The Economic Benefits of Snowmobiling to Wyoming Residents: A Travel Cost Approach with Market Segmentation

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Little research has been done on the economic benefits of snowmobiling. This study uses cluster analysis to identify different snowmobiler segments, and then uses the travel cost method to estimate the respective consumer surplus values for the pooled sample and the different market segments. Consumer surplus per trip for the pooled sample is $68 and for the different market segments ranged from $31 to $101 per trip. Differences between the pooled model and segments highlight the importance of differentiating recreational users for both management related issues and for economic benefit measurements.

KEYWORDS: *Snowmobiling, segmentation, count-data, travel cost*

Introduction

Snowmobiling has become an increasingly popular recreational activity in Wyoming and the Rocky Mountain west. The majority of snowmobiling in Wyoming takes place on trails which are 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 is composed of 76 developed snowmobile-trail systems which are primarily on federal land. Potential sites for snowmobilers using this trail system may include Department of Interior lands, National Forest Lands, and some State Lands. The program is self funded through registration fees and gasoline taxes.

Snowmobiling as a form of recreation is an increasingly important activity for residents and visitors to the west. Participation in outdoor recreation including snowmobiling has increased substantially in recent decades. With 10.3 percent of the State's population participating in snowmobiling, it trails only cross-country skiing and downhill skiing in popularity among winter sports Buchanan and Kamby (1990). It has been estimated that the activity brings $109.1 million dollars a year into Wyoming from non-residents alone, Taylor, Fletcher, and Skidgel, (1995).

Because of its increasing importance in many areas of the Western United States, (and notoriety to some), understanding the motivation and behavior of participants of various winter activities will help managers and policy-makers design appropriate policies for managing winter recreational areas. Recently snowmobiling has been the object of policy reviews in the National Park Service due to the Agency's re-assessment of the suitability of the activity in our National Park System NPS (2000), and both Teton National Park and Yellowstone National Park have on going winter use studies. Since snowmobiling is the largest winter activity, policy changes of winter use can affect a substantial number of users.

Psychological and social foundations of recreating play an important role in most activities, and snowmobiling is no exception. Adams (1979) and Bryan (1979) found different distinct groups of anglers based on reasons for fishing. Allen (1988) built on this work using social psychological motivations for fishing adapted from Driver (1983). Dalton, et al (1998) found different license groups had different values for fishing. Bowker and Leeworthy (1998) found a different price response among different ethnic groups. These studies indicate the potential for distinct groups of recreationists participating in a particular activity. It was hypothesized that distinct groups of snowmobilers might exist as well. If users have different reasons for participating they may place different economic values on participating. It is our intent to investigate the degree to which users with different reasons for recreating affect the value they place on the activity.

The few existing studies of snowmobiler behavior also suggest a heterogeneous population. Jackson and Wong (1982) found that "being with family and friends", "adventure and challenge", "doing some very different things", "meeting other people", "getting away from radio and TV", "interest in getting to a destination", and "prestige" were motivations perceived as most important by snowmobilers in Alberta, Canada. McLaughlin and Paradice (1980), from the University of Minnesota, found that snowmobilers were older than cross-country skiers, completed a high school education, and considered themselves experienced at the sport. Additionally, 70 percent of the sampled snowmobilers were in family groups. Finally, these snowmobilers found it desirable to see groups or individuals engaged in motorized recreation. Keith, Haws, Wennegren, and Fullerton (1978) found that snowmobilers had a higher average income than the general population of Utah, had more children than the general population of Utah, and had completed 1.8 years of college. Of the respondents 53 percent were employed in professional, technical, or managerial fields. It was estimated that many of the trips were probably family trips as 80 percent of the trips involved more than two people.

Two recent studies focused on Yellowstone National Park examined motivations for visiting the Park and values users placed on the visit. Borrie, Freimund, Davenport, Manning, and Valliere (1999) evaluated the motivations for winter park users by drawing up social psychological foundations from Driver (1983) to cluster users into four groups, (a process similar to

the procedure explained below in this study). Duffield, and Neher (2000) conducted a contingent valuation study on winter users of Yellowstone National Park. That study grouped snowmobilers, skiers, snow-coach users, and others into one sample to estimate willingness to pay and preferences related to different Park policies.

