

FISHERY DATA SERIES NO. 90-46

NORTHERN SOUTHEAST ALASKA
DOLLY VARDEN RESEARCH AND
GREEL SURVEYS IN
HAINES AND SITKA, 1988-1989¹

By

Randolph P. Ericksen,
Art Schmidt,
and
Bob Marshall

Alaska Department of Fish and Game
Division of Sport Fish
Anchorage, Alaska

September 1990

¹ This investigation was partially financed by the Federal Aid in Sport Fish Restoration Act (16 U.S.C. 777-777k) under project F-10-5, Job T-1-5.

The Alaska Department of Fish and Game operates all of its public programs and activities free from discrimination on the basis of race, religion, color, national origin, age, sex, or handicap. Because the department receives federal funding, any person who believes he or she has been discriminated against should write to:

O.E.O.
U.S. Department of the Interior
Washington, D.C. 20240

TABLE OF CONTENTS

	<u>Page</u>
LIST OF TABLES	ii
LIST OF FIGURES	iii
ABSTRACT	1
INTRODUCTION	2
METHODS	6
Over-Wintering Abundance Study	6
Harvest Studies	8
Age, Weight, and Length	10
Contribution Estimate	11
RESULTS	11
Over-Wintering Abundance - Chilkat Lake	11
Harvests	14
Haines	14
Sitka	14
Age, Weight, and Length	14
Migrations	21
DISCUSSION	27
ACKNOWLEDGMENTS	28
LITERATURE CITED	29

LIST OF TABLES

<u>Table</u>	<u>Page</u>
1. Estimated harvest of Dolly Varden and effort in angler days in the Haines/Skagway and Sitka areas, 1978 to 1988	4
2. Estimated effort, harvest, and selected sampling statistics for the Chilkat River Dolly Varden creel survey by sampling period and area, 1989	15
3. Estimated effort and harvest, and selected statistics for the Sitka roadside Dolly Varden creel survey by sampling period and area, 1989	17
4. Number (N), mean fork length, and mean weight of Dolly Varden sampled at Chilkat Lake during the 1988 fall tagging event, by age and sex	20
5. Number (N), mean fork length, and mean weight of Dolly Varden sampled in the Chilkat River spring fishery March 27 through May 7, 1989, by age and sex	22
6. Number (N), mean fork length, and mean weight of Dolly Varden sampled in the Chilkat Lake cutthroat trout fishery May 20 through October 7, 1989, by age and sex	23
7. Number (N), mean fork length, and mean weight of Dolly Varden sampled in the Chilkoot River fishery May 8 through November 5, 1989, by age and sex	24
8. Detailed release and recovery information from all Dolly Varden char tagged and released at Chilkat Lake during the fall of 1988 and spring of 1989	25

LIST OF FIGURES

<u>Figure</u>		<u>Page</u>
1.	The Haines/Skagway area	3
2.	The Sitka road system, showing Dolly Varden creel sampling sites, 1989	5
3.	Length frequency of Dolly Varden marked in Chilkat Lake during the fall, 1988	12
4.	Length frequency of Dolly Varden recaptured at the outlet of Chilkat Lake during the spring, 1989, with two lognormal distributions fit to the data	13

ABSTRACT

Two large recreational fisheries for Dolly Varden *Salvelinus malma* in Southeast Alaska occur near Haines and near Sitka, Alaska. A two-year program was initiated in 1989 to study these fisheries. During the fall of 1988 and spring of 1989 a mark-recapture experiment was conducted to estimate the number of Dolly Varden greater than or equal to 200 millimeters in length over-wintering in Chilkat Lake, near Haines. Creel surveys were conducted during the spring of 1989 to estimate angler effort, harvest, and catch in roadside fisheries around both Haines and Sitka. Fork lengths, age, weight, and sex of adults captured in Chilkat Lake and in the Haines spring sport fishery were also recorded.

During October 1988, 1,813 Dolly Varden greater than or equal to 200 millimeters in fork length which were aggregated along beaches of tributaries entering Chilkat lake were captured with beach seines and marked. A modified Fyke trap set in the outlet stream of Chilkat lake during April and May 1989 recaptured only 5 marked fish, and the length distributions of marked and recaptured fish were very different. The majority of large Dolly Varden which over-wintered in the lake apparently avoided our trap, or emigrated before our trap was set, well before ice-out. A preliminary estimate of 46,700 (standard error \approx 17,300) Dolly Varden greater than or equal to 267 millimeters in fork length over-wintered in Chilkat Lake during the winter of 1988-1989.

In the Haines roadside fishery, approximately 1,290 angler hours of effort (standard error = 288) were expended to catch an estimated 1,481 (standard error = 323) and harvest an estimated 1,340 (standard error = 320) Dolly Varden between March 27 and May 21, 1989. Sitka anglers expended an estimated 1,481 hours of effort (standard error = 260) to catch 1,632 (standard error = 417) and harvest 731 (standard error = 312) Dolly Varden between 27 March and 30 April.

Length, weight, sex, and age were recorded for 105 Dolly Varden seined from Chilkat lake in October 1988, and for an additional 355 Dolly Varden sampled from angler creels in the Haines area. Tagged Dolly Varden were captured in salt water up to 146 kilometers by water from Chilkat Lake.

KEY WORDS: Dolly Varden, *Salvelinus malma*, Southeast Alaska, population estimate, Chilkat Lake, creel survey, angler effort, harvest, Haines, Sitka, age-weight-length composition, migrations, condition factor.

INTRODUCTION

Resident and anadromous Dolly Varden *Salvelinus malma* are the focus of large recreational fisheries in Southeast Alaska. Anadromous Dolly Varden reside in lakes and large rivers during winter, migrate to sea in the spring or early summer, and return to their natal streams or lakes to spawn in the fall. In Southeast Alaska, immature Dolly Varden migrate to sea at ages II-IV, may migrate between several fresh water systems during a given year, and may over-winter in a non-natal system (Armstrong 1974). Dolly Varden marked in southeast Alaska have been recaptured at sea 59 km (95 mi) from their natal systems and in fresh water systems 45 km (72 mi) from their natal systems (Armstrong 1965).

The recreational fishery for Dolly Varden near Haines and Skagway, Alaska expanded from an estimated annual harvest of about 10,000 fish in 1978 to about 30,000 fish in 1985 (Mills 1989, Table 1). These harvests are from the Alaska portion of all drainages into northern Lynn Canal. However, most of the harvest is occurring in freshwater and most of this appears to occur in the Chilkat River below Chilkat Lake (Table 1). In 1987 and 1988, estimated harvests in the Chilkat River and estimated total harvests were about 37% below the estimates for 1985 and 1986. It is assumed that Chilkat and Chilkoot Lakes provide the most important wintering habitats for Dolly Varden in Lynn Canal.

Chilkat Lake is located 29 km northwest of Haines (Figure 1). The lake is 10 km long, has a surface area of 984 ha, a surface elevation of approximately 53 m, and a maximum depth of 57 m (Barto and Koenings, 1989). It has substantial littoral areas, although the western perimeter of the lake drops abruptly. The lake outlet is approximately 1.6 km in length and flows into the Tsirku River, a tributary of the Chilkat River. The largest Dolly Varden fishery on the Chilkat River occurs along the Haines road system early in the spring. This fishery usually starts in late March and continues through May. The fishery is popular with residents of Whitehorse, Yukon Territory, Canada, who are eager to escape their harsh winter weather. Another popular Dolly Varden fishery occurs during the summer at Chilkoot Lake and River (Table 1).

The harvest of Dolly Varden in the Sitka area has varied from a low of about 3,000 to high of about 10,000 fish per year during the past ten years (Mills 1989, Table 1). These estimates include harvests from Baranof, Chichagof, and several other islands in the immediate vicinity. In contrast to the fisheries in Lynn Canal, most of the harvest and angler effort near Sitka occurs in saltwater. Harvests appear stable, although angler effort was at decade high levels in 1987 and 1988. Approximately 53% of the estimated total harvest in the Sitka area in 1988 occurred in the Sitka Sound/Starrigavan vicinity and most of this occurs on the roadside (Table 1).

The Dolly Varden fishery in the immediate Sitka area is composed of several fisheries. The first and most intense fishery occurs along the road system (Figure 2) early in the spring when Dolly Varden first appear after over-wintering in lakes and larger rivers. This fishery usually starts in late March and continues through May. Another Dolly Varden fishery begins along the roadside in July when the fish begin entering the streams concurrent with salmon *Oncorhynchus* sp. runs. This fishery is popular with non-residents who are visiting the area. The third fishery occurs in the late summer when local fishermen concentrate at mouths of larger rivers to catch anadromous fish that are returning to spawn. Anglers trolling for salmon also catch Dolly Varden.

