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Alaska Angler Survey: Use and Valuation Estimates for 1997 with a Focus on Salmon Fisheries in Region III

by
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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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ALASKA ANGLER SURVEY: USE AND VALUATION ESTIMATES FOR 1997 WITH A FOCUS ON SALMON FISHERIES IN REGION III

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ABSTRACT

A social and economic analysis was designed to estimate net economic values for salmon *Oncorhynchus sps* sport fishing in Region III. A second goal of the study was to estimate changes in visitation to fishing sites which would result from the implementation of alternative regulations. In addition to these primary goals, information on angler and trip characteristics, trip expenditures, preferences for alternative fishing experiences and angler opinions regarding proposed regulation changes was collected. Five populations of anglers who purchased Alaska sport fishing licenses in 1997 were surveyed: Seward Peninsula residents, Copper River area residents, residents of the remainder of Region III exclusive the previous two populations, Region I and II residents, and U.S. nonresidents. Two versions of the survey were mailed: one asked about the most recent trip targeting any salmon species, and the second specifically asked about the most recent trip targeting chinook salmon. A total 10,201 surveys were mailed. Of this number 1,068 surveys were returned as undeliverable. Of the remaining 9,133 surveys successfully delivered, 3,546 completed surveys were returned, for a 38.8% response rate.

The dichotomous choice contingent valuation method was used to estimate anglers' net economic value for their most recent Region III salmon sport fishing trip. An examination of the estimated models and mean net economic value estimates derived from these models showed two clear and consistent patterns: 1) nonresidents value their salmon fishing trips to Region III significantly more highly than do Region III residents; and, 2) salmon fishing trips in Region III on which chinook salmon are the primarily targeted species are valued much the same as the Region III fishing trips targeting other salmon, specifically sockeye and coho salmon.

The overall Region III estimated net economic value per fishing trip for all salmon species was $816.50 (SE = 47.69) for nonresidents, $191.57 (SE = 16.34) for Region I and II residents, $136.56 (SE = 13.97) for Seward Peninsula residents, $135.90 (SE = 11.46) for the remainder of Region III residents, and $121.70 (SE = 9.99) for Copper River area residents. Overall, 1997 sport fishing for salmon in Region III is estimated to have a total net economic value of $13,697,500. Of this total, approximately 67% is attributable to nonresident fishing trips. Estimated average expenditures per fishing trip was highest for nonresidents ($1,892.90 per trip) followed by Region I and II residents ($199.38 per trip). The benefit/cost ratio for the Region III salmon research and management program was 33.4 in FY98.

The survey contained five contingent behavior questions on specific management options for the Copper River and Tanana River drainages and the Unalakleet River. The responses to these questions indicate that all proposed regulation changes would lead to small to moderate changes in visitation to the rivers. Consistently across models, over three-fourths of respondents said that the proposed regulation changes would have no effect on the number of trips they would take to the rivers. This suggests that of the variables influencing angler trips, fishing regulations designed to alter bag limit and bait as a legal fishing means at the three rivers specified in this study may play a minor role.

Key Words: nonmarket economic analysis, net economic value, contingent valuation, contingent behavior, benefit/cost ratio, sport fishing, salmon, 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 1997 (Figure 1). In particular this report focuses on fishing trips and anglers specifically targeting salmon species *Oncorhynchus sps* 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 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 is 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, including proposed changes to access fees for personal use fishing in the Copper River area.

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

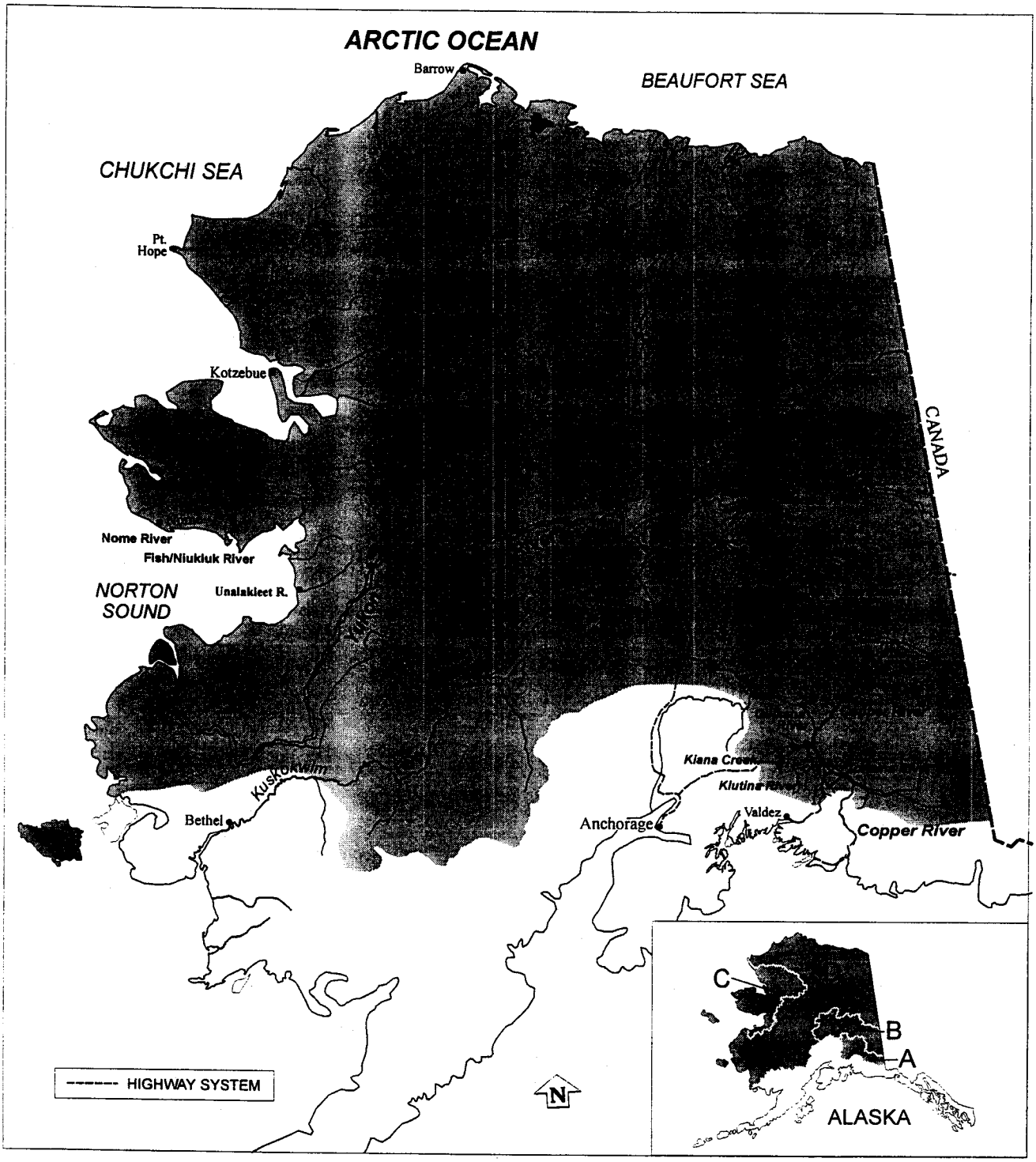

Figure 1.-Map of Region III, Alaska in 1997.

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 salmon fishing trips in Region III. Well established markets for sport fishing on public lands in Alaska do not exist. Therefore, the basic problem to be faced in determining the economic value of fishing trips to this region is one of measuring these nonmarket values. 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. 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. In Montana, the CVM has been used by the state fish and wildlife agency to value coldwater fishing on all major fisheries in the state (Duffield et al. 1987); to examine the relationship between congestion and fishing values on the Bighorn River (Duffield and Neher 1994); and to estimate appropriate market-level prices for nonresident big game hunting permits (Duffield 1997). Additionally, 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. We will discuss how each of these elements is addressed in turn.

In the Alaska Region III salmon survey, anglers were asked to place a value on their most recent salmon 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 the respondent, not because they would not pay the amount, 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 would be. In the dichotomous choice method, respondents are asked a simple "yes" or "no" question: whether they would pay a specified amount for the specified 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 the decisions we make every day when we decide to buy, or not buy, goods and services based on the qualities of the goods and services and also upon their price.

While the dichotomous choice method has the advantage of being easily implemented and similar in design to other economic decisions we make each day, it has the disadvantage of being relatively 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 the Copper River drainage, Tanana River drainage, and Unalakleet River would change if alternative fishing regulations for salmon 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 July through August 1998, a mail survey was administered to resident and non-resident anglers holding 1997 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 salmon survey was ambitious given the resources available for the survey implementation. The survey was ideally designed to estimate NEVs for waters within four geographic areas within Region III (Tanana drainage, Copper River drainage, Seward Peninsula waters, and remainder of Region III). Given the constraints of sample size, however, a more realistic objective was to obtain value estimates for the more heavily used rivers in these areas. Additionally, it was hoped that final sample sizes would be large enough to estimate NEVs for nonresidents, and Region I and II residents as well as for Region III residents. A final objective was to estimate region-wide or water specific NEVs for trips specifically targeting different salmon species.

Five specific populations were sampled in this survey effort (see Table 1).

(1) Seward Peninsula license holders

In order to maximize the probability of receiving sufficient survey responses to estimate Seward Peninsula waters fishing trip values, all 1997 sport fishing license holders (1,243) in the towns of Nome and Unalakleet were surveyed.

(2) Copper River area license holders

Similarly, all 1997 sport fishing license holders (2,659) in the Copper River region[2] were surveyed in an attempt to estimate the NEV for trips to specific waters in this area of Region III.

(3) Remainder of Region III license holders

A random sample of 1,999 1997 license holders in Region III exclusive of the censused towns listed in (1) and (2) was drawn and sampled. Because Fairbanks is the largest urban center in Region III, proportionally the majority of licenses drawn in this population were Fairbanks residents.

(4) U.S. nonresidents of Alaska

This population was problematic in that it is a very large population yet only a small proportion of the population likely fished in Region III. The result of this low participation rate is that a very large number of non-resident 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.

In an effort to sidestep this problem of low participation rates in Region III angling, the sampled population was narrowed to those non-resident anglers who bought their 1997 licenses in Region III. The assumption made in this sampling decision was that nonresidents who actually purchased their licenses in Region III are much more likely to have fished in Region III than those nonresidents who purchased their licenses in Regions I or II. The assumption was also made that those nonresidents who purchased licenses in Region III and fished in Region III were not significantly different from those nonresidents who purchased licenses in Regions I or II and then fished in Region III in terms of the value they attach to their Region III fishing experiences. A random sample of 1,995 of these non-resident anglers who bought 1997 licenses in Region III was drawn and these individuals were surveyed.

(5) Region I and Region II resident anglers

The same problems existed with sampling Region I and II anglers as was faced with non-resident anglers. That is, Region I and II anglers are a very large population with likely very low participation rates for fishing in Region III. As with the non-resident population, the target population was narrowed to only those Region I and II residents who bought their 1997 licenses in Region III. All anglers in this sample were surveyed (2,305).

One limitation of the sampling strategy employed in this study was that the sample pool for Alaska residents only included those individuals holding 1997 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 angler trip estimates used in this study were estimated by ADF&G and do include PID holders.

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

Table 1.-Summary of sampled populations.

Population of 1997 Sport Fishing License Holders Sampled	Type of Sample	Sample Size
Seward Peninsula (Nome, Unalakleet)	Census	1,243
Copper River area	Census	2,659
Remainder of Region III	Random	1,999
Nonresidents (lower 49) who bought licenses in Region III	Random	1,995
Region I and II residents who bought licenses in Region III	Census	2,305
Total		10,201

3.2 Survey Design and Administration

The survey instrument (see Appendix C) was designed cooperatively by Bioeconomics and ADF&G personnel. To reduce recall bias, questions were asked about characteristics and values of the most recent salmon fishing trip, including trips taken in 1997 or the early portion of the 1998 salmon fishing season. It was assumed that between 1997 and 1998 there was no significant change in NEV of a salmon fishing trip. Responses pertaining to trip expenditures and values in 1997 and 1998 were combined with 1997 angler trip information in estimating NEV.

The final survey contained four sections. Section I asked the respondents several general questions about their fishing patterns and their visitation to Region III waters. Section II focused the questioning on the Region III water most recently sport fished by the respondent. Questions in this section asked about the specifics of that trip, salmon species targeted and caught, and the respondent's assessment of the quality of this trip. This section also included the contingent valuation question used in estimating the NEV of trips to the waters. Section III asked questions on the respondents' preferences for fishing regulations on specific Region III waters as well as how their visitation to Copper River area, Tanana River area and Seward Peninsula waters would change under alternative fishing regulations. Section IV asked respondents a number of socioeconomic questions.

One goal of the survey was to gather trip and valuation information on fishing for different species of salmon. Because the survey was distributed at one point during the year, and because angling for different salmon species occurs at different times in different areas, two versions of the survey were developed to reduce the chance that trips to fish for only one salmon species would heavily dominate the survey responses. One survey version asked only about the respondent's most recent chinook salmon fishing trip. The other version asked about the respondent's most recent trip targeting any salmon species. These two survey versions were equally apportioned among the populations.

