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DALL SHEEP HUNTING IN ALASKA: WHAT IS IT WORTH?

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Abstract: Economic values for Dall sheep (Ovis dalli dalli) hunting in Alaska are needed for comparison with economic values of competing development alternatives for sheep habitat. Such alternatives include grazing, settlement, agriculture, and mining. A mail survey was used to question all who hunted Dall sheep in Alaska in 1983. Eighty-eight percent responded. Expenditures by respondents exceeded $5.9 million with 85% of the expenditures occurring in Alaska. Nonresident hunters contributed 50% of this total even though they accounted for only 17% of the hunters. The total value of Dall sheep hunting to hunters was over $9.6 million as determined by hunters' expenditures (costs) and consumer surplus (net benefits). Use of the willingness-to-accept-compensation contingent valuation technique for varying degrees of lost hunting opportunities showed the total value to hunters of future Dall sheep hunting opportunities was between $3.2 billion and $28.4 billion.

This study was conducted in response to concern that no economic values were yet established for Dall sheep (Ovis dalli dalli) for comparison with economic values of proposed alternative uses of sheep habitat. Examples of proposed alternatives include grazing of domestic animals, mining, and homesites, all of which may not be compatible with wild sheep.

The purpose of this study was to determine economic values for Dall sheep habitat based on the expenditures associated with hunting and on the value sheep hunters place on their hunting experience. These values represent minimum values for Dall sheep habitat as they do not include other values for sheep such as viewing, just knowing they are "out there," and the value of providing wildlife resources for future generations. Values for these nonconsumptive uses are more difficult to define and were not addressed in this study.

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BACKGROUND

Dall Sheep Hunting in Alaska

Approximately 2,600 people hunt Dall sheep each year in Alaska and harvest approximately 1,100 sheep in the 40-day season (10 August-20 September). Approximately 80% of the hunters are residents and 20% are nonresidents (Alaska Department of Fish and Game, unpubl. data).

Sheep hunters in Alaska can choose from a variety of hunting opportunities in eight major mountain ranges, each having its own unique characteristics of terrain, weather, and accessibility (Fig. 1). When deciding where to hunt, hunters may consider the sheep populations within these mountain ranges. Some have particular characteristics of horn growth (Heimer and Smith 1977) and population density which may affect hunter success. Hunters interested in trophy animals may choose to hunt in different areas than those hunters who are content with sheep whose horns just meet legal minimum size.

However, sheep hunters do not have unlimited opportunities in Alaska. Hunting is restricted in national parks and monuments where about 27% of the approximate 70,000 sheep in the state reside (Heimer 1985). State regulations include restrictions to one ram per hunter, minimum horn length of rams, and area-specific restrictions on transportation. All hunters are required to purchase a hunting license and obtain a harvest report form. Nonresidents must purchase a Dall sheep tag and must also hire a guide unless hunting with a resident within the second degree of kindred.

Despite restrictions, those who hunt sheep in Alaska enjoy a greater potential of hunting opportunities than in any other state in the U.S. (Thorne et al. 1985, Weaver 1985). The Alaska Department of Fish and Game would like to ensure that these opportunities continue.

Alaska is undergoing rapid changes since major land ownership decisions were made by legislation such as the Alaska Native Claims Settlement Act (1972) and the Alaska National Interest Lands Conservation Act (1980). Alaska is subjected to a degree of land use planning probably never exceeded in history (Gallagher 1985). Many land use decisions are and will be made weighing the economic importance of alternative uses. Economic valuation is a procedure which is increasingly being used by natural resource managers for determining maximum benefit. Economic valuation recognizes that tradeoffs must be made and provides an objective and consistent basis for comparing different uses of the same land. The economic value of areas used for wildlife habitat must be determined if wildlife habitat is to be considered among the alternative uses of land.

Natural Resource Economic Valuation

Value-in-use:

Economic value to the consumer may be defined in two general ways. Value-in-use is the total satisfaction the consumer receives from one

Figure 1. The eight major Dall sheep ranges in Alaska.

