Fishery Data Series No. 00-20

A Trap Efficiency Study for Dolly Varden in Kenai Lake, 1998

by

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October 2000

Alaska Department of Fish and Game Division of Sport Fish

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Weights and measures (metric)

centimeter	cm
deciliter	dL
gram	g
hectare	ha
kilogram	kg
kilometer	km
liter	L
meter	m
metric ton	mt
milliliter	ml
millimeter	mm

Weights and measures (English)

cubic feet per second	ft^3/s
foot	ft
gallon	gal
inch	in
mile	mi
ounce	oz
pound	lb
quart	qt
yard	yd

Spell out acre and ton.

Time and temperature

day	d
degrees Celsius	°C
degrees Fahrenheit	°F
hour (spell out for 24-hour clock)	h
minute	min
second	s

Spell out year, month, and week.

Physics and chemistry

all atomic symbols	
alternating current	AC
ampere	A
calorie	cal
direct current	DC
hertz	Hz
horsepower	hp
hydrogen ion activity	pH
parts per million	ppm
parts per thousand	ppt, ‰
volts	V
watts	W

General

All commonly accepted abbreviations.	e.g., Mr., Mrs., a.m., p.m., etc.
All commonly accepted professional titles.	e.g., Dr., Ph.D., R.N., etc.
and	&
at	@
Compass directions:	
east	E
north	N
south	S
west	W
Copyright	©
Corporate suffixes:	
Company	Co.
Corporation	Corp.
Incorporated	Inc.
Limited	Ltd.
et alii (and other people)	et al.
et cetera (and so forth)	etc.
exempli gratia (for example)	e.g.,
id est (that is)	i.e.,
latitude or longitude	lat. or long.
monetary symbols (U.S.)	$, ¢
months (tables and figures): first three letters	Jan,...,Dec
number (before a number)	# (e.g., #10)
pounds (after a number)	# (e.g., 10#)
registered trademark	®
trademark	™
United States (adjective)	U.S.
United States of America (noun)	USA
U.S. state and District of Columbia abbreviations	use two-letter abbreviations (e.g., AK, DC)

Mathematics, statistics, fisheries

alternate hypothesis	H_A
base of natural logarithm	e
catch per unit effort	CPUE
coefficient of variation	CV
common test statistics	F, t, χ^2, etc.
confidence interval	C.I.
correlation coefficient	R (multiple)
correlation coefficient	r (simple)
covariance	cov
degree (angular or temperature)	°
degrees of freedom	df
divided by	÷ or / (in equations)
equals	=
expected value	E
fork length	FL
greater than	>
greater than or equal to	≥
harvest per unit effort	HPUE
less than	<
less than or equal to	≤
logarithm (natural)	ln
logarithm (base 10)	log
logarithm (specify base)	$log_{2,}$ etc.
mideye-to-fork	MEF
minute (angular)	'
multiplied by	x
not significant	NS
null hypothesis	H_O
percent	%
probability	P
probability of a type I error (rejection of the null hypothesis when true)	α
probability of a type II error (acceptance of the null hypothesis when false)	β
second (angular)	"
standard deviation	SD
standard error	SE
standard length	SL
total length	TL
variance	Var

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ABSTRACT

Fyke traps, minnow traps, hoop traps with leads, and hoop traps without leads were tested for their catch efficiency and length selectivity of Dolly Varden *Salvelinus malma* within the littoral zone of Kenai Lake, a glacial lake. Hoop traps with leads had significantly greater catch rates of Dolly Varden > 200 mm fork length than the other three trap designs. Hoop traps with leads also captured Dolly Varden across the greatest range of lengths.

Key words: Kenai Lake, Kenai Peninsula, Dolly Varden, *Salvelinus malma*, trap efficiency, fyke trap, hoop trap, minnow trap, fork length.

INTRODUCTION

The Kenai River drainage is the most heavily utilized system for freshwater sport fishing in Alaska. Although most of the anglers participate in the river's salmon fisheries, the Kenai River drainage also supports a major Dolly Varden *Salvelinus malma* fishery. Based on the Statewide Harvest Survey (Mills 1994; Howe et al. 1995-1997), angler harvest and catch of Dolly Varden declined between 1993 and 1996 throughout the major fishing areas upstream of Skilak Lake, despite an increase in fishing effort within some fisheries. The cause of this trend is not well understood and has lead to recent biological studies of Dolly Varden.