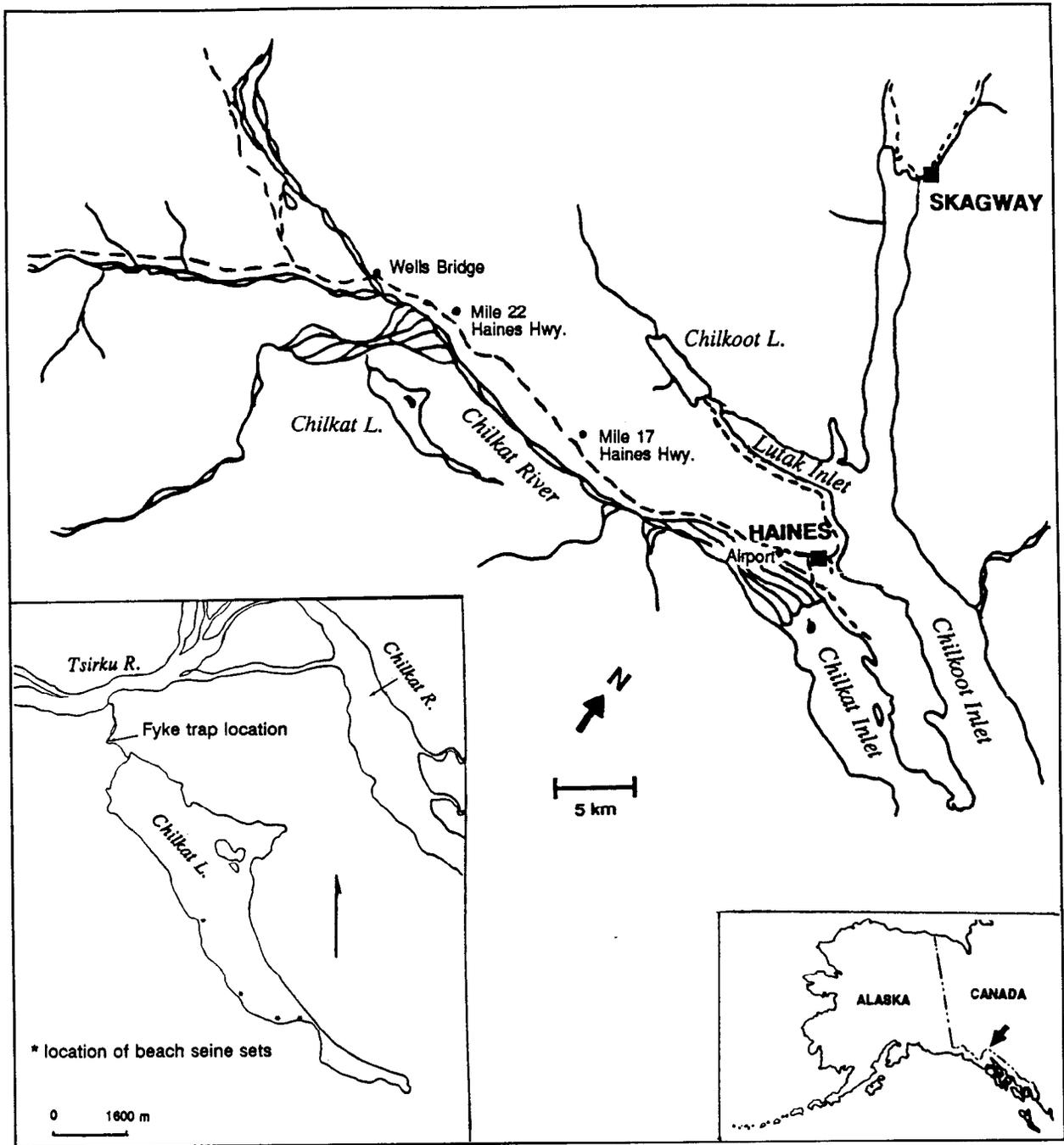


Figure 1. The Haines/Skagway area.

Table 1. Estimated harvest of Dolly Varden and effort in angler days in the Haines/Skagway and Sitka areas, 1978 to 1988.

Haines/Skagway Area Dolly Varden Harvests														
Year	Chilkoot River		Chilkoot Lake		Chilkat River		Chilkat Lake		Saltwater		Freshwater		Total	
	Harvest	Effort ^a	Harvest	Effort ^a	Harvest	Effort ^a	Harvest	Effort ^a	Harvest	Effort ^a	Harvest	Effort ^a	Harvest	Effort ^a
1978 ^b	1,953	3,533	1,483	2,757					2,775	8,035	7,215	9,866	9,990	17,901
1979 ^c	554	1,478	1,327	1,587					1,373	5,203	2,690	4,526	4,063	9,729
1980 ^d	1,765	3,884	2,066	1,985					1,455	7,654	7,593	10,510	9,048	18,164
1981 ^e	5,098	6,364	2,354	1,947					2,149	10,144	11,366	10,617	13,515	20,761
1982 ^f	4,067	4,470	1,572	2,184					1,813	10,339	8,590	9,315	10,403	19,654
1983 ^g	3,564	6,637	3,542	2,959					4,164	13,100	14,208	17,081	18,372	30,181
1984 ^h	6,630	8,249	3,900	2,139	6,260	4,043			3,822	17,629	17,245	15,073	21,067	32,702
1985 ⁱ	9,069	11,362	5,185	4,365	12,346	5,845			2,756	17,344	28,195	23,068	30,951	40,412
1986 ^j	6,823	6,988	2,720	1,767	11,202	8,669	3,296	1,131	4,356	23,827	27,637	20,043	31,993	43,870
1987 ^k	4,075	10,377	5,668	6,501	7,063	4,763		543	2,083	1,232	17,130	17,891	28,881	19,123
1988 ^l	4,075	6,385	2,819	3,383	7,913	6,148	1,182	1,019	3,257	21,368	16,825	18,801	20,082	40,169

Sitka Area Dolly Varden Harvests														
Year	Starrigavan				Sitka Sound				Saltwater		Freshwater		Total	
	Boat		Shore		Boat		Shore		Harvest	Effort ^a	Harvest	Effort ^a	Harvest	Effort ^a
1978 ^b									1,600	27,638	1,736	5,303	3,336	32,941
1979 ^c									3,081	36,564	2,627	3,946	5,708	40,510
1980 ^d									4,736	33,172	5,407	5,510	10,143	38,682
1981 ^e									4,017	34,650	1,739	3,884	5,756	38,534
1982 ^f									5,565	37,686	3,605	5,663	9,170	43,349
1983 ^g									5,570	39,160	1,582	4,998	7,152	44,158
1984 ^h	466	5,238	2,603	4,938	50	9,139			4,636	35,791	931	4,258	5,567	40,049
1985 ⁱ	1,144	6,017	867	2,774	243	9,589			3,884	31,935	2,826	4,680	6,710	36,615
1986 ^j	382	1,940	961	2,042	198	17,384	641	1,416	3,214	35,173	2,214	4,587	5,428	39,760
1987 ^k	937	4,067	937	3,438	487	19,537	937	3,257	4,606	39,972	2,066	5,611	6,672	45,583
1988 ^l	964	4,734	1,619	2,769	545	20,213	2,128	2,369	6,675	43,603	3,275	5,077	9,950	48,680

^a Effort = Total effort for all species in angler days

^b Mills 1980

^c Mills 1981a

^d Mills 1981b

^e Mills 1982

^f Mills 1983

^g Mills 1984

^h Mills 1985

ⁱ Mills 1986

^j Mills 1987

^k Mills 1988

^l Mills 1989

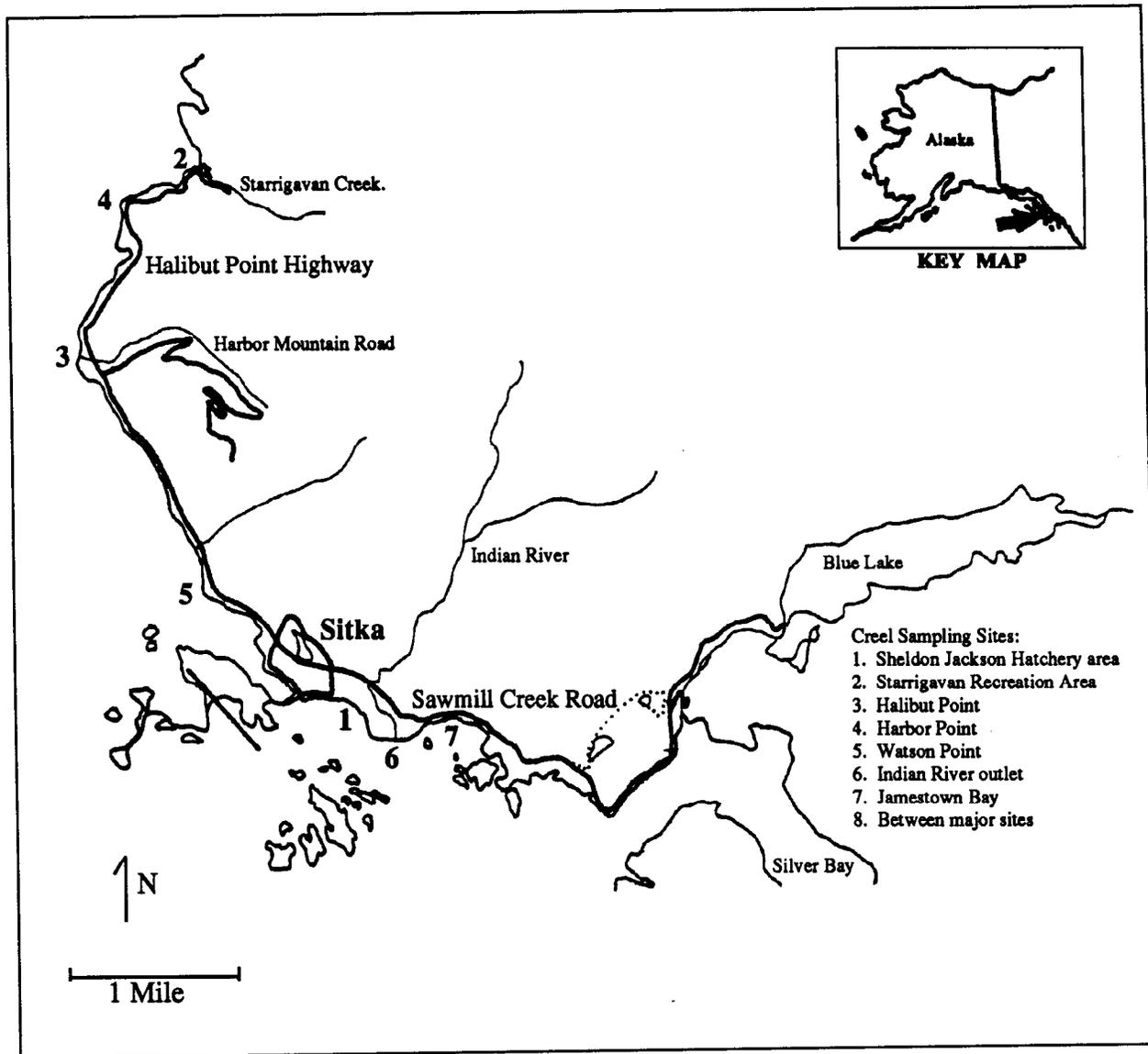


Figure 2. The Sitka road system, showing Dolly Varden creel sampling sites, 1989.