In addition to the two versions of the survey, one other variation among surveys was included to investigate the possible effect of respondent incentives on response rates to the survey. One half of survey recipients also received an entry card which, when completed and returned with a completed survey, entered the respondent in a drawing for a high quality fishing rod and reel valued at $350. It was expected that those respondents who received the entry forms would have

a higher response rate than would those who did not receive such an opportunity to enter into a drawing. The different survey versions and incentive cards are included in Appendix C. An analysis of the response rates for those strata receiving the incentive card and those who did not receive the card showed no significant difference between the groups. There were six identifiable strata in which the comparison of response rates was possible. In four of these strata the half of the sample receiving the incentive card had a higher response rate. In the remaining two strata the sample who did not receive the incentive had a higher response rate. In none of the six strata, however, was the difference in response rates between the two groups statistically significant. Thus, it does not appear that the use of an incentive card significantly affected response rates for those respondents who received the incentive.

After the survey was developed it was pretested during the month of June, 1998 on a randomly drawn sample of 200 anglers from the 1997 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 the top bid level for the contingent valuation question. Several wording changes to the survey were made as a result of the pretest responses and the top bid level was set at $500 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 1978). A survey was mailed between July 10 - 17, 1998 to the sample of 1997 license holders. After two weeks a reminder postcard was sent to all potential respondents (see Appendix C). Finally, nonrespondents were sent a second copy of the survey on August 28, 1998.

3.3 Response Rate

A total of 10,201 anglers' names and addresses were included in the survey sample. Of this number, 1,068 surveys (10.5%) were returned as undeliverable. Of the remaining 9,133 surveys that were successfully delivered to anglers, 3,546 completed surveys were returned by the end of the survey process. The resulting response rate to the survey was therefore 38.8%.

4.0 RESULTS

4.1 General Fishing and Socioeconomic Statistics

The Alaska salmon survey asked several questions about general fishing habits and socioeconomic characteristics. In general, all statistics in this report are presented specifically for each population (Seward Peninsula, Copper River area, the remainder of Region III, nonresidents, and Region I and II residents). There are many similarities in general fishing characteristics between the populations (Table 2). For Alaska residents, a high percentage (> 60%) specifically fish for salmon. Nonresidents were 8 to10 years older (average of 48.2 years), 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 four populations (Table 3).

4.2 Site-Specific Statistics and Trip Characteristics

The salmon 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

Table 2.-General fishing characteristics of respondents to the salmon survey, by population, Region III, 1997.

Statistic	Respondent Population				
	Seward Peninsula	Copper River	Non-residents	Remainder of Region III	Regions I & II
Average years fished in life	22.3	22.5	27.3	21.2	19.9
Average number of days fished per year	22.0	18.7	24.6	18.2	14.9
Percent who specifically fish for salmon	73.1	62.9	54.1	69.6	65.2
Sample size[a]	465	1,031	817	675	604

[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 salmon survey, by population, 1997.

Statistic	Respondent Population				
	Seward Peninsula	Copper River	Non-residents	Remainder of Region III	Regions I & II
Average age	40.2	41.0	48.2	37.0	38.4
Percent male	67.8	68.1	81.7	70.2	77.1
Average years of formal schooling attended	12.8	12.0	12.5	12.5	12.7
1997 household income before taxes					
Percent less than $20,000	14.7	24.9	5.5	11.4	18.3
Percent $20,000-$39,999	16.2	24.5	22.4	21.0	15.4
Percent $40,000-$69,999	34.3	30.3	32.1	35.1	28.3
Percent $70,000-$79,999	9.3	7.5	12.4	10.1	11.2
Percent $80,000 - $124,999	20.3	10.6	16.5	12.0	16.4
Percent over $125,000	5.2	1.9	11.2	4.1	10.3

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

Statistic	Respondent population				
	Seward Peninsula	Copper River	Non-residents	Remainder of Region III	Regions I & II
Fishing easily accessible site near a road	39.2	39.4	40.0	36.9	23.2
Fishing in a wilderness setting	70.8	65.5	63.3	62.8	79.3
Catching and keeping salmon	58.1	53.5	37.9	48.0	50.2
Catching and releasing salmon	22.2	22.0	40.5	25.4	23.4
Having good trail access to fishing waters	38.2	48.3	58.6	51.3	35.1
Having more developed camping facilities	18.0	28.0	38.2	31.7	20.2

[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.

are many similarities across populations (Table 4). Respondents in all populations strongly preferred fishing in a wilderness setting to fishing an easily accessible site near a road. Catching and releasing salmon was less preferred by all populations except nonresidents to catching and keeping salmon. Having good trail access and more developed camping facilities was more preferred by nonresidents, the remainder of Region III residents, and Copper River Area residents than by residents of the Seward Peninsula or Regions I and II (Table 4).

Table 5 shows the average number of salmon fishing trips per year that respondents from each population made to each of the waters included in the salmon survey. The bolded entries in Table 5 indicate those waters that are in the same area as the sampled population. Thus, Tanana River drainage streams are highlighted for the remainder of Region III residents, Seward Peninsula streams for Seward Peninsula residents, and the Copper River drainage streams for Copper River Area residents. Not surprisingly, these populations had much higher visitation rates to streams in their own areas than to those in other areas. Fishers residing in the Copper River traveled to the Gulkana River more frequently (average of 1.5 trips) than other salmon fishing sites in the Copper River. There were more trips to the Chena River (average of 1.2 trips) than to other fishing sites in the Tanana drainage. By far, the Nome River received the greatest number of visits (average of 3.2 trips) to fish for salmon by Seward Peninsula anglers. Section II of the salmon survey asked respondents a number of questions on their most recent trip, the number of salmon they caught, and the overall rating of their fishing experience on their most recent trip (Table 6). Seward Peninsula and Region I and II respondents reported keeping substantially more salmon on their most recent salmon fishing trip to Region III than did respondents from the other sampling stratas. A higher percentage of nonresidents reported having an "above average" fishing experience on their most recent salmon fishing trip (Table 6).

Table 5.-Average 1997 reported fishing trips to Region III waters, by population.

Fishing Site	Respondent population				
	Seward Peninsula	Copper River	Non-residents[a]	Remainder of Region III	Regions I & II[a]
Copper River Area					
Gulkana River	.02	**1.53**	.45	.61	.15
Klutina River	.01	**.93**	.39	.14	.06
Tonsina River	.00	**.32**	.06	.04	.02
Kiana River	.03	**.01**	.01	.01	.00
Other Copper River Area waters	.07	**.64**	.10	.18	.30
Tanana River Drainages					
Chena River	.01	.08	.12	**1.19**	.11
Salcha River	.00	.09	.04	**.55**	.07
Delta Clearwater River	.00	.43	.04	**.10**	.08
Chatanika River	.01	.01	.04	**.28**	.02
Other Tanana Area waters	.00	.05	.02	**.23**	.01
Seward Peninsula Waters					
Unalakleet River	**2.1**	.00	.01	.00	.06
Fish / Niukluk River	**1.6**	.00	.02	.00	.03
Nome River	**3.2**	.00	.01	.00	.03
Other Seward waters	**2.4**	.00	.03	.01	.04
Remainder of Region III Waters	.22	.04	.11	**.08**	1.39

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

Table 6.-Fishing trip experiences and quality ratings from respondents to the salmon survey, Region III, 1997.

Statistic	Respondent Population				
	Seward Peninsula	Copper River	Non-residents	Remainder of Region III	Regions I & II
Average number of salmon caught	10.4	3.6	7.4	3.4	8.9
Average number kept	7.2	1.6	2.2	1.7	5.5
Above average fishing experience[a]	30.8	21.8	52.5	23.8	27.5
Average number of people in party	3.3	3.5	3.9	3.3	3.6

[a] Percent of 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.

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 7 shows the average reported expenditures by category for each of the five populations. Nonresidents who fished in Region III spent significantly more per trip than did all other sample populations ($1,892 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.

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. In general, over 68% 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

Table 7.-Average expenditures per trip by category and respondent population.

Expenditure category	Respondent Population: Seward Peninsula	Copper River	Non-residents	Remainder of Region III	Regions I & II
Travel	$36.14	$75.06	$789.84	$54.56	$85.26
Food	$31.40	$35.27	$243.35	$41.4	$50.57
Lodging	$ 3.95	$ 8.54	$317.10	$15.36	$17.49
Equipment	$17.61	$29.74	$331.59	$30.22	$33.86
Other expenses	$ 4.20	$15.46	$211.02	$21.16	$12.20
Total expenditures	$93.30	$164.07	$1,892.90	$162.70	$199.38

information on their NEV for their most recent fishing 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 six or eight bid levels (10, 25, 50, 100, 200, and 500 dollars for Alaska residents and 10, 25, 50, 100, 200, 500, 1,000, and 2,000 dollars for nonresidents). The responses to this question were analyzed for many 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 8a through 12b 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 bootstrapped standard errors of the mean NEV estimates are estimated based on the procedures suggested by Duffield and Patterson (1991), and are also reported.

The final models of NEV are presented in five pairs of tables (Tables 8a through 12b). These tables report the estimated model parameters, as well as the mean NEV estimates based on these models. Each of the five pairs of NEV tables contains a (a) table reporting the estimated model parameters and goodness-of-fit statistics, and a (b) table reporting the estimated truncated mean NEV estimate (truncated at the maximum bid level per the discussion in Appendix A). Also

Table 8a.-Bivariate current trip models of net economic value for a salmon sport fishing trip by population, for all salmon species, 1997.

Variable / statistic	Respondent population				
	Seward Peninsula	Copper River	Non-residents	Remainder of Region III	Regions I & II
Intercept	3.286	2.32	1.697	3.610	2.77
(t-stat)	(6.09)	(6.40)	(4.77)	(7.07)	(4.58)
Ln (BID)	-0.763	-0.595	-0.20	-0.775	-0.526
(t-stat)	(6.26)	(7.17)	(2.99)	(6.83)	(3.93)
Chi-square degrees of freedom	4	4	6	4	4
Chi-square	3.86	7.89	8.96	13.58	5.56
P-statistic	0.425	0.096	0.176	0.009	0.235
Sample size	230	433	366	288	193

Table 8b.-Estimates of adjusted mean net economic value for a salmon sport fishing trip by population, for all salmon species, 1997.

Population	Mean NEV[a] (standard error)[b]	Percent of respondents with NEV greater than expenses	Adjusted mean NEV per trip
Seward Peninsula	$171.34 (17.28)	.797	$136.56 (13.97)
Copper River	$159.29 (13.08)	.764	$121.70 (9.99)
Nonresidents	$1,186.77 (69.32)	.688	$816.50 (47.69)
Remainder of Region III	$195.82 (16.51)	.694	$135.90 (11.46)
Regions I and II	$249.76 (21.31)	.767	$191.57 (16.34)

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

[b] Standard errors are based on 200 bootstrap iterations following the methodology of Duffield and Patterson (1991).

Table 9a.-Bivariate current trip models of net economic value for a salmon sport fishing trip by population - chinook salmon trips only, 1997.

Variable / statistic	Respondent population				
	Seward Peninsula	Copper River	Non-residents	Remainder of Region III	Regions I & II
Intercept	3.2769	2.2215	1.836	3.4329	3.201
(t-stat)	(4.13)	(5.46)	(4.24)	(5.89)	(3.75)
Ln (BID)	-0.7305	-0.5591	-0.240	-0.7359	-0.6135
(t-stat)	(4.05)	(6.02)	(2.98)	(5.66)	(3.38)
Chi-square degrees of freedom	4	4	6	4	4
Chi-square	6.36	8.17	8.15	10.79	3.10
P-statistic	0.174	0.085	0.227	0.029	0.5418
Sample size	102	334	257	224	116

Table 9b.-Estimates of adjusted mean net economic value for a salmon sport fishing trip by population - chinook salmon trips only, 1997.

Population	Mean NEV[a] (standard error)[b]	Percent of respondents with NEV greater than expenses	Adjusted mean NEV per trip
Seward Peninsula	$183.66 (24.21)	.796	$146.19 (19.27)
Copper River	$169.35 (14.57)	.757	$128.20 (11.03)
Nonresidents	$1,124.71 (89.01)	.674	$758.05 (59.99)
Remainder of Region III	$197.72 (18.07)	.683	$135.04 (12.34
Regions I and II	$249.29 (27.19)	.75	$186.97 (20.39)

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

[b] Standard errors are based on 200 bootstrap iterations following the methodology of Duffield and Patterson (1991).

Table 10a.-Bivariate current trip models of net economic value for a salmon sport fishing trip by population - salmon species other than chinook, 1997.

Variable / statistic	Respondent population	
	Copper River[a]	Seward Peninsula[b]
Intercept	1.9311	3.4169
(t-stat)	(1.99)	(4.20)
Ln (BID)	-0.5851	-0.8251
(t-stat)	(2.55)	(4.49)
Chi-square degrees of freedom	4	4
Chi-square	5.02	4.02
P-statistic	0.285	0.4027
Sample size	61	108

[a] Sockeye (65.6%) and coho (26.6%) salmon were the primary targets for "other" salmon fishing trips in the Copper River.

[b] Coho (54.0%) and chum (39.0%) salmon were the primary targets for "other" salmon fishing trips on the Seward Peninsula.