The U.S. Fish and Wildlife Service (USFWS) has investigated Dolly Varden movement behavior upstream of Skilak Lake (Figure 1) since 1996 and the Alaska Department of Fish and Game (ADF&G) has located spawning, rearing and staging areas since 1997. The USFWS has utilized radiotelemetry to track the movement of Dolly Varden and ADF&G has deployed various trapping devices and conducted visual observations. Considerable effort has been expended fishing various capture devices, but the effectiveness of each in capturing Dolly Varden has been questionable. The question of whether poor Dolly Varden catches are a product of trap design or fish availability needed to be tested.

OBJECTIVES

This study was designed to test various capture devices for trap efficiency within a glacial lake environment, specifically Kenai Lake. The results of this study should provide biologists with reasonable expectations of Dolly Varden trapping success from fyke traps, hoop traps with leads, hoop traps without leads, and minnow traps. The proper capture tools and locations for sampling Dolly Varden of various lengths were explored. Specific objectives were:

1. To determine which gear type (fyke traps, hoop traps with leads, hoop traps without leads, or minnow traps) is most effective in capturing Dolly Varden > 200 mm in fork length (FL); and
2. To determine which gear type (fyke traps, hoop traps with leads, hoop traps without leads, or minnow traps) is least size selective in capturing Dolly Varden > 200 mm FL.

METHODS

Based on exploratory work conducted by ADF&G on Kenai Lake during 1997, the alluvial areas near Quartz Creek and the outlet of Kenai Lake are some of the most extensive littoral zones, which is the preferred habitat of Dolly Varden. Therefore, these were the most likely areas in which to capture Dolly Varden (Figures 1 and 2). The capture experiment took place during