During 1989 our objectives were to:

1. estimate the abundance of Dolly Varden ≥ 200 mm fork length (FL) residing in Chilkat Lake during the winter of 1988-1989;
2. estimate catch, harvest, and fishing effort along the roadside fishery in Haines from March 27 through May 21, 1989;
3. estimate the contribution of Dolly Varden which over-wintered in Chilkat Lake to the Haines sport fishery from March 27 to May 21, 1989; and,
4. estimate catch, harvest, and fishing effort along the roadside fishery in Sitka from 27 March to 7 May, 1989.

This report also presents results of length, weight, and age (otolith) sampling conducted during field operations on Chilkat Lake and during the Haines roadside creel survey. Migration patterns of Dolly Varden tagged in Chilkat Lake are also described.

METHODS

Over-Wintering Abundance Study

The number of large Dolly Varden in Chilkat lake during the winter of 1988-1989 was estimated using the Chapman modification of the Peterson estimator (Seber 1982):

$$\hat{N} = \frac{(n_1+1)(n_2+1)}{(m_2+1)} - 1 \quad (1)$$

$$V[\hat{N}] = \frac{(n_1+1)(n_2+1)(n_1-m_2)(n_2-m_2)}{(m_2+1)(m_2+2)} \quad (2)$$

where:

- \hat{N} = abundance;
- n_1 = number of Dolly Varden marked in the fall of 1988;
- n_2 = number of Dolly Varden examined in the spring of 1989; and,
- m_2 = number of marked Dolly Varden recaptured in the spring of 1989.

For the first sampling event, beach seines were used to capture fish aggregated on beaches at four lake-tributary junctions (Figure 1) between October 1 and 21, 1988. Dolly Varden were separated from other species, anesthetized using an electroshock basket (Gunstrom and Bethers 1985), measured to the nearest mm of fork length (FL), and tagged with a uniquely numbered Hallprint t-bar anchor tag if FL ≥ 200 mm. The adipose fins of tagged fish were also removed so that tag loss could be estimated.

Data collected during seining included: (1) date and location of set; (2) number of fish captured by species; (3) length and tag number of Dolly Varden tagged; (4) tag numbers of Dolly Varden recaptured; and (5) number of adiposeless Dolly Varden captured that did not have tags. Approximately every tenth fish sampled was sacrificed to collect otoliths for age-weight-length (AWL) measurements.

The second (spring) sampling was accomplished by setting a modified fyke trap in the outlet of Chilkat lake during the emigration. We tentatively assumed that every fish would have an equal probability of being captured during the second sampling event. Captured Dolly Varden ≥ 200 mm FL were counted, measured to the nearest mm, inspected for a tag or missing adipose fin, tagged with a uniquely numbered Hallprint t-bar anchor tag (if untagged), marked with a caudal punch to permit estimation of tag loss, and released. Unmarked emigrants were tagged to study the migration patterns of Dolly Varden once they leave Chilkat Lake.

Data collected during the fyke trap operation included: (1) time and date; (2) duration of the set; (3) number of fish captured by species; and (4) tag numbers and fork lengths of recaptures and unmarked fish ≥ 200 mm FL that were marked and released alive.

In estimating abundance (\hat{N}) with the equations above we assumed:

- a) the population was closed with respect to fish ≥ 200 mm FL;
- b) all fish had the same probability of capture during the first sample or in the second sample or marked and unmarked fish mixed completely during the two samples;
- c) marking did not affect the probability of recapture; and
- d) fish did not lose marks between sampling events.

We assumed over-winter survival would be high ($\geq 94\%$), as measured by Armstrong (1965, p. 24) in Eva Lake, and that any mortalities would affect marked and unmarked fish equally. If unmarked fish recruited to the population (either from growth or immigration), estimates for the time of tagging would be biased. Growth recruitment could be culled from the fish measured at the weir using the non-parametric procedure of Robson and Flick (Seber 1982, p. 74-81).

We assumed marked and unmarked fish mixed completely over the winter. Assumptions b) and c) could be tested with Kolmogorov-Smirnov two-sample goodness-of-fit tests. Results of the two tests can be used to determine the methodology to alleviate bias in the abundance estimation (Clark and Ridder 1990, p. 9).

Armstrong (1965, p.18) estimated that only about 1 in 1,000 Dolly Varden in Eva Creek (Southeast Alaska) were naturally missing an adipose fin. Armstrong also found the rate of adipose fin regeneration were very low. We thus assumed that the incidence of Dolly Varden with missing adipose fins and missing numbered floy tags in the Fyke trap could be used to correct for tag loss (Seber 1982, p. 94-96).

Harvest Studies

The spring roadside fishery on the Chilkat River was monitored from Mile 3 to Mile 24 of the Haines Highway (Figure 1). Anglers concentrate around major parking areas and are counted and interviewed by roving near the parked vehicles. Three areas along the highway are defined for reporting purposes: (1) from the airport (Mile 3) to Mile 17; (2) from Mile 17 to Mile 22; and (3) the Well's Bridge area (around Mile 24).

The spring roadside fishery in Sitka occurs at specific locations near hatchery sites, creek mouths, and rocky outcrops or points along the road system. Eight "sites" are identified for reporting purposes: (1) Sheldon Jackson College hatchery; (2) Starrigavan recreation area; (3) Halibut Point; (4) Harbor Point; (5) Watson Point; (6) Indian River; (7) Jamestown Bay; and (8) "Between" these major sites.

A roving type creel survey (Neuhold and Lu 1957) with a modified random sampling design was used to estimate total angler effort and harvest in both surveys. Sampling was stratified by 14-day periods and by type of day (i.e. weekday or weekend/holiday). The 14-day strata were: 27 March to 9 April; 10 April to 23 April; 24 April to 7 May; and 8 May to 21 May. In Sitka, the last 14-day strata ended on May 7, and morning- and evening-day stratification was defined because a strong early morning fishery was suspected. There were thus 8 distinct strata in Haines and 12 distinct strata in Sitka (not counting reporting areas).

Fishing days in Haines started between 0600 and 0635 AM and ended within 15 minutes of the average time of civil twilight during the 14-day strata. Three equal sampling periods were defined in each day of the first 14-day season, and four equal sampling periods were defined in each day of the 3 remaining 14-day seasons. Morning fishing days in Sitka were defined as the time between sunrise and sunrise-plus-four-hours, while evening fishing days were the remainder of the day until sunset. In Sitka, two equal sampling periods were defined in each morning and 4 to 6 equal sampling periods (depending on the 14-day strata) 2 hours in length were defined for sampling evenings.

Both surveys considered periods within strata as primary sampling units and anglers within periods as secondary sampling units. Both weekend days and all but two contiguous weekdays in each week were selected for sampling. Then, both morning and one evening period in each day was randomly selected for sampling in Sitka, and two periods per day were randomly selected for sampling in Haines. These are considered to be a simple random sample of periods in the strata. Periods to sample in each day were selected by randomly counting forward or backward from the first or last period in the day to randomly selected period numbers.

During each period selected for sampling anglers were counted once while driving the roadside and walking to observe anglers if necessary. The "counts" were considered to be instantaneous measures of fishing effort at the time of the count (Von Geldern and Tomlinson 1973). During the same sampling periods anglers were also interviewed to obtain catch per unit effort (CPUE) and release per unit effort (RPUE) for other species. During each interview anglers were asked how many hours they fished, whether their trip was complete or incomplete, and the number of fish they caught and kept or caught and released, by species. Angler effort in each stratum was estimated:

$$\hat{E}_h = R_h \frac{\sum_{i=1}^{d_h} x_{hi}}{d_h} \quad (3)$$

where R_h was the total number of hours available for fishing in stratum h , x_{hi} was the number of anglers counted in sample i stratum h , and d_h was the number of "count" samples taken in stratum h . The variance of E_h was estimated:

$$\hat{V}(\hat{E}_h) = (1-f_h) R_h^2 \frac{\sum_{i=1}^{d_h} (x_{hi} - \bar{x}_h)^2}{d_h(d_h-1)} \quad (4)$$

where \bar{x}_h was the mean number of anglers counted ($\bar{x}_h = \sum_{i=1}^{d_h} x_{hi}/d_h$), f_h was the sampling fraction (d_h/D_h) in stratum h , and D_h was number of possible samples.

Total catch (or harvest) in each stratum was estimated:

$$\hat{H}_h = \hat{E}_h \hat{T}_h \quad (5)$$

where \hat{T}_h was the estimated catch (or harvest) per unit effort in stratum h .

