Special Publication No. 01-3

Alaska Angler Survey: Use and Valuation Estimates for 1998, with a Focus on Burbot, Pike, and Lake Trout Fisheries in Region III

by
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May 2001

Alaska Department of Fish and Game **Division of Sport Fish**

Symbols and Abbreviations

The following symbols and abbreviations, and others approved for the Système International d'Unités (SI), are used in Division of Sport Fish Fishery Manuscripts, Fishery Data Series Reports, Fishery Management Reports, and Special Publications without definition. All others must be defined in the text at first mention, as well as in the titles or footnotes of tables and in figures or figure captions.

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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TABLE OF CONTENTS

Page

TABLE OF CONTENTS (Continued)

Page

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

ABSTRACT

A social and economic analysis was designed to estimate net economic values for burbot *Lota lota*, pike *Esox lucius*, and lake trout *Salvelinus namaycush* fishing in Region III. Four populations of anglers who purchased Alaska sport fishing licenses in 1998 were surveyed: Copper River area residents, residents of Region III exclusive of the Copper River Area, Region I and II residents, and nonresidents. A total of 5,468 surveys were mailed. Of this number, 449 surveys were returned as undeliverable. Of the remaining 5,019 surveys successfully delivered, 1,957 completed surveys were returned, for a 39% response rate. Between 25.1% (nonresidents) and 51.6% (Copper River residents) of respondents in the four sample groups said that they take fishing trips specifically to target pike, burbot, or lake trout.

A dichotomous choice contingent valuation method was used to estimate anglers' net economic value for their most recent Region III fishing trip. The Region III estimated net economic value per fishing trip for burbot, pike, and lake trout species combined was $371.16 (SE = 105.47) for nonresidents, $161.24 (23.66) for remainder of Region III residents, $158.80 (SE = 47.49) for Copper River area residents, $238.22 (SE = 55.21) for Region I and II residents. Overall, sport fishing for burbot, pike and lake trout in 1998 in Region III is estimated to have a total net economic value of $4,291,918. Of this total, approximately 68.1% is attributable to Region III residents. Estimated average expenditures per fishing trip was highest for nonresidents ($1,198.09 per trip) followed by Region I and II residents ($263.36 per trip). The benefit/cost ratio for the Region III research and management program was 13.7 in FY 99.

Proposed regulation changes for the Copper and Tanana River drainages and the Dall River would lead to small changes in visitation to the rivers. Consistently across models, over 90% of respondents said that the proposed regulation changes would have no effect on the number of fishing trips they would take to the specified waters. This suggests that of the variables influencing angler trips, the possible changes in fishing regulations at the waters specified in this study may play a minor role.

Key Words: Nonmarket economic analysis, net economic value, contingent valuation, contingent behavior, sport fishing, burbot, pike, and lake trout, Alaska.

1.0 INTRODUCTION

This report provides a social and economic analysis of current and alternative conditions for sport fishing in Region III, Alaska in 1998 (Figure 1). In particular this report focuses on fishing trips and anglers specifically targeting burbot *Lota lota*, pike *Esox lucius*, and lake trout *Salvelinus namaycush* on their Region III fishing trips. This study was completed under a contract between Bioeconomics, Inc. of Missoula, MT and the State of Alaska Department of Fish and Game (ADF&G), Sport Fish Division.

This study had two primary goals. The first was estimation of the net economic value[1] or NEV that sport users of Region III waters place on fishing experiences at these waters. The NEV of a trip is the amount of money a person would be willing to pay to take the trip in addition to what they actually did pay. NEVs are recommended by the U.S. Water Resources Council (1983) for use in benefit/cost analysis, and evaluation of land use questions such as instream flow allocation. NEVs have also been used in litigation involving natural resource damages (Duffield 1997). Objectives in fishery-specific management plans in Region III state that, in addition to

[1] The net economic value is also called the willingness to pay or consumer surplus; these terms are equivalent.

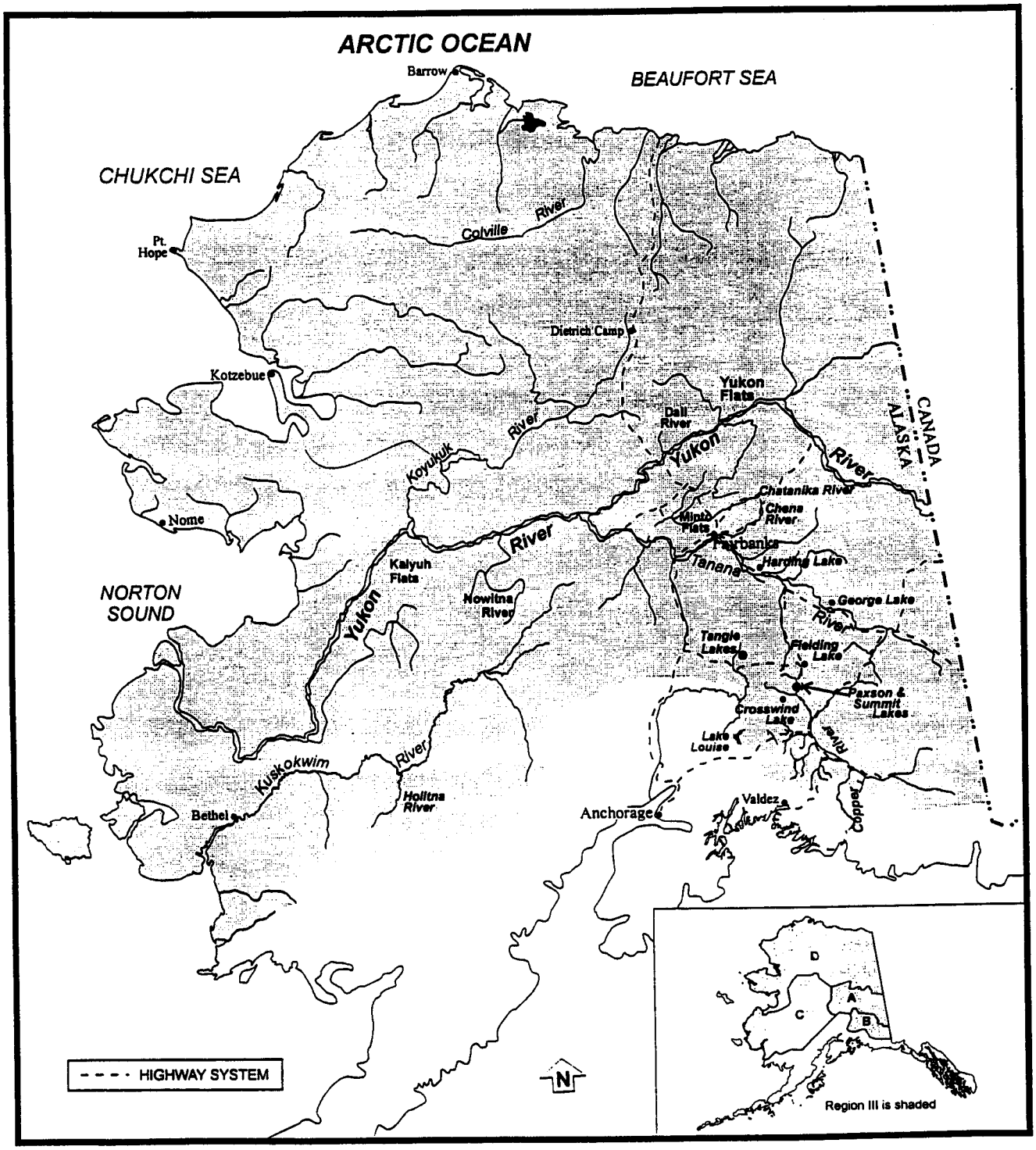

Figure 1.-Map of Region III, Alaska in 1998.

managing for sustainable harvests and maintaining access, public benefits will outweigh management costs. Thus, the intent of the first study goal was to estimate public benefits in terms of NEVs in order to calculate the benefit/cost ratio for program evaluation and planning. The method employed to provide NEV estimates was contingent valuation modeling.

In Alaska, public opinion is important to shaping fisheries management policy. But, because fisheries management must address multiple, sometimes conflicting objectives, and adhere to governing mandates, there is a need to periodically evaluate policy for its influence on public welfare. The second primary goal of the study was to estimate changes in visitation to fishing sites that would result from the implementation of alternative fishing regulations. For example, what would be the overall social welfare change resulting from ADF&G altering gear regulations or bag limits for sport fishing on certain waters? Trip frequency is used in this study as one indicator of public welfare. The method employed to provide estimates of changes in trip frequency was contingent behavior modeling. Sport Fish Division goals are to conserve wild stocks, provide for diverse sport fishing opportunities, and to optimize social and economic benefits from recreational fisheries. The question relating to the study's second goal was: can an optimization be performed? The few management options available to Sport Fish Division are generally limited to stocking, regulation, access and site facility alternatives.

In addition to these two primary goals, information was collected on respondent and fishing trip characteristics, trip expenditures, preferences for alternative fishing experiences, and respondent opinions regarding proposed regulation changes.

2.0 THEORY

2.1 Contingent Valuation Methodology

The contingent valuation method (CVM) uses survey techniques to determine the values which people would place on traditionally nonmarket goods and services if markets did exist for these commodities. In this study, the nonmarket commodities being measured through the use of contingent valuation are burbot, pike, and lake trout fishing trips in Region III. Well established markets for sport fishing on public lands in Alaska do not exist. Contingent valuation has been widely applied (Cummings et al. 1986, Mitchell and Carson 1989) and is recognized by the U.S. Water Resources Council (1983) as an appropriate method for valuing nonmarket resources. This approach has also been designated in federal guidelines (U.S. Department of Interior 1986, 1991) as a best available procedure for valuation of damages arising in superfund natural resource damage cases. The contingent valuation method has been employed numerous times to inform state and federal agency decision makers on resource issues. Federal agencies have used CVM to inform decision makers in several large-scale Environmental Impact Statements on wildlife issues such as wolf reintroduction to Yellowstone National Park (U.S. Fish and Wildlife Service 1994), and reintroduction of grizzlies to Central Idaho and western Montana (U.S. Fish and Wildlife Service 1997).

The essence of the CVM approach is to ask individuals their willingness to pay (WTP) contingent on a hypothetical situation. The application of the CVM involves three elements: 1) a description of the resource which is to be valued; 2) the "payment vehicle," or method by which the respondent will pay for the resource; and, 3) the "question format" or specific method by which the value of the resource will be elicited.

In the Alaska Region III burbot, pike, and lake trout survey, anglers were asked to place a value on their most recent burbot, pike, or lake trout fishing trip to a Region III water. The "payment vehicle," or method by which respondents were asked to place a value on their recreational experience was an increase in travel costs to the site. The use of increased travel costs as a payment vehicle has been used extensively in CVM studies and has the advantage of being relatively neutral. Other possible payment vehicles, such as site access fees or increased taxes, may elicit a "no" response from respondents, not because they are unwilling to pay increased costs, but because they are fundamentally opposed to increased taxes or site fees.

The third feature of all CVM applications is the method by which the resource value is elicited from respondents. There are several basic genres of CVM elicitation techniques including open-ended CVM questions and dichotomous choice CVM questions. In the open-ended CVM respondents are asked what the maximum amount they would be willing to pay for a good or resource. In the dichotomous choice method, respondents are asked a simple "yes" or "no" question: whether they would pay a specified amount for the specific good or resource. This study utilized the dichotomous choice CVM. The dichotomous choice question format has the advantage of presenting respondents with a simple yes or no decision on whether the described "economic good" is worth the dollar amount asked. This type of decision making is similar to decisions made daily by consumers when purchasing goods and services based on quality and price.

While the dichotomous choice method has the advantage of being easily implemented and similar in design to other economic decisions made each day, it is somewhat more difficult to calculate welfare measures from the survey responses. A detailed discussion of the calculation of welfare measures from dichotomous choice question responses is included in Appendix A.

2.2 Contingent Behavior Methodology

Contingent behavior questions ask respondents to predict how their behavior would change given a hypothesized change in the attributes of (for example) a fishing trip. In this study respondents were asked how their visitation patterns to various Region III waters would change if alternative fishing regulations for burbot, pike, and lake trout were adopted for those waters. Appendix B provides a detailed discussion of the motivation for and literature associated with contingent behavior modeling methods.

3.0 METHODS

In April through May 1999, a mail survey was administered to resident and nonresident anglers holding 1998 Alaska sport fishing licenses. The design and administration of this survey are discussed in the following sections.

3.1 Population Sampling Design

The scope of the Alaska Region III survey was ambitious given the resources available for the survey implementation. The survey was ideally designed to estimate NEVs for burbot, pike or lake trout angling on waters within Region III. The final sample sizes were large enough to estimate NEVs for nonresidents, and Region I and II residents as well as for Region III residents.

(1) Copper River[2] area license holders

All 1998 sport fishing license holders (531) in the Copper River were surveyed in an attempt to estimate the NEV for trips to waters in this area of Region III.

(2) U.S. Nonresidents

This population was problematic because it is a large population but only a small proportion of the population likely fished in Region III. The result of this low participation rate is that a large number of nonresident license holders would need to be surveyed to ensure receiving responses from enough anglers who had fished in Region III to allow the estimation of a valuation model.

Because of the low participation rates in Region III angling, the sampled population was narrowed to those nonresident anglers who bought their 1998 licenses in Region III. The assumption made was that nonresidents who purchased their licenses in Region III were much more likely to have fished in Region III. A random sample of 1,271 of these nonresident anglers who bought 1998 licenses in Region III was drawn and these individuals were surveyed.

(3) Region III license holders

A random sample of 2,500 1998 license holders in Region III exclusive of the censused area listed in (1) was drawn and sampled.

(4) Region I and Region II resident anglers

Region I and II anglers are a very large population with low participation rates for fishing in Region III. As with the nonresident population, the target population was narrowed to only those Region I and II residents who bought their 1998 licenses in Region III. A sample of 1,166 anglers from this population were surveyed.

One limitation of the sampling strategy employed in this study was that the sample pool for Alaska residents only included those individuals holding 1998 sport fishing licenses. Those residents over 60 years of age holding permanent identification cards (PIDs) were not included in the pool. While this study did survey a number of Alaska residents over 60, this population would be larger if PID holders were included. Total trip estimates used in this study were estimated by ADF&G and do include PID holders.

Table 1.-Summary of sampled populations.

Population of 1998 sport fishing license holders sampled	Type of Sample	Sample Size
Copper River area	Census	531
Region III	Random	2,500
Nonresidents who bought licenses in Region III	Random	1,271
Region I and II residents who bought licenses in Region III	Census	1,166
Total		5,468

[2] Management uses the designation “Upper Copper/Upper Susitna drainages” however for this report we have shortened the designation to “Copper River”.

3.2 Survey Design and Administration

The survey instrument (see Appendix C) was designed cooperatively by Bioeconomics and ADF&G personnel. The final survey contained four sections. Section I asked several general questions about fishing patterns and visitation to Region III waters during 1998. Section II focused the questioning on the Region III waters most recently fished by the respondent. Questions in this section asked about the specifics of that trip, burbot, pike, and lake trout targeted and caught, and the anglers' assessment of the quality of this trip. This section also included the contingent valuation question used in estimating the NEV of trips. Section III asked questions about the respondents' preferences for fishing regulations on specific Region III waters as well as how their visitation to Copper River area, and Tanana River area waters would change under alternative fishing regulations. Section IV asked a number of demographic questions.

After the survey was developed it was pretested in March 1999 on a randomly drawn sample of 200 anglers from the 1998 license file. The purpose of this pretest was to 1) test the effectiveness of the wording and question sequencing of the survey instrument, and 2) to determine what the top bid level for the contingent valuation question should be. Several wording changes to the survey were made as a result of the pretest responses and the top bid level was set at $1,000 for Alaska residents and $2,000 for nonresidents for the final survey administration.

