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KODIAK RED SALMON INVESTIGATIONS

Plan of Operations - April through October, 1961

REVIEW OF KARLUK INVESTIGATIONS

Since the beginning of the Karluk red salmon fishery in the 1880's, the run has declined to almost one-tenth of its former size. In 1921, investigation of the fluctuation of the abundance of red salmon in this area commenced. The White Act of 1924, designed to protect spawning reserves, provided for a 50 percent escapement of the run. However, even with a high level of escapement, there was a continuing decline.

Gilbert and Rich (1927) did basic research at Karluk Lake on the life-history pattern and spawning ground distribution. Barnaby (1944), studying marine survival, determined that the marine mortality of the Karluk red salmon was about 20 percent. As a result of Barnaby's study, which showed a lack of correlation between escapements and returns, attention was focused on changes in freshwater survival as the primary factor responsible for the continuing decline in the run.

Juday et al. (1926) in a limnological study of Karluk Lake, found that at times certain nutrients were in low concentrations. They concluded that the level of these nutrients was affected by the abundance of decaying red salmon carcasses. Barnaby (1944) found that a long-term change in the relative abundance of 53's and 64's had occurred. He postulated that juvenile red salmon were spending an extra year in lake residence because of a declining growth rate caused by a diminished food supply.



This theory of decreasing fertility was investigated by artificially fertilizing Bare Lake, a small, shallow lake approximately 10 miles from Karluk Lake. Commercial fertilizers were added to the lake waters for a period of seven years beginning in 1950. Concomitant with this program were studies assessing the level of productivity as measured by phytoplankton production, and growth and survival of the red salmon population. Early findings from this study suggested an increase in growth of lake residents (Nelson, 1959). Although artificial fertilization of the lake has been terminated, data are still being collected, and hence results must be considered inconclusive.

Decline of the Karluk red salmon run has also been thought by some to be caused by increased predation on young sockeye. DeLacy (1941), DeLacy and Morton (1943), and Shuman (1950) have studied the food habits of such predators as the chars (Salvelinus malma and S. alpinus) and the Kodiak brown bear (Ursus middendorfi). It is felt, however, that these findings, although informative, are inconclusive as they do not demonstrate the overall significance of predation upon sockeye survival.

Rounsefell (1958) in his analysis of Karluk data believes that the decline of the Karluk run can be attributed to the lower return per spawner, rather than the lack of spawning success. He states that productivity of escapements has been less than the runs from which they originated. This decline in productivity has been explained by some as being a decrease in fertility; however, a decrease in the fertility of Karluk Lake and long-term limnological changes have not been demonstrated.

#### CURRENT RESEARCH

Current research on the decline of the Karluk run is aimed at determining if the run is heterogeneous and if more than one population exists. If the run is heterogeneous, then various segments of the run may exhibit higher rates of productivity than others. Since the Karluk fishery is seasonal in character, the timing could be such that the more valuable stocks could be drastically reduced.

An analysis of Karluk data has shown that there is a change in the age composition of the run over the season, with fish of greater ocean age returning first, and the fish with greater freshwater age returning last. A greater period of marine residence results in

larger sizes which in turn controls the fecundity of females (Hartman and Conkle, 1960). Since there is a change in age composition and size throughout the season, there is, therefore, a fluctuation in the reproductive potential.

Karluk Lake has three types of spawning areas: lateral streams, terminal streams, and lake beaches. All three areas differ in physical characteristics. These three types of environments are used at different times throughout the season by different stocks of spawners having varying reproductive capacities.

The main phase of investigation at Karluk Lake in 1961 will be continued research into racial characteristics, fry survival in two diverse stream types, enumeration of smolts and mapping the extent of beach spawners. A final study of post fertilization conditions at Bare Lake will be made, with emphasis placed on changes in abundance of the fish populations. Studies of the growth, distribution, and survival of Karluk Lake juvenile salmon will commence in 1961.

#### OBJECTIVES

The objectives of the 1961 field season at Karluk and Bare Lakes are:

##### Karluk Lake

1. Comparative study of rates of production from representative lateral and terminal streams
  - a. Enumeration of spawning populations
  - b. Fry enumeration in two representative streams
  - c. Migration behavior and causes of mortality.
2. Smolt outmigration
  - a. Estimation of total numbers
  - b. Age and length data.
3. Adult escapement
  - a. Total count of fish returning to spawning grounds
  - b. Sampling for age, length, sex ratio, and fecundity.