Catch or harvest rates (CPUE or HPUE) in each stratum were estimated:

$$\hat{T}_h = \frac{\sum_{i=1}^{d_h} \sum_{j=1}^{o_i} c_{hij}}{\sum_{i=1}^{d_h} \sum_{j=1}^{o_i} e_{hij}} \quad (6)$$

where c_{hij} and e_{hij} were the catch and effort of angler j sample i stratum h , and o_i was the number of anglers interviewed in sample i . The number of interview samples and the number of "count" samples were the same (d_h) since counts were taken once during each sample period. Both complete- and incomplete-trip interview data were used to calculate CPUE. The variance of \hat{H}_h was estimated:

$$\hat{V}_h(\hat{H}_h) = \hat{E}_h^2 \hat{V}_h(\hat{T}_h) + \hat{T}_h^2 \hat{V}_h(\hat{E}_h) - \hat{V}_h(\hat{E}_h) \hat{V}_h(\hat{T}_h) \quad (7)$$

after a formula in Goodman (1960) for a product of two independent random variables. The variance of the CPUE or (HPUE) was estimated:

$$\hat{V}_h(\hat{T}_h) = \left(\frac{\bar{c}_h}{\bar{e}_h} \right)^2 \left(\frac{s_{(c)h}^2}{\bar{c}_h^2} + \frac{s_{(e)h}^2}{\bar{e}_h^2} - \frac{2 \text{cov}(c, e)_h}{\bar{c}_h \bar{e}_h} \right) \quad (8)$$

after a formula in Jessen (1978, p.128) for a ratio of random variables. \bar{c}_h was the overall mean catch per angler ($\bar{c}_h = \sum_{i=1}^{d_h} \bar{c}_{hi}/d_h$, $\bar{c}_{hi} = \sum_{j=1}^{o_i} c_{hij}/o_i$) in stratum h , \bar{e}_h was the same statistic for effort, and $s_{(c)h}^2$, $s_{(e)h}^2$, and $\text{cov}(c, e)_h$ were variances and covariance for estimating catch and effort components of the CPUE (or HPUE) using a modified two-stage sampling estimator (Cochran 1977):

$$s_{(c)_h}^2 = (1-f_h) \frac{\sum_{i=1}^{d_h} (\bar{c}_{hi} - \bar{c}_h)^2}{d_h(d_h-1)} + \frac{1}{D_h d_h} \frac{\sum_{i=1}^{d_h} \sum_{j=1}^{o_i} (c_{hij} - \bar{c}_{hi})^2}{o_i(o_i-1)} \quad (9)$$

$$\text{cov}(c, e)_h = (1-f_h) \frac{\sum_{i=1}^{d_h} (\bar{c}_{hi} - \bar{c}_h) (\bar{e}_{hi} - \bar{e}_h)}{d_h(d_h-1)} + \frac{1}{D_h d_h} \frac{\sum_{i=1}^{d_h} \sum_{j=1}^{o_i} (c_{hij} - \bar{c}_{hi}) (e_{hij} - \bar{e}_{hi})}{o_i(o_i-1)} \quad (10)$$

and $s_{(e)_h}^2$ was calculated by substituting e for c in equation 9.

Equation 9 shows that a modified two-stage estimator was used even though the sampling design was more accurately a stratified random design (we defined sampling periods as primary units and anglers as secondary units). Variance equations 9 and 10 did not include a finite population correction factor for sampling anglers within periods since the anglers were a random component in the model.

Harvest and effort for the season (and their variances) were the sums across strata $\sum H_h$ and $\sum V[H_h]$, and $\sum E_h$ and $\sum V[E_h]$.

HPUE or CPUE estimates across strata were obtained by dividing the total estimated catch by the total estimated effort:

$$\text{CPUE} = \frac{\sum_{h=1}^q \hat{H}_h}{\sum_{h=1}^q \hat{E}_h} \quad (11)$$

where q was the number of stratum to be combined.

Approximate 95% confidence intervals (CI) were obtained for harvest and effort estimates by assuming normality. The CI for harvest (or effort) was:

$$\text{C.I.} = \hat{H} \pm 2 (\hat{V}(\hat{H}))^{1/2} \quad (12)$$

The lower CI was set equal to the value obtained by equation 12, or to the actual number of fish observed in the sampled harvest, whichever was greater. Since the harvest and effort estimates may not be normal, CI limits should be considered approximate.

Age, Weight, and Length

Fork length to the nearest mm, weight to the nearest 10 gm, sex, and otolith samples were collected from harvested Dolly Varden encountered during the Haines creel survey. Both sagittal otoliths were removed for age determination if possible. Otoliths were stored dry until 48 hours before examination when they were covered with a solution of 50% glycerine and 50% water. Otoliths were then viewed on a watch glass over a dark background using a 10X stereoscopic microscope and reflected light. Age was estimated by counting the number of hyaline zones (assumed to be winter growth increments).

Contribution Estimate

Every Dolly Varden with FL ≥ 200 mm that was captured at Chilkat Lake during the emigration was marked with a uniquely numbered Hallprint t-bar anchor tag. A caudal punch was applied so that tag loss could be estimated. All Dolly Varden encountered during the Haines creel survey were examined for marks. Contributions to the sport fishery were to be estimated according to procedures in Clark and Bernard (1987). However, no contribution could be estimated as explained in the Results section below.

RESULTS

Over-Wintering Abundance - Chilkat Lake

One thousand nine hundred and seventy-one (1,971) Dolly Varden were captured in 43 beach seine sets between October 1 and October 21. An additional 7 Dolly Varden were captured with large (1 m) minnow traps and 18 were captured by rod and reel. Of the captured fish, 1,813 were tagged, marked, and released alive. Three tagged fish were subsequently removed from the population during a different study conducted in November 1989. The length frequency distribution of the tagged fish is skewed and has a mode near 320 mm (Figure 3). Seventy-one of the 1813 tagged fish were recaptured during the seining operation and four of these were missing tags (6%).

The fyke trap was installed in the lake outlet stream on April 11 and was removed on May 28, 1989. The trap fished the main thalweg of the outlet stream and accumulated about 80% of its catch between midnight and 3:00 am. A total of 939 Dolly Varden were captured, but only 292 of these were ≥ 200 mm in length (Figure 4). We assume that the large number of small Dolly Varden in our sample were smolt and were unavailable to our fishing gear during October (ie. either gear selectivity or sampling site selection). Only five marked Dolly Varden were recaptured in the trap, and no untagged fish were missing adipose fins.

To estimate the number of Dolly Varden ≥ 200 mm FL over-wintering in the lake, recruitment of smolts must be removed from the second sample. This was accomplished by a curve fitting procedure, since traditional methods (eg., Robson and Flick 1965) were judged unusable with our sample of only 5 relatively large sized (FL) recaptures. Curve fitting was implemented using the MIX software package (Macdonald and Green 1988). Two lognormal distributions were fit to the spring length frequency data (Figure 4). The second mode of the length distribution for the spring sampling and the lognormal fit (Figure 4) occurred at about 340 mm FL. This is about 20 mm above the mode at about 320 mm observed during the fall (Figure 3), which seems somewhat high but not entirely unreasonable (DeCicco 1990). After the curve fitting, there were 158 recaptures above 267 mm FL, which is where the two lognormal curves cross. Using this model, the Chapman equation parameters were $n_1=1,761$, $n_2=158$, $m_2=5$. The population point estimate was 46,700 Dolly Varden (≥ 267 mm FL) and the standard error (SE) was 17,300.

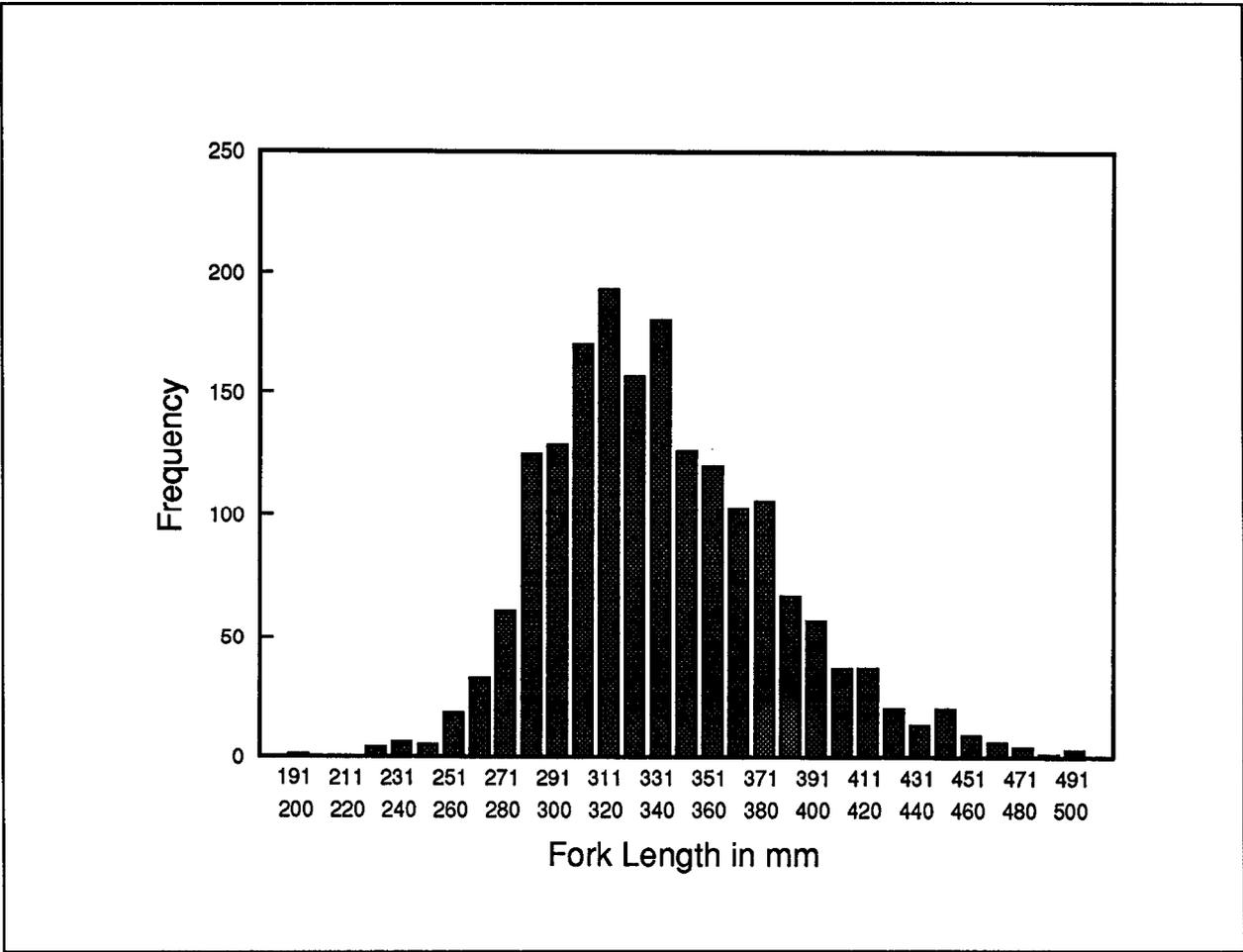


Figure 3. Length frequency of Dolly Varden marked in Chilkat Lake during the fall, 1988.

