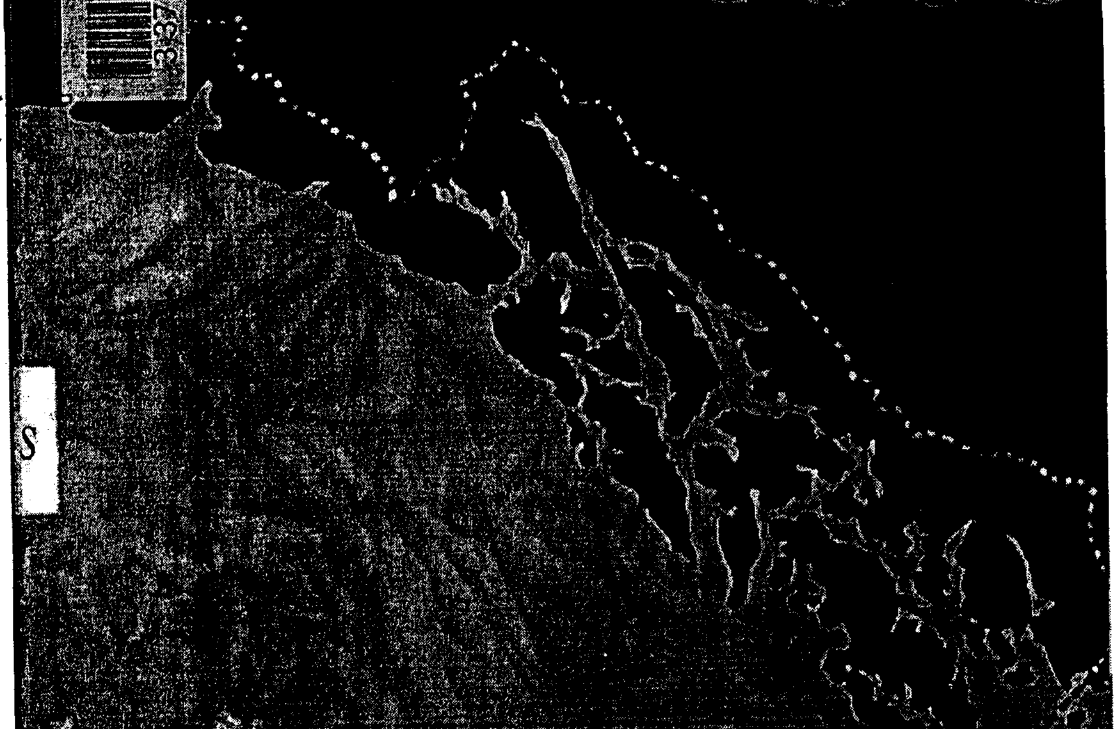
Annual Report FOR 1959



Department of

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SPECIAL STUDIES

King Salmon—Growth and Mortality

During the spring of 1959 Robert Parker completed his doctorate at the University of British Columbia. His thesis entitled "Growth and Mortality in Relation to Maximum Yield in Pounds of Chinook Salmon" will be published as several papers in the Journal of the Fisheries Research Board of Canada. The references of the first of the publications is: Parker, R. R., E. C. Black, and P. A. Larkin, "Fatigue and mortality in troll-caught Pacific salmon," *Journal Fish. Res. Bd. Can.*, Vol. 16, No. 4, pp. 429-484, August 1959. A copy of the thesis abstract follows:

ABSTRACT

Life history events of chinook salmon preclude determination of a critical size for this species by established methods. The use of size, rather than age, as a basic correlate of growth rate is discussed and compared to analagous treatment of physiological rates described in literature. *Ecological* opportunity and *physiological opportunity* are visualized as the two interacting components that determine growth, both of which are related to size attained. Growth opportunity occurs in stanzas which are entered at "threshold" sizes.

The function $dw/t - kw^x$ is developed into a growth equation for linear dimensions, $l \; + 1 = a + l$, and three methods of fitting this equation to growth data are demonstrated. Application is explored and discussed using steelhead trout and chinook salmon as examples. Significant differences in growth rate were found between life history types and sexes. The chinook data were then treated on a $l_t + l, l_t$ plot and it was shown how an apparent fit of the von Bertalanffy type growth equation can result from selectively fishing for the larger fish of any brood year. Accordingly, life history subgroups of a year class must either be treated separately or weighted according to relative abundance in determining critical size. The former alternative is followed in lieu of necessary weighting data.

Natural mortality of a chinook population is estimated from the pattern of tag recoveries, taking advantage of the fact that maturity occurs at different ages for individuals of a year class and that the fishery operated mainly on maturing individuals. Annual instantaneous natural mortality was estimated to lie in the range 0.36 to 0.51.