The administration of the survey was by ADF&G personnel and followed a modified Dillman methodology (Dillman 1982). A survey was mailed between March 31 and April 1, 1999 to the sample of 1998 license holders. After three weeks a reminder postcard was sent to all potential respondents (see Appendix C). Finally, nonrespondents were sent a second copy of the survey on May 13-20, 1999.

3.3 Response Rate

A total of 5,468 anglers' names and addresses were included in the survey sample. Of this number, 449 surveys (8.2%) were returned as undeliverable. Of the remaining 5,019 surveys that were successfully delivered to anglers, 1,957 completed surveys were returned by the end of the survey process. The resulting response rate to the survey was 39%.

4.0 RESULTS

4.1 General Fishing and Socioeconomic Statistics

The Alaska burbot, pike, and lake trout survey contained several questions about general fishing habits and socioeconomic characteristics. In general, all statistics in this report are presented specifically for each population (Copper River area, the remainder of Region III, nonresidents, and Region I and II residents). As expected there are many similarities in general fishing characteristics between the populations (Table 2). However, nonresidents and Regions I and II residents are less likely than Region III respondents to specifically target pike, burbot, or lake trout on their fishing trips. Nonresidents were 5 to 6 years older, were comprised of a higher percentage of males, and indicated a higher percentage of income in the $125,000 + bracket than respondents in the remaining three populations (Table 3).

Table 2.-General fishing characteristics of respondents to the burbot, pike and lake trout survey, by population, Region III, 1998.

	Respondent population			
Statistic	Copper River	Non-residents	Region III	Regions I & II
Average years fished in life	24.9	24.7	22.2	24.7
Average number of days fished per year	21.0	28.8	20.0	21.1
Percent who specifically fish for pike, burbot, or lake trout	51.6	25.1	45.5	30.3
Sample size[a]	225	418	946	360

[a] Sample sizes for individual statistics vary from reported overall sample size. This is due to varying response rates on individual questions.

Table 3.-Socioeconomic characteristics of respondents to the Region III burbot, pike and lake trout survey, by population, 1998.

	Respondent population			
Statistic	Copper River	Nonresident	Region III	Regions I & II
Average age (in years)	40.0	45.0	38.7	40.1
Percent Male	73.0	82.9	70.9	72.0
Average years of formal schooling attended	12.2	12.8	13.4	13.0
1998 household income before taxes				
Percent less than $20,000	23.6	7.3	10.4	8.3
Percent $20,000-$39,999	25.8	20.5	19.1	14.3
Percent $40,000-$69,999	28.6	34.2	34.8	31.7
Percent $70,000-$79,999	7.7	10.8	10.6	11.7
Percent $80,000 - $124,999	11.5	15.8	19.5	23.5
Percent over $125,000	2.7	11.4	5.6	10.5

4.2 Site-Specific Statistics and Trip Characteristics

The survey presented each respondent with a series of alternative fishing trip attributes. Respondents were asked to rate their preference for each attribute on a scale of 1 to 5 with 1 being least preferred and 5 being most preferred. The statistics presented in Table 4 are the percentage of respondents in each sample strata who rated the attribute as either a 4 or a 5. There are several differences across populations (Table 4). Nonresidents were less likely to prefer ice fishing for burbot than were the other angler groups. The majority of Copper River and Region I and II

Table 4.-Percent of respondents who preferred alternative fishing experiences, by population.[a]

Statistic	Respondent population			
	Copper River	Nonresidents	Region III	Regions I & II
Fishing for burbot with a baited set line, ice cover	66.0	7.5	27.8	35.0
Fishing for burbot with set line, open water	37.5	23.5	29.1	15.8
Fishing for burbot with hand held line (rod & reel), ice cover	36.2	7.7	17.4	22.5
Fishing for burbot with hand held line (rod & reel) open water	44.0	68.3	54.8	43.3
Harvesting pike	48.5	46.2	44.5	41.1
Catching and releasing pike	39.4	61.2	50.9	27.3
Harvesting lake trout	68.9	62.0	60.0	56.1
Catching and releasing lake trout	37.9	53.2	46.1	41.8
Sample size[b]	116	105	430	109

[a] Table statistics represent the percentage of respondents in each population who rated the fishing experience either a “4”, or “5” on a scale of 1-5 with 1 being least preferred and 5 being most preferred.

[b] Sample sizes for individual statistics vary from reported overall sample size. This is due to varying response rates on individual questions.

residents preferred harvesting pike and lake trout to catching and releasing. While the majority of nonresidents and the remainder of Region II residents preferred to release pike, they preferred to harvest lake trout (Table 4).

Table 5 shows the average number of fishing trips per year that respondents from each population made to the waters included in the survey to fish for pike, burbot or lake trout. Copper River residents traveled most frequently to waters in the Copper River, and specifically to Lake Louise

Table 5.-Average 1998 reported fishing trips to Region III waters, by population.

Fishing Site	Respondent population			
	Copper River	Nonresidents[a]	Region III	Regions I & II[a]
Tanana River Drainages				
Chena River	0.10	0.70	1.76	0.24
Tanana River	1.01	0.22	0.86	0.10
Minto Flats/ Chatanika River	0.04	0.10	0.64	0.06
Harding Lake	0.07	0.17	0.62	0.10
Fielding Lake	0.01	0.02	0.12	0.07
Tangle Lake	0.30	0.02	0.24	0.18
George Lake	0.04	0.07	0.08	0.00
Other Area A water	0.69	0.48	1.06	0.37
Copper River Area				
Paxson Lake	0.29	0.03	0.30	0.10
Summit Lake	0.16	0.02	0.15	0.03
Lake Louise	0.61	0.03	0.05	0.48
CrossWind Lake	0.19	0	0.01	0.09
Other Area B water	1.70	0.15	0.14	0.36
Kuskokwim/Yukon				
Kaiyuh Flats	0	0	0	0
Nowitna River	0.03	0	0.01	0
Dall River	0	0.01	0.04	0.01
Holitna River	0	0	0.02	0.02
Koyukuk River	0	0.01	0.07	0.09
Other Area C water	0.05	0.05	0.48	0.16
Region III Waters (Brooks Range, Northwest, Seward Peninsula)	0.01	0.16	0.66	0.39

[a] Averages for nonresidents and Regions I and II anglers refer to those anglers from these groups who bought their licenses in Region III.

(an average of 0.61 trips annually). Nonresidents listed their most frequent destination in Region III as the Chena River (an average of 0.70 trips). Anglers residing in the remainder of Region III took an average of 1.76 trips to fish for pike or burbot to the Chena River annually. Residents of Region I and II traveled most frequently to Lake Louise to fish in Region III waters (an average of 0.48 trips annually).

Section II of the survey asked respondents questions about their most recent trip, the number of burbot, pike, and lake trout they caught, and the overall rating of their angling experience on their most recent trip. The majority of trips were taken in 1998 for all four angler groups (Table 6). Nonresidents and Region I and II residents were more likely than Region III respondents to be on

Table 6.-Percent of respondents indicating the year of their most recent fishing trip, by population.

	Respondent Population			
Year	Copper River	Nonresidents	Region III	Regions I & II
1998	83.1	95.0	84.5	88.5
1999	12.3	3.3	11.9	5.8

Table 7.-Fishing trip experiences and quality ratings from respondents to the burbot, pike and lake trout survey, Region III, 1998.

Statistic	Respondent Population			
	Copper River	Nonresidents	Region III	Regions I & II
Importance of fishing on this trip				
Fishing this site was the main purpose for this trip	46.5%	27.6%	46.5%	25.0%
Fishing this site was one of the main purposes for this trip	43.3%	32.8%	31.7%	36.5%
Fishing this site was just one of several activities on this trip	10.3%	39.6%	21.9%	38.5%
Respondents targeting specific species on this trip				
Burbot	33.8%	5.0%	17.8%	7.7%
Pike	18.5%	43.3%	28.4%	23.1%
Lake trout	47.7%	51.7%	43.8%	69.2%
Average number of fish caught and kept				
Burbot	1.2 / 0.8	0.1 / 0.1	0.5 / 0.3	0.2 / 0
Pike	2.3 / 0.4	9.2 / 0.5	3.8 / 0.6	2.6 / 0.1
Lake trout	1.8 / 0.7	2.3 / 0.3	1.4 / 0.4	2.7 / 0.7
Above average fishing experience[a]	26.9%	31.7%	20.7%	27.0%
Average number of people in party	2.9	3.5	3.0	2.5

[a] Those respondents who rated the overall quality of their fishing experience as either a 4 or 5 on a scale of 1 to 5 with 1 being poor and 5 being excellent.

multi-purpose trips on their most recent pike, burbot, or lake trout fishing trip (Table 7). While a large percentage of anglers from all four groups primarily targeted lake trout on their trip (between 43.8% and 69.2%), nonresidents were more likely to specifically target pike than were anglers from the other strata. Additionally, nonresidents and Region I and II residents were the least likely of the groups to specifically target burbot. All four populations released far greater numbers of pike and lake trout than were kept. This is especially evident in nonresidents, who caught an average of 9.2 pike and kept an average of 0.5 pike per trip (Table 7). A higher percentage of nonresidents (31.7%) reported having an "above average" or "excellent" fishing experience on their most recent fishing trip (Table 7).

4.3 Trip Expenditures

In Section II of the survey, respondents were asked how much money they spent in a number of expenditure categories on their recent trip to the study waters. Table 8 shows the average reported expenditures by category for each of the four populations. Nonresidents who fished in Region III spent significantly more per trip than did all other sample populations ($1,198 per trip).

When expenditures and NEVs are added together, the sum is termed gross NEV. This measures the gross total value associated with an activity. Gross NEV may correspond roughly to the market price for a package fishing trip including all expenses. Gross values are not appropriate for valuing a site since they include many other goods and services utilized on a fishing trip such as gasoline and food.

Table 8.-Average expenditures per trip by category and respondent population.

	Respondent Population			
Expenditure category	Copper River	Nonresidents	Region III	Regions I & II
Travel	$39.42	$493.50	$40.60	$123.37
Food & beverages	$28.51	$180.92	$33.53	$72.77
Lodging or camping fees	$10.30	$313.90	$7.15	$20.98
Equipment purchased for this trip	$5.84	$114.67	$46.61	$11.82
Other expenses & equipment rentals	$0.40	$95.10	$23.26	$34.42
Calculated total expenditures	$84.47	$1,198.09	$151.15	$263.36

4.4 Net Economic Value per Trip

Section II of the survey concluded by asking respondents two questions designed to elicit information on how much their most recent fishing trip was worth to them. The first question simply asked anglers if their most recent trip was worth more to them than they actually spent on the trip. Over 75% of respondents felt that their most recent fishing trip to Region III was worth more than they spent on the trip. The second question asked anglers to provide information on their NEV for their most recent angling experience. Specifically, the valuation questions asked:

> Was this trip worth more than what you actually spent? (Yes or No)
>
> If YES, Would you still have made the trip if your share of the expenses had been $_____ more?

The bid amount asked in this question was varied across respondents and consisted of one of seven or eight bid levels ($10, $25, $50, $100, $200, $500 and $1000 for Alaska residents and $10, $25, $50, $100, $200, $500, $1000, and $2,000 for nonresidents). The responses to this question were analyzed for alternative population groupings in order to estimate the truncated mean NEV for a fishing trip. The distribution of yes responses to the individual bid levels in the current trip contingent valuation question is generally consistent with the hypothesis that the percentage of yes answers will drop as the bid level is increased.

As described above in Section 3.2, the sampling and survey design allowed for the possibility of estimating many subsample models of NEV. The ability to estimate meaningful subsample models was dependent on sample size. Tables 9a through 10b show the estimated bivariate logistic regression models of NEV and mean NEV estimates for all subsamples of interest with adequate sample sizes. In general, models reported in these tables that had sample sizes below approximately 60 were included only if all estimated parameters were significant at the 90^{th} percentile or greater. Models not meeting this level of significance due to insufficient samples are not reported. The estimated simulated standard errors of the mean NEV estimates are estimated based on the procedures suggested by Krinsky and Robb (1986), and are also reported.

Table 9a.-Bivariate current trip models of net economic value for a fishing trip in Region III for burbot, pike, and lake trout combined, by population, 1998.

	Respondent population			
Variable / statistic	Copper River	Nonresidents	Region III	Regions I & II
Intercept	4.163	3.962	4.833	4.283
(t-stat)	(3.63)	(3.29)	(7.23)	(3.30)
Ln (BID)	-0.998	-0.795	-1.08	-0.870
(t-stat)	(3.92)	(3.44)	(7.68)	(3.41)
Chi-square degrees of freedom	5	6	5	5
Chi-square	4.74	12.57	3.63	5.99
P-statistic	0.449	0.051	0.727	0.424
Sample size	64	59	218	52

Table 9b.-Estimates of adjusted mean net economic value for a fishing trip in Region III for burbot, pike, and lake trout combined, by population, 1998.

Population	Mean NEV[a] (standard error)[b]	Percent of respondents with NEV greater than expenses	Adjusted mean NEV per trip
Copper River	$191.10	83.1%	$158.80
	(57.15)		(47.49)
Nonresidents	$494.88	75.0%	$371.16
	(140.62)		(105.47)
Region III	$211.33	76.3%	$161.24
	(31.01)		(23.66)
Regions I & II	$317.62	75.0%	$238.22
	(73.61)		(55.21)

[a] Mean NEV measures are truncated means, truncated at the highest bid level.

[b] Standard errors are based on a simulation procedure using 10,000 simulated draws.

Table 10a.-Bivariate current trip models of net economic value for a burbot, pike, and lake trout fishing trip by species for remainder of Region III respondents, 1998.

	Primary target species		
Variable / statistic	Burbot	Pike	Lake Trout
Intercept	4.435	5.290	4.766
(t-stat)	(3.16)	(4.49)	(4.89)
Ln (BID)	-1.064	-1.231	-0.996
(t-stat)	(3.32)	(4.82)	(4.94)
Chi-square degrees of freedom	5	5	5
Chi-square	6.60	3.95	7.73
P-statistic	0.252	0.683	0.259
Sample size	39	83	96

Table 10b.-Estimates of adjusted mean net economic value for a burbot, pike, and lake trout fishing trip by species, for remainder of Region III respondents, 1998.

Species	Mean NEV [a] (standard error)[b]	Percent of respondents with NEV greater than expenses	Adjusted mean NEV per trip
Burbot	$186.46	74.4%	$138.73
	(74.77)		(55.63)
Pike	$170.32	76.2%	$129.78
	(42.80)		(32.61)
Lake Trout	$273.17	77.1%	$210.61
	(54.98)		(42.39)

[a] Mean NEV measures are truncated means, truncated at the highest bid level.

[b] Standard errors are based on a simulation procedure using 10,000 simulated draws.

The final models of NEV are presented in two pairs of tables (Tables 9a and b and 10a and b). These tables report the estimated model parameters, as well as the mean NEV estimates based on these models. Each of the two pairs of NEV tables contains (a) a table reporting the estimated model parameters and goodness-of-fit statistics, and (b) a table reporting the estimated truncated mean NEV estimate (truncated at the maximum bid level per the discussion in Appendix A). Also included in the (b) tables are the adjusted mean NEV estimates. These estimates are adjusted for the percent of respondents in each model who said that their most recent trip was not worth more

than they spent on it. Those giving this response were not asked the CVM question, and thus their "zero" net NEV must be factored into the NEV estimate for those other respondents who all had a positive net NEV. Therefore, the adjusted mean NEV estimate includes all respondents, those with a positive and those with a zero net NEV. Associated with the adjusted mean NEV estimates are simulated standard errors which are calculated under the assumption that the percent of respondents in the targeted population with a zero net NEV is constant. The standard errors in the b tables, 9 and 10, are computed using a standard variance formula. The first set of tables, 9a and 9b, show the estimates for each of the four populations considering all trips taken to Region III.

