DEVELOP SYSTEMS AND DIET STRATEGIES TO REDUCE YELLOW PERCH LARVAL MORTALITY BURST IN INDOOR RECIRCULATING AQUACULTURE SYSTEMS

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Funding Request:	$190,000
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Objectives:

1. Develop system(s) to address physical and behavioral barriers to enhance mass production and survival of yellow perch (YP) from onset of first feeding up to 70 days.
2. Develop strategies to increase survival of fry and larvae of yellow perch reared indoors using different feeding regimens.

Deliverables:

1. Develop modules for self/group training for YP aquaculturists. Modules should be prepared at the initiation of the project and updated to include new procedures/protocols learned from the project.
2. Prepare an overall report of the findings including an executive summary.

Proposed Budgets:

Institution	Principal Investigators	Objectives	Year 1	Year 2	Total
The Ohio State University	Han-Ping Wang	2 & Deliverables	$53,465	$46,535	$100,000
University of Wisconsin-Steven Point	Christopher F. Hartleb Gregory Fischer	1 & Deliverables	$40,500	$34,500	$75,000
Iowa State University	D. Allen Pattillo	Deliverables	$5,300	$9,700	$15,000
		TOTALS	**$99,265**	**$90,735**	**$190,000**

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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 since 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. For example, wholesale prices for yellow perch fillets reached a peak of $14.50−20.00/kg ($6.60-9.00/lb), and retail prices to $20.00-33.00/kg ($9.00-15.00/lb) as compared to $11/kg ($5/lb) retail for catfish (Kentucky State University 2003) and $8-12/kg ($3.64-5.45/lb) for fresh tilapia fillet (Lutz et al. 2003). Despite this opportunity, rapid expansion of the yellow perch aquaculture industry has not occurred in the NCR and the GLR. One roadblock hindering expansion has been low survival and availability of fry and fingerlings. The survival rate of pond nursed fry is dependent on weather and late winter storms can kill all the fry in ponds overnight. Yellow perch can reach market size in 1 year with constant temperature and photoperiod in an indoor system, which limits sexual maturation. Therefore, developing the indoor culture of yellow perch has significant advantages over pond culture. Limiting this possibility has been the poor indoor survival of newly hatched fry to the stage where they are completely feed-trained. Developing strategies to increase indoor survival of larvae and fry using live feed is critical to the yellow perch industry development

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 5−8 million kg/year (5,512-8,818 tons/year) to the current limit of less than 3 million kg/year (3,307 tons/year). 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. Invasive species such as viral hemorrhagic septicemia and Asian carp 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 Midwest USA. Improving yellow perch production efficiencies and resolving the larval mortality burst, which occurs in recirculating culture systems, will lead to the growth of the yellow perch industry. This will result in more farm operations remaining sustainable and profitable and will lead 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.A. 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. Yellow perch frequently show a high mortality during the larval stage of development in natural waters. According to Carlander (1995), egg survival to 8-mm fry varied from 1.6 – 18.4% in Oneida Lake, NY; the natural mortality of perch fry, 8-20 mm (0.31-0.79 inches), was 54%, 71% and 62% in Oneida Lake, in NY in 1965, 1966 and 1967 (mean 62.3%), respectively; the survival of larval perch for 9 weeks in Spirit Lake, IA, was 46% in 1973, 18% in 1974 and 23% in 1975 (mean 29%). The high mortality is often attributed to the combination of extrinsic and intrinsic factors (Czesny et al. 2005). Complex interactions of abiotic (turbidity, water flow, tank color) and biotic (cannibalism, prey capture, mortality) factors can have profound impacts on survival during early-life stages of most fish species and represent non-random bottlenecks to increased production in all culture systems (Czesny et al. 2005).

In culture conditions, there are several critical factors affecting survival of percid species, including small mouth gape, dependence on live food organisms, non-feeding behavior, non-inflation of the gas bladder, clinging behavior, and cannibalism (Craig 2000). Despite the availability of high quality feeds for small larvae, mainly formulated for marine species, the acceptance, growth and survival of percid fishes fed formulated diets as starting food are still highly variable and rather unsatisfactory (Kestemont and Melard 2000). One of the major reasons is that mouth gap of yellow perch is too small to take most dry commercial feeds at beginning.

RELATED CURRENT AND PREVIOUS WORK

Since the 1980s many commercial ventures have attempted to use recirculating aquaculture systems (RAS) to produce one popular percid species, the yellow perch. Most of these ventures eventually failed, however, due largely to problems resulting during the early-life stages such as poor feed acceptance, slow growth, and cannibalism. Over a decade ago, scientists from Iowa State University developed a method for rearing walleye (*Sander vitreus*) fry to the fingerling stage in tanks exclusively on formulated feed (Summerfelt 1996). Initially, the survival and growth of walleye fry reared in tanks was low. But continual refinements to the original methods, including tank designs, feeds, and feeding strategies, greatly improved the survival and growth, and reduced severe problems with swim bladder inflation (Summerfelt et al. 2011).

Advances in walleye culture techniques such as tank design, tank color, surface sprays, in-tank turbidity, and stocking densities have produced excellent results that can be transferrable to other percid fishes. Depending upon species, turbidity can have either a positive or negative effect on the feeding ability of larval fish. Juvenile and adult walleye are well adapted to feeding under low light and turbid conditions. Larval fishes of other species are less tolerant of suspended solids than adults or eggs. Larvae of yellow perch are able to tolerate suspended solids levels of 50 mg/L. For larval walleye, survival, length, and weight of fry reared in water of high turbidity (>15 NTU) are significantly greater than for fry reared in water of low turbidity (<0.3 NTU). The main benefit of increased turbidity is its effect on fry behavior. Walleye fry in turbid water do not orient or cling to the tank walls as they do in tanks supplied with clear water. The substantial differences in performance are attributed to increased feeding success of larvae in turbid water. Feeding, growth, and survival are substantially greater for walleye fry reared in turbid water (23.8 NTU) than for fry reared in clear water (0.4 NTU). Fish reared in the turbid water tanks have greater gas bladder inflation than fish reared in other treatments. Clinging by fry to the tank sidewalls is inversely related to turbidity. Fry distribution may influence feeding opportunities because fry that cling to the sidewalls of the tank are ill-positioned to feed (Summerfelt et al. 2011). Fry that are dispersed in the tank have an increased chance to encounter and consume feed particles. Turbidity may also influence the visibility of feed. Other researchers have suggested that the contrast of prey with the surroundings increases the ability of larval fish to distinguish prey (Bristow et al. 1996).

