GENERAL PROGRAM FOR SALMON RESTORATION AND MANAGEMENT

by

George A. Rounsefell
Aquatic Biologist

I. Restoration of runs in streams now devoid of salmon.

A. Evaluation of factors affecting the stream survival of young salmon.

This is to guide in the selection of streams for restoration by indicating the effect of certain natural factors on the survival of planted stock, and by showing what factors may need correction in any particular stream.

1. Type of stream.

Only quantitative experiments can provide an accurate measure of differences in survival in gravel riffles, among boulders or on muddy bottom, or the part played by shelter. This knowledge is of special value in deciding on the suitability of a stream for restoration work and in determining where to plant young salmon.

2. Water temperatures.

The effect on survival of maximum summer temperatures is especially valuable as a guide in evaluating streams for restoration work.

3. Predators.

To indicate the difference in mortality with and without the presence of predators. The effect of abundance and species of predator to be determined.

4. Food and space.

To indicate the effect of density of planting or survival and growth, correlated with the supply of food.

REMARKS:

This portion of the program will be carried out through an experimental design in which varying numbers of young salmon will be held in equal-sized fenced portions of a natural stream. Some of these.

sections will contain no predators, others will contain predators in varying numbers and species. An attempt will be made to include a few sections of each general type of stream bottom. Because of the variety of factors to be tested, the physical limitations will necessitate that this be continued for several years.

B. Selection of streams for salmon restoration.

1. Evaluation of obstructions to migration.

This is placed first, because in cases where a stream is badly blocked there is no need to make extended studies to determine if it is otherwise suitable.

a. Height, construction materials and plans of dams and fishways.

This information is very important in planning a long-term program for salmon study as the durability of the fishway and the non-leaking construction of the dam are a big factor in maintaining clear passage of fish.

b. Number and size of water diversions.

Location and feasibility of screening to prevent the loss of downstream migrants.

c. Location and description of any natural barriers.

d. General extent and intensity of pollution.

Where a stream is not otherwise blocked to migration, it is suggested that a study of the suitability of the stream be made and if found satisfactory, then the pollution situation be carefully studied with a view to remedial measures.

e. Cost estimates should be made of all needed improvements, and then the improvements either should be made or definitely assured before the stream is listed for restoration attempts.

2. Suitability of the stream for adult salmon and for natural reproduction.

This point is listed second as it takes less investigation than the next, and is absolutely essential if the stream is to maintain a self-perpetuating run of salmon.

a. Sufficient flow in summer and fall to permit the ascent of adults, and to provide resting pools in which they can mature.

b. A sufficient quantity of gravel or small rubble bottom in moving water to provide spawning beds.

3. Suitability of the stream for the survival of young salmon.

This point must be studied and steps taken to correct or avoid conflict with any factors found to be adverse to survival.

a. Amount and variation of water flow.

Tributaries need to be visited in midsummer to be certain of sufficient flow to support the young at minimum water levels. In cases where the flow is subject to considerable change, especially during low-water periods, due to the holding back of water for power requirements, it may be necessary to specify a minimum water flow to be maintained at all times before the stream is considered desirable for restoration.

b. Maximum summer water temperatures.

These need to be obtained and the degree and duration of high temperatures checked with the survival experiments (See section I-A-4) before stocking. In cases of doubt, holding experiments are indicated.

c. Predators.

Some method of evaluating the abundance and species of predators may have to be worked out if they prove to be a severe limiting factor (See section I-A-3). In some streams it may be necessary to undertake predator control in order to effect restoration of salmon.

d. Pollution.

Where pollution appears to be a factor, it may be necessary to study its extent and institute corrective measures before the stream is deemed suitable for restoration.

C. Determination of survival from different stocking procedures.

In order to obtain a sufficient survival of young salmon to ensure a run of adults, and in order to obtain the highest returns from a given number of young salmon it is essential to determine the best season, etc., for planting.

1. Season of liberation.

Young salmon to be marked and liberated at different times of the year. The returning adults to be enumerated and examined for marks to determine the survival from each experiment.

2. Size or age when planted. Marking and recovery as above.

3. Tributaries or localities in which liberated. Marking and recovery as above.

REMARKS:

With the present limited egg supply it is absolutely essential that the maximum survival be attained whenever possible, or whenever costs are not out of proportion. These experiments will be carried out on the St. Georges and Pemaquid rivers. The results can be checked by comparison with similar experiments on survival rates in streams that now contain natural runs. These latter experiments will need to be run as part of the management program.

II. Development of management methods.

This includes streams in process of restoration as well as streams now having limited natural runs.