Using behavioral and demographic variables to segment the market can result in even greater effectiveness in managing snowmobiling programs and projects. McLaughlin and Paradice (1980) gathered information on user preferences to gain insight into what information should be collected to better understand dispersed winter recreation planning and management. They identified four groups of experience types for snowmobilers and cross country skiers: General nature experiences, exercise-physical fitness, being with similar people, and privacy. Their conclusion was that types of activities, desired characteristics of a particular setting, and desired experiences are important for management of dispersed winter recreation.

The purpose of this study is to gain an understanding of snowmobilers' characteristics, preferences, and motivations, and compare their elicited value for the recreation activity by market segment. This analysis is based upon work by May (1997) that reported the results of an extensive survey and modeling effort to investigate the economics of resident snowmobiling in Wyoming. Specific objectives of this analysis are:

● Determine Wyoming snowmobilers' characteristics, preferences and motivations for snowmobiling.
● Identify unique groups (or market segments) of snowmobilers based upon their reasons for snowmobiling.
● Estimate the individual economic benefits associated with snowmobiling in Wyoming using the Travel Cost Method.

Research Methods

The research approach in this analysis first uses a cluster analysis to identify market segments based upon psychological reasons for recreating, and then uses an individual travel cost model to estimate the economic benefits of snowmobiling for each cluster. Our method of analysis is to first identify whether there are distinct groups with the data set. For this we used cluster analysis and discriminant analysis. Once we identify groups, we estimate travel cost models for each group and compare the final group model with pooled specification. Then given the distinct groups and separate models, we calculate consumer surpluses of each groups.

Following the work of Driver, Tinsley, and Manfredo (1991), social and behavioral factors are used to segment the market for snowmobilers. We begin with Driver's psychological reasons in the recreation experience preference scale (REP) to construct a list of possible motivations for why people snowmobile. This list is used as a basis for segmenting the market. Survey questions regarding motivations to snowmobile were derived from the REP scales to capture human need gratified by leisure behavior as discussed in Driver et al (1991). The REP inventory is designed to evaluate each scale

item as to its importance as a reason for recreating in a particular activity and or site.

The travel cost method (TCM) typically assumes a utility maximization framework subject to an income constraint. This leads to a set of consumer demand functions for both market and non-market goods, where the number of recreational trips is used as a proxy for demand for the non-market good and the cost per trip used as a proxy for price. Estimates result in an ordinary demand function for a non-market good where number of trips is inversely proportional to cost per trip. From the demand curve, benefits in the form of consumer surplus can be calculated. TCM approaches have been used to measure a variety of non-market activities, including mountain biking, Fix and Loomis, (1997) and hunting, (Creel and Loomis, 1990; Offenbach and Goodwin, 1994), and many other recreation activities Rosenberger and Loomis, (2000).

For travel costs to be a valid proxy for price of a recreation activity two assumptions must be reasonably imposed Loomis and Walsh (1997). First, utility increases derived from the activity must not include the travel time itself. While it is conceivable that there may be some small benefit to the travel itself, for snowmobilers the nature of the activity and the difficult winter driving conditions suggest otherwise. Another assumption is the activity must be the primary destination, which is dealt within the survey design.

Survey Design and Sampling Procedure

The Wyoming Department of Commerce, Division of State Parks and Historic Sites which administers the Wyoming State Trails Program provided a list of 1,544 registered snowmobile owners whom were sent questionnaires. The list was generated from every seventh Wyoming household in the database of snowmobiles registered with the Wyoming Department of Commerce. This registration and associated permit is used to gain access to snowmobile trails maintained under the state program. Questions in the survey were designed to elicit information on trip cost, trip behavior, reasons for snowmobiling, substitute sites, and general demographic information. Travel cost estimates were based on responses to questions about their most recent trip and the number of visits made to that site. The questionnaire was designed to provide information for a travel cost model of snowmobiling in Wyoming using individual data. A pretest of the survey design was conducted at a popular snowmobiling trail head in Albany County, Wyoming during the winter of 1996. The survey was sent out April 1996, towards the end of the 1996 snowmobile season. The total design method from Dillman (1978) was used with 1,544 mailed surveys, of which 818 were returned and 112 were returned as undeliverable resulting in a 57 percent response rate. A total of 427 of the returned surveys had complete responses to reasons for snowmobiling.