The effects of light intensity on feeding activity are largely dependent on physical variables such as the color of the tank walls or water turbidity. The combination of light intensity and tank color can modify the efficiency of food perception and the feeding behavior of fish larvae. Hinshaw (1985) suggested that yellow perch larvae are attracted to white walls and cease feeding, thereby recommending the use of grey walls and a diffuse light source. Craig (2000) suggested the use of white or light color tanks walls for the larval culture of perch under a maximum light source of 800 lux at the water surface. Recent studies indicate that medium (0 lux) to high (400 lux) light intensity and long photoperiod (24-h daylight) can significantly reduce mortality due to cannibalism in perch larvae, while low intensity (5 and 30 lux) under 16-24 h of day length appears more appropriate for post-larvae (Craig 2000). Clearly, light intensity and the synergistic effects with turbidity and tank color require further investigation.

In walleye, problems related to non-inflation of the gas bladder can be reduced with a surface spray [0.5L/min (0.13-0.26 gal/min)] in circular tanks) which removes the oil film and cleans the surface of food and debris. Swim bladder inflation is an essential event associated with early development in most fish larvae. In physoclistous fish, initial inflation occurs when air, gulped by the larvae from the surface, passes through the gut and is transferred via a pneumatic duct to the swim bladder lumen. Because the pneumatic duct exists for only a brief period of time in larval development before it regresses, inflation must occur during this narrow window of opportunity. Once the physical connection between the gut and swim bladder lumen has degenerated, swim bladder inflation cannot occur. Experimental evidence demonstrates slower growth of fish with non-inflated swim bladders compared with normal fish (Czesny et al. 2005).

Czseny et al. (2005) showed that yellow perch larvae with an inflated swim bladder grew faster than those with a non-inflated swim bladder during the initial two weeks after hatching. Average daily growth rate of yellow perch with inflated swim bladders was 0.50 $\pm$ 0.02 mm/d (0.02 $\pm$ 0.0008 in/d) versus 0.32 $\pm$ 0.01 mm/d (0.013 $\pm$ 0.0004 inches/d) for fish without inflated swim bladders. Swim bladder inflation affected yellow perch prey capture efficiency. Yellow perch larvae with inflated swim bladders always captured prey more efficiently than individuals without inflated swim bladders from the same size-class when foraging on the same prey. Also, yellow perch with non-inflated swim bladders consumed more oxygen than fish with inflated swim bladders. Czseny et al. (2005)

concluded that yellow perch larvae without inflated swim bladders captured evasive prey poorly, expended more energy to maintain position, and were more vulnerable to predation relative to those with inflated swim bladders. In practical application, these deficiencies translate into declining survival and slower growth.

The Ohio State University (OSU) has established several new strains of yellow perch and has developed spawning, culture and pond nursery techniques for yellow perch. The OSU Bowling Green Aquaculture Center (BGAC) successfully developed a hatchery and nursery facility for baitfish and successfully nursed spotfin shiners (*Cyprinella spiloptera*) entirely indoors using cultured marine rotifers. In spring 2012, the OSU Aquaculture Research Center at Piketon successfully nursed yellow perch larvae in indoor RAS using marine rotifer and baitfish nursery techniques developed by the BGAC. By using an indoor marine rotifer culture and production system, algal enrichment of rotifers, and then intermixing rotifers with *Artemia* and micro-diets we were able to successfully rear and maintain multiple tanks of yellow perch fry to 70 d post-hatch using this approach. The trials were conducted in 3-ft diameter tanks with two batches of fry in two replicates. The original stocking rate was 10,000 larvae in each tank. Approximately 28% of yellow perch fry were successfully reared to 70 d and transferred to a complete artificial diet. From these trials, the critical time to add micro-diets has been identified. We hypothesize that these techniques can be applied to yellow perch at a commercial-scale to achieve feeding and survival success with the ultimate goal of using a commercial diet from onset of exogenous feed similar to what has been done in walleye culture.

For the last several years, researchers at the University of Wisconsin-Stevens Point/Northern Aquaculture Demonstration Facility (UWSP-NADF) have been conducting studies to address physical and behavioral problems and improve survival of intensively reared larvae and fry in walleye, a fish species having many of the same problems with larval culture as yellow perch (Summerfelt et al. 2011). The physical and behavioral problems with these small larvae include non-inflation of the swim bladder, clinging behavior, feed acceptance, and cannibalism as documented by the lifetime of work conducted by Summerfelt et al (2011). We have found that in walleye, these problems can be largely overcome using a combination of increased water turbidity, directional water inflow, controlled lighting, dark room environment, dark tank coloration, and water spray on the surface of the tank to minimize the coverage of the water surface with particles and films that impede swim bladder inflation. Using these methods, UWSP-NADF personnel have now been able to produce sufficient purebred and hybrid walleye fingerlings in indoor intensive systems to aid the fledgling walleye food-fish industry into commercial-scale production. We hypothesize that similar techniques will be successful at overcoming the early-life stage mortality in intensively raised yellow perch.

ANTICIPATED BENEFITS

Results garnered from this commercial-scale research will be incorporated into an overall report, including executive summary, about culture strategies and protocols that can be used to increase the survival or larval (fry) yellow perch in indoor recirculating systems using culture methods and feeding regimens that maximize mass production. These new methodologies will greatly improve larval yellow perch survival and help feed the growing RAS production of yellow perch food fish, an important aquacultured species in the NCR.

The impact of this proposed project will be primarily through the development of systems and strategies to enhance mass production and survival of yellow perch from onset of first feeding up to 70 d, the critical period for yellow perch in recirculating aquaculture systems. The greatest return on investment for this project is the ultimate reduction in production costs due to increased growth rate and survival of larval yellow perch by using tank systems and feeding regimes optimized for the early-life stage. At the completion of this project, we expect to not only have information available about recirculating system components, feeding strategies, and feed types for successfully reducing the early-life stage bottlenecks, but to have online training modules available through the NCRAC website for aquaculturists in the NCR. The online training modules will provide direct information to yellow perch culturists on current and updated procedures and protocols for reducing yellow perch larval mortality burst in indoor recirculating aquaculture systems.

OBJECTIVES

1. Develop system(s) to address physical and behavioral barriers to enhance mass production and survival of yellow perch (YP) from onset of first feeding up to 70 days.
2. Develop strategies to increase survival of fry and larvae of yellow perch reared indoors using different feeding regimens.

DELIVERABLES

1. Develop modules for self/group training for yellow perch. Modules should be prepared at the initiation of the project and updated to include new procedures/protocols learned from the project.
2. Prepare an overall report of the findings including an executive summary.

