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The Size Relationship of 12 Days Post-Exodus Larvae with 56 Day Post-Exodus Fingerlings Regarding Growth and Survival in Bluegill (Lempomis macrochirus)

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THE SIZE RELATIONSHIP OF 12 DAYS POST-EXODUS LARVAE WITH 56 DAY POST-EXODUS FINGERLINGS REGARDING GROWTH AND SURVIVAL IN BLUEGILL *LEPOMIS MACROCHIRUS*

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Abstract

Low survival and quality of early life-stage bluegill is an obstacle to viable production where size may influence weaning efficiency. Herein, we investigate though two trials the effects of fry size 12-d post-exodus on total length, weight, production and survival through 56-d post-exodus. Full sibling broods (trial 1=10, trial 2=6) were reared with feedings of brine shrimp *Artemia* sp. nauplii (BS) through 12-d post-exodus (PE). Broods of trial 1 were visually sorted 12 d PE into small and large size groups. Fry (n = 25) from each size group were sampled for measures total length (TL) and weight. Starting 14 d PE, a 7-d co-feeding period with a commercial dry feed (#0 crumb) that was continued through 27 d PE with subsequent feedings using a larger version (#1 crumb) of the same diet continuing through 56 d PE (trial end). Broods of trial 2 were split 4 d post-conception into two groups of pro-larvae (n = 400). Slow growing groups were fed hourly 0800 – 1700 while fast growing were fed additionally at 0400 and 2200 through 12 d PE. Surviving fish from each size group were collected, with random samples (n = 25 fish) measured for TL and weight. Fry (n = 100 where possible) were placed into 151-L aquariums with slow and fast growing feeding regimens maintained through 13-d PE. Culture regimen thereafter was same as trial 1. Fish of both trials were harvested, measured for TL, weight and survival. The Wilcoxon Signed Rank Test was run one-tailed using SAS. Results of trial 1 indicate size at 12 d was a predictor of TL, weight and survival through 56 d PE ($p \leq 0.014$). Trial 2 results indicate growth rate during first 12 d was not a predictor of growth and survival through 56 d PE ($p \geq 0.156$). Size variation at 12 d as a function of genetics is a predictor of growth and survival through 56 d while at least some size variation resulting from early growth rate differences can be overcome by compensatory growth.

Introduction

Sunfishes [Centrarchidae] are produced by 400+ U.S. farmers (Morris and Clayton 2009) with interest in sunfish *Lepomis* spp. for food fish production increasing in the north central region of the U.S. (Hayward and Wang, 2006). Traditionally sunfish production occurs in outdoor ponds which can be limited by seasonality, poor knowledge of inventory and bio-security which can be particularly problematic with food fish production where profit margins are tight. Indoor rearing can help overcome some of these limitations and has been demonstrated as possible (Smith 1976, Bryan et al. 1994). Most efforts to culture sunfish fry indoors has been restricted to northern bluegill *L. macrochirus macrochirus* (Eaton 1974; Bryan et al. 1994; and Mischke and Morris 1997, 1998) using recirculating aquaculture system (RAS) technologies.

Indoor rearing of early life stage sunfishes (larvae) often relies upon use of live zooplankton cultures (Eaton 1974) especially brine shrimp, *Artemia* sp. nauplii (BS) for initial feedings (Smith 1976; Mischke and Morris 1998, Dudenhoeffer et al. 2011, in review). Feeding of BS is intensive and expensive making it desirable to wean to manufactured feed quickly. Age was indentified to be an important factor influencing survival during the transition to a commercial diet with older and typically larger fry doing the best (Mischke and Morris 1998). The efficiency of transition (survival and growth), from live food to commercial starting diets maybe influenced as much by size of fish at onset of weaning as age (Dudenhoeffer et al. 2011). This study investigates the effects of size variation on transition efficiency from live food (BS) to a commercial starter diet. Two trials were set up where 1) fry were sorted by size prior to initiation of weaning process and 2) size disparity was promoted by differing feeding regimes during first 14 days of exogenous feeding.

