Farm-based Production Parameters and Break-even Costs for Yellow Perch Grow-out in Ponds in Southern Wisconsin

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Introduction

For over 30 years the yellow perch (Perca flavescens) has been viewed as a species with great potential for aquaculture in the North Central Region (NCR). The species has been the focus of a significant amount of research over this period, and has been a priority species for research sponsored by the North Central Regional Aquaculture Center (NCRAC) since its inception in 1988. Despite these efforts almost no information has been available on "real world" production parameters and costs of raising yellow perch to market size using different system types. The lack of such basic information on production costs is a primary reason for the failure of numerous yellow perch operations in the NCR.

In the mid-1990s, two scientists (Jean Rosscup Riepe, then at Purdue University, and Harvey Hoven, then at University of Wisconsin-Superior) developed enterprise budgets for raising yellow perch in ponds, net pens and recirculating aquaculture systems (Riepe, 1997a,b; Hoven 1998). These models, although useful, had significant limitations because they used theoretical or "best guess" estimates for many production parameters including growth rates, food conversions, rearing densities, and survivals. Clearly, these parameters have an overarching effect on production costs. Recognizing the limitations of the budgets developed by Riepe and Hoven, NCRAC funded a major research effort from 2001 to 2004, the primary goal of which was to gather information on "actual" production parameters and costs of raising yellow perch to market size using different system types. This publication is a detailed summary of the information collected on pond culture systems.

Production Parameters

We conducted yellow perch grow-out trials in 17 ponds in a three-year period (2002-2004). The ponds were located at Coolwater Farms, LLC, Deerfield, (CWF) and at the Lake Mills State Fish Hatchery, Lake Mills, (LMSFH), two locations in south-central Wisconsin about 11.3 km (7 miles) apart. The ponds ranged in size 0.04-0.61 ha (0.1-1.5 ac), and were sloped from approximately 0.9 m (3 ft) deep at the shallow end to 1.8-2.4 m (6-8 ft) deep at the deep end. Ponds were stocked with uniformly size-graded, feed-trained fingerlings in April, and were harvested in October at the end of the growing season (growing season = approximately 190 d). It should be pointed out that the fish were monosex females (originally derived from Lake Mendota, Madison, Wisconsin), which many studies have shown grow faster than mixed sex perch. Fish were fed daily using a standard floating trout grower diet (Silver Cup steelhead 1.5 mm or trout 3.5 mm; Nelson and Sons, Inc., Murray, Utah). The fish were fed at times of low light levels (dawn or dusk), and, in general, a strong feeding response was observed in all ponds.

The ponds had virtually no flow-through water, but water was added as needed to make up for evaporation and seepage. The water supply at CWF was well water at 11°C (52 °F), and at LMSFH was water from nearby Rock Lake at 12-18°C (54-64°F). Water quality measurements taken throughout the summer indicated that ammonia and nitrite concentrations were always negligible, and dissolved oxygen levels were always at or above the level needed to allow for good perch growth (>3 mg/L, and at most times 4.5-8.5 mg/L). The ponds were provided with continuous airlift pump aeration, which was probably not sufficient to provide any meaningful direct oxygen addition to the ponds, but did serve to keep the ponds mixed and de-stratified. Pond water temperatures were generally as follows: April <12°C (54°F), May 12-20°C (54-68°F), June 18-22°C (64-72°F), July and August 21-25°C (70-77 °F), September 18-22°C (64-72°F), and October 12-18°C (54-64°F). Except for brief (4-8-d) periods during mid summer heat spells, water temperatures remained below 27°C (81°F). However, temperatures increased to 27-28°C (81-83°F), and the feeding activity of the fish occasionally diminished on extremely hot days. To minimize the temperature increase during excessive high water tempeatures, water was added to the ponds, and airlift aeration was turned off during the daytime.

The production parameters for the ponds are shown in Table 1. We evaluated the performance of age-1 fingerlings of three different initial size categories, because of the high variability in the size of fish produced by fingerling producers. We also evaluated three different feeding regimes.

As can be seen, the variables of initial size, feeding regime, and stocking density are statistically correlated producing results that preclude the use of traditional statistics. This design was driven primarily by the availability of fingerlings and ponds for the study. Accordingly, all of our discussion on comparing these variables refers to general trends and not to true statistical differences. Accurate feed/gain measurements are only reported for four ponds. Important feeding records for one location in one year (three ponds) were lost and at one location ducks consumed significant quantities of the floating food, making feeding records inaccurate.