The estimated coefficients for these models are significant at the 95% level of confidence. For the chi-square coefficient the null hypothesis is one of general association (i.e., the estimated model fits the logistic functional form). With a p statistic greater than 0.05, the model fits the data at the 95% confidence level; with a $p < 0.05$, the null hypothesis is rejected and the model does not fit particularly well.

Tables 10a and 10b show estimated models and mean NEV estimates for fishing trips made by the remainder of Region III population fishing each target species of burbot, pike, and lake trout. All three species-specific models had a significant estimated coefficient and fit the hypothesized distribution well. Based on point estimates it appears that lake trout trips may be more highly valued than those trips targeting pike or burbot; however, given the estimated standard errors the adjusted mean NEVs are not significantly different.

An examination of the models and mean NEV estimates show:

1) while nonresidents value their fishing trips for burbot, pike, and lake trout in Region III more than residents, the difference is not statistically significant; and,

2) fishing trips in Region III by Region III residents (exclusive of Copper River area) on which burbot and pike are primarily targeted appear to be valued somewhat lower than those fishing trips targeting lake trout; the difference between these estimates, however, is not statistically significant.

4.5 TOTAL NET ECONOMIC VALUE ESTIMATES

4.5.1 Total Trip Estimates

The ADF&G conducts an annual survey of fishing trips in the state however, estimates of trips reported in the statewide harvest survey (Howe et al. *In press*) are for household-trips. Estimates of angler-trips per household trip for the four populations were approximated following the equations documented in Appendix D. The annual statewide harvest survey does not directly estimate angler use by species. Therefore, estimates of burbot, pike and lake trout angler trips were derived from two independent sources: 1) the 1996 Region III angler survey (Duffield et al. 2001*b*) which collected information on species targeted per fishing trip; and 2) the 1994 and 1995 targeted angler-days survey (Howe and Fleischman *In prep*.) for the Copper River area. (Data on the percentage of trips targeting specific species from the 1996 Region III angler survey did not include questions about Copper River area fishing because at the time of the 1996 survey, the Copper River was not in Region III's jurisdiction). It is assumed that: 1) the percentage of angler-days targeting burbot, pike or lake trout is related to the percentage of angler-trips targeting burbot, pike and lake trout; 2) fishing for multiple species in an angler-day is minimal; and, 3) the

percentages of sport fishing trips targeting burbot, pike and lake trout in 1994-96 are similar to those in 1998.

The total estimated angler trips to fish for all species in Region III in 1998 was 164,376; nonresidents accounted for 16.6% of fishing trips. Sport fishing trips specifically targeting burbot, pike and lake trout accounted for a small percentage of the total fishing trips taken for all populations (Table 11).

4.5.2 Total Estimated Net Economic Value of Fishing Trips

The NEV per trip estimates shown in Tables 9a and 9b can be used in conjunction with annual burbot, pike and lake trout angler trip estimates (shown in Table 11) to estimate the total annual NEV of burbot, pike and lake trout sport fishing in Region III (Table 12).

Table 11.-Estimates of sport fishing trips for burbot, pike and lake trout to Region III by population, 1998.

Sample Population	Estimated total angler trips[a] (se)	Estimated percent burbot, pike and lake trout fishing trips[b]	Estimated total burbot, pike and lake trout fishing trips
Copper River	6,030 (345)	--	--
Remainder of Region III	108,227 (3,001)	15.3[c]	16,559
Nonresidents	27,255 (943)	7.7[c]	2,099
Regions I and II	22,864 (973)	10.8[c]	2,469
Total	164,376	--	--

[a] From the revised 1998 statewide harvest survey (Howe et al. *In press*).

[b] Average of the 1994 and 1995 targeted angler days survey results (Howe and Fleischman *In prep*).

[c] Derived from data collected in the 1996 Region III angler survey (Duffield et al. 2001*b*).

Table 12.-Estimated total annual net economic value of sport fishing for burbot, pike and lake trout in Region III, 1998.

Population	Total Estimated Net Economic Value
Copper River	$254,715
Remainder of Region III	$2,669,973
Nonresidents	$779,065
Regions I and II	$588,165
Total	$4,291,918

Overall, 1998 burbot, pike and lake trout fishing in Region III is estimated to have a total NEV of approximately $4.3 million in 1998 (Table 12). Of this total, approximately 18.2% is attributable

to nonresident fishing trips. Of the 81.8% of estimated value attributable to Alaska residents, 13.7% is from Region I and II anglers fishing in Region III, and the remaining 68.1% is from Region III residents including the Copper River.

4.6 Benefit/Cost Ratio

The cost basis was limited to those activities relating to research and management of burbot, pike and lake trout fisheries in Region III (Table 13). Management costs were estimated from the proportion of time spent by individual managers on burbot, pike and lake trout management issues by geographic area. Not included are indirect costs associated with supervision and administration. The estimated benefit/cost ratio was 13.7 in FY 99. Obviously, the benefits of Region III's burbot, pike and lake trout research and management program outweigh the costs.

Table 13.-The cost basis used to evaluate the benefit/cost ratio for program planning relating to burbot, pike and lake trout research and management in Region III, for fiscal year 1999.

Budget component	FY99
Research	$193,100
Management[a]	$120,200
Total	$313,300

[a] Computed from the estimated amount of time each of five area managers normally spend on burbot, pike and lake trout management within their respective areas per fiscal year (total allocation x percentage of time). These estimated percentages are: lower Tanana-31%, upper Tanana-25%, northwest-0%, AYK-45%, Copper River-14%.

4.7 Analysis of Contingent Behavior Responses

In section III of the survey respondents were asked to predict how their visitation to the specific waters would change under certain management strategies for waters in the Copper, Tanana and Kuskokwim/Yukon river drainages, and if so, how many more or fewer trips they would take under the new regulations (Questions 18-23). Respondents were also asked what their level of support for the proposed changes would be (see Appendix C). On occasion, respondents will include a letter or write comments in the margins of the survey relating their opinions on a particular question in more detail or on another topic. Appendix E is a summary of respondent comments grouped by topic.

Question 18 concerned the sport fishery for lake trout at Fielding Lake. The contingent behavior component of this question dealt with a possible regulatory action to increase the minimum length limit of lake trout from 22 to 24 inches due to conservation concerns:

> If the minimum length limit for harvest was increased to 24 inches how would this change affect your fishing trips?

Across all four populations 96-97% of respondents said that increasing the minimum length of lake trout at Fielding Lake from 22 to 24 inches would not alter the number of trips they take to the lake. The overall estimated changes in total trips to Fielding Lake under the proposed regulatory action ranges between a 6% decline for nonresidents to a 15% increase for Region I and II residents (Table 14). That is, 15% of predicted visitation changes to Fielding Lake in the

Regions I and II population would come from only 3% of that population. Because such a high percentage of respondents said they would not alter their visitation to Fielding Lake under the proposed regulatory action, the estimated visitation changes are based on very small numbers of responses and, though they are relatively large in percentage terms, may represent the responses of only a few of the respondents to the survey.

In general, there was moderate support from all populations for increasing the minimum length limit, however, many respondents were relatively neutral (Figure 2). In contrast, a strong majority of all angler groups support an alternative regulatory action to close the lake trout fishery at Fielding Lake during September to protect spawning fish (Figure 3).

Table 14.-Percentage of respondents who would change their visitation to Fielding Lake if the minimum length limit was increased (Q18).

	Copper River	Nonresidents	Region III	Regions I and II
Percentage of no change in visitation	97.0%	96.0%	97.0%	97.0%
Predicted percentage change in visitation	0%	-6%	0%	15%
Sample size	131	235	705	223

Question 19 was concerned with the sport fishery for pike at Harding Lake. The contingent behavior component of this question dealt with a possible regulatory action to shorten the fishing season due to conservation concerns:

> If the opening day was changed from June 1 to June 30, how would this change affect your fishing trips?

A majority of respondents (93-97%) would not alter the number of trips taken to Harding Lake under the proposed change in Question 19. The overall estimated changes in total trips to Harding Lake under the proposed regulatory action to delay the fishery opening ranges between a 10.5% decline for nonresidents and a 7.7% increase for Region I and II residents (Table 15).

There was general support for three proposed conservation actions at Harding Lake: shortening the season (Figure 4), increasing the minimum length limit from 26 to 30 inches (Figure 5) and reducing the bag limit from 5 to 2 pike (Figure 6). Many respondents were neutral on season length and bag limit reductions; the largest levels of support were for increasing the minimum length limit of pike from 26 to 30 inches.

Table 15.-Percentage of respondents who would change their visitation to Harding Lake if the season was shortened (Q19).

	Copper River	Nonresidents	Region III	Regions I and II
Percentage of no change in visitation	97%	95.8%	93.8%	96.4%
Predicted percentage change in visitation	-0.3%	-10.5%	-1.7%	7.7%
Sample size	132	240	713	223

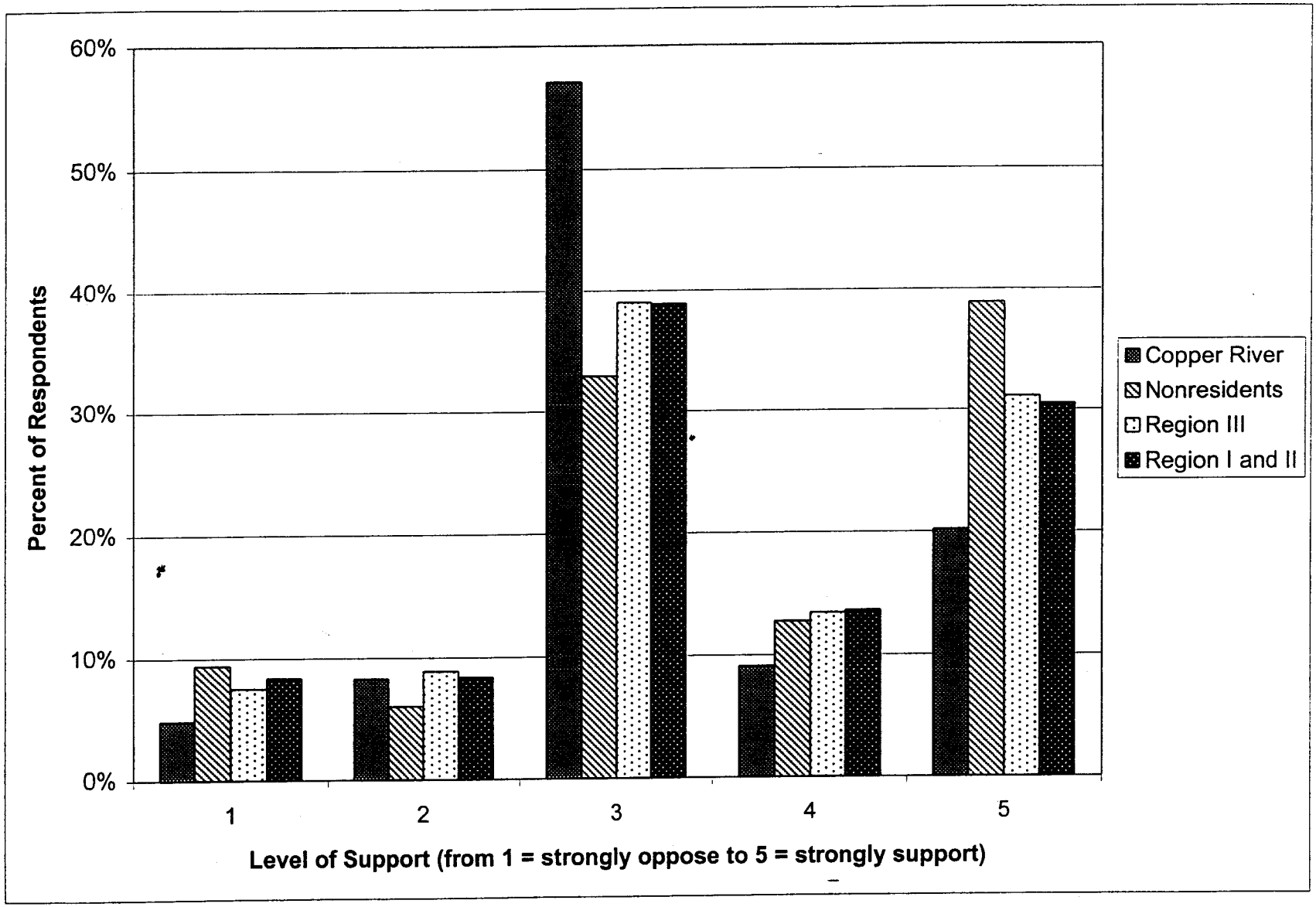

Figure 2.-Level of public support for increasing the minimum harvest length of lake trout at Fielding Lake, by population.

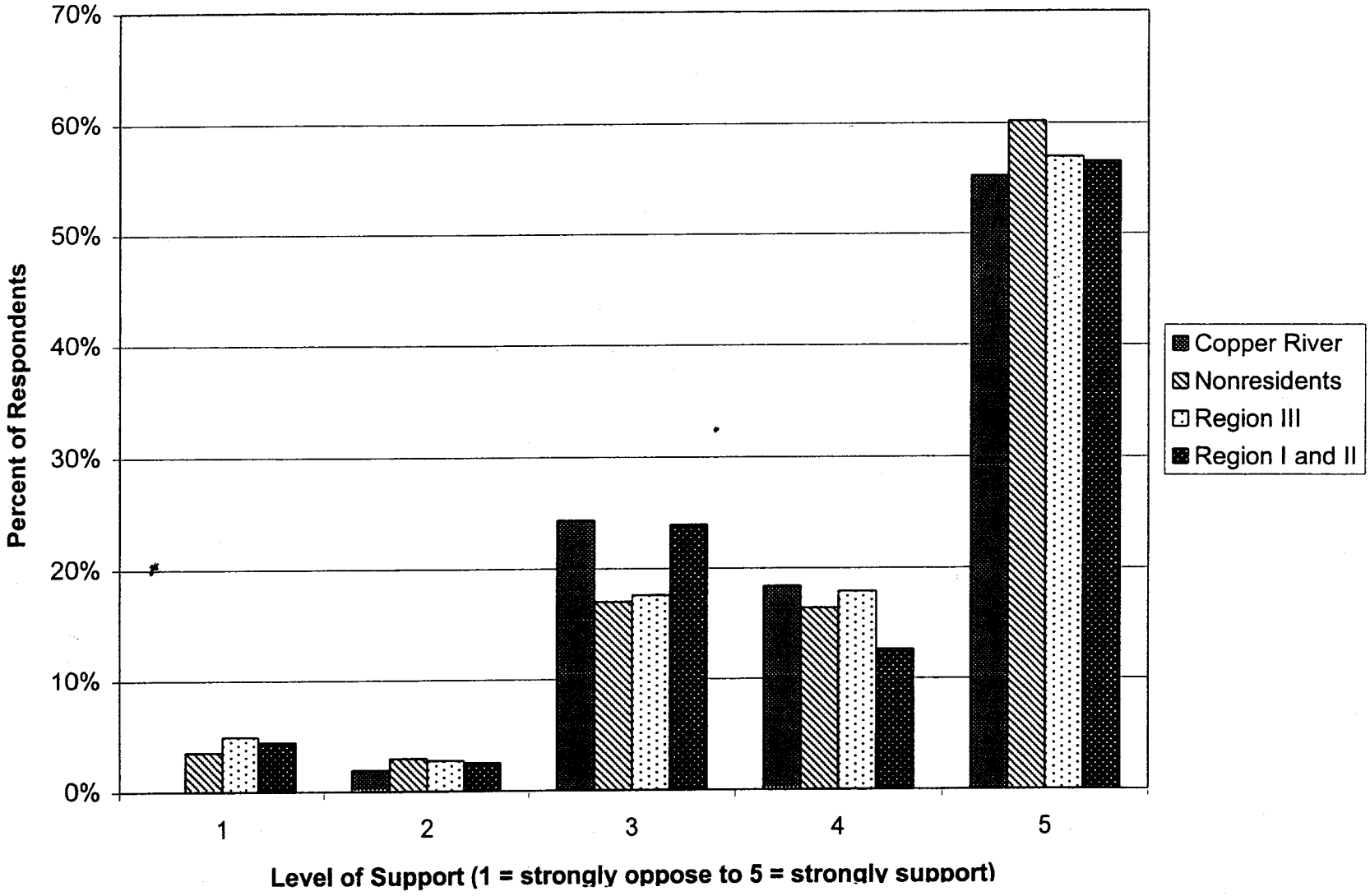

Figure 3.-Level of public support for closing the lake trout sport fishery at Fielding Lake during September to protect spawning fish, by population.