Survey questions regarding motivations to snowmobile were derived from the REP scales developed to capture human needs gratified by leisure behavior as discussed in Driver, et al (1991). The psychological dimensions

from the REP inventory used in this study are presented in Table 1. The REP scales were modified and added to based on information gained from the pretest with local snowmobilers. In the survey respondents were asked to rate each reason for snowmobiling from extremely unimportant (1) to extremely important (7).

Market Segmentation

Two of the most common multivariate analysis techniques used to analyze complex arrays of data are cluster analysis and factor analysis. Bieber and Smith (1986) compare these methods using a single data set and discuss conceptually how each is interpreted and relates to one another. There are two reasons for using cluster analysis over intuitive groupings or other quantitative methods like factor analysis and multi-dimensional scaling for this project. First, there has been very little previous work done on analyzing

TABLE 1

Reasons for Participating in an Outdoor Recreation Activity

Reasons for Snowmobiling in the Survey	Driver (1983) Motivations for Outdoor Recreation
1. To view the scenery	1. Enjoy nature
2. To be with friends	2. Physical fitness
3. To get away from the usual demands of life	3. Reduce tension
4. To have a change from my daily routine	4. Escape phyisical stress
5. To do something with my family	5. Outdoor learning
6. To be close to nature	6. Share similar values
7. To use my equipment	7. Independence
8. To be away from crowds	8. Family Relations
9. To experience more elbow room	9. Introspection
10. To learn the topography	10. Be with considerate people
11. To become better at it	11. Achievement/Stimulation
12. To help release or reduce built up tensions	12. Physical rest
13. To experience solitude	13. Teach/lead others
14. To have thrills	14. Risk taking
15. To do things my own way	15. Risk reduction
16. To be in control of things that happen	16. Meet new people
17. To avoid everyday responsibilities for awhile	17. Creativity
18. To share what I have learned with others	18. Nostalgia
19. To test my abilities	19. Agreeable temperatures
20. To gain a sense of self confidence	
21. To be on my own	
22. To think about my personal values	
23. To talk to others about my equipment	
24. To think about who I am	
25. To take risks	

snowmobiling as an outdoor activity. Therefore, intuitive groupings based upon prior information was not possible. Cluster analysis minimizes the probability of intuitive bias in the groups identified. Second, given the lack of prior research detailing psychological and environmental information for snowmobiling, cluster analysis is used in this study because it has been shown to provide a robust set of discrete groupings over other quantitative methods (Bieber and Smith, 1986.) Given the objective of finding distinct groups based on reasons for snowmobiling and the results of Bieber and Smith, cluster analysis was chosen as the method of analysis in this study.

The set of procedures used in the cluster analysis starts with a divisive hierarchical clustering procedure to group variables within categories, and then an iterative clustering procedure was used to place respondents into thematic groups. Finally, canonical disrcriminant analysis is used to test the significance of the groupings. The procedures evaluate and group individual responses to generate a cluster of respondents that are more similar to each other than they are to other clusters, creating a situation of homogeneity within clusters and heterogeneity between clusters (Hair, Anderson, Tatham, and Black 1992; Aldenderfer and Blashfield, 1984).

Divisive hierarchical clustering procedure was used to separate the 26 individual reason variables into smaller groups of variables. The procedure reduces the total number of variables without losing a significant amount of information. The SAS procedure VARCLUS was used to group variables that represent similar things and reduced the number of variables into manageable groups, SAS (1989). This new cluster group then is added as a distinct variable by adding the scores for the variables in the new variable cluster and dividing that total score by the number of variables in the cluster to standardize the new variable. This standardized variable is then used for cluster observations. Five variable clusters were found that best summarized the psychological reasons for snowmobiling without significantly reducing the amount of information given by the original variables. These five clusters are:

(1) Achievement/Stimulation dimension,
(2) Escape Personal/Social Pressure dimension,
(3) Enjoy Nature dimension and the Geography of Area,
(4) Being with Family and Friends, and
(5) Escape Physical Pressure.

The variable clusters and their associated reasons identified are presented in Table 2.