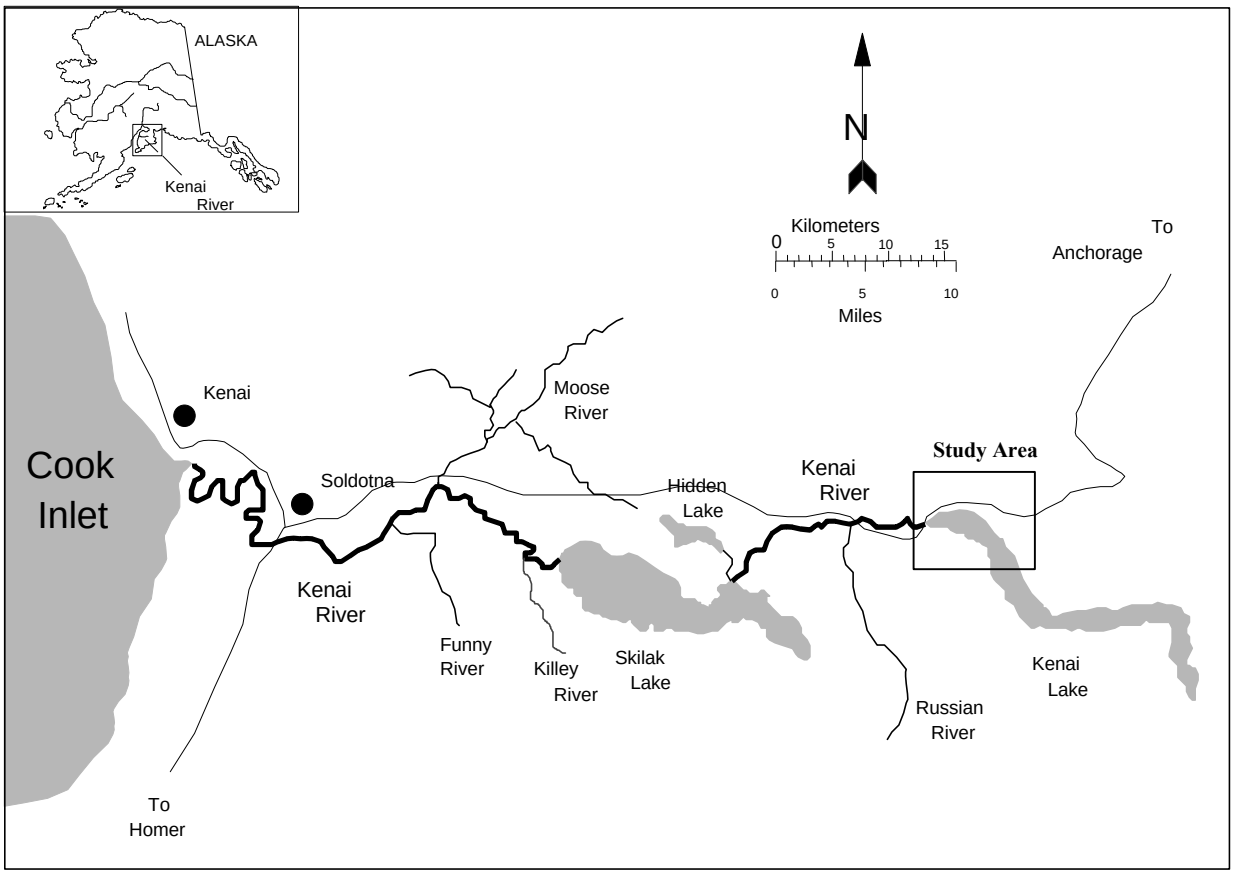

Figure 1.-Map of the Kenai River drainage with study area delineated.

8 days in July and 8 days in August at both alluvial locations. A randomized block design (Table 1) was used to compare the effectiveness and selectivity of the four gear types. Dolly Varden >200 mm FL are fully recruited to all gear types in the study. The number of Dolly Varden >200 mm FL caught by a gear type was the measure of effectiveness, and the variability (sample variance) in lengths of Dolly Varden caught was used as the measure of the gear's size selectivity. Each location was subdivided into four shoreline sites with a minimum of 0.16 km between sites (Figure 2). The distance between sites was great enough that it was assumed there was no overlap of effective fishing area. Care was also taken to assure the habitat was as uniform as possible across all areas. Each gear type was systematically assigned to an area within a location according to the schedule in Table 1. The randomized block design was used in both July and August.

The four gear types included fyke traps with leads, hoop traps without leads, hoop traps with leads, and a minnow trap design. All traps were placed 15 m offshore at each site and fished for approximately 24 hours. Each trap was baited with approximately 1 cup of salted, fresh sockeye salmon eggs. The bait was placed in a plastic, 4-inch diameter perforated bait jar that allowed the bait to be used as an attractant but not consumed by fish. The leads on traps with leads (fyke and hoop) extended from the trap entrance to shore, a distance of 15 m, and were perpendicular to the shoreline.