Fish growth was very uniform both between and within ponds, and averaged 0.34 g/fish/d. The weight gain of fish was proportional to stocking size; small fish (5 g) gained 52.8 g per season and 0.31g/d, medium fish (20 g) gained 55.9 g per season and 0.33 g/d, and large fish (50 g) gained 68.5 g per season and 0.40 g/d. In ponds stocked with large fish, 17% of the fish harvested were 80-100 g, 60% of the fish were 100-150 g, and 23% of the fish were 150-210 g. In ponds stocked with medium fish, 11% of the fish harvested were 30-60 g, 75% of the fish were 60-100 g, and 14% of the fish were 100-140 g. Ponds stocked with small fish, 6% of the fish harvested were 10-40 g, 89% of the fish were 40-80 g, and 5% of the fish were 80-90 g. Survival of fish was inversely proportional to stocking size (small = 89%, medium = 81% and large = 79%). Part of this difference may have been due to stress-related post-spawning mortalities of some medium and large fish.

We found little difference in water quality, fish growth rate, survival or feed conversion between ponds stocked at different fish densities. Our initial plans were to stock ponds at approximately (42,006, 61,774, and 84,013 fish/ha (17,000, 25,000 and 34,000 fish/ac). However due to a shortage of suitable fingerlings, we had to reduce our stocking densities. Total seasonal fish production averages were as follows: 37,064 fish/ha = 1,455 kg/ha (15,000 fish/ac =

Table 1. Production parameters for raising yellow perch in ponds in southern Wisconsin, 2002-2004.

Initial Size	Stocking Density [# x 2,471/ha (# x 1000/ acre)]	Feeding Re-gime*	Survival (%)	Weight Gain per Fish (Estimated Final Weight = initial size + weight gain) [g]	Production kg/ha (lb/acre)	Food Conversion Ratio (FCR)
5	49 (20)	1	99	51.7 (56.7)	2,530 (2,257)	
5	49 (20)	1	93	54.8 (59.8)	2,391 (2,133)	1.25
5	62 (25)	1	77	44.2 (47.2)	2,031 (1,812)	
5	62 (25)	1	91	58.5 (63.5)	3,434 (3,063)	1.45
5	124 (50)	2	83	54.9 (59.9)	5,395 (4,813)	1.48
20	37 (15)	1	86	50. 3 (70.3)	1,535 (1,369)	
20	37 (15)	1	72	56.9 (76.9)	1,303 (1,162)	
20	37 (15)	1	93	57.9 (77.9)	1,937 (1,723)	
20	37 (15)	SR	74	65.5 (85.5)	1,632 (1,456)	
20	37 (15)	2	66	62.4 (82.4)	1,278 (1,140)	
20	49 (20)	1	85	49.5 (69.5)	1,889 (1,685)	
20	62 (25)	1	100	37.1 (57.1)	2,287 (2040)	
20	62 (25)	1	86	52.2 (72.2)	2,253 (2010)	
20	62 (25)	SR	67	71.5 (91.5)	2,537 (2,263)	1.81
50	37 (15)	1	86	57.2 (107.2)	1,498 (1,336)	
50	37 (15)	SR	66	78.7 (128.7)	1, 088 (970)	
50	37 (15)	2	86	69.7 (119.7)	1,373 (1,225)	
Overall mean ± Standard error			82.9 ±2.6	57.2 ± 2.5	2,141 ±250 (1910 223) ±0.12	

The mean initial size of the fish and stocking densities are shown in categories, to facilitate interpretation of the data. The actual mean initial size and stocking density varied by ± 20%. *The fish were fed once (1) or twice (2) daily to satiation, or a set ration (SR) which was 0.25g/fish/d when water temperature was below 13°C (59°F), and otherwise 0.5g/fish/d, based upon the initial number of fish stocked.

1,298 lbs/ac); 49,419 fish/ha = 2,270 (20,000 fish/ac = 2,025 lbs/ac); and 61,774 fish/ha = 2,509 kg/ha (25,000 fish/ac = 2,238 lbs/ac). These findings demonstrate the feasibility of stocking yellow perch fingerlings for grow-out at densities as high as 61,774 fish/ha (25,000 fish/ac). It also should be noted that in the one pond that was stocked at 123,548 fish/ha (50,000 fish/ac); we observed no problems with water quality and fish growth rate and survival in this pond was similar to the ponds stocked at lower densities. Hence, higher stocking densities may be possible. We also found no differences or trends in any production variable with regards to pond size.