PROCEDURES

General Approach

Developing systems and diet strategies to increase indoor survival of larvae and fry using live feeds and, more importantly, dry microdiets are critical to yellow perch industry development. To accomplish this:

1) We will use a multi-team, multi-component and systematic approach to address the development of such systems and strategies by testing and building on methods that have proven successful in walleye and baitfish culture, and by using different combinations of marine rotifers, brine shrimp and dry microdiets, and different feeding regimens.
2) We will develop larviculture system components to address physical and behavioral barriers to enhance mass production and survival of yellow perch while using first-feed, dry microdiets.
3) Since marine L-type strain rotifer *Brachionus plicatilis* is very productive and is recognized as a commercialized live feed item for larval fish that are known to be difficult first-time, exogenous feeders, we will improve marine rotifer production, feeding systems as an alternative diet strategy for larval yellow perch.
4) We will conduct commercial-scale experiments that will produce results that fish farmers can directly apply.
5) We will disseminate current and new procedures and protocols through online self/group training modules and workshops.
6) Economic analyses will be conducted for each strategy based on survival across feed types.

Similar procedures will be followed at each research site to obtain yellow perch larvae. Single-pair mating will be conducted in 50 cm-diameter (19.69 in) tanks with flow-through water in March when fish have reached a mature stage. For those females that can be stripped, eggs will be fertilized by a semen pool collected from multiple males. We will synchronize females with one or two injections of HCG at the dosage of 200 - 600 IU/kg body weight based on their need and maturity. The fertilized egg ribbon will be collected daily from spawning tanks starting 2 days post-injection. Hardened egg ribbons will be incubated communally in tanks with flow-through well water at a temperature of 10 - 14 °C (50 – 57.2 °F). 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 post hatch, fry will be siphoned and counted for stocking into tanks for commercial-scale experiments.

Specific Approaches

Objective 1 (UWSP-NADF): Develop systems to address physical and behavioral barriers to enhance mass production and survival of yellow perch from onset of first feeding up to 70 days.

A two-stage series of experiments will be conducted. The 1st (Objective 1.1) stage will examine individual effects of physical and behavioral barriers, while the 2nd (Objective 1.2) stage will examine the combined effects of these barriers so that techniques/systems can be optimized for mass production of early-life stage yellow perch.

Objective 1.1 (Year 1) - Non-feeding behavior, non-inflation of the gas bladder, clinging behavior, and cannibalism will be examined using a series of methodical experiments evaluating the effects of:

- **Turbid water** – three treatments of clear (0 NTU), slightly (50 NTU), and turbid (100 NTU) water will be used to examine the effects on non-feeding behavior, such as clinging (an innate phototactic response), and incidences of cannibalism, while using standard black colored tanks.
- **Water surface spray** – three treatments of no flow (0 L/min, 0 gal/min), moderate (0.4 L/min, 0.11 gal/min), and high (0.8 L/min, 0.21 gal/min) water flow will be achieved using an overhead spray to determine the dispersion effects on surface oil film and debris, swimming response due to possible non-inflation of the swim bladder, and possibly reduced cannibalism from increased dispersion of fish in the tanks.
- **Tank color –** three treatments of white, blue, and black interior colored tanks will used to examine the effects of background contrast on food detection by larval yellow perch. Attraction to the walls, based on color, by larval yellow perch will also be documented and quantified through observations.

In the experiments for <u>each</u> <u>factor</u> we will use nine, 240-L (63.4-gal), fiberglass, circular tanks with specialized center standpipe drains and screens designed for larval fish culture. The tanks will be supplied with oxygen (>6 mg/L) aeration and will be stocked with 3,000 larval yellow perch per tank (approx. 12 larvae/L, 46 larvae/gal). Newly hatched larval yellow perch will be placed into experimental tanks and fed high quality, dry diets, including microencapsulated, and then trained to standard commercial yellow perch diet and fed life-stage specific optimum rations. Modified rotary automatic aquarium feeders (Lifeguard model, Pentair Aquaculture, CA) will be used to continuously feed the fry. The tanks will be inspected and cleaned daily by siphoning bottoms and sides. Experiments will be run for up to 70 d.

For intensive, high-density indoor fish rearing systems, water temperature is a key component of fish survival and growth. Generally, high temperatures (near or at the optimum for a species) promote maximum feeding response and growth, but can also result in problems with disease and fish health. Somewhat lower temperatures may reduce growth rates but usually reduce disease and health-related problems. We have found that the best “compromise” temperature for rearing yellow perch fry is at 21 °C (69.8 F; Wang and Eckmann 1994), and therefore this is the temperature that will be used.

Turbid water will be created using clay (L&R Specialties, MO) that will be added to maintain either slightly (50 NTU) or turbid (100 NTU) water, along with the control (clear, 0 NTU), for the turbid water experiments. The clay suspension will be added via a separate 151-L (40-gal) clay-mixing tank and peristaltic metering pump (Blue-White Industries, CA; Bristow et al. 1996). The water will be delivered at 2.0 L/min (0.53 gal/min) in a manner to provide constant directional current, which acts to align the fry continuously into the current, thereby minimizing fish- fish aggression and cannibalism. Water flow will be increased to 6.0 L/min (1.6 gal/min) as fry grow to maintain good water quality with increased feeding.

A constant surface spray on the top of the water, using horticultural hanging basket flex-misters (Hummert International, MO) will be provided to create directional water flow and facilitate gas bladder inflation. Surface sprayers will be adjusted to provide the three treatments of no flow (0 L/min, 0 gal/min), moderate (0.4 L/min, 0.1 gal/min), and high (0.8 L/min, 0.21 gal/min) flow. Flow will be monitored using a digital water velocity meter (Global Water, CA). Surface spray volume will also be measured as it relates to tank surface area.

Tank color will be established by applying epoxy paint to the inside of nine replicate tanks per color with the three treatments of white, blue, and black. A reflectometer will be used to quantify the shade of each color compared to a neutral gray card. Interior tank color should provide a background contrast for food detection by larval yellow perch. First feeding by yellow perch larvae occur sooner when prey have a higher contrast. Prey contrast is a more important factor in survival and growth of larval yellow perch than absolute light levels, and that contrast of the prey or food is especially important to the larvae near the onset of feeding (Hinshaw 1985). Attraction to the walls, based on color, by larval yellow perch will be documented and quantified using the method described by Bristow et al. (1996) which uses a sample plate with quadrants to measure clinging behavior.

Tanks will be housed in a darkroom environment, where lighting can be controlled, and to limit stress from normal activities in the facility. Tanks will be lit using adjustable overhead, low level (<100 lux), diffuse lighting provided by incandescent bulbs set to provide 24-hours daylight as described by Craig (2000). Mid-tank light intensity will be measured using an underwater quantum light sensor (Li-Cor, NE) at the start, middle and end of the experiment as it is influenced by tank color and water turbidity.