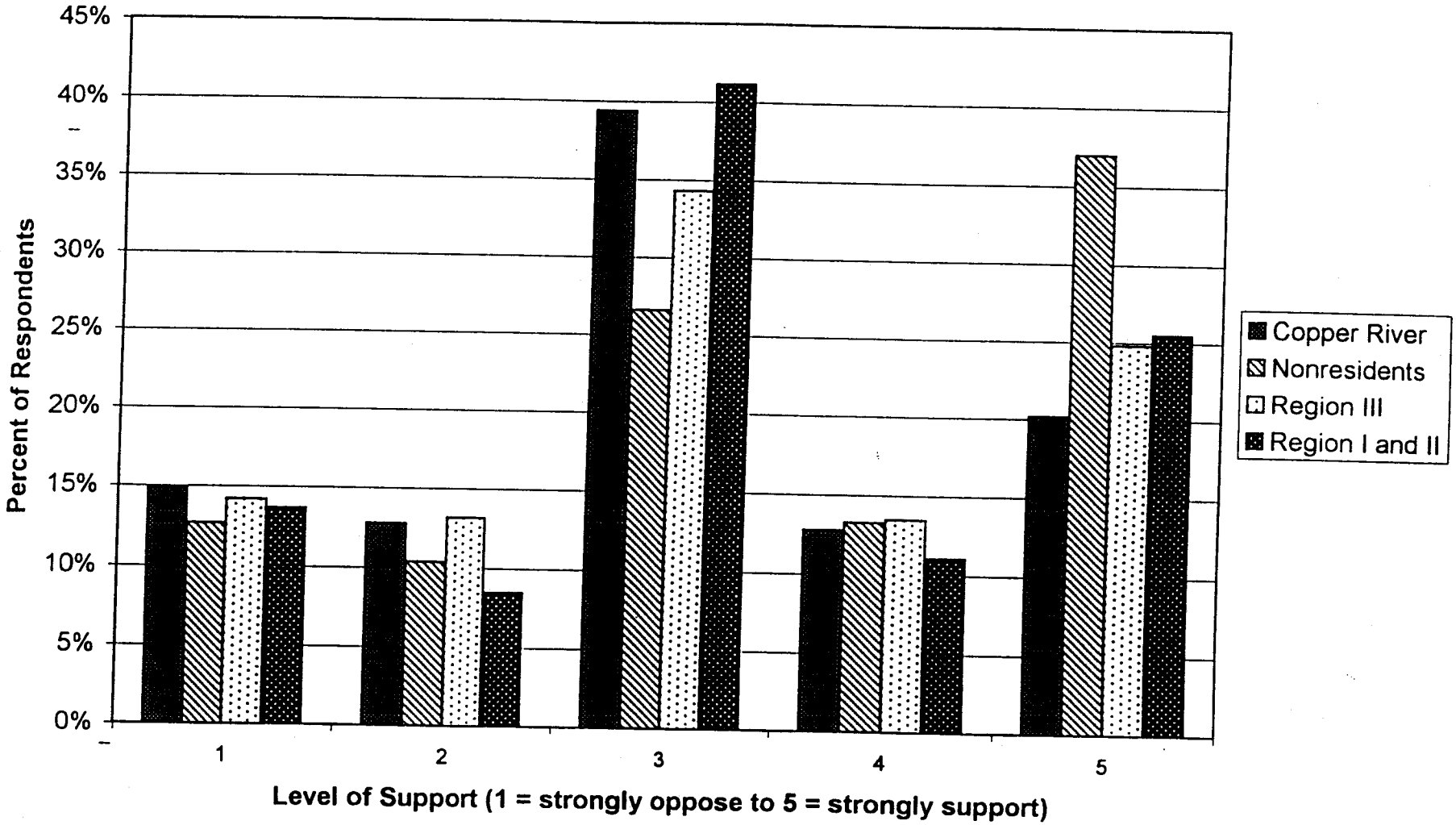

Figure 4.-Level of public support for shortening the sport fishing season of pike at Harding Lake by delaying opening day from June 1 to June 30, by population.

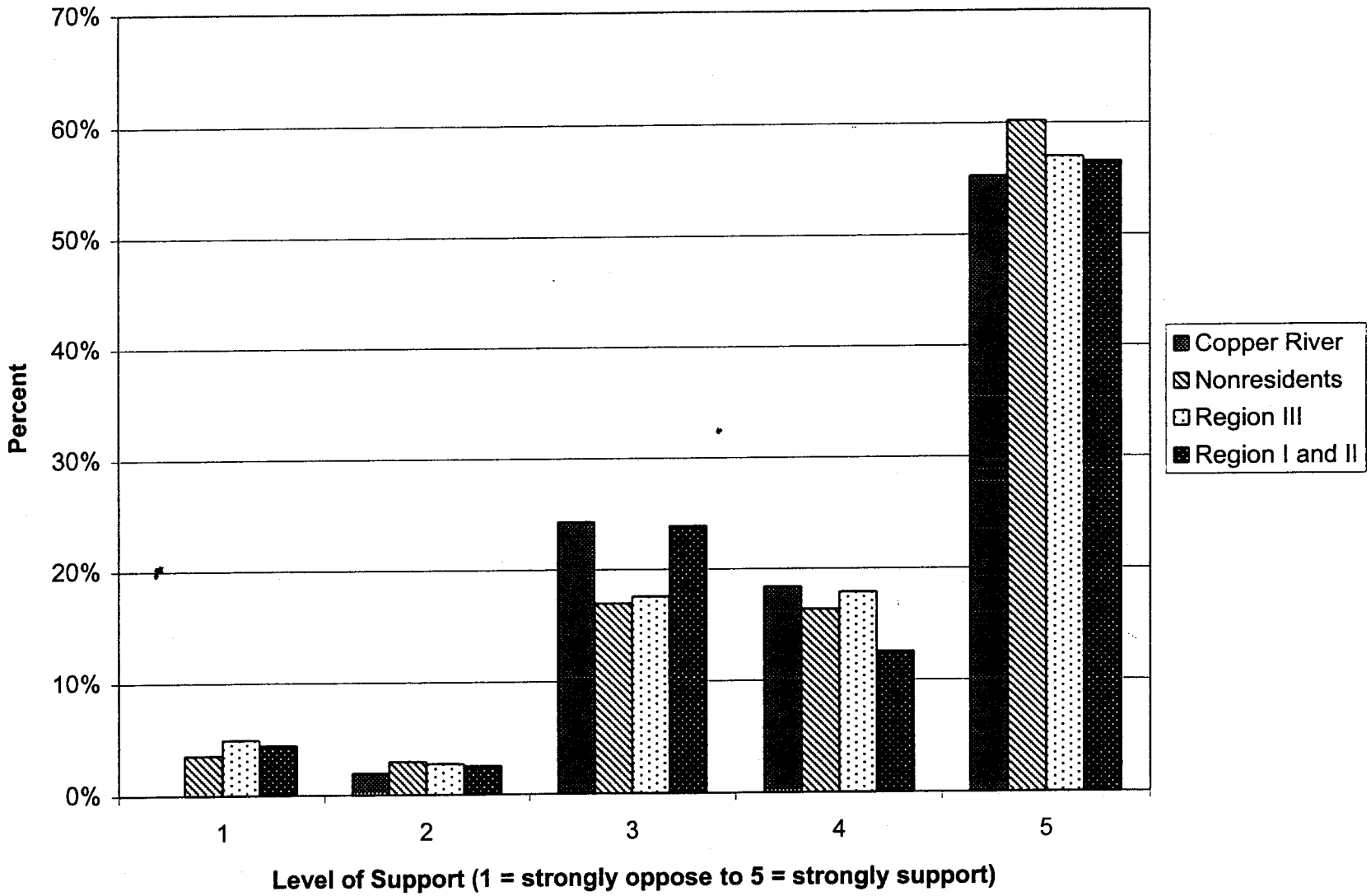

Figure 5.-Level of public support for increasing the minimum harvest length of pike at Harding Lake from 26 to 30 inches, by population.

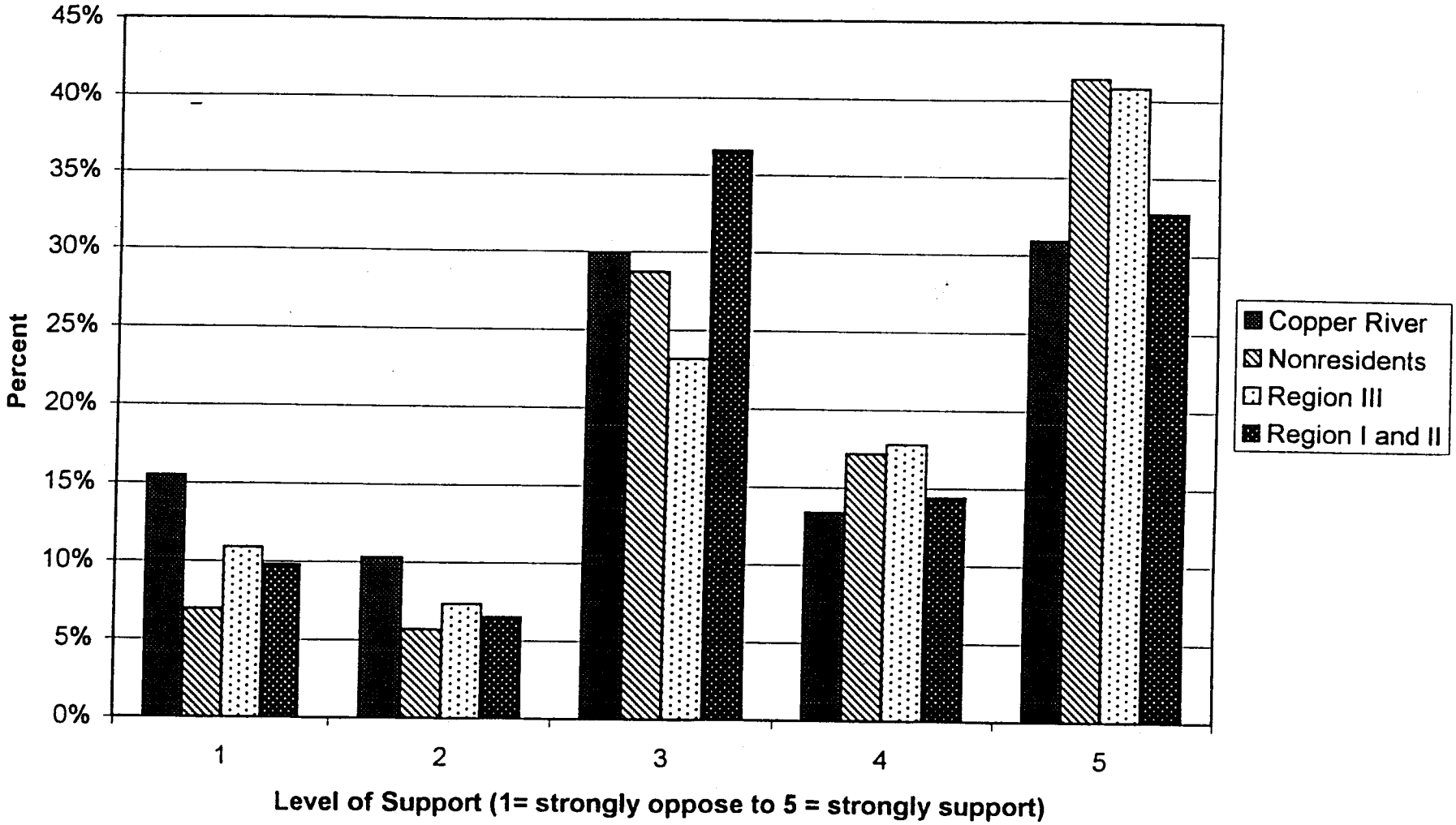

Figure 6.-Level of public support for reducing the bag limit of pike from five to two fish at Harding Lake, by population.

Question 20 asked respondents the following about a possible regulatory action to the Lake Louise sport fishery for burbot:

> Lake Louise has been closed to the keeping of burbot since 1990 due to low population levels. ADF&G will reopen this fishery to minimal harvest when the population of burbot has recovered; use of set lines will remain prohibited. If a bag limit of 1 burbot per day were allowed, how would this affect your fishing trips?

A vast majority of respondents (91-97%) would not alter the number of trips taken to Lake Louise under the Question 20 change in burbot bag limit. The overall estimated changes in total trips to the Lake Louise drainage under the proposed regulatory action ranges between a 0% change for nonresidents and a 15% increase for Copper River residents (Table 16).

There was general support for the proposed increase in bag limit, however the majority of respondents were neutral (Figure 7).

Table 16.-Percentage of respondents who would change their visitation to Lake Louise if a bag limit of 1 burbot was allowed (Q20).

	Copper River	Nonresidents	Region III	Regions I and II
Percentage of no change in visitation	96%	98%	98%	95%
Predicted percentage change in visitation	15%	0%	5%	6%
Sample size	152	183	538	212

Question 21 was concerned with the sport fishery for burbot on the Copper River. The contingent behavior component of this question dealt with a possible regulatory action to allow set lines, with a bag limit of two burbot:

> If set lines were allowed in the sport fishery, with a bag limit of 2 burbot per day and open all year, how would this change affect your fishing trips?

A large majority of respondents (96-97%) would not alter the number of trips taken to the Copper River drainage under the Question 21 changes. The overall estimated changes in total trips to the Copper River under the possible regulatory action to allow set lines ranges between a 16% decrease for nonresidents to a 17% increase by Copper River residents (Table 17).

Table 17.-Percentage of respondents who would change their visitation to the Copper River if set lines were allowed.