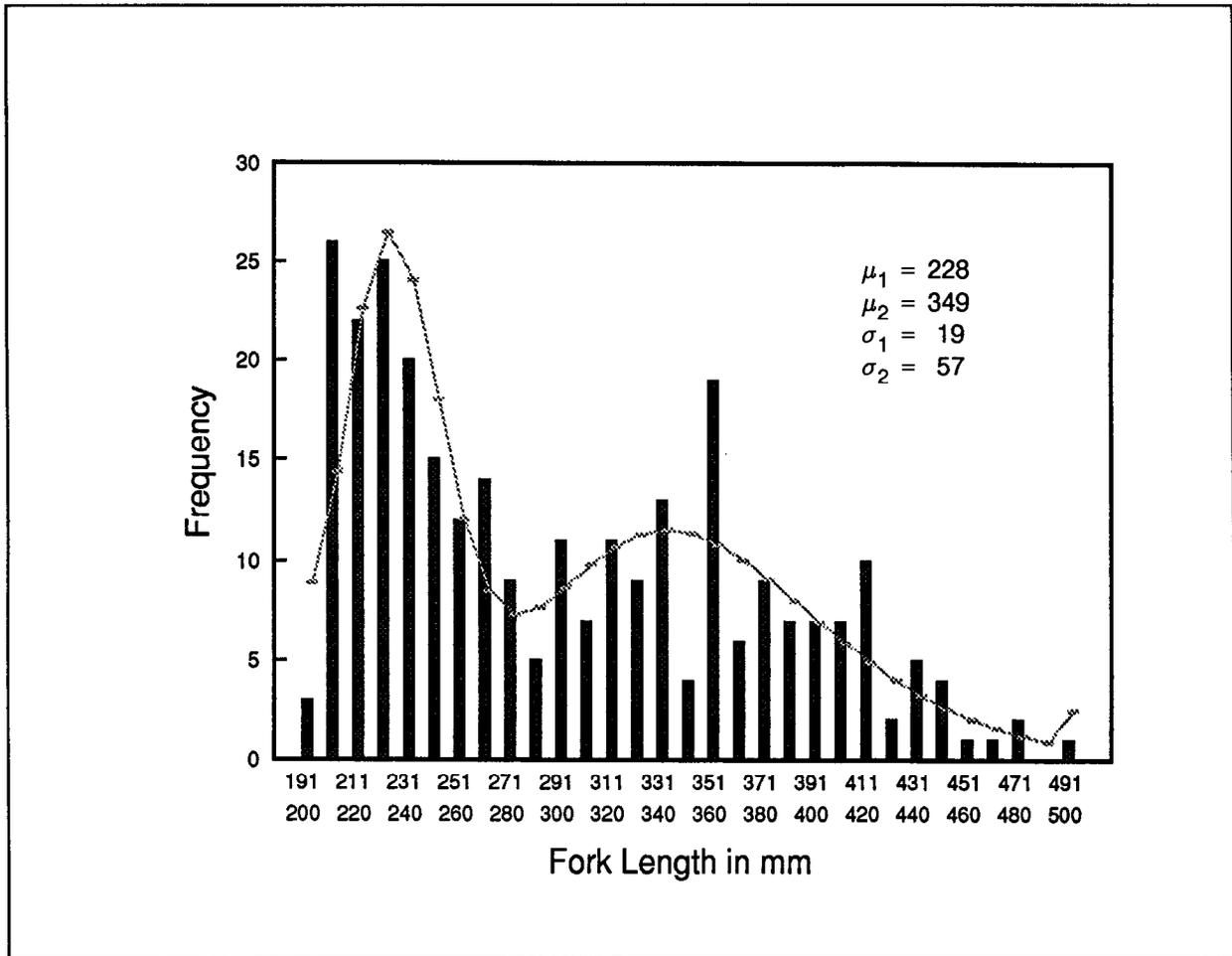


Figure 4. Length frequency of Dolly Varden recaptured at the outlet of Chilkat Lake during the spring, 1989, with two lognormal distributions fit to the data.

Harvests

Haines:

Warm sunny weather created high and turbid flows on the Chilkat River by early May. Sport fishing effort along the river dropped 77% between the second biweekly period (April 10 - April 23) and the third period (April 24 - May 7). Because of increasing high water and turbid conditions, and very little observed angling, sampling was suspended on May 8.

Forty-eight sampling periods and 142 interviews were conducted from March 27 through May 7 (Table 2). An estimated 1,292 angler hours of effort (SE=288) were expended to catch an estimated 1,476 (SE=323) and harvest an estimated 1,335 (SE=320) Dolly Varden during this period. Most of the effort occurred before April 24 (89%), and along the section of the Haines highway between mile 17 and mile 22 (66%). Approximately 51% of the catch and 49% of the harvest occurred at the Wells Bridge area. Peak catch per unit effort (4.49 Dolly Varden per angler hour fished) occurred at the Wells Bridge area between March 27 and April 9 (Table 2).

A total of 226 Dolly Varden in angler's creels were examined for the presence of marks. Four fish with missing adipose fins were found, but none had anchor tags or visible tag scars. Thus, we assumed that the four fish had not been tagged. Contribution of large Dolly Varden over-wintering in Chilkat Lake to the Chilkat River spring sport fishery could not therefore be estimated.

Sitka:

Due to budgetary constraints, sampling was suspended after April 30. Seventy-three sampling periods and 158 interviews were conducted from March 27 through April 30 (Table 3). Anglers expended an estimated 1,481 hours of effort (SE=260) to catch 1,632 (SE=417) and harvest 731 (SE=312) Dolly Varden from 27 March through 30 April. Most of the effort (1,330 hours) and nearly all harvest (725) occurred in front of the Sheldon Jackson hatchery. The remainder of the catch was from the Starrigavan area.

Peak catch per unit effort (1.49 fish per hour) occurred at the Sheldon Jackson hatchery area between April 24 and April 30 (Table 3).

A total of 67 Dolly Varden in angler's creels were examined and two were missing adipose fins. We assume that this occurrence rate for missing adipose fins is natural, as we are aware of no other studies that have marked Dolly Varden in this manner in the Sitka area.

Age, Weight, and Length

One hundred and five (105) Dolly Varden sacrificed for age, weight, length, and sex information during the October 1 to October 21 1988 tagging event at Chilkat Lake were successfully aged (Table 4). Fish ranged from 3 to 9 years in age, from 206 to 432 mm (8.1 to 17.0 inches) in length, and from 60 to 1002 g (0.1 to 2.2 lbs.) in weight. Most of the samples were 5 (48%) or 6 (33%) years of age. Females were predominately age 5 (55%) while most males were 6 (40%) or 5 (36%) years of age.

Table 2. Estimated effort, harvest, and selected sampling statistics for the Chilkat River Dolly Varden creel survey by sampling period and area, 1989.

Area	March 27 April 09	April 10 April 23	April 24 May 07	Total
Chilkat R. - Airport to 17-Mile				
Number of Count Samples	16	16	16	48
Number of Interview Samples	16	16	16	48
Number of Possible Samples	182	210	210	602
Number of Anglers Interviewed	16	12	0	28
Angler-hours effort	92	38	20	150
Var. of Angler-hours effort	7,555	104	363	8,022
Dolly Varden Kept	40	8	---	48
Var. of Dolly Varden Kept	1,409	7	---	1,416
Dolly Varden Released	0	0	---	0
Var. of Dolly Varden Released	0	0	---	0
CPUE	0.43	0.21	0.00	0.32
Chilkat R. - 17-Mile to 22-Mile				
Number of Count Samples	16	16	16	48
Number of Interview Samples	16	16	16	48
Number of Possible Samples	182	210	210	602
Number of Anglers Interviewed	30	25	8	63
Angler-hours effort	356	390	106	852
Var. of Angler-hours effort	23,264	41,775	4,152	69,191
Dolly Varden Kept	344	222	64	629
Var. of Dolly Varden Kept	26,690	11,001	2,717	40,408
Dolly Varden Released	22	26	0	48
Var. of Dolly Varden Released	150	394	0	544
CPUE	1.03	0.63	0.60	0.79
Chilkat R. - Wells Bridge Area				
Number of Count Samples	16	16	16	48
Number of Interview Samples	16	16	16	48
Number of Possible Samples	182	210	210	602
Number of Anglers Interviewed	8	42	1	51
Angler-hours effort	95	179	16	290
Var. of Angler-hours effort	2,044	3,455	91	5,590
Dolly Varden Kept	427	230	0	658
Var. of Dolly Varden Kept	54,056	6,609	0	60,665
Dolly Varden Released	0	93	0	93
Var. of Dolly Varden Released	0	1,258	0	1,258
CPUE	4.49	1.79	0.00	2.59

-(Continued)-

Table 2. (page 2 of 2)

Area	March 27 April 09	April 10 April 23	April 24 May 07	Total
All Areas Combined				
Number of Count Samples	48	48	48	144
Number of Interview Samples	48	48	48	144
Number of Possible Samples	546	630	630	1,806
Number of Anglers Interviewed	54	79	9	142
Angler-hours effort	543	607	142	1,292
Var. of Angler-hours effort	32,863	45,334	4,606	82,803
Dolly Varden Kept	811	460	64	1,335
Var. of Dolly Varden Kept	82,155	17,617	2,717	102,489
Dolly Varden Released	22	119	0	141
Var. of Dolly Varden Released	150	1,651	---	1,801
CPUE	1.49	0.76	0.45	1.03

Table 3. Estimated effort and harvest, and selected statistics for the Sitka roadside Dolly Varden creel survey by sampling period and area, 1989.

