Relative Survival of Walleye Fry Versus Fingerlings in Two Illinois Reservoirs

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Abstract: Instead of hatcheries having quotas based strictly on number of fish, it would be more desirable to set quotas in terms of "hatchery benefit units." This can be done once the range of the relative survival of different sized individuals in various lakes for different species is known. In 2 Illinois reservoirs, the relative survival of walleye fingerlings *(Stizostedion vitreum)* was 62.1 times greater than fry in Collins Pond and 15.9 times greater than fry in Little Grassy Lake.

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Walleye are one of the most frequently reared fish in the United States. Webster et al. (1978) reported that production of walleye larvae by the federal hatcheries exceeded 54 million in 1976, while 23 states also are producing walleye. Production by states probably exceeds 700 million larvae each year. Most commonly, walleye are released into receiving waters as swim-up larvae, although it is believed the fingerling walleye have higher survival. Success of stocking and establishing walleye populations has been examined by a number of investigators, among them Carver et al. (1976) and Prentice and Clark (1978). However, the efficacy of stocking walleye swim-up larvae versus fingerlings needs to be examined more fully. This study was conducted to compare the relative survival of walleye stocked as swim-up larvae with walleye stocked as fingerlings in a northern and a southern Illinois reservoir.

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Methods

The southern Illinois lake chosen for this study was Little Grassy Lake, a 43-year-old, 405-ha reservoir located in the Crab Orchard National Wildlife Refuge, Williamson County, Illinois. The lake has a mean depth of 7.8 m and a maximum depth of 23.5 m. Its alkalinity is fairly low (20 mg/liter) and Secchi disk readings commonly exceed 2 m. Walleye were not present in Little Grassy Lake at the time of stocking. Collins Pond, located in Grundy County in northern Illinois, is a 805-ha bermed pond with an average depth of 3.1 m and a maximum depth of 7 m. Alkalinity is moderate (165 mg/liter) and Secchi disk readings are <1 m. This pond was constructed in 1976 to cool water from Commonwealth Edison Co.'s 540-MWE oil-fired peaking electric power generating facility. During the present study water did not overflow the spillway and no blowdown occurred; thus no fish escaped from the pond. Adult walleye were present in Collins Pond at the beginning of this study.

Walleye fry and finclipped fingerlings were stocked in Little Grassy Lake in the spring and summer of 1982 and 1983, and in Collins Pond in the spring and summer of 1984. A sample of finclipped fingerlings was held for 24 to 48 hours after the pectoral fin was removed. During this holding period mortality was less than 1%. Sampling was conducted by electrofishing and gill netting throughout both lakes. Walleye were collected in the fall of 1983 and the spring and fall of 1984 from Little Grassy Lake and in the late fall of 1984 from Collins Pond. All fish were examined for marks, weighed, and measured. Saggital otoliths were removed from all fish for age determination. Relative survival of fingerlings versus fry was calculated by the following formula:

$$\text{Relative survival} = \frac{\text{Fr}}{\text{Fs}} \times \frac{\text{Ls}}{\text{Lr}}$$

Fr and Fs are the number of fingerlings returned and stocked and Lr and Ls are the number of larvae returned and stocked. Confidence limits (95%) were calculated for the relative survival by assuming a binomial distribution.

Results

A total of 447 walleye fry and 17 marked walleye fingerlings per hectare was stocked into Little Grassy Lake and 3,640 fry and 15 fingerlings per hectare were stocked into Collins Pond (Table 1). Of 50 walleye recovered from Little Grassy Lake, 31 were stocked as fry and 19 as fingerlings. Thus, relative survival of walleye fingerlings is 15.9 times greater than the survival of walleye swim-up larvae. The 95% confidence interval ranged from 8.4 to 27.6. In Little Grassy Lake there was substantial variation between the relative survival of fingerlings versus fry in 1982 and 1983. Fingerling survival during 1982 was approximately 286 times higher than for fry, whereas in 1983 fingerling survival was only about 4 times that of fry. Of the 219 walleye recovered from Collins Pond, 58 were initially stocked as

Table 1. Stocking density and recovery of walleye from Little Grassy Lake and Collins Pond.

	Fry			Fingerlings			
Stocking date	*N* stocked	*N*/ha	*N* returned	*N* stocked	*N*/ha	Total length stocking (mm)	*N* returned
			Little Grassy Lake				
1982	81,000	200	7	526	1.3	113	13
1983	100,000	247	24	6,438	15.9	43	6
Total	181,000	447	31	6,964	17.2		19
			Collins Pond				
1984	2,125,000	3,640	161	12,332	15.4	74	58

Table 2. Mean total lengths and weights of walleye recovered from Collins Pond and Little Grassy Lake, comparing marked (fingerlings) and non-marked fish.[a]

		Total length (mm)		Weight (g)	
Location	Age (months)	Fingerlings	Fry	Fingerlings	Fry
Collins Pond	8	248.6	258.6	133.1	150.4
Little Grassy Lake	8	269.0	275.4	174.3	201.0
Little Grassy Lake	20	446.8	426.0	851.6	751.6

[a]No significant difference in the growth rate of fry versus fingerlings (ANOVA, $P = 0.05$).

marked fingerlings and 161 were from the fry stocking. These returns indicate a relative fingerling survival rate 62.1 times greater than fry. The 95% confidence interval ranged from 44.8 to 82.3. Survival of fingerling walleye was significantly greater than survival of fry in both lakes (sign test, $P \leq 0.05$).