It is difficult to compare the three feeding regimes because feeding regime is affected by initial stocking size, which had a noticeable effect on growth. Fish fed a set ration once daily, however, had growth rates that tended to be on the high side of our data set.

Enterprise Budgets

To develop enterprise budgets, the actual production costs from our 3-year study were used in the model initially developed by Riepe (1997b). Facility, construction, and equipment costs were an average of the real costs at both CWF and LMSFH, adjusting for inflation to 2005 using the consumer price index. CWF was constructed in 1994-1995, and the ponds at LMSFH were built in 1998-1999. Our model is based on the construction of a farm that has 18 ponds that are 0.6 ha (1.5 ac) each, for a total of 10.9 ha (27 ac) of water. In comparison, CWF has an actual total of 10.5 ha (26 ac) of water.

Economy of scale can have significant impact on the profitability of a commercial aquaculture venture. Bulk purchases of feed and fingerlings are likely to reduce per unit costs to a considerable degree and therefore can be very beneficial to "the bottom line". In contrast, large-scale expenditures on facilities and equipment may be less sensitive to savings, and therefore have a lesser impact on profitability. Our model of a 10.9-ha (27 ac) farm may be somewhat large when compared to other fish farms in the Midwest, but is small compared to those in other regions. This paper shows three spreadsheets (one for investment costs and two for production costs) using the actual costs and production parameters obtained during our 3-year study.
These spreadsheets are available for downloading at www.ncrac.org/. By downloading these spreadsheets, individuals will be able to change most of the variables in the models to obtain breakeven costs customized for their specific information.

Based on the data collected during our study, we developed two production models. The first model consists of a 1-year grow-out scenario, in which relatively large fingerlings are purchased so that the fish reach a market size in one growing season. The second model consists of a 2-year grow-out scenario, in which smaller fingerlings can be purchased and grown to market size over the course of two growing seasons.

For both models, the initial investment costs for facilities construction and development are shown in Table 2.

Table 2. Investment costs for grow-out of yellow perch in ponds in southern Wisconsin

Category	Item	Unit	Unit cost	No.	Total cost	Useful life (years)	Depreciation (annual)
Facilities	land cost	acre	$3,500	35	$122,500		-6,125
	pond construction	acre	$4,000	27	$108,000	50	2,160
	pond plumbing	pond	$350	18	$6,300	25	252
	well		$70,000	1	$70,000	50	1,400
	aeration system	each	$150	18	$2,700	25	108
	levee improvements		$3,000	1	$3,000	50	60
	building		$20,000	1	$20,000	50	400
	tanks (5,000 gal)	each	$3,000	2	$6,000	25	240
	water system		$1,500	1	$1,500	25	60
	electric service		$8,000	1	$8,000	25	320
	Subtotal				**$348,000**		**-1,125**
Equipment							
	ATV	each	$6,000	1	$6,000	10	600
	boat	each	$800	1	$800	20	40
	mower	each	$1,000	1	$1,000	5	200
	well pump	each	$30,000	1	$30,000	10	3,000
	blower	each	$500	2	$1,000	5	200
	water pump	each	$200	2	$400	5	80
	D.O. meter	each	$500	1	$500	5	100
	feeder	each	$500	1	$500	5	100
	balance	each	$200	1	$200	5	40
	nets	each	$25	6	$150	3	50
	boots/waders	each	$50	3	$150	1	150
	seine	each	$1,000	1	$1,000	10	100
	totes	each	$5	10	$50	3	17
	buckets	each	$2	10	$20	3	7
	tools	each	$300	1	$300	10	30
	Subtotal	**asst**			**$42,070**		**4,713**
Total investment					**$390,070**		
Total depreciation							**3,588**

Our assumptions relevant to both models are as follows:

- Land appreciates at 5% per year.

- 100% of the money for investment is borrowed at an interest rate of 6.5% per year. Interest only is paid (i.e., any repayment of the original investment debt is considered profit beyond breakeven).

