DETERMINATION OF PRODUCTION PARAMETERS OF SELECTED YELLOW PERCH LINES AT COMMERCIAL DENSITIES IN PONDS AT TWO OR MORE FACILITIES IN THE NORTH CENTRAL REGION

Chairperson: Hanping Wang, Ohio State University

Industry Advisory Council Liaison: Charles E. Hicks, New Bloomfield, Missouri

Extension Liaison: Geoffrey K. Wallat, Ohio State University

Funding Request: $150,000

Duration: 3 Years (September 1, 2010 – August 31, 2013)

Objectives:

1. Using consistent protocols, assess survival and growth rate of two replications of first-year fingerlings of improved lines of yellow perch as compared to fingerlings from local brood stock (feed-trained fingerlings to be stocked at 60,000/acre (150,000 fish/ha).

2. Using consistent protocols, assess 2nd year survival, growth rate, and market parameters (production, fillet yields, percent market size) of both replications of improved lines of yellow perch as compared to local fish.

3. Disseminate results to industry and to end-user customers via fact sheets, scientific publications, and an on-farm field day.

Proposed Budgets:

Institution/Company	Principal Investigator(s)	Objec -tives	Year 1	Year 2	Year 3	Total
Ohio State University	Hanping Wang (Laura G. Tiu & Geoffrey K. Wallat, Co-PIs)	1-3	$49,246	$47,517	$15,237	$112,000
University of Wisconsin-Stevens Point	Christopher F. Hartleb	1 & 2	$18,680	$17,680	$1,640	$38,000
		Totals	**$67,926**	**$65,197**	**$16,877**	**$150,000**

Non-funded Collaborators:

Facility	Collaborators
Coolwater Farms, LLC	Jeffrey A. Malison
Mill Creek Perch Farms, LLC	William E. Lynch, Jr.

TABLE OF CONTENTS

JUSTIFICATION

Yellow perch (*Perca flavescens*) is a particularly important aquacultural and ecological species in the Great Lakes Region (GLR) and the North Central Region (NCR). The demand for yellow perch has remained very high in the GLR because they are the traditional fish species used in local restaurants, social organizations, and the Friday night fish fry dinners that are a staple in many Great Lakes states. Although there are several mature aquaculture industries such as catfish, trout, and salmon in this country, yellow perch has its unique niche market in the GLR and the NCR. Despite this opportunity, rapid expansion of the yellow perch aquaculture industry has not occurred in the NCR and the GLR. One reason in particular hindering expansion has been relatively slow growth of currently cultured populations of this species (Malison et al. 2003). Using current yellow perch strains, only 60% of the fish cultured in aquaculture operations reach market size in a normal growth cycle (16 months), with the rest being below market size. This is an inefficient use of resources, feed, and operational costs, and leads to marginal profits at best. Therefore, improving and promoting yellow perch growth and aquaculture using new technology will significantly improve the profitability of fish farmers.

Historically, the supply of yellow perch largely relied on capture fisheries in the Great Lakes, but during the 1980s and 1990s wild harvests began to decline from 5.0−8.0 million kg/yr (11.0−17.6 million lb/yr) to the current limit of less than 3.0 million kg/yr (6.6 million lb/yr). Except for Lake Erie and Green Bay, commercial fishing of yellow perch has been closed in the Great Lakes due to overfishing and quotas for sport fishing have also been greatly reduced. Emerging diseases such as viral hemorrhagic septicemia (VHS) are expected to further threaten wild yellow perch populations. Increasing yellow perch aquaculture production will reduce the pressure on the natural resource, therefore, sustaining and improving the ecological environment and natural resource in the Great Lakes.

Yellow perch have a high nutritional value due to their low fat and phospholipid content (Malison 1999). The health benefits of yellow perch and its history of consumer fidelity in the market place present significant marketing opportunities for farmers in the NCR. Improving the production efficiencies of yellow perch will lead to the growth of the yellow perch industry as more farm operations will remain sustainable and profitable, leading to increased income and job opportunities in the rural communities where many NCR aquaculture farms are located. Farm-raised fish have a high quality value among many consumers, and the health benefits of yellow perch contribute to society as a whole by providing a safe, high quality, and healthy product.

Yellow perch aquaculture has received tremendous interest in the Midwest and elsewhere in the U.S. during the past 20 years due to their high market demands, the decline of wild populations, and concern over micro-contaminant levels in Great Lakes fishes. Brown et al. (2002) assessed aquaculture performance of yellow perch from Lake Mendota, Wisconsin alongside strains from Green Bay, Wisconsin, Nebraska, Pennsylvania, and North Carolina. Over several years of evaluation they observed significant differences among strains for weight gain and food conversion ratios. Other researchers, such as Miller (2003), Todd and Hatcher (1993), Billington (1993), and Leary and Booke (1982), documented genetically distinct stocks in Michigan and elsewhere. Therefore, although limited, the published studies to date provide adequate justification for the assumption that stock differences observed in yellow perch have a genetic basis.

Genetic improvement of aquaculture species offers a substantial opportunity for increasing production efficiency, health, production quality and, ultimately, profitability in aquaculture industries. The potential of these gains has long been recognized as a significant impetus for aquaculture. Gains in profit resulting from genetic improvement have been realized in terrestrial domesticated livestock species; agricultural, horticultural, and ornamental plants; forest trees; and aquaculture species such as salmonids, tilapia, and catfish. Therefore, the real challenge for the next decade is to get the aquaculture industries to introduce an effective genetic improvement program using selective breeding.

Several large scale selection experiments and breeding programs aimed at increasing growth rate were conducted recently, resulting in 10–20% gain per generation in channel catfish (*Ictalurus punctatus)* (Smitherman and Dunham 1985; Dunham and Brummet 1999), rainbow trout (*Oncorhynchus mykiss*) (Gjerde 1986), Atlantic salmon (*Salmo salar)* (Gjerde 1986; Gjerde and Korsvoll 1999; Gjedrem 2000), coho salmon (*Oncorhynchus kisutch)* (Hershberger et al. 1990; Myers et al. 2001), Nile tilapia (*Oreochromis niloticus)* (Eknath et al. 1993; Bentsen et al. 1998; Basiao and Doyle 1999; Longalong et al. 1999; Rye and Mao 1998), and other tilapias (Brzeski and Doyle 1995). The products from these breeding programs are used commercially by the industry in the respective countries. An evaluation of the performance of the genetically improved Nile tilapia in comparison to local stocks has been performed in several Asian countries, revealing variable degrees of superiority of the selected fish (Eknath et al. 1998). Several of these breeding programs, which started as experimental projects, have been expanded to include the industry (e.g., Atlantic salmon), or have been continued by private companies (e.g., Atlantic salmon, rainbow trout, channel catfish, Nile tilapia).

A combination of traditional selection (quantitative genetics) and marker assisted breeding (molecular genetics) offers substantial potential for improvement of yellow perch. Molecular fingerprinting or "tagging" allows us to reconstruct the pedigrees of communally reared individuals without performing physical tagging so that crossing between related fish is minimized for each generation and common environmental effects can be reduced (Doyle and Herbinger 1994). This technique has been demonstrated to be successful in providing for high selection intensities, low inbreeding, and extreme economy and efficiency (Naish and Skibinski 1998). We have undertaken this integrated strategy to improve brood stock and growth of yellow perch since 2004 and will have the 3rd generation of improved fish by 2010. Judging by genetic selection programs conducted in other agricultural and aquacultural species, <u>these 3rd generations should be an ideal starting point for commercialization</u>.

