ANADROMY AND RESIDENCY

IN BROOK CHARR *(SALVELINUS FONTINALIS)*:

THE IMPORTANCE OF GROWTH DURING

THE EARLY LIFE HISTORY STAGES

Véronique Thériault
CIRSA-GIROQ, Département de Biologie, Pavillon Vachon,Université Laval,
Qc, Canada, G1K7P4.
Phone number: 418 656-2131 #8022,
Fax number: 418 656-2043,
e-mail address: veronique.theriault@giroq.ulaval.ca

Julian J. Dodson
CIRSA-GIROQ, Département de Biologie, Pavillon Vachon, Université Laval,
Qc, Canada, G1K7P4. e-mail address : Julian.Dodson@bio.ulaval.ca

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Introduction

Partial migration occurs in many anadromous salmonids species, where only a fraction of the population migrates to sea. The remainder stay in freshwater for their entire life-cycle. In Atlantic salmon (*Salmo salar*), a portion of male parr stay in freshwater. In others, such as arctic charr (*Salvelinus alpinus*), brown trout (*Salmo trutta*) and brook charr, some individuals of both sexes reside solely in freshwater while others migrate to sea. The advantage associated with residency is probably a low mortality rate compared to anadromous fishes of the same species, but this benefit is counter-balanced by a significant decrease in fecundity due to limited growth in freshwater relative to growth in the marine environment. Some efforts have been made to find genetic differences between these two forms, but it is generally believed that when no geographical barriers are present, the two forms are genetically identical (Northcote, 1992). Partial migration can then be viewed as a conditional strategy, where the tactic adopted (residency or anadromy) depends on the state or status of the individual (Gross, 1996). This state is often a result of growth, where individuals experiencing good growth conditions mature in freshwater (Nordeng, 1983). Nevertheless, due to higher mortality associated with smaller size at migration (Bohlin *et al*, 1993), fast-growing fish tend to migrate first.

This study attempts to examine a conditional strategy based on growth in brook charr, *Salvelinus fontinalis*. We hypothesised that growth rate among young brook charr would be different for resident and migrant fish, thus influencing their decision to migrate or not.

Methods

Fish were collected from Morin creek (average 5.6m wide, 0.3m deep), a small tributary of the Sainte-Marguerite River, (48°20′N, 70°00′W), Québec, Canada. Migrants were captured in traps in 1998 and 1999 during the downstream migration in early spring. Traps were built in such a way that the whole width of the stream was blocked, except in 1998 when a small opening allowed fishes to move upstream, which was needed for other experiments. Fish caught in the traps were marked with T-bar tags (Floy) and capture-mark-recapture experiments confirmed that these fishes were real migrants. Residents were captured by electrofishing during the summers of 1998 and 1999, once the downstream migrations were over. All fish caught were measured to the nearest mm.

Of the 211 and 425 migrant fishes caught in 1998 and 1999, respectively, 44 and 82 were randomly sacrificed for analysis. A further 40 and 82 resident fishes were also sacrificed in 1998 and 1999 respectively. Sagital otoliths were removed and subsequently ground with fine sand paper. Age was then read and the lengths at emergence and at the end of each growing season were backcalculated using the biological intercept method (BI) (Campana, 1990) using an image analyser system (Scion/SXM). These backcalculated lengths and growth rates were then compared between migrants and residents with a Komolgorov-Smirnov test.

Results and conclusions

Migrant brook charr left the stream at ages 1+ and 2 + during a short period of time in spring for both years studied. Preliminary results for 1999 show no differences in backcalculated lengths at the end of the first growing season between 1+ migrant and resident fishes (fig.1a, KS, $p=0.12$) but differences were found in backcalculated lengths at the end of the second growing season for 2+ fishes : residents were bigger than migrants (fig 1b, KS, $p<0.0001$). Size distribution of both 1+ and 2+ migrant fish are close (modal size of 87 and 98 mm respectively) suggesting that they may be a critical threshold level beyond