Materials and Methods

Bluegill broods (trial 1 = 10 broods, trial 2 = 6 broods) were reared in the lab following modifications in respect to trial of Mischke and Morris (1997) through 12 d PE using BS feedings as indicated below. Trial 1. Each entire brood was reared through day 12 PE with BS feedings 0800 – 1700 hourly. Larvae (n = 300) from each brood were sorted visually into small and large groups. Each size group was sampled (n = 25) randomly for measures of TL and weight. Each size group was stocked with randomly selected individuals (n = 100) into a 151-L aquarium where the feeding regimen continued through day 13. Trial 2. Each brood was split as pro-larvae 4 days post-conception into slow and fast growing groups (n = 400 / group). Slow growing groups were fed BS 0800 – 1700 hourly through day 12 PE while fast growing groups had same feeding regimen plus feedings at 0400 and 2200. Day 12 PE each group was randomly sampled (n=25) for measures of TL and weight with remaining fish used to stock 151-L aquarium 100 individuals per aquarium where feeding regimen was continued for slow versus fast growing groups through day 13. Thereafter, conditions for both trials were similar except for BS feedings where in trial 2 both fast and slow growing groups were fed at 0400 and 2200 in addition to feeding of 0800 – 1700 used in trial 1. Co-feeding started day 14 with dry feed (Bio-Oregon® Bio Vita Starter crumble size #0) along with BS application through day 21 where BS ended and dry feed application continued unchanged.

Starting day 27, Bio-Oregon® Bio Vita Starter crumble size #1 was applied which continued through day 56. Commercial feed was applied using a 12-h belt feeder at 2 g daily / aquarium. At 56 day post-exodus each group of fry was euthanized with MS-222 and measured for TL and individual weight.

Statistical analysis were run using SAS (Version 9.1). Wilcoxon paired-sample one-tailed test was used to analyze the initial mean TL and weights, final mean TL and weights and survival. Natural log transformations were made of TL and weight data to facilitate graphic representation. Survival per tank was logarithmically transformed and analyzed using the Wilcoxon paired-sample test (Zar 1996).

Results

Trial 1

- Individual size TL and weight at 12 days PE was reflected in size 56 days PE (Figure 1).
- Survival was lower for initially small group relative to initially large group (Figure 2) .

Trial 2

- Slow and fast growing feeding regimen groups differed 12 days PE in respect to TL and weight.
- Size as function of feeding regimen during first 12 d PE did not affect TL, weight (Figure 3) and survival (Figure 4) at 56 days PE.

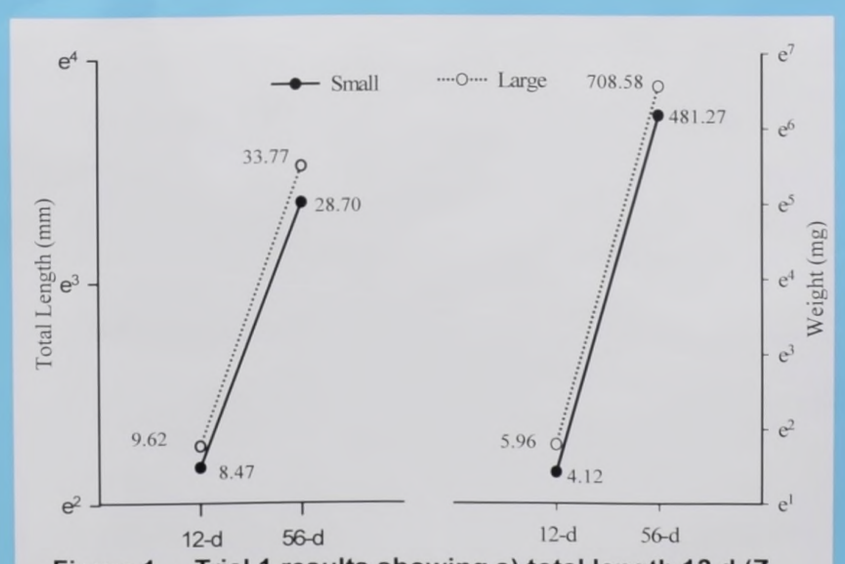

Figure 1. – Trial 1 results showing a) total length 12 d (Z = -27.5; p = 0.001) 56 d (Z = -22.5; p = 0.002) and b) weight 12 d (Z = -27.5; p = 0.001) 56 d (Z = -27.5; p = 0.001) of small vs. large bluegill at 12 and 56 days post-exodus.

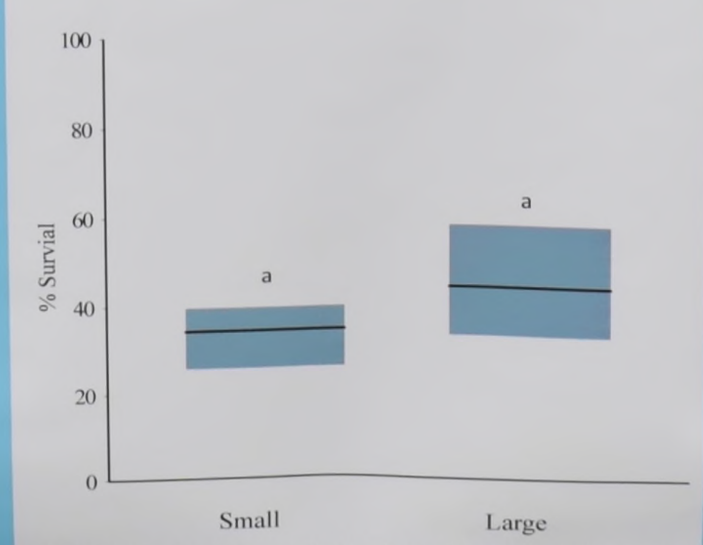

Figure 2. –Trial 1 survival of small vs. large bluegill at 56 days post-exodus (Z = -21.5; p = 0.014).