On-station and on-farm tests are important steps for commercialization of genetically improved strains. Communal rearing has been proved to be an effective way for a growth performance test of different strains (Charo-Karisa et al. 2006). This is because fish performance may vary in separate ponds even though the ponds are treated similarly (Riley and Edwards 1998). For example, while rearing tilapia fry in seawater pools fertilized with chicken manure, Ernst et al. (1989) found considerable variability in fish performance among pools despite identical management methods. For this proposed project, the 3rd generation of selected lines will be used in both communal rearing and separate rearing approaches aimed to obtain accurate data to accelerate the distribution of selected lines to the aquaculture industry.

RELATED CURRENT AND PREVIOUS WORK

Selective Breeding

The Ohio State University Center for Aquaculture Research and Development (OCARD) has been conducting commercial-scale (50–100 families/yr) selective breeding of yellow perch using marker-assisted cohort selection (MACS) for five years. Eight stocks representing major populations were obtained from eight states (Maine, Michigan, Nebraska, New York, North Carolina, Ohio, Pennsylvania, and Wisconsin) as a base population. By performing cross breeding, approximately 2,000 fast-growing and unrelated brood fish were selected as a base generation based on both phenotypic and genetic data in two overlapping generations. The first generations of selected fish were created in 2006 from selected brood fish of the 2004 year-class and in 2007 from selected brood fish of the 2005 year-class. The second generations of selected lines were created in 2008 and 2009. Research data showed that the selected lines grew 28%–42% faster than unselected fish. The 3rd generations will be created in spring of 2010 and 2011.

Evaluation of Base Populations and Improved Lines

Three studies were completed and the eight stocks representing major populations were assessed for growth rates, gross growth efficiency (GGE), and genetic variation for the selective breeding program. Experiments on evaluation of growth and GGE of different strains were performed at different temperature regimes for eighteen months. Genetic variation evaluation of different strains was completed using microsatellite markers and the results were published in the journal Aquaculture (Brown et al. 2007).The growth evaluation indicated that the North Carolina and Wisconsin strains performed better than the others (Wang et al. 2005). Genetic variance analysis results suggested that all strains had genetic value to the breeding program. Thus, the current data indicate that for yellow perch, this prerequisite of a genetically diverse base population is met to the extent possible (Brown et al. 2007). On-station tests were conducted on the two improved lines of the first generation. Current research data shows that the two improved lines grow 42.0% and 28.0% faster than unimproved fish.

Development of Markers and Related Methods for the Breeding Program

Sixty-six new microsatellite markers have been developed (Li et al. 2007; Zhan et al. 2009). Using these markers, a method for analysis of parentage and genetic relatedness of yellow perch has been established for simple marker-assisted cohort selection in the newly established Aquaculture Genetics and Breeding Laboratory (AGBL) at Piketon, Ohio (Wang et al. 2009).

Genotype by Environment Interaction on Breeding Program

Two studies were also completed on the evaluation of relative growth performance and genotype by environment effects for cross-bred yellow perch families reared in communal ponds (Wang et al. 2009), and family-tank interactions on early growth performance of yellow perch reared in single family tanks versus mixed-family tanks as inferred using molecular pedigrees (Wang et al. In review). The results indicated that families with superior growth performance in one pond also exhibited the same superior growth performance in the replicate pond. However, there were no significant correlations detected in family mean weights of the top 10% of fish between any two of the experimental ponds, suggesting there were strong genotype-environment interactions on growth of certain yellow perch families and that environmental effects were not so great as to override the higher genetic growth capacity of yellow perch communally-reared in commercial-scale ponds (Wang et al. 2009). In the second study, strong effects of genotype by environment interactions on early growth of yellow perch families reared in single family tanks versus in multi-family tanks were found (Wang et al. 2009).

ANTICIPATED BENEFITS

The impact of this proposed project will be primarily through the delivery of superior yellow perch strains to farmers for use in a wide range of culture and exposure conditions across the NCR. The greatest return on investment for this project is the ultimate reduction in production costs due to increased growth rate and reduced feed costs by using genetically improved strains. At the completion of this project, multiplication stations will be established to produce enough fry/fingerlings from improved strains for fish farmers in the NCR. Success in this project should be similar to that achieved for striped bass, rainbow trout, and catfish. Improved strains should show increased growth by 20–25% per generation and have a tremendous positive impact on the NCR yellow perch aquaculture industry.

OBJECTIVES

1. Using consistent protocols, assess survival and growth rate of two replications of first-year fingerlings of improved lines of yellow perch as compared to fingerlings from local brood stock (feed-trained fingerlings to be stocked at 60,000/acre (150,000 fish/ha)).

2. Using consistent protocols, assess 2nd year survival, growth rate, and market parameters (production, fillet yields, percent market size) of both replications of improved lines of yellow perch as compared to local fish.

3. Disseminate results to industry and to end-user customers via fact sheets, scientific publications, and an on-farm field day.

PROCEDURES

3rd generation of selected yellow perch lines will be used for the proposed project tests using the following approach aimed to accelerate the distribution of the selected lines to farmers.

Assess Survival and Growth Rate of Two Replications of First-Year Fingerlings (Objective 1)

General Approach and Project Design

(1) To best examine genotype by environmental interactions and obtain sound results applicable across the NCR, it would be optimal to run one test cycle with multiple replications and rearing types. Therefore, both on-farm and on-station tests of selected lines with local control lines will be conducted at four locations using both separate rearing and communal rearing methods. Ponds will be used at four geographic locations at different latitudes: two demonstration/research stations at OCARD (39°N) and the University of Wisconsin-Stevens Point (UW-Stevens Point) Northern Aquaculture Demonstration Facility (NADF [46°N]), and two commercial farms at Mill Creek Perch Farms (MCPF, Ohio [40.5°N]) and Coolwater Farms, LLC (CWF, Wisconsin [43°N]). Consistent rearing protocols will be developed and adhered to for all and each of the selected sites.
(2) Early in year 1, the 3rd generation of selected lines of fish (fingerlings) will be produced.
(3) In year 1, the selected and local lines of yellow perch fingerlings will be stocked and reared in ponds at 75,000–150,000 fish/ha (30,000–60,000 fish/acre), depending on the survival rate through feed training. In the autumn of year 1, all of the ponds will be harvested and the key production parameters of fingerling production (e.g., survival, growth, feed conversion) will be evaluated. The fish will be size-graded and the largest survivors re-stocked at 20,000 fish/ha (8,000/acre) for year 2 rearing.
(4) In year 2, the selected and local lines of large yellow perch fingerlings will be reared in ponds. In the autumn of year 2, all of the ponds will be harvested and the key production parameters (e.g., survival, growth, feed conversion for separate rearing, fillet yield) will be evaluated. Differences between females and males will be carefully measured.
(5) Should poor weather, shortage of brood fish or other extraordinary reasons affect the hatch of the improved line of egg ribbons and the results in year 1, the approach will be repeated or restarted in year 2.

Specific Steps and Protocol

Brood fish selection
Ohio State University (OSU) will use the previously developed 2nd generation of selected brood fish to create the 3rd generation of selected lines via MACS. When a majority of the 2nd generation of improved lines has reached harvest size, 2,000 of the best fish will be selected for the selection line based on their body weight and breeding value. Of the 2,000 brood stock selected, 1,000 fish will be PIT tagged and genotyped at the OSU AGBL using microsatellite markers. Molecular genetic pedigrees will be determined and a genetic relatedness chart will be constructed for mating. Among the 1,000 fish, at least 300 pairs of the least-related fish having the highest breeding value will be selected and divided into five cohorts with each cohort having 60 females and 60 males. If the constraint on the rate of inbreeding cannot be achieved, another batch of fish will be genotyped and included in the total number of candidates. A testing line will be created by pair-mating at least 50 pairs within each cohort (250 pairs in total) to produce at least 150 survival families and a total of 1.2–1.5 million fry. A control line from at least 15 pairs of local brood fish will also be produced at each testing site. Finclips of local brood fish for producing fry will be collected.