	Copper River	Nonresidents	Region III	Regions I and II
Percentage of no change in visitation	91.0%	97.0%	97.0%	95.0%
Predicted percentage change in visitation	17%	-16%	8%	12%
Sample size	131	235	705	223

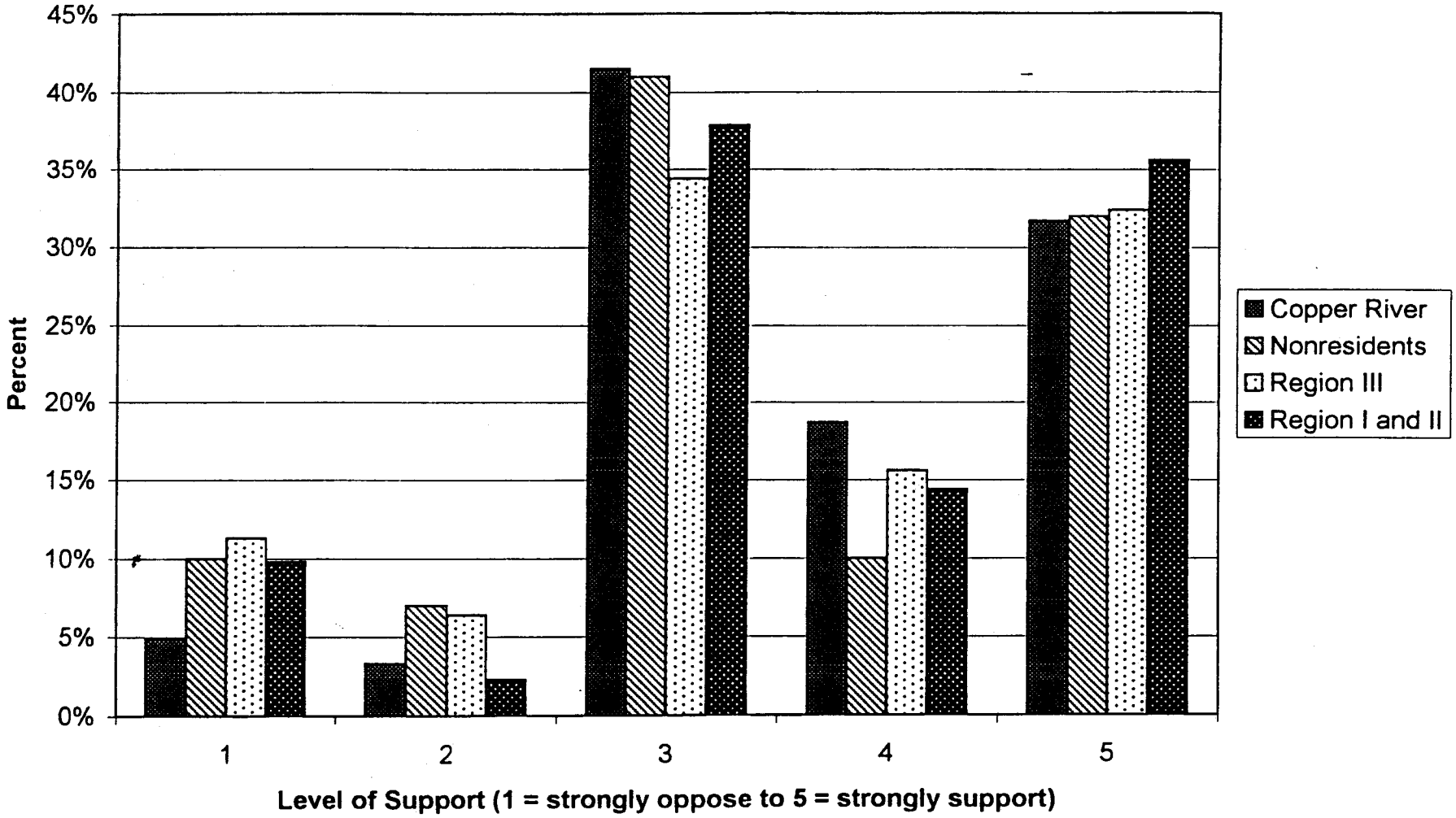

Figure 7.-Level of public support for permitting a bag limit of one burbot per day at Lake Louise, by population.

There was in general more support than opposition for the proposed regulatory action to allow set lines, however many respondents were neutral (Figure 8). Support for an alternative regulatory action, to increase the bag limit from two to five burbot a day using attended lines only, was also greater than opposition; again, many respondents were neutral (Figure 9).

The final contingent behavior question, Question 22, asked respondents the following about possible management change to the Dall River:

> Currently within the Dall River an opportunity exists to keep 5 pike per day with 1 over 30 inches. ADF&G is considering a proposal for catch and release of pike larger than 30 inches, while retaining the 5 pike per day limit. The regulation would preserve the opportunity to catch but not harvest large pike. If the keeping of pike larger than 30 inches was prohibited with the goal of preserving the opportunity to catch and release a large pike, how would this affect your fishing trips?

A large majority of respondents (over 95%) would not alter the number of trips taken to the Dall River under the Question 22 change (Table 18). The overall estimated changes in total trips to the Dall River under the proposed regulatory action ranges from a 5% decrease by Region I and II respondents to a 14% increase by Copper River respondents.

Table 18.-Percentage of respondents who would change their visitation to the Dall River if keeping pike greater than 30 inches was prohibited (Q22).

	Copper River	Nonresidents	Region III	Regions I and II
Percentage of no change in visitation	98%	97%	95%	99%
Predicted percentage change in visitation	14%	11%	6%	-5%
Sample size	97	206	576	194

There appears to be more support than opposition to the proposed regulatory action in the Dall River pike fishery (Figure 10).

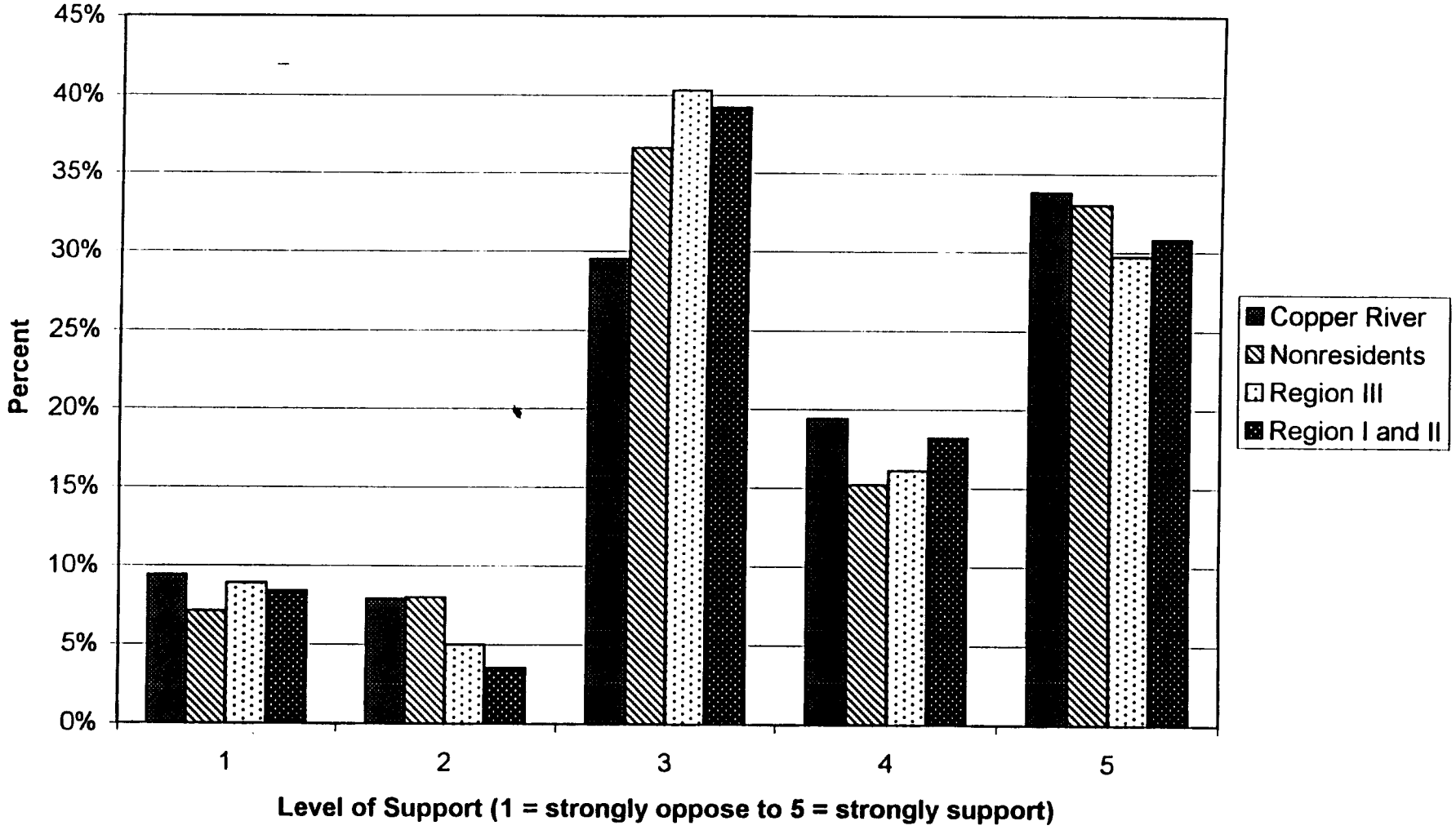

Figure 8.-Level of public support for regulations allowing set lines and a daily bag limit of two burbot in the Copper River, by population.

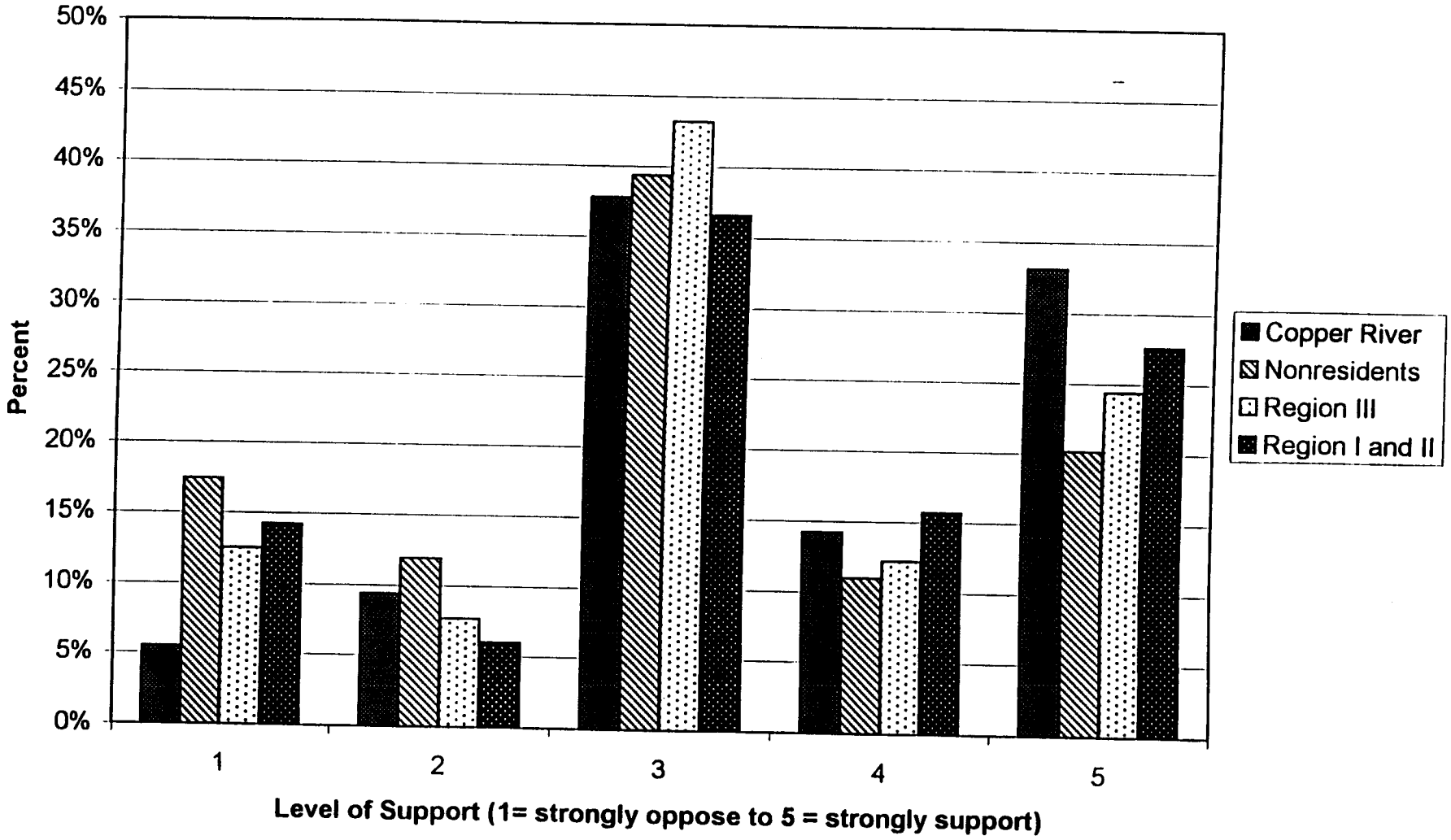

Figure 9.-Level of public support for a regulation allowing a daily bag limit of five burbot using attended lines only in the Copper River, by population.

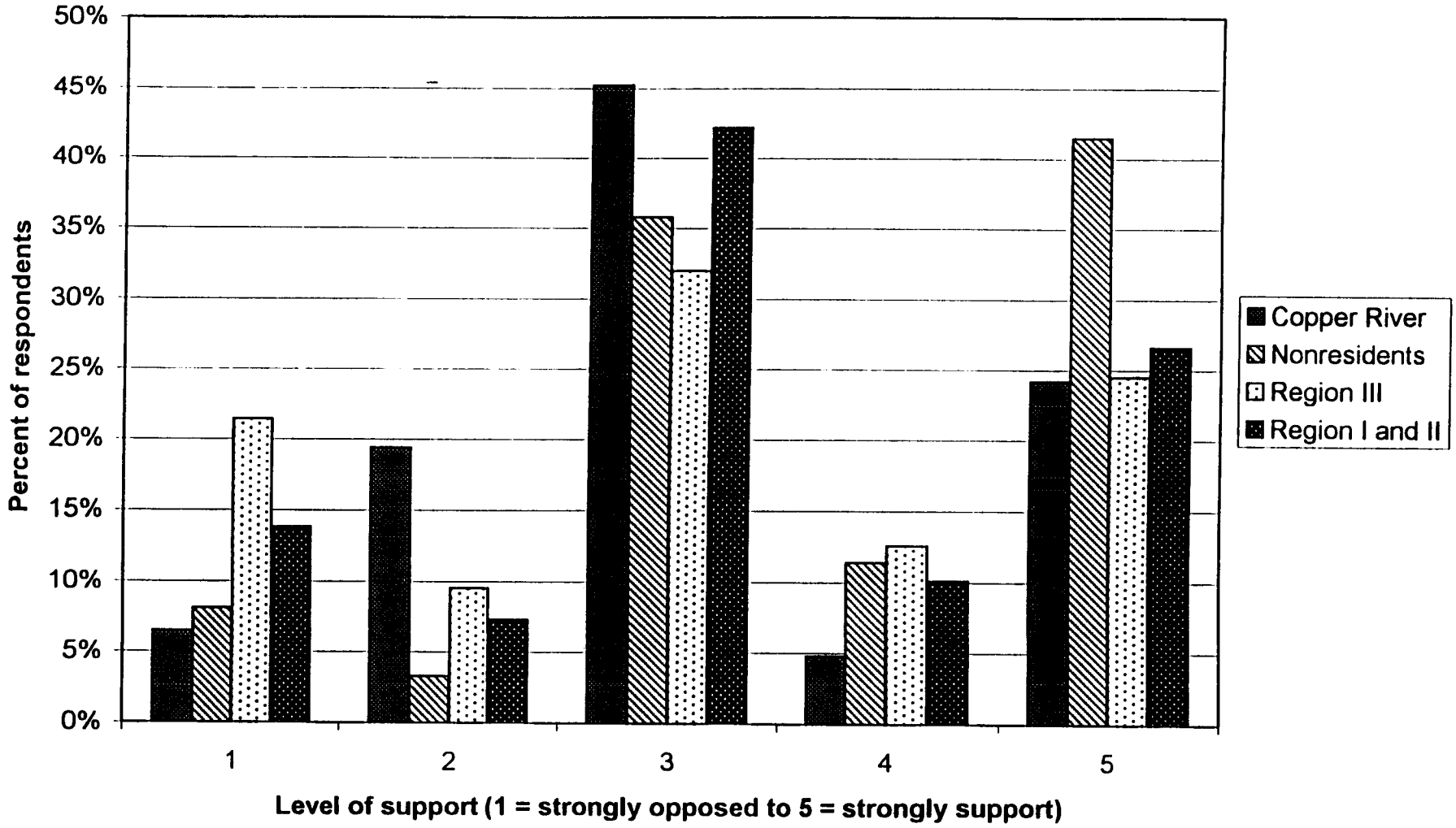

Figure 10.-Level of public support for a regulation prohibiting the keeping of pike longer than 30 inches in the Dall River, by population.

