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The Wyoming Snowmobile Trails Program required information which could be used to evaluate benefits and costs associated with the program. This study found that earned income for Wyoming for each nonresident day of snowmobiling on state trails amounted to $52.04/day. The estimated consumer surplus for resident snowmobilers was $36.30/day.

Wyoming's wide open spaces, mountains and abundance of natural resources makes it an ideal location for outdoor recreation. Winter recreation in Wyoming includes snowmobiling, ice fishing, downhill skiing, cross-country skiing and ice skating. Snowmobiling is the third most popular winter recreation activity with 10.3% of the state's population participating in snowmobiling (Buchanan and Kamby, 1990).

The majority of snowmobiling takes place on state trails managed by the State Snowmobile Trails Program. The State Snowmobile Trails Program is administered by the Department of Commerce through the Division of State Parks and Historic Sites. The trails system consists of 76 developed snowmobile trail sites which are primarily on federal land. The program is responsible for the building and maintenance of parking lots, restrooms and trails. This program, like many other state programs, must continually justify costs of the program and any improvements to the trails. As such, the Snowmobile Trails Program requires information which can be used to evaluate costs and benefits associated with maintaining the current program and developing new sites or facilities. The costs of maintenance and development of sites is more readily available than an estimate of benefits, however.

Not much research has focused on the economic benefits of snowmobiling. Keith et al. (1978) estimated rent differentials for snowmobilers in Utah and New Mexico. These rent differentials were calculated by multiplying cost per mile by trip distance and then subtracting the least cost travel option to an alternative site. Keith et al. (1978) used this rent value as an indicator of respondents' willingness to travel further in order to snowmobile at a higher quality site. Sylvester and Nesary (1994) estimated the economic

impacts generated by nonresident snowmobiling in Montana as a source of new revenue for the state. The mean expenditures for nonresidents was $140.60 per day. While these results are interesting they do not provide much useful input for the Wyoming State Snowmobile Trails Program.

Ward and Loomis (1986) state that there are potentially four components which could be used by government agency decision makers to evaluate the economic efficiency of a program or improvement to a recreation site. Those four components are direct on-site recreationist benefits, benefits accruing to off-site users such as option or existence values, revenues accruing to the managing agency from entrance fees and the net gain in regional income derived from on-site visitor expenditures. In 1992 the Division of State Parks and Historic Sites funded research by the University of Wyoming Department of Agricultural Economics to estimate the economic benefits associated with snowmobiling on state trails in Wyoming. This study has been done in two phases. First, a study was done on nonresident snowmobilers using state trails to estimate the net gain in regional income for the state derived from on-site visitor expenditures. Second, a study was conducted to estimate consumer surplus of resident snowmobilers using state trails. This information coupled with registration fee information should provide a relatively complete benefits estimate for the Wyoming State Snowmobile Trails Program.

Data Collection And Estimation Procedures
Net Gain In Regional Income From Nonresident Snowmobilers

Regional economic gains associated with nonresident snowmobiling were calculated using the Wyoming Input/Output model. Previous research in Wyoming has

shown that some nonsurvey county models overestimate the proportion of lodging sector output going to the household sector by over 200 percent (Moline et al., 1992; Taylor et al, 1995a). This difference can lead to substantial variations in the estimates of economic impacts for recreation based economic activities. Thus, another model such as IMPLAN was not chosen for this study. The Wyoming Input/Output model is a hybrid model developed from a combination of primary and secondary data specific to Wyoming.

Information for the Wyoming Input/Output model was gathered at snowmobile trailheads and lodges by members of the Wyoming Snowmobile Club and State Park personnel during the 1993-94 and 1994-95 seasons. A total of 158 nonresident snowmobilers were sampled. In addition, parking lot counts were conducted during the 1993-94 season to develop estimates of the percentage of resident and nonresident snowmobile use in Wyoming.