Table 10b.-Estimates of adjusted mean net economic value for a salmon sport fishing trip by population - salmon species other than chinook, 1997.

Population	Mean NEV[a] (standard error)[b]	Percent of respondents with NEV greater than expenses	Adjusted mean NEV per trip
Seward Peninsula	$150.48	.774	$116.47
	(25.53)		(19.76)
Copper River	$129.70	.803	$104.15
	(30.37)		(24.39)

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

[b] Standard errors are based on 200 bootstrap iterations following the methodology of Duffield and Patterson (1991).

Table 11a.-Bivariate current trip models of net economic value for a salmon sport fishing trip by population and water in the Copper River drainage, 1997.

	Respondent population				
	Gulkana River			Klutina River	
Variable / statistic	Other Region III	Copper River	Non-residents	Copper River	Non-residents
Intercept	4.687	2.4077	1.2662	2.2464	2.6553
(t-stat)	(4.43)	(4.53)	(1.98)	(2.78)	(3.04)
Ln (BID)	-0.9527	-0.5898	-0.190	-0.7061	-0.2978
(t-stat)	(4.11)	(4.81)	(1.59)	(3.68)	(1.83)
Chi-square degrees of freedom	4	4	6	4	6
Chi-square	10.27	4.95	8.76	10.22	4.25
P-statistic	0.0362	0.2921	0.1873	0.0369	0.6424
Sample size	93	191	88	104	93

Table 11b.-Estimates of adjusted mean net economic value for a salmon sport fishing trip by population and water in the Copper River drainage, 1997.

River / Population	Mean NEV[a] (standard error)[b]	Percent of respondents with NEV greater than expenses	Adjusted mean NEV per trip
Gulkana / Other Region III	$279.05	.688	$191.99
	(49.00)		(33.71)
Gulkana / Copper River	$171.60	.78	$133.85
	(19.86)		(15.49)
Gulkana / Non Residents	$997.76	.64	$638.57
	(133.32)		(85.32)
Klutina / Copper River	$144.54	.74	$106.96
	(32.66)		(24.17)
Klutina / Non Residents	$1,319.14	.753	$993.31
	(156.03)		(117.49)

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

[b] Standard errors are based on 200 bootstrap iterations following the methodology of Duffield and Patterson (1991).

Table 12a.-Bivariate current trip models of net economic value for a salmon sport fishing trip by population and water in the Tanana drainage and Seward Peninsula, 1997.

	River / Respondent population		
Variable / statistic	Chena River / Other Region III	Fish River / Seward Peninsula	Unalakleet River / Seward Peninsula
Intercept	5.0278	5.5897	3.3841
(t-stat)	(3.36)	(3.54)	(2.62)
Ln (BID)	-1.2053	-1.3043	-0.7266
(t-stat)	(3.35)	(3.53)	(2.48)
Chi-square degrees of freedom	4	4	4
Chi-square	1.05	5.91	6.61
P-statistic	0.9021	0.2059	0.1582
Sample size	52	45	46

Table 12b.-Estimates of adjusted mean net economic value for a salmon sport fishing trip by population and water in the Tanana drainage and Seward Peninsula, 1997.

River / Population	Mean NEV[a] (standard error)[b]	Percent of respondents with NEV greater than expenses	Adjusted mean NEV per trip
Chena / Other Region III	$139.66	.731	$102.09
	(41.71)		(30.49)
Fish / Seward Peninsula	$247.65	.80	$198.12
	(93.22)		(74.58)
Unalakleet / Seward Peninsula	$144.54	.913	$131.97
	(32.66)		(29.82)

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

[b] Standard errors are based on 200 bootstrap iterations following the methodology of Duffield and Patterson (1991).

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" NEV must be factored into the NEV estimate for those other respondents who all had a positive NEV. Therefore, the adjusted mean NEV estimate includes all respondents, those with a positive and those with a zero NEV. Associated with the adjusted mean NEV estimates are bootstrapped standard errors which are calculated under the assumption that the percent of respondents in the targeted population with a zero NEV is constant. The standard errors in the b tables are computed using a standard variance formula. The first set of tables, 8a and 8b, show the estimates for each of the five populations considering all trips taken to Region III.

The estimated coefficients for these models are (with two exceptions, as determined from t-statistics) 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. Four models did not fit the hypothesized distribution particularly well.

Tables 9a and 9b show estimated models and mean NEV estimates for fishing trips made by the sample populations in which chinook (king) salmon were the primarily targeted salmon species. Only the Seward Peninsula and Copper River area resident models had adequate sample sizes to provide reliable NEV measures and estimated models for trips in which non-chinook salmon species were the targeted species (Tables 10a and b). The estimated mean NEV for trips on which chinook salmon are the primary targeted salmon species are similar to those for trips targeting primarily sockeye and coho salmon. While both NEV point estimates for the non-chinook salmon trip valuation models (Seward Peninsula and Copper River area populations) are lower than for trips targeting chinook, considering the precision levels of the estimates, the differences are not statistically significant.

Tables 11a and b, and 12a and b show the results of water-specific NEV modeling. Water-specific models of NEV were estimated for the Gulkana, Klutina, Chena, Fish, and Unalakleet rivers for trips targeting any salmon species.

In summary, an examination of the models and mean NEV estimates reported in Tables 8a through 12b show two clear and consistent patterns:

1. nonresidents value their fishing trips to Region III significantly more highly than do Region III residents. This is consistent with the findings of many other recreational WTP studies; and,
2. fishing trips in Region III on which chinook salmon are the primarily targeted salmon species are valued much the same as the Region III fishing trips targeting other salmon, specifically sockeye and coho salmon.

4.5 Total Net Economic Value Estimates

4.5.1 Total Trip Estimates

The ADF&G conducts an annual survey of sport 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 five 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 salmon angler trips were derived from two independent sources: 1) the 1996 Region III angler survey (Duffield et al. 2001) 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 salmon is related to the percentage of angler-trips targeting salmon; 2) fishing for multiple species in an angler-day is minimal; and, 3) that the percentages of sport fishing trips targeting salmon in 1994-96 are similar to those in 1997.

4.5.2 Total Estimated Net Economic Value of Fishing Trips to Study Waters

The NEV per trip estimates shown in Tables 8a and 8b can be used in conjunction with annual trip estimates derived by ADF&G (Table 13) to estimate the total annual NEV of sport fishing for salmon in Region III (Table 14).

Overall, 1997 salmon sport fishing in Region III is estimated to have a total NEV of approximately $13,697,500. Of this total, approximately 67% is attributable to nonresident fishing trips. Of the 33% of estimated value attributable to Alaska residents, 15.3% is from Region I and II anglers fishing in Region III, and the remaining 84.7% is from Region III residents angling within the region.

Table 13.- Estimates of sport fishing trips for salmon to Region III by population, 1997.

Sample Population	Estimated 1997 angler trips[a]	Estimated percent salmon fishing trips	Estimated total angler salmon fishing trips[d]
Seward Peninsula Residents	6,042	73.2[b]	4,423
Copper River Residents	5,919	48.5[c]	2,871
Remainder of Region III Residents	100,920	20.6[b]	20,790
Nonresidents	29,077	38.9[b]	11,311
Regions I and II Residents	27,024	13.2[b]	3,567
Total	168,982		42,962

[a] From the statewide harvest survey (A. Howe, ADF&G, Anchorage, personal communication).

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

[c] Average of the 1994 (48.1%) and 1995 (48.8%) targeted angler-days survey results (Howe and Fleischman *In prep*.).

[d] Product of 1997 total angler trip estimates and estimates of percent salmon angler trips.

Table 14.- Estimated total annual net economic value of sport fishing for salmon in Region III, 1997.

Population	1997 Total Estimated Net Economic Value
Seward Peninsula Residents	$604,000
Copper River Residents	$349,400
Remainder of Region III Residents	$2,825,350
Nonresidents	$9,235,420
Regions I and II Residents	$683,330
Total of all subgroups	$13,697,500

An estimate of the total value of salmon fishing trips in the Copper River area for 1997 (Table 15) was derived from the statewide harvest survey data on the total number of sport fishing trips for all species to the Copper River area in 1997 (A. Howe, ADF&G, Anchorage, personal communication). Additionally, the use survey data from 1994 and 1995 (Howe and Fleischman *In prep*.) provides an estimate of total angler days in the Copper River area that are attributable to resident and nonresident anglers; and, total angler days spent fishing for salmon in the Copper River area. Overall, approximately 31% of the 13.7 million dollar NEV of salmon sport fishing in Region III in 1997 can be attributed to salmon fishing in the Copper River area. Insufficient information was available to estimate salmon sport fishing trips in other areas of Region III.

Table 15.-Estimated net economic value of sport fishing for salmon in the Copper River area, 1997.

Residency	Estimated angler trips	NEV/Trip	Total 1997 NEV
Alaska Residents	11,607	$121.70	$1,412,570
Nonresidents	3,486	$816.50	$2,846,320
Total	15,093	--	$4,258,890

4.6 Benefit/Cost Ratio

The cost basis was limited to those activities relating to research and management of salmon fisheries in Region III (Table 16). Management costs were estimated from the proportion of time spent by individual managers on salmon management issues by geographic area. Not included are indirect costs associated with supervision and administration. The estimated benefit/cost ratio was 33.4 in FY98. Obviously, the benefits of Region III's salmon research and management program outweigh the costs to a high degree.

Table 16.-The cost basis used to evaluate the benefit/cost ratio for program planning relating to salmon research and management in Region III, for fiscal year 1998.

Budget Component	FY98
Research	$178,200
Management [a]	$231,900
Total	$410,100

[a] Computed from the estimated amount of time each of five area managers normally spend on salmon management within their respective areas per fiscal year (total allocation x percentage of time). These estimated percentages are: lower Tanana-20%, upper Tanana-13%, northwest-40%, AYK-30%, and upper Copper/upper Susitna-75%.

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 five regulation alternatives for waters in the Copper River drainage, Tanana River drainage, and Seward Peninsula area, and if so, how many more or fewer trips they would take under the new regulations (Questions 18, 19, 20, 23, and 24). Survey respondents were also asked what their level of support for the proposed changes would be (see Appendix C). Questions 21 and 22 asked for responses to possible changes in Personal Use (PU) salmon fishing regulations in the Copper River. 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.

The first of the contingent behavior questions in the survey (Question 18) asked respondents the following:

> Currently there is a seasonal bag limit of 5 chinook (king) salmon in the Copper River drainage. Due to conservation concerns, the seasonal bag limit may be reduced to 3 kings. How would this possible change affect your fishing trips to the Copper River drainage?

A large majority of respondents (over 88%) would not alter the number of trips taken to the Copper River drainage under the hypothetical regulation alternative in Question 18 (Table 17). The overall estimated changes in total trips to the Copper River drainage under the regulation alternative range between a 2.5% decline for Copper River area residents and an 8.4% decline for Region I and II residents. While estimates are presented for each of the sampled populations, it is important to note that for populations with very low fishing rates in a specific area (such as is the case for Seward Peninsula residents fishing in the Copper River drainage) estimated visitation changes are based on small sample sizes and, though relatively large in percentage terms, would likely represent a very small change in the actual number of trips. Therefore, these estimates should be viewed with caution. All five populations, on average, supported the regulation alternative, with the lowest support from Copper River area respondents (Figure 2).

Table 17.-Stated changes in trips to fish for chinook salmon in the Copper River in response to a hypothetical reduction in the sport bag limit from 5 to 3 fish, by respondent population.