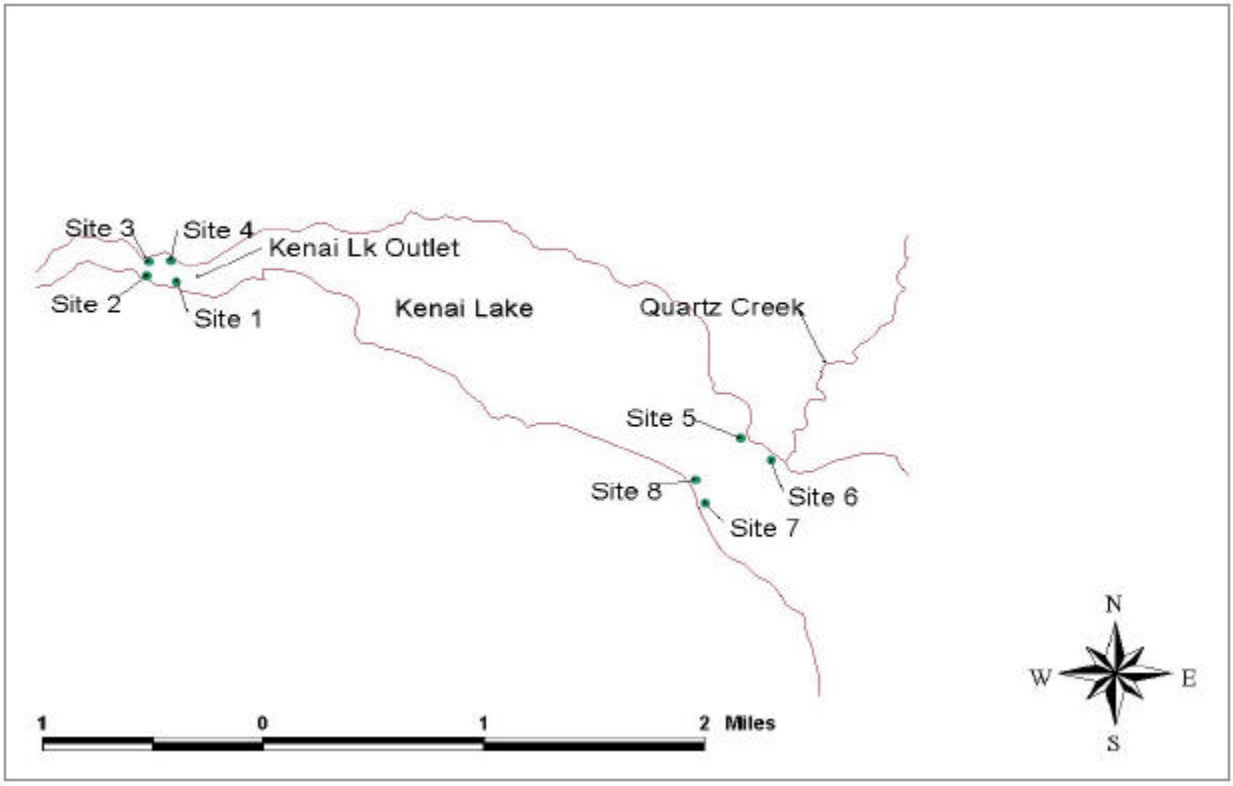

Figure 2.-Trap site locations in Kenai Lake, 1998.

Fyke traps were cube-shaped frames constructed of 1.3 cm diameter concrete reinforcement bars, covered with 0.6 cm galvanized hardware cloth and measured 1.2 m along each edge. Two vertical-slot openings on one face were 3.8 cm wide and allowed fish to enter the trap. A 15 m lead extended from the center of the fyke entrance to the shoreline and two 7.5 m wings extended from the outside edge of the trap entrance at a 45-degree angle to encourage fish to enter the trap entrance. All leads extended from the water surface to the lake bottom and were constructed of 1.0 cm mesh knotless nylon webbing, equipped with floats on the top and lead line on the bottom.

The hoop traps were of two sizes and of standard commercial manufacture. Hoop traps without leads were constructed of six fiberglass hoops with two throats placed on the first and third hoops. Each hoop was progressively smaller in diameter with the opening hoop diameter 75 cm and the last hoop 52.5 cm. The trap consisted of 2.5 cm tarred, square mesh fabric from front to back. The hoop traps with leads were constructed with seven, 105 cm diameter fiberglass hoops with two throats placed on the second and fourth hoops. The trap consisted of 3.8 cm tarred, square mesh fabric on the front and 2.5 cm tarred, square mesh fabric on the back of each trap. Leads were 15 m in length, 1.8 m deep and of 1 square inch tarred mesh fabric. The leads had a single top and bottom line of 0.5 cm braided polypropylene rope. Floats were hung approximately 75 cm apart on the top and 1-ounce leads were hung approximately 30 cm apart on the bottom lead ropes.

Table 1.-Randomized block design used to test for differences in gear efficiency in Kenai Lake, 1998.

	Sites at Outlet of Kenai Lake				Sites at Quartz Creek Area			
Day	1	2	3	4	5	6	7	8
1	A	B	C	D	A	B	C	D
2	D	A	B	C	D	A	B	C
3	C	D	A	B	C	D	A	B
4	B	C	D	A	B	C	D	A
5	A	B	C	D	A	B	C	D
6	D	A	B	C	D	A	B	C
7	C	D	A	B	C	D	A	B
8	B	C	D	A	B	C	D	A

Note: A, B, C, and D are gear types: A = fyke trap, B = hoop trap without lead, C = hoop trap with lead, D = minnow trap.