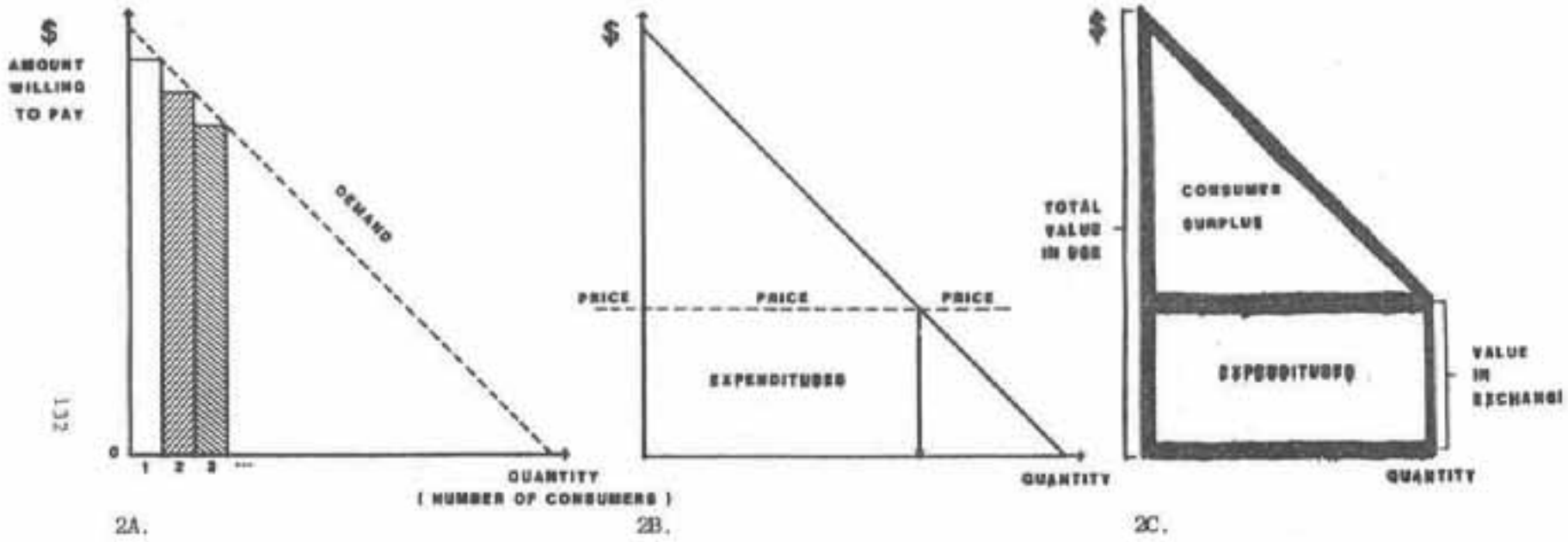

Figure 2. The amount different consumers are willing to pay for a good or service form a demand curve (Fig 2A). The price actually charged for a good or service multiplied by the quantity of consumers willing to pay at least that price equals expenditures. Those consumers not willing to pay the price will not buy the good or service (Fig. 2B). Expenditures are the total value exchanged for the good or service. The amount above the price consumers were willing to pay is termed consumer surplus. Consumer surplus added to the expenditures is one way of expressing the total value in use of a good or service (Fig.2C).

unit of a good or service. In this study, the unit is the sheep hunt or the opportunity to go sheep hunting. Value-in-use is measured by the maximum amount the consumer would be willing to pay to gain this satisfaction. The amount of satisfaction gained from a good or service varies from person to person. Generally, only a few are willing to pay a great deal and an increasing number of individuals are willing to pay as price levels decline. When graphed, this is called the "demand curve" for one unit of the good or service (Fig. 2A). The area enclosed by the plot is the total willingness to pay or the total value-in-use for the consumers.

Another way to define value-in-use is to determine the minimum amount the consumer (a hunter) would have to be compensated for the loss of one unit of the good (one less sheep hunting opportunity). This is often determined by asking the consumer what minimum price value they would place on the good. Both methods have their advantages and disadvantages and serve for much discussion among economists (Larson and Workman 1983).

Value-in-exchange:

Value-in-exchange is the price consumers actually have to pay for the good or service. For most goods, the price is usually set on the open market via the interaction of supply and demand. The price applies to all consumers and is not tailored to fit each individual's willingness to pay. The area under the price designation on the demand curve equals the total expenditures, or the total value-in-exchange, for the good. The amount of satisfaction some consumers gain above the price is termed "consumers' surplus" (Fig. 2B and 2C). (If the price is greater than the value-in-use, that is, if the good costs more than its worth to the consumer, the consumer is not likely to buy.)

Comparison of the consumer surpluses or the net benefits is the basis for many economic decisions. It answers a manager's problem: "Where will the money do the most good?"

Defining these values for wildlife is difficult because wildlife is usually considered a "public good" as it is available to all and is not diminished by use. The nonconsumptive use of wildlife resources on public lands has virtually no price or nearly zero value-in-exchange to consumers. Even the price hunters must pay for the opportunity to hunt, the cost of a hunting license, does not truly express value as determined by the interaction of supply and demand. It is difficult for consumers to express their value-in-use for something they do not normally pay for. Because of this situation, the total value-in-use for wildlife is often called "priceless" and left undefined. "Priceless" cannot be used in economic analyses and, with such a designation, wildlife may not be considered among the economically important alternatives. If only expenditures are used, the value for wildlife may be set artificially low and, when compared with other land uses, protecting wildlife habitat can look like a poor investment. In this study, therefore, I used three measures of economic value.

METHODS

Economic values of Dall sheep hunting were measured using a questionnaire prepared by ADF&G biologists with help from economic and

social research experts from the University of Alaska. The questionnaire was mailed to all hunters who legally hunted Dall sheep in Alaska during the 40-day season of 1983. We did not survey about 75 hunters who hunted in the 9-month-long subsistence season. The design of the questionnaire and the mailing strategies are described in Watson (1984).