The growth equation was then transformed to a length-specific average annual instantaneous growth (weight) rate and critical size was observed to occur at maturity for each life history type. Since fishing is presently allowed on the immature stock, a size limit protecting the older life history type causes a loss in yield from the younger life history types. This loss might be offset, depending on the relative abundance of life history types in the stock, providing mortality due to hooking and releasing is negligible.

Capture by trolling was found to subject feeding coho and chinook salmon to hyperactivity which may lead to a distressed condition or death, and death cannot be predicted from examination of individual fish at time of capture. Mortality of coho was estimated to be in the 0.95 confidence interval of 34 percent and 52 percent; of chinook in the 0.95 confidence interval of 40 percent and 71 percent. Time of maximum death rate is shown to coincide with the period of maximum blood lactate response. Survival occurred either when blood lactate did not reach critical levels (above 125 mg%) or reached critical levels and subsequently subsided. Holding salmon in a live box for 8-14 hours before release did not improve tag recovery, suggesting additional indiscriminant stress was caused at release. Adult coho in freshwater did not appear capable of lethal hyperactivity. This led to the hypothesis that cessation of feeding during spawning migration has adaptive significance for survival of Pacific salmon.

The combination of natural mortality, mortality from hooking injury and delayed mortality from fatigue gave a total instantaneous first year mortality rate (exclusive of fishing) greater than 1.0 and possibly as high as 2.5. This mortality rate results in a critical size of not more than 22.5 inches and most likely about 15.0 inches fork length.

Note
Catch + Release
Lactate

mortality
34–52%

It is thus concluded that for maximum yield in pounds (1) fishing for chinook should be restricted to their ultimate year (maturity) and (2) the use of non-selective gear should be encouraged. These recommendations are opposite to present practices. If fishing is to be allowed on the immature stock, size limits should be abolished.

PLASTIC SALMON FRY REARING TANKS

by Dr. W. A. Smoker

In order to solve problems of limitations in both hatchery building space and in budget at the Kitoi Bay Research Station, circular tanks for winter rearing of salmon fry that could be easily erected and then demounted and stored away were devised from plastic wading pools by the Alaska Department of Fish and Game.

The plastic pools were obtained through a well-known mail order house catalog. They were eight feet in diameter and could hold a maximum of twenty inches of water. Each pool accommodated about 150,000 red salmon fry in water at 33-36° F. from November 1958 to May 1959. The hatchery building was insulated and the outside air temperatures at times dropped to 0° F. In order to obtain a convenient working height and to allow for drainage of discharging water, the pools were supported on wooden platforms standing eighteen inches off the concrete hatchery floor.

A standpipe hole four inches in diameter was cut in the center of the plastic pool bottom and also a hole to match in the supporting wood surface. The small red salmon fry were prevented from entering into the standpipe intake by placing a box screen around the entire center standpipe assembly.

The total cost of each rearing tank, completely assembled, was about forty dollars which is almost negligible compared to the cost in thousands of dollars of standard concrete rearing tanks. Further details were submitted for publication in the USFWS *Progressive Fish Culturist* 1960.

FISH COLLECTIONS

by U. B. C. Ichthyologists

The Department received during 1959 a check list of fish specimens collected by Dr. C. C. Lindsey and crew in 1958 in Alaska. This group were from the Institute of Fisheries, University of British Columbia, Vancouver, Canada and during their travels in Alaska were guests of the department at the Kitoi and Canyon Island Research Stations. From these areas the following fish were noted in their collections: (the numbers are from their published list: "Preliminary list of fish collections in the Institute of Fisheries, from Alaska, Yukon River, and Gulf of Alaska Drainages," I. D. McPhail and C. C. Lindsey–December 1958, Revised January 1959).

1 *Osmerus dentex* Steindachner–rainbow smelt, Taku system: Boundary Cr.

2 *Acipenser medirostris* Ayres–green sturgeon, Taku Inlet.

3 *Prosopium cylindraceum* (Pallas)–round white fish, Taku system: Flannigan slough.

14 *Oncorhynchus kisutch* (Walbaum)–coho salmon, Taku system: Canyon Island, Boundary Cr., MacDonald's Lagoon (Afognak Id. Kitoi area).

17 *Oncorhynchus nerka* (Walbaum)–sockeye salmon Kodiak Islands: Big Kitoi Lk. (Afognak Id.).

18 *Salmo clarki clarki* Richardson–coastal cutthroat trout, Twin Glacier Lake, Flannigan Slough.

19 *Salmo gairdneri* Richardson–rainbow trout, Taku system, Canyon Id. Kodiak; Big Kitoi Ck., Fern Lake, Fraser Lk.