- 100% of the money for operating costs is borrowed at an interest rate of 6.5% per year. For the one year scenario the money is borrowed at the beginning of the growing season (day 0) and paid back in full at the end of the growing season (day 190). For the 2-year scenario the money is borrowed at the beginning of the first growing season and paid back in full at the end of the second growing season (day 555).

- The labor needed for each year is 2 hrs for set up for each pond, 3 hrs/d for feeding fish, 1 hr/d for maintenance and repair, and 20 hrs/pond for harvest.

For both models we used stocking densities that targeted a production of approximately 3,363 kg/ha (3,000 lbs/ac) per season. Although these densities are higher than those used in most of the results detailed in Table 1, other unreported findings at CWF, LMSFH and other pond-based yellow perch farms have indicated that yellow perch can generally be raised at these densities with little risk of incurring problems with water quality. If users of these models wish to do so, they can reduce rearing densities and production values in our downloadable excel spreadsheets. For ease of analysis, all subsequent results will be reported primarily in English units.

For the 1-year grow-out model, fingerlings were purchased at 5.5 inches and 50 g, at $0.085 per inch. Fingerlings were stocked at 30,412 fish/ac and and production was estimated at 3,350 lbs/ac. The fish gained 68.5g each, and the survival rate was 79%. 6,350 lbs of fish/a were harvested, and 2,953 lbs/a of growth was obtained. The breakeven costs of production for a 1-year grow-out scenario are shown in Table 3.

For the 2-year grow-out model, fingerlings were purchased at 3.0 inches and 5 g, at $0.07 per inch. Fingerlings were stocked at 34,325 fish/ac and 378 lbs/ac. In year 1 the fish gained 52.8 g each, and the survival rate was 89%. 3,537 lbs of fish/ac were harvested at the end of the year, and 3,159 lbs/a of growth was obtained. The fish were over wintered (assuming 100% survival), and 75% of the fish spawned the following spring. Each fish that spawned lost 25% of its weight, for a total weight loss of 18.75%. In the beginning of the second year, post-spawn fish were stocked at 30,412/ac and production was estimated at 3,148 lbs/ac. In year 2 the fish gained 68.5 g each, and the survival rate was 79%. 6,143 lbs of fish/ac were harvested, and 2,995 lbs/ac of growth was obtained. Breakeven costs of production for a 2-year grow-out scenario are shown in Table 4.

In addition to developing the previous tables, we have also done a limited sensitivity analysis using the data garnered from our research (Tables 5 and 6). In these tables, the variable costs of fingerlings have the most substantial effect on break-even costs.

Table 3. Breakeven costs for grow-out of yellow perch in a 1-year production cycle in southern Wisconsin.

Category	Item	Unit	Unit cost	No. of units	Total cost	% of total cost	% of operating cost
Production costs							
	fingerlings ($0.085/inch)	each	$0.47	821,124	$383,875	75.2	82.2
	feed	lb	$0.33	121,500	$40,095	7.8	8.6
	herbicides				$500	0.1	0.1
	fuel (mower, ATV)	gal	$2.30	200	$460	0.1	0.1
	electricity	kwh	$0.09	111,111	$10,000	2.0	2.1
	labor (unskilled) ($7.50 + 25% fringe)	hr	$9.38	1,120	$10,500	2.1	2.2
Total production costs					$445,430	87.2	95.4
Sales/Marketing costs							
	ice	lb	$0.07	85,087	$5,956	1.2	1.3
	pickup charge	mile	$1.25	150	$188	0.0	0.0
Total sales/marketing costs					$6,144	1.2	1.3
Miscellaneous							
	interest on operating capital for 190 days (0.52 years)	%	6.5		$15,263	3.0	3.3
Total operating cost					$466,837	91.4	100.0
Production (lbs)					170,173		
Breakeven operating cost per lb.					$2.74		
Annual ownership costs							
	total annual depreciation (investment/useful life)				$3,588	0.7	
	interest on investment				$25,355	5.0	
	real estate taxes				$2,000		
	insurance				$3,000		
	repairs				$10,000	2.0	
Total annual ownership cost					$43,943	8.6	
Total annual cost					$510,780	100.0	
Production (lbs)					170,173		
Breakeven total cost per lb					$3.00		

Table 4. Breakeven costs for grow-out of yellow perch in a 2-year production cycle in southern Wisconsin.