Average annual nonresident expenditures for equipment and other fixed cost items, as well as, average daily trip expenditures by nonresidents were collected. Fixed cost items included purchases of snowmobiles, trailers, safety equipment, clothing, repairs/parts, registration/license, tax, club dues, and other. Daily expenditures included lodging, eating/drinking, grocery/liquor, gas/oil, retail items, snowmobile rental, snowmobile tours, and other items. The total economic impact of nonresident trip expenditures on the Wyoming economy was estimated by taking into consideration the multiplier effect from the economic linkages between the various sectors of the Wyoming economy (Taylor et al., 1995b). Expenditure data on resident snowmobilers was not used in this part of the analysis as expenditures by residents are seen as a shifting of dollars

from one activity to another within the local economy and not a net gain to the region (Taylor, 1996).

Consumer Surplus Estimates For Resident Snowmobilers

The second phase of this study estimated benefits for resident snowmobilers. The consumer surplus associated with resident snowmobiling was used to measure the value of resident snowmobile recreation. A mail questionnaire was sent to a random sample of registered Wyoming snowmobile owners to develop a travel cost model. Of the 1,544 surveys mailed, 818 were returned and 112 were returned as undeliverable resulting in a 57% response rate. The survey gathered trip related information, information on substitute sites, and demographic information.

Travel Cost Model

The travel cost method calculates the quantity demanded of the recreational good as a function of the cost of traveling to the recreation site, a measure of substitutes for the site, a vector of characteristics of the site, and a vector of characteristics of the recreationist. The recreation good itself is measured in terms of the number of trips taken to the site (Rosenthal et al., 1984). This study uses individual data in the estimation of the demand model. The use of individual data is more consistent with the theory of consumer utility and the assumption that the theory of consumer demand is based upon the individual consumer (Fletcher et al., 1990). The use of individual data to estimate the demand function avoids loss of information associated with aggregating data in zonal travel cost models. More specifically, information on demand shifters such as income, price of substitutes, and tastes and preferences is not lost. Furthermore, the use of

individual data avoids problems of multicollinearity that are associated with the time and distance variables in zonal travel cost models. This results in increased precision of estimators (Ward and Loomis, 1986).

The economic model used in this study incorporates physical attributes of the recreation site as well as the recreationist's experience with snowmobiling to define the trip. This is consistent with Fletcher et al. (1990) which states perception of environmental quality factors affect site selection and substitution. The value of time both traveling to the site and on-site is important when estimating the demand equation using the travel cost model (Miller and Hay, 1984; Bockstael et al., 1987). A substantial amount of literature has been written on this subject, and no consensus has been reached on how to appropriately deal with the time issues. Summarizing commuting studies, Cesario (1976) found the appropriate value of non-work travel time to be between one-fourth and one-half of the wage rate. These values are commonly used when applying the travel cost model (Ward and Loomis, 1986). The wage rate was based upon the respondent's indicated income level . The median income value from the income group checked was divided by 2080 (the number of working hours in the typical working year) to derive an hourly wage rate. For this economic model a value of one-third the hourly wage rate is used to value travel time. This is consistent with McConnell and Strand (1981) and Ward (1983a, b). Following the work of Cesario and Knetsch (1970) this value of travel time is added to transportation cost for a total travel cost variable.[1]

[1] The cost per person per trip = ((2 * one way distance *.1994)/number of people in vehicle) + (hours one way*2*.3333*wage rate).

Transportation costs were based upon the variable costs of driving a four wheel drive vehicle consuming gasoline at the rate of 10 miles to the gallon. According to Kim Raap of the Wyoming Department of Commerce, the majority of snowmobilers use four wheel drive vehicles. Gasoline and oil expenses were calculated to be 12 cents per mile for a four wheel drive vehicle. American Automobile Association figures for maintenance and tires on a two wheel drive sport utility vehicle were adjusted based upon the difference in cost for gasoline and oil between the two wheel drive vehicle and the four wheel drive vehicle. Total transportation costs were equal to $0.1994 per mile.

A final issue relating to the specification of the travel cost model is the use of substitutes. Ward and Loomis (1986) state that economic theory suggests the price and availability of substitutes is an important determinant of demand. The omission of substitutes results in an upward bias of estimates of consumer surplus according to Rosenthal (1987). A measure of substitute site travel cost is used in this analysis. The respondent's were asked for information, such as one way distance and one way travel time to their preferred alternative site. This site and its corresponding travel cost was used to represent substitutes in the model. Travel cost to the substitute site was computed in the same way as travel cost to the site visited on their last trip.