The questionnaire asked 2,517 hunters about their hunt expenditures (value-in-exchange) including costs of transportation, equipment, and time off from work without pay (foregone income). Because many nonresident hunters come to Alaska for reasons other than for hunting Dall sheep, they were asked what fraction of the total expenditures could be attributed to their sheep hunt.

To estimate hunters' consumer surplus, the questionnaire asked how much more they would have been willing to pay before deciding not to go sheep hunting. Their answers, when added to their expenditures, would estimate total value-in-use. Value-in-use was also estimated using the alternative question of how much would they charge for the sale of their opportunity to go sheep hunting. This was presented as a series of questions which were time and area specific.

The questionnaires were coded and entered into a computer system for analysis using SPSS-PC (Norusis 1984) software.

RESULTS

Questionnaire Response

Ninety-two (4%) of the 2,517 questionnaires mailed to hunters were returned as undeliverable. Of the remaining 2,425 questionnaires, 2,127 (88%) were returned by the hunters (Table 1). Two percent of the returned questionnaires were not usable in the analysis. Most of those were from residents. The results represent only the sample (although a large one) of sheep hunters who provided usable information and do not necessarily represent the values of all sheep hunters.

Expenditures

Hunters spent at least $5.2 million on sheep hunts in 1983. They purchased hunting licenses, camping equipment, guns and ammunition, transportation, food, lodging, and other items. Some hunters also took time off from work without pay to go sheep hunting. This cost hunters $1.4 million in foregone income. In addition to the expenditures listed above, nonresident hunters spent over $682,000 hunting other game species, visiting relatives, or vacationing. This brought total expenditures associated with sheep hunting to almost $5.9 million. Almost $5 million (85% of the total expenditures) was spent within Alaska.

Nonresident hunters accounted for about half of the expenditures even though they accounted for only 17% of the hunters. Nonresidents had higher transportation costs and, by law, had to hire a guide unless hunting with a resident relative within the second degree of kindred.

Resident hunters spent an average of $1,519 on each sheep hunt (Table 2). Ninety-six percent of this was spent in the state. Nonresident

Table 1.

NUMBER AND PERCENT OF ALASKA'S 1983 DALL SHEEP HUNTERS, BY RESIDENCY, WHO RECEIVED AND RETURNED QUESTIONNAIRES AFTER FIRST MAILING, REMINDER POSTCARDS, AND SECOND MAILING.

	RESIDENTS	NONRESIDENTS	TOTAL
TOTAL QUESTIONNAIRES DELIVERED 20-27 FEB 1984	2035	390	2425
RETURNED BY 12 MAR 1984 (REMINDER POSTCARDS SENT)	1052 (52%)	182 (47%)	1229 (51%)
RETURNED BY 30 MAR 1984 (SECOND MAILING)	1415 (70%)	239 (61%)	1654 (68%)
RETURNED BY 25 APR 1984	1756 (86%)	307 (79%)	2063 (85%)
RETURNED BY 15 JAN 1985	1806 (89%)	351 (90%)	2127 (88%)
NUMBER USABLE IN ANALYSIS	1728 (85%)	351 (90%)	2079 (86%)

Table 2. Mean expenditures by commodity for the surveyed resident and nonresident Dall sheep hunters of Alaska in 1983.

Commodity	Residents (n = 1728)	Nonresidents[a] (n = 351)
Camera and film	$ 93	$ 237
Camp gear	184	230
Entertainment and restaurants	27	137
Forgone income	535	1,427
Guide fee	30	4,477
Guide tip	1	196
Guns and ammunition	183	518
License and tag fees	18	570
Lodging	14	106
Miscellaneous	126	119
Taxidermy	103	449
Tourism and gifts	5	243
Travel in Alaska	258	224
Travel to Alaska	--	973
Average total	$1,567	$9,850

[a] Nonresident expenditures not adjusted to reflect only sheep hunting costs.

hunters spent an average of $9,850 in total expenditures with $7,780 (79%) spent specifically on their sheep hunt. Seventy-eight percent of their total expenditures went directly into Alaska's economy.

Hunter expenditures were also analyzed by hunt area using the eight major mountain ranges as area designations (Table 3). More money was spent for sheep hunts in the Wrangell Mountains than in any other area due to its popularity with resident hunters and the number of guides operating in the area. Resident hunters spent more on hunting in the Brooks Range than in any other location due to high transportation costs. Nonresident hunters paid the highest average costs (excluding the Unspecified Area designation) for permit hunts in the Tanana-Yukon Uplands, although the sample size for nonresidents in this area was very low and resident hunters incurred little more than average costs there. The Brooks Range had the second highest costs to nonresidents. Both residents and nonresidents spent the least amount of money on sheep hunting in the Kenai Mountains.

Consumer Surplus

As a group, hunters would have been willing to spend at least another $4.4 million before deciding not to go sheep hunting in 1983. Residents would have spent another $1.3 million ($\bar{x}$ = $821) while nonresidents would have spent $3.1 million ($\bar{x}$ = $9,897) (Table 4).