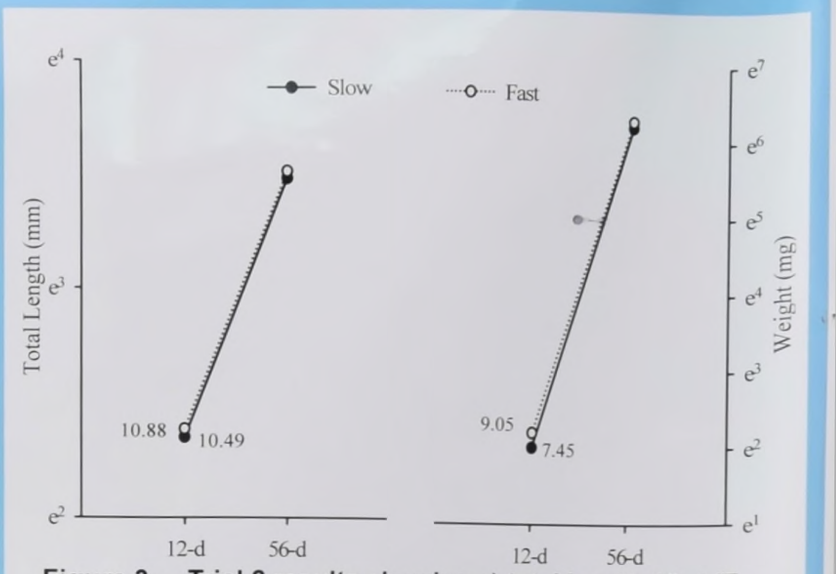

Figure 3. – Trial 2 results showing a) total length 12 d (Z = -8.5; p = 0.047) 56 d (Z = -5.5; p = 0.156) and b) weight 12 d (Z = -9.5; p = 0.031) 56 d (Z = -4.5; p = 0.219) of slow vs. fast growing bluegill at 12 and 56 days post-exodus.

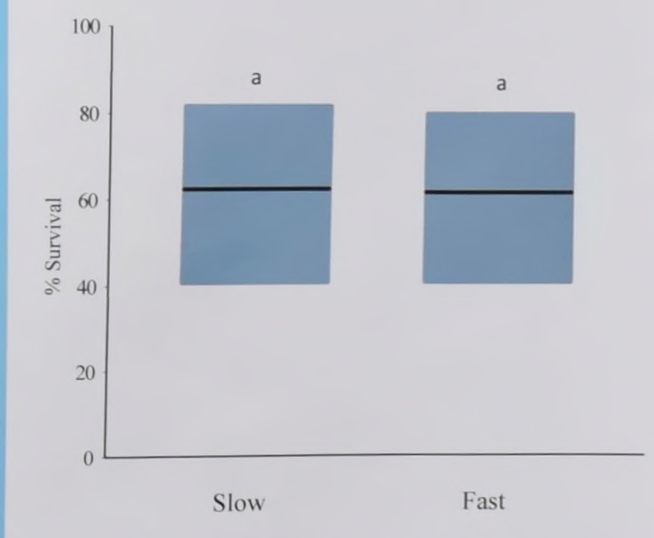

Figure 4. –Trial 2 survival of slow vs. fast growing bluegill at 56 days post-exodus (Z = 0.5; p = 0.500).

Discussion

Trial 1 supports Dudenhoeffer et al. (2011) and Mischke and Morris (1998) in that larger size of larvae at onset of transitioning from live food to commercial diet may influence subsequent growth and survival when differences within broods that a potentially genetically based. Effects of size differences induced by feeding regimen during first 12 d PE can be compensated for as shown with larger bluegill (Hayward et al 2000). Survival rate differences between trials suggest another variable needs to be identified.

Conclusion

Fry size variation at 12 d PE can affect growth through 56 d PE when influences operate on a population reared under uniform conditions, justifying the use of size grading to reduce subsequent variation and potentially improve production if subsequent efforts restricted to larger size fry. Bluegill fry have at least a limited capacity to compensate for sub-optimal conditions during fry development. Future research should focus on modifying feeding regime from live food to commercial diets.

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