Short Communication

INTERSPECIFIC HYBRIDIZATION OF SALMONID FISH II. SURVIVAL AND GROWTH UP TO THE 4TH MONTH AFTER HATCHING IN F1 GENERATION HYBRIDS

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ABSTRACT

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Among various combinations attempted with six species of Salmonidae, eight crosses provided viable fry 15 days after hatching. Subsequent survival of these hybrids was studied up to the 4th month after hatching. Reasonably good success rates were exhibited by coho salmon ♀ × chinook salmon ♂ hybrids (50% of control) and, to a much lesser degree, by brown trout ♀ × brook trout ♂ and rainbow trout ♀ × coho salmon ♂ hybrids (20% of control).

Body length was measured in the lots which could be raised to fingerling stage. No hybrid superiority in growth was evidenced, with the exception of brown trout ♀ × brook trout ♂ which performed better than the brown trout control lot.

The use of such hybrids for practical aquaculture would require evidence of superiority at the adult stage and the possibility of improved larval survival.

INTRODUCTION

Research on interspecific hybridization among salmonids is motivated (1) by the potential value of some hybrids for aquaculture and fisheries management and (2) by the need to evaluate the risk of introgression following the introduction of foreign species into waters already inhabited by salmonids, should natural interbreeding occur. The bibliographical reviews of Dangel et al. (1973) and Chevassus (1979) summarize most of the available knowledge in this field.

Additional information has been obtained more recently from a series of interspecific crosses, the progenies of which were studied up to the 15th day after hatching (Blanc and Chevassus, 1979). The present report deals with the subsequent survival and growth of the alevins obtained from some of these crosses.

MATERIAL AND METHODS

Eight types of hybrid were used in this study, according to the availability of alevins. Samples of monospecific alevins from the corresponding maternal parents were used as control lots (Table I). The origins of broodstocks, the methods of fertilization and incubation and the results obtained through incubation and hatching have been described previously (Blanc and Chevassus, 1979).

Two weeks after hatching, surviving fry were placed into compartmentalized troughs, supplied with filtered water from the Nivelle river. Each compartment measured 100 cm × 42 cm, with a water depth of 12 cm.

Mortality was recorded in every lot during the following month (yolk-sac absorption and start of feeding). Later on, the best surviving lots of 2-month-old alevins were reduced to a maximum population size of 300, and again 1 month later to 100, in order to avoid overcrowding.

Among hybrid types showing adequate survival and among corresponding controls, growth of 3- to 4-month-old alevins was estimated by means of two series of body length (fork length) measurements. Statistical comparisons of growth performances were done after logarithmic transformation of length, according to the exponential growth model: $L_2 = L_1 e^{rt}$ (Ricker, 1979). Heterogeneity of hatching time was corrected by an analysis of covariance (Snedecor and Cochran, 1967).

RESULTS

Survival

Survival rates are given in Table I. While control lots exhibited good survival, all hybrid types showed significantly lower performances. Mortalities occurred mainly during the first weeks of the experiment and could frequently be related to difficulties either in absorbing the yolk sac (blue sac syndrome) or in feeding (deformities of the head).

Growth

Table II gives the mean body lengths of each lot at 3 and 4 months of age. Statistical comparison of the regressions on age shows that the differences in slopes are not significant, i.e. they can be attributed to sampling error. This implies that the different lots of alevins had about the same relative growth rate, which can be estimated as 0.7% in length per day.

Comparison of the mean lengths adjusted for age effect is therefore meaningful, and provides evidence of a large variability. Substantial differences occurred among lots of the same type (in rainbow trout ♀ × coho salmon ♂ and in coho salmon control). Comparisons between hybrid lots and their monospecific controls give the following results:

- Rainbow trout ♀ × coho salmon ♂ progenies did not differ from rainbow trout controls.
- Coho salmon ♀ × chinook salmon ♂ and rainbow trout ♀ × brook trout ♂ hybrids were significantly smaller than their respective maternal controls.
- By contrast, brown trout ♀ × brook trout ♂ hybrids performed better than brown trout controls, although they were far behind all other lots.