Broodstock genotyping
All the brood fish candidates will be genotyped as was done for their parents using eight microsatellite loci that have been developed and optimized. Microsatellite amplification reactions for each experimental individual will be performed using approximately 100 ng genomic DNA derived from ethanol-preserved tissue. Polymerase chain reaction will be performed using BioRad PTC-200 DNA engine thermal cycler to cycle according to Li et al. (2007). Genotyping will be performed using ABI 3130 DNA Sequencing and Genotyping System, and genotypes automatically scored using Genemapper. Individual genotypes will be checked for accuracy and consistency.

Genetic pedigree and relatedness chart construction

Microsatellite profiles for the eight loci will be used to identify the parents of all the brood fish candidates. Parentage assignment will be performed using the exclusion-based approach implemented in the program CERVUS 2.0 (Marshall et al. 1998). Also the likelihood-based method described in CERVUS 2.0 will be applied to obtain a probability of the most confident parent as an additional support to the exclusion-based strategy. All brood stock individuals will be included as putative candidates. To ascertain the possible influence of kinship among breeders in the deviation of theoretical and actual exclusion power of microsatellites (Marshall et al. 1998), relatedness coefficients (r) between all pairs of breeders from experimental brood stock will be obtained using the statistical package RELATEDNESS (Queller and Goodnight 1989). Based on the parentage assignment and relatedness coefficients, a microsatellite pedigree and genetic relatedness chart will be constructed for pair-mating.

Mating, spawning and incubation
Single-pair mating based on the genetic pedigree and relatedness chart will be conducted in 50.0 cm-diameter (19.7 in-diameter) tanks with flow-through water in March when fish have reached a mature stage. Females will be synchronized with one or two injections of HCG at the dosage of 200–600 IU/kg (91–273 IU/lb) body weight based on their need and maturity. PIT tags will be used to identify and track parents of all families. The fertilized egg ribbon from each pair-mating will be collected daily from spawning tanks starting two days post-injection. Hardened egg ribbons will be shipped to each testing site for incubation and hatching. The OSU Piketon research center will have all brood fish groups health inspected and VHS tested each year to comply with federal Animal Plant Health Inspection Service regulations so that the egg ribbons can be transported to test sites in multiple states. Import permits will be obtained and state fish health regulations will be met at the time of egg shipment.

At each site, egg ribbons will be incubated separately or communally in tanks with flow-through well water at a temperature of 10–14EC (50–57EF). Incubation rings will be constructed of chicken wire and egg ribbons will gently be woven in and out of the wire to hold them in place and under water. Aeration will be increased once clumps of eggs or individual eggs are released from the ribbon to keep eggs gently moving in the water. Two days posthatch, fry will be siphoned and counted for stocking for the nursery ponds.

Larval nursery and feed training
All nursery ponds will be fertilized with an initial alfalfa meal application of 225 kg/ha (200 lb/acre) prior to pond filling a week before stocking and an additional 113 kg/ha (100 lb/acre) weekly thereafter. Sixteen kg/ha (14 lb/acre) liquid organic ammonium nitrate fertilizer (28-0-0) and/or 1.3 kg/ha (1.2 lb/acre) phosphoric acid (0-54-0) will be applied once a week to stimulate phytoplankton and zooplankton blooms. The ammonium nitrate and phosphoric acid will be mixed in pond water and sprayed on the pond surface with a hand sprayer. Fertilizer amounts can also be based on the concentrations recommended by Culver and Dabrowski (1998).

Four ponds of the same size (0.1–4 ha; 0.25–1.0 acre) will be used at each location, with half of the ponds at each location receiving 15–30 egg ribbons of improved yellow perch from OSU. The remaining ponds (half at each location) will receive the same number of a local-strain of yellow perch fry. Fry at all locations will be pond-reared until they reach 25.0–35.0 mm (1.0–1.4) in (~6 weeks), at which time they will be moved into indoor tanks for feed-training.

Feed-training will be conducted in 1.8–3.0 m (6.0–10.0 ft) tanks at a stocking density of 4.0–5.0 kg of fingerlings/m^3 (0.25–0.30 lb of fingerlings/ft^3) at a temperature of 20–24EC (68–75EF) for 3–4 weeks. Fish will be fed AquaMax Fry Powder and Starter 100 with high protein using automatic feeders. Feeding rates will be about 5% of body weight (BW) for the first two days, and then be increased 7–8% BW. Tanks will be siphoned once a day. Daily temperature, dissolved oxygen (DO), and mortality will also be recorded for each tank.

Each location will produce ~30,000–60,000 selected and ~30,000–60,000 local feed-trained fingerlings based on needs for the pond fingerling production tests. Wisconsin local fingerlings may be 2–3 weeks younger than the selected yellow perch from Ohio because spawning is about 2–3 weeks later in Wisconsin than in Ohio. This difference may be unavoidable, and will be accounted for during data analysis.

Fingerling grow out in year 1
The four test sites will conduct replicated tests of the improved fish versus the local-strain using two types of rearing tests: (1) two sites (Piketon station and NADF) with well-controlled conditions will rear the selected line of yellow perch and a local-strain (control) in separate ponds, each having two replicates; (2) two sites (MCPF and CWF) will raise the selected line and a local-strain communally in two ponds. This communal rearing is necessary in order to avoid environmental effects (pond environment, different densities, and feeding rations resulting from differential survival, water quality, etc.), and to get solid results for quality publications. The common environmental effects can account for up to 30% of fish growth (Winkelman and Peterson 1994). If survival is different among ponds because of genotype by environment interaction (Ernst et al. 1989; Wang et al. 2009, 2010), the fish growth would be significantly different due to different densities with fish at the lower density growing much faster. In that situation, it would be difficult to compare growth data. Therefore, communal rearing is an effective and necessary back-up design which can increase testing security and power. Also, new knowledge of testing methods can be gained by comparing the results. Molecular markers will be used to assign selected and local-strain yellow perch to their family of origin for trait comparisons using methods previously published (Wang et al. 2009, 2010). All fish will be raised at all locations using consistent rearing protocols (i.e. feeding frequency, feeding amount, and seasonal aeration) briefly as follows:

Stocking: Feed-trained improved and local-strain yellow perch fingerlings will be stocked to each pond in year 1 at 75,000–150,000 fish/ha (30,000–60,000 fish/acre), depending on the survival rate through feed training. Before stocking, improved strain or local group fish will be well mixed to ensure that each pond will have all or an even number of families from its group. All ponds will be stocked at equivalent rates.

Feed and feeding: AquaMax Starter 100 to AquaMax Grower 400 feed will be used for all experimental ponds with a feeding rate of 5% (before 5.0 g [0.2 oz] BW)–3% BW based on weather. Feeding amount and rates will be adjusted monthly based on an assumed survival of 80% and calculated biomass using mean weight. Feeding amount will be recorded in order to calculate feed conversion ratio (FCR). The daily ration will be distributed over the feeding area of each pond 2–3 times/day. For the first two weeks after stocking, both belt feeding and hand feeding will be used; the amount in the belt feeders will slowly be reduced each day until all feeding is done by hand at two weeks.

Water quality and management: Daily temperature, DO, and mortality will be recorded for each pond; pH, ammonia and nitrite will be monitored monthly for each pond. Temperatures, DO levels, water exchange rate, and feeding regimes in all ponds will be kept the same at each testing site.

Sampling and harvest: Before stocking at Day 0, 500 feed-trained fingerlings will be randomly sampled from the combined or mixed group for weight and total length of both improved strain and local strain, and preserved individually with 95–100% alcohol in small vials for future identification of family composition by genotyping. Thereafter, 100 fish from each pond will be randomly sampled monthly for weight and feeding ration adjustment. At the end of year 1, fish will be harvested and 500 fish from each of separate ponds and 1,000 fish from each of communal ponds will be individually weighed, measured, and finclipped. Finclip samples will be preserved individually with 95–100% alcohol in small vials. Using the data, survival, growth, and FCR (for fish raised in separate ponds) of the selected yellow perch will be compared to the local strain.