Value-in-use

The value-in-use of sheep hunting, when defined as the value-in-exchange (costs) plus consumer surplus (net benefits), for survey respondents was over $9.6 million. When value-in-use was defined by the amount hunters would have to be compensated for the sale of their opportunity to go sheep hunting in their 1983 hunting area the following year, the statewide total value-in-use was over $3 billion (Table 5, Fig. 3). When their foregone opportunity for sheep hunting the following year was not limited to their hunt area but was expanded to hunting anywhere in Alaska the following year, they asked for over $4.5 billion in compensation (Table 6). If these respondents had to give up hunting in their 1983 hunting area forever (as might be the case if an alternative land use were to preclude sheep and/or sheep hunting), the total amount of compensation required would be at least $16.6 billion (Table 7). And when this situation was expanded to preclude hunting anywhere in Alaska, the lowest price charged would be over $28 billion (Table 8).

Many of the hunters indicated they had difficulty answering some or all of these specific questions. They indicated this either by not answering the questions or writing "priceless" instead of a price. The number of such hunters increased from 18% to 57% through the question series. Residents and nonresidents had similar percentages of "priceless" answers or no response until asked how much they would charge for the sale of all of their future opportunities to hunt Dall sheep in Alaska. Sixty-two percent of the residents gave such answers while 33% of the nonresidents said priceless or gave no answer.

Indications of value were also inferred from comments written on the back and in the margins of the questionnaires. These included "sheep

Table 3. Total and average expenditures of the sample of Alaska's 1983 Dall sheep hunters (by residency and hunt area).

Location	Residents (n)	Nonresidents (n)	Total (n)
AK Range, east of DNP[a]	$ 585,056 (394) $\bar{x}$= 1,485	$ 383,911 (49) 7,835	$ 968,967 (443) 2,185
AK Range, west of DNP[a]	162,098 (101) $\bar{x}$= 1,605	381,625 (49) 7,788	543,723 (150) 3,625
Brooks Range	437,577 (191) $\bar{x}$= 2,291	652,606 (76) 8,587	1,090,183 (267) 4,083
Chugach Mtn Range	358,498 (259) $\bar{x}$= 1,384	260,228 (39) 6,673	618,727 (298) 2,076
Kenai Mtn Range	90,078 (125) $\bar{x}$= 721	38,767 (8) 4,971	129,845 (133) 976
Talkeetna, Chulitna, Watana Mts	214,020 (175) $\bar{x}$= 1,223	173,250 (25) 6,930	387,270 (200) 1,936
Tanana-Yukon Uplands	59,747 (38) $\bar{x}$= 1,572	19,720 (2) 9,860	79,467 (40) 2,684
Wrangell Mts	704,442 (417) $\bar{x}$= 1,689	632,042 (81) 7,803	1,336,484 (498) 2,684
Unspecified Area	12,537 (7) $\bar{x}$= 1,791	39,790 (3) 13,263	52,327 (10) 5,233
Total	$ 2,624,053 (1,707) $\bar{x}$= 1,537	$ 2,582,940 (332) 7,780	$ 5,206,993 (2,039) 2,554

[a] DNP = Denali National Park

Table 4. Total and average increased costs by area and residency) given by the sample of Alaska's Dall sheep hunters in response to the question: "How much greater would your total 1983 costs have to have been before you would have decided not to go sheep hunting?"

Location		Residents	(n)	Nonresidents	(n)	Total	(n)
AK Range, east of DNP[a]	$	354,075	(372)	$ 65,513	(50)	$ 419,588	(422)
	$\bar{x}$=	952		1,310		994	
AK Range, west of DNP[a]		69,455	(91)	55,300	(47)	125,755	(138)
	$\bar{x}$=	763		1,177		904	
Brooks Range		181,275	(176)	2,747,325	(75)	2,928,600	(251)
	$\bar{x}$=	1,030		36,631		11,668	
Chugach Mtn Range		169,392	(248)	42,300	(34)	211,692	(282)
	$\bar{x}$=	683		1,244		751	
Kenai Mtn Range		67,013	(116)	22,500	(6)	89,513	(122)
	$\bar{x}$=	578		3,750		734	
Talkeetna, Chulitna, Watana Mts		95,060	(163)	30,625	(24)	125,685	(187)
	$\bar{x}$=	583		1,276		672	
Tanana-Yukon Uplands		32,487	(38)	1,250	(2)	33,737	(40)
	$\bar{x}$=	855		625		843	
Wrangell Mts		337,530	(392)	128,888	(70)	466,418	(462)
	$\bar{x}$=	861		1,841		1,010	
Unspecified Area		9,175	(6)	4,025	(5)	13,200	(11)
	$\bar{x}$=	1,529		805		1,200	
Total	$	1,315,462	(1,602)	$ 3,097,726	(313)	$ 4,413,188	(1,915)
	$\bar{x}$=	821		9,897		2,305	