5.0 DISCUSSION

5.1 TOTAL NET ECONOMIC VALUE OF SPORT FISHING AND BENEFIT/COST ANALYSIS

The primary goal of this study was the estimation of public benefits as NEV that anglers of Region III waters place on their burbot, pike and lake trout sport fishing experiences. Few studies to estimate the nonmarket value of sport fishing trips in Alaska have been conducted. In 1986, Jones and Stokes conducted sport fishing economic studies under contract to ADF&G in southeast and southcentral Alaska (Jones and Stokes 1987) Duffield et al. (*2001 a, b, c*) conducted socioeconomic studies of sport fisheries in Region III, Alaska in 1995, 1996 and 1997.

While non-resident anglers have a higher NEV ($371) for trips than do all other Alaska anglers (ranging from $158 to $238), the difference is not statistically significant. Many previous studies of recreational NEV have found nonresident NEVs to be higher than residents' (see for example Duffield and Neher 1994, Duffield et al. 1992, and Duffield 1992). The adjusted mean NEV estimates shown in Table 9 are quite consistent in magnitude to estimates of the value of cold water fishing in Montana. In a study conducted by Duffield et al. (1992) it was estimated that resident float anglers on the Bitterroot River had a NEV of $48 per trip and non-resident float anglers on the same river had a NEV of $236 per trip. In the same study it was estimated that NEV values on the Big Hole River were $87 per trip for resident float anglers and $540 per trip for non-resident float anglers. In 1994, Duffield and Neher estimated that on the Bighorn River of Montana resident anglers had a NEV of $199 per trip and non-resident anglers had NEV of $564 per trip.

In 1998, sport fishing for burbot, pike and lake trout in Region III is estimated to have a total NEV of approximately $4.3 million. The majority of this total (68.1%) is from Region III resident sport fishing trips in Region III. The NEV is influenced by changes in site attributes, substitute fishing sites, and the regional wealth. If these factors remain relatively stable, there is no reason to believe that the NEV has changed. Because total net economic benefits is a product of the NEV and angler trips, variability in angler trips plays an important role in the total net economic benefits of burbot, pike and lake trout sport fishing in Region III.

Objectives in fishery management plans state that, in addition to managing for sustainable harvests and maintaining access, public benefits will outweigh management costs. The problem then was to estimate public benefits in dollar terms, and to calculate the benefit/cost ratio for program evaluation and planning. Benefit/cost analysis is designed to examine and measure factors that influence efficient allocation or resources and to determine the extent to which a given policy produces net economic gains or losses (Herrick et al. 1994). Since enactment of the Magnuson Act, which requires an analysis of proposed actions in economic and social terms, fishery managers are being asked more often to examine the efficiencies and impacts associated with management actions and program decisions. This study is not intended to be a rigorous analysis of the benefit/cost problem, however will provide managers with guidance in their policy-making.

The benefit/cost ratio for burbot, pike and lake trout sport fisheries in Region III was 13.7 in FY99. Obviously, the benefits of Region III's burbot, pike and lake trout research and management program outweigh the costs to a high degree.

5.2 STATED CHANGES IN TRIPS AND OPINIONS RELATED TO PROPOSED REGULATION CHANGES

A second goal of the study was to estimate changes in angler trip frequency resulting from hypothetical implementation of regulation changes. Division goals, created in 1992, are to conserve wild stocks, provide for diverse sport fishing opportunities, and to optimize social and economic benefits from recreational fisheries. The question prompting this component of the research was: can we perform an optimization? There is a need to evaluate management policy for its influence on public welfare. The few management options available to the Sport Fish Division include sportfishing regulations. Changes in bag limit, minimum length, gear and season were examined in this study for their effects on stated trip frequency. Angler trip frequency is one indicator of public welfare, and can be directly tied to changes in total net economic value of a fishery. Predicted changes in angler trips resulting from regulation changes can also be used in the context of a benefit/risk analysis. Benefits (angler trips) accrued or lost as a result of a management change can be weighed against the risks of over- or underutilization of the fishery resource.

Consistently across models, the vast majority of respondents in every population said that the proposed regulation changes would have no effect on the number of fishing trips they would take to fish for burbot, pike and lake trout in the waters specified. Predicted percentage changes in trips are dominated by a minority of respondents indicating they would either increase or decrease their visitation by a significant number of trips (for instance 10 to 20). The small number of responses which drive many of these estimates lead to uncertainty regarding the actual change in fishing trips, however the change would likely be minimal.

The ability of managers to influence anglers' decisions to take fishing trips may be overshadowed by more significant variables, such as weather, the anglers' employment and economic situation, and the anglers' motives for initiating a trip. While the ability to influence trip frequency by a majority of anglers using bag limit, minimum length, gear and season regulation changes does not appear feasible, nevertheless, a fraction of the angling public indicates their visits will be impacted. These anglers, then, influence the marginal net benefits of the sport fisheries facing changes in regulations.

Possible restrictions on length limit for lake trout in Fielding Lake and the pike fishing season at Harding Lake evoked the greatest changes in stated trips in nonresidents and Region I and II residents; while nonresidents indicated they would take less trips to the sites (from 6 to 10.5% less), Alaskans residing outside of Region III said they would take more trips (from 7.7 to 15% more). Region III residents reported that these possible restrictions would have virtually no effect on their fishing trips to either Fielding or Harding lakes. Possible liberalization of burbot regulations in the Copper River drainage evoked the greatest changes in stated trips in Copper River residents and Region I and II residents; Copper River residents indicated a 15% increase in trips to Lake Louise if a daily bag of one burbot was allowed, and Region I and II residents reported a 15% increase in trips to the Copper River if set lines were allowed. Regarding the possible regulation for catch and release of pike over 30 inches on the Dall River, the greatest stated changes in trips came from Copper River residents and nonresidents, who reported increases of 14% and 11%, respectively; this is not surprising given the preference stated in Table 4 for catching and releasing pike.

Our research sought anglers' opinions about possible regulation changes so that managers can consider public attitude in their decision-making. Management policies must be at least minimally supported by anglers or these clients will use the political process to lobby for changes. The policy that brings about positive changes in social and economic benefits from sport fisheries, while still achieving biological objectives, is likely to enjoy public support. Incorporating angler's opinions in decision-making affecting fishery policy is one way to increase angler satisfaction, thereby managing for a social optimum; it also helps to build a supportive client base. Because anglers are diverse in preferences for regulation changes, not all changes are likely to be supported or opposed by a clear majority.

The question type used in this survey (measuring levels of support for changes) provides a fairly robust measure of angler attitudes regarding differing types of regulation changes. There was general support for all proposed regulatory changes, particularly for those at Fielding and Harding lakes.

5.3 Angler Preferences for Fishing Experiences

Measuring angler preferences provides valuable input to the manager on whether current management is aligned with anglers' desires (Pollock et al. 1994). Angler preference is another indicator of social welfare. If managers are informed about preferred fishing experiences, and can plan accordingly, the more likely the angler is to give the fishery a higher satisfaction rating. The higher the angler satisfaction rating, the closer the fishery is to a social optimum. In this study, general questions were asked about alternative fishing experiences. Copper River residents preferred fishing for burbot in ice cover, and fishing for burbot using set lines more than the other populations. The highest ratings across respondent populations were given to harvesting lake trout, and fishing for burbot using a hand held line. Percentages of respondents preferring to harvest pike were similar to those preferring to catch and release pike, with nonresidents and Region III residents making up the bulk of those preferring to practice catch and release pike fishing. Thus, management strategies that preserve harvest opportunities for lake trout and burbot using set lines for Copper River residents, and, opportunities for harvesting lake trout and catching and releasing pike for remainder of Region III residents, are likely to produce the greatest angler satisfaction.

5.4 Angler and Fishing Trip Characteristics

Angler characteristics are useful for understanding angler groups, known as market segments. Market research provides information on resource users, and how to attract those segments with low rates of sport fishing participation. Additionally, angler characteristics can help to explain such variables as fishing motivation.

Residents were somewhat similar in average years fished (22-25 years), number of days fished per year (20-21 days), age (39-40 years), percent male (71-73%), and years of schooling (12-13). There were disparities for income, with the Copper River and remainder of Region III populations having the lowest percentages in the highest income brackets. Nonresidents were the most avid (29 days per year), were older (45 years), and were a higher percentage of males (83%) than residents.

More than 50% of Copper River anglers, and nearly half (45.5%) of the remainder of Region III respondents fishing in Region III waters specifically target burbot, pike and lake trout, indicating the importance of these top trophic predators to Region III's total sport fishing opportunities.

The greatest number of average trips to sport fish for burbot, pike or lake trout were by remainder of Region III residents (1.76 trips) to the Chena River, followed by Copper River residents (1.70 trips to a Copper River drainage water).

Nonresidents gave their fishing experience a higher satisfaction rating than did residents. For Copper River residents and those from the remainder of Region III, only 26.9% and 20.7%, respectively, thought that the overall quality of their burbot, pike and lake trout fishing experience was good to excellent. There are factors influencing the quality of the fishing experience that are not in the ability of the manager to control, such as weather.

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APPENDIX A. THE DICHOTOMOUS CHOICE CONTINGENT VALUATION MODEL

Appendix A. The Dichotomous Choice Contingent Valuation Model.

Dichotomous Choice Contingent Valuation

In dichotomous choice, individuals respond "yes" or "no" as to their willingness to pay (WTP) a specific cash amount for a specified commodity or service. The advantages of this approach, as compared to open-ended or bidding game questions formats, have been discussed elsewhere (Boyle and Bishop 1987, Bowker and Stoll 1988). The disadvantage of this approach is that analysis and interpretation are relatively complex, since WTP is inferred rather than observed.

Hanemann (1984) has investigated the theoretical motivation for dichotomous choice models. He provides both a utility difference approach and an alternative derivation based on the relationship of the individual's unobserved true valuation compared to the offered threshold sum (see also Cameron 1988). In the latter, it is assumed that if each individual has a true WTP, then the individual will respond positively to a given bid only if his WTP is greater than the bid. For example, suppose that an individual is confronted with an offered price (t) for access to a given resource or recreational site. The probability of accepting this offer $\pi(t)$, given the individual's true (unobserved) valuation WTP is then:

$$\pi(t) = \Pr(WTP > t) = 1\text{-}F(t) \tag{1}$$

where F is a cumulative distribution function of the WTP values in the population. In the logit model F(.) is the c.d.f. of a logistic variate and in the probit model F(.) is the c.d.f. of a normal variate. The specification of this model can be briefly illustrated for the case where the WTP values are assumed to have a logistic distribution in the population of interest conditional on the value of covariates. A statistical model is developed that relates the probability of a "yes" response to explanatory variables such as the bid amount, preferences, income, and other standard demand shifter type variables. The specific model is:

$$\pi(t, \tilde{\chi}) = [1 + \exp(-\alpha t - \tilde{\gamma}' \tilde{\chi})]^{-1} \tag{2}$$

where $\pi(t, \tilde{\chi})$ is the probability that an individual with covariate vector $\tilde{\chi}$ is willing to pay the bid amount t. The parameters to be estimated are α and $\tilde{\gamma}'$ (the constant term is included in $\tilde{\chi}$). The equation to be estimated can be derived as:

$$L = \ln[p/(1-p)] = \alpha t + \tilde{\gamma}' \tilde{\chi} \tag{3}$$

where L is the "logit" or log of the odds of a "yes" and p are observed response proportions. In application, the logit and probit models are so similar that it is difficult to justify one over the other on the basis of goodness of fit. We choose to work with the logistic specification here because the probit model does not lead to closed-form derivatives. Maximum likelihood estimates of the parameters in equation 3 can be obtained with a conventional logistic regression program. We have utilized SAS (SAS Institute 1988).

Hanemann (1984) has shown that the linear specification in equation 3 is consistent with utility maximization based on his utility difference motivation. However Cameron (1988) argues that from the standpoint of the threshold motivation, any of a variety of WTP distributions are

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theoretically plausible. This implies that the choice of functional form for F(.) be based on empirical considerations. Some investigators (e.g., Boyle and Bishop 1987, Bowker and Stoll 1988) have found that WTP distributions are skewed to the right. In these cases, a better estimate may be obtained with a log-logistic model (replacing t in equation 3 with log t).

Because we estimate the distribution of WTP values with dichotomous choice contingent valuation, the question remains as to which parameter of the distribution to use. A variety of welfare measures for dichotomous choice models have been proposed in the literature including a truncated mean (Bishop and Heberlein 1992), the overall mean, and percentiles of the distribution, including the median (Hanemann 1984, 1989). In all cases the distribution of F is assumed to be continuous and nonnegative. As developed below, we utilize the truncated mean and several different percentiles in this application. The truncated mean is defined by:

$$M_T = \int_0^T [1 - F(\chi)]dx \qquad (4)$$

where f(x) is the probability density function of the distribution. The truncated mean has the interpretation of being a mean, but with all values above the truncation point, T, set equal to T. Accordingly, the truncated mean is more conservative than the overall mean, but has a clear interpretation for purposes of aggregation. T is generally set equal to the highest bid offer; as a result the integrand in equation 4 is within the range of observed data. Previous applications indicate that the truncated mean is also much more precisely estimated than the overall mean (Patterson and Duffield 1991).

The p^{th} quantile (100 p^{th} percentile) of the distribution is given by $F^{-1}(p)$. For the log-logistic model, the p^{th} quantile is given by:

$$\eta_p(\overline{\chi}) = \exp(-\tilde{\gamma}'\overline{\chi}/\alpha)[p/(1-P)]^{-1/\alpha} \qquad (5)$$

Of course when p = 0.50 equation 5 provides an estimate of the median. For the case where WTP values are skewed, as demonstrated in previous studies (e.g. Bowker and Stoll 1988), the median and the truncated mean may differ considerably. As Hanemann (1989) has discussed, choice of the welfare measure is a value judgment in that there is an implicit weighing of whose values are to count.

Methods have recently been developed to identify the precision of dichotomous choice based welfare estimates. The procedures utilized in this study is bootstrapping (Efron 1982). Details of the procedure for applying this method to logistic models are described elsewhere (Park et al. 1989; Duffield and Patterson 1991).

APPENDIX B. CONTINGENT BEHAVIOR METHODS

Appendix B.-Contingent Behavior Model.

Contingent behavior methods have in common the use of survey questions in which respondents are asked to predict their future behavior contingent on the circumstances described in a given question. There is a very large scientific literature that fits within this general definition, including the use of polls to predict voting behavior and market research (and U.S. Census efforts) to predict consumer purchases.

In the context of resource economics, contingent behavior methods utilize survey data in which respondents are asked how they would change the level of some activity in response to some change in services, such as in the level of an environmental amenity. If the activity can be interpreted in the context of a behavioral model, it may be possible to develop a measure of willingness-to-pay. Contingent behavior is mentioned in many of the texts on economic valuation including Mitchell and Carson (1989), Kopp and Smith (1993), and Freeman (1993). (Freeman refers to the survey questions at issue as contingent activity questions.) Nonetheless, the economic literature on contingent behavior as a specific valuation tool is fairly limited. In the remainder of this brief literature review, the economic literature on contingent behavior and valuation is discussed first, followed by an overview of the much larger related literature on voting behavior and buying intentions. The latter literature is equally relevant to the specific contingent behavior questions used in the current study related to fishery management issues in Alaska. The contingent behavior from the current study is used to predict behavior and is not used to develop the valuation models.