Adult Grow Out in Year 2 (Objective 2)

After harvest at the end of year 1, commercial grading practice will be performed. Each pond of yellow perch will be size-graded and the largest fish will be re-stocked into year 2 grow-out ponds at 20,000/ha (8,000 fish/acre).

The above established consistent rearing protocols will be repeated at all four sites in year 2. The four testing sites will be used in year 2 to repeat the culture of the yellow perch for a second year of grow out. Similar replicated tests of the selected fish versus the local strain will be conducted with two types of rearing tests as in year 1. Fish in all experimental ponds will be fed AquaMax Grower 500 feed with a feeding rate of 3% BW 2–3 times/day from June to August and 2% BW for 1–2 times/day from September to October based on temperature. Fish will be fed once a day to satiation when water temperature is above 6EC (43EF) during winter. At the end of year 2, yellow perch in all ponds will be harvested and 500 fish from each of separate ponds and 1,000 fish from each of communal ponds will be randomly weighed, measured, and finclipped for future family identification by DNA parentage analysis. Production data including survival, growth rate, and market parameters (total production at time of harvest, fillet yields, FCR for separate rearing, and percent market size) will be compared between the selected and the local strain of yellow perch, with particular emphasis being placed on the differences between females and males. Breeding values and genetic gain will be estimated also using genetic pedigrees.

<u>Data Analysis</u>

Microsatellite markers will be used for genotyping and for family identification for mating and communal rearing practices. Parentage assignment will be performed using the program CERVUS 3.0. Based on the parentage assignment and relatedness coefficients, a microsatellite pedigree and genetic relatedness chart will be constructed for pair-mating for producing experimental fry. Performance response (production, growth rate, FCR, survival, fillet yields, and percent market size) will be evaluated using standardized *t*-tests between two groups (selected lines versus local strain) for on-station and on-farm tests. After experimental progeny are assigned to a family for communal rearing, differences among families will also be tested, and variance components and Best Linear Unbiased Prediction breeding values and genetic gain will be computed for performance traits using the restricted maximum likelihood method in PEST and/or ASReml software. Sex related differences at harvest (growth rate, fillet yield, and percent market size) will be measured and compared between the selected and local-strain yellow perch.

Result Dissemination (Objective 3)

On-farm field days will be held to disseminate project results at harvest at the end of year 2. Project results will be disseminated to the aquaculture industry and to end-users via fact sheets, scientific publications, and Web site media. At the completion of this project, it is expected that genetically improved seed (fertilized “eyed eggs” or fry) will be available for distribution to additional fingerling producers or hatcheries for dissemination of improved fingerlings to commercial grow out producers or farmers. At the same time, some improved fry/fingerling will be distributed to grow out farmers directly.

FACILITIES

OCARD has an active and productive breeding program. The research team consists of a fish geneticist, three aquaculture research and extension specialists, and several graduate students/postdoctoral researchers. The OSU OCARD has 12, 1.0 ha (0.25-acre) ponds, some of which will be used for on-station tests for this project. Up to 148 spawning and hatching tanks in a wet laboratory will be available to produce 150 families/ribbons for 1.5 million fry. A new facility with 60, 1.8 m (6-ft) round tanks for housing brood stocks and feed training is nearly completed. This new tank system will be used for feed training for this project. The OSU aquaculture genetics laboratory at Piketon is equipped with a variety of equipment including a high throughput ABI Genetic Analyzer for genetic analysis. Genotyping and parentage analyses will be conducted in this lab. The genetic lab, wet lab, and pond facility make the OCARD a unique station to conduct a genetic improvement program for yellow perch in the NCR.

The UW-Stevens Point NADF in Red Cliff, Wisconsin has four 0.2 ha (0.5-acre) rearing ponds supplied with well water, aerators, drain funnels, and external concrete fish-collecting basins. The entire system is controlled by a Supervisory Control and Data Acquisition (SCADA) computerized system that monitors pumps, aquifer levels, water usage, and security issues. NADF has several flow-through culture systems which will be used for feed training.

Mill Creek Perch Farms in Ohio has two 0.4 ha (1-acre) ponds which will be used for conducting one of the communal rearing tests, and has tank facilities for feed-training. Coolwater Farms, LLC in Wisconsin has 18, 0.2–1.4 ha (0.5–3.5-acre) ponds available for this study, as well as eight 757–9,464 L (200–2,500 gal) indoor, temperature controlled tanks that will be used for feed-training.

REFERENCES

Basiao, Z. U., and R. W. Doyle, 1999. Test of size specific mass selection for Nile tilapia, *Oreochromis niloticus* L., cage farming in the Philippines. Aquaculture Research 10:373-378.

Bentsen, H. B., A. E. Eknath, M. S. Palada-de Vera, J. C. Danting, H. L. Bolivar, R. A. Reyes, E. E. Dionisio, F. M. Longalong, A. V. Circa, M. M. Tayamen, and B. Gjerde. 1998. Genetic improvement of farmed tilapias: growth performance in a complete diallel cross experiment with eight stains of *Oreochromis niloticus*. Aquaculture 160:145-173.

Billington, N. 1993. Genetic variation in Lake Erie yellow perch *perca flavescens* demonstrated by mitochondrial DNA analysis. Journal of Fish Biology 43:941-943.

Brown, B., H. P.Wang., L. Li, C. B. Givens, and G. K.Wallat. 2007. Yellow perch strain evaluation I: Genetic variance of six broodstock populations. Aquaculture 271(1-4):142-151.

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

Brzeski, V. J., and R. F. Doyle. 1995. A test of an on-farm selection procedure for tilapia growth in Indonesia. Aquaculture 137:219-230.

Charo-Karisa, H, H. Komen, M. A. Rezk, R. W. Ponzoni, J. A. M. Arendonk , H. Bovenhuis. 2006. Heritability estimates and response to selection for growth of Nile tilapia (*Oreochromis niloticus*) in low-input earthen ponds. Aquaculture 261:479-486.

Culver, D. A., and K. Dabrowski. 1998. Fertilization and stocking procedures for pond culture of percids. World Aquaculture Society Book of Abstracts, 29th Annual Meeting of the World Aquaculture Society, Las Vegas, Nevada, February 15-19, 1998.

Doyle, R. W., and C. M. Herbinger. 1994. The use of DNA fingerprinting for high intensity, within-family selection in fish breeding. Pages 364-371 *in* Proceedings of the 5th World Congress on Genetics Applied to Livestock Production. Department of Animal and Poultry Sciences, University of Guelph, Guelph, Ontario.

Dunham, R. A., and R. E. Brummett. 1999. Response of two generations of selection to increased body weight in channel catfish, *Ictalurus punctatus,* compared to hybridization with blue catfish, *I. furcatus,* males. Journal of Applied Aquaculture 9:37-45.

Eknath, A. E., M. M. Tayamen, M. S. Palada-de Vera, J. C. Danting, R. A. Reyes, E. E. Bentsen, B. Gjerde, T. Gjedrem, and R. S .V. Pullin. 1993. Genetic improvement of farmed tilapias: the growth performance of eight strains of *Oreochromis niloticus* tested in different farm environments. Aquaculture 111:171–188.

Eknath, A. E., M. M. Dey, M. Rye, B. Gjerde, T. A. Abella, R. Sevilleja, M. M. Tayamen, R. A. Reyes, and H. B. Bentsen. 1998. Selective breeding of Nile tilapia for Asia. Pages 89-96 *in* Proceedings of the 6th World Congress on Genetic Applied to Livestock Production.