A. Annual census of the spawning escapement in all rivers being studied.

A knowledge of the number of adults in each year's run is necessary in evaluating increases or decreases in the size of the run, in judging the effect of fishing on the size of the spawning escapement, and in discovering the effect on the run of any conservation or management measures employed. The census of the spawning escapement coupled with the amount caught from each river will give the total number of adults returning to the river.

1. Rivers in which a census is necessary for experimental work.

   a. Penobscot at Veazie dam fishway in 1943 and annually.

   b. Pemaquid at Pemaquid Falls fishway in 1944 and annually.

   c. St. Georges at Warren dam fishway in 1945 and annually. (A few grilse may ascend in 1944.)

B. Statistics on numbers caught before ascending the rivers.

This information is very important in order to obtain the total run to a river.

1. Careful canvassing of weirs. By Department of Sea and Shore Fisheries.

2. Collection of anglers' catch in each river. Aid of salmon clubs.

3. Estimates of illegal catches where evidence is sufficient.

C. Comparison of survival from natural spawning and from artificial propagation.

This needs to be tested adequately on one river. From the standpoint of importance and favorable conditions for testing, the Penobscot River would be the best stream on which to run this test.

1. Relation between the number of natural spawners and the number of adults returning to the river from such spawning.

   In order to obtain these figures it will be necessary to count the number of ascending fish each year. To know the numbers of adult fish returning as the result of any one year's spawning it will also be necessary to collect sufficient scale samples from each year's run to give a good estimate of the age composition of the run.

2. Relation between the number of fish removed from the river for artificial propagation and the number of adult salmon returning from the resulting plants of young fish. It is to be noted that in order to put the two methods on an equitable basis it is the number of adults taken for spawning (in other words the amount of natural spawning interfered with) that is compared to the number of returning adults.

   This will necessitate the marking of the young fish before planting and the examination of all adults passing up the river in a search for the marked adults. In order to make a fair test of the two methods it is desirable that the plants be made in waters as favorable as those utilized by the "wild" young salmon, and that the density of planting be no greater than will give fair survival rates (See I-A).

D. Development of the most efficient stocking policy as a part of the management program.

This is essential in order to obtain the best yield from the limited egg supply and to cut the cost per returning adult.

1. Experiments on the best season, age and location to plant similar to those carried out on the experimental streams (See I-C), except that this will be carried on in streams already possessing natural runs.

2. Holding of samples of young salmon in livecars in streams where planted for limited periods to check on the loss in planting resulting from:

   a. Temperature differences between water in the hatchery and in the stream.

   b. Effect of different methods of carrying the fish.

e. Effect of distance fish are carried, or time in transit.

E. Evaluation of the effect of factors limiting the size of the runs and development of measures for their improvement or control.

1. Loss of young salmon occasioned by man.

a. Loss of downstream migrants in power or other water diversions.

Loss from this source needs to be carefully estimated. It may be high on small streams where most of the water is diverted for power. It may necessitate the screening of water diversions as a conservation measure.

b. Loss of young salmon by angling.

It is known that quantities are often caught and kept by trout fishermen, often with the knowledge that they are young salmon. This may be a severe limiting factor, particularly when the runs are small, but there is no accurate data on its extent or on the quantities taken. Many of the streams so fished for trout are said to contain few trout.

2. Inefficient use of river systems by natural runs through lack of runs in suitable tributaries.

Because of the remarkable homing instinct of salmon some tributaries of a river system may be overcrowded while others that are equally desirable have meager runs if any. This necessitates working out a method of determining the relative use of each tributary, either by counting the run at points far upstream, or by developing a method of estimating the abundance of young salmon in each tributary. Where suitable tributaries are not as fully utilized as others, stocking of these tributaries on an experimental basis is indicated.

3. Predators.

From the study of predators in the holding experiments, (See section I-A-3) the possible effect of predators can be estimated. If a method of sampling can be developed to indicate their abundance in a stream, then the cost of control and the estimated increase in survival of young salmon can be calculated.

4. Obstructions to migrations.

A dam, or succession of dams, by slowing migration, especially if some of the fishways are passable at only certain stages of water, may so delay fish in their passage upstream as to reduce their stored-up energies to such a point that they cannot perform the journey to the headwaters. This wastes a great deal of potential nursery grounds for young salmon. Time of upstream migration needs

to be checked, especially on the Penobscot, by marking experiments on the adult fish while passing upstream, in order to test the readiness with which they pass the dams. These data will indicate the efficiency of the present fishways, so that correction may be made if necessary.