University of Wisconsin Sea Grant Institute, Madison.

Hartleb, C.F. 2004. Floating raceways to raise yellow perch at cranberry farms. Aquaculture Magazine Jan/Feb.

Hartleb. C.F. 2003. Food chain dynamics and diets of larval and post-larval yellow perch in culture ponds. *In* T.P. Barry, and J.A. Malison, editors. Proceedings of Percis III: The Third International Percid Fish Symposium, University of Wisconsin Sea Grant Institute, Madison.

Hartleb, C.F., and S.A. Timm. 2000. Survival and hatching success of stonefly eggs (*Paragnetina media*) following ingestion by three stream fishes. Journal of Freshwater Ecology 15:107-114.

**VITA**

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Lincoln University of Missouri
Foster Hall, 904 Chestnut St.
Jefferson City, MO 65101

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**EDUCATION**

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

**POSITIONS**

Assistant Professor (2002-present), Cooperative Research, Lincoln University of Missouri
Assistant Fisheries and Wildlife Extension Specialist (2000-present), University of Missouri
Aquaculture Specialist (1993-1998), Missouri Department of Agriculture
General Manager (1987-1989), South Florida Aquaculture Center, Inc., Florida City, Florida
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

**SCIENTIFIC AND PROFESSIONAL ORGANIZATIONS**

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

**SELECTED PUBLICATIONS**

Hicks, C.E., Ellersieck, M.R., 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., Hayward, R.S., Parcell, J., 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.G. 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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Fax: (765) 583-2490
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**EDUCATION**

B.S. University of Maine at Orono, 1981, Wildlife Management
M.S. Auburn University, 1991, Fisheries and Allied Aquaculture

**POSITIONS**

Aquaculture Facilities Manager (2006-present), Purdue University
Fish Culturist (2002-2006), Great Bay Aquaculture
Pond Manager (1991-1997), University of Arkansas at Pine Bluff

**SCIENTIFIC AND PROFESSIONAL ORGANIZATIONS**

Indiana Aquaculture Association
World Aquaculture Society

**SELECTED PUBLICATIONS**

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

Rode, R., and C. Engle. 1997. Catfish production cost estimates for farms with level land. MP 263. Arkansas Cooperative Extension Service, Little Rock.

Stone, N., C. Engle, and R. Rode. 1996. Developing aquaculture businesses among under-represented groups in rural communities. National Small Farm Conference. USDA. Nashville, Tennessee.

Fijan, N., and R. Rode. 1995. Experimental fish filter for reduction of nutrient surplus in catfish ponds. World Aquaculture Society Annual Meeting, San Diego, California.

Rode, R., and N. Stone. 1994. Small scale catfish production: holding fish for sale. FSA 9075. Arkansas Cooperative Extension Service, Little Rock.

## VITA

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### EDUCATION

B.S. Purdue University, 1989, Fisheries and Aquatic Sciences
M.S. Purdue University, 1993, Aquaculture
Ph. D. Southern Illinois University, 2004, Zoology

### POSITIONS

Assistant Professor of Aquaculture (2007-present) and Research Investigator (2005-2006), Lincoln University of Missouri

Technical Help/Para-Professional (2003-2005); Researcher II (Aquaculture Technology Transfer) (2000-2002); Research Assistant of Aquaculture (1999-2000); Dissertation Fellowship (1998-1999); and Research Assistant of Aquaculture (1994-1998), Southern Illinois University

Research Assistant of Fisheries and Aquatic Sciences (1989-1992) and Assistant Forester of Martel and Darlington Forest (1989), Purdue University

Assistant Biologist of Gypsy Moth Survey (1988), Indiana Department of Natural Resources

### PROFESSIONAL AFFLILIATIONS

Missouri Academy of Sciences
North American Native Fishes Association
World Aquaculture Society

### 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.

Wetzel, J.E. II. 2006. Spawning and raising the bantam sunfish. American Currents 33(1):11-15.