	Copper River	Non-residents	Other Region III	Regions I and II	Seward Peninsula
Sample size	826	549	559	401	236
Percentage who would not change trips	90.0 %	88.9 %	90.7 %	94.8 %	98.3 %
Predicted percentage change in trips	-2.5 %	-8.4 %	-6.8 %	-8.4 %	-16.6 %

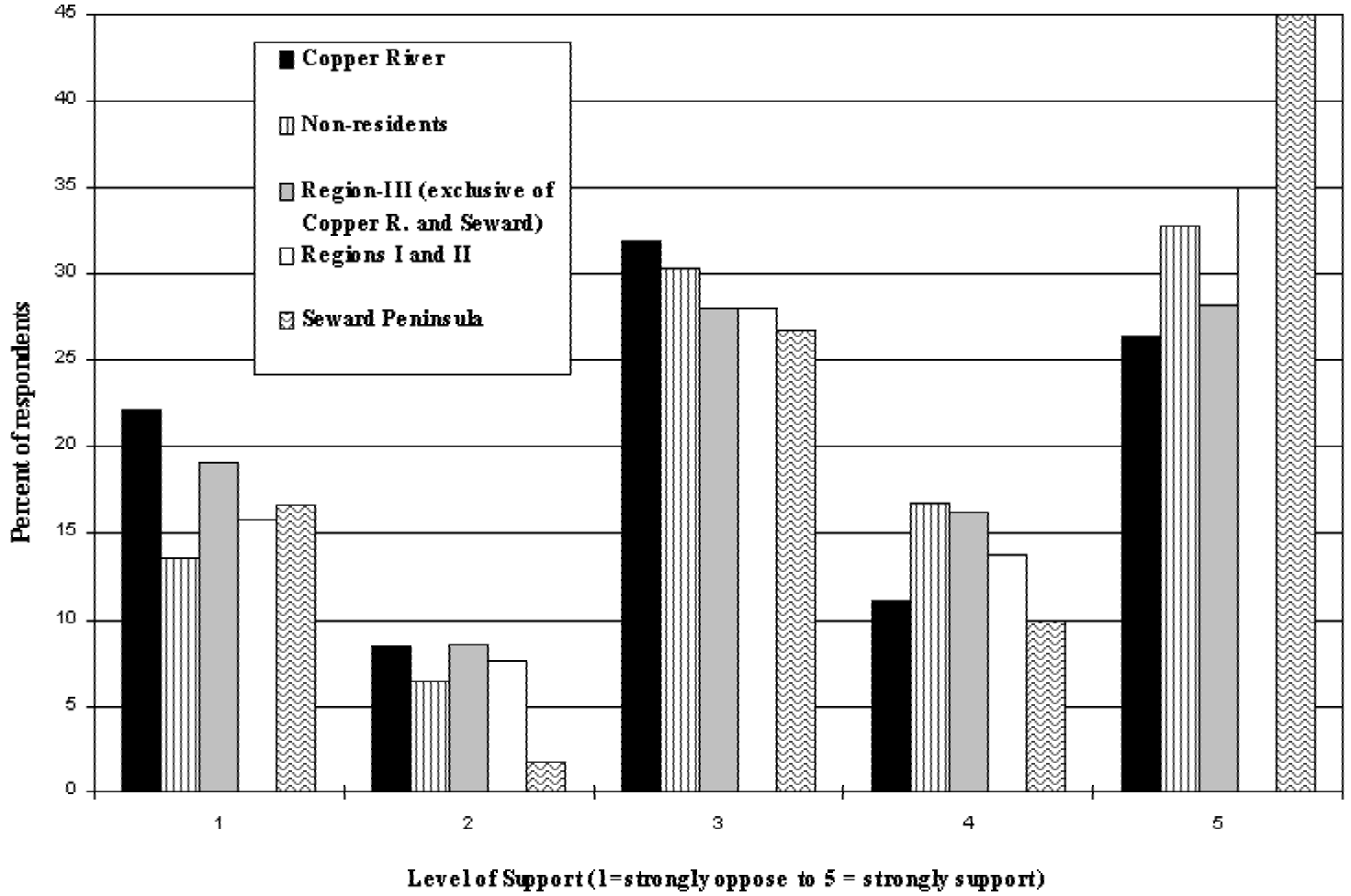

Figure 2.-Stated levels of support and opposition for reducing the sport bag limit for chinook salmon in the Copper River from 5 to 3 fish, by respondent population.

The second of the contingent behavior questions in the survey (Question 19) asked respondents the following:

> With the exception of the Tonsina River drainage, bait is legal for fishing for chinook (king) salmon in the Copper River drainage, however conservation concerns may necessitate bait being eliminated as a legal fishing means. How would this possible change influence your fishing trips to the Copper River drainage?

A majority of respondents (over 79%) would not alter the number of trips taken to the Copper River drainage under the regulation alternative in Question 19 (Table 18). The overall estimated changes in total trips to the Copper River drainage range between a 6.8% decline for Copper River area residents and an 14.3% decline for Region I and II residents. Support for the alternative was mixed among the five sampled populations, with Copper River, and remainder of Region III opposing the alternative on average, and nonresidents and Seward Peninsula residents supporting it on average. Regions I and II respondents supported and opposed the alternative in nearly identical proportions (Figure 3).

Table 18.-Stated changes in trips to fish for chinook salmon in the Copper River in response to a hypothetical management action to eliminate bait as a legal fishing means, by respondent population.

	Copper River	Nonresidents	Other Region III	Regions I and II	Seward Peninsula
Sample size	813	539	543	398	236
Percentage who would not change trips	79.8 %	80.9 %	84.2 %	91.5 %	98.7 %
Predicted percentage change in trips	-6.8 %	-11.1 %	-11.1 %	-14.3 %	-8.3 %

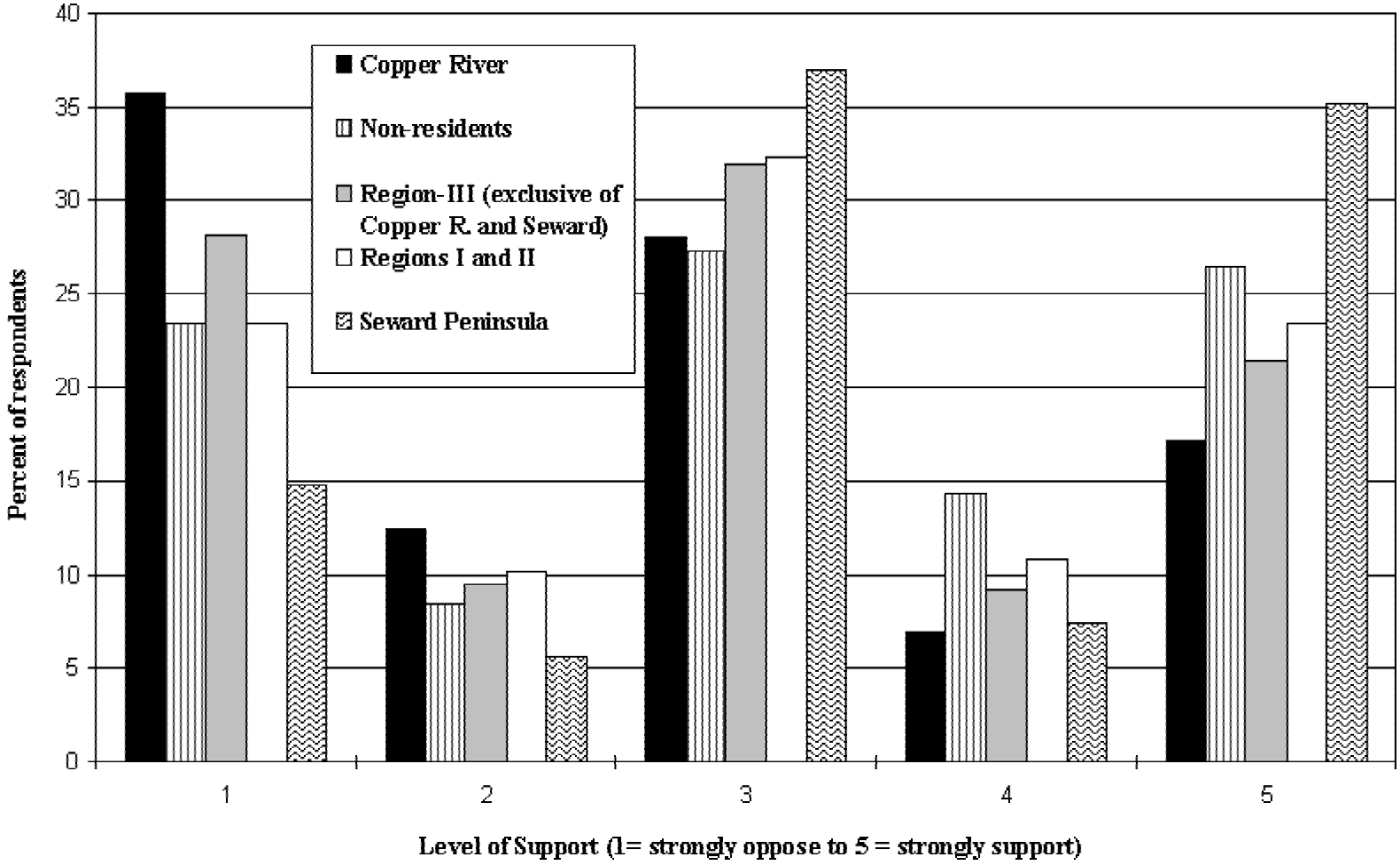

Figure 3.-Stated levels of supporting bait as a legal means to fish chinook salmon in the Copper River, by respondent population.

Question 20 asked respondents the following:

> Currently there is a daily bag limit of 3 sockeye (red) salmon in the Gulkana and Klutina rivers. In years of high sockeye returns to these systems, the daily bag limit may be increased to 6 sockeye. How would this change affect your fishing trips to the Copper River drainage?

A majority of respondents (over 84%) would not alter the number of trips taken to the Copper River drainage under the regulation alternative in Question 20 (Table 19). The overall estimated changes in total trips to the Copper River drainage range between a 6.1% increase for Copper River area residents and an 30.9% increase for Region I and II residents. Support for the alternative was strong among all five sampled populations (Figure 4).

Table 19.-Stated changes in trips to fish for sockeye salmon in the Gulkana and Klutina rivers in response to a hypothetical increase in the daily sport bag limit from 3 to 6 fish in years of high returns, by respondent population.

	Copper River	Non-residents	Other Region III	Regions I and II	Seward Peninsula
Sample size	831	548	548	399	236
Percentage who would not change trips	86.9 %	88.3 %	84.9 %	88.0 %	97.5 %
Predicted percentage change in trips	6.1 %	8.9 %	26.6 %	30.9 %	66.7 %

Question 23 asked respondents the following about a possible regulation alternative to Tanana Area waters:

> Currently there is a daily bag limit of 1 chinook (king) salmon, any size. Managers may increase the daily bag limit to 2 kings, if one is a “jack”, less than 21 inches in total length. How would this change affect your fishing trips to Tanana Area waters?

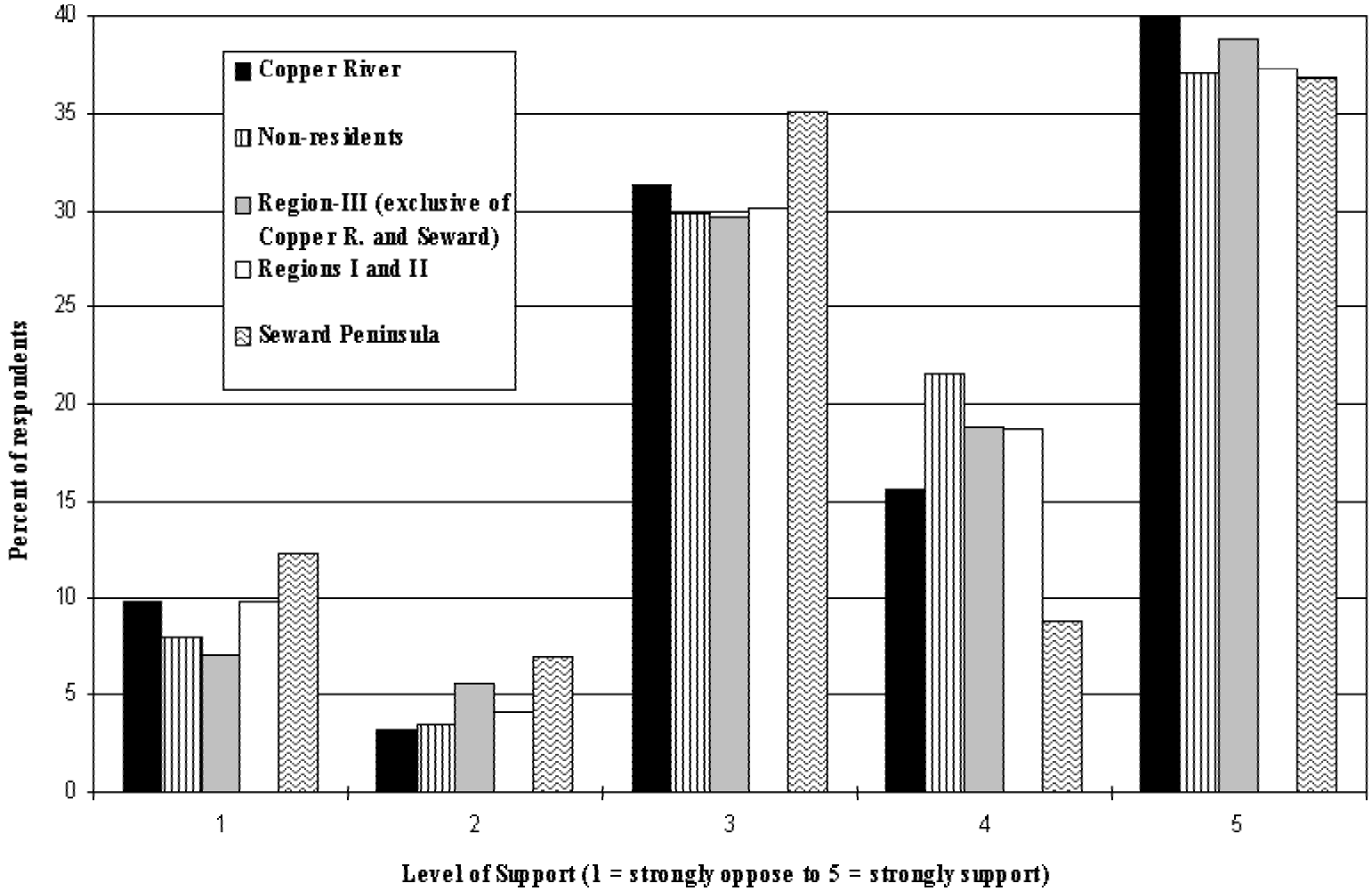

Figure 4.-Stated levels of support and opposition for an increase in the daily sport bag limit from 3 to 6 sockeye salmon in the Gulkana and Klutina rivers during years of high returns, by respondent population.