[a] DNP = Denali National Park

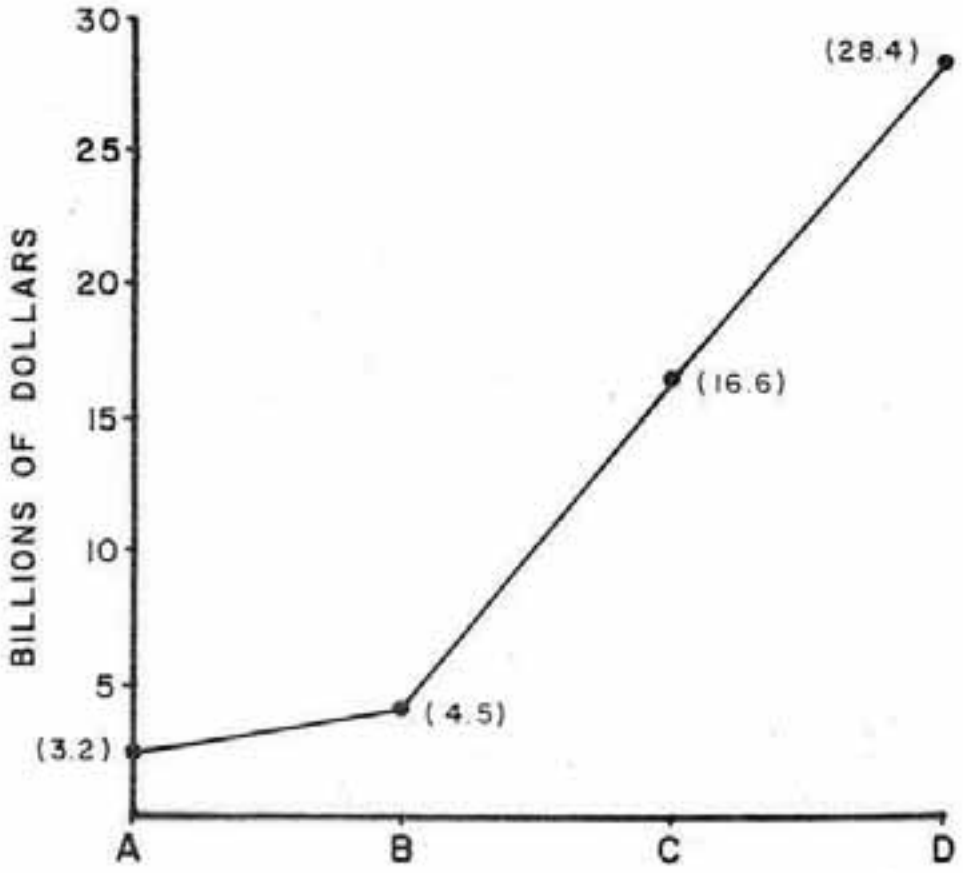

Figure 3. Total dollar amounts the sample of Alaska's 1983 Dall sheep hunters gave in response to the following questions:
What is the lowest price you'd charge for the sale of:

A....your opportunity to hunt Dall sheep in 1984 in your 1983 hunting area?
B....your opportunity in 1984 to hunt Dall sheep in any mountain range in Alaska?
C....all of your future opportunities to hunt Dall sheep in your 1983 hunting area?
D....all of your future opportunities to hunt Dall sheep in Alaska?

Table 5. Total and average price (by hunt area and residency) given by the sample of Alaska's 1983 Dall sheep hunters in response to the question: "What is the lowest price you would charge for the sale of your opportunity to hunt Dall sheep in 1984 in your 1983 hunting area?"

Location	Residents (n)		Nonresidents (n)		Total (n)	
AK Range, east of DNP[a]	$ 2,007,647,043	(338)	$ 552,688	(43)	$ 2,008,199,731	(381)
	$\bar{x}$= 5,939,784		12,853		5,270,865	
AK Range, west of DNP[a]	101,326,368	(90)	1,140,050	(43)	102,466,418	(133)
	$\bar{x}$= 1,125,849		26,513		770,424	
Brooks Range	1,001,777,037	(164)	4,840,975	(67)	1,006,618,012	(231)
	$\bar{x}$= 610,836		72,253		4,357,654	
Chugach Mtn Range	9,517,009	(220)	110,200	(34)	9,627,209	(254)
	$\bar{x}$= 43,259		3,241		37,902	
Kenai Mtn Range	1,434,950	(108)	15,750	(6)	1,450,700	(114)
	$\bar{x}$= 13,287		2,625		12,725	
Talkeetna, Chulitna, Watana Mts	11,024,114	(151	101,350	(23)	11,125,464	(174)
	$\bar{x}$= 73,007		4,223		63,939	
Tanana-Yukon Uplands	109,700	(33)		(0)	109,700	(33)
	$\bar{x}$= 3,324				3,324	
Wrangell Mts	107,109,793	(243)	234,738	(67)	107,344,531	(310)
	$\bar{x}$= 404,781		3,504		346,273	
Unspecified Area	59,000	(5)	6,675	(3)	65,675	(8)
	$\bar{x}$= 11,800		2,225		8,209	
Total	$ 3,240,005,014	(1,352)	$ 7,002,426	(286)	$ 3,247,007,440	(1,648)
	$\bar{x}$= 2,396,453		24,484		1,970,272	

[a] DNP = Denali National Park

Table 6. Total and average price (by hunt area and residency) given by the sample of Alaska's 1983 Dall sheep hunters in response to the question: "What is the lowest price you'd charge for the sale of your opportunity in 1984 to hunt Dall sheep in any mountain range in Alaska?" Area listed below based on respondents' 1983 hunt area.

