Weight-Length Regressions and Growth for Two Bluegill Populations in Rhode Island

David H. Kesler

Division of Biological Sciences, University of Michigan
Ann Arbor, Michigan 48109

ABSTRACT: Significant differences in weight-length regressions and growth were observed between populations of bluegills (*Lepomis macrochirus*) in two physicochemically similar Rhode Island ponds about 500 m apart. Bluegills were heavier and grew faster in the pond in which their density was lower and which had a population of sea-run alewives (*Alosa pseudoharengus*).

If native fishes are to be used in pond aquaculture in the United States, it is necessary that growth characteristics of local populations be known. It is also desirable to know how much natural variation there is between populations of different and similar habitats.

In this study I compare the growth characteristics of the populations of bluegills (*Lepomis macrochirus*) inhabiting two Rhode Island ponds, Mill Pond (MP) and Hamilton Reservoir (HR), which are within 500 m of each other. The ponds have similar physical, chemical, and biological characteristics (Vigerstad 1974), except that HR has a population of sea-run alewives (*Alosa pseudoharengus*).

Methods

Fish were collected during summer 1973 with fyke nets and seines. Small fish collected in hauls with standard 3-m seines were immediately placed in 10% formalin and weighed and measured within 1 week. Samples from both ponds were analyzed at the same time to avoid differences caused by formalin preservation (Engel 1974). Rotenone was also applied at a concentration of 0.5 ppm to a volume of about 825 m^3 previously surrounded by nets. Fish collected with rotenone and fyke nets were measured and weighed before preservation.

Scales were sampled from the second scale row above the lateral line at the end of the pectoral fin (Proffitt 1950, location D). Scale impressions were made on cellulose acetate strips and identifications of annuli were based on the criteria of Regier (1962). Transformations, suggested by Hennemuth (1955) because of discrepancies in sample sizes, were performed on growth increments derived from back-calculated lengths. Transformations were performed on growth increments only.

Slopes of the simple linear regressions of log weight on log length were compared by the analysis of covariance (Snedecor and Cochran 1967).

Results and Discussion

The simple linear body-scale regressions calculated for bluegills from HR and MP in July and October are given in Table 1. Because the variances of the back-calculated lengths were not equal (F_{max}-test, Sokal and Rohlf 1969), I used an appropriate t-test (Sokal and Rohlf 1969) to compare lengths of bluegills from HR and MP for each year class (Table 2). With one exception, back-calculated lengths and lengths at capture of bluegills were greater for bluegills in HR than for fish in MP, and were significantly greater in recent years. When growth increments of fish from HR and MP in their second summer were compared, fish from HR had significantly greater growth increments than did MP fish in 1967-1972 ($t = 3.49$; $df = 5$; $P < 0.025$). Growth increments for fish of older age classes were not significantly different.

Von Bertalanffy growth equations for fish 3-7 years old, calculated from the mean back-calculated length data (Table 2), were

Mill Pond: $\ell_t = 18.3\left[1 - e^{-0.619(t - 1.34)}\right]$

Hamilton Reservoir: $\ell_t = 26.7\left[1 - e^{-0.233(t+0.16)}\right]$

indicating that HR bluegills were ultimately longer (26.7 cm) and approached this length faster than did the MP bluegills.

To prevent size-class domination of weight-length regressions, I established 19 length intervals for MP fish and 20 for HR fish. In early July the bluegill weight-length regression equations (N = 129 fish) were

Mill Pond: $\log W = 4.439 + 2.877 \log L$

Hamilton Reservoir: $\log W = 4.808 + 3.066 \log L$

where W = weight in grams and L = total length in millimeters. Saila and Horton (1957) reported a similar regression equation ($\log W = -4.5172 + 2.9238 \log TL$) for Rhode Island bluegills. The regression equations for fish

Table 1. Simple linear body-scale regressions for bluegills from Hamilton Reservoir (HR) and Mill Pond (MP), Rhode Island, collected in July and October 1973, where Y = total length in centimeters and X = scale radius in millimeters.

Sample size	Month	Location	r^2	Standard error of estimate	$\bar{Y}$	Equation
45	July	HR	0.704	0.396	17.52	Y = 6.184 + 4.349X
81	July	MP	0.781	0.385	17.09	Y = 4.089 + 4.554X
74	Oct.	HR	0.469	0.647	16.75	Y = 4.554 + 4.100X
100	Oct.	MP	0.927	0.355	12.12	Y = 2.226 + 5.215X

*Table 2. Mean back-calculated lengths (in millimeters) of bluegills from Mill Pond (MP) and Hamilton Reservoir (HR), Rhode Island, and lengths at capture on 8-9 July and 28 September to 11 October 1973. Significant differences, developed from t-tests, are given by * ($P < 0.05$) and ** ($P < 0.01$).*

Year class	Age class (years) and location														Length at capture				Total fish	
	1		2		3		4		5		6		7		July		Sept.-Oct.			
	MP	HR	MP	HR	MP	HR	MP	HR	MP	HR	MP	HR	MP	HR	MP	HR	MP	HR	MP	HR
1967	39	42	77	87	115	147	142	185	159	198	179	208	176	217			181	219	3	1
1968	38	39	76	98	115	144*	141	163	169	177	176	189*			182	190*	180	197*	15	5
1969	39	38	81	88	125	130	154	157	172	179					184	189	167	194*	33	24
1970	40	43	80	86	119	127	150	165**							170	181**	154	181**	47	29
1971	39	45**	77	98**	122	149**									151	165*	144	179**	34	21
1972	44	46*	79	106**											123	145	110	151**	68	14
1973	40	40															78	96	50	3
Mean	40	42*	78	94**	119	139*	147	168**	164	185**	178	199	176	217						

collected in September and in October were not significantly different.

The slope of the regression equation was significantly greater ($F = 6.71$; $df = 1,37$; $P < 0.025$) for fish in HR than for those in MP. Thus, HR fish not only were heavier than MP fish at any given length, but also increased in weight with increasing length at a significantly greater rate than MP fish. Condition indices (K) of both sexes were significantly greater ($P < 0.01$) for HR bluegills (except young of the year).

The significantly greater rate of weight increase with length and greater ultimate length for HR bluegills suggest that HR is the better habitat for the species. Further research would be needed to determine whether factors other than the presence of alewives caused this difference.

Density of young-of-the-year bluegills was estimated (on the basis of rotenone application and recovery of fish) to be 2,600 fish/ha in MP and 300/ha in HR. The smaller number of bluegills in HR suggests that less intraspecific competition occurs at the lower density. Careful stocking and management of farm ponds are necessary to prevent overcrowding and stunting of bluegills (Bennett et al. 1940).

This study points up the need for careful evaluation of local conditions, even in apparently similar habitats, before intensive aquaculture is undertaken.

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