Area	March 27 April 09	April 10 April 23	April 24 April 30	Total
Sheldon Jackson				
Number of Count Samples	29	29	15	73
Number of Interview Samples	29	29	15	73
Number of Possible Samples	186	202	108	496
Number of Anglers Interviewed	26	65	44	135
Angler-hours effort	326	536	468	1,330
Var. of Angler-hours effort	26,537	16,833	22,478	65,847
Dolly Varden Kept	166	205	354	725
Var. of Dolly Varden Kept	15,348	24,718	57,201	97,268
Dolly Varden Released	18	542	341	901
Var. of Dolly Varden Released	125	22,772	53,367	76,265
CPUE	0.56	1.39	1.49	1.22
Starrigavan				
Number of Count Samples	29	29	15	73
Number of Interview Samples	29	29	15	73
Number of Possible Samples	186	202	108	496
Number of Anglers Interviewed	5	3	3	11
Angler-hours effort	18	22	49	89
Var. of Angler-hours effort	240	296	379	915
Dolly Varden Kept	6	0	0	6
Var. of Dolly Varden Kept	27	0	0	27
Dolly Varden Released	0	0	0	0
CPUE	0.33	0.00	0.00	0.07
Halibut Point				
Number of Count Samples	29	29	15	73
Number of Interview Samples	29	29	15	73
Number of Possible Samples	186	202	108	496
Number of Anglers Interviewed	1	0	2	3
Angler-hours effort	10	0	0	10
Var. of Angler-hours effort	81	0	0	81
Dolly Varden Caught	0	0	0	0

-(Continued)-

Table 3. (page 2 of 3)

Area	March 27 April 09	April 10 April 23	April 24 April 30	Total
Harbor Point				
Number of Count Samples	29	29	15	73
Number of Interview Samples	29	29	15	73
Number of Possible Samples	186	202	108	496
Number of Anglers Interviewed	1	0	0	1
Angler-hours effort	15	0	0	15
Var. of Angler-hours effort	221	0	0	221
Dolly Varden Caught	0	0	0	0
Watson Point				
Number of Count Samples	29	29	15	73
Number of Interview Samples	29	29	15	73
Number of Possible Samples	186	202	108	496
Number of Anglers Interviewed	1	0	0	1
Angler-hours effort	2	0	0	2
Var. of Angler-hours effort	2	0	0	2
Dolly Varden Caught	0	0	0	0
Indian River				
Number of Count Samples	29	29	15	73
Number of Interview Samples	29	29	15	73
Number of Possible Samples	186	202	108	496
Number of Anglers Interviewed	0	4	0	4
Angler-hours effort	0	9	0	9
Var. of Angler-hours effort	0	47	0	47
Dolly Varden Caught	0	0	0	0
Jamestown Bay				
Number of Count Samples	29	29	15	73
Number of Interview Samples	29	29	15	73
Number of Possible Samples	186	202	108	496
Number of Anglers Interviewed	0	0	0	
Angler-hours effort	0	0	0	0
Dolly Varden Caught	0	0	0	0

-(Continued)-

Table 3. (page 3 of 3)

Area	March 27 April 09	April 10 April 23	April 24 April 30	Total
"Between" major sites				
Number of Count Samples	29	29	15	73
Number of Interview Samples	29	29	15	73
Number of Possible Samples	186	202	108	496
Number of Anglers Interviewed	0	2	1	3
Angler-hours effort	0	7	19	26
Var. of Angler-hours effort	0	26	348	374
Dolly Varden Caught	0	0	0	0
All Areas Combined				
Number of Count Samples	232	232	120	584
Number of Interview Samples	232	232	120	584
Number of Possible Samples	1,488	1,616	864	3,968
Number of Anglers Interviewed	34	74	50	158
Angler-hours effort	371	574	537	1,481
Var. of Angler-hours effort	27,080	17,202	23,205	67,488
Dolly Varden Kept	172	205	354	731
Var. of Dolly Varden Kept	15,375	24,718	57,201	97,294
Dolly Varden Released	18	542	341	901
Var. of Dolly Varden Released	125	22,772	53,367	76,265
CPUE	0.51	1.30	1.29	1.10

Table 4. Number (N), mean fork length, and mean weight of Dolly Varden sampled at Chilkat Lake during the 1988 fall tagging event, by age and sex.

Otolith Age	Length			Weight		
	N	Mean	SE	N	Mean	SE
MALES						
4	4	283	10	4	215	26
5	17	322	40	17	326	122
6	19	342	39	19	392	154
7	5	369	15	5	464	71
8	1	425	0	1	1,002	0
9	1	391	0	1	500	0
FEMALES						
3	2	211	5	2	60	0
4	4	321	5	4	283	27
5	30	305	43	30	293	98
6	16	324	29	16	330	92
7	3	338	26	3	353	90
COMBINED ^a						
3	2	211	5	2	60	0
4	8	302	20	8	249	43
5	50	307	46	50	295	112
6	35	334	36	35	363	133
7	8	357	25	8	423	95
8	1	425	0	1	1,002	0
9	1	391	0	1	500	0

^a Includes males, females, and unsexed fish.

A total of 355 Dolly Varden were sampled from sport fisheries in the Haines area in 1989, and 263 of these fish were successfully aged. One hundred and ten (110) of the 355 Dolly Varden were sampled (88 were successfully aged) from the spring Chilkat River fishery (Table 5). Forty (40) of the 355 Dolly Varden were sampled (32 were successfully aged) from the Chilkat Lake cutthroat trout *O. clarki* fishery between May 22 and October 8, 1989 (Table 6, Ericksen and Bingham, *In press* 1990a). Another 205 of the 355 Dolly were sampled (143 were successfully aged) in the May 8 to November 5, 1989 Chilkoot River sockeye *O. nerka* and coho *O. kisutch* salmon roadside sport fisheries (Table 7, Ericksen and Bingham, *In press* 1990b).

Dolly Varden sampled in the Chilkat River spring fishery (Table 5) were mostly females (78%) and most frequently 7 years of age (42%). Fish sampled from this fishery tended to be older (and thus larger) than those sampled during the summer from harvests in Chilkat Lake or the Chilkoot River/Lake fisheries. Dolly Varden sampled from the Chilkat River fishery ranged from 231 to 580 mm (9 to 22.8 inches) in length and from 320 to 1900 g (0.7 to 4.2 lbs) in weight.

Dolly Varden sampled in the summer Chilkat Lake fishery (Table 6) were predominately age 6 (59%). Sampled fish ranged from 201 to 465 mm (7.9 to 18.3 inches) in length and 150 to 890g (0.3 to 2.0 lbs.) in weight. Sex composition was nearly equal: 44% were females.

Dolly Varden sampled in the summer Chilkoot River fishery (Table 7) were predominately age 6 (31%) and age 7 (28%). Sampled fish ranged from 230 to 541 mm (9.1 to 21.3 inches) in length and from 100 to 1600 g (0.2 to 3.5 lbs.) in weight. Sex composition was nearly equal: 45% were females.

Migrations

A total of 53 Dolly Varden tagged during this study were recaptured through June 1990 (Table 8), 13 by fishermen. One fish was recovered in February 1989 by an angler ice fishing on Mosquito Lake, which drains into the Chilkat River. One fish was recovered in March 1990 by an angler ice fishing on Chilkat Lake. Three tags were recovered by anglers fishing on Chilkat Lake during the summer of 1989. One tag was recovered by an angler fishing the outlet of Chilkat Lake during the fall of 1989. Two other tags were recovered by anglers fishing from the seashore along Chilkat Inlet 41.9 km (26 mi) by water from the Chilkat Lake outlet. Commercial gillnet fishermen recovered a Dolly Varden in salt water off Seduction Point 51 km (31.7 mi) from the outlet, and another off the mouth of the Endicott River 33 km (20.5 mi) from the outlet. Three Dolly Varden were reported by an angler fishing along the Juneau road system; one at the Shrine of St. Therese 127 km (79 mi) by water from the outlet during the summer of 1989, one at 32 Mile along Glacier Highway 114 km (71 mi) by water from the outlet during the summer of 1990, and one at Smuggler's Cove 146 km (91 mi) from the outlet of Chilkat Lake during the summer of 1990. As previously mentioned, five tagged Dolly Varden were recaptured in our fyke trap operating on the lake outlet during the spring of 1989. In addition, we recaptured 12 Dolly Varden tagged in this study during the fall of 1989 while tagging Dolly Varden in Chilkat Lake, and 24 while monitoring the 1990 spring emigration on the lake outlet. Information on other recaptures reported during the experiment is also contained in Table 8.

Table 5. Number (N), mean fork length, and mean weight of Dolly Varden sampled in the Chilkat River spring fishery March 27 through May 7, 1989, by age and sex.