A random sample of 25 fry per tank will be collected every two weeks and measured for length and weight gain; mortalities will be recorded as observed mortality and removed daily. These fish will also be examined microscopically for swim bladder inflation and food in the alimentary canal (as a proxy of feed acceptance). At the end of the study, the remaining fish will be counted and measured for total length and an aggregate weight of 100 fry which will be used as an estimate of mean fry weight along with 100 fry/tank examined for the presence of food in the gut and gas bladder inflation. Percentages of unobserved mortality (cannibalism) and observed mortality (death) will be calculated. Each treatment will be analyzed independently using ANOVA and differences will be considered significant at the 5% level. When the P-value of an ANOVA is significant, Fisher's protected least significant difference test (a multiple-comparison test) will be used to determine which treatment differed significantly.

Objective 1.2 (Year 2) – We will build upon the experiments of Year 1 by optimizing the results of stage-1 using a 3x3x1 factorial design with three replicates per treatment. Once the amount of turbidity is defined in the broad categories of stage-1, three narrower ranges of turbidity will be investigated in stage-2. These will be simultaneously examined along with three narrower levels of water flow that will be investigated based on the broad categories tested in stage-1. Finally, one tank color, determined in stage one as the optimum color, will be used for the combined experimental treatments in stage-2. The same general tank setups and feeding will be used, as well as the same data factors collected. ANOVA will be used to analyze the data in stage-2 with multiple comparisons among the treatments within each factor used to determine optimum culture conditions.

Objective 2 (OSU): Develop strategies to increase survival of fry and larvae of yellow perch reared indoors using different feeding regimens.

Objective 2.1 - Improve commercialized, marine rotifer production as an alternative diet strategy for freshwater RAS to enhance survival of larval yellow perch.

Commercialized marine rotifer production has a well-established reputation for improving the exogenous first-feeding of many marine and freshwater fish. Its comparative and alternative role in feeding strategies for providing adequate nutrition to yellow perch has not been explored well and may fill a unique niche in overcoming larval mortality burst in RAS. By improving marine rotifer feeding systems to deliver rotifer to the fish frequently, based on a rotifer survival of 15-20 minutes in freshwater, the critical period of feed acceptance by larval yellow perch may be extended. This may diminish the larval mortality burst observed in RAS culture of yellow perch. Using the established hatchery and nursery procedures for baitfish at BGAC, two commercial-scale algae auto-feeders and rotifer production systems will be constructed that will allow us to culture and concentrate the needed number of rotifers to feed at a rate and concentration deemed necessary for the amount of fry in each tank. Rotifers will be fed 24 h per day using a peristaltic pump and digital repeat cycle timer. To ensure proper feeding and harvesting, rotifers will be sampled daily and counted. From this number, the rotifer feeding amount will be determined along with the amount to be harvested.

To stimulate movement and feeding behavior of fry and increase density and availability of marine rotifer, sixteen rotifer auto-feeders will be constructed and paired with sixteen yellow perch production tanks (1-m [3.28-ft] diameter). The feed reservoirs holding the rotifers in the feeders will be placed in campus-style refrigerators that allow us to "cold bank" the rotifers, slowing their metabolism and maintaining their nutritional value above that which could be achieved through storing them at room temperature. Rotifers will be harvested from rotifer production systems in the morning and afternoon and loaded into the rotifer feeders, which will deliver rotifers to larvae tanks 4 minutes every 12 min for 24 h/d.

To harvest rotifers, and to maintain proper water quality, approximately 30 percent of the rotifer tanks will be processed daily. After the rotifer feeding stage, the auto-feeders will be used for brine shrimp feeding. The sixteen sets of systems will be used and tested with 16 feeding regimens in Objective 2.2 to select the two best feeding protocols. One set of a similar system was preliminarily tested in spring, 2002 and we achieved approximately 50% survival rate of yellow perch fry.

Objective 2.2 - Develop diet strategies and protocols to increase survival of fry and larvae of yellow perch reared indoors using marine rotifers, microdiets and various feeding regimens.

Two commercial feeds (Otohime A2, Marubeni Nisshin, 58% protein and AP 100, Zeigler Feeds, 50% protein) will be used based on their size (50-250 micron) and protein contents which approach that of the marine rotifer (*Brachionus plicatili,* 58%). Sixteen 400-L (106-gal) tanks with rotifer auto-feeders will be randomly divided into four treatments, each having four replicates, for the first live feeding phase. Each treatment will be sub-divided into to two sub-treatments, each having two replicates, for the micro-diet phase (each diet will be a sub-treatment with two replicates). The following feeding regimens will be tested for at least 70 d in year 1:

- Treatment 1: Fish will be fed ~100 rotifers per fish per day for 5 d post swim up; then each replicate will be fed 50 rotifers per fish per day plus either of the two weaning diets (2 tanks/reps on Otohime and 2 tanks/reps on Zeigler) for an additional 15 d. After this overlap period, the fish will be fed commercial micro-diet for at least 50 additional days.
- Treatment 2: Same as treatment 1 with rotifer amounts changed to ~200 and 100/fish/d, respectively.
- Treatment 3: Fish will be fed ~100 rotifers per fish per day for 10 d post swim up; then each sub-replicate will be fed 50 rotifers per fish per day plus either of the two weaning diets for an additional 20 d. After this overlap period, the fish will be fed commercial micro-diet for at least 40 additional d.
- Treatment 4: Same as treatment 3 with rotifer amounts changed to ~200 and 100/fish/d, respectively.

In year 2, the same eight regimens will be tested, but rotifers will be replaced with brine shrimp in the overlap period phase.

Deliverables 1 & 2 (ISU, UWSP and OSU):

Deliverable 1 (Year 1 & 2) Develop modules for self/group training for yellow perch aquaculturists. Modules should be prepared at the initiation of the project and updated to include new procedures/protocols learned from the project.

Specialized delivery technologies can provide efficient and timely access to learning materials (Seitz and Sutton 2010). Online learning allows for flexibility of access, from anywhere and usually anytime, because online learning knows no times zones, and location and distance are not an issue (Edge and Loegering 2000). In early 2004, 63% of Americans had access to the internet and that grew to 73% by the beginning of 2006. 40 million Americans rely on the internet as their primary source for news and information about science – this is second only to television. 67% of Americans said they would turn to the internet first for information about science. 87% of internet users report they use the internet as their primary research tool because of convenience, the internet provides a better understanding of science information, and it is easier to search (Horrigan 2006). In asynchronous, online learning users can access the online material at any time. The goal of any instructional system is to promote learning. Therefore, as learning material is developed the educator must tacitly know the principles of the audience that is learning. This is especially true for online learning, where the educator (project investigators) and the learner (yellow perch aquaculturist) are separated. Strategies should be used in online learning that allow the learner to perceive and attend to the information in an applied or working format so that it has real-world and immediate application.