Category	Item	Unit	Unit cost	No. of units	1st year cost	2nd year cost	Total Total cost	% of total cost	% of operating cost
Production costs									
	fingerlings ($0.07/inch)	each	$0.21	926,775	$194,623		$194,623	43.7	54.4
	feed	lb	$0.33	127,940	$42,220				
			$0.33	121,295		$40,027			
							$82,247	18.4	23.0
	herbicides				$500	$500	$1,000	0.2	0.3
	fuel (mower, ATV)	gal	$2.30	200	$460	$460	$920	0.2	0.3
	electricity	kwh	$0.09	111,111	$10,000	$10,000	$20,000	4.5	5.6
	labor (unskilled) ($7.50 + 25% fringe)	hr	$9.38	1,120	$10,500	$10,500	$21,000	4.7	5.9
Overwinter costs									
	feed	lb	$0.33	2,160	$713		$713		
	labor	hr	$9.38	96	$900		$900		
	electricity	kwh	$0.09	13,000	$1,170		$1,170		
Total production costs							$319,790	71.7	89.3
Sales/Marketing costs									
	ice	lb	$0.07	82,906		$5,803	$5,803	1.3	1.6
	pickup charge	mile	$1.25	150		$188	$188	0.0	0.1
Total sales/marketing costs							$5,991	1.3	1.7
Miscellaneous									
	interest on operating capital for 555 days (1.52 years)	%	6.5				$32,187	7.2	9.0
Total operating cost							$357,968	80.3	100.0
Production (lbs)							165,811		
Breakeven operating cost per lb							$2.16		
Annual ownership costs									
	total annual depreciation (investment/useful life)				$3,588	$3,588	$7,177	1.6	
	interest on investment				$25,355	$25,355	$50,709	11.4	
	real estate taxes				$2,000	$2,000	$4,000	0.9	
	insurance				$3,000	$3,000	$6,000	1.3	
	repairs				$10,000	$10,000	$20,000	4.5	
Total annual ownership cost							$87,886	19.7	
Total annual cost							$445,854	100.0	
Production (lbs)							165,811		
Breakeven total cost per lb.							$2.69		

Table 5. Cost analysis by alternative fingerling and feed prices for 1-year yellow perch operations in Wisconsin, 2002-2004.

Production levels are at 3,000 lbs/ac/yr with a feed to gain ratio of 1.5.

Feed price	Fingerling cost ($/head)						
($/lb)	0.30	0.35	0.40	0.45	0.50	0.55	0.60
0.20	2.07	2.32	2.57	2.82	3.07	3.32	3.57
0.25	2.11	2.36	2.61	2.86	3.10	3.35	3.60
0.30	2.14	2.39	2.64	2.89	3.14	3.39	3.64
0.35	2.18	2.43	2.68	2.93	3.18	3.43	3.68
0.40	2.22	2.47	2.72	2.97	3.22	3.46	3.71
0.45	2.25	2.50	2.75	3.00	3.25	3.50	3.75
0.50	2.29	2.54	2.79	3.04	3.29	3.54	3.79
0.55	2.33	2.58	2.83	3.08	3.33	3.58	3.82

Production levels are at 3,000 lbs/ac/yr with a feed to gain ratio of 2.0.

Feed price	Fingerling cost ($/head)						
($/lb)	0.30	0.35	0.40	0.45	0.50	0.55	0.60
0.20	2.12	2.37	2.62	2.87	3.12	3.37	3.62
0.25	2.17	2.42	2.67	2.92	3.17	3.42	3.66
0.30	2.22	2.47	2.72	2.97	3.22	3.46	3.71
0.35	2.27	2.52	2.77	3.02	3.26	3.51	3.76
0.40	2.32	2.57	2.81	3.06	3.31	3.56	3.81
0.45	2.37	2.61	2.86	3.11	3.36	3.61	3.86
0.50	2.41	2.66	2.91	3.16	3.41	3.66	3.91
0.55	2.46	2.71	2.96	3.21	3.46	3.71	3.96

Production levels are at 2,000 lbs/ac/yr with a feed to gain ratio of 1.5.