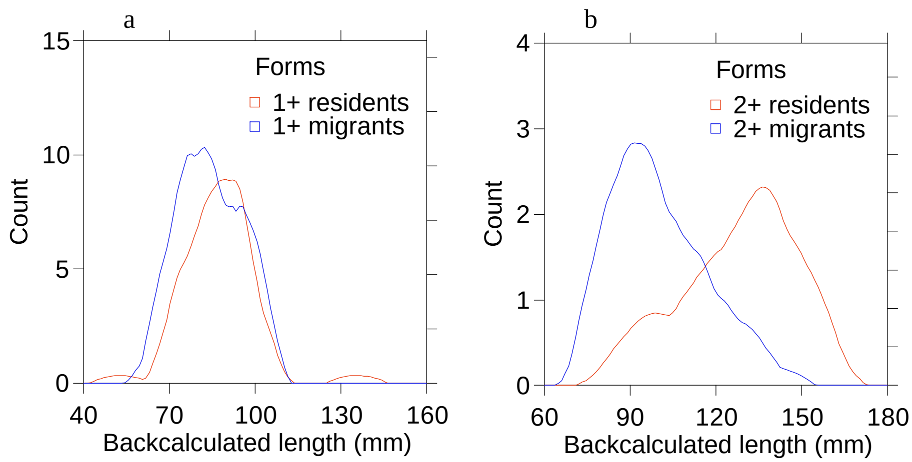

Figure 1. Backcalculated length for migrants and residents at the end of a) the first growing season for 1+ fish (N=68 and 53 respectively) and b) the second growing season for 2+ fish (N=24 and 29 respectively).

which residency is the favored tactic. Furthermore, when backcalculated length at the end of the first growing season is compared between 1999 2+ migrant fishes and 1998 1+ resident fish (fig.2), the former are smaller. This observation suggest that there may be a minimal body size needed for migration such that the smallest 1+ fish delay their decision to migrate or not until the following year.

Two alternative scenarios may explain these observations.

(a) There is a true conditional strategy based on growth, where a threshold size is needed for migration. Individuals aged 1+ that are smaller than this threshold size delay the decision to migrate until the following year. Individuals that are larger than this threshold may stay as resident fish for their entire life-cycle. This should result in a bimodal distribution of 1+ fish within the residents (fish smaller than the threshold size for migration that delay their decision and the largest fish that remain in freshwater), which is not observed (fig.1a). One reason for this may be the small sample size of 1+ resident fish. This scenario indicates that once the threshold size for migration is reached, those fish experiencing slower growth rates migrate to sea whereas those fish experiencing the fastest growth rates remain as freshwater residents.

(b) anadromy and residency may represent two strategies such that migration occurs at 1+ or 2+ depending on growth only for the progeny of anadromous fish. The respective merits of these alternative scenarios will be discussed during the oral presentation.

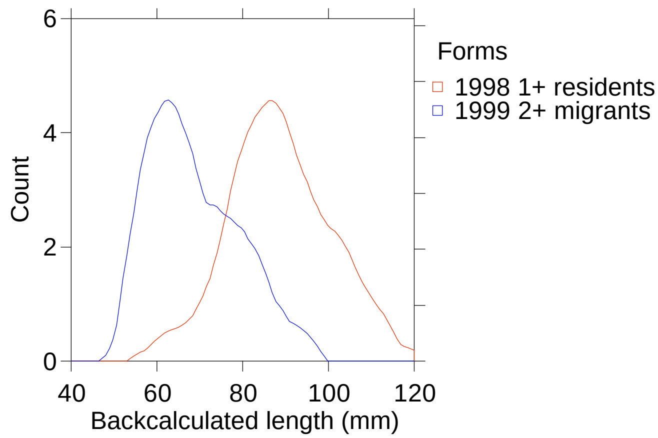

Figure 2. Backcalculated length at the end of the first growing season for 2+ migrant fish caught in the trap in 1999 (N=24) and 1+ resident from 1998 (N=26). The comparison thus represents the same cohort of fish followed over two years.

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