Contingent behavior data has been used in a variety of ways in the resource economics literature, usually in conjunction with travel cost or contingent valuation models. Some economic studies have used contingent behavior questions to measure changes in visitation rates and to derive demand curve shifts. McConnell (1986) asked respondents how visits to local beaches would change if pollution of New Bedford Harbor, Massachusetts by polychlorinated byphenyls (PCBs) could be eliminated. Thayer (1981) asked recreationists how their choice of sites to visit would be altered by construction of a geothermal plant in the vicinity of the recreation sites. Narayanan (1986) uses a conceptually similar approach to estimate values associated with instream flow in the context of a travel cost demand model. Duffield et al. (1990) also used contingent behavior to model changes in visitation rates in response to changes in instream flow (but with baseline values derived from a contingent valuation model). Other studies have used essentially contingent behavior responses (for example, site choice in the face of varying travel costs and site attributes) in the context of a discrete choice model derived from the contingent valuation literature. For example, Morton et al. (1995) develop a contingent behavior analysis of recreational hunting in northwest Saskatchewan. Another approach is to combine actual and contingent behavior data in recreation or other resource demand models (Cameron et al. 1996; Cooper 1997).

To our knowledge there has not been work done on validation of contingent behavior valuation models. One comparison of predicted and actual recreational visitation has been undertaken by the defendants in a natural resource damages lawsuit. Cicchetti et al. (1991) resurveyed the

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respondents to the government study (McConnell et al. 1986) at New Bedford Harbor after 12 months had passed and concluded that the first study overestimated actual beach usage by 30%. It is not known what rebuttal of this finding was made by the plaintiffs.

While the literature on using contingent behavior models to measure valuation changes is fairly limited, there is a very large and varied literature on the basic problem of using surveys to predict future behavior. Two of the largest areas of application are voting behavior and consumer buying intentions.

With regard to voting, the accuracy the polls used to predict the election outcomes is closely scrutinized. In general, surveys of voters are fairly good predictors of actual voting patterns. For example, Mitofsky (1996) compared predictions and actuals for U.S. presidential elections from 1956-1996 and found that the percentage difference between actual and predicted for the winner was only 1.9%. Of course some years are better than others, and the difference for 1948 (4.9%) was enough to create the infamous wrong prediction for the Truman-Dewey race. However, an interesting result from the voting literature is the overestimation of voter turnout based on surveys compared to actual voter records. This is a well-known result that has been reported in many studies over the years. For example, Traugot and Katosh (1979) noted that the Center for Population Studies 1976 national elections survey estimated 72% voter turnout, the U.S. Census Bureau estimated 59% and the actual based on voter records was 54%. Belli (1997) found survey estimates of voter participation in the 1996 Oregon vote-by-mail special senate election overestimated voter turnout by 12% to 20% (depending on the specific survey questions) compared to actual. These findings are not specifically for a contingent behavior prediction per se but illustrate the problems inherent in collecting and interpreting survey data having to do with behavior.

The literature on the accuracy of polls to predict voter turnout is directly relevant for contingent valuation models that use a referendum question format. Carson et al. (1986) conducted a validation study of this type by conducting a CV-like study of how California voters intended to vote on a referendum proposition (for a sewage treatment plan) with the actual voting behavior in a subsequent election. As summarized in Mitchell and Carson (1989), the study developed a demand function that predicted a passing vote of 70% to 75% at the level of the actual project cost. The actual vote in favor was 73%, well within the 95% confidence interval for the predicted result. This finding of predictable referendum voting is replicated in other studies of referendum voting behavior conducted by political scientists (Magleby 1984).

The other very large literature related to contingent behavior are the fields of market research and buying intentions. The latter is of considerable interest for macro-economic forecasts of future business activity and economic growth. A good example from this literature are studies by Theil and Kosobud (1968) and Ferber and Piskie (1965) that both used subsamples from large data sets developed by the U.S. Bureau of the Census in its Current Population Survey of 36,500 households in the late 1950s and into the mid-1960s. Households were asked about their intentions to buy consumer durables (such as cars), household services, education and vacations.

-continued-

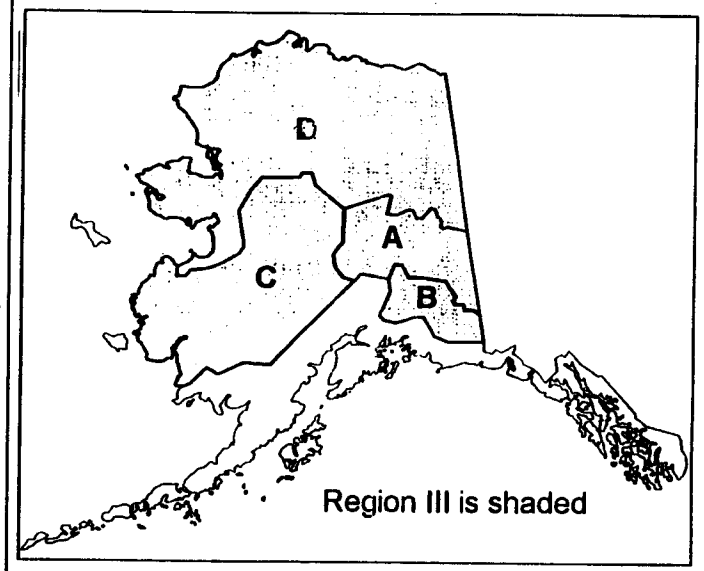
The same households were resampled 12 months later so that predicted and actual behavior could be compared. A basic finding from this literature is that generally buying intentions overstate actual future purchases. This is not surprising since the response categories include not only "yes-probably" and "yes-definitely" but also "maybe-depends on…" and "maybe-other reason." For example, for a subsample of respondents reported in Ferber and Piskie, for those who stated that the probability of a future purchase for a given commodity was from 60% to 100%, the actual percentage who purchased durables (such as cars) was 33% of those with planned purchases. The percentage was much higher for house services, vacation and education purchase decisions (60%, 62% and 67% respectively). The latter categories indicate some level of overestimating purchase, but it is not clear how much since the distribution of probability within the 60% to 100% range is not provided. For example, if almost all respondents were clustered at the 60% level, there is no or little overstatement.

To conclude, the economics literature shows that contingent behavior data is used by resource economists for a variety of purposes, including resource valuation. The broader scientific literature including polling and market research shows that survey questions can fairly accurately predict at least some kinds of future behavior – for example, with regard to voting choices. The results from the buying intentions surveys having to do with decisions to take vacations are most like the kinds of questions asked of recreationists regarding trip and site choice. A general finding from this literature is that respondents tend to overstate the likelihood of an actual purchase. However, the extent of this overstatement varies considerably being quite large for consumer durables and smaller for things like vacation and education purchases. The literature shows that overstatement can be reduced by using question formats that allow the possibility of excluding responses that are less certain or indicate a lower probability of future purchase.

APPENDIX C. SURVEY INSTRUMENT, CONTACT LETTER, REMINDER POSTCARD AND REMINDER LETTER

Region III

Angler Survey



Alaska Department of Fish and Game
Division of Sport Fish

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The purpose of this survey is to obtain information about angler use of burbot, pike and lake trout in Region III and your preference for management options. The map on the cover of this survey shows the different areas within this region. The map on the back of the letter enclosed with this survey shows the location of the specific waters we are asking about. We appreciate your participation in this survey.

Section I. General questions about your sport fishing.

1. How many years have you been sport fishing? ____ years
2. About how many days per year do you spend sport fishing for all species? _____days
3. Do you take fishing trips specifically to try to catch burbot, pike or lake trout? ____ yes ____ no **(If no, skip to question 5).**
4. Please rate your preferences (circle the number) from least preferred (1) to most preferred (5) for each type of fishing listed below.

Fishing Experience	Preference				
	Least Preferred				Most Preferred
Fishing for burbot with:					
Baited set line, ice cover	1	2	3	4	5
Baited set line, open water	1	2	3	4	5
Hand held line (rod & reel), ice cover	1	2	3	4	5
Hand held line (rod & reel), open water	1	2	3	4	5
Catching and releasing pike	1	2	3	4	5
Catching and keeping pike	1	2	3	4	5
Catching and releasing lake trout	1	2	3	4	5
Catching and keeping lake trout	1	2	3	4	5

5. Did you sport fish in 1998? _____**yes (continue with question 6)**
_____**no (please skip to Section III)**

6. Please check yes or no for each site at which you sport fished for pike, burbot or lake trout in 1998 and indicate how many fishing trips you made from home to each site in 1998 (See map on the back of the enclosed letter). If you fished for pike, burbot or lake trout in other Region III waters that are not listed below, please write in the name of the water you fished most frequently in 1998.

Fishing Site	Fished in 1998		Number of fishing trips
	YES	NO	1998
Area A. Tanana River Waters			
Chena River	___	___	___
Tanana River	___	___	___
Minto Flats/Chatanika River	___	___	___
Harding Lake	___	___	___
Fielding Lake	___	___	___
Tangle Lakes	___	___	___
George Lake	___	___	___
Other Area A water (write in)	___	___	___
_____			
Area B. Copper River Area			
Paxson Lake	___	___	___
Summit Lake	___	___	___
Lake Louise	___	___	___
Cross Wind Lake	___	___	___
Other Area B water (write in)	___	___	___
_____			
Area C. Kuskokwim/Yukon			
Kaiyuh Flats	___	___	___
Nowitna River	___	___	___
Dall River	___	___	___
Holitna River	___	___	___
Koyukuk River	___	___	___
Other Area C water (write in)	___	___	___
_____			
Area D. Remainder of Region III (Brooks Range, Northwest, Seward Peninsula)	___	___	___

If you did not fish for pike, burbot or lake trout in Region III in 1998, please skip to Section III

If you did fish for pike, burbot or lake trout in Region III in 1998, please continue with question 7

-continued-

Section II. In this section, we would like to ask you about your most recent pike, burbot or lake trout fishing trip to one of the sites or areas during 1998.

7. Please look back at the sites listed in Question 6 and circle the name of the site to which you took your most recent 1998 fishing trip.

Please write the name of the water or area that you circled in Question 6 on the following line _____

The rest of the questions in this section are about this most recent fishing trip to the site or area you indicated above.

8. What was the approximate date of your most recent fishing trip to this site?

_____ _____ _____
Month Day Year

9. Please indicate which of the following best describes the importance of fishing on this trip (check one).

❑ Fishing this site was the main reason I took this trip.

❑ Fishing this site was one of the main reasons I took this trip.

❑ Fishing this site was not one of the main reasons I took this trip.

10. How many days did you fish at this site on your most recent trip?
_____ days

11. On this trip, for what species were you primarily fishing?

❑ Burbot ❑ Pike ❑ Lake Trout ❑ Other_____ ❑ No preference

12. On this most recent trip, how many
burbot did you catch? _____ keep? _____
pike did you catch? _____ keep? _____
lake trout did you catch? _____ keep? _____

13. For this site, would you characterize your fishing experience on your most recent trip as: (Check one)

❑ Poor ❑ Below average ❑ Average ❑ Above average ❑ Excellent

14. How many people were in your group on this particular trip?
_____ Number of people

15. How much did you personally spend in dollars on this trip including the following (if you can't recall the exact amount, please give your best estimate):

Auto, air, or other travel expenses $_____
Food & beverages $_____
Lodging or camping fees $_____
Equipment purchased just for this trip $_____
Equipment rentals and Other trip expenses $_____
Total amount you spent on this trip $_____
Number of people (including yourself) covered by these expenses _____

16. Was this trip worth more to you than what you actually spent?

☐ Yes ☐ No

17. If YES, would you still have made the trip if your share of the expenses had been **$50.00** more?

☐ Yes ☐ No

If NO, what is the main reason you would not take this trip under these circumstances?

_____
_____

Section III. Regardless of whether you fished for pike, burbot or lake trout in 1998 or not, we would like to ask your preferences for possible Alaska Fish & Game fishing regulations.

Group I. Options for pike or lake trout in the Tanana River Area (Area A)

I would not fish for pike or lake trout in the Tanana River Area regardless of regulation changes. _____ Agree (Please skip to Group II)
_____ Disagree (please continue with the next question)

How many fishing trips for any species did you take to the Tanana River Area in 1998?_____trips

18. Currently for lake trout at **Fielding Lake** only 1 fish 22 inches in length or greater may be harvested per day. Due to conservation concerns, ADF&G is considering taking one of the following actions to limit harvest yet preserve fishing opportunity: **(A) increasing the minimum length limit** or **(B) closing the fishery in September during fish spawning.**

(A) If the minimum length limit for harvest was increased to 24 inches how would this change affect your fishing trips?

____ I would not change the number of trips taken to Fielding Lake.
____ I would take fewer fishing trips. → How many less? _____
____ I would take more trips. → How many more? _____

Please indicate your level of support for this management action from
1=strongly oppose to 5=strongly support (circle one) 1 2 3 4 5

(B) If the fishery was closed during September to protect spawning fish:
Please indicate your level of support for this management action from
1=strongly oppose to 5=strongly support (circle one) 1 2 3 4 5

19. Currently for pike at **Harding Lake** there is a daily bag limit of 5 fish over 26 inches in length or greater which may be harvested from June 1 to March 31. Due to conservation concerns, ADF&G is considering taking one of the following actions: **(A) reduction in the season length (B) an increase in the minimum length limit or (C) reduction in daily bag from 5 to 2.**

(A) If the opening day was changed from June 1 to June 30, how would this change affect your fishing trips?

____ I would not change the number of trips taken to Harding Lake.
____ I would take fewer fishing trips. → How many less? _____
____ I would take more trips. → How many more? _____

Please indicate your level of support for this management action from
1=strongly oppose to 5=strongly support (circle one) 1 2 3 4 5

(B) If the minimum length limit was increased from 26 inches to 30 inches:
Please indicate your level of support for this management action from
1=strongly oppose to 5=strongly support (circle one) 1 2 3 4 5

(C) If the daily bag was reduced from 5 to 2 fish:
Please indicate your level of support for this management action from
1=strongly oppose to 5=strongly support (circle one) 1 2 3 4 5

-continued-

Group III. Options for pike in the Kuskokwim/Yukon Area (Area C).

I would not fish for pike in the Kuskokwim/Yukon area regardless of regulation changes. ____ Agree **(Please skip to Question 23)**
____ Disagree **(Please continue with the next question)**

How many fishing trips for any species did you take to the Kuskokwim/Yukon Area in 1998? _____ trips

22. Currently within the **Dall River** an opportunity exists to keep 5 pike per day with 1 over 30 inches. ADF&G is considering a proposal for catch and release of pike larger than 30 inches, while retaining the 5 pike per day limit. The regulation would preserve the opportunity to catch but not harvest large pike.

If the keeping of pike larger than 30 inches was prohibited with the goal of preserving the opportunity to catch and release a large pike, how would this change affect your fishing trips?

____ I would not change my number of trips to the Dall River.
____ I would take fewer fishing trips. → How many less? _____
____ I would take more trips. → How many more? _____

Please indicate your level of support for eliminating the harvest of pike larger than 30 inches from

1=strongly oppose to 5=strongly support (circle one) 1 2 3 4 5

23. If you indicated that you would take more fishing trips under any of the regulation changes listed in questions 18 - 22, is this increase in trips because:

❑ You think you would take more fishing trips during the year.
❑ You would take fewer trips to other fisheries so that you could fish more often for burbot, pike or lake trout in Region III.

Section IV. These last few questions will help us to compare respondents to the general population.

24. Where do you live? City: _____ State:_____
25. What is your age? _____ years
26. Are you: ❑ male ❑ female
27. How many years of formal schooling (elementary, high school, college, voc. tech) have you attended? _____ years
28. Please circle your household's income before taxes for 1998:

1. Less than $20,000
2. $20,000 to $39,999
3. $40,000 to $69,999
4. $70,000 to $79,999
5. $80,000 to $124,999
6. Over $125,000

-continued-

Group II. Options for burbot in the Copper River Area (Area B).

I would not fish for burbot in the Copper River Area regardless of regulation changes. ____ Agree **(Please skip to Group III)**
____ Disagree **(Please continue with the next question)**

How many fishing trips for any species did you take to the Copper River Area in 1998? ____trips

20. **Lake Louise** has been closed to the keeping of burbot since 1990 due to low population levels. ADF&G will reopen this fishery to minimal harvest when the population of burbot has recovered; use of set lines will remain prohibited.

If a bag limit of 1 burbot per day were allowed, how would this change affect your fishing trips?