Location	Residents (n)	Nonresidents (n)	Total (n)
AK Range, east of DNP[a]	$ 2,015,501,635 (319) 6,318,187	$ 165,126 (43) 3,840	$ 2,015,666,761 (362) 5,568,140
AK Range, west of DNP[a]	100,353,992 (82) 1,223,829	1,197,450 (43) 27,848	101,551,442 (125) 812,412
Brooks Range	100,297,825 (154) 651,285	4,799,710 (65) 73,842	105,097,535 (219) 479,897
Chugach Mtn Range	18,574,060 (206) 90,165	101,385 (32) 3,168	18,675,445 (238) 78,468
Kenai Mtn Range	104,255,530 (113) 922,615	20,200 (6) 3,367	104,275,730 (119) 876,267
Talkeetna, Chulitna, Watana Mts	1,110,197,067 (141) 7,873,738	149,101 (22) 6,777	1,110,346,168 163 6,811,940
Tanana-Yukon Uplands	1,130,800 (31) 36,477	(0)	1,130,800 (31) 36,477
Wrangell Mts	1,060,929,007 (322) 3,294,811	248,612 (62) 4,010	1,061,177,619 (384) 2,763,483
Unspecified Area	55,000 (4) 13,750	7,500 (3) 2,500	62,500 (7) 8,929
Total	$ 4,511,294,916 (1,372) 3,288,116	$ 6,689,084 (276) 24,236	$ 4,517,984,000 (1,648) 2,741,495

[a] DNP = Denali National Park

Table 7. Total and average price (by hunt area and residency) given by the sample of Alaska's 1983 Dall sheep hunters in response to the question: "What is the lowest price you'd charge for the sale of all of your future opportunities to hunt Dall sheep in your 1983 hunting area?"

Location	Residents (n)	Nonresidents (n)	Total (n)
AK Range, east of DNP[a]	$ 5,151,694,667 (302) $\bar{x}$= 17,058,592	$ 1,594,088 (38) 41,950	$ 5,153,288,755 (340) 15,156,732
AK Range, west of DNP[a]	9,257,808 (77) $\bar{x}$= 120,231	2,332,125 (40) 58,303	11,589,933 (117) 99,059
Brooks Range	2,117,697,800 (131) $\bar{x}$= 16,165,632	37,086,800 (61) 607,980	2,154,784,600 (192) 11,222,836
Chugach Mtn Range	3,048,932,675 (201) $\bar{x}$= 15,168,819	163,750 (26) 6,298	3,049,096,425 (227) 13,432,143
Kenai Mtn Range	8,914,300 (92) $\bar{x}$= 96,895	20,500 (5) 4,100	8,934,800 (97) 92,111
Talkeetna, Chulitna, Watana Mts	517,934,083 (122) $\bar{x}$= 4,245,361	2,726,400 (23) 118,539	520,660,483 (145) 3,590,762
Tanana-Yukon Uplands	2,308,825 (29) 79,614	(0)	2,308,825 (29) 79,614
Wrangell Mts	5,687,198,008 (301) $\bar{x}$= 18,894,346	2,900,088 (57) 50,879	5,690,098,096 (358) 15,894,129
Unspecified Area	1,044,000 (6) $\bar{x}$= 174,000	14,000 (3) 4,667	1,058,000 (9) 117,556
Total	$16,544,982,166 (1,261) $\bar{x}$= 13,120,525	$ 46,837,751 (253) 185,129	$ 16,591,819,917 (1,514) 10,958,930

[a] DNP = Denali National Park

Table 8. Total and average price (by hunt area and residency) given by the sample of Alaska's 1983 Dall sheep hunters in response to the question: "What is the lowest price you'd charge for the sale of all of your future opportunities to hunt Dall sheep in Alaska?"