Ernst, D. H., L. J. Ellingson, B. L. Olla, W. I. Wicklund, W. O. Watanabe, and J. L. Grover. 1989. Production of Florida red tilapia in seawater pools: nursery rearing with chicken manure and growout with prepared feed. Aquaculture 80:247-260.

Gjedrem, T. 2000. Genetic improvement of cold-water fish species. Aquaculture Research 31: 25-33.

Gjerde, B. 1986. Growth and reproduction in fish and shellfish. Aquaculture 57:37-55.

Gjerde, B., and S. A. Korsvoll, 1999. Realized selection differentials for growth rate and early sexual maturity in Atlantic salmon. Pages 73-74 *in* Towards Predictable Quality, Abstracts of Contributions Presented at the Aquaculture Europe 99. European Aquaculture Society Special Publication 27, Oostende, Belgium.

Hershberger, W. K., J. M. Meyers, W. C. McAuley, and A. M. Saxton. 1990. Genetic changes in growth of coho salmon (*Oncorhynchus kisutch*) in marine netpens, produced by 10 years of selection. Aquaculture 85:187-197.

Leary, R., and H. E. Booke. 1982. Genetic stock analysis of yellow perch from Green Bay and Lake Michigan. Transactions of the American Fisheries Society 111: 52-57.

Li, L., H. P. Wang, C. Givens, S. Czesny, and B. Brown. 2007. Isolation and characterization of microsatellites in yellow perch (*Perca flavescens*). Molecular Ecology Notes 7:600-603.

Longalong, F. M., A. E. Eknath, and H. B. Bentsen. 1999. Response to bi-directional selection for frequency of early maturing females in Nile tilapia (*Oreochromis niloticus*). Aquaculture 178:13-25.

Malison, J. A. 1999. A White Paper on the Status and Needs of Yellow Perch Aquaculture in the North Carolina Regions. North Central Regional Aquaculture Center, Michigan State University, East Lansing.

Malison, J., P. Kestemont, and R. Summerfelt. 2003. Percid aquaculture: current status and future research needs. Page 1 *in* Barry, T.P. and J.A. Malison, editors. Proceedings of Percis III: The Third International Percid Fish Symposium. University of Wisconsin Sea Grant Institute, Madison.

Marshall, T. C., J. Slate, L. E. Kruuk, and J. M. Pemberton. 1998. Statistical confidence for likelihood-based paternity inference in natural populations. Molecular Ecology 7:639-655.

Miller, L. M. 2003. Microsatellite DNA loci reveal genetic structure of yellow perch in Lake Michigan. Transactions of the American Fishisheries Society 132:203-13.

Myers, J. M., P. O. Heggelund, G. Hudson, and R. N. Iwamoto. 2001. Genetics and broodstock management of coho salmon. Aquaculture 197:43-62.

Naish, K. A., and D. O. F. Skibinski. 1998. Tetranucleotide microsatellite loci for Indian carp, *Catla catla*. Journal of Fish Biology 53:886-889.

Queller, D. C., and K. F. Goodnight. 1989. Estimating relatedness using genetic markers. Ecology 43:258-275.

Riley, J., and P. Edwards. 1998. Statistical aspects of aquaculture research: pond variability and pseudoreplication. Aquaculture Research 29:281-288.

Rye, M., and I. L. Mao. 1998. Nonadditive genetic effects and inbreeding depression for body weight in Atlantic salmon (*Salmo salar*). Livestock Production Science 57:15-22.

Smitherman, R. O., and R. A. Dunham, 1985. Genetics and breeding. Pages 283-316 *in* C. S. Tucker, editor. Channel catfish culture. Elsevier Scientific Publishing, Amsterdam, The Netherlands.

Todd, T. N., and C. O. Hatcher. 1993. Genetic variability and glacial origins of yellow perch (*Perca flavescens*) in North America. Canadian Journal of Fisheries and Aquatic Sciences 50:1828-1834.

Wang, H. P, G. K. Wallat, L. G. Tiu, J. D. Rapp, P. O'Bryant, and C. Leighfield. 2005. Strain evaluation of yellow perch *Perca flavescens* in growth and feed conversion rates. World Aquaculture Society Book of Abstracts, Annual Meeting of the American Aquaculture, February, 2005. New Orleans, Louisiana.

Wang, H. P., L. Li, G. K. Wallat, B. Brown, H. Yao, Z. Gao, L. G. Tiu, P. O'Bryant, D. Rapp, and R. MacDonald. 2009. Evaluation of relative growth performance and genotype by environment effects for cross-bred yellow perch families reared in communal ponds using DNA parentage analyses. Aquaculture Research 40:1363-1373.

Wang, H. P., H. Yao, P. O'Bryant, D. Rapp, G. K. Wallat, L. G. Tiu, and R. MacDonald. In review. Family-tank interactions on early growth performance of yellow perch reared in single family tanks versus mixed-family tanks as inferred using molecular pedigrees. Journal of Fish Biology.

Winkelman, A. M,. and R. G. Peterson. 1994. Heritabilities, dominance variation, common environmental effects and genotype by environment interactions for weight and length in Chinook salmon. Aquaculture 125:17-30.

Zhan, A. B, W. Yao, B. Brown, and H. P. Wang, 2009. Isolation and characterization of novel microsatellite markers for yellow perch (*Perca flavescens*). International Journal of Molecular Science 10:18-27.

PROJECT LEADERS

State	Name/Institution	Area of Specialization
Ohio	Hanping Wang Ohio State University	Aquaculture, Genetic Breeding
	Laura G. Tiu Ohio State University	Aquaculture
	Geoff K. Wallat Ohio State University	Aquaculture
Wisconsin	Christopher F. Hartleb University of Wisconsin-Stevens Point	Fish Biology, Aquaculture

PARTICIPATING INSTITUTIONS AND PRINCIPAL INVESTIGATORS

Ohio State University
Hanping Wang
Laura G. Tiu
Geoffrey K. Wallat

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 Ohio State University Research Foundation 1960 Kenney Rd., Columbus, OH 43210-1063 PROJECT DIRECTOR(S) Hanping Wang, Laura G. Tiu, and Geoffrey K. Wallat				USDA AWARD NO. Year 1: Objectives 1-3			
				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	**CSREES FUNDED WORK MONTHS** Calendar	Academic	Summer				
a. ___ (Co)-PD(s)							
b. ___ Senior Associates							
2. No. of Other Personnel (Non-Faculty) a. 1 Research Associates-Postdoctorates . . .	6.0			$19,300			
b. ___ Other Professionals							
c. ___ Paraprofessionals							
d. ___ Graduate Students							
e. ___ Prebaccalaureate Students							
f. ___ Secretarial-Clerical							
g. ___ Technical, Shop and Other							
Total Salaries and Wages				$19,300			
B. Fringe Benefits (If charged as Direct Costs)				$5,501			
C. Total Salaries, Wages, and Fringe Benefits (A plus B)				$24,801			
D. Nonexpendable Equipment (Attach supporting data. List items and dollar amounts for each item.)							
E. Materials and Supplies				$19,945			
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.)				$3,000			
K. Total Direct Costs (C through I)				$49,246			
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)				$49,246			
N. Other							
O. Total Amount of This Request				$49,246			

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)