The first variable cluster is best described as an "Achievement/Stimulation" dimension. There are nine member variables in this cluster, four of which fall under the Achievement/ Stimulation dimension. Other dimensions which are included in this cluster are Risk Taking, Equipment, Introspection, and Autonomy/Leadership. The second variable cluster is best described as an "Escape Personal/Social Pressure" dimension. This cluster contains seven member variables, four of which fall under the Escape Per-

TABLE 2
Reasons Groups for Snowmobiling Based Upon the Divisive
Hierarchical Clustering Procedure

Variable Cluster Name	Reasons Associated with the Cluster Name
1. Achievement/ Stimulation dimension	• To take risks (Risk Taking) • To become better at it (Achievement/Stimulation) • To have thrills (Achievement/Stimulation) • To use my equipment (Equipment) • To test my abilities (Achievement/Stimulation) • To gain a sense of self-confidence (Achievement/ Stimulation) • To think about who I am (Introspection) • To be in control of things that happen (Autonomy/ Leadership) • To talk to others about my equipment (Equipment)
2. Escape Personal/Social Pressure dimension	• To do things my own way (Autonomy/Leadership) • To get away from the usual demands of life (Escape Personal/Social Pressure) • To have a change from my daily routine (Escape Personal/ Social Pressure) • To avoid everyday responsibility for a while (Escape Personal/Social Pressure) • To be on my own (Autonomy/Leadership) • To think about my personal values (Introspection) • To help release or reduce some built up tension (Escape Personal/Social Pressure)
3. Enjoy Nature dimension and the Geography of Area	• To be close to nature (Enjoy Nature) • To learn about the topography of the land (Learning) • To get to know the lay of the land (Learning) • To view the scenery (Enjoy Nature)
4. Being with Family and Friends	• To share what I have learned with others (Teaching-Leading Others) • To do something with my family (Family Togetherness) • To be with friends (Similar People)
5. Escape Physical Pressure	• To experience more elbow room (Escape Physical Pressure) • To experience solitude (Escape Physical Pressure) • To be away from crowds of people (Escape Physical Pressure)

sonal/Social Pressure dimension. The other dimensions included in this cluster are the Autonomy/Leadership, and Introspection dimensions. The third variable cluster is best described as a combination of the Enjoy Nature dimension and the Geography of Area subset of the Learning dimension. This cluster contains four member variables, two of which fall under the Enjoy Nature dimension and two of which fall under the Learning dimension. The fourth variable cluster is a combination of multiple dimensions and can best

be described as Being with Family and Friends. This cluster had three member variables whose dimensions are Teaching-Leading Others, Family Togetherness, and Similar People. The fifth variable cluster can best be described as Escape Physical Pressure as all three member variables fall under this dimension. These reasons all revolve around getting away from crowds.

Based upon the results of the hierarchical clustering procedure, five new variables: reason 1 through reason 5 were created. These reason variables were estimated by summing all of the variables in each cluster and then dividing by the number of variables that were in each reason cluster. These composite reason variables are the basis for clustering procedures which placed observations in groups by minimizing the sum of the squared distances from cluster group means of the reason variables. This was done using SAS procedure FASTCLUS, which is an iterative method (SAS,1989). This procedure minimizes the distance within groups and maximizes the distance across groups for these reason variables.

Sample means for the five composite reasons variables were examined in order to determine the appropriate number of clusters. Given the lack of previous work in this area, there were no clear a priori expectations on the composition for each cluster. Clusters were chosen based upon minimizing the merging of non-homogenous clusters, providing clusters that were meaningful and interpretable, and the feasibility of the clusters for agency management purposes and additional economic analysis. A five-cluster solution was chosen as having the most distinct groups, which best met the criteria specified.

The first cluster contains 141 members, the second contains 116 members, the third contains 39 members, the fourth contains 33 members, and the fifth contains 98 members for a total of 427. A high score for the mean indicates that the reasons to snowmobile incorporated into the composite reasons variable were important considerations in the respondent's decision to take their most recent snowmobiling trip. The means of the reasons variables for these clusters are reported in Table 3.

Canonical discriminant analysis was used to further analyze the differences between the clusters. The SAS procedure CANDISC is used to distinguish how the clustered groups from the iterative partitioning method differ from each other. The results indicate distinct differences between the values for the class means on canonical variables giving an indication of different clusters from the canonical functions. Analysis of these canonical scores further clarified the important composite reasons for each cluster. For an elaboration of the clustering procedure used in this analysis see May, Bastian, Taylor, and Whipple (2001).