Otolith Age	Length			Weight		
	N	Mean	SE	N	Mean	SE
MALES						
6	5	393	19	4	543	56
7	6	449	46	5	732	268
8	5	478	24	5	996	243
9	2	535	45	2	1290	610
10	1	460	0	1	720	0
FEMALES						
5	5	354	69	4	498	112
6	17	407	35	15	595	191
7	31	406	28	26	568	115
8	12	435	33	12	703	215
9	3	405	8	3	537	37
COMBINED ^a						
5	5	354	69	4	498	112
6	22	404	32	19	584	173
7	37	413	35	31	594	162
8	18	441	45	17	789	260
9	5	457	70	5	838	535
10	1	460	0	1	720	0

^a Includes males, females, and unsexed fish.

Table 6. Number (N), mean fork length, and mean weight of Dolly Varden sampled in the Chilkat Lake cutthroat trout fishery May 20 through October 7, 1989, by age and sex.

Otolith Age	Length			Weight		
	N	Mean	SE	N	Mean	SE
MALES						
4	1	240	0	1	150	0
5	1	310	0	1	270	0
6	10	323	22	10	317	66
7	4	387	16	4	503	48
8	2	415	50	2	665	225
FEMALES						
4	1	20	0	0		
5	2	285	5	2	205	25
6	9	329	18	9	350	54
7	1	310	0	1	250	0
8	1	352	0	1	400	0
COMBINED ^a						
4	2	221	20	1	150	
5	3	293	13	3	227	37
6	19	326	20	19	333	63
7	5	372	34	5	452	110
8	3	394	51	3	577	222

^a Includes both males and females.

Table 7. Number (N), mean fork length, and mean weight of Dolly Varden sampled in the Chilkoot River fishery May 8 through November 5, 1989, by age and sex.

Otolith Age	Length			Weight		
	N	Mean	SE	N	Mean	SE
MALES						
4	7	290	25	5	230	81
5	18	304	32	16	286	78
6	20	353	41	20	452	152
7	24	403	38	24	716	228
8	8	428	32	8	872	231
9	1	454	0	1	900	
FEMALES						
4	1	289	0	0		
5	13	300	34	11	271	107
6	24	357	27	22	502	130
7	16	365	22	15	498	79
8	7	375	21	7	589	140
9	3	470	44	3	950	245
COMBINED ^a						
4	8	290	23	5	230	81
5	31	303	33	27	280	91
6	45	356	34	43	479	141
7	40	388	37	39	632	213
8	15	403	38	15	740	240
9	4	466	39	4	938	213

^a Includes males, females, and unsexed fish.

Table 8. Detailed release and recovery information from all Dolly Varden char tagged and released at Chilkat Lake during the fall of 1988 and spring of 1989.

<u>Tag Number</u>	<u>Date Tagged</u>	<u>Length at Tagging</u>	<u>Date Recovered</u>	<u>Days Out</u>	<u>Length at Recovery</u>	<u>Growth^a</u>	<u>Recovery Location</u>	<u>Recovery Source^b</u>
1038	04/17/89	440	04/17/90	365	473	33	Chilkat Outlet	ADFG-O
1059	04/18/89	332	05/01/90	378	399	43	Chilkat Outlet	ADFG-O
1060	04/18/89	351	05/07/90	384	399	48	Chilkat Outlet	ADFG-O
1100	04/28/89	397	04/19/90	356	422	25	Chilkat Outlet	ADFG-O
1136	04/28/89	391	04/26/90	363	441	50	Chilkat Outlet	ADFG-O
1153	04/29/89	388	07/28/89	90	420	32	PT. Seduction	DGN
1156	04/29/89	293	10/23/89	177	367	74	Chilkat Lake	ADFG-T
1156	04/29/89	293	04/25/90	361	352	59	Chilkat Outlet	ADFG-O
1166	04/30/89	436	04/24/90	359	467	11	Chilkat Outlet	ADFG-O
1167	04/30/89	378	03/18/90	322	---	--	Chilkat Lake	sport
1173	04/30/90	283	05/01/90	366	334	51	Chilkat Outlet	ADFG-O
1183	05/03/89	325	04/26/90	358	426	101	Chilkat Outlet	ADFG-O
1187	05/04/89	283	04/28/90	359	319	36	Chilkat Outlet	ADFG-O
1205	05/04/89	214	04/27/90	358	315	101	Chilkat Outlet	ADFG-O
1225	05/13/89	208	05/02/90	354	289	81	Chilkat Outlet	ADFG-O
1226	05/14/89	229	05/03/90	354	315	86	Chilkat Outlet	ADFG-O
1246	05/16/89	232	05/12/90	361	311	79	Chilkat Outlet	ADFG-O
1257	05/18/89	223	05/12/90	359	---	--	Chilkat Outlet	ADFG-O
1262	05/18/89	221	05/09/90	356	284	63	Chilkat Outlet	ADFG-O
1266	05/18/89	260	05/09/90	356	355	95	Chilkat Outlet	ADFG-O
1269	05/18/89	225	05/08/90	355	304	79	Chilkat Outlet	ADFG-O
1271	05/18/89	216	05/12/90	359	302	86	Chilkat Outlet	ADFG-O
1278	05/20/89	200	05/17/90	362	264	64	Chilkat Outlet	ADFG-O
3008	10/01/88	315	10/19/89	383	---	--	Chilkat Outlet	sport
3117	10/01/88	280	07/23/89	295	---	--	Chilkat Lake	sport
3221	10/05/88	347	07/25/89	293	---	--	Chilkat Lake	sport
3377	10/08/88	443	10/23/89	380	460	17	Chilkat Lake	ADFG-T
3477	10/09/88	338	10/16/89	372	413	75	Chilkat Lake	ADFG-T
3511	10/11/88	358	04/14/89	185	367	9	Chilkat Outlet	ADFG-O

-(Continued)-

Table 8. (page 2 of 2).

<u>Tag Number</u>	<u>Date Tagged</u>	<u>Length at Tagging</u>	<u>Date Recovered</u>	<u>Days Out</u>	<u>Length at Recovery</u>	<u>Growth^a</u>	<u>Recovery Location</u>	<u>Recovery Source^b</u>
3550	10/11/88	320	06/29/90	626	590	270	32M Glacier Hwy ^c	sport
3660	10/11/88	318	10/17/89	371	377	59	Chilkat Lake	ADFG-T
3639	10/11/88	344	04/18/90	554	388	44	Chilkat Outlet	ADFG-O
3732	10/11/88	350	04/20/89	191	350	0	Chilkat Outlet	ADFG-O
4019	10/12/88	366	10/18/89	371	350	-16	Chilkat Lake	ADFG-T
4041	10/12/88	290	10/12/89	365	358	68	Chilkat Lake	ADFG-T
4239	10/12/88	352	02/09/89	120	---	--	Mosquito Lake	sport
4327	10/13/88	317	07/03/89	263	---	--	Off Endicott R.	DGN
4368	10/20/88	393	10/30/89	375	465	72	Chilkat Lake	ADFG-T
4369	10/20/88	410	04/15/89	177	396	-14	Chilkat Outlet	ADFG-O
4388	10/20/88	409	05/05/90	554	---	--	Smuggler's Cove ^c	sport
4458	10/20/88	350	10/18/89	363	380	30	Chilkat Lake	ADFG-T
4511	10/20/88	371	10/16/89	361	394	23	Chilkat Lake	ADFG-T
4512	10/20/88	456	04/28/89	190	---	--	Chilkat Outlet	ADFG-O
4529	10/20/88	363	05/20/89	212	---	--	Chilkat Inlet	sport
4575	10/20/88	325	07/16/89	269	---	--	Chilkat Inlet	sport
4603	10/20/88	330	04/16/90	543	408	78	Chilkat Outlet	ADFG-O
4641	10/20/88	306	10/13/89	358	355	49	Chilkat Lake	ADFG-T
4662	10/20/88	332	04/20/89	182	335	3	Chilkat Outlet	ADFG-O
4720	10/20/88	365	04/17/90	544	408	43	Chilkat Outlet	ADFG-O
4739	10/20/88	315	06/29/89	252	---	--	Shrine St Therese ^c	sport
4925	10/21/88	306	04/17/90	543	362	56	Chilkat Outlet	ADFG-O
4959	10/21/88	352	07/22/89	274	---	--	Chilkat Lake	sport
4962	10/21/88	315	10/30/89	374	367	52	Chilkat Lake	ADFG-T

^a Difference between lengths at recovery and release.

^b sport = sport catch

DGN = commercial drift gill net

ADFG-T= Ak. Dept. Fish & Game tagging crew

ADFG-O= Ak. Dept. Fish & Game crew monitoring emigration

^c On the Juneau road system.

DISCUSSION

The population estimate in this study should be used with caution due to the numerous difficulties encountered. The small number of recaptures (5) is reason for considerable concern by itself (Seber 1982, p.60). Our rough estimate of over-wintering population size (46,700 fish ≥ 267 mm FL) does not seem excessive: Armstrong (1965) reports 93,303 Dolly Varden of all lengths migrated from Lake Eva in 1963, which has about 11% of the surface area of Chilkat Lake. Renewed efforts to mark and recapture fish during 1989 and 1990 should provide a much better estimate of population size. We plan to recapture fish with a weir instead of fyke nets during 1990, and believe that this will improve recapture rates.

The distribution of Dolly Varden lengths in our spring 1989 sample of the emigration is probably more representative of the population (excluding resident and rearing Dolly Varden) that over-winter in the lake than is our sample from the fall of 1988. Size selectivity of the seine net may have been partly responsible for the fall sample not containing smaller fish, but we do not believe that size selectivity was high. We failed, for example, to capture smaller fish when a seine with smaller mesh size was used. Blackett (1968) showed that juvenile Dolly Varden (age 0,I,II,and III) utilized stream habitat in lake tributaries of Lake Eva in southeast Alaska, while older fish were notably absent from these areas. Small Dolly Varden may occupy different habitat within the Chilkat Lake drainage than do the larger fish. If this is true, the size distribution of the fish we marked in the fall may reflect where we sampled in the lake, rather than gear selectivity. However, selective tagging of larger fish in the lake is not a significant problem here, because we are ultimately only attempting to estimate the size of the population of large fish.