Minnow traps were homemade traps resembling traditional minnow traps, but constructed from 5-gallon pails. Their purpose was to allow the capture of fish larger than permitted by the traditional minnow traps. Each minnow bucket trap was constructed from two, 5-gallon plastic pails. The tops of each pail were fastened together with hinge and hasp hardware forming a trap similar in shape to the traditional minnow trap. The bottom of each pail was cut out and replaced with a cone shaped 1.9 cm (¾ inch) square Vexar™ plastic mesh fabric with approximately a 2-inch diameter entrance hole. Numerous 3.75 cm (1½ inch) diameter holes were punched randomly through the walls of each pail. The inside of each pail was lined with the same 1.9 cm (¾ inch) square Vexar ™ mesh used to build the entrance cones. Finally, the white pails were spray painted in a camouflage pattern using brown, green and black epoxy spray paint. Each trap was weighted with a 2.25 kg lead weight to anchor it to the lake bottom.

Trap efficiency was determined using a Kruskal-Wallis nonparametric analysis of variance. Comparisons were made between gear types, trapping stations, and months. To determine which gear type was least size selective in capturing Dolly Varden > 200 mm in fork length, the variation (both sample variance and range) in the distribution of lengths of fish caught by each of the four gear types was compared.

RESULTS

A total of 162 Dolly Varden > 200 mm FL were captured in Kenai Lake in 1998, 106 fish during July and 56 fish in August. Hoop traps with leads caught 138 Dolly Varden, followed by hoop traps without leads (12 Dolly Varden), fyke traps (7 Dolly Varden), and minnow buckets (5 Dolly Varden; Table 2). Dolly Varden caught in fyke traps ranged from 202-465 mm, those caught in hoop traps without leads from 225-440 mm, those caught in hoop traps with leads from 208-535 mm, and those caught in minnow buckets from 200-226 mm (Table 2).

Table 2.-Lengths (millimeters FL) and number of Dolly Varden >200 mm FL captured with four gear types in Kenai Lake, 1998.

Statistic	Fyke Traps	Hoop Traps without Leads	Hoop Traps with Leads	Minnow Buckets
Min. Length	202	225	208	200
Max. Length	465	440	535	226
Mean Length	259	300	277	214
SE	94	75	74	12
Catch (number of fish)	7	12	138	5

Hoop traps with leads were the most efficient, followed by hoop traps without leads, fyke traps, and minnow buckets (ANOVA, Table 3). Although there was a significant interaction between gear type and trapping station, hoop traps with leads always caught the most Dolly Varden (Table 3 and Figure 3).

Although the sample variance of the length distribution was greatest for fyke traps, hoop traps with leads were the least size selective, as they caught fish over the greatest range of lengths (Figure 4).

Table 3.-ANOVA comparison between gear types, trapping stations, and months, 1998.

ANOVA					Post ANOVA		
Source	df	Mean Square	F Value	Pr > F	Gear	Mean Rank	Duncan Grouping
Month	1	0.51	0.28	0.601	Hoop Trap ^{w}/Leads	6.59	A
Gear	3	74.64	40.58	0.000	Hoop Trap ^{wo}/Leads	4.04	B
Station	7	2.37	1.29	0.266	Fyke Traps	3.65	B
Month*Gear	3	0.92	0.50	0.683	Minnow Buckets	3.43	B
Gear*Station	21	3.82	2.07	0.009			
Error	94	1.84					
Corrected Total	129						