The five clusters represent groups with substantially different reasons for snowmobiling and different social/demographic characteristics, Table 4. The first cluster can best be described as, "The Nature Lovers Who Need To Be Alone" cluster. These individuals scored high on the composite reason variables that encompass the Enjoy Nature dimension and the Escape Physical Pressure dimension. This group also scored high on the composite rea-

TABLE 3
Five Reason Clusters for Segmenting the Snowmobile Market

Reason	1	2	3	4	5
CLUSTER	Achievement/ Stimulation	Escape Personal/ Social Pressure	Enjoy Nature Dimension and the Geography	Being with Family and Friends	Escape Physical Pressure
1) The nature lovers who need to be alone	4.907	5.530	5.901	5.671	5.972
2) Those who want to experience it all	5.851	6.204	6.416	6.345	6.437
3) Those who want to be alone but not get too excited	3.157	4.641	5.462	5.299	5.761
4) Nature lovers who don't want to get too excited	3.236	3.974	4.871	4.465	3.950
5) Nature lovers who want to be with family and friends	4.590	4.687	5.622	5.599	4.752

TABLE 4
Respondent Profile by Group

	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5
Age	42	41	47	46	46
% Receiving at Least Some College Training	72.40%	56.90%	79.50%	60.60%	66.30%
% Employed Full Time	83.70%	86.20%	89.70%	75.80%	74.50%
% Retired	6.40%	6.00%	7.70%	21.20%	19.40%
% With Income < 19,999	6.30%	7.80%	7.70%	6.00%	5.00%
% With Income 20,000 - 39,999	27.60%	32.70%	28.30%	21.20%	32.50%
% With Income 40,000 - 74,999	48.20%	48.20%	43.60%	57.60%	41.80%
% With Income >75,000	17.70%	11.20%	20.50%	15.10%	20.40%
% Whose Enjoyment of the Trip was Reduced by the Number of People They Saw	15.80%	20.80%	7.70%	9.10%	5.10%
# of Days Snowmobiling Per Year	23	31	21	19	24
# of Trips Snowmobiling Per Year	10.67	16.59	9.36	8.35	10.83
# of Miles to Snowmobiling Site	89.95	76.31	94.85	70.61	90.8
$ Amount Spent on Trip	$124.80	$100.96	$282.82	$84.67	$98.98

sons variables for Escaping Personal/Social Pressure and Being with Family and Friends, however, these scores were noticeably lower and thus are not used as a primary descriptor. The second cluster can best be described as, "Those Who Want To Experience It All." These individuals scored very high on all the composite reason variables. Of somewhat less importance to this group is Achievement/Stimulation, although they still viewed it as important when they were considering their most frequent trip. The third cluster is best described as, "Those Who Want To Be Alone But Not Get Too Excited." These individuals scored high on the composite reason variable for Escaping Physical Pressure and scored low on the composite reason variable for Achievement/Stimulation. Also of importance to this group is Enjoying Nature and Being with Family and Friends. Cluster 4 is best described as, "Nature Lovers Who Don't Want To Get Too Excited." This group scored relatively high on the composite reason variable for Enjoy Nature and low on the Achievement/Stimulation composite reason variable. Being with Family and Friends is also somewhat important to this group. Escaping Personal/Social Pressure or Physical Pressure are not important considerations to this group. Cluster 5 is best described as, "Nature lovers who want to be with family and friends." This group scored high on the composite reasons variables for Enjoy Nature and Being with Family and Friends. Of somewhat lesser importance to this group is Achievement/Stimulation, Escape Personal/Social Pressure, and Escape Physical Pressure.

The importance of assessing psychological reasons for snowmobiling is underscored by looking at baseline demographic and economic statistics of the respondents. These statistics illustrate both that there are important differences between clusters, but also there are similarities that can mask these differences, Table 4. Respondent income varies substantially between clusters. Cluster 3 and 5, "Those that want to be alone but not get too excited" and "nature lovers who want to be alone", contain a higher percentage of individuals who earn more than $75,000 per year (20.5 percent and 20.4 percent respectively) compared to Clusters 1, 4, and 2 (17.7 percent, 15.1 percent, and 11.2 percent, respectively). Cluster 4, "nature lovers who don't want to get too excited", contains a higher percentage of individuals earning between $40,000 and $74,999 per year (57.6 percent). Cluster 2 contains the greatest percentage of individuals earning between $20,000 and $39,999 per year (32.7 percent), and also contains the greatest number of individuals earning less than $19,999 per year (7.8 percent).