TABLE I

Survival rates of 4-month-old salmonids

Paternal sp.	Maternal sp.	Chinook salmon (<i>O. tsa- wytscha</i>)	Coho salmon (<i>O. kisutch</i>)	Rainbow trout (<i>Salmo gairdneri</i>)	Brown trout (<i>S. trutta</i>)	Atlantic salmon (<i>S. salar</i>)	Brook trout (<i>Salvelinus fontinalis</i>)
Coho salmon	N	143	624 (3)	*	*	*	*
	P	52.4	89.0	—	—	—	—
	R	50.5	control	0.0	0.0	0.0	0.0
Rainbow trout	N		1130 (2)	2043 (2)	876	47	969
	P		32.3	95.5	0.0	0.0	2.0
	R		20.0	control	0.0	0.0	1.4
Brown trout	N		15	*	1580 (2)	38	284
	P		6.7	—	87.4	0.0	48.9
	R		0.1	0.0	control	0.0	21.0

N: initial number of 15-day-old fry; the number of experimental lots is given in parentheses when several were used.

P: percentage survival from 15 days to 4 months.

R: relative rate of hybrid success from fertilization to 4 months (as a percentage of the control from the maternal species).

*: all embryos dead before hatching.

DISCUSSION AND CONCLUSION

The good survival observed in monospecific controls asserts the good quality of the environment, and contrasting mortalities among hybrids are therefore attributable to genetic causes. Already mentioned by other authors are the failure of rainbow trout ♀ × brown trout ♂ and rainbow trout ♀ × brook trout ♂ (Suzuki and Fukuda, 1971) for which rare viable adults have, nevertheless, been described (Buss and Wright, 1958), and the failure of rainbow trout ♀ × Atlantic salmon ♂ (Refstie and Gjedrem, 1975). On the other hand, Refstie and Gjedrem (1975) and Piggins (1970) obtained live fingerlings from brown trout ♀ × Atlantic salmon ♂ crosses, which was not the case in this experiment. Alm (1955) indicates, however, that the results are far better when using sea trout than brown trout.

TABLE II

Growth rates of hybrids and controls from 3 to 4 months of age

Exp.	Genotype	1st measurement			2nd measurement		
		D_F	D_H	L	D_F	D_H	L
A	{ coho control coho ♀ × chinook ♂	158	102	59.60	180	124	72.44
			102	57.38		124	63.78
B	{ coho control rainbow control brown control rainbow ♀ × coho ♂ rainbow ♀ × brook ♂ brown ♀ × brook ♂	145	91	57.74	167	113	69.06
			101	59.18		123	68.96
			95	43.78		117	48.88
			90	55.50		112	64.56
			99	54.21*		121	64.00*
			91	44.52		113	51.82
C	{ rainbow control rainbow ♀ × coho ♂	131	89	53.36	153	111	62.22
			77	46.14		99	55.62

 D_F : age (days) from fertilization. D_H : age (days) from hatching. L : mean body length (mm) of 50 fingerlings (*20 fingerlings only). r : relative growth rate (as a percentage of the body length per day).

Only a few hybrid types showed fairly good survival: coho salmon ♀ × chinook salmon ♂, rainbow trout ♀ × coho salmon ♂ and brown trout ♀ × brook trout ♂, the latter being known already from several authors (Alm, 1955; Suzuki and Fukuda, 1971).

Growth of these hybrids, however, was poorer than that of the control lots, except brown trout ♀ × brook trout ♂ progenies which are known (Alm, 1955) to grow approximately like brook trout during the first summer. Size measurements of rainbow trout ♀ × coho salmon ♂ and coho salmon ♀ × chinook salmon ♂ fingerlings have not been reported before, although Bellet (1975) mentioned the potential interest of rainbow trout ♀ × coho salmon ♂ hybrids for aquaculture. Studies on further growth are nevertheless necessary to define the exact value of these hybrids.

Although some hybrids may be of interest at the adult stage (Chevassus, 1979; Suzuki and Fukuda, 1971), larval mortalities constitute a serious hindrance. Programs aiming at the development of valuable hybrids should first evaluate the possibilities of genetic or environmental improvement of juvenile survival and growth.

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