OMB Approved 0524-0039
Expires 03/31/2004

BUDGET

ORGANIZATION AND ADDRESS Ohio State University Research Foundation 1960 Kenney Rd., Columbus, OH 43210-1063 PROJECT DIRECTOR(S) Hanping Wang, Laura G. Tiu, and Geoffrey K. Wallat				USDA AWARD NO. Year 2: Objectives 1-3			
				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	**CSREES FUNDED WORK MONTHS**						
	Calendar	Academic	Summer				
a. ___ (Co)-PD(s)							
b. ___ Senior Associates							
2. No. of Other Personnel (Non-Faculty) a. 1 Research Associates-Postdoctorates ...	6.0			$19,785			
b. ___ Other Professionals							
c. ___ Paraprofessionals							
d. _ Graduate Students							
e. ___ Prebaccalaureate Students..........							
f. ___ Secretarial-Clerical							
g. ___ Technical, Shop and Other							
Total Salaries and Wages				$19,785			
B. Fringe Benefits (If charged as Direct Costs)				$5,837			
C. Total Salaries, Wages, and Fringe Benefits (A plus B)				$25,622			
D. Nonexpendable Equipment (Attach supporting data. List items and dollar amounts for each item.)							
E. Materials and Supplies				$15,895			
F. Travel				$3,000			
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)..........				$47,517			
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)..........				$47,517			
N. Other							
O. Total Amount of This Request..........				$47,517			

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
Ohio State University Research Foundation
1960 Kenney Rd., Columbus, OH 43210-1063

PROJECT DIRECTOR(S)
Hanping Wang, Laura G. Tiu, and Geoffrey K. Wallat

USDA AWARD NO. Year 3: Objectives 1-3

	CSREES FUNDED WORK MONTHS: Calendar	Academic	Summer	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							
a. ___ (Co)-PD(s)							
b. ___ Senior Associates							
2. No. of Other Personnel (Non-Faculty) a. 1 Research Associates-Postdoctorates	2.0			$5,887			
b. ___ Other Professionals							
c. ___ Paraprofessionals							
d. _ Graduate Students							
e. ___ Prebaccalaureate Students							
f. ___ Secretarial-Clerical							
g. ___ Technical, Shop and Other							
Total Salaries and Wages				$5,887			
B. Fringe Benefits (If charged as Direct Costs)				$1,796			
C. Total Salaries, Wages, and Fringe Benefits (A plus B)				$7,683			
D. Nonexpendable Equipment (Attach supporting data. List items and dollar amounts for each item.)							
E. Materials and Supplies				$6,104			
F. Travel				$1,000			
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)				$15,237			
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)				$15,237			
N. Other							
O. Total Amount of This Request				$15,237			

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 OHIO STATE UNIVERSITY

(Wang/Tiu/Wallat)

Objectives 1-3

A. Salaries and Wages: A portion of the salary for a research associate/assistant (RA) is requested in Years 1 (50%), 2 (50%), and 3 (two months). The RA will be involved in genotyping, parentage analysis and breeding work, managing pond rearing of experimental fish and data collection.

B. Fringe Benefits: Year1: the Fringe Benefit rate is 28.5%; Year 2: the fringe benefit rate is 29.5%; Year 3: the Fringe Benefit rate is 30.5%

E. Materials and Supplies: Year 1: feed ($9,000); PIT tags for brood fish ($2,800); laboratory chemicals and supplies ($3,500); water quality kits ($345); fertilizer ($2,100); six belt feeders ($1,200); and pond and tank supplies ($1,000). Year 2: feed ($12,000); laboratory chemicals and supplies ($2,000); and pond and tank supplies ($1,895). Year 3: feed ($3,104) and laboratory chemicals and supplies ($3,000).

F. Travel: Year 1: transportation, lodging, and meals to conduct farm visits and collect data ($1,500). Year 2: transportation, lodging, and meals to conduct farm visits and attend one professional meeting at a location to be determined ($3,000). Year 3: transportation, lodging, and meals to conduct farm visits for collecting data and attend one field day at a location to be determined ($1,000).

J. All Other Direct Costs: Power and water costs: Year 1 ($3,000); Year 2 ($3,000); and Year 3 ($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	USDA AWARD NO. Year 1: Objectives 1 & 2			
University of Wisconsin-Stevens Point, 800 Reserve St., Stevens Point, WI 54481 PROJECT DIRECTOR(S) Christopher F. Hartleb	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	CSREES FUNDED WORK MONTHS: Calendar	Academic	Summer	Funds Requested by Proposer	Funds Approved by CSREES	Non-Federal Proposed	Non-federal Approved
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. ___ Prebaccalaureate Students							
f. ___ Secretarial-Clerical							
g. 1 Technical, Shop and Other				$8,000			
Total Salaries and Wages				$8,000			
B. Fringe Benefits (If charged as Direct Costs)				$3,680			
C. Total Salaries, Wages, and Fringe Benefits (A plus B)				$11,680			
D. Nonexpendable Equipment (Attach supporting data. List items and dollar amounts for each item.)							
E. Materials and Supplies				$2,000			
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.)				$5,000			
K. Total Direct Costs (C through I)				$18,680			
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)				$18,680			
N. Other							
O. Total Amount of This Request				$18,680			

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

Q. Cost Sharing/Matching (Breakdown of total amounts shown in line O)	Non-Federal Proposed	Non-federal Approved
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	USDA AWARD NO. Year 2: Objectives 1 & 2			
University of Wisconsin-Stevens Point, 800 Reserve St., Stevens Point, WI 54481 PROJECT DIRECTOR(S) Christopher F. Hartleb	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)

	CSREES FUNDED WORK MONTHS: Calendar	Academic	Summer	Funds Requested by Proposer	Funds Approved by CSREES	Non-Federal Proposed	Non-Federal Approved
A. Salaries and Wages 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. ___ Prebaccalaureate Students							
f. ___ Secretarial-Clerical							
g. 1 Technical, Shop and Other				$8,000			
Total Salaries and Wages				$8,000			
B. Fringe Benefits (If charged as Direct Costs)				$3,680			
C. Total Salaries, Wages, and Fringe Benefits (A plus B)				$11,680			
D. Nonexpendable Equipment (Attach supporting data. List items and dollar amounts for each item.)							
E. Materials and Supplies				$1,000			
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.)				$5,000			
K. Total Direct Costs (C through I)				$17,680			
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)				$17,680			
N. Other							
O. Total Amount of This Request				$17,680			

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

Q. Cost Sharing/Matching (Breakdown of total amounts shown in line O)	Non-Federal Proposed	Non-Federal Approved
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
University of Wisconsin-Stevens Point, 800 Reserve St., Stevens Point, WI 54481

PROJECT DIRECTOR(S)
Christopher F. Hartleb

USDA AWARD NO. Year 3: Objectives 1 & 2

	CSREES FUNDED WORK MONTHS: Calendar	Academic	Summer	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							
a. ___ (Co)-PD(s)							
b. ___ Senior Associates							
2. No. of Other Personnel (Non-Faculty)							
a. ___ Research Associates-Postdoctorates . . .							
b. ___ Other Professionals							
c. ___ Paraprofessionals							
d. ___ Graduate Students							
e. ___ Prebaccalaureate Students							
f. ___ Secretarial-Clerical							
g. 1 Technical, Shop and Other				$1,123			
Total Salaries and Wages				$1,123			
B. Fringe Benefits (If charged as Direct Costs)				$ 517			
C. Total Salaries, Wages, and Fringe Benefits (A plus B)				$1,640			
D. Nonexpendable Equipment (Attach supporting data. List items and dollar amounts for each item.)							
E. Materials and Supplies							
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)				$1,640			
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)				$1,640			
N. Other							
O. Total Amount of This Request				$1,640			

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 UNIVERSITY OF WISCONSIN-STEVENS POINT

(Hartleb)

Objectives 1 and 2

A. **Salary and Wages.** Year 1: salary for limited term employee (LTE, technical) to assist PIs in research (~667 hours @ $12.00/hr). Year 2: salary for limited term employee (LTE, technical) to assist PIs in research (~667 hours @ $12.00/hr). Year 3: salary for limited term employee (LTE, technical) to assist PI's in research (~94 hours @$12/hr).

