TR 76-19

MICHIGAN DEPARTMENT OF NATURAL RESOURCES

Fisheries Division

Technical Report: No. 76-19

November, 1976

EVALUATION OF A BROODSTOCK PROGRAM FOR SALMONID BROODSTOCKS BASED ON THE CONTINUED PRODUCTION OF A STRAIN-HYBRID

Vernon E. Bennett, Fisheries Biologist

SUMMARY

A broodstock program is proposed based on the annual production of an F_1 strain-hybrid.

The proposed program was experimentally implemented at the Harrietta Broodstock Hatchery and was easily integrated with existing programs without additional cost or effort.

A small scale study conducted to test the resulting hybrid failed to demonstrate hybrid heterosis.

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INTRODUCTION

The suitability of hatchery produced salmonids for management of a fishery is of major concern to fisheries resource managers. Concern exists because many domestic salmonid broodstocks have been chosen on the basis of hatchery objectives such as; hatchery growth, survival, and egg production. Selection for these hatchery attributes may have resulted in a fish that displays undesirable growth, survival or catchability when stocked into the wild environment.

In response to this concern, a broodstock program was proposed based on the theory that hybridization of domestic strains could yield a more desirable fish.

The proposed program consisted of 4 parts. These were:

A. The Maintenance of Two Separate Strains at the Broodstock Facility.

   A strain of a species is defined as a population of fish which has been subjected to a selection process and which has developed a characteristic population gene pool. Original development in differing geographical areas is advisable.

B. A Genetic Selection Program Applied to Each Strain.

   The selection program suggested for use was proposed by Dr. Graham A. E. Gall in his article Rainbow Trout Broodstock Selection.[1] This program would be applied to each strain in its year of selection.

C. Selection via Alternating Year Classes.

   One strain of species would be selected on even years, the other would be selected on odd years--thereby eliminating a duplication of year classes of broodstock and keeping cost comparable to a one strain approach.

D. Egg Production via Strain-Hybridization

   The annual production of an F_1 strain-hybrid. Male and female of one strain mated to male and female of the other strain.

This study attempted on a small scale to evaluate the proposed program.

METHODS

In 1970, the Harrietta Brood Stock Hatchery, Harrietta, Michigan, was supplied with two additional strains of rainbow trout Salmo gairdneri. One was received from the federal brood stock hatchery located at Manchester, Iowa; the other from the brood stock from the State of Wisconsin. The three strains will hereafter be identified as: Strain H - Harrietta Strain, Strain M - Manchester Strain, and Strain W - Wisconsin Strain.

Also received at that time was one additional strain of brown trout Salmo trutta, the strain was received from the State of South Dakota. The two strains will hereafter be referred to as: Strain H - Harrietta, and Strain D - South Dakota Strain.

All five strains of fish were reared separately under similar conditions, and matured during the fall of 1972. At that time, six lots of reciprocal strain hybrids were produced from the three strains of rainbow and two lots of reciprocal strain-hybrids were produced from the two strains of browns. A control lot was kept from each parent strain.

The resulting lots were reared separately under similar conditions until large enough to be fin clipped. Each lot was then given an identifying clip and lots were combined by species for hatchery rearing.

After 12 months of hatchery rearing, the fish were released by species into outside spring ponds where the only food available was naturally occurring aquatic invertebrates and terrestrial insects. Both species had freedom of downstream migration. After 10 months, the ponds were drawn down and the remaining fish were examined.

The factors considered during this study were growth and survival in the hatchery and growth and survival in the ponds.

RESULTS AND DISCUSSIONS

Rainbow Hybrid Evaluation

The control lots of pure or parent strain rainbows were not comparable to test lots because they were held in a slightly different type of trough and did not suffer a gill disease mortality.

RAINBOW HYBRID DATA

TABLE I

	HATCHERY STUDY 1-73 to 1-74	
	LENGTH GAIN	SURVIVAL
Hybrid H x M	4.63	.75
Hybrid H x W	4.64	1.7
Hybrid M x W	4.82	.70

TABLE II

	POND STUDY 1-74 to 11-74		
	LENGTH GAIN	RECOVERY	SURVIVAL-EST.
Hybrid H x M	3.33	36.3	.28
Hybrid H x W	3.30	40.3	.68
Hybrid M x W	3.30	26.3	.27

Comparison of the 6 lots of hybrid rainbows while in the hatchery, Table I, showed hybrid cross M x W to have only slightly greater growth in terms of length gained. Evaluation of survival while in the hatchery was difficult due to the epizootic of bacterial gill disease, however, strain cross H x W appeared to show slightly better survival.

Comparison of the 6 lots of hybrid rainbows while in the pond environment, Table II, showed length gains to be almost identical. Evaluation of survival as determined by recovery from the pond environment showed hybrid cross H x W to once again have slightly greater survival. The low survival rates for all lots could be due to either migration or mortality.

There was no evidence to indicate any superiority among the hybrid rainbows. Failure to obtain hybrid heterosis in rainbow trout has been recorded by G. G. Savost'yanova[2] in work with strains of rainbow from different countries.

Brown Hybrid Evaluation

BROWN HYBRID DATA

TABLE III

	HATCHERY STUDY 1-73 to 1-74	
	LENGTH GAIN	SURVIVAL
Parent H	3.53	44.6
Hybrid H x D	4.06	51.5
Parent D	3.52	17.9

TABLE IV

	POND STUDY 1-74 to 11-74		
	LENGTH GAIN	RECOVERY	EST. SURVIVAL
Parent H	3.41	10.4	4.7
Hybrid H x D	3.21	10.0	5.9
Parent D	3.79	11.1	2.1

Comparison of the brown trout lots while in the hatchery, Table III, showed hybrid cross H x D to have gained 15% more length than the best parent. Evaluation of survival while in the hatchery showed hybrid cross H x D to have survived at a rate of 15% greater than the best parent.

Comparison of the brown trout lots while in the pond environment, Table IV, showed a marked growth increase for parent D, therefore, hybrid cross H x D finished with less growth. Evaluation of survival as determined by recovery from the pond environment showed hybrid H x D to have maintained slightly greater survival.

The low recovery rates for brown trout could indicate either large migration or heavy mortalities. The similarity of recovery rates does not necessarily indicate that these factors applied equally to all lots.

There was insufficient evidence to indicate that superiority was expressed by the hybrid browns.

CONCLUSIONS

During this evaluation, the proposed broodstock program was easily integrated with existing programs; and the annual production of an F_1 generation strain hybrid was accomplished at a continuing operational cost which was comparable to a one strain program.

The efforts expended to test the hybrid fish were poorly designed and did not answer the question whether a hybrid would be a better fish for resource managers.

The fact that this study failed to demonstrate the production of a superior strain hybrid does not necessarily detract from the acceptability of the proposed program. A program of this type using two strains that have demonstrated the production of a strain hybrid which is least equal to either parent, will insure a continuing quality product with more certainty than any single strain program.

REFERENCES

1. Gall, Graham, A. E., 1971. Rainbow Trout Broodstock Selection Inland Fisheries Administrative Report No. 7, 1-10 Dept. of Fish and Game, California

2. Savost'yanova, G. G. Comparative Fishery Characteristics of Different Groups of Rainbow Trout. Genetics, Selection, and Hybridization of Fish. Translated from Russian for National Marine Fisheries Service. 1973