A series of online training modules will be designed that include procedures and protocols of developing systems to address physical and behavior barriers to enhance mass production and survival of yellow perch from onset of first feeding up to 70 days (Objective 1). These online modules will use the successful framework previously developed, by one of the investigators of this project, for the Online Fish Health Certificate Program for Producers. The modules will also include training videos (similar to the video developed by UWSP-NADF that focused on the reproduction and spawning of yellow perch), guidelines, links to resources, and a program evaluation component.

The Iowa State University portion of the online training modules will be designed to include procedures and protocols of current and updated methods for improving the indoor culture of early life stage yellow perch through different diet strategies (Objective 2). Modules will be made available in online format, using voiceover PowerPoint with integrated and independent training videos, culture guidelines, links to resources, and a program evaluation component. The evaluation component will promote assessment of learning outcomes and impacts from the modules, and aid in program modification based on user feedback and successful application of the content. Learning modules will be housed at the Fish Nutrition Launchpad (http://www.ncrac.org/nutrition/) and/or on the NCRAC video gallery, which is accessible through NCRAC website (www.NCRAC.org).

Deliverable 2 (Year 2) Prepare an overall report of the findings including an executive summary.

An overall report of the findings including an executive summary will be developed and published by the principal investigators. Hands-on workshops will be offered at both the OSU and UWSP-NADF demonstrating the successful procedures and practices identified during these studies. Both facilities already offer open-house events and we will incorporate the larval yellow perch workshops into these events.

FACILITIES

The OSU has commercial-scale research facilities in Aquaculture Research Center (ARC) at Piketon. Up to 200 indoor tanks including thirty 400-L (106-gal) round tanks can be used for this project. A first-class hatchery and nursery facility for baitfish in former OSU-BGAC was moved to ARC in summer, 2012, and can be used for this project also. UWSP-NADF is a state-of-the-art aquaculture demonstration and research facility located in Red Cliff, Wisconsin. The rearing facilities include a bell jar incubation system, a heath tray incubation system, several (37,850-45,425 L (10,000-12,000 gal) RAS and a multi-tank, research system of 227-L (60-gal) tanks that will be used in this study. Iowa State University has professional-grade HD video recording and audio equipment, and computer editing software that can be used to develop training modules.

REFERENCES

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PROJECT LEADERS

State	Name/Institution	Area of Specialization
Ohio	Han-Ping Wang The Ohio State University	Fish Culture/Fish Genetics
Wisconsin	Christopher Hartleb University of Wisconsin-Stevens Point	Fish Culture/Fish Biology
	Gregory Fischer University of Wisconsin-Stevens Point	Fish Culture/RAS
Iowa	Allen Pattillo Iowa State University	Extension/Fish Culture

PARTICIPATING INSTITUTIONS AND CO-PRINCIPAL INVESTIGATORS

The Ohio State University
Han-Ping Wang

University of Wisconsin-Stevens Point
Christopher F. Hartleb
Gregory Fischer

Iowa State University
Allen Pattillo

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

OMB Approved 0524-0039

ORGANIZATION AND ADDRESS Ohio State University South Centers 1864 Shyville Rd Piketon, OH 45661 PROJECT DIRECTOR(S) Han-Ping Wang	USDA AWARD NO. Year 1: Objective 2 & deliverables 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 Cost-Sharing	Non-federal Cost-Sharing 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. 0.5 Research Associates/Postdoctorates	6			20,500.00			
b. ____ Other Professionals							
c. ____ Paraprofessionals							
d. ____ Graduate Students							
e. 1 Prebaccalaureate Students							
f. ____ Secretarial-Clerical							
g. ____ Technical, Shop and Other							
Total Salaries and Wages ☐				20,500.00			
B. Fringe Benefits (If charged as Direct Costs)				7,605.00			
C. Total Salaries, Wages, and Fringe Benefits (A plus B) ☐				28,105.00			
D. Nonexpendable Equipment (Attach supporting data. List items and dollar amounts for each item.)							
E. Materials and Supplies				22,960.00			
F. Travel				2,400.00			
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 J) ☐				53,465.00			
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 included in on/off campus bases.)							
M. Total Direct and F&A/Indirect Costs (K plus L) ☐				53,465.00			
N. Other ☐							
O. Total Amount of This Request ☐				53,465.00			

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

Q. Cost-Sharing/Matching (Breakdown of total amounts shown on 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
BUDGET

OMB Approved 0524-0039

ORGANIZATION AND ADDRESS Ohio State University South Centers 1864 Shyville Rd Piketon, OH 45661 PROJECT DIRECTOR(S) Han-Ping Wang				USDA AWARD NO. Year 2: Objective 2 & deliverables			
				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				
1. No. Of Senior Personnel							
a. ____ (Co)-PD(s)							
b. ____ Senior Associates							
2. No. of Other Personnel (Non-Faculty) a. __0.5_ Research Associates/Postdoctorates	6			21,115.00			
b. ____ Other Professionals							
c. ____ Paraprofessionals							
d. ____ Graduate Students							
e. _1__ Prebaccalaureate Students							
f. ____ Secretarial-Clerical							
g. ____ Technical, Shop and Other							
Total Salaries and Wages ☐				21,115.00			
B. Fringe Benefits (If charged as Direct Costs)				8,045.00			
C. Total Salaries, Wages, and Fringe Benefits (A plus B) ☐				29,160.00			
D. Nonexpendable Equipment (Attach supporting data. List items and dollar amounts for each item.)							
E. Materials and Supplies				14,075.00			
F. Travel				3,300.00			
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 J) ☐				46,535.00			
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 included in on/off campus bases.)							
M. Total Direct and F&A/Indirect Costs (K plus L) ☐				46,535.00			
N. Other ☐							
O. Total Amount of This Request ☐				46,535.00			

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

Q. Cost-Sharing/Matching (Breakdown of total amounts shown on 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 OHIO STATE UNIVERSITY

(Wang)

Objective 2 & deliverables

A. Salaries and Wages. Six months' Salary for a RA for year 1: $20,500 and year 2: $21,115. The RA will be involved in managing all experiments, experimental fish and data collection analyses.