The dependent variable is quantity of snowmobiling trips taken to the site of the recreationist's most recent trip, and it is a function of the cost of traveling to the site (both in terms of time and distance) and a vector of independent variables. The vector of independent variables includes the snowmobiler's income (INCOME), the number of days spent snowmobiling on the trip (DAYSTRIP), the extent to which the site was a favorite

site to snowmobile (COMPARE), a measure of how often and how many years the individual has been snowmobiling (ACTEXPER), the snowmobiler's age (AGE), a measure of how many different winter activities the snowmobiler participates in (WINTERAC), the quality of the site visited (QUALITY), the cost of traveling to a substitute site (ALTCOST), and a measure of the quality of the substitute site (ALTQUAL).

The functional form of the model is:

$$T = \beta_0 + \beta_1 TC + \beta_2 TC^2 + \beta_3 Z_1 + ... + \beta_m Z_Z + \varepsilon$$

where T = number of trips

β = regression coefficients

TC = total travel cost

Z_k = vector of independent variables (k = 1,...,z)

ε = error term

The quadratic functional form was chosen based on goodness-of-fit statistics, accuracy in predicting the number of trips, results in a downward sloping demand function, assures curvature in the underlying utility function, and meets the restrictions implied by consumer demand theory.

Results

Net Income From Nonresident Snowmobilers

Taylor, et al. (1995b) found that nonresident snowmobilers spent 8.7 days snowmobiling in Wyoming annually. Average nonresident snowmobilers spent a total of

$956 in Wyoming for equipment and other fixed cost items on a per household basis annually. The average nonresident daily trip expenditures amounted to $91.48 per person. A total of $142.40 (including trip expenditures and equipment and fixed cost items) was estimated to be spent by nonresident snowmobilers per use day. Taylor et al. (1995b) calculated this figure using information from the 1990 State Comprehensive Outdoor Recreation Plan, snowmobile surveys, and parking lot surveys.

Table 1 reports the economic activity generated in Wyoming as a result of nonresident snowmobiler expenditures. According to the Wyoming Input/Output model expenditures of 142.40 per use day generates an additional $101.23 in economic activity for Wyoming's economy, resulting in a total of $243.63 of economic activity per use day for each nonresident snowmobiler. Of this total, $52.04 is earned income for Wyoming residents. Following the work of Ward and Loomis (1986) this net gain ($52.04/use day) in regional income is used as a component of benefits.

Table 1. Economic Impact of Nonresident Snowmobilers Per Day

			Employment	
Total Direct	Indirect Induced	Total Impact	Total FTE's	Personal Income
$142.40	$101.23	$243.63	0.003998	$52.04

Consumer Surplus Estimates For Resident Snowmobilers

Table 2 reports the results of the estimation of the travel cost model. The equation was estimated using ordinary least squares in SAS. The signs on all of the variables are consistent with theory and met with a-priori expectations. The travel cost variable (COSTPPER) had an inverse relationship with the number of trips demanded. The

Table 2. Travel Cost Model.

VARIABLE	PARAMETER ESTIMATE	T-STATISTIC	
INTERCEPT	6.370864	1.348	n.s.
COSTPPER	-0.161711	-5.347	***
COSTSQRD	0.000377	3.538	***
INCOME	0.000030858	1.468	n.s.
DAYSTRIP	-0.216411	-0.563	n.s.
COMPARE	1.723501	2.680	***
ACTEXPER	0.016812	15.183	***
AGE	-0.127429	-3.268	***
WINTERAC	-0.931323	-1.849	*
QUALITY	0.085714	1.686	*
ALTCOST	0.021995	1.993	**
ALTQUAL	-0.278918	-0.437	n.s.
F		29.096	***
R^2		0.4200	
N		454	
CONSUMER SURPLUS PER TRIP	$56.95		
MEAN NUMBER OF DAYS ON TRIP	1.569		
CONSUMER SURPLUS PER DAY	$36.30		

Single, double, and triple asterisks indicate significance at the 0.1, 0.05, and 0.01 levels, respectively; n.s. indicates not significant.