Feed price	Fingerling cost ($/head)						
($/lb)	0.30	0.35	0.40	0.45	0.50	0.55	0.60
0.20	2.26	2.51	2.76	3.01	3.26	3.51	3.76
0.25	2.30	2.55	2.80	3.05	3.30	3.55	3.80
0.30	2.34	2.59	2.84	3.09	3.34	3.59	3.84
0.35	2.38	2.63	2.87	3.12	3.37	3.62	3.87
0.40	2.41	2.66	2.91	3.16	3.41	3.66	3.91
0.45	2.45	2.70	2.95	3.20	3.45	3.70	3.95
0.50	2.49	2.74	2.99	3.23	3.48	3.73	3.98
0.55	2.52	2.77	3.02	3.27	3.52	3.77	4.02

Table 5. Cost analysis by alternative fingerling and feed prices for 1-year yellow perch operations in Wisconsin, 2002-2004. (continued)

Production levels are at 2,000 lbs/ac/yr with a feed to gain ratio of 2.0.

Feed price	Fingerling cost ($/head)						
($/lb)	0.30	0.35	0.40	0.45	0.50	0.55	0.60
0.20	2.31	2.56	2.81	3.06	3.31	3.56	3.81
0.25	2.36	2.61	2.86	3.11	3.36	3.61	3.86
0.30	2.41	2.66	2.91	3.16	3.41	3.66	3.91
0.35	2.46	2.71	2.96	3.21	3.46	3.71	3.96
0.40	2.51	2.76	3.01	3.26	3.51	3.76	4.01
0.45	2.56	2.81	3.06	3.31	3.56	3.81	4.06
0.50	2.61	2.86	3.11	3.36	3.61	3.86	4.11
0.55	2.66	2.91	3.16	3.41	3.66	3.91	4.16

Production levels are at 2,500 lbs/ac/yr with a feed to gain ratio of 1.5.

Feed price	Fingerling cost ($/head)						
($/lb)	0.30	0.35	0.40	0.45	0.50	0.55	0.60
0.20	2.15	2.40	2.65	2.90	3.15	3.40	3.64
0.25	2.18	2.43	2.68	2.93	3.18	3.43	3.68
0.30	2.22	2.47	2.72	2.97	3.22	3.47	3.72
0.35	2.26	2.51	2.76	3.01	3.26	3.51	3.76
0.40	2.30	2.55	2.79	3.04	3.29	3.54	3.79
0.45	2.33	2.58	2.83	3.08	3.33	3.58	3.83
0.50	2.37	2.62	2.87	3.12	3.37	3.62	3.87
0.55	2.41	2.66	2.91	3.15	3.40	3.65	3.90

Production levels are at 2,500 lbs/ac/yr with a feed to gain ratio of 2.0.

Feed price	Fingerling cost ($/head)						
($/lb)	0.30	0.35	0.40	0.45	0.50	0.55	0.60
0.20	2.20	2.45	2.70	2.95	3.19	3.44	3.69
0.25	2.25	2.50	2.75	2.99	3.24	3.49	3.74
0.30	2.30	2.55	2.79	3.04	3.29	3.54	3.79
0.35	2.34	2.59	2.84	3.09	3.34	3.59	3.84
0.40	2.39	2.64	2.89	3.14	3.39	3.64	3.89
0.45	2.44	2.69	2.94	3.19	3.44	3.69	3.94
0.50	2.49	2.74	2.99	3.24	3.49	3.74	3.99
0.55	2.54	2.79	3.04	3.29	3.54	3.79	4.04

Table 6. Cost analysis by alternative fingerling and feed prices for 2-year yellow perch operations in Wisconsin, 2002-2004.

Production levels are at 3,000 lbs/ac/yr with a feed to gain ratio of 1.5.

Feed price ($/lb)	Fingerling cost ($/head)						
	0.10	0.15	0.20	0.25	0.30	0.35	0.40
0.20	1.90	2.21	2.52	2.82	3.13	3.44	3.75
0.25	1.95	2.25	2.56	2.87	3.17	3.48	3.79
0.30	1.99	2.29	2.60	2.91	3.22	3.52	3.83
0.35	2.03	2.34	2.64	2.95	3.26	3.57	3.87
0.40	2.07	2.38	2.69	2.99	3.30	3.61	3.92
0.45	2.12	2.42	2.73	3.04	3.34	3.65	3.96
0.50	2.16	2.46	2.77	3.08	3.39	3.69	4.00
0.55	2.20	2.51	2.81	3.12	3.43	3.74	4.04

Production levels are at 3,000 lbs/ac/yr with a feed to gain ratio of 2.0.