During the spring Fyke trap sampling, approximately 61% of the Dolly Varden ≥ 200 mm FL were captured before ice breakup on May 7, while smaller fish emigrated and were captured after breakup. Similar patterns have been observed in other systems. In 1977 and 1978, large Dolly Varden also emigrated from Auke Lake near Juneau before small fish (Doug Jones, ADF&G, Division of Sport Fish, Juneau, personal communication). In 1990, a similar pattern was observed for Dolly Varden at Buskin Lake near Kodiak (Doug McBride, ADF&G, Division of Sport Fish, Anchorage, personal communication).

Armstrong (1965) noted that Dolly Varden emigrated from Lake Eva during the hours of darkness, except during peak migration when they moved day and night. Our results support those findings. This may be a response to predation, as fish traveling during the night would be less susceptible to predation than those traveling during the day. During the spring of 1989 several otters preyed on Dolly Varden emigrating from Chilkat Lake.

The contribution of Dolly Varden over-wintering in Chilkat Lake to the Chilkat River spring sport fishery was not estimated because no tagged fish were observed among any of the fish we sampled during our creel surveys. This may not be surprising, since only about 4% (1,813/46,700) of the estimated Chilkat Lake Dolly Varden population were marked and only 266 fish were sampled. If the Chilkat Lake Dolly Varden population was the only one contributing to the Chilkat River sport fishery, we would still only expect to see about 9 tagged fish in a sample of that size.

In Haines, four (of 226 examined) Dolly Varden sampled during the spring fishery were missing adipose fins and exhibited no apparent tag scars. In addition, 2 of 67 sport harvested fish examined in Sitka did not have an adipose fin. In contrast, we found no missing adipose fins on fish that had not been previously tagged in Chilkat Lake during the fall of 1988, and Armstrong (1965) found that only about one Dolly Varden in one thousand emigrating from Lake Eva in southeast Alaska were naturally missing an adipose fin. Evidence for a high natural incidence of Dolly Varden without adipose fins has been observed, however, among smaller Dolly Varden from the Buskin River on Kodiak Island (Dave Bernard, ADF&G, Division of Sport Fish, Anchorage, personal communication). The surprisingly high incidence of questionable missing adipose fins on the Chilkat River and near Sitka suggests caution in future studies that rely on the fin being present.

Overall mean CPUE in the Chilkat River spring sport fishery (1.14 Dolly Varden per angler hour fished) is comparable to the overall mean CPUE in the Sitka spring roadside sport fishery (1.15). Both overall catch rates are considerably higher than in popular late-season sport fisheries in the Haines area: Chilkat Lake, CPUE=0.12 (May 22 - October 8 1989); Lutak Inlet, CPUE=0.34 (May 8 - November 5 1989); and Chilkoot River, CPUE=0.19 (May 8 - November 5 1989). The spring sport fisheries probably target on Dolly Varden, while the late-season fisheries target other species. Descriptions of the Chilkat Lake, and the Chilkoot River and Lutak Inlet sport fisheries can be found in Ericksen and Bingham (*In press* 1990a & 1990b) respectively.

Results from our tag returns indicate that once anadromous Dolly Varden over-wintering in Chilkat Lake leave freshwater, they move southward up to 146 km from the over-wintering site. No tagged Dolly Varden were recovered in the Chilkoot Lake drainage on the east side of the Chilkat Peninsula, despite a large sport fishery along the Chilkoot River and Lake. In contrast, Dolly Varden over-wintering in Lake Eva tended to scatter in all directions once leaving the over-wintering area (Armstrong 1965).

ACKNOWLEDGMENTS

We thank creel survey technician Sandra Barclay for her data collection efforts and suggestions on creel survey techniques. Technicians Anthony Feldhausen, Dale Kohlmos, Patricia Faverty, and Nicolas Cassara conducted the field work and data collection for the Chilkat Lake study, and helped improve those sampling techniques. Roger Harding of the Division of Sport Fish (SF) assisted with procedures and techniques for aging otoliths. Paul Suchanek (SF) did our final data editing and ran SAS programs to analyze the creel survey data. We thank Donna Buchholz and Gail Heineman of the Research and Technical Services Unit (RTS) for diligence in mark sense form processing and data control. We also thank Allen Bingham (RTS) for the creel survey design. Al Didier (SF) contributed his editing skills and made useful suggestions on the manuscript.

LITERATURE CITED

- Armstrong, R. H. 1965. Some migratory habits of the anadromous Dolly Varden *Salvelinus malma* (Walbaum) in southeast Alaska. Alaska Department of Fish and Game Research Report 3. 26 p.
- Armstrong, R. H. 1974. Migration of anadromous Dolly Varden (*Salvelinus malma*) in Southeastern Alaska. Journal of the Fisheries Research Board of Canada 31: 435-444.
- Barto, D. L., and J. P. Koenings. 1989. Summary of limnology and fisheries investigations of Chilkat, Chilkoot, and Mosquito Lakes 1987 - 1988. Draft Report. Alaska Department of Fish and Game, Division of Fisheries Rehabilitation, Enhancement and Development, (P.O. Box 3-2000, Juneau, Alaska 99802-2000).
- Blackett, R. F. 1968. Spawning behavior, fecundity, and early life history of anadromous Dolly Varden *Salvelinus malma* (Walbaum) in southeastern Alaska. Alaska Department of Fish and Game Research Report 6. 85p.
- Clark, J.E., and D.B. Bernard. 1987. A compound binomial-hypergeometric distribution describing coded microwire tag recovery from commercial salmon catches in southeastern Alaska. Alaska Department of Fish and Game, Informational Leaflet No. 261. 113 pp.
- Clark, R. A., and W. P. Ridder. 1990. Stock assessment of Arctic Grayling in the Salcha, Chatanika, and Goodpaster Rivers. Alaska Department of Fish and Game, Fishery Data Series No. 90-7. 84 pp.
- Cochran, W. G. 1977. Sampling techniques. John Wiley and Sons, New York, New York, USA.
- DeCicco, A. L. 1990. Northwest Alaska Dolly Varden Study. Alaska Department of Fish and Game, Fishery Data Series No. 90-8. 42 pp.
- Ericksen, R. P., and A. E. Bingham. 1990a. Evaluation of the recreational fishery for Cutthroat Trout in Chilkat Lake, Alaska, 1989. Alaska Department of Fish and Game, Fishery Data Series. *In press*.
- Ericksen, R. P., and A. E. Bingham. 1990b. Harvest estimates for selected roadside sport fisheries in Haines Alaska, 1989. Alaska Department of Fish and Game, Fishery Data Series. *In press*.
- Goodman, L. A. 1960. On the exact variance of products. Journal of the American Statistical Association 55:708-713.
- Gunstrom, G., and M. Bethers. 1985. Electrical anesthesia for handling large salmonids. The Progressive Fish-Culturist 47:67-69.
- Jessen, R. J. 1978. Statistical survey techniques. John Wiley and sons, New York, New York, USA.
- Macdonald, P. D. M., and P. E. J. Green 1988. User's guide to program MIX: An interactive program for fitting mixtures of distributions.

LITERATURE CITED (Continued)

- Mills, M.J. 1980. Alaska statewide sport fish harvest studies. Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Performance Report, 1979-1980, Project F-9-12, 21 (SW-I-A). 65 pp.
- _____. 1981a. Alaska statewide sport fish harvest studies (1979). Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Performance Report, 1980-1981, Project F-9-13, 22 (SW-I-A). 78 pp.
- _____. 1981b. Alaska statewide sport fish harvest studies (1980). Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Performance Report, 1980-1981. Project F-9-13, 22 (SW-I-A). 107 pp.
- _____. 1982. Alaska statewide sport fish harvest studies (1981). Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Performance Report, 1981-1982, Project F-9-14, 23 (SW-I-A). 115 pp.
- _____. 1983. Alaska statewide sport fish harvest studies (1982). Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Performance Report, 1982-1983, Project F-9-15, 24 (SW-I-A). 119 pp.
- _____. 1984. Alaska statewide sport fish harvest studies (1983). Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Performance Report, 1983-1984, Project F-9-16, 25 (SW-I-A). 123 pp.
- _____. 1985. Alaska statewide sport fish harvest studies (1984). Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Performance Report, 1984-1985, Project F-9-17, 26 (SW-I-A). 137 pp.
- _____. 1986. Alaska statewide sport fish harvest studies (1985). Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Performance Report, 1985-1986, Project F-10-1, 27 (RT-2) 137 pp.
- _____. 1987. Alaska statewide sport fisheries harvest report. Alaska Department of Fish and Game, Fishery Data Series No 2. 140 pp.
- _____. 1988. Alaska statewide sport fisheries harvest report. Alaska Department of Fish and Game, Fishery Data Series No. 52. 142 pp.
- _____. 1989. Alaska statewide sport fisheries harvest report (1988). Alaska Department of Fish and Game, Fishery Data Series No. 122. 142p.
- Neuhold, J. M., and K. H. Lu. 1957. Creel census method. Utah State Department of Fish and Game Publication 8, Salt Lake City, Utah.
- Seber, G. A. F. 1982. The estimator of animal abundance. MacMillan Publishing Company, Inc. New York.
- Von Geldern, C. E., Jr., and P. K. Tomlinson. 1973. On the analysis of angler catch rate data from warmwater reservoirs. California Fish and Game 59:281-292.