Walleye in both Little Grassy Lake and Collins Pond exhibited rapid growth rates (Table 2). There were no significant differences in total length or weight after 8 months of age between walleye stocked as fry versus fingerlings in either Collins Pond or Little Grassy Lake. No difference in weight was found for 20-month-old walleye in Little Grassy Lake.

Relative abundance of other species of fish collected in the gillnets from Collins Pond and Little Grassy Lake is given in Table 3. Pelagic piscivorous fishes, such as the white bass *(Morone chrysops),* walleye, yellow bass *(Morone mississippiensis),* and *Morone* hybrid, are much more abundant in Collins Pond than in Little Grassy Lake. However, Little Grassy Lake contains more crappie *(Pomoxis* sp.) and largemouth bass *(Micropterus salmoides)* than Collins Pond.

Discussion

Relative survival of fingerlings versus fry in Collins Pond (62.1) was approximately 4 times that in Little Grassy Lake (15.9) when the two years of data from Little Grassy Lake are averaged. This difference may be the result of such variables as the larger number of pelagic predators in Collins Pond, states of plankton popula-

Table 3. Species composition and relative abundance from gillnet sampling of Collins Pond (1983) and Little Grassy Lake (1984).

Species	Relative abundance (%)	
	Collins Pond[a]	Little Grassy Lake
Gizzard shad	46.0	16.7
White bass	12.9	<0.1
Common carp	9.9	1.9
Walleye	8.0	1.3
Yellow bass	7.6	1.5
Threadfin shad	7.1	0.3
Channel catfish	2.2	0.5
Yellow bullhead	1.5	23.9
Morone hybrid	1.1	
Black bullhead	0.9	2.4
Freshwater drum	0.7	
Smallmouth buffalo	0.6	
Striped bass	0.3	
Bluegill	0.2	4.8
Largemouth bass	0.2	1.8
Golden redhorse	0.2	0.7
Longnose gar	0.1	
Goldfish	0.1	
Silver redhorse	0.1	
Green sunfish	0.1	0.3
Shorthead redhorse	<0.1	
Muskellunge	<0.1	
Grass pickerel		<0.1
Crappie spp.		10.1
Redear sunfish		0.4
Warmouth		2.4
Longear sunfish		<0.1
Spotted sucker		30.5

[a]From Heidinger et al. (1985).

tions at the time of fry stocking, and differences in optimum stocking densities. Quantitative data are not available to partition out the effects of each of these variables. Based on the higher alkalinity and lower Secchi disk readings, Collins Pond is much more fertile than Little Grassy Lake; therefore, one would expect a higher zooplankton density and a greater survival of fry, which was not the case.

The difference in the relative survival rate of fry and fingerlings in Little Grassy Lake between 1982 and 1983 may be a result of inherent variability in relative survival rates within a lake from year to year, or to the size of the fingerlings stocked. In 1983, when survival of fingerlings was approximately 4 times that of fry, fingerlings having a mean total length of 43 mm were stocked. In 1982, when the ratio was 286-to-1, walleye fingerlings that averaged 113 mm TL were stocked.

Several factors could bias these estimates of relative survival, including natural recruitment, mortality of fingerlings from finclipping, and tag loss (fin regeneration). Walleye were not present in Little Grassy Lake prior to their introduction in our study, thus no natural recruitment occurred. Adult walleye were present from

previous stockings in Collins Pond, but natural recruitment is very low if it exists at all. Egg reabsorption by walleye in Collins Pond is common, but a few spent fish have been found in the pond. In the spring of 1985 an unsuccessful effort was made to collect walleye eggs from the rocks in Collins Pond. Meter netting was conducted during the spawning season, but no walleye fry were collected from natural spawns. Within 36 hours of fry stocking all meter net tows contained walleye fry.

Mortality of walleye fingerlings after finclipping does not appear to affect relative survival. A sample of walleye (60 fish) of the 1983 stocking, and 12,332 fish of the 1984 stocking were held for 24 to 48 hours after finclipping with $<1\%$ mortality.

Regeneration of clipped fins could also bias estimates of relative survival. Walleye fingerlings <50 mm long have thin, clear pectoral fins, which tend to adhere to the fish when they are removed from water. Finclipping is thus difficult, resulting in some incomplete marks. Finclips of recaptured walleye varied from total absence of a fin to full regeneration except for lines of scar tissue in the fin rays.

These 3 possible biases would all manifest themselves as apparent better survival of the fish stocked as larvae. Therefore, values for relative survival presented here should be considered minimum values.

Growth rate of the fry versus fingerlings is also an important consideration of whether fry or fingerlings should be stocked. We found no difference in the mean total length after 8 months of age of walleye stocked as fry versus fingerlings in Little Grassy Lake or Collins Pond. There was also no statistically significant difference between the size of fish stocked as fry and as fingerlings after 20 months of age in Little Grassy Lake.

Variations between the 2 lakes indicate that relative survival estimates may have to be calculated for an individual lake. It is also likely that different sizes of fingerlings would have different rates of survival. This has been shown to be true for channel catfish *(Ictalurus punctatus)* (Krummrich and Heidinger 1973) and rainbow trout *(Salmo gairdneri)* (Keith and Barkley 1970). Once the relative survival of different sized individuals of various species has been documented and a weighting system set up for each species, it will be possible for hatchery managers to equate production in terms of a common denominator. Thus, instead of hatcheries having quotas based strictly on number, quotas can be set in terms of "hatchery benefit units." For example, "hatchery benefit units" could be defined in terms of walleye fry: i.e., a 43-mm walleye in Little Grassy Lake has a value of 3.9 fry; a 74-mm walleye has a value of 62.1 fry in Collins Pond; or 113-mm fingerlings in Little Grassy Lake are worth 154.0 walleye fry.

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