A large majority of respondents (over 93%) would not alter the number of trips taken to the Tanana River drainage under the regulation alternative in Question 23 (Table 20). The overall estimated changes in total trips to the Tanana River drainage range between a 6.9% increase for Copper River area residents and a 12.4% increase for nonresidents. Support for the alternative was strong among all five sampled populations (Figure 5).

Table 20.-Stated changes in trips to fish for chinook salmon in the Tanana drainage in response to a hypothetical increase in the daily sport bag limit from 1 to 2 fish if 1 is less than 21 inches in total length, by respondent population.

	Copper River	Non-residents	Other Region III	Regions I and II	Seward Peninsula
Sample size	752	462	551	366	214
Percentage who would not change trips	95.5 %	93.5 %	93.1 %	94.8 %	98.1 %
Predicted percentage change in trips	6.9 %	12.4 %	9.6 %	8.6 %	20.0 %

The final contingent behavior question in the salmon survey, Question 24, asked respondents the following about a possible regulation alternative to the Unalakleet River:

> Currently the daily bag limit for coho (silver) salmon on the Unalakleet River is 10 fish. Conservation concerns may necessitate a reduced bag limit of 5 salmon per day. How would this change affect your fishing trips to the Unalakleet?

A large majority of respondents (over 88%) would not alter the number of trips taken to the Unalakleet River under the regulation alternative in Question 24 (Table 21). The overall estimated changes in total trips to the Unalakleet River range between no change for Copper River area residents and an 8.0% increase for Seward Peninsula residents. Support for the alternative was relatively strong among all five sampled populations (Figure 6).

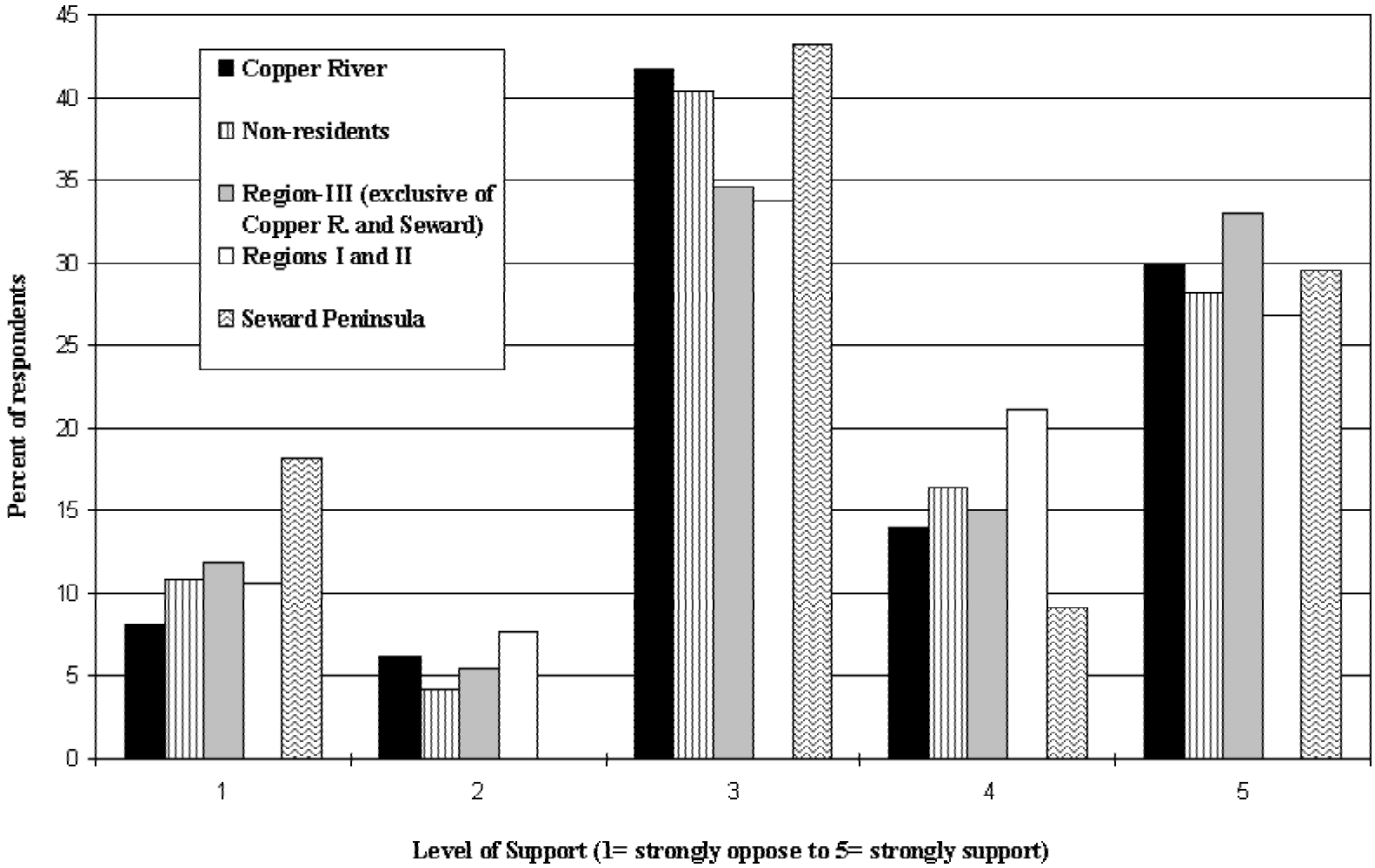

Figure 5.-Stated levels of support and opposition for an increase in the daily sport bag limit from 1 to 2 chinook salmon in the Tanana drainage if 1 is less than 21 inches in total length, by respondent population.

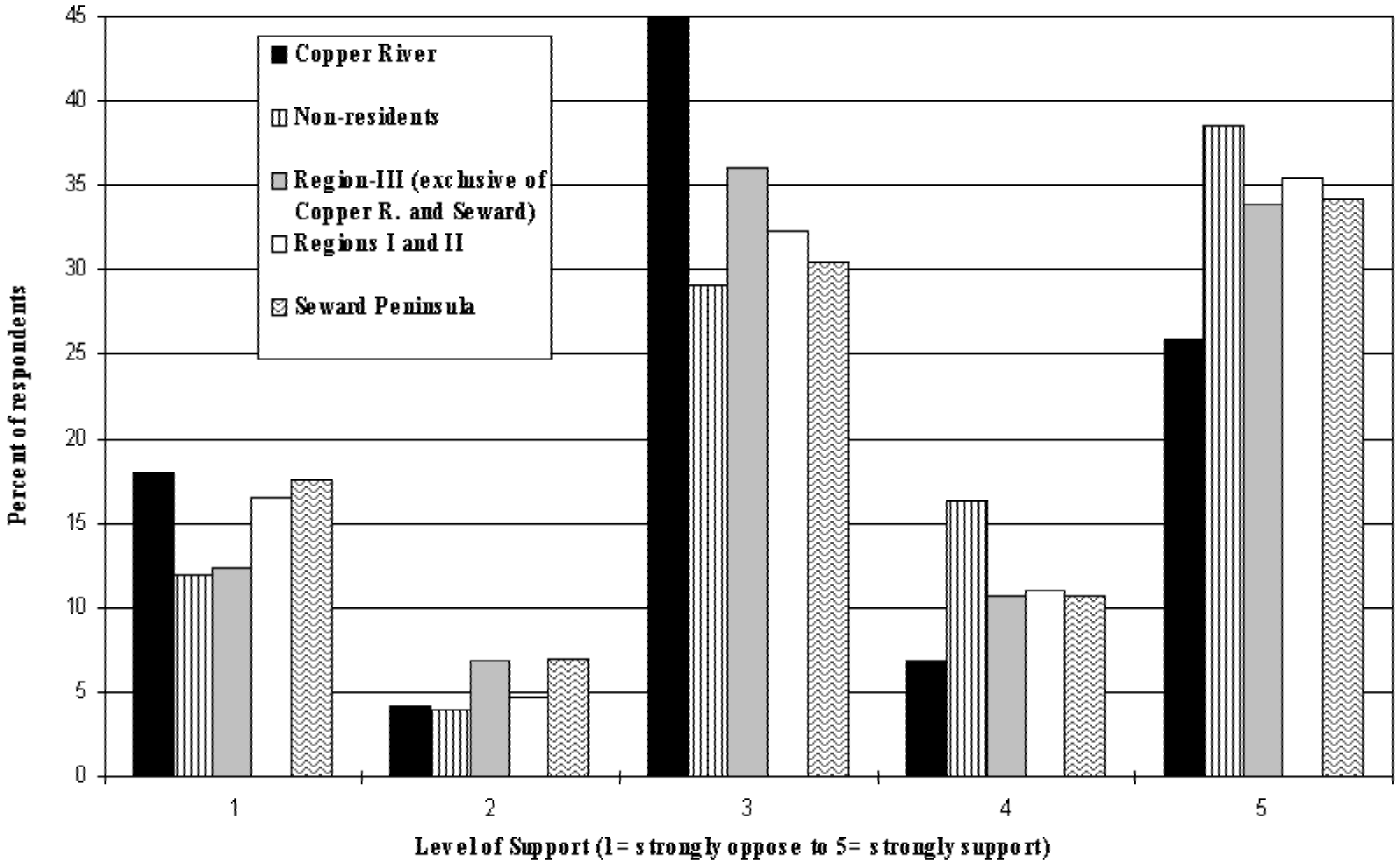

Figure 6.-Stated levels of support and opposition for a reduction in the daily sport bag limit from 10 to 5 coho salmon in the Unalakleet River, by respondent population.

Table 21.-Stated changes in trips to fish for coho salmon in the Unalakleet River in response to a hypothetical reduction in the daily sport bag limit from 10 to 5 fish, by respondent population.

	Copper River	Non-residents	Other Region III	Regions I and II	Seward Peninsula
Sample size	727	458	521	376	275
Percentage who would not change trips	97.7 %	94.5 %	97.1 %	96.0 %	88.0 %
Predicted percentage change in trips	0.0 %	2.1 %	-23.1 %	-15.5 %	8.0 %

One question within the contingent behavior section of the survey asked respondents who engaged in Personal Use (PU) fishing about their PU trips to Chitina and willingness to pay PU access fees. In general, between 40% and 60% of respondents in the sample populations said they would still purchase a permit if the PU access fee were increased from $10 to $25 (Table 22). Copper River area anglers and Region III (exclusive of the Seward Peninsula and Copper River area) anglers reported the highest PU use (0.4 trips per year). In 1997, trips involving charter services were one-quarter of total PU trips to Chitina. Nonresidents and Seward Peninsula residents reported extremely low PU fishing trips to Chitina.

Table 22.-Personal use fishing responses by sample population.

	Copper River	Non-residents	Other Region III	Regions I and II	Seward Peninsula
Sample size	223	19	174	46	n/a
Percent who would still buy personal use fishing permits with access fee increase	54.7 %	42.1 %	59.8 %	60.9 %	n/a
Average number of personal use fishing trips to Chitina in 1997	0.4	0.1	0.4	0.1	0.0
Average number of charter PU trips to Copper River area in 1997	0.1	0.1	0.1	0.0	0.0

5.0 DISCUSSION

5.1 Total Net Economic Value of Salmon 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 salmon 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). More recently, Layman et al. (1996) used a travel cost method in an attempt to estimate consumer surplus of the chinook salmon sport fishery in the Gulkana River. Jones (1998) used a travel cost method to examine the NEV of the personal use and subsistence salmon fisheries in the Copper River. Duffield et al. (2001) estimated total NEV of sport fishing in Region III, specifically focusing on grayling sport fisheries.

Non-resident anglers have a higher NEV ($816) for trips than do all other Alaska anglers (ranging from $121.70 to $191.57). This is consistent with the findings of many previous studies of recreational NEV (see for example Duffield and Neher 1994, Duffield et al. 1992, and Duffield 1992). The adjusted mean NEV estimates shown in Table 8b are also 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 a NEV of $564 per trip.

In 1997, sport fishing for salmon in Region III is estimated to have a total NEV of approximately $13.7 million. The majority of this total (67%) is from nonresident sport fishing trips in Region III. The revelation of the overwhelming contribution of nonresidents to net economic benefits relating to salmon sport fishing in Region III may promote discussion for fisheries management planning.

A weakness of this study is incomplete direct measures of species-specific angler trip information by fishery. The ADF&G, Sport Fish Division does not currently collect this data. Instead, our analysis relied on species-specific trip information collected by the authors during a 1996 survey; and, by a special survey conducted by ADF&G in 1994 and 1995. 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 <u>total</u> 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 for salmon sport fishing in Region III. Among the years examined for analysis relating to this study (1994-1996), the proportion of total trips for salmon sport fishing varied little.

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 salmon sport fisheries in Region III was 33.4 in FY98. Obviously, the benefits of Region III's salmon 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 sport fishing regulations. Changes in bag limit and bait as a legal fishing means 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.