Location	Residents (n)		Nonresidents (n)		Total (n)	
AK Range, east of DNP[a]	$ 9,374,220,255 $\bar{x}$= 33,841,950	(277)	$ 2,640,001 $\bar{x}$= 69,474	(38)	$ 9,376,860,256 $\bar{x}$= 29,767,810	(315)
AK Range, west of DNP[a]	20,945,833 $\bar{x}$= 299,226	(70)	2,477,326 $\bar{x}$= 58,984	(42)	23,423,159 $\bar{x}$= 209,135	(112)
Brooks Range	3,135,971,525 $\bar{x}$= 26,133,096	(120)	36,575,760 $\bar{x}$= 653,139	(56)	3,172,547,285 $\bar{x}$= 18,025,837	(176)
Chugach Mtn Range	3,115,831,092 $\bar{x}$= 18,328,418	(170)	214,500 $\bar{x}$= 8,500	(25)	3,116,045,592 $\bar{x}$= 15,979,721	(195)
Kenai Mtn Range	2,017,450,290 $\bar{x}$= 24,017,265	(84)	32,800 $\bar{x}$= 6,560	(5)	2,017,483,090 $\bar{x}$= 22,668,349	(89)
Talkeetna, Chulitna, Watana Mts	2,040,708,322 $\bar{x}$= 18,722,095	(109)	3,798,000 $\bar{x}$= 18,000	(21)	2,044,506,322 $\bar{x}$= 15,726,972	(130)
Tanana-Yukon Uplands	2,995,100 $\bar{x}$= 119,804	(25)		(0)	2,995,100 $\bar{x}$= 119,804	(25)
Wrangell Mts	8,655,308,542 $\bar{x}$= 31,938,408	(271)	1,068,501 $\bar{x}$= 21,370	(50)	8,656,377,043 $\bar{x}$= 26,966,907	(321)
Unspecified Area	2,035,000 $\bar{x}$= 407,000	(5)	$\bar{x}$= 37,000 12,333	(3)	2,072,000 $\bar{x}$= 259,000	(8)
Total	$28,365,465,959 $\bar{x}$= 25,079,988	(1,131)	$ 46,843,888 $\bar{x}$= 195,183	(240)	$ 28,412,309,847 $\bar{x}$= 20,723,785	(1,371)

[a] DNP = Denali National Park

hunting is a priceless experience," "hunting is a right and can't be sold," or "I don't like these questions and I refuse to answer them." Thirty-three percent of residents and 16% of nonresidents made such comments regardless of whether they answered the questions.

DISCUSSION

So, what is sheep hunting worth? All of the values obtained in this study represent some portion of the full value of sheep hunting, sheep, and sheep habitat to hunters. It is important for those making land use decisions to remember what is being measured and whether benefits are being included as well as costs.

The value-in-exchange or expenditures method measures only hunters' costs. The $5-6 million dollar figure is impressive, especially when one remembers it is a minimum amount and is spent annually by approximately 2,600 people who harvest only 1,100 sheep. The cost per sheep for hunters responding to this survey was over $6,400 including the expenses of unsuccessful hunters. An input-output model designed for Alaska's current economy would be able to translate these expenditures into jobs and income levels. Such a model does not yet exist, although there has been some progress (J. Wettleton, University of Alaska, pers. commun.).

One must be cautious when comparing expenditure values. They are useful as "wow" figures, and may indicate the effects of resource management decisions on local employment and income levels. But they measure only costs and not benefits of particular activities or land uses.

For example, Wyoming Game and Fish estimated hunters spent $2,500 per bighorn sheep (Ovis canadensis canadensis) harvested in 1982, with total expenditures by hunters in the state reaching nearly $500,000 (Thorne et al. 1985). If hunters in Alaska spent at least $6,400 per Dall ram harvested, then is Dall sheep hunting more important than bighorn sheep hunting? More jobs may be supported and more income may change hands in Alaska, but value measured in terms of costs does not measure the benefits gained. Loomis et al. (1984) give examples of how misuse of expenditure information can even be detrimental to wildlife.

If the expenditure figures seem impressive, the amount hunters were willing to pay in addition to their expenditure level is even more so. The reason nonresidents were willing to pay more could be due to at least two factors. Residents tended to have lower income levels than nonresidents and were less able to pay should the price increase. In addition, nonresidents were less likely to be able to return regularly to Alaska and may have thought of their hunt as perhaps a once (or twice)-in-a-lifetime experience.

The alternative technique (what is the lowest price...?) for determining value-in-use is not affected by income restraint. This can explain part of the difference between the two value-in-use amounts.

The different results may also be due to the latter technique's tendency to provoke emotional responses especially when used for valuing a public good or an activity which has high personal value. It is difficult