quadratic of the travel cost variable (COSTSQRD) was positive, thus insuring that the demand function decreases at a decreasing rate. Neither the income variable or the variable for length of trip (INCOME AND DAYSTRIP respectively) were significant at the α=0.10 level. A positive relationship was estimated between COMPARE and quantity of trips demanded. A positive relationship was estimated between ACTEXPER and the quantity of trips demanded. An inverse relationship was found between AGE and the number of trips. A negative relationship was found between WINTERAC and quantity of trips demanded. A positive relationship was found between the quality of the site visited (QUALITY) and the number of trips to the site. A positive relationship was estimated

between the travel cost to substitute sites (ALTCOST) and the quantity of trips demanded to the original site. ALTQUAL had the correct expected sign, but it was not statistically significant at the α=0.10 level.

A second stage demand function was generated using the mean values of the vector of independent variables and increments of a dollar added to current cost (mean total travel cost) to represent a hypothetical fee increase. The area under the second stage demand curve was estimated by integrating the function between the current price and an additional cost of $170.[2] This resulted in a total average annual consumer surplus estimate of $633.31. Using the mean values for the independent variables, the model predicted 11.12 trips for resident snowmobilers. Dividing the consumer surplus estimate by predicted trips resulted in a consumer surplus value of $56.95 per trip. The estimated consumer surplus per day for a snowmobiling trip was $36.30.

The fees which accrue to the Division of State Parks and Historic Sites of the Wyoming Department of Commerce, are the registration fees of $15.00 per snowmobile. Of this $15.00, $1 is returned to the establishment where the registration was sold. These registration fees come primarily from resident snowmobilers.

Table 3 summarizes an estimate of economic benefits associated with the Wyoming State Trails Program. This is based on the nonresident surveys done for the 1993-94 and 1994-95 seasons in the first phase of the project, and the resident surveys done for the second phase in the 1995-96 season. Taylor et al. (1995b) estimated total annual snowmobiling days on state trails to be 1,454,141 with 47.3% of those snowmobiling days

being enjoyed by residents and 52.7% being enjoyed by nonresidents. Registered snowmobiles for the 1995-96 season equaled 17,940. Based on historical snowfall, temperature and registration information it is assumed that survey results for the '93-94, '94-95 and '95-96 seasons are representative of snowmobile user days and registrations. Given this assumption, the Wyoming State Snowmobile Program could potentially generate $39,879,917 additional net income for Wyoming from nonresident snowmobilers, $24, 967,467 in consumer surplus to residents and $ 251,160 in registration fees for a total of $65,098,544 to the state (Table 3).

Table 3. Estimated Benefits To The State From the Wyoming State Snowmobile Program.

Nonresident Users	766,332 days	$52.04/day	$39,879,917
Resident Users	687,809 days	$36.30/day	$24,967,467
Snowmobile Registrations	17,490 snowmobiles	$14.00/snowmobile	$251,160
		Total Benefits	$65,098,544

Concluding Comments

Little work has been done on the benefits of snowmobiling. This study estimated that earned income to Wyoming from each nonresident day of snowmobiling on state trails amounted to $52.04/day. The TCM study done for resident snowmobilers estimated consumer surplus to be $36.30 per day of snowmobiling. It is hoped this information will help decision makers make better choices concerning snowmobile recreation and the Wyoming State Snowmobile Trails Program.

[2] The quadratic equation changed directions at this point and the remainder of the function was

Both economic impact analysis and measures of consumer surplus are accepted and commonly used methods of valuing changes in recreational opportunities. However, neither measure gives a complete picture of the benefits being realized. By utilizing the framework presented here (including registration fees), a managing agency can use a more complete set of benefits to evaluate a program. Based on the survey responses nonresident and resident benefits could also be broken down by site and used to evaluate proposed site improvements or maintenance programs.

It is important to note that option and existence values were not included in this analysis, but they were not expected to be large for snowmobiling. It is expected that there are snowmobiles which use the state trails but are unregistered. Sylvester and Nesary (1994) found that 66% of that state's snowmobiles were not registered. Many unregistered snowmobiles may use state trails, but this study did not ascertain such information. Further research needs to address costs to the state for other services such as promotion costs and winter road maintenance and opportunity costs to other winter recreationists associated with the snowmobile program.

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determined to be irrelevant.

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