Reproductive Ecology of Brook Trout (*Salvelnus fontinalis*) in Algonquin Lakes

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The study of mating systems focuses on the interactions of males and females from the perspective that all individuals compete to maximize their reproductive success. Although there has been extensive study of reproductive patterns in salmonid fishes (salmon, trout, char), there is limited understanding of the reproductive interactions that occur under natural conditions. Early research on the reproductive requirements of brook trout (*Salvelinus fontinalis*) in Algonquin lakes were fundamental in establishing the association between groundwater flow through permeable, lake bottom substrate and spawning site location (Fraser 1982, 1985). These findings provide the framework from which to test theoretical predictions on the relationship between resource quality (groundwater flow) and reproductive success. I studied the reproductive strategies of lake-spawning brook trout at Scott Lake, Algonquin Provincial Park, and relate these findings to current mating system theory.

Breeding was characterized by competition among females for spawning sites that contain upwelling groundwater. Extensive re-use of spawning sites and female removal experiments indicated that groundwater sites were a limiting resource. Egg survival experiments showed that very few spawning sites used by females during the four years of this study had rates of groundwater flow that would result in greatest offspring survival (20 $mL \cdot m^{-2} \cdot min^{-1}$). Female body size was an important component of reproductive success (number of eggs surviving to hatching). Larger females were more fecund and, in general, spawned earlier and at better quality sites than small females. At the population level, only 15% of eggs deposited by females were estimated to survive to hatching. Reproductive success of females is constrained by the limited number of spawning sites that have high rates of groundwater flow in this population.

Males competed for access to females and were present in greater numbers than females throughout the spawning season. Mate searching by males included many repeat visits to females and allowed males to predict female readiness to spawn. Large body size conferred a reproductive advantage to males searching for mates, but searching behaviours became restricted with increasingly male-biased sex ratios. Peripheral males exerted a mating cost to dominant males and females. The potential for stolen fertilizations was greatest for males paired with large females due to the presence of numerous peripheral males. Latency to spawn by females increased when paired with relatively small males, and resulted in females obtaining a larger spawning partner and size-assortative mating. Genetic analyses of multiple-male spawning show a first male advantage in fertilization success, the number of males around females are not indicative of the number of males obtaining paternity, and that male reproductive success is highly skewed, with a large proportion of males not contributing to future generations.

References

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