PATTERNS OF GROWTH AND NUTRIENT DEPOSITION IN BROOK TROUT (*SALVELINUS FONTINALIS*), LAKE TROUT (*SALVELINUS NAMAYCUSH*) AND THEIR HYBRID, SPLAKE (*S. FONTINALIS* X *S. NAMAYCUSH*) AS A FUNCTION OF TEMPERATURE

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Introduction

Brook trout (*Salvelinus fontinalis*), lake trout (*Salvelinus namaycush*) and their hybrid, F1 splake (*Salvelinus namaycush* X *Salvelinus fontinalis*) account for 80-90% of total fish stocked in lake rehabilitation efforts of the Ontario Ministry of Natural Resources (OMNR). Yet, little information exists in the literature on the patterns of growth and carcass composition for these species (Sadler *et al*., 1986). Such information could be useful for the development of bioenergetics, nutrient-flow, feed requirement, and waste output models for these fish species. These models can allow fish culturists to estimate such factors as time to stocking size, feed requirement, standing biomass, waste output, etc. There have been many attempts to mathematically describe growth of other fish species using a large diversity of approaches and concepts (Iwama and Tautz, 1981). These attempts, however, are often made without reference to water temperatures. Fish are poikilotherms and as such, water temperature is the major factor regulating their metabolic rate and energy expenditure. Fish growth tends to increase as temperature increases within an optimum range of temperatures (Sadler *et al*., 1986). Brook trout and lake trout have different thermal optima for growth which, may result in significantly different patterns of growth at different temperatures. F1 splake offers an opportunity to compare the effects of temperature on growth of a hybrid with its parents. Water temperature vary greatly between the fish culture stations of the OMNR contributing to a wide range of growth rates observed for the species cultured.

The objectives of this study were to examine 1) growth of juvenile brook trout, lake trout and splake 2) the effect of water temperature on the growth of the three species 3) the pattern and cost of nutrient deposition in the three species as a function of temperature.

Materials and Methods

Triplicate groups (100 fish per group) of each species, initial body weight 2.5, 3.3 and 4.1g for lake, brook and splake respectively, were raised at 5, 10 and 15^{o}C over a 16-week period. Fish were fed three times per day to near-satiation with MNR98HS starter diet (ca. 50% protein, 17% lipid). Temperature was monitored continuously; feed intake was measured weekly and weight gains every 28 days. Carcass samples, taken at 0, 8 and 16 weeks, were analysed for moisture, crude protein, lipid and ash contents.

Results

Live weight gain increased as temperature increased for all species. Brook trout weight gain was highest, splake intermediate and lake trout lowest at each temperature (Table 1). In all cases the hybrid, F1 splake, performed intermediately between its parents.

Table 1. Weight gain (g/fish) of brook trout, lake trout and splake at each temperature

	5^{o}C	10^{o}C	15^{o}C
Brook trout	8.3 ± 0.1	19.7 ± 0.4	38.3 ± 0.6
Splake	4.7 ± 0.2	12.7 ± 0.3	18.7 ± 1.1
Lake trout	3.8 ± 0.2	8.8 ± 0.17	12.2 ± 0.5

Iwama and Tautz (1981) showed, for rainbow trout, that a cubic root transformation of live weight resulted in a linear function whose slope increased linearly with increasing temperature. This observation resulted in the development of a growth model known as the Thermal-unit Growth Coefficient (TGC = 100 x (Final body weight$^{1/3}$ - Initial body weight$^{1/3}$)/ Sum (Days * Temp

(°C)). Results indicate that brook trout growth at 5, 10 and 15°C was well described by the TGC model. However, for lake trout and splake, the slope of the curve decreases between 10 and 15°C and was not well described by the TGC model. Modification of the TGC model is needed to better describe the growth of these species at different temperatures.

Carcass analysis (Table 2) showed an effect of final body weight on carcass contents. Accordingly, analysis was performed using final body weight as a covariate. An effect of species ($P<0.05$) and temperature ($P<0.06$) on moisture contents was evident. The relative percentage of which, decreased with increasing temperature for all species. Trends in crude protein contents were shown to be species specific, only lake trout showed an increase in crude protein with increase in temperature. Trends in lipid contents were also shown to be species specific. A linear increase of lipid contents with increasing temperature was evident for brook trout ($P< 0.05$) but no such trends were evident for lake trout or splake. No species or temperature trends were evident for ash contents.

Table 2. Final carcass composition, percentage of live weight, of brook trout lake trout and splake at each temperature

		5 °C	10 °C	15 °C
Brook	H_20	77.0 ± 0.2	75.9 ± 0.1	74.9 ± 0.2
	CP	14.5 ± 0.0	14.9 ± 0.1	15.3 ± 0.0
	LIPID	5.9 ± 0.2	6.7 ± 0.1	7.4 ± 0.2
	ASH	2.0 ± 0.0	2.0 ± 0.0	2.1 ± 0.0
Lake	H_20	80.1 ± 0.1	78.7 ± 0.1	79.4 ± 0.1
	CP	15.4 ± 0.1	15.9 ± 0.2	15.0 ± 0.1
	LIPID	2.7 ± 0.1	3.4 ± 0.1	4.6 ± 0.1
	ASH	2.1 ± 0.0	2.1 ± 0.0	2.2 ± 0.0
Splake	H_20	78.9 ± 0.1	77.6 ± 0.2	76.5 ± 0.3
	CP	15.3 ± 0.1	15.0 ± 0.2	16.3 ± 0.1
	LIPID	3.8 ± 0.1	4.7 ± 0.2	5.6 ± 0.3
	ASH	2.1 ± 0.0	2.1 ± 0.0	2.1 ± 0.1

The information gathered from this project will now be used to develop models of nutrient deposition and to extend the applicability of the bioenergetics, feed requirement, and waste outputs models of Cho (1992) and Cho and Bureau (1998) to these fish species.

References

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