Wetzel, J.E., and C.C. Kohler. 2005. Distinction between gastric digestion and evacuation in black bass fed piscine prey. Transactions of the American Fisheries Society 134:533–536.

Roberts, M.E., J.E. Wetzel, R.C. Brooks, and J.E. Garvey. 2004. Daily increment formation in otoliths of red spotted sunfish. North American Journal of Fisheries Management 24:270-274.

Wetzel, J.E. 2002. Form alternation of adult female crayfishes of the genus *Orconectes* (Decapoda: Cambaridae). American Midland Naturalist 147:326-337.

Brown, P.B., J.E. Wetzel, J. Mays, K.A. Wilson, and C.S. Kasper. 2002. Growth differences between stocks of yellow perch (*Perca flavescens*) are temperature dependent. Journal of Applied Aquaculture 12:43-56.

Rangen inc.
115 13 Ave. So. Buhl, Idaho 83316 P.O. Box 706 Phone (208) 543-6421

June 21, 2012

Joseph E. Morris, Director-NCRAC
339 Science II
Iowa State University
Ames, Iowa 50011-3221

Dear Dr. Morris;

Rangen, Inc, is writing this letter in support of your research to field test the open formula diet recently developed for the North Central Regional Aquaculture Center by Dr. Hayward of the University of Missouri. This testing is important to the private aquaculture industry, as the proper diet is critical to the success of rearing any fish or crustacean. Testing this diet in commercial setting is the final step in the process of diet development as it enables production fish culturists to evaluate its merits.

As a fish feed nutritionist in a commercial setting, research information of this sort is critical in Rangen being able to supply species-specific diets to our customers.

Sincerely,

David Brock
Nutritionist

**APPENDIX1. Diet Formulations for Juvenile Bluegill**

| Diet cost ($ tonne$^{-1}$) → | | Control diet 885.99 | Alternative diet 1 730.37 |
|---|---|---|---|
| Ingredients | | | |
| Fish meal[1] | 975.9 | 550.0 | 100.0 |
| Poultry byproduct meal (pet-food grade) | 731.9 | 0.0 | 278.5 |
| Porcine meal & bone meal[2] | 421.6 | 0.0 | 0.0 |
| Blood meal[2] | 955.1 | 52.5 | 158.5 |
| Soybean meal[3] | 376.8 | 85.2 | 0.0 |
| Corn gluten meal[4] | 622.5 | 0.0 | 0.0 |
| Corn[5] | 171.5 | 0.0 | 47.1 |
| Wheat[5] | 259.3 | 251.3 | 374.9 |
| Fish oil[6] | 1477.1 | 40.0 | 20 |
| Lecithin[7] | 4188.7 | 3.0 | 3.0 |
| Dicalcium phosphate[8] | 4133.6 | 2.0 | 2.0 |
| Vitamin premix[9] | 11022.9 | 10.0 | 10.0 |
| Vitamin C[10] | 1543.2 | 0.7 | 0.7 |
| Choline chloride[10] | 1543.2 | 1.4 | 1.4 |
| Mineral mix[11] | 1543.2 | 1.0 | 1.0 |
| Binder[12] | 2314.8 | 3.0 | 3.0 |

[1]Eldon C. Stutsman, Inc., Hills, IA, USA.
[2]American Midwest Distributors, LLC, Kansas City, MO, USA.
[3]ADM Soybean Meal Plant, Mexico, MO, USA.
[4]Grain Processing Corporation, Muscatine, IA, USA.
[5]Bourn Feed, Columbia, MO, USA.
[6]Refined Menhaden Oil (Virginia Prime Gold), Omega Protein, Inc., Houston, TX, USA.
[7]Archer Daniels Midland Company, Decatur, IL, USA.
[8]American livestock and pet supply, Inc., Madison, WI, USA.
[9, 11] Nelson's Silvercup Fish Feed, Nelson & Sons, Inc., Murray, UT, USA.
[10]MP Biomedicals, Solon, OH, USA.
[12]Ultra-Bond™, Uniscope, Inc., Johnstown, CO, USA.