Our research shows that changes in visitation would come from a minority of anglers. Consistently across models, over three-fourths of respondents said that the proposed regulation changes would have no effect on the number of trips they would take to rivers in the specified rivers. 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 and bait 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 reduction in bags for chinook salmon in the Copper River and coho salmon in the Unalakleet River resulted in predicted decreases in trips to both areas. For the Copper River, both nonresidents & Regions I and II populations reported the greatest reduction: 8.4%. Since their trips have the most value, the greatest loss in net economic value as a result of implementing a reduced bag limit would come from these populations. For the Unalakleet River, large losses in trips are predicted for the populations from the remainder of Region III (-23.1%), and Regions I and II residents (-15.5%). Respondents were largely supportive of the proposal to reduce bag limits for conservation concerns. This suggests that while there may be a small to modest negative

net economic impact, anglers will largely be supportive of the proposed bag limit reductions necessitated by conservation concerns.

Possible increases in bags for sockeye salmon in the Gulkana and Klutina rivers and chinook salmon in the Tanana drainage resulted in predicted increases in trips. For the Copper River streams, large increases in trips are predicted for the Remainder of Region III and Regions I and II populations. For the Tanana drainage, the largest predicted trip increases are for nonresidents (12.4%). Public opinion was largely supportive of these regulation changes.

The possible elimination of bait for chinook salmon in the Copper River resulted in predicted decreases in trips, with populations from Regions I and II (-14.3%) and nonresidents and remainder of Region III residents (-11.1%) stating the greatest changes. Public reaction was mixed, with Copper River residents stating the most opposition: 48.1% were opposed, while just 24% were supportive.

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 public 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. The highest rating across respondent populations was given to "fishing in a wilderness setting". Concomitant with this finding is that a low percentage of respondents preferred "having more developed camping facilities". "Catching and keeping salmon" was more preferred by roughly twice as many respondents as "catching and releasing" salmon. Thus, strategies that preserve harvest opportunities for salmon in a wilderness setting are likely to produce the greatest angler satisfaction, especially for resident anglers.

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 (20-22 years), number of days fished per year (15-22 days), age (37-41 years), percent male (68-77%), and years of schooling (12). 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 fished the longest (27 years), were the most avid (25 days per year), were older (48 years), and were a higher percentage of males (82%) than residents.

More than 60% of resident anglers fishing in Region III waters specifically target salmon, indicating the importance of salmon to Region III's total sport fishing opportunities. The greatest number of trips to sport fish for salmon was by Seward Peninsula residents, who also reported the highest average number of salmon harvested (7) on their most recent salmon sport fishing trip.

About twice as many nonresidents gave their salmon fishing experience a high rating as did residents. For Copper River residents and those from the remainder of Region III, only 21.8% and 23.8%, respectively, thought that the overall quality of their salmon 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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LITERATURE CITED

Belli, R. F. 1997. Reducing vote overreporting in surveys: social desirability, memory failure, and source monitoring. Public Opinion Quarterly 63(1):90-108.

Bishop, R. C. and T. A. Heberlein. 1992. The contingent valuation method, in natural resource damages: law and economics, by K. Ward and John Duffield. John Wiley. New York.

Boyle, K. J. and R. C. Bishop. 1987. Valuing wildlife in cost-benefit analysis: a case study involving endangered species. Water Resources Research 23(5): 943-950.

Bowker, J. M. and J. R. Stoll. 1988. Use of dichotomous choice methods to value the whooping crane resource. American Journal of Agricultural Economics 70: 372-381.

Cameron, T. A. 1988. A new paradigm for valuing non-market goods using referendum data: maximum likelihood estimation by censored logistic regression. Journal of Environmental Economics and Management 15: 355-379.

Cameron, T. A., W. D. Shaw, S. E. Ragland, J. Maccala, and S. Keefe. 1996. Using actual and contingent behavior data with differing levels of aggregation to model recreation demand. Journal of Agricultural and Resource Economics 21(1):130-149.

Carson, R. T., W. M. Hanemann, and R. C. Mitchell. 1986. Determining the demand for public goods by simulating referendums at different tax prices. Manuscript, University of California, San Diego.

Cicchetti, C. J., J. A. Dubin, and L. L. Wilde. 1991. The use and misuse of surveys in economic analysis: natural resource damage assessment under CERCLA. California Institute of Technology Social Science Working Paper 786.

Cooper, J. C. 1997. Combining actual and contingent behavior data to model farmer adoption of water-quality protection practices. Journal of Agricultural and Resource Economics 22(1):30-43.

Cummings, R., D. Brookshire, and W. Schultz. 1986. Valuing environmental goods. Rowman and Allenheld, Totowa, N.J. 270 pp.

Dillman, D. 1978. Mail and telephone surveys. John Wiley. New York.

Duffield, J. 1992. An economic analysis of wolf recovery in Yellowstone: Park visitor attitudes and values. Pages 2-35 to 2-87 *in* J. D. Varley and W. G. Brewster, eds. Wolves for Yellowstone? A report to the United States Congress, Volume 4, Research and Analysis. NPS, Yellowstone National Park, Wyoming, 739 pp.

Duffield, J. 1997. Predicting market-clearing prices for nonresident hunting permits. Report for Montana Department of Fish, Wildlife and Parks.

Duffield, J. 1997. Nonmarket valuation and the courts: the case of the Exxon Valdez. Contemporary Economic Policy 15:98-100.

Duffield, J.W., C. Neher, D. Patterson and S. Allen. 1990. Instream flows in the Missouri River basin: A recreation survey and economic study. Report for the Montana Department of Natural Resources and Conservation. Helena.

LITERATURE CITED (Continued)

Duffield, J. and D. Patterson. 1991. Inference and optimal design for a welfare measure in dichotomous choice contingent valuation. Land Economics 67(2): 225-39.

Duffield, J., J. Loomis, and R. Brooks. 1987. The net economic value of fishing in Montana. Report for the Montana Dept. of Fish, Wildlife, and Parks. Helena, MT.

Duffield, J., C. Neher, and T. Brown. 1992. Recreation benefits of instream flow: Application to Montana's Big Hole and Bitterroot Rivers. Water Resources Research 28 (9): 2169-2181.

Duffield, J., and C. Neher. 1994. Bighorn River angler survey: analysis of responses to congestion and contingent valuation questions. Report for the Montana Department of Fish, Wildlife, and Parks. Billings, MT.

Duffield, J., C. Neher and M. Merritt. 2001. Alaska angler survey: use and valuation estimates for 1996, with a focus on Arctic grayling in Region III. Alaska Department of Fish and Game, Special Publication Number 01-5, Anchorage.

Efron, B. 1982. The jackknife, the bootstrap, and other resampling plans. Society for Industrial and Applied Mathematics, Philadelphia, PA.

Ferber, R. and R. A. Piskie. 1965. Subjective probabilities and buying intentions. The Review of Economics and Statistics 47:322-325.

Freeman, A. M. III. 1993. The measurement of environmental and resource values: theory and methods. Washington, D.C.: Resources for the Future.

Goodman, L. A. 1960. On the exact variance of products. Journal of the American Statistical Association 55:708-713.

Hanemann, W. M. 1984. Welfare evaluation in contingent valuation experiments with discrete responses. American Journal of Agricultural Economics 66: 332-341.

Hanemann, W. M. 1989. Welfare evaluation in contingent valuation with discrete response: reply. American Journal of Agricultural Economics 66:332-341.

Herrick, S. and 6 co-authors. 1994. Application of benefit-cost analysis to fisheries allocation decisions: the case of Alaska walleye pollock and Pacific cod. North American Journal of Fisheries management 14:726-741.

Howe, A. L., G. Fidler, C. Olnes, A. E. Bingham, and M. J. Mills. *In press*. Revised edition: Harvest, catch, and participation in Alaska sport fisheries during 1997. Alaska Department Fish and Game, Fishery Data Series Number 98-25, (Revised) Anchorage.

Howe, A. and S. Fleischman. *In prep*. Targeted angler-days fished for selected Alaska sport fisheries, 1994 and 1995. Alaska Department of Fish and Game, Anchorage.

Jones and Stokes Associates. 1987. Sport fishing economic study. Consultants report, 1725-23rd St, Sacramento, Calif.

Jones, M. 1998. The economic value of Alaska's Copper River personal use and subsistence fisheries: an application of the zonal travel cost model. M.S. Thesis. University of Alaska Fairbanks.

Kopp, R. J. and V.K. Smith. 1993. Valuing natural assets: the economics of natural resource damage assessment. Washington, D.C.: Resources for the Future.

Layman, R., J. Boyce and K. Criddle. 1996. Economic valuation of the chinook salmon sport fishery of the Gulkana River, Alaska, under current and alternate management plans. Land Economics 72:113-128.

Magleby, D. B. 1984. Direct Legislation: Voting on Ballot Propositions in the United States. Baltimore: The Johns Hopkins University Press.

McConnell, K. E. 1986. The Damages to Recreational Activities from PCBs in New Bedford Harbor. Cambridge, MA: Industrial Economics.

Mitchell, R.C., and R.T. Carson. 1989. Using Surveys to Value Public Goods: the Contingent Valuation Method. Resources for the Future, Washington, D.C. 463pp.

Mitofsky, W.J. 1996. Review: was 1996 a worse year for polls than 1948? Public Opinion Quarterly 62(2):230-249.

LITERATURE CITED (Continued)

Morton, K.M., W.L. Adamowicz and P.C. Boxall. 1995. Economic effects of environmental quality change on recreational hunting in northwest Saskatchewan: a contingent behavior analysis. Canadian Journal of Forest Research 25:912-920.

Narayanan, R. 1986. Evaluation of recreational benefits of instream flow. Journal of Leisure Research 18(2):116-128.

Park, T., J. Loomis, and M. Creel. 1989. Confidence intervals for evaluating benefit estimates from dichotomous choice contingent valuation survey. Dept. of Agricultural Economics, University of Nebraska.

Patterson, David and John Duffield. 1991. Cameron's censored logistic regression model: comment and extension. Journal of Environmental Economics and Management 20: 275-283.

Pollock, K., C. Jones and T. Brown. 1994. Angler survey methods and their applications in fisheries management. American Fisheries Society, Special Publications 25. Bethesda, Maryland.

SAS Institute. 1988. SAS/STAT Users Guide. Release 6.04 Edition. Cary, N.C.

Thayer, M.A. 1981. Contingent valuation techniques for assessing environmental impacts: further evidence. Journal of Environmental Economics and Management 8(2):27-44.

Theil, H. and R.F. Kosobud. 1968. How informative are consumer buying intentions surveys? The Review of Economics and Statistics 50:50-59.

Thompson, S. K. 1992. Sampling. John Wiley and Sons, New York, USA.

Traugott, M.W. and J.O. Katosh. 1979. Response validity in surveys of voting behavior. Public Opionion Quarterly 43(3):359-377.

U.S. Department of the Interior. 1986. Natural resource damage assessment rules and regulations. Federal Register 51(148):27725-27753(August 1).

U.S. Department of the Interior. 1991. Natural resource damage assessments: notice of proposed rulemaking. Federal Register 56(82): 19752-1973 (April 29).

U.S. Fish and Wildlife Service. 1994. The reintroduction of gray wolves to Yellowstone National Park and Central Idaho: Final Environmental Impact Statement. Helena, MT.

U.S. Fish and Wildlife Service. 1997. Grizzly bear recovery in the bitterroot ecosystem: Draft Environmental Impact Statement.

U.S. Water Resources Council. 1983. Economic and environmental principles for water and related land resources implementation studies. U.S. Government Printing Office, Washington, D.C. 137pp.

APPENDIX A. THE DICHOTOMOUS CHOICE CONTINGENT VALUATION MODEL

Appendix A. The Dichotomous Choice Contingent Valuation Model

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:

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

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:

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

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:

$$L = 1n[p/(1-p)] = \alpha t + \tilde{\gamma}' \bar{\chi} \qquad \textbf{(3)}$$

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:

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

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:

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

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 Methods.

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, Traugott 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-

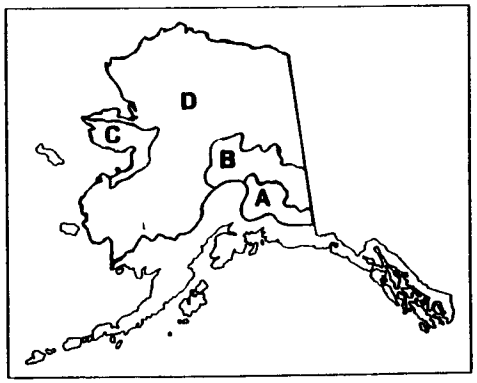
The same households were resampled 12 months later so that predicted and actual behavior could be compared. A basic finding from this literature is that generally buying intentions overstate actual future purchases. This is not surprising since the response categories include not only "yes-probably" 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 INSTRUMENTS, CONTACT LETTERS, REMINDER POSTCARD AND REMINDER LETTER

Region III

Salmon Angler and Personal Use Survey



Alaska Department of Fish and Game
Division of Sport Fish

1998

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The purpose of this survey is to obtain information about angler or personal use of salmon in Region III. The map on the cover of this survey shows the different general 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.

For the purposes of this survey, angling with a rod and reel is considered sport fishing

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? _____days

3. Do you take trips specifically to try to catch salmon? ____yes ____no

4. Please rate your preferences (circle the number) from least preferred (1) to most preferred (5) when fishing for salmon.