B. Fringe Benefits. Year 1: the fringe benefit is 37.1% ($7,606); Year 2: the fringe benefit is 38.1% ($8,045).

E . Materials and Supplies.: Year 1: Algae, rotifer and micro-feeds and regular diets ($6,100); Twelve campus-style refrigerators for constructing rotifer auto-feeders ($3,000); Other materials for constructing twelve rotifer auto-feeders ($1,200); Two commercial-scale algae auto-feeders and rotifer production systems ($3,500); Belt feeders x 16 for feeding ($3,200); Small heaters x 32 for heating water ($960); Lab chemicals ($1,000); Pond and tank supplies (net, bucket et al.) ($1,000); Power and water costs ($3,000); Total of $22,960. Year 2: Algae, rotifer and micro-feeds and regular diets ($7,375); Lab chemicals ($1,300); Pond and tank supplies (net, bucket et al.) ($1,400); Power and water costs ($4,000); Total $14,075

E. Travel. Each Year: One professional meeting to report on project findings - (American or World Aquaculture Society) for one person to report of project findings: $2,400/year - Air ticket: $400-500; registration-$450; Hotel: 5 x $170=$850; Food per diem: 6 x 60=$360; Travel to Airport and hotel: $150 (round trip from Piketon to Columbus: 170 mile x 0.565 = $96); Other-$50. Year 2: One trip to UWSP-NADF for project coordination and workshop: $900 - Air ticket: $300; Travel to Airport and hotel: $140 (round trip from Piketon to Columbus: 170 miles x 0.565 = $96); Hotel: 2 x 140=$280; Food per Diem: 3 x 60=$180.

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

OMB Approved 0524-0039

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 Gregory Fischer				USDA AWARD NO. Year 1: Objective 1 &deliverables			
				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**						
1. No. Of Senior Personnel	Calendar	Academic	Summer				
a. ____ (Co)-PD(s)			1.5	$6,000			
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 ☐				$17,440			
B. Fringe Benefits (If charged as Direct Costs)				$4,480			
C. Total Salaries, Wages, and Fringe Benefits (A plus B) ☐				$21,920			
D. Nonexpendable Equipment (Attach supporting data. List items and dollar amounts for each item.)				$6,000			
E. Materials and Supplies				$10,080			
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.)							
K. Total Direct Costs (C through J) ☐				$40,500			
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 included in on/off campus bases.)							
M. Total Direct and F&A/Indirect Costs (K plus L) ☐				$40,500			
N. Other ☐							
O. Total Amount of This Request ☐				$40,500			

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

Q. Cost-Sharing/Matching (Breakdown of total amounts shown on 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
BUDGET

OMB Approved 0524-0039

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 Gregory Fischer				USDA AWARD NO. Year 2: Objective 1 &deliverables 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						
1. No. Of Senior Personnel	Calendar	Academic	Summer				
a. ____ (Co)-PD(s)			1.5	$6,000			
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 ☐				$17,440			
B. Fringe Benefits (If charged as Direct Costs)				$4,829			
C. Total Salaries, Wages, and Fringe Benefits (A plus B) ☐				$22,269			
D. Nonexpendable Equipment (Attach supporting data. List items and dollar amounts for each item.)							
E. Materials and Supplies				$9,731			
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.)							
K. Total Direct Costs (C through J) ☐				$34,500			
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 included in on/off campus bases.)							
M. Total Direct and F&A/Indirect Costs (K plus L) ☐				$34,500			
N. Other ☐							
O. Total Amount of This Request ☐				$34,500			

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

Q. Cost-Sharing/Matching (Breakdown of total amounts shown on 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 and Fischer)

Objectives 1 & 3

A. Salaries, Wages. Salary for PI, who is on a 9-month faculty appointment, to cover 240 h/year to supervise project/LTE and collect content and develop modules for deliverables. Salary for limited term employee (LTE, technical) to assist PI in research; (salary @ $11.00/hour, 1,040 hours/year = $11,440). Year 1: PI = $6,000; LTE = $11,440; Year 2: PI = $6,000; LTE = $11,440.

B. Fringe benefits.
Year 1: 35.2% for PI (faculty) and 20.7% for LTE. Total = $4,480
Year 2: 37.2% for PI (faculty) and 22.7% for LTE. Total = $4,829

D. Nonexpendable equipment. Twenty seven, 240-L fiberglass tanks for multi-replicate treatments in Objective 1. ($222.22 per tank x 27 = $6,000)

E. Materials and Supplies. Lighting; turbidity supplies (clay, pumps, storage tanks, dispensing hoses/sprayers); miscellaneous plumbing; epoxy paints; microscopy supplies; fish feed; 27 fish feeders; water chemistry reagents; video equipment and software for module development that includes training video; workshop supplies. Year 1: $10,080; Year 2: $9,731

F. Travel. Requested support is to conduct aquaculture research, develop diet strategies for larval yellow perch, demonstration techniques, and conduct extension education to enhance viable and profitable U.S. aquaculture which will benefit consumers, producers, service industries, and the American economy. Travel from university (UWSP) to field stations (UWSP-NADF and OSU-Piketon) to conduct experiments, collect data, and record video for deliverables (Objective 1). UWSP is four hours from the NADF field station where experiments will be conducted. Requested travel will partially cover cost of travel and lodging for staff to collect information for modules at the field station. Similarly, UWSP staff is requesting partial travel expense coverage for travel to OSU-Piketon to assist with recording content video for training modules and workshops. Alternatively, we could request video equipment and software for both locations, thereby limiting travel, but this would be a more costly option. Partial travel expense coverage from UWSP to ISU to collaboratively develop, edit and produce modules and training videos as deliverables (Deliverables). Quality module and training video creation is best accomplished in a timely manner when all staff involved is present at one location; this is especially true for voice-over PowerPoint presentations where proper narration is important for clarity and accuracy. Year 1: $2,500; Year 2: $2,500.

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

OMB Approved 0524-0039

BUDGET

ORGANIZATION AND ADDRESS Iowa State University	USDA AWARD NO. Year 1: Deliveables			
PROJECT DIRECTOR(S) Allen Pattillo	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						
A. Salaries and Wages	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. __1__ Other Professionals	0.27			$2,560.00			
c. ____ Paraprofessionals							
d. ____ Graduate Students							
e. ____ Prebaccalaureate Students							
f. ____ Secretarial-Clerical							
g. ____ Technical, Shop and Other							
Total Salaries and Wages ☐				$2,560.00			
B. Fringe Benefits (If charged as Direct Costs)							
C. Total Salaries, Wages, and Fringe Benefits (A plus B) ☐				$2,560.00			
D. Nonexpendable Equipment (Attach supporting data. List items and dollar amounts for each item.)							
E. Materials and Supplies							
F. Travel				$2,100.00			
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.) VHS testing				$2,820.00			
K. Total Direct Costs (C through J) ☐				$7,480.00			
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 included in on/off campus bases.)							
M. Total Direct and F&A/Indirect Costs (K plus L) ☐				$7,480.00			
N. Other ☐							
O. Total Amount of This Request ☐				$7,480.00			

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

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

NAME AND TITLE (Type or print)Allen Pattillo, Aquaculture Extension Specialist III	**SIGNATURE** (required for revised budget only)	**DATE 8/26/2012**
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 and reviewing the collection of information.