___ I would not change the number of trips taken to Lake Louise.
___ I would take fewer fishing trips. → How many less? _____
___ I would take more trips. → How many more? _____

Please indicate your level of support for opening the fishery and allowing a 1 burbot bag limit from

1=strongly oppose to 5=strongly support (circle one) 1 2 3 4 5

21. To increase the number of people fishing in the **Copper River** sport fishery for burbot, ADF&G is considering taking one of the following actions: **(A) increase the bag limit** from 2 to 5 burbot per day, or **(B) allow sport fishing for burbot using set lines with a bag limit of 2 burbot per day.**

(A) If set lines were allowed in the sport fishery, with a bag limit of 2 burbot per day and open all year how would this change affect your fishing trips?

___ I would not change the number of trips taken to the Copper River Area.
___ I would take fewer fishing trips. → How many less? _____
___ I would take more trips. → How many more? _____

Please indicate your level of support for this management action from

1=strongly oppose to 5=strongly support (circle one) 1 2 3 4 5

(B) If a bag limit was increased from 2 to 5 fish, with attended lines only, and open all year:

Please indicate your level of support for this management action from

1=strongly oppose to 5=strongly support (circle one) 1 2 3 4 5

Appendix C2.-Text of Contact Letter Accompanying Initial Survey Mailing and map.

Dear Angler,

The Alaska Department of Fish and Game is conducting research on sport and personal use fishing in Region III of Alaska. Our goal is to improve the quality of fishing. In this study we are interested in gathering information on all open water fishing and particularly on salmon fishing in the region. To achieve our goal, we need to know how anglers use these fisheries.

Your name has been randomly selected from a list of Alaska sport fish license holders. In order for the survey to be comprehensive and accurate, it is important that we hear from everyone. We would appreciate it very much if you would complete the attached questionnaire and return it in the enclosed postage-paid envelope. We have purposely kept the survey brief so that it will take only a few minutes of your time.

If you are unfamiliar with the area or waters mentioned in this survey, please refer to the regional map on the cover of the survey booklet and the detailed area map on the back of this letter.

All survey responses are completely confidential. The surveys are numbered only to allow us to keep track of who has responded. If you have any questions about the survey, please feel free to call me at 907-459-7296.

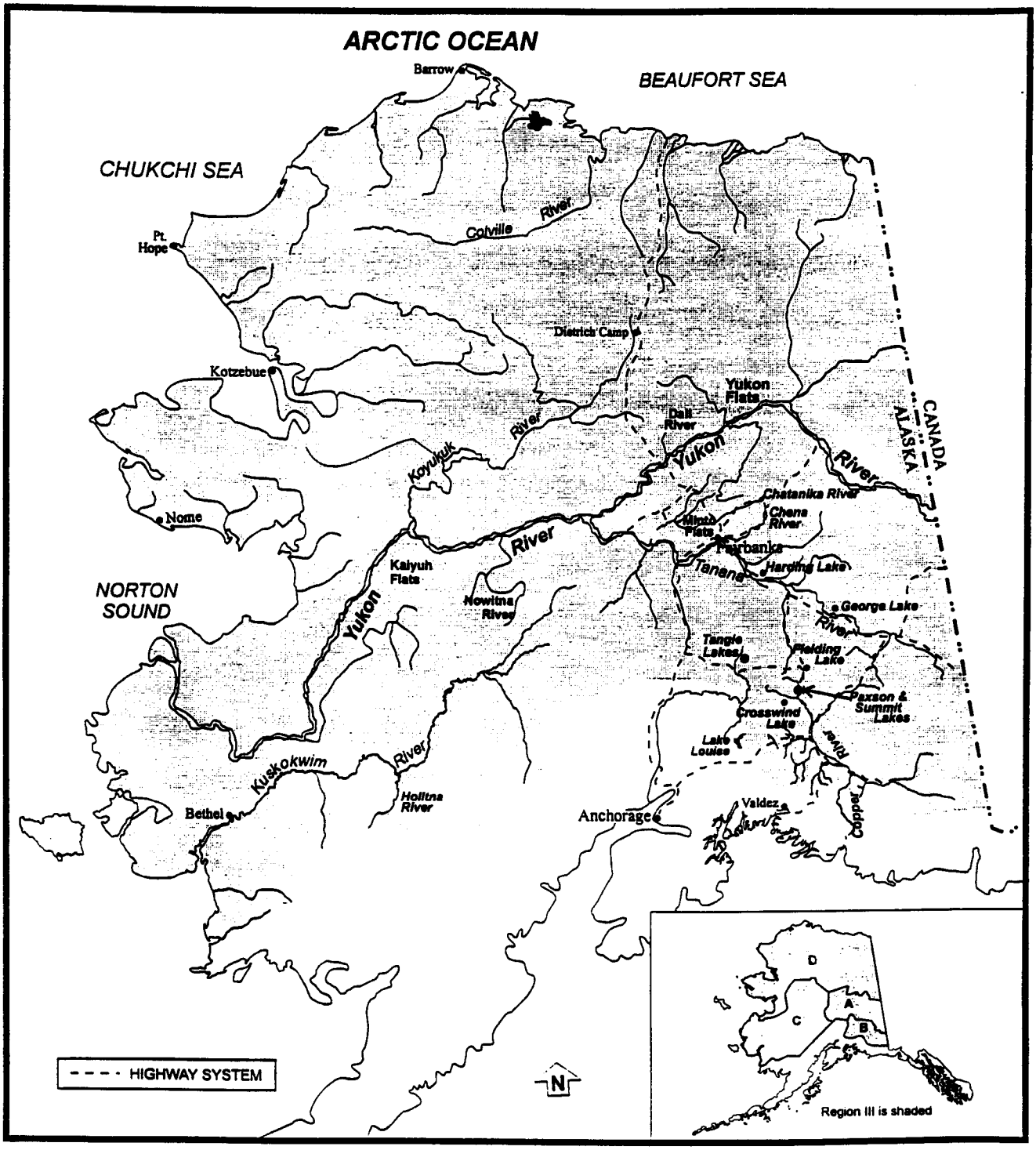
Thank you very much for your help.

Sincerely,

M. Merritt, Ph.D.
Regional Research Supervisor

-continued-

Appendix C2.-Page 2 of 2.



Appendix C3.-Text of Reminder Postcard.

Dear Angler,

Two weeks ago, we sent you a survey concerning sport Fishing in Region III of Alaska. If you have not returned the survey, we ask that you do so as soon as possible. If you have already returned the survey, thanks very much for your help!

M. Merritt, Ph.D.
ADF&G/Sport Fish Division
1300 College Road, Fairbanks, AK 99701

Appendix C4.-Text of Reminder Letter.

Dear Angler,

A few weeks ago we sent you a survey concerning sport and personal use salmon fishing in Region III of Alaska (gray shaded area of map on back). Our goal is to improve the quality of fishing. In this study we are interested in gathering information on all open water fishing and particularly on salmon fishing in the region. To achieve our goal, we need to know how anglers use these fisheries. Won't you please take a few minutes to complete the survey and return it to us in the enclosed postage paid envelope?

Your name has been randomly selected from a list of Alaska sport fish license holders. In order for the survey to be comprehensive and accurate, it is important that we hear from everyone.

If you are unfamiliar with the area or waters mentioned in this survey, please refer to the regional map on the cover of the survey booklet and the detailed area map on the back of this letter.

All survey responses are completely confidential. The surveys are numbered only to allow us to keep track of who has responded. If you have any questions about the survey, please feel free to call me at 907-459-7296.

Thank you very much for your help.

Sincerely,

M. Merritt, Ph.D.
Regional Research Supervisor

APPENDIX D. ESTIMATED ANGLER-TRIPS

Appendix D1.-Estimated angler-trips per household-trip from the statewide harvest survey.

This documents the equations used for estimates of angler-trips per household-trip along with estimates for angler-trips for various fishery groupings and poststrata from information from the statewide harvest survey (SWHS) for 1996.

The estimated number of angler-trips expended in a fishery by a poststrata was approximated by (where subscripts denoting fishery or poststrata are dropped for simplicity):

$$\hat{A} \approx \hat{T}\overline{apht}\,; \tag{1}$$

where:

$\hat{A}$ = the estimated number of angler-trips;

$\hat{T}$ = the estimated number of household-trips as provided by the SWHS;

$\overline{apht}$ = the estimated average number of angler-trips per household-trips, which was approximated as outlined in the procedures below.

The variance for the estimated number of angler-trips was obtained utilizing Goodman's (1960) approach:

$$\hat{V}\left[\hat{A}\right] \approx \hat{T}^2\hat{V}\left[\overline{apht}\right] + \overline{apht}^2\hat{V}\left[\hat{T}\right] - \hat{V}\left[\overline{apht}\right]\hat{V}\left[\hat{T}\right]; \tag{2}$$

where:

$\hat{V}\left[\hat{T}\right]$ = the variance of the estimated number of household-trips as provided by the SWHS, by squaring the standard errors as obtained from the bootstrap estimation procedure;

$\hat{V}\left[\overline{apht}\right]$ = the variance of the estimated average number of angler-trips per household-trips, which was calculated as outlined in the procedures outlined below.

The estimated ratio of angler-trips to household-trips ($\overline{apht}$) along with its variance (and standard errors) was calculated as a weighted average of the ratio estimated from two categories of households responding to the SWHS. Households with only one angler reporting fishing at a fishery or reported only one household-trip to the fishery were called "Case 1" households. The number of angler-trips for Case 1 households could be logically derived from the data reported by each household, as follows (with subscripts denoting fishery and poststrata dropped for simplicity):

$$a_{1i} = \max\left(m_{1i}, t_{1i}\right); \tag{3}$$

-continued-

where:

a_{1i} = the derived number of angler-trips expended in the fishery by the i^{th} household for Case 1 households;

m_{1i} = the number of anglers in the i^{th} household for Case 1 households; and

t_{1i} = the number of household-trips expended in the fishery by the i^{th} household for Case 1 households.

These derived values of angler-trips were then used to calculate the ratio of angler-trips per household-trips for Case 1 households:

$$\overline{apht}_1 = \frac{\sum_{i=1}^{n_1} a_{1i}}{\sum_{i=1}^{n_1} t_{1i}}; \quad (4)$$

where:

n_1 = the number of Case 1 households participating in the fishery.

A ratio estimation approach was used for approximating the ratio for non-Case 1 households (termed Case 2 households), by using information from both Case 1 and Case 2 households. The approximation involved using the ratio between the derived angler-trips to number of angler-days fished for Case 1 households to "expand" the ratio between angler-days fished to household-trips for Case 2 households. This calculation is assumed to be approximate since we're using the characteristics of Case 1 households to "model" Case 2 households, which may not be entirely accurate. The calculation is as follows:

$$\overline{apht}_2 \approx \hat{w}_1 \hat{r}_2; \quad (5)$$

where:

$$\hat{w}_1 = \frac{\sum_{i=1}^{n_1} a_{1i}}{\sum_{i=1}^{n_1} d_{1i}}; \quad (6)$$

-continued-

$$\hat{r}_2 = \frac{\sum_{i=1}^{n_2} d_{2i}}{\sum_{i=1}^{n_2} t_{2i}}; \tag{7}$$

with:

d_{1i} = the number of angler-days expended in the fishery by the i^{th} household for Case 1 households;

d_{2i} = the number of angler-days expended in the fishery by the i^{th} household for Case 2 households; and

n_2 = the number of Case 2 households participating in the fishery.

The combined estimate of $\overline{apht}$ was calculated as a weighted average:

$$\overline{apht} \approx \left(\frac{n_1}{n}\right)\overline{apht}_1 + \left(\frac{n_2}{n}\right)\overline{apht}_2; \tag{8}$$

where:

$$n = n_1 + n_2. \tag{9}$$

The variance of $\overline{apht}$ was calculated by expansion (using the component weights) as:

$$\hat{V}\left[\overline{apht}\right] \approx \left(\frac{n_1}{n}\right)^2 \hat{V}\left[\overline{apht}_1\right] + \left(\frac{n_2}{n}\right)^2 \hat{V}\left[\overline{apht}_2\right]; \tag{10}$$

where the variance of $\overline{apht}_1$ was calculated using the procedure outlined by Thompson (1992, pages 61 and 62):

$$\hat{V}\left[\overline{apht}_1\right] = \frac{\sum_{i=1}^{n_1}\left(a_{1i} - t_{1i}\overline{apht}_1\right)^2}{\bar{t}_1^2 n_1 (n_1 - 1)}; \tag{11}$$

-continued-

with:

$$\bar{t}_1 = \frac{\sum_{i=1}^{n_1} t_{1i}}{n_1}; \tag{12}$$

the variance of $\overline{apht}_2$ was calculated using the procedure of Goodman (1960):

$$\hat{V}\left[\overline{apht}_2\right] \approx \hat{r}_2^2 \hat{V}[\hat{w}_1] + \hat{w}_1^2 \hat{V}[\hat{r}_2] - \hat{V}[\hat{w}_1]\hat{V}[\hat{r}_2]; \tag{13}$$

where both variances for $\hat{w}_1$ and $\hat{r}_2$ were calculated by the procedure outlined by Thompson (1992, pages 61 and 62):

$$\hat{V}[\hat{w}_1] = \frac{\sum_{i=1}^{n_1} (a_{1i} - d_{1i}\hat{w}_1)^2}{\bar{d}_1^2 n_1 (n_1 - 1)}; \tag{14}$$

$$\hat{V}[\hat{r}_2] = \frac{\sum_{i=1}^{n_2} (d_{2i} - t_{2i}\hat{r}_2)^2}{\bar{t}_2^2 n_2 (n_2 - 1)}; \tag{15}$$

in which:

$$\bar{d}_1 = \frac{\sum_{i=1}^{n_1} d_{1i}}{n_1}; \text{ and} \tag{16}$$

$$\bar{t}_2 = \frac{\sum_{i=1}^{n_2} t_{2i}}{n_2}. \tag{17}$$

Standard errors were simply the square root of the variance estimates.

Appendix D2.-Estimated angler-trips per household-trip and estimated angler-trips for four populations of sport fish license holders from statewide harvest survey data for Region III, 1998.

Population	Estimated Household Trips	SE of Household Trips	Estimated Angler-Trips/ hh-Trips	SE Angler-trips/ hh-Trips	Estimated Angler Trips	SE of Angler Trips
Copper River Residents	5,465	648	1.10347	0.03032	6,030	345
Nonresidents	23,041	1,238	1.18288	0.02286	27,255	943
Regions I and II Residents	18,090	1,098	1.26389	0.02633	22,864	973
Remainder of Region III Residents	94,226	4,820	1.14859	0.01337	108,227	3,001

Appendix D3.-Number of households with one angler or one household trip (Case 1) and number of households with multiple anglers or trips (Case 2) from the statewide harvest survey, used in estimating angler-trips.

Population	Sample Size		
	Case 1	Case 2	Total
Copper River Residents	114	48	162
Nonresidents	1,032	130	1,162
Regions I and II Residents	671	148	819
Remainder of Region III Residents	1,769	775	2,544

APPENDIX E

Appendix E.-Summary of opinions in letters or comments by respondents to the survey for 1998 use and valuation estimates, with a focus on burbot, pike and lake trout.

Topic	Population/Residence	Comments
Regulations	Remainder of Region III Fairbanks	I recommend that artificial hooks be required to be only one, because smaller pike have a tendency to damage their gills. If we want a healthy population, we need to make sure that when smaller pike hit a lure they do not come off with a fatal injury.
	Fairbanks	I recommend that George Lake be closed for 2 years to pike fishing because heavy sport fishing seems to be removing larger pike, which may be needed to keep the pike population in stable balance.
	Copper River area	I cannot understand the blanket regulation for "no unattended sets" for burbot on lakes that are not road accessible and receive almost no fishing pressure. You have effectively stopped my burbot fishing. How might the regulation be modified to specific areas?