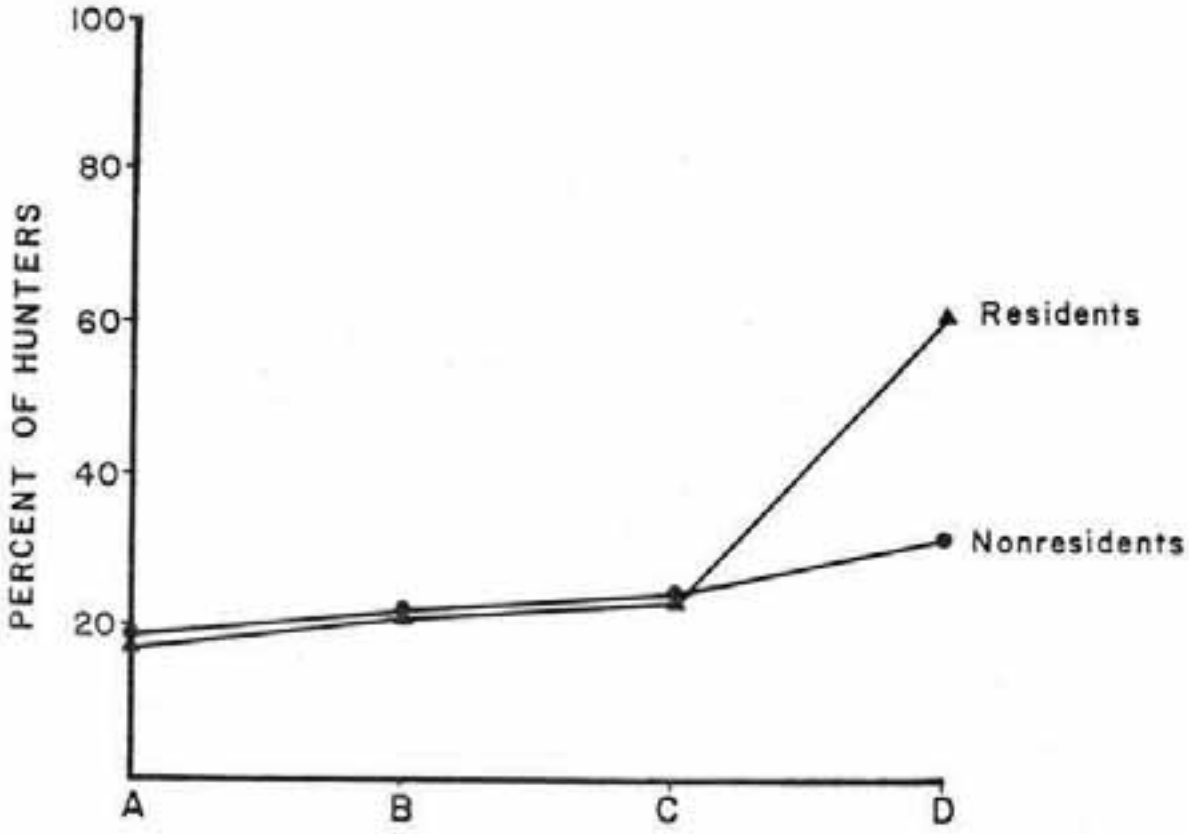

Figure 4. Percent of sample of Alaska's 1983 Dall sheep hunters who did not answer or answered "priceless" in response to the following questions:

What is the lowest price you'd charge for the sale of:

A....your opportunity to hunt Dall sheep in 1984 in your 1983 hunting area?
B....your opportunity in 1984 to hunt Dall sheep in any mountain range in Alaska?
C....all of your future opportunities to hunt Dall sheep in your 1983 hunting area?
D....all of your future opportunities to hunt Dall sheep in Alaska?

to say whether the high dollar responses were given honestly or inflated by emotion. Some degree of difficulty was reflected in the increasing number of "priceless" and nonresponses received (Fig. 4). These responses, though not usable in estimating an economic value, are an indication of the importance sheep hunters place on the activity, and should not be entirely discounted.

Is $28 billion, or $20.7 million per hunter who answered this question, a reasonable amount of compensation for the loss of all of these hunters' future sheep hunting opportunities in Alaska? If the average compensation requested for the loss of a year's opportunity to hunt sheep is $2.7 million (Table 6), then the average number of years for which hunters want to be compensated ($20.7 million ÷ $2.7 million per year) is 7.7 or 8 years. With a discount rate of 10%, the compensation would cover 12 years. If the average hunter is in his 30's or 40's (Watson, in press), 12 more years of the opportunity to go sheep hunting might approximate what these hunters would be losing in their lifetimes should they not be able to hunt sheep again.

The $2.7 million amount may seem like an inappropriate value to be placed on the loss of a year's opportunity to hunt. But this figure is not the result of a court of law's determination of an award for damages. What is being measured in economic terms are human values. Obviously, the opportunity to go sheep hunting is extremely important to hunters.

The values obtained here are minimum values. The values of all sheep hunters are not included; subsistence hunters were not surveyed and not all who were surveyed chose to respond. In addition to these values directly associated with Dall sheep hunting are those values held by nonconsumptive users. These additional values must also be considered in land use decisions.

Putting dollar values on public goods is a difficult proposition for economists, biologists, and for the general public who has to help them. As an increasing number of land use decisions are being made on an economic basis, it is important to understand the benefits and the costs of land uses. The best decisions cannot be made without both benefits and costs in mind.

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QUESTIONS AND ANSWERS

Bruce Smith, Wyoming: I'm interested in how you might be able to apply this information to benefit either hunting or conservation of wildlife?

Sarah Watson: I'm hoping to be able to apply this information and I'm hoping to get planners to apply it. Our habitat division has been working with me trying to make sure we use techniques that are going to be comparable with alternative uses, like mining or homesites. The techniques used here are being used more and more by economists. I understand there;s several studies being done in the lower 48; if anybody knows about them I would appreciate references because I would like to compare the values I've obtained, to see just how close or far off I am. Most of the values are for comparative purposes and when you compare the benefits, the one that has the higher benefits is probably the one you should invest in. Politics is not being included in this decision and that is really something I can't do anything about.