The majority of the respondents for all of the clusters were male, ranging between 91 and 97 percent. Age varied somewhat between clusters, but the mean age in all clusters was between 41 and 47. The majority of the individuals for all of the clusters had completed at least a high school education. More of Cluster 3 individuals had received at least some college training (79.5 percent) in comparison to the members of the other clusters. Cluster 1 members followed Cluster 3 members in education with 72.4 percent receiving at least some college training. Following Cluster 1 were Cluster 5 with 66.3 percent, Cluster 4 with 60.6 percent and Cluster 2 with 56.9 percent receiving at least some college training.

The majority of the respondents for all of the clusters are employed full time ranging at the highest cluster 3 (89.7 percent) to the lowest Cluster 5 (74.5 percent). Percent of respondents that are retired ranged from a high of 21.2 percent, Cluster 4, to a low of Cluster 2 with 6.0 percent. The demographic and economic results above suggest substantial differences (and similarities) in the types of people who snowmobile and why they snowmobile, and thus points to why managers may want to pay attention to market segmentation.

Model Estimation

The travel cost approach to valuing a recreation activity involves estimating a Marshallian demand equation and then using this equation to estimate a users' consumer surplus. Consumer surplus represents value a recreational user places on an activity over and above what it costs to travel to a site. A number of methodological and statistical problems associated modifications have been associated with TCM models. The issues related to the design of this analysis involve error distribution and truncation bias. TCM model estimators are biased upwards, but consistent when estimated through ordinary least squares, Creel and Loomis (1990). Estimates assume continuous distribution when in fact they are discrete. Furthermore, the error distribution is truncated at zero. To account for this we impose a poisson or negative binomial distribution. A poisson distribution assumes that the conditional mean equals the conditional variance of trips. Models were first estimated using a poisson distribution and then tested for over-dispersion, Greene (1998). Then each model was estimated using a negative binomial distribution in cases of significant over-dispersion, which is consistent with Creel and Loomis (1990).

Economic models were developed for the entire sample and for each of the market segment groups using LIMDEP, Greene (1998). The functional form for these economic models varied across the different groups, but the general demand function for snowmobiling is presented in equation 1.

No. of trips

$$= \begin{pmatrix} \textit{Travel cost per trip, Income, Days snowmobiling,} \\ \textit{Favored snowmobiling site, Experience level,} \\ \textit{Age, Number of Winter Activities participatng, in Index of site quality} \\ \textit{Alternative Site Travel Cost, Quality of Alternative Site.} \end{pmatrix}$$

$$(1)$$

The number of trips is a function of the cost of participation (both in terms of time and distance), income, and a vector of independent variables that relate to quality and reasons for participating. Travel costs were estimated by calculating mileage cost and the respondents' opportunity cost of time. Travel costs were based upon the cost of operating a 4-wheel drive vehicle. American Automobile Association (1996) 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 two wheel drive vehicles and the four wheel drive vehicle. Total transportation costs were calculated to be $0.1994 per mile.

The value of time in travel to the site and on the site is based upon an estimate of the respondents' hourly wage rate given the 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. 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) where the value of travel time was between the range of one-fourth to one-half the wage rate as found by Cesario (1976). Total cost per person per trip was calculated by equation 2.

$$\text{Cost/person/trip} = \left(\left(\frac{2*\text{one way dist.}*0.1994}{\text{No. of people in vehicle}} \right) \right.$$
$$\left. + \; (\text{hours one way}*2*0.333*\text{wage rate}) \right) \quad (2)$$

The vector of independent variables consist of the number of days spent snowmobiling on the trip, an index variable that represents how the respondent ranked the site in an overall sense, the number of years the individual has been snowmobiling, the snowmobiler's age, a measure of how many different winter activities the snowmobiler participates in (ranged from zero to nine depending upon how activities were checked), an index of the quality of the site, the cost of traveling to a substitute site, and an index of the quality of the substitute site.

Results and Analysis

Results of Poisson regressions on the pooled sample and clusters all showed significant over-dispersion, so a negative binomial distribution was imposed for all the models, Table 5. The estimated models for the pooled model and all the cluster models were significant. Each cluster equation was first estimated using the pooled model specification. We then modified the specification for each cluster to improve the statistical performance. Trip cost per person is significant for all clusters. Household income is significant for all except cluster 3. We included non-significant variables in when they added to the overall performance of the model estimation.