Fishing Experience	Preference				
	Least				Most
Fishing easily accessible site near a road	1	2	3	4	5
Fishing in a wilderness setting	1	2	3	4	5
Harvesting salmon	1	2	3	4	5
Catching and releasing salmon	1	2	3	4	5
Having good trail access to fishing waters	1	2	3	4	5
Having more developed camping facilities	1	2	3	4	5

5. Did you sport fish for salmon in 1997 or have you done so in 1998?
_____yes **(continue with question 6)**
_____no **(please skip to Section III)**

6. In which of the following sites have you sport fished for salmon in 1997 or 1998? Please check yes or no for each site and indicate how many salmon fishing trips you made from home to each site in 1997 and so far in 1998 (See map on the back of the enclosed letter). If you fished other Area III waters that are not listed below, please write in the name of the water you fished most frequently in 1997 or 1998.

Salmon Fishing Site	Fished in 1997 or 1998?		Number of salmon fishing trips	
	YES	NO	1997	1998
Area A. Copper River Area				
Gulkana River	___	___	___	___
Klutina River	___	___	___	___
Tonsina River	___	___	___	___
Kiana Creek	___	___	___	___
Other Area A water (write in)				
_____	___	___	___	___
Area B. Tanana River drainages				
Chena River	___	___	___	___
Salcha River	___	___	___	___
Delta Clearwater River	___	___	___	___
Chatanika River	___	___	___	___
Other Area B water (write in)				
_____	___	___	___	___
Area C. Seward Peninsula				
Unalakleet River	___	___	___	___
Fish/Niukluk River	___	___	___	___
Nome River	___	___	___	___
Other Area C water (write in)				
_____	___	___	___	___
Area D. Remainder of Region III				
Other Area D water (write in)				
_____	___	___	___	___
_____	___	___	___	___

If you only fished for salmon outside of Region III, please skip to section III

Section II. In this section, we would like to ask you about your most recent chinook (king) salmon fishing trip to one of the sites or areas during 1997 or 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 1997 chinook (king) salmon 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 chinook (king) salmon fishing trip to the site or area you indicated above.

8. What was the approximate date of your most recent chinook (king) salmon 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 purpose I took this trip.
- ☐ Fishing this site was one of the main purposes I took this trip
- ☐ Fishing this site was just one of several activities for me on this trip.

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

11. On this most recent trip, how many chinook (king) salmon did you catch? _____ keep? _____

12. For this site, would you characterize your fishing experience on your most recent trip as: (Check one)
- ☐ Poor
- ☐ Below average
- ☐ Average
- ☐ Above average
- ☐ Excellent

13. How many people were in your party on this particular trip?
_____ Number of people

-continued-

14. 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	$ _____

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

☐ Yes ☐ No

16. If YES, would you still have made the trip if your share of the expenses had been $ 200.00 more?

☐ Yes ☐ No

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

_____

_____

Section III. In this section, we would like to ask your preferences for possible options for the Alaska Fish & Game salmon fishing regulations.

Group I. Options for Salmon in the Copper River Area (Area A)

_____ I would not fish for salmon in the Copper River Area regardless of regulation changes **(Please skip to Group II)**

How many fishing trips did you take to the Copper River Area in 1997?
_____trips

17. Currently there is a seasonal bag limit of 5 chinook (king) salmon in the Copper River drainage. Due to conservation concerns, the seasonal bag limit may be reduced to 3 kings. How would this possible change affect your fishing trips to the Copper River drainage?

___ I would not change the number of trips taken to the Copper River drainage.
___ 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

18. With the exception of the Tonsina River drainage, bait is legal for fishing for chinook (king) salmon in the Copper River drainage, however conservation concerns may necessitate bait being eliminated as a legal fishing means. How would this possible change influence your fishing trips to the Copper River drainage?

___ I would not change the number of trips taken to the Copper River drainage.
___ 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

19. Currently there is a daily bag limit of 3 sockeye (red) salmon in the Gulkana and Klutina rivers. In years of high sockeye returns to these systems, the daily bag limit may be increased to 6 sockeye. How would this change affect your fishing trips to the Copper River drainage?

___ I would not change the number of trips taken to the Copper River drainage.
___ 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

-continued-

If you Personal Use (PU) fish please answer the following questions. If not, skip to Group II.

20. The $10 fee charged for the Copper River PU dipnet fishery permit is paid to private landowners for access to O'Brian and Haley creeks at Chitina. Without this trespass fee, access to the fishery would not be permitted. The access contract is up for renewal at the end of 1998 and it is possible the fee will increase to $25 for the 1999 PU fishery season, with no change in site cleaning services.

How many PU fishing trips did you take to Chitina in 1997 _____?

If the PU access fee were increased from $10 to $25 for 1999, would you still purchase the Permit? _____yes _____no.

IF NO, Why not? _____

_____

21. How many charter trips for PU fishing to the Copper River area did you take in 1997? _____trips.

Group II. Options for salmon in the Tanana Drainage (Area B).

_____ I would not fish for salmon in the Tanana Area regardless of regulation changes. (Please skip to Group III)

How many fishing trips did you take in the Tanana Area in 1997? _____trips

22. Currently there is a daily bag limit of 1 chinook (king) salmon, any size. Managers may increase the daily bag limit to 2 kings, if one is a "jack", less than 21 inches in total length. How would this change affect your fishing trips to Tanana area waters?

___ I would not change the number of trips taken to the Tanana drainage.
___ 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

Group III. Options for salmon in the Seward Peninsula area (Area C).

_____ I would not fish for salmon in the Seward Peninsula area regardless of regulation changes. (Please skip to Section IV)

How many fishing trips did you take to the Unalakleet River in 1997? _____trips

23. Currently the daily bag limit for coho (silver) salmon on the Unalakleet River is 10 fish. Conservation concerns may necessitate a reduced bag limit of 5 coho salmon per day. How would this change affect your fishing trips to the Unalakleet?

___ I would not change my number of trips to the Unalakleet River drainage.
___ 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

24. If you indicated that you would take more salmon fishing trips under any of the regulation changes, 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 salmon at the Region III waters discussed above.

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

25. Where do you live? City: _____ State: _____

26. What is your age? _____ years

27. Are you: ☐ male ☐ female

28. How many years of formal schooling have you attended? _____years

29. Please circle your household's income before taxes for 1997:

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

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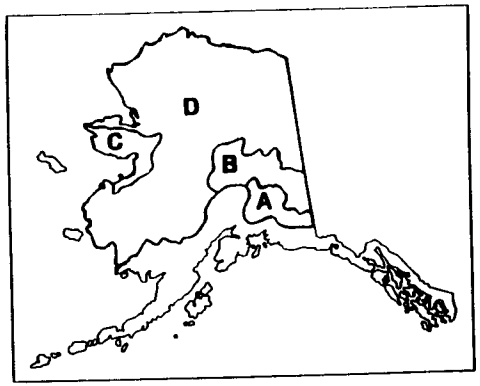
Region III

Salmon Angler and Personal Use Survey



Alaska Department of Fish and Game
Division of Sport Fish

1998

-continued-

The purpose of this survey is to obtain information about angler or personal use of salmon in Region III. The map on the cover of this survey shows the different general 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.

For the purposes of this survey, angling with a rod and reel is considered sport fishing

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? _____days

3. Do you take trips specifically to try to catch salmon? ____yes ____no

4. Please rate your preferences (circle the number) from least preferred (1) to most preferred (5) when fishing for salmon.

Fishing Experience	Preference				
	Least				Most
Fishing easily accessible site near a road	1	2	3	4	5
Fishing in a wilderness setting	1	2	3	4	5
Harvesting salmon	1	2	3	4	5
Catching and releasing salmon	1	2	3	4	5
Having good trail access to fishing waters	1	2	3	4	5
Having more developed camping facilities	1	2	3	4	5

5. Did you sport fish for salmon in 1997 or have you done so in 1998?
_____**yes (continue with question 6)**
_____**no (please skip to Section III)**

If you Personal Use (PU) fish please answer the following questions. If not, skip to Group II.

21. The $10 fee charged for the Copper River PU dipnet fishery permit is paid to private landowners for access to O'Brian and Haley creeks at Chitina. Without this trespass fee, access to the fishery would not be permitted. The access contract is up for renewal at the end of 1998 and it is possible the fee will increase to $25 for the 1999 PU fishery season, with no change in site cleaning services.

How many PU fishing trips did you take to Chitina in 1997 _____?

If the PU access fee were increased from $10 to $25 for 1999, would you still purchase the Permit? _____yes _____no.

IF NO, Why not? _____

_____

22. How many charter trips for PU fishing to the Copper River area did you take in 1997? _____trips.

Group II. Options for salmon in the Tanana Drainage (Area B).

_____ I would not fish for salmon in the Tanana Area regardless of regulation changes. (Please skip to Group III)

How many fishing trips did you take in the Tanana Area in 1997? _____trips

23. Currently there is a daily bag limit of 1 chinook (king) salmon, any size. Managers may increase the daily bag limit to 2 kings, if one is a "jack", less than 21 inches in total length. How would this change affect your fishing trips to Tanana area waters?

___ I would not change the number of trips taken to the Tanana drainage.
___ 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

Group III. Options for salmon in the Seward Peninsula area (Area C).

_____ I would not fish for salmon in the Seward Peninsula area regardless of regulation changes. (Please skip to Section IV)

How many fishing trips did you take to the Unalakleet River in 1997? _____trips

24. Currently the daily bag limit for coho (silver) salmon on the Unalakleet River is 10 fish. Conservation concerns may necessitate a reduced bag limit of 5 coho salmon per day. How would this change affect your fishing trips to the Unalakleet?

___ I would not change my number of trips to the Unalakleet River drainage.
___ 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

25. If you indicated that you would take more salmon fishing trips under any of the regulation changes, 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 salmon at the Region III waters discussed above.

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

26. Where do you live? City: _____ State: _____

27. What is your age? _____ years

28. Are you: ☐ male ☐ female

29. How many years of formal schooling have you attended? _____years

30. Please circle your household's income before taxes for 1997:

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-

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	$ _____

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 **$ 10.00** more?

☐ Yes ☐ No

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

_____

_____

Section III. In this section, we would like to ask your preferences for possible options for the Alaska Fish & Game salmon fishing regulations.

Group I. Options for Salmon in the Copper River Area (Area A)

_____ I would not fish for salmon in the Copper River Area regardless of regulation changes **(Please skip to Group II)**

How many fishing trips did you take to the Copper River Area in 1997?
_____trips

18. Currently there is a seasonal bag limit of 5 chinook (king) salmon in the Copper River drainage. Due to conservation concerns, the seasonal bag limit may be reduced to 3 kings. How would this possible change affect your fishing trips to the Copper River drainage?

___ I would not change the number of trips taken to the Copper River drainage.
___ 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

19. With the exception of the Tonsina River drainage, bait is legal for fishing for chinook (king) salmon in the Copper River drainage, however conservation concerns may necessitate bait being eliminated as a legal fishing means. How would this possible change influence your fishing trips to the Copper River drainage?

___ I would not change the number of trips taken to the Copper River drainage.
___ 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

20. Currently there is a daily bag limit of 3 sockeye (red) salmon in the Gulkana and Klutina rivers. In years of high sockeye returns to these systems, the daily bag limit may be increased to 6 sockeye. How would this change affect your fishing trips to the Copper River drainage?

___ I would not change the number of trips taken to the Copper River drainage.
___ 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

-continued-

6. In which of the following sites have you sport fished for salmon in 1997 or 1998? Please check yes or no for each site and indicate how many salmon fishing trips you made from home to each site in 1997 and so far in 1998 (See map on the back of the enclosed letter). If you fished other Area III waters that are not listed below, please write in the name of the water you fished most frequently in 1997 or 1998.

Salmon Fishing Site	Fished in 1997 or 1998?		Number of salmon fishing trips	
	YES	NO	1997	1998
Area A. Copper River Area				
Gulkana River	___	___	___	___
Klutina River	___	___	___	___
Tonsina River	___	___	___	___
Kiana Creek	___	___	___	___
Other Area A water (write in) _____	___	___	___	___
Area B. Tanana River drainages				
Chena River	___	___	___	___
Salcha River	___	___	___	___
Delta Clearwater River	___	___	___	___
Chatanika River	___	___	___	___
Other Area B water (write in) _____	___	___	___	___
Area C. Seward Peninsula				
Unalakleet River	___	___	___	___
Fish/Niukluk River	___	___	___	___
Nome River	___	___	___	___
Other Area C water (write in) _____	___	___	___	___
Area D. Remainder of Region III				
Other Area D water (write in) _____ _____	___	___	___	___

If you only fished for salmon outside of Region III, please skip to section III

Section II. In this section, we would like to ask you about your most recent salmon fishing trip to one of the sites or areas during 1997 or 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 1997 or 1998 salmon 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 salmon fishing trip to the site or area you indicated above.