4. Spawning ground survey
  - a. Timing and distribution of escapement to spawning areas
5. Continuance of racial analysis to determine discreteness of spawning populations
6. Abundance, growth, distribution, and survival of juvenile salmon
  - a. Lake resident study
7. Collection of weather data
  - a. Operation of Weather Bureau field station

#### Bare Lake

1. Adult escapement
  - a. Enumeration of spawning population
  - b. Length, numbers, and sex ratio of fish in each age group
2. Outmigration
  - a. Enumeration of red salmon smolts
  - b. Length, weight, and number of red salmon in each age group
  - c. Number of fish of other species entering and leaving.
3. Dolly Varden population
  - a. Mark and recapture program to determine size of Dolly Varden population.

#### SPECIFIC OPERATING PLANS

##### Karluk Lake

#### Comparative productivity of a representative lateral and terminal stream

Grassy Point Creek and upper Thumb River, representative lateral and terminal stream types, were weired in 1959. Adults entering these

streams were counted by sex, and scale samples and length measurement were taken. This program was continued in 1960, and will once again be repeated this coming field season and comparable data collected.

The spring fry production of 1960 was measured in each of the streams and survival rates were determined. The enumeration of fry will be continued. This work is expected to provide information on variability in survival as related to numbers of spawners and habitat types.

In upper Thumb, the abundance of fry will be determined through use of stationary fry traps. The proportion of fry captured in these traps will be estimated by means of a staining and recovery program. The stain and method to be used in upper Thumb will be developed prior to the field season at either the Auke Bay Laboratory or at the University of British Columbia.

Fry enumeration at Grassy Point Creek will be done by utilizing Wolf traps. Since this is a small lateral stream, an attempt to make a total fry count will be made.

#### Smolt Migration

In the past attempts to estimate the size of the smolt migration have produced questionable results. This year an expanded effort will be made to improve our measures of outmigrations. Estimates of downstream migration will be made by using winged fyke nets. Samples of smolts will be taken for length and age data.

#### Adult Escapement

Enumeration of the escapement this year, as in 1960, will be a cooperative effort between the Bureau of Commercial Fisheries and the Alaska Department of Fish and Game. Spawners will be sampled by means of a stationary trap built into the weir. Such data as age, length, and sex will be obtained. Random samples of females will be taken for fecundity studies.

#### Spawning Ground Survey

As a continued study on spawning grounds, weekly stream surveys will be made on all spawning habitats. Particular attention will

be focused this year on beach spawners in relationship to extent and numbers. Data on numbers and location of fish by date will also be made on all spawning grounds.

### Racial Analysis

Fundamental to the rational management of the Karluk Lake run, and as a necessary prerequisite to the understanding of the biology and life history of the salmon is a knowledge of the population composition. Since the number of populations comprising the Karluk run is of such great importance, a program commenced in 1959 to try and determine if discrete sub-populations exist. Scale samples and length measurements were taken from spawners in various spawning habitats. In 1960, fry and adults were collected from major spawning areas to determine composite stocks by racial analysis. This study will be continued this year, and was undertaken by Mr. Robert F. Raleigh as a doctoral problem.

### Juvenile Salmon

A lake resident study will be initiated in Karluk Lake to determine if discrete nursery areas exist; if there is population movement from one area to another if distinct nursery areas do exist; if there are racial differences in these areas; and the mortality rates of lake residents. This study will be carried out by means of a tagging and recovery program. Lake residents will be tagged with staple tags developed by the Fisheries Research Board of Canada and which will be painted in various color combinations.

### Weather Data

A U. S. Weather Bureau field station will be maintained as has been done in past years. Routine data such as rainfall, wind direction, and velocity, and maximum and minimum temperatures will be collected. This information will be forwarded monthly to the Weather Bureau in Anchorage.

Bare Lake

### Adult Escapement

This will be the final year of sampling at this site. It is felt that enough data have been collected to show the effects of artificial enrichment. All red salmon entering Bare Lake will be counted,

measured, sexed, and scale samples taken.

### Outmigration

Total counts by species of all fish leaving Bare Lake will be made. Sampling of red salmon smolts will include length, weight, and scales.

### Dolly Varden Population

A mark and recovery program will be made to estimate the Dolly Varden population. An estimation of the abundance of other species of lake residents will again be made from the relationship of the Dolly Varden catch to that of other species caught in a lake trap.

### SAFETY PROGRAM

Instructions in the safe handling of boats and firearms will be given to all employees. All field camps within the confines of the Karluk Lake investigation will have first aid kits with appropriate instructions.

### PERSONNEL

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Seasonal Aids - 8

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Submitted by:

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