Form CSREES-2004 (12/2000)

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

OMB Approved 0524-0039

ORGANIZATION AND ADDRESS Iowa State University	USDA AWARD NO. Year 2: Deliverables			
PROJECT DIRECTOR(S) Allen Pattillo	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**			Funds Requested by Proposer	Funds Approved by CSREES	Non-Federal Proposed	Non-federal Approved
1. No. Of Senior Personnel	Calendar	Academic	Summer				
a. ____ (Co)-PD(s)							
b. ____ Senior Associates							
2. No. of Other Personnel (Non-Faculty) a. _____ Research Associates/Postdoctorates							
b. __1__ Other Professionals	0.27			$2,560.00			
c. ____ Paraprofessionals							
d. ____ Graduate Students							
e. ___ Prebaccalaureate Students							
f. ____ Secretarial-Clerical							
g. ____ Technical, Shop and Other							
Total Salaries and Wages ☐				$2,560.00			
B. Fringe Benefits (If charged as Direct Costs)							
C. Total Salaries, Wages, and Fringe Benefits (A plus B) ☐				$2,560.00			
D. Nonexpendable Equipment (Attach supporting data. List items and dollar amounts for each item.)							
E. Materials and Supplies							
F. Travel				$2,100.00			
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.) VHS testing				$2,860.00			
K. Total Direct Costs (C through J) ☐				$7,520.00			
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 included in on/off campus bases.)							
M. Total Direct and F&A/Indirect Costs (K plus L) ☐				$7,520.00			
N. Other ☐							
O. Total Amount of This Request ☐				$7,520.00			

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

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

NAME AND TITLE (Type or print) Allen Pattillo, Aquaculture Extension Specialist III	**SIGNATURE** (required for revised budget only)	**DATE 8/26/2012**
Project Director		
Authorized Organizational Representative		
Signature (for optional use)		

Form CSREES-2004 (12/2000)

BUDGET EXPLANATION FOR IOWA STATE UNIVERSITY

(Pattillo)

Deliverables

A. Salaries, Wages. Videography and Information Technology Specialist. Year 1: 64 hours @ $40/hr = $2,560.00 Year 2: 64 hours @ $40/hr = $2,560.00. Total: $5,120.00

F. Travel. Transport, lodging, and meals associated with travel to The Ohio State University during media collection for module development for Allen Pattillo and videographer. Year 1: 2 flights ($1,000), 3 nights lodging ($600), 3 days car rental ($180), 4 days meals ($320) = $2,100.00; Year 2: 2 flight ($1,000), 3 nights lodging ($600), 3 days car rental ($180), 4 days meals ($320) = $2,100.00; Total: $4,200.00

J. Other Direct Costs. Audio and video recording supplies, as well as computer hardware and editing software fees for module development. Year 1: 6 hrs @ $110/hr + 39.27 hrs @ $55/hr =$2,820.00; Year 2: 6 hrs @ $110/hr + 40 hrs @ $55/hr =$2,860.00. Total: $5,680.00

BUDGET SUMMARY FOR EACH YEAR FOR EACH PARTICIPATING INSTITUTIONS

Year 1

	OSU	UWSP	ISU
Salaries, Wages, and Fringe Benefits	$28,105	$21,920	$2,560
Nonexpendable equipment	$	$6,000	$0
Materials and Supplies	$22,960	$10,080	$0
Travel	$2400	$2,500	$2,100
All Other Direct Costs	$0	$0	$2,820
Total Project Costs	$53,465	$40,500	$7,480

Year 2

	OSU	UWSP	ISU
Salaries, Wages, and Fringe Benefits	$29,160	$22,269	$2,560
Materials and Supplies	$14,075	$9,731	$0
Travel	$3,300	$2,500	$2,100
All Other Direct Costs	$0	$0	$2,860
Total Project Costs	$46,535	$34,500	$7,520

SCHEDULE FOR COMPLETION OF OBJECTIVES

Start date: September 1, 2013
Completion date: August 31, 2015

Objectives and Tasks	**Year 1**						**Year 2**					
	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												
Mating, spawning & incubation												
Broad examination of turbidity, surface spray & tank color												
Refinement of turbidity, surface spray & one tank color												
Objective 2												
***Obj. 2.1* -** develop and improve marine rotifer production and feeding systems												
***Obj. 2.2* -** test 8 protocols using marine rotifers, microdiets and various feeding regimens												
***Obj. 2.2* -** test additional 8 protocols using marine rotifers, microdiets and various feeding regimens												
Objective 3												
Module development & deployment												
Result dissemination												
Manuscript and project report submission												

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EDUCATION

B. S., Fisheries & Wildlife Management, Lake Superior State University, 1992
Assoc. of Arts w/honors, Jackson Community College, 1988

POSITIONS

Facility Manager, University of Wisconsin Stevens Point Northern Aquaculture Demonstration Facility, 2002-present
Natural Resources/Fish Hatchery Program Director, Red Cliff Band of Lake Superior Chippewa 1994-2002
Fisheries Technician, U.S. Fish & Wildlife Service, 2001-2002
Wildlife Technician, U. S. Fish & Wildlife Service, NPWRC, 1993
Raptor Research Biologist, Whitefish Point Bird Observatory, 1990-1993
Associate Research Biologist, Kalamazoo Nature Center, 1992
Fish Hatchery Technician, Lake Superior State University Aquatics Lab, 1990-1991

SCIENTIFIC AND PROFESSIONAL ORGANIZATIONS

American Fisheries Society
World Aquaculture Society/U.S. Aquaculture Society
International Aquacultural/ Recirculating Systems Engineering Society
Wisconsin Aquaculture Association/ Wisconsin Aquaculture Industry Advisory Council

SELECTED PUBLICATIONS

Hartleb, C.F., G. Fischer, M. Symbal and K. Holmes. 2010. Evaluation of lake herring (*Coregonus artedii*) propagation on a commercial-scale for the aquaculture industries of Northern Wisconsin. Final report to the WI Department of Agriculture, Trade & Consumer Protection.

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

Schreiner, D.R., K.I. Cullis, M.C. Donofrio, G.J. Fischer, L. Hewitt, K. G. Mumford, D.M. Pratt, H.R. Quinlan, and S.J. Scott. 2008. Management Perspectives on Coaster Brook Trout Rehabilitation in the Lake Superior Basin. North American Journal of Fisheries Management, 28:1350-1364.