B. **Fringe benefits**. Annual costs: 46%.

E. **Materials and Supplies.** Year 1: purchase local-strain yellow perch, fish feed, netting, and sampling gear ($2,000). Year 2: fish feed, netting, and sampling yellow perch ($1,000).

J. **Other Direct Costs.** Years 1 and 2: $5,000 sub-contract to Coolwater Farms, LLC for conducting the studies done at their farm, as described in the proposal. These funds will be used to pay primarily for the labor (250 hours/yr @ $20.00/hr) needed to conduct the proposed studies. Coolwater Farms, LLC will not charge any fringe benefits or supplies to the project.

BUDGET SUMMARY FOR EACH PARTICIPATING INSTITUTION

Year 1

	OSU	UWSP-NADF	TOTAL
Salary and Wages	$19,300	$8,000	$27,300
Fringe Benefits	$5,501	$3,680	$9,181
Total Salaries, Wages, and Fringe Benefits	$24,801	$11,680	$36,481
Nonexpendable Equipment			
Materials and Supplies	$19,945	$2,000	$21,945
Travel	$1,500		$1,500
All Other Direct Costs	$3,000	$5,000	$8,000
Totals	$49,246	$18,680	$67,926

Year 2

	OSU	UWSP-NADF	TOTAL
Salary and Wages	$19,785	$8,000	$27,785
Fringe Benefits	$5,837	$3,680	$9,517
Total Salaries, Wages, and Fringe Benefits	$25,622	$11,680	$37,302
Nonexpendable Equipment			
Materials and Supplies	$15,895	$1,000	$16,895
Travel	$3,000		$3,000
All Other Direct Costs	$3,000	$5,000	$8,000
Totals	$47,517	$17,680	$65,197

Year 3

	OSU	UWSP-NADF	TOTAL
Salary and Wages	$5,887	$1,123	$7,010
Fringe Benefits	$1,796	$ 517	$2,313
Total Salaries, Wages, and Fringe Benefits	$7,683	$1,640	$9,323
Nonexpendable Equipment			
Materials and Supplies	$6,104		$6,104
Travel	$1,000		$1,000
All Other Direct Costs	$ 450		$ 450
Totals	$15,237	$1,640	$16,877

SCHEDULE FOR COMPLETION OF OBJECTIVES

Objectives and Task	Year 1						Year 2						Year 3					
	S O	N D	J F	M A	M J	J A	S O	N D	J F	M A	M J	J A	S O	N D	J F	M A	M J	J A
Objective 1																		
Brood stock selection from previously selected lines																		
Brood stock genotyping *Pedigree and relatedness chart construction*																		
Mating, spawning, and incubation																		
Larval nursery and feed-training																		
Year 1 fingerling grow out and data collection																		
Objective 2																		
Year 2 adults grow out and data collection																		
Objective 3																		
Result dissemination																		
Genotyping, and parentage analysis *Data statistical analysis*																		
Manuscript and project report submission																		

VITA

Christopher F. Hartleb
Northern Aquaculture Demonstration Facility
Department of Biology
University of Wisconsin-Stevens Point
800 Reserve Street
Stevens Point, WI 54481

Phone: (715) 346-3228
Fax: (715) 346-3624
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 Cooperative Fish & Wildlife Research Unit, 1996, Fisheries Biology

POSITIONS

Professor of Fisheries Biology & Aquaculture, Department of Biology and Co-Director, Northern Aquaculture Demonstration Facility (2006-present); Associate Professor of Fisheries Biology & Aquaculture (2002-2006); Assistant Professor of Biology & Water Resources (1996-2002), 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 Association
Wisconsin Aquaculture Industry Advisory Council
World Aquaculture Society/U.S. Aquaculture Society

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., C. F. Hartleb, J. A. Held, K. Holmes, and J. Malison. In press. Evaluation of brook trout in a coldwater recycle aquaculture system. Aquacultural Engineering.

Malison, J. A., and C. F. Hartleb, editors. 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.

Hartleb, C. F., and J. F. Haney. 1998. Use of a thermal and light refugium by *Daphnia* and its effects on foraging pumpkinseeds. Environmental Biology of Fishes 51:339-349.

VITA

Jeffrey A. Malison
Coolwater Farms, LLC
340 State Farm Rd.
Deerfield, WI 53531

Phone: (608) 444-2769
E-mail: ljmalison@hotmail.com

EDUCATION

B.S. University of Wisconsin-Stevens Point, 1976
M.S. University of Wisconsin-Madison, 1980
Ph.D. University of Wisconsin-Madison, 1985

POSITIONS

Partner (1994-present), Coolwater Farms, LLC
Director (1995-present), Assistant Director (1990-1995), and Associate Researcher (1987-1990), University of Wisconsin Aquaculture Program, University of Wisconsin-Madison
Co-director (2006-present), University of Wisconsin-Stevens Point Northern Aquaculture Demonstration Facility

SCIENTIFIC AND PROFESSIONAL ORGANIZATIONS

American Fisheries Society
Wisconsin Aquaculture Industry Advisory Council
Wisconsin Aquaculture Association
World Aquaculture Society

SELECTED PUBLICATIONS

Malison, J. A., and J. A. Held. 2008. Farm-based production parameters and breakeven costs for yellow perch grow-out in ponds in southern Wisconsin. North Central Regional Aquaculture Center Technical Bulletin #121. NCRAC Publications Office, Iowa State University, Ames.

Ng, Y., S. Hanson, J. A. Malison, B. C. Wentworth, and T. P. Barry. 2006. Genistein and other isoflavones in soybeans inhibit estrogen metabolism in salmonid fish. Aquaculture 254:658-665.

Hart, S. D., D. L. Garling, and J. A. Malison, editors. 2006. Yellow perch (*Perca flavescens*) culture guide. North Central Regional Aquaculture Center Culture series #103. NCRAC Publications Office, Iowa State University, Ames.

Jurgella, G. F., T. P. Barry, A. Marwah, J. A. Malison, and R. E. Peterson. 2006. Effects of xenobiotics and steroids on estrogen metabolism in lake trout. General and Comparative Endocrinology 148:273-281.

Lima, L. C., L. P. Ribeiro, J. A. Malison, T. P. Barry, and J. A. Held. 2006. Effects of temperature on performance parameters and the cortisol stress response of surubim Pseudoplatystoma sp. Journal of the World Aquaculture Society 37:89-95.

D'Souza, N., D. I. Skonberg, M. E. Camire, K. E. Guthrie, J. Malison, and L. Lima. 2005. Influence of dietary genistein levels on tissue genistein deposition and on the physical, chemical and sensory quality of rainbow trout, *Oncorhynchus mykiss*. Journal of Agricultural food Chemistry 53:3631-3636.

Malison, J. A., and C. F. Hartleb, editors. 2005. Best management practices manual for aquaculture in Wisconsin and the Great Lakes region. Publication WISCU-H-05-001. University of Wisconsin Sea Grant Institute, Madison.

VITA

Laura G. Tiu
Ohio Center for Aquaculture Development
Ohio State University
1864 Shyville Rd.
Piketon, OH 45661

Phone: (740) 289-2071 ext. 121
Fax: (740) 289-4591
E-mail: tiu.2@osu.edu

EDUCATION

B.S.	Silliman University, Philippines, 1987, Biology/Marine Biology
M.S.	Mississippi State University, 1990, Wildlife Ecology/Fisheries Management
Ph.D., A.B.D.	Ohio State University, in progress, Human and Community Resource Development/Adult Education

POSITIONS

Senior Research and Extension Associate (2003-present) and Research and Extension Associate for Aquaculture (1998-2003), Ohio State University

Co-Investigator for Aquaculture (1992-1998) and Research Assistant for Aquaculture (1991-1992), Kentucky State University

SCIENTIFIC AND PROFESSIONAL ORGANIZATIONS

Ohio Aquaculture Association
National Association of State Aquaculture Coordinators
United States Aquaculture Society
World Aquaculture Society

SELECTED PUBLICATIONS

Wang, W. J., H. P. Wang, G. K. Wallat, L. G. Tiu, H.Yao, and Q. Y. Wang. In revision. Genetic linkage mapping and sex-specific marker locating of bluegill sunfish (*Lepomis macrochirus*) using AFLP markers. Aquaculture International.

