CAUSES AND CONSEQUENCES OF SEXUAL DIFFERENCES IN INDIVIDUAL BROOK TROUT, *Salvelinus fontinalis*, GROWTH RATE

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Introduction

The work described here is part of a research programme that addresses the following general question: What is the influence of environmental heterogeneity on life history? For indeterminately growing organisms, individual growth rate is often a reliable metric of environmental variability. From a behavioural perspective, temporal changes to the physical and biological environment can result in directed movement or undirected displacement. From a life history perspective, environmental variability can effect changes to age-specific rates of survival, fecundity, and growth rate, all of which significantly influence fitness.

To study seasonal patterns in growth rate and movement, naturally occurring brook trout, *Salvelinus fontinalis*, were tagged individually, returned to their natal river, and monitored over a 5-year period. The primary objectives of the research were to: 1) describe patterns of individual movement within an unexploited population near equilibrium; 2) determine whether lifetime movement is sex-biassed; and 3) examine whether seasonal growth rate, and possibly costs of reproduction, differ between males and females.

Material and Methods

The field work was conducted on nonanadromous trout inhabiting Freshwater River, Newfoundland, Canada, a population for which considerable data on life history and survival exist (e.g., Hutchings, 1993, 1994, 1996). PIT (Passive Integrated Transponder) tags were inserted into the body cavities of 943 trout (minimum length of 7 cm, the smallest size at maturity recorded in this population) in June, 1995 and June, 1996. The entire 2.2-km length of the river was electrofished twice annually (June, October) until June, 2000.

Results and Discussion

Patterns in lifetime movement

Among the 192 recaptured fish of known sex, fork length at initial marking did not differ between sexes (females: 9.3 cm, males: 9.4 cm). Lifetime movement differed between sexes, males moving 2.5 times further throughout their lives than females. The difference between sexes was most evident during the spawning period. Notwithstanding this sex bias in movement, most trout moved relatively little, with approximately 85% of females and 65% of males having moved less than 100 m throughout their lives. Interestingly, if an individual was recaptured at a location other than that in which it was originally marked, subsequent recaptures of the same individual revealed movement back to its initial location, suggesting that trout are able to recognise a home territory or range and appear to select these areas preferentially after movement to other sections of the river.

Growth rate

There were significant seasonal differences in growth rate between sexes. The proportionate increase in length experienced by individual males during summer (June through September) was almost double that of individual females. However, the proportionate annual increase in length was not sex-biassed, indicating that females grew significantly faster than males from autumn through early spring.

The faster growth rate experienced by males during summer can be attributed to the doubling of lipids allocated to gonadal tissue by females relative to that allocated by males (Hutchings et al., 1999). Similarly, sex differences in energy allocated during the spawning period might account for the slower growth experienced by males during winter.

Hutchings et al. (1999) found that male trout from nearby Watern Cove River lost significantly more lipids between early October and early April (58%) than females (42%). Although females expend energy during nest construction, mate competition among male salmonids (which can lead to death; Hutchings and Myers, 1987) might account for their significantly greater energy losses. One consequence of these greater lipid losses by males appears to be an increased probability of death during winter (Hutchings et al., 1999). A second consequence may be reduced growth rate during the non-summer months. Furthermore, the energy that males require to undertake their significantly greater within-stream movements might also contribute to a post-spawning energy deficit greater than that of females, resulting again in reduced seasonal growth rate.

Summary

A 60-month study of individually-marked brook trout in Freshwater River, Cape Race, Newfoundland, has revealed sexual differences in seasonal patterns of individual growth rate and movement. Although annual growth rate did not differ between sexes, males grew significantly faster during summer while females grew significantly faster during the remainder of the year. These seasonal differences can be attributed to sexual differences in both allocation of energy to gonads (greater among females) and energetic costs of reproduction (greater among males). Sex-biassed patterns of movement, manifested by a 2.5-fold increase in distance moved by males, may also contribute to the seasonal constancy in male growth rate observed during autumn and winter.

References

Hutchings, J.A. 1993. Adaptive life histories effected by age-specific survival and growth rate. Ecology 74: 673-684

Hutchings, J.A. 1994. Age- and size-specific costs of reproduction within populations of brook trout, *Salvelinus fontinalis*. Oikos 70: 12-20

Hutchings, J.A. 1996. Adaptive phenotypic plasticity in brook trout, *Salvelinus* *fontinalis*, life histories. Ecoscience 3: 25-32

Hutchings, J.A. and R.A. Myers. 1987. Escalation of an asymmetric contest: mortality resulting from m ate competition in Atlantic salmon, *Salmo salar*. Can. J. Zool. 65: 766-768

Hutchings, J.A., Pickle, A., McGregor-Shaw, C.R. and L. Poirier. 1999. Influence of sex, body size, and reproduction on overwinter lipid depletion in brook trout. J. Fish Biol. 55: 1020-1028

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