Fischer, G.J., and J.A. Malison. 2007-08. Spotfin Shiner: Baitfish progress report. A progress report of the North Central Regional Aquaculture Center.

Fischer, G.J. University of Wisconsin-Stevens Point Walleye Project-Summer of 2005. 2006. Aquaculture Magazine. July-August 2006, Volume 32, Number 4, pgs 15-17.

Fischer, G. J. 2006 NADF Walleye Project Report. Midwest Tribal Aquaculture Network. June, 2007.

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EDUCATION

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

POSITIONS

Professor of Fisheries Biology & Aquaculture, Department of Biology, University of Wisconsin-Stevens Point, 2006-present
Co-Director, University of Wisconsin-Stevens Point, Northern Aquaculture Demonstration Facility, 2006-present
Associate Professor of Fisheries Biology & Aquaculture, Department of Biology, University of Wisconsin-Stevens Point, 2002-2006
Assistant Professor of Biology & Water Resources, Department of Biology, University of Wisconsin-Stevens Point, 1996-2002
Research Assistant, Maine Cooperative Fish & Wildlife Research Unit, University of Maine, 1992-1996
Research Assistant, Rensselaer Fresh Water Institute, Rensselaer Polytechnic Institute, 1988-90

SCIENTIFIC AND PROFESSIONAL ORGANIZATIONS
American Fisheries Society (Member: Fish Culture & Education sections)
World Aquaculture Society / U.S. Aquaculture Society
Wisconsin Aquaculture Association
Wisconsin Aquaculture Industry Advisory Council
USDA, North Central Regional Aquaculture Center, Member: Technical Committee-Research

SELECTED PUBLICATIONS

Hartleb, C.F., Johnson, J.A. and J.A. Held. 2012. Walleye and yellow perch pond fertilization. Pages 147-161 i*n* Pond Fertilization: Impacts of Nutrient Input on Aquaculture Production, C.C. Mischke, editor. Wiley-Blackwell Publishing, Ames, Iowa.

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, Wisconsin.

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. Pages 31-32 *in* Proceedings of Percis III: The Third International Percid Fish Symposium, Y.P. Barry and J.A. Malison, editors). University of Wisconsin Sea Grant Institute, Madison, Wisconsin.

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.

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EDUCATION

B.S. The University of Georgia, 2008, Fisheries and Aquaculture
M.S. Auburn University, 2010, Aquaculture

POSITIONS

Aquaculture Extension Specialist III, Natural Resource Ecology and Management, Iowa State University, 2011-present
Graduate Research Assistant, Department of Fisheries and Allied Aquacultures, Auburn University, 2008-2010
Aquarium Technician, Department of Marine Sciences, University of Georgia, 2007-2008
Fisheries Technician, Warnell School of Forestry and Natural Resources, University of Georgia, 2007-2008

SCIENTIFIC AND PROFESSIONAL ORGANIZATIONS

American Fisheries Society
World Aquaculture Society
United States Aquaculture Society
International Association of Astacology
Xi Sigma Pi

SELECTED PUBLICATIONS

Pattillo, D. A. , C. E. Hicks, J. E. Wetzel, P. B. Brown, R. A. Rode, J. E. Morris. *In Prep.* Evaluation of the Newly-Developed, Least-Cost Experimental Diet for Bluegill at Commercial Densities.

Pattillo, D. A. and J. A. Stoeckel. *In Review.* The effectiveness of Aqui-S^{TM} and temperature manipulation for anesthetizing juvenile redclaw crayfish (*C. quadricarinatus*). Aquaculture.

Pattillo, D. A. and J. A. Stoeckel. *In Prep.* The effectiveness of androgenic gland ablation for the sex reversal of juvenile male redclaw crayfish (*C. quadricarinatus*).

Pattillo, D. A. and J. A. Stoeckel. *In Prep.* Potential escapement effects of the Australian redclaw crayfish (*Cherax quadricarinatus*), on a common crayfish species, (*Procambarus acutissimus*) in the Southeastern United States.

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EDUCATION

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

POSITIONS

Adjunct Professor (2005–present), Department of Animal Science; Principal Scientist & Director (2005–present), OARDIP, OSU 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 (1993–1999), Assistant Professor (1987-1993), Research Associate (1984-1986), Department of Aquaculture & Environment, YFI, Chinese Academy of Fisheries Sciences.

PROFESSIONAL MEMBERSHIPS

World Aquaculture Society
American Society of Animal Sciences
USDA-North Central Regional Aquaculture Center, Member of Technical Committee-(R)

SELECTED PUBLICATIONS

Wang, H.P, Z. Gao, Paul O'Bryant, D. Rapp, H. Yao, G. R. MacDonald, and W. Wang. In Press. Temperature effects and genotype-temperature interactions on sex determination in bluegill sunfish. Aquaculture.

Eissa, N., and H.P. Wang. Physiological stress response of yellow perch subjected to repeated handlings and salt treatments at different temperatures. North American Journal of Aquaculture, 75:449–454, 2013.

Xu, Y.J., H.P. Wang, H. Yao, P. O'Bryant, and Q.Y. Wang. In Press. GH, IGF-I and IGF-II mRNA expression in fast and slow growing strains and families of yellow perch *Perca flavescens*. Aquaculture.

Cao, X, H.P. Wang, H. Yao, P. O'Bryant, J. D. Rapp and G. K. Wallat. 2012. Evaluation of one-stage and two-stage selection in yellow perch I: genetic and phenotypic parameters for growth traits of F_1 fish reared in ponds using microsatellite parentage. Journal of Animal Sciences 90:27–36.

Xu, Y.J., X.Z. Liu, M.J. Liao, H.P. Wang, and Q.Y. Wang. 2012. Molecular Cloning and differential expression of three GnRH genes during ovary maturation of *Verasper variegates*. Journal of Experimental Zoology 317:434-46.

Wang, H.P., H. Yao, P. O'Bryant, D. Rapp, G.K. Wallat, L.G. Tiu and R. MacDonald. 2011. Family-tank interactions on early growth performance of yellow perch reared in single family tanks versus mixed-family tanks as inferred using molecular pedigrees. *Aquaculture research* 42:1694-1702.

Gao, Z., H.P. Wang, H. Yao, L.G. Tiu, W. Wang, R. MacDonald and L.G. Tiu. 2010. No sex-specific markers detected in bluegill sunfish Lepomis macrochirus by AFLP. J. Fish Bio., 76: 408 - 414.

Wang , W.J., H.P. Wang, L. Li, G.K. Wallat, L.G. Tiu, H.Yao, and Q.Y. Wang. 2010. A first genetic linkage map of bluegill sunfish (Lepomis macrochirus) using AFLP markers. *Aqua Intl*, 18:825–835.