Wang, H. P., L. Li, G. K. Wallat, B. Brown, H. Yao, Z. Gao, L. G. Tiu, P. O'Bryant, D. Rapp, and R. MacDonald. 2009. Evaluation of relative growth performance and genotype by environment effects for cross-bred yellow perch families reared in communal ponds using DNA parentage analyses. Aquaculture Research 40:1363-1373.

Wang, H. P., G. K. Wallat, R. Hayward, L. G. Tiu, P. O'Bryant, and D. Rapp. 2009. Establishment of mostly-male groups of bluegill by size-selection and evaluation of their growth performance. North American Journal of Aquaculture 71:216-223.

Gao, Z., H. P. Wang, D. Rapp, P. O'Bryant, H. Yao, G. K. Wallat, W. Wang, R. MacDonald, and L. G. Tiu. 2009. Gonadal sex differentiation in the bluegill sunfish *Lepomis macrochirus* and its relation to fish size and age. Aquaculture 294:138-146.

Wang, H. P., Z. Gao, B. Beres, J. Ottobre, G. K. Wallat, L. G. Tiu, D. Rapp, P. O'Bryant, and H. Yao. 2008. Effects of estradiol-17β on survival, growth performance, sex reversal and gonadal structure of bluegill sunfish *Lepomis macrochirus.* Aquaculture 285:216-223.

VITA

Geoffrey K. Wallat
Ohio Center for Aquaculture Development
Ohio State University
1864 Shyville Rd.
Piketon, OH 45661

Phone: (740) 289-2071 ext. 146
Fax: 740-289-4591
E-mail: wallat1@ag.osu.edu

EDUCATION

B.S. University of Rhode Island, 1989, Aquaculture and Fishery Technology
M.S. University of Florida, 1996, Fisheries and Aquatic Sciences

POSITIONS

Aquaculture Specialist/Senior Research Associate (2003-present); Research Associate II/Facility Coordinator (200-2003); and Research Assistant/Facility Coordinator (1998-2000), Ohio State University, South Centers at Piketon

SCIENTIFIC AND PROFESSIONAL ORGANIZATIONS

American Fisheries Society – Fish Culture Section
U.S. Aquaculture Society (Chapter of WAS)
World Aquaculture Society

SELECTED PUBLICATIONS

Gao, Z., H. P. Wang, D. Rapp, P. O'Bryant, H. Yao, G. K. Wallat, W. Wang, L. G. Tiu, and R. MacDonald. In press. Effects of a nonsteroidal aromatase inhibitor on sex reversal, gonadal differentiation and growth performance of bluegill sunfish *Lepomis macrochirus.* Aquaculture Research.

Wang , W. J., H. P. Wang, G. K. Wallat, L. G. Tiu, H. Yao, and Q. Y. Wang. In revision. Genetic linkage mapping and sex-specific marker locating of bluegill sunfish (*Lepomis macrochirus*) using AFLP markers. Aquaculture International.

Wang, H. P., L. Li, G. K. Wallat, B. Brown, H. Yao, Z. Gao L. G. Tiu, P. O'Bryant, D. Rapp, and R. MacDonald. 2009. Evaluation of relative growth performance and genotype by environment effects for cross-bred yellow perch families reared in communal ponds using DNA parentage analyses. Aquaculture *Research* 40:1363-1373.

Wang, H. P., G. K. Wallat, R. Hayward, L. G. Tiu, P. O'Bryant, and D. Rapp. 2009. Establishment of mostly-male groups of bluegill by size-selection and evaluation of their growth performance. North American Journal of Aquaculture 71:216-223.

Gao, Z., H. P. Wang, D. Rapp, P. O'Bryant, H. Yao, G. K. Wallat, W. Wang, R. MacDonald, and L. G. Tiu. 2009. Gonadal sex differentiation in the bluegill sunfish *Lepomis macrochirus* and its relation to fish size and age. Aquaculture 294:138-146.

Wang, H. P., Z. Gao, B. Beres, J. Ottobre, G. K. Wallat, L. G. Tiu, D. Rapp, P. O'Bryant, and H. Yao. 2008. Effects of estradiol-17β on survival, growth performance, sex reversal and gonadal structure of bluegill sunfish *Lepomis macrochirus.* Aquaculture 285:216-223.

VITA

Hanping Wang
Ohio Center for Aquaculture Development
Ohio State University
1864 Shyville Rd.
Piketon, OH 45661

Phone: (740) 289-2071 ext. 125
Fax: (740) 289-4591
E-mail: wang900@ag.osu.edu

EDUCATION

B.S.	Central China Agricultural University (CCAU), 1982, Fisheries Science
M.S. equivalent	Yangtze River Fisheries Institute (YFI), 1987, Aquaculture Science
Ph.D.	CCAU and University of Missouri-Columbia (a joint training program), 2001, Aquaculture Science

POSITIONS

Adjunct Professor (2005-present), Department of Animal Science; Research Scientist (2004-present); and Director, Ohio Aquaculture Research and Development Integration Program (2008-present), Ohio State University South Centers

Adjunct Professor (2005-present), Key Laboratory of Fish Genetic Resources and Biotechnology, Chinese Ministry of Agriculture

Research Associate Professor (2003) and Senior Research Associate (2000-2003), Department of Fisheries & Wildlife, University of Missouri-Columbia

Associate Professor (1993-2000); Assistant Professor (1987-1993); and Research Associate (1984-1986), Department of Aquaculture & Environment, YFI, Chinese Academy of Fisheries Sciences

SCIENTIFIC AND PROFESSIONAL ORGANIZATIONS

American Fisheries Society
Asian Fisheries Society
World Aquaculture Society

RECENT PUBLICATIONS

Wang, H. P., L. Li, G. K. Wallat, B. Brown, H. Yao, Z. Gao, L. G. Tiu, P. O'Bryant, D. Rapp, and R. MacDonald. 2009. Evaluation of relative growth performance and genotype by environment effects for cross-bred yellow perch families reared in communal ponds using DNA parentage analyses. Aquaculture Research 40:1363-1373.

Zhan, A. B, W. Yao, B. Brown, and H. P. Wang. 2009. Isolation and characterization of novel microsatellite markers for yellow perch (*Perca flavescens*). International Journal of Molecular Science 10:18-27.

Wang, H. P. G. K. Wallat, R. Hayward, L. G. Tiu, P. O'Bryant, and D. Rapp. 2009. Establishment of mostly-male groups of bluegill by size-selection and evaluation of their growth performance. North American Journal of Aquaculture 71:216-223.

Gao, Z., H. P. Wang, D. Rapp, P. O'Bryant, H. Yao, G. K. Wallat, W. Wang, R. MacDonald, and L. G. Tiu. 2009. Gonadal sex differentiation in the bluegill sunfish *Lepomis macrochirus* and its relation to fish size and age. Aquaculture 294:138-146.

Wang, H. P., Z. Gao, B. Beres, J. Ottobre, G. K. Wallat, L. G. Tiu, D. Rapp, P. O'Bryant, and H. Yao. 2008. Effects of estradiol-17β on survival, growth performance, sex reversal and gonadal structure of bluegill sunfish *Lepomis macrochirus.* Aquaculture 285:216-223.