8. What was the approximate date of your most recent salmon 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 purpose I took this trip.
- ☐ Fishing this site was one of the main purposes I took this trip
- ☐ Fishing this site was just one of several activities for me on 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 of salmon were you primarily fishing ?
- ☐ Chinook (king)
- ☐ Coho (silver)
- ☐ Sockeye (red)
- ☐ Chum (dog)
- ☐ Pink (humpy)

12. On this most recent trip, how many salmon did you catch? _____ keep? _____

13. For this site, would you characterize your fishing experience on your most recent trip as: (Check one)
- ☐ Poor
- ☐ Above average
- ☐ Below average
- ☐ Excellent
- ☐ Average

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

-continued-

Appendix C3.-Text of Contact Letters and Map Accompanying Initial Survey Mailing.

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-

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.

To thank you for taking the time to complete this survey, we are giving anglers who return a completed survey the opportunity to enter a drawing for a new custom made Loomis IMX 8 ½ ft salmon fishing rod for 10-20 lb test line and a Penn spin fishing reel, 5500 series (total value approximately $350.00). In order to enter this drawing, simply write your name and phone number on this letter and return it with your completed survey (only completed surveys will be entered in the drawing). A drawing for the prize will be held on September 15 and the winner will be notified immediately after.

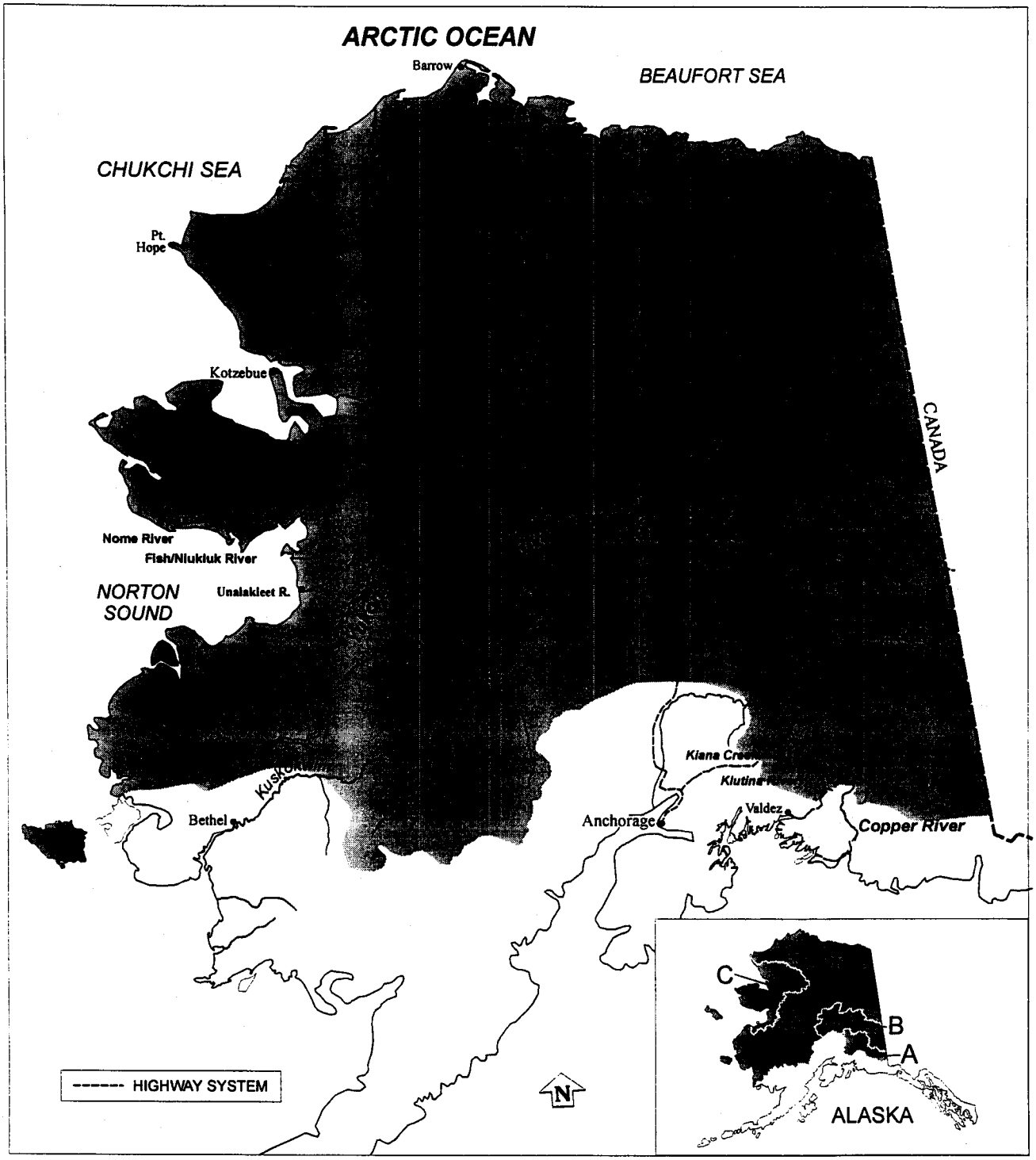
If you are unfamiliar with the area or waters mentioned in this survey, please refer to the regional map on the cover of the survey booklet and the detailed area map on the back of this letter.

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


ARCTIC OCEAN
Barrow
BEAUFORT SEA
CHUKCHI SEA
Pt. Hope
Kotzebue
CANADA
Nome River
Fish/Niukluk River
NORTON SOUND
Unalakleet R.
Kiana Creek
Klutina
Valdez
Bethel
Anchorage
Copper River
HIGHWAY SYSTEM
N
C
B
A
ALASKA

Appendix C4.-Reminder Postcard.

Dear Alaska 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 C5.-Reminder Letters.

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

-continued-

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.

To thank you for taking the time to complete this survey, we are giving anglers who return a completed survey the opportunity to enter a drawing for a new custom made Loomis IMX 8 ½ ft salmon fishing rod for 10-20 lb test line and a Penn spin fishing reel, 5500 series (total value approximately $350.00). In order to enter this drawing, simply write your name and phone number on this letter and return it with your completed survey (only completed surveys will be entered in the drawing). A drawing for the prize will be held on September 15 and the winner will be notified immediately after.

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 PER HOUSEHOLD-TRIP FROM THE STATEWIDE HARVEST SURVEY

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 1997.

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):

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

where:

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

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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:

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

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

with:

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

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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):

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

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):

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

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

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

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

in which:

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

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

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

Appendix D2.-Estimated angler-trips per household-trip and estimated angler-trips for five populations of sport fish license holders from statewide harvest survey data for Region III, 1997.

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	4,925	760	1.202	0.065	5,919	600
Nonresidents	24,663	1,174	1.179	0.017	29,077	848
Region I and II residents	20,806	1,190	1.298	0.032	27,024	1,188
Remainder of Region III residents	89,618	3,268	1.126	0.013	100,920	2,040
Seward Peninsula	5,438	1,452	1.111	0.640	6,042	785

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	73	58	131
Nonresidents	954	121	1,075
Region I and II residents	674	179	853
Remainder of Region III	1,607	778	2,385
Seward Peninsula	30	41	71

APPENDIX E. SUMMARY OF OPINIONS IN LETTERS

Appendix E.-Summary of opinions in letters.

Population	Comment
Fairbanks	We get all the salmon we eat from the Chitina dipnetting permit. If the price of the fee goes up we are not sure we would keep going to Chitina – maybe we'd go to other areas to get our salmon.
Nikolai	Our village has very poor salmon fishing.
Nome	There should be greater restrictions on the commercial fishers – there used to be fish in the rivers but now with the draggers the bycatch is uncalled for. Only 18% of the fish that the draggers are catching are kept and the rest is dumped out. We (Nome residents) are the ones who lose!
Fairbanks	In reference to reducing the seasonal bag on king salmon: "I would contribute to a class action lawsuit arguing that failure to control commercial fishing in the Copper River Flats violated public trust access rights to sport fisheries.
Kotlik	I am not a sport fisher – I am a subsistence fisher.
Delta	I cannot understand why sport fishers are penalized a salmon or two when millions of kings and sockeyes are caught by commercial fishermen each year. You let those commercial fishers catch all they want & then slap fees on sport fishers and take away fish from us guys who just want to put some meat in the freezer and on the table. I strongly oppose any restrictions on sport, personal use and subsistence fishers. The problem is all the boats and nets around Cordova that won't let the salmon up the river.
Bethel	I am proud to say I am no sports fisherman – I don't believe in using food as a play toy. My definition of sports = play. I hate sportsman!! I am a subsistence user.
Nonresident	Alaska tripled the price of a nonresident fishing license. Alaska is only interested in how much money they can take the tourist for. I am contacting my Congressman about a national fishing license & I hope every nonresident that was in your state does the same.
Glennallen	Please change the rules of not using bait in the Copper Valley. We have for years used bait for grayling & Dolly Varden fishing in the Tonsina drainage until just last year. Please reinstate the use of bait.
Delta	A large part of the problem is the commercial fisherman. Last time I heard they had caught 70,000 kings this season so far. If 10,000 more kings came into the hands of sport fishers would you need a survey about sport fishing restrictions? I agree the limit should be 3 kings per year per person for the Copper River, for both sport & personal use fishing. Restrict guides on the Gulkana River. I have fished this river for 23 years & since guides have started I have seen a steady decline in fishing quality. Cap the number of guides on the river; have each boat be identified on each side of the boat-I have seen a guide showing clients how to snag reds; limit the number of days a guide could be on the river to four. Limit motor size to a 35 HP jet. This should limit guides from taking more than 2-3clients at a time. It would also help prevent erosion. In years of high sockeye returns, I think snagging should be legal as it is very difficult to catch them by mouth.

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Population	Comment
Fairbanks	Sport fishers take only a small fraction of king salmon. If the commercial fishers cut back a few percent, sport fishers could continue taking a few, with eggs, with a 5 fish per season bag. Rather than cur sport fishers again, cut the commercial fishers – they took 70,000 kings in 1998.
Fairbanks	In regards to possibly reducing the seasonal bag to 3 kings, this is totally political-limit commercial openings. It is totally unnecessary to eliminate bait, as most kings that are caught are released anyway. Jack kings often run 22 – 24 inches in length – I suggest changing the minimum length of a jack from 21 to 24 inches – the fish are dead anyway.
Glennallen	The sports fisher people bring more money into the state than commercial fishermen. Don't penalize the sportsman.
Delta	I am physically handicapped and bought a sport license to get a proxy permit so my son could go to Chitina for me. He caught 20 red salmon. I hope to be able to take advantage of the proxy fishing permit program again.
Anchorage	I am very tired of my sportfishing opportunities being lost because of overfishing by the commercial guys. I am sick & tired of 97% of my resource being allocated to the commercial fishery.
Glennallen	Last year the only fishing I did was subsistence dip netting on the Copper. I caught about 50 reds above the bridge.
Nonresident	We observed a major problem on the Klutina River. There was an officer at the mouth when the river was closed to fishing, but not long enough. On the last day there were many, many fish taken there. The problem was, in part, the lack of a sign, saying that the Copper at the mouth of the Klutina, was closed to salmon fishing. Also, we believe that caught & released kings on the swift Klutina River are spent & do not survive. Why should anyone be allowed to catch 10 to 20 kings, and release them to die (before spawning)?
Nonresident	I am an Alaska resident, and own property in Alaska, however my husband is military & I choose to live with him out of state part of the year. As a result, I no longer qualify for a resident fishing license. I am really disappointed in my state.
Anderson	I only buy a sport fish license to help conservation. I work in the cannery and do not really have time to fish.
Glennallen	There is a problem of crowding on the Gulkana River. You can no longer go out & enjoy the river. Most locals would like to see fewer boats on the river. I suggest banning nonresident guides and king fishing above Sourdough.
Aniak	I've never sport fished in my life. I'm a subsistence gatherer. I'm against sport fishing.

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Appendix E.-Page 3 of 3.

Population	Comment
Delta	I dip net for my winter food supply. I enjoy the trip to Chitina most of the time but it definitely isn't sport fishing – it is work necessary to fill freezer or jar them.
Seward Pen.	I do not consider my self a sport fisherman, whether I hold a license that may indicate this or not. I am a subsistence user and very pro rural preference. The sooner the state steps aside and allows this to happen the better.
Nonresident	I fished out of Valdez. Fishing was good in the early part of our trip but when the commercial netters were allowed inside the narrows fishing turned very poor. They were supposed to be taking the pinks but they completely destroyed the silver run. With only line fishermen inside the narrows most of the silvers would have made it to their spawning grounds. However, for a 10 day period in the heart of the silver run, the run was decimated. If you can or want to survive without revenue from people interested in fishing in Alaska, continuing to allow overfishing by commercial fishers will assure you a continuing decline of sport fishermen. In the 28 days I spent in Valdez I talked to a number of sport fishers that expressed their opinion they would not return, & would travel to Canada instead. Many nonresidents had spent big dollars to come to Alaska to fish, and were extremely disappointed during the 10 day netting period because they have only a few days to sport fish.
Glennallen	Guides and transporters are commercial operators and should be regulated as such. Restrict the number of commercial operators to protect the resource & enhance quality experiences. King salmon are more valuable to upriver users (sports fishermen) through tourism. The most help you can provide commercial operators is to extend our seasons with additional species enhancement. Access is critical. We have enough fish – we just need fair management for all user groups. The free-for-all guide operations are not conducive to good quality experiences. If we don't do something soon the Gulkana will become an overcrowded Kenai.