Feed price ($/lb)	Fingerling cost ($/head)						
	0.10	0.15	0.20	0.25	0.30	0.35	0.40
0.20	2.05	2.36	2.66	2.97	3.28	3.58	3.89
0.25	2.10	2.41	2.72	3.03	3.33	3.64	3.95
0.30	2.16	2.47	2.78	3.08	3.39	3.70	4.00
0.35	2.22	2.52	2.83	3.14	3.45	3.75	4.06
0.40	2.27	2.58	2.89	3.20	3.50	3.81	4.12
0.45	2.33	2.64	2.94	3.25	3.56	3.87	4.17
0.50	2.39	2.69	3.00	3.31	3.62	3.92	4.23
0.55	2.44	2.75	3.06	3.36	3.67	3.98	4.29

Production levels are at 2,000 lbs/ac/yr with a feed to gain ratio of 1.5.

Feed price ($/lb)	Fingerling cost ($/head)						
	0.10	0.15	0.20	0.25	0.30	0.35	0.40
0.20	2.31	2.62	2.93	3.23	3.54	3.85	4.15
0.25	2.35	2.66	2.97	3.27	3.58	3.89	4.20
0.30	2.40	2.70	3.01	3.32	3.62	3.93	4.24
0.35	2.44	2.75	3.05	3.36	3.67	3.97	4.28
0.40	2.48	2.79	3.09	3.40	3.71	4.02	4.32
0.45	2.52	2.83	3.14	3.44	3.75	4.06	4.37
0.50	2.57	2.87	3.18	3.49	3.79	4.10	4.41
0.55	2.61	2.91	3.22	3.53	3.84	4.14	4.45

Table 6. Cost analysis by alternative fingerling and feed prices for 2-year yellow perch operations in Wisconsin, 2002-2004. (continued)

Production levels are at 2,000 lbs/ac/yr with a feed to gain ratio of 2.0.

Feed price ($/lb)	Fingerling cost ($/head)						
	0.10	0.15	0.20	0.25	0.30	0.35	0.40
0.20	2.46	2.76	3.07	3.38	3.68	3.99	4.30
0.25	2.51	2.82	3.13	3.43	3.74	4.05	4.35
0.30	2.57	2.88	3.18	3.49	3.80	4.10	4.41
0.35	2.63	2.93	3.24	3.55	3.85	4.16	4.47
0.40	2.68	2.99	3.30	3.60	3.91	4.22	4.52
0.45	2.74	3.05	3.35	3.66	3.97	4.27	4.58
0.50	2.80	3.10	3.41	3.72	4.02	4.33	4.64
0.55	2.85	3.16	3.47	3.77	4.08	4.39	4.69

Production levels are at 2,500 lbs/ac/yr with a feed to gain ratio of 1.5.

Feed price ($/lb)	Fingerling cost ($/head)						
	0.10	0.15	0.20	0.25	0.30	0.35	0.40
0.20	2.07	2.37	2.68	2.99	3.29	3.60	3.91
0.25	2.11	2.42	2.72	3.03	3.34	3.64	3.95
0.30	2.15	2.46	2.77	3.07	3.38	3.69	3.99
0.35	2.19	2.50	2.81	3.11	3.42	3.73	4.04
0.40	2.24	2.54	2.85	3.16	3.46	3.77	4.08
0.45	2.28	2.59	2.89	3.20	3.51	3.81	4.12
0.50	2.32	2.63	2.93	3.24	3.55	3.86	4.16
0.55	2.36	2.67	2.98	3.28	3.59	3.90	4.21

Production levels are at 2,500 lbs/ac/yr with a feed to gain ratio of 2.0.

