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Relationships of Parentage and Smolt Age to Age at First Maturity of Atlantic salmon *(Salmo salar)*

by

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ABSTRACT

In this paper the relationships of parentage and smolt age to age at first maturity of Atlantic salmon are examined in tagging data for hatchery-reared smolts produced and released in southern Nova Scotia. One-year smolts produced fewer grilse than 2-year smolts, while progeny of grilse parents produced more grilse than smolts from large salmon parents. The combination of 1-year smolts and large salmon parentage produced the fewest grilse (28%) while 2-year smolts of grilse parents produced almost entirely grilse (91%). The results point to the positive contribution that can be made to hatchery programs through the selection of multi-sea-winter salmon for broodstock and the production of one year smolts. Mention is made of the potential damaging effects of fisheries that disportionately harvest the older maturing salmon in a population.

INTRODUCTION

The effects of stock management strategies and fish culture practices on the age composition of Atlantic salmon populations is being viewed with increasing interest by fisheries workers in Canada. This interest is stimulated by an awareness of changes in the sea-age composition of spawning populations of several rivers (Ruggles and Turner 1973; Paloheimo and Elson 1974; Schaffer and Elson 1975), and evidence that hatchery-reared stocks differ from their wild counterparts in the age at which they first mature. An example of the latter occurrence can be seen on the Saint John River, New Brunswick, where the hatchery-reared smolts are producing proportionately 1 1/2x to 2x as many grilse as the wild smolts.

In light of the concerns mentioned above, investigations are ongoing to learn more about age at first maturity in Atlantic salmon and the factors influencing it. Parentage and smolt age are two of these factors for which data are available and presented in this paper.

METHODS

The data reported herein are for groups of 1-year and 2-year smolts of Medway River, Nova Scotia, origin. Each group represents a specific crossing pattern derived from more than one mating. The three crossing patterns were: (i) grilse x grilse, derived from matings of mature 1-sea-winter salmon, commonly called grilse; (ii) large salmon x large salmon, derived from matings of mainly maiden 2-sea-winter salmon, although a few 3-sea-winter salmon and previous spawners were included in the spawning; and (iii) grilse x large salmon derived from mating grilse males with large salmon females.

Eight groups of smolts were produced at Kejimkujik Hatchery, situated in southern Nova Scotia. All smolts were marked with modified Carlin tags (Saunders 1968) and released in the LaHave River, also situated in southern Nova Scotia and adjacent to the native river of the smolts. Three of the groups were liberated in 1973 and five groups in 1974.

Tag recaptures for the groups were from commercial and sport fisheries and included trap counts representative of spawning escapements. The maturity status of the fish at recapture was determined on the basis of time and location of capture.

RESULTS AND DISCUSSION

The results of the tagging investigations were consistent for releases made in both years and confirm that age at which Atlantic salmon first mature is both influenced by heredity and related to smolt age (Table 1).

One-year smolts produced proportionately fewer grilse than did comparable groups of 2-year smolts (79% vs 91% for grilse parents, 28% vs 68% for large salmon parents). Progeny of grilse parents produced more grilse than smolts from large salmon parents (79% vs 28% for 1-year smolts; 91% vs 68% for 2-year smolts). Progeny from the cross between grilse and large salmon yielded almost as many grilse proportion-wise as the comparable group of 1-year smolts from grilse parents (73% vs 79%). Data for this latter comparison are however inconclusive as the release groups are not replicated and the number of recaptures in each is few (49 and 42). Of the select crosses and age classes, 2-year smolts of grilse parents produced the highest proportion of grilse (91%) while 1-year smolts of large salmon parents produced the fewest grilse (28%).

The relationships observed in the data confirm literature reports (Peterson 1971; Elson 1971; and Ritter 1975), although the exact proportions of grilse produced by the different groups are specific for the river stock from which the smolts originated and the hatchery rearing program under which they were produced. For example, the proportions of grilse produced by 2-year smolts originating from matings of grilse and 2-sea-winter salmon of the Miramichi River, New Brunswick, were both lower (61% and 37%) (Elson, 1971) than those reported herein for 2-year smolts of grilse and large salmon parents of Medway River origin (91% and 68%). Also 1-year and 2-year smolts released in their native Saint John River, New Brunswick, produced proportionately few grilse (8% and 46%) (Ritter 1975) relative to the levels produced by 1-year and 2-year smolts reported in this paper (28% to 79% and 68% to 91%). The effect of hatchery practices is referred to in an earlier paper (Ritter 1975) in which data presented were suggestive that selection practices, such as grading to remove the smaller individuals, could select the age composition of adults originating from a particular hatchery operation and stocking program.

The objective of most Atlantic salmon hatchery programs in North America is to contribute to the enhancement or restoration of the species in our rivers. Many of these programs are demanding maximum production of older maturing salmon because of their high reproductive potential relative to that of grilse, and the demands of the fisheries for large fish. From the relationships discussed in this paper it is apparent that both selection of multi-sea-winter salmon for broodstock and the production of smolts in one year enhance the production of multi-sea-winter salmon in a given stock.

The heredity factor pointed to in the relationships discussed above emphasizes the potential damage by fisheries which disproportionately harvest the older maturing salmon. Fisheries of this type contribute to an increased proportion of grilse in the spawning escapements, which in turn can be expected to positively contribute to the "grilsification" of salmon stocks.

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TABLE 1. Comparison of percent grilse produced by 1-year and 2-year hatchery-reared smolts of specific crossing patterns. All smolts originated from parent fish of the Medway River, Nova Scotia.

Year of release	Smolt age	Parentage	No. of smolts	No. of returns	Percent grilse[1]
1973	1	Large salmon	4970	13	31
	2	Large salmon	3998	127	69
	2	Grilse	3973	132	92
1974	1	Large salmon	2080	12	25
	1	Grilse x Large salmon	3974	49	73
	1	Grilse	3904	42	79
	2	Large salmon	2955	47	66
	2	Grilse	2936	63	89

[1] Recaptures of 1-sea-winter salmon that were, according to location and time of capture, destined to mature first as 2-sea-winter or 3-sea-winter salmon were included with the multi-sea-winter salmon in determining the percent grilse produced.