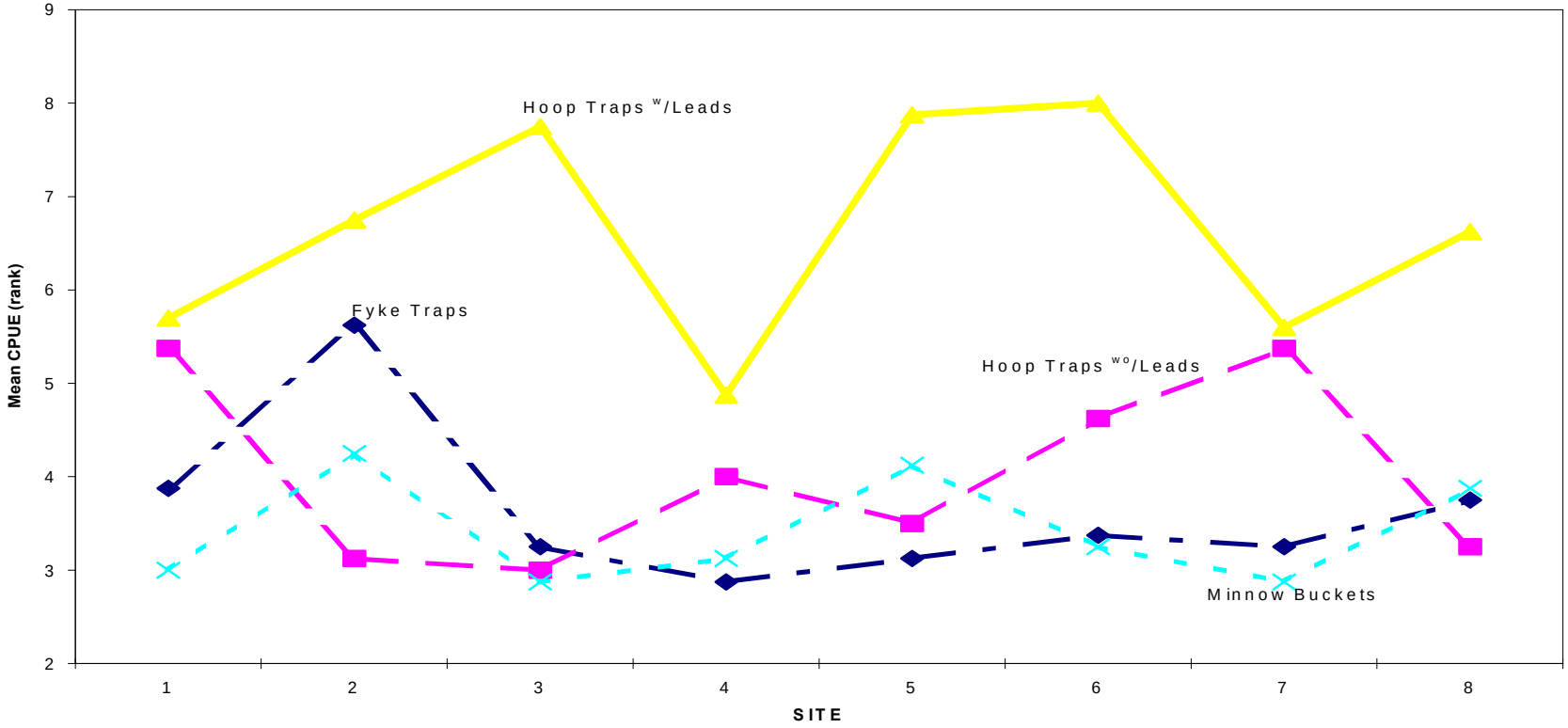

Figure 3.-Catch per unit of effort by gear type and trapping location, 1998.