˙ The final specification for each cluster model was compared with the pooled model specification, using a log likelihood ratio test. In segments 1 through 4 the null hypothesis that the cluster model specification was not significantly different than the pooled model specification could be rejected. For cluster 3 the hypothesis that the cluster model specification was not significantly different than the pooled model could not be rejected at the 10 percent level. Furthermore, the pooled model structure on Segment 4

TABLE 5
Results of the pooled model and segmented models

	Pooled Sample Semi-log	Cluster 1 log-log	Cluster 2 Semi-log	Cluster 3 log-log	Cluster 4 Semi-log	Cluster 5 Semi-log
Log-likelihood ratio	1526.97	23.87	81.62	6.54*	23.66	8.10
N	427	141	116	39	33	98
Overdispersion Parameter	0.5878	0.962	1.749	1.249	0.3028	0.3165
	(0.0607)	(0.2247)	(0.3409)	(0.6705)	(0.3409)	(0.0657)
Parameter Estimates and Standard Errors						
Cost per Person	−0.012	−0.454	−0.026	−0.704	−0.022	−0.011
	(0.001)	(0.109)	(0.005)	(0.337)	(0.007)	(0.003)
household Income	5.518E-06	0.344	0.000	0.482*	0.000	0.000
	(0.000)	(0.055)	(0.000)	(0.294)	(0.000)	(2.002)
Ave. No. of Days in the trip	−2.135E-04**		0.219	.8716*		−0.116**
	(3.26E-02)		(0.084)	(0.5081)		(0.076)
No. of Winter activities participating in	−0.036**					−0.044**
	(0.045)					(0.124)
Quality index of the site	0.017					0.010*
	(0.003)					(0.006)
Age	−0.010			−0.770**		−0.006**
	(0.004)			(0.767)		(0.005)
Travel cost to the alternative site	0.002**			0.529**		0.000
	(0.001)			(0.326)		(0.002)
Quality of alternative site	0.115	−0.495*	0.527			0.048**
	(0.049)	(0.279)	(0.058)			(0.091)
Snowmobiling experience level	0.001*					0.001
	(0.000)					(0.000)

TABLE 5
(Continued)

	Pooled Sample Semi-log	Cluster 1 log-log	Cluster 2 Semi-log	Cluster 3 log-log	Cluster 4 Semi-log	Cluster 5 Semi-log
Favored snowmobiling site comparison	0.341	0.556			0.595	0.499
	(0.040)	(0.241)			(0.140)	(0.084)
Mean # of Trips per year	12.06	10.67	16.60	9.36	8.85	10.84
C.S. per Year	817	328	518	942	319	820
C.S. per Trip	68	31	31	101	36	76
Ave. Days per Trip	1.6	1.6	1.7	1.6	1.4	1.6

*significant at the 1 percent level
**not significant at the 1 or 5 percent level
a. Log-likelihood ratio (LLR) is compared to the restricted LLR of the same pooled data set and compared to the pooled specification for each cluster specification.

would not converge suggesting significant differences. Characteristics of segment 5 however did conform to the pooled model specification. The individual segment modeling results show a substantial variation in a snowmobiler's consumer surplus based upon the coefficients attached to the cost per person, and estimated consumer surplus, across clusters. Both cost per person and income are significant for all models. These results give additional evidence beyond cluster analysis results that distinct segments may exist within snowmobile recreationists.

Consumer surplus estimates were calculated by estimating the area under the curve between the mean price and quantity and the price at which quantity of trips was predicted to be zero. Consumer surplus per trip across the entire sample averaged $68 per snowmobiler. The sign of the alternate site quality is unexpectedly positive. However, the variable is highly correlated with alternate site cost. This suggests that the higher the quality of sites identified as alternatives, the higher the cost.

Individuals in Cluster 3 (Those Who Want to Experience It All) ranked highest with a consumer surplus of $101 per trip. Individuals in Cluster 5 (Nature Lovers Who Want to Be With Family and Friends) valued snowmobiling the next highest with $76 per trip. Individuals in Cluster 1 (The Nature Lovers Who Need to Be Alone) and Cluster 2 (Those who want to be alone but not get too excited) valued the experience the least on a per trip basis. In terms of consumer surplus per year, cluster 2 (Those who want to be alone but not get too excited), ranked slightly higher (third) because of a higher number of trips over the year.