Feed price ($/lb)	Fingerling cost ($/head)						
	0.10	0.15	0.20	0.25	0.30	0.35	0.40
0.20	2.21	2.52	2.83	3.13	3.44	3.75	4.05
0.25	2.27	2.57	2.88	3.19	3.50	3.80	4.11
0.30	2.32	2.63	2.94	3.25	3.55	3.86	4.17
0.35	2.38	2.69	2.99	3.30	3.61	3.92	4.22
0.40	2.44	2.74	3.05	3.36	3.67	3.97	4.28
0.45	2.49	2.80	3.11	3.42	3.72	4.03	4.34
0.50	2.55	2.86	3.16	3.47	3.78	4.09	4.39
0.55	2.61	2.91	3.22	3.53	3.84	4.14	4.45

Discussion and Conclusions

The investment and production costs displayed in the tables in this paper represent the real expenditures at CWF and LMSFH from 2001 to 2004. Depreciation rates can vary, but we note that most of the ponds, wells and major utilities at the LMSFH are over 50 yr old, and such facilities can have an extremely long life expectancy given an adequate repair budget (as we incorporated into our model). This is in contrast to numerous published economic studies that use 10-20 yr for a pond's useful life. All production models have limitations based on location, time, and a wide range of other variables. Land and pond construction costs, for example, can vary greatly by location. Location will also affect water temperature and growing season. Likewise, feed, labor, and fingerling costs can vary greatly over time, location and operational scale. Potential producers also should be aware of market limitations on the availability and quality of fingerlings. Given these concerns, the associated spreadsheets will allow individual producers the ability to make suitable adjustments for their specific location and experiences, e.g., a pond's useful life.

The authors strongly suggest that anyone using these models should download the available spread sheets and manipulate different variables to evaluate their effect on production costs. For example, changing the fingerling price in the 2-yr scenario from $0.07/inch to $0.10/inch changes the breakeven cost from $2.69 to $3.24 ($0.55 increase), similarly changing the production level from 3,000lbs/ac/yr to 2,000lbs/ac/yr raises the breakeven cost from $2.69 to $3.10. Riepe (1997) indicated that a 5 cent increase in fingerling cost resulted in $0.17-30/lb increase in breakeven costs. Changes in investment costs and depreciation rates have relatively minor effects. For example, changing the useful life of pond construction, well, levee improvements and building from 50 to 20 yr increases the breakeven cost from $2.69 to $2.76.

One striking feature of both 1- and 2-yr models is the extremely high relative costs of purchasing fingerlings (approximately 75% of the total production costs for the 1-yr scenario, and 44% of the total costs for the 2-year model). For the culture of most other food fish species, fingerlings normally represent no more than 10-30% of the total production costs. The disparity between yellow perch and other species can be largely attributed to the fact that yellow perch are harvested at a comparatively small size. It should be noted that our models use the approximate wholesale price for purchasing fingerlings in 2005 (according to personnel of CWF). Fingerling costs could possibly be lowered significantly if one were to produce their own fingerlings. Regardless of production scenario, the development of methods for reducing fingerling production costs will clearly have a major impact on the efficiency of yellow perch grow-out.

The savings on initial fingerling costs makes a 2-yr grow-out scenario more than 10% more efficient than a 1-yr scenario. By its very nature, however, a 2-yr scenario carries higher risk, because the fish need to be kept alive and healthy for a much longer period of time. In addition, the weight lost with overwintering and spawning needs to be addressed.

The grow-out of yellow perch in pond systems, in either a 1- or 2-year scenario, is apparently more efficient than grow-out in recirculating systems, net pens, or flow through systems. The mean breakeven costs for the different system types have recently been reported as follows: pond, 1 year - $2.95/lb, 2 year - $2.59/lb, recirculating systems $6.86/lb, net pens - $4.80/lb., and flow-through - $5.50/lb (NCRAC 2006). These numbers suggest that grow-out of yellow perch in ponds could be a profitable endeavor. However, prior to selecting any specific culture system, size distribution within each system as well as costs/lb need to be considered. For instance, yellow perch processors often require a specific size yellow perch, often 120 g, for processing. As with all forms of aquaculture production, profitability is highly dependent on both species-specific markets and the marketing strategies of the producer.

Over the past decade, the wholesale market price for yellow perch in the round has varied considerably, both seasonally and annually. It is important to note that profitability of the 1- and 2-yr production scenarios are approximately equal (approximately $50,000/yr) at a market price of $3.29/lb. Prices lower than $3.29/lb make the 2-yr scheme comparatively more profitable, while prices higher than $3.29/lb favor the 1-yr production cycle. As with all fish species, market price of yellow perch can vary widely, e.g., <$2.00 to as much as $3.50/lb for this specific species. Yellow perch market factors are discussed in more detail by Malison (1999). Most producers will recognize that marketing "value-added" products, such as processed fillets, offer the potential of improving the "bottom line".

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