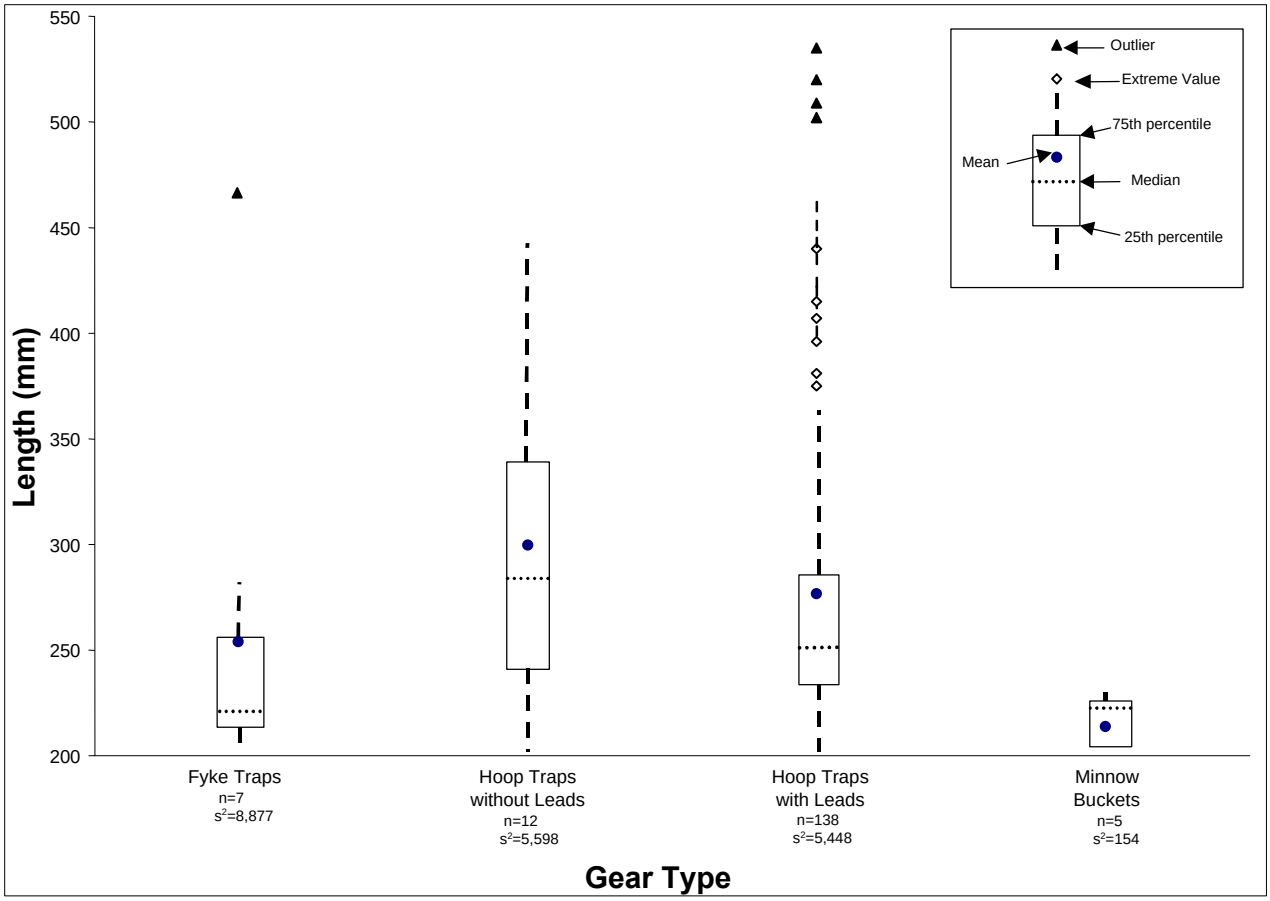

Figure 4.-Dolly Varden fork length variance by gear type.

DISCUSSION

Hoop traps with leads not only caught the most Dolly Varden of the four gear types but also caught the widest size range and are therefore recommended for use in littoral areas of glacial lakes. Although this trap design was significantly more efficient than the other three gears, catch rates of hoop traps with leads were still relatively low. Within Kenai Lake, hoop traps with leads were not only labor intensive but were also limited in their use by the scarcity of broad littoral areas.

Approximately two-thirds of the Dolly Varden > 200 mm FL were captured during July, supporting previous observations of Dolly Varden movements in Kenai Lake. It is believed that many of the Dolly Varden that are resident in Kenai Lake during July migrate into tributaries to rear by August, thereby decreasing the availability of Dolly Varden during August. This was substantiated in 1983 by fish counts through a weir located approximately ¼ mile upstream of the Quartz Creek confluence with Kenai Lake. ADF&G personnel counted 2,171 Dolly Varden > 200 mm FL immigrating past the weir site (unpublished weir counts), with substantial numbers immigrating after mid-July. The Dolly Varden immigration coincided with the salmon

immigration. Therefore, the recommended time to catch Dolly Varden in Kenai Lake is prior to mid-July.

Although variance in length of fish caught in fyke traps was the greatest, not enough fish were caught with this gear type to accurately describe the distribution of lengths (n = 7). One can only speculate why the minnow bucket trap design failed to capture fish larger than 226 mm. Although it was physically possible for fish over 400 mm FL to enter minnow bucket traps, minnow buckets were the smallest of the four trap designs and had the smallest entrance, both possible deterrents for capturing large fish.

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