20 *Salvalinus alpinus* (Linnaeans)–arctic char, Kodiak Is., Fraser Lk., Karluk Lk.

mately 992,000 rainbow trout, steelhead trout and silver salmon fry and 330,000 steelhead eyed eggs for distribution during the 1959 season. These stations raise only sub-catchable size fish (fry and fingerlings) for use in the State's management program. The actual rearing of the fish to catchable size is accomplished in the natural environment. This type of operation permits maximum production, for the facilities available, at minimal expense.

FIRE LAKE HATCHERY

Fire Lake

The Fire Lake Hatchery, Anchorage, began its 1959 season in March with the arrival of one million rainbow trout eggs procured from Spokane, Washington. These eggs were hatched and the resulting fry were reared at this station until ready for stocking in the various lakes. Again this year the Anchorage station carried the quota of rainbow eggs for the Fairbanks station in addition to its own. In June, 280,000 feeding fry were transported to the Fairbanks station via Department tank trucks. An additional 150,000 steelhead eggs from Kodiak were received in the Fire Lake station at the end of June.

Water temperatures were again a problem at this station. During early spring, water temperatures below 32 degrees Fahrenheit were recorded in the rapidly flowing water supply. Sub-freezing air temperatures were an additional impairment to normal hatchery operation in the unheated building. During this period, about two weeks, two auxiliary type hot air heaters were put into operation to prevent the formation of skim ice in the hatchery troughs. It also proved necessary to install a portable steam generating plant at the water supply intake to overcome ice formation in the water supply line. This icing condition was in sharp contrast to the mid-summer operation when the hatchery water supply rose to high temperatures—a maximum of 70 degrees Fahrenheit—during the latter part of June and early July. Table I.

1959 water Temp.

Table I. Water Temperatures at Fire Lake Hatchery 1959

	Degrees Fahrenheit		
	High	Low	Mean
April	38	32	33
May	59	33	42
June	70	49	64
July	69	50	59
August	68	52	60

Disease

The high water temperatures put the hatchery fish off their feed. Consequently the lack of nutrition weakened the fish and increased their susceptibility to disease. As a result of the difficulties encountered and because of the contemplated year-round operation for this station, plans and preparations for a new water system were formulated. The hatchery was closed down at the end of August and a new eight-inch pipeline was installed. The pipeline intake was moved from the Fire Lake outlet stream to the lake itself and preparations were made for the construction of a tower out in the lake. The completion of this tower is expected by early 1960. The pipeline will be extended to the tower and a vertically adjustable intake installed. This new water system will accomplish the following:

1) Increase the water flow to the hatchery four times from its present flow, thus providing added hatching and rearing capacity.
2) Enable the regulation of water temperature by the adjustment of the intake depth.

This limited temperature control can be accomplished because of the physical characteristics of water. Water, as most liquids, expands as it is heated (becomes lighter). Conversely it contracts as it cools (becomes heavier). One peculiar property of water is that it will become heavier as it cools only up to a given point, approximately 39 degrees Fahrenheit. Below this temperature water again expands, or becomes lighter, until it reaches the freezing point, 32°F., where continued expansion forms ice. Because the expansion resulting in ice formation increases a given volume of water 1/11 times, ice readily floats. It is this peculiar characteristic that enables fish to survive in our northern lakes. If water, contrary to its nature, increased in density, becoming heavier, as it cooled to the freezing point then ice formation would begin at the bottom of the lakes and Alaska, as most northern states, would have lakes of solid ice. Fortunately, this does not occur. As the water cools at the surface and gradually sinks it displaces the warmer water below it and forces this warmer water to the surface.

During the winter water reaches its maximum density at 39.2°F. below the surface of the lake with stratifications of lighter, cooler water above and with ice forming on the surface. Conversely during the summer the cooler water, again 39.2°F., is at the bottom of the lake and the lighter warmer water above it. It is this peculiar property of water that the Department will be utilizing in the new Fire Lake Hatchery water system. By adjusting the up and down placement of the intake pipe, hatchery personnel will be able to take water from the warmer, 39.2°F. water layer near the bottom of the lake for use in the hatchery during winter operation. The water, having high heat retention qualities, is capable of retaining its heat as it passes through the hatchery thus preventing ice formation in the troughs. During the summer, as the waters warm to an undesirable temperature near the surface of the lake, the hatchery men can lower the intake pipe to the cooler depths, taking water at the 55°F. level for hatchery use. See Figure 1. With this control of water temperature, the hatchery will be able to achieve (1) year-around operation (2) better growth of fish and (3) reduced susceptibility of the fish to disease and parasites.

During the 1959 season a total of 668,100 rainbow and steelhead trout and silver salmon were stocked in 31 lakes in the Cook Inlet-Matanuska Valley, Glenn Highway, Homer and Valdez areas from this station. A complete list of fish plantings made from the Fire Lake Station may be found at the end of this report. Table VII.

BIRCH LAKE HATCHERY

The Birch Lake Hatchery, Fairbanks, began its operation in June with the arrival of 280,000 feeding fry from the Anchorage station. The Fairbanks station normally begins its seasonal operation in June due to the late winter ice break-up in that area. By starting operations with feeding fish this station was able to go into full production at the beginning of the season, rather than experience a 5-6-week delay. In late June an additional 100,000 steelhead eyed eggs were received from the Kodiak Hatchery.

Water temperatures reached critical peaks for a short period in late June when a high of 77°F. was experienced. The average water temperature for a nine-day period during this time was 68.4°F. Cool weather, a result of heavy rainfall during July and August, lowered and maintained the water temperature in the low 60's.

Birch Lake

This change in the weather prevented serious losses of the feeding fry and enabled this station to stock in the various Interior lakes approximately 70% of its fish. The Birch Lake Hatchery, operating only during the summer months, has water temperature problems similar to Anchorage (Table II) which limits its production.

Table II. Water Temperatures at Birch Lake Hatchery, 1959

water Temp.
1959

	Degrees Fahrenheit High	Low	Mean
June	77	55	66
July	64	44	59
August	70	44	59

A total of 268,800 rainbow and steelhead trout fry were planted in 10 lakes and gravel pits in Interior Alaska from the Fairbanks station. A list of the waters stocked from this station can be found at the end of this report. Table VIII.

KODIAK CONSERVATION CLUB HATCHERY

A full-time biologist is stationed at the Conservation Club Hatchery on the Kodiak Naval Station. This man cooperated with the Club in carrying out various sport fish projects and worked on sport fishing problems in the Kodiak, Alaska Peninsula, and Aleutian Islands areas. The Department has maintained a biologist in this area since 1956. Biological surveys have been conducted on some 27 lakes in the Kodiak area. In addition a comprehensive survey was completed on Adak in the Aleutian Islands this season. Table III. Ten accessible lakes and the majority of their tributaries were investigated. The fish species present were determined by test netting, using graduated mesh gill nets, hook and line fishing, and shore line observation. All specimens collected were measured, scale samples taken, sex determined, and stomach contents examined. Physical lake data consisting of pH tests, depth measurements and aquatic flora and fauna were collected and recorded. The following is a summary of the findings from ten lakes and some tributary streams on Adak and Kagalaska:

Table III. Fish Population Survey, Adak

Lake	Approx. Acres	Max. depth found	Fish Species Present Rainbow	Dolly Varden	Stickleback	Sockeye Salmon
Andrews	2,300	86 ft.	X	X	X	
Haven Pond	5	6 ft.	X	X	X	
Leone	35	20 ft.	X	X	X	
Mitt	4	15 ft.		X		
Heart	25	25 ft.	X	X	X	
DeMarie	150	30 ft.	X	X	X	
Boy Scout Pond	2.5	18 ft.		X		
No-Luck Pond	3	6 ft.		X	X	
Bell's	7	7 ft.		X	X	
Kagalaska	125	8 ft.	X	X		X

Again this season the Department assisted the Kodiak Conservation Club in securing sufficient steelhead eggs to operate the Kodiak hatchery and provide eggs for various activities throughout Alaska. A portion of the Karluk River steelhead run was trapped by use of a weir and the eggs taken were flown to the Kodiak Naval Station hatchery. The Karluk River is isolated; therefore the steelhead are only lightly harvested. The egg take occurs in early May and lasts approximately two weeks. The weir is then disassembled to allow the natural spawning run of the remaining steelhead to take place.

During the 1959 egg take approximately 1,100,000 steelhead eggs were taken, of which 580,000 were shipped to other stations. The remainder were planted as fry from the Kodiak station. The 1959 egg shipments were as follows:

Steelhead

Agency	Location	Number
Alaska Department of Fish and Game	Anchorage	150,000
Alaska Department of Fish and Game	Fairbanks	100,000
Alaska Department of Fish and Game	Juneau	40,000
U. S. Navy	Adak	190,000
Washington State Department of Game	Olympia, Washington	100,000
	Total	580,000
Eggs held for Kodiak area		383,000
Total pick-off mortality		140,000
	Total egg-take	1,103,000

A total of 335,000 steelhead trout fry were planted in 27 lakes on Kodiak and adjacent areas from the Kodiak Conservation Club Hatchery. A list of the waters stocked from this station may be found at the end of this report. Table IX.