Summary and Conclusions

The objectives of this study were to examine the characteristics, preferences and motivations for snowmobiling of Wyoming snowmobilers, to identify groups of snowmobilers based upon their reasons for snowmobiling, and to estimate economic benefits associated with resident snowmobiling. In order to determine economic benefits, the travel cost method was used to estimate consumer surplus values.

Our method is a distinct series of steps. First we wanted to make the case statistically that there are distinct groups. For this we used cluster analysis and discriminant analysis. Then given the distinct groups, we calculate separate travel cost models for each group. Finally we compare the calculated consumer surpluses of each groups. Our motivation for performing this multi-step approach is so that the hypothesis that there are policy relevant, distinct groups is not justified through a two-dimensional metric: consumer surplus, but through a more detailed analysis that cluster analysis and discriminant analysis provides.

Multiple clustering methods were used to segment the market. Five distinct groups of snowmobilers were found using both agglomerative and iterative clustering techniques. Condensed reason variables that best describe the motivations of snowmobilers were achievement/stimulation dimension,

escaping personal/social pressure dimension, enjoying nature and learning the geography of the area dimensions, being with family and friends dimensions, and escaping physical pressure dimension. An iterative hierarchical clustering procedure is used with the new variables from the variable cluster technique to separate the respondent's into natural groups based upon their reasons for snowmobiling.

The travel cost method was used to calculate consumer surplus values on a statewide basis, for each of the market groups. Unique travel cost models were estimated for each of the market groups. The models for the market groups differed from each other both in their functional form and model specification. Likelihood ratio tests confirm superior specification of four of the five cluster models compared to the pooled model specification. Consumer surplus for Wyoming snowmobilers in the statewide model was estimated to be $68 per trip. Consumer surplus values for the market segments varied with a high of $101 per trip for Cluster 3 (Those who want to be alone but not get too excited) to a low of $31 per trip for Cluster 2 (Those Who Want To Experience It All).

The results of the pooled model and segmented models suggest two implications for modeling recreational behavior and for management of snowmobiling. First, the significant variation in consumer surplus estimates across clusters underscores the importance for researchers to dis-aggregate recreationists into groups based upon behavioral and other reasons when possible, to more precisely capture their economic benefits. The heterogeneous nature of the recreationist suggests that benefit estimates could vary substantially across recreationists within a site as well as across different sites. While there are certainly more scales for grouping recreationists than the scale by Driver and the approach taken here, the results suggest that research which further addresses motivational factors would be valuable. Second, attempts to target policies and programs to specific groups by managers can significantly increase the benefits to residents of a recreation activity or recreation area, and therefore the value the public places on programs and facilities that attract recreationists. Understanding what motivates the recreationist could help the manager promote recreation site characteristics that may be appealing to different groups. Managers could use intercept surveys to identify recreationists' motivations for visiting a particular area and thereby identify different user groups which might exist. The managers could target specific groups with high consumer surplus or simply be sensitive to potential recreationists in those groups using the area. In other cases, understanding the motivations for different groups would aid manager's in developing sound policies and evaluating potential improvements to recreation sites.

Potential weaknesses of this study include the limited number of observations for Cluster 3 and Cluster 4. The limited number of observations made it difficult to fit a model to the data for Cluster 3 and Cluster 4. Additionally, the limited number of observations makes the models particularly sensitive to outliers and influential observations. However, there was quite a bit of

variation in the total number of trips. Responses in Clusters 3 and 4 varied from 1 to 50 total trips, with means of approximately 9 trips, to the area of the respondent's last trip for both clusters. Lastly, since our segmentation procedure is one of the first of its kind done on snowmobilers, there is potential for refinement and improvements to the categories developed that could strengthen managers' tools for managing snowmobiling.

Moreover, these results are primarily for in state snowmobilers and estimate values in this analysis are pooled across sites to illustrate differences in potential economic values for different segments of the snowmobiling population. To elicit values for specific sites additional analysis would have to be conducted. Results of this study should be qualified in light of these constraints. We conducted a likelihood ratio test to test the specification of the cluster models against the pooled model specification. Since goodness of fit is improved, by this difference specification for the cluster, we assert that the cluster sample characteristics are significantly different from the pooled sample characteristics. A more formal procedure to test whether the models are different would be problematic given the difference in specification between the pooled model and the cluster model[1].

Strengths of this study include the breadth of information that was gathered on Wyoming snowmobilers and the applicability of that information to the management of the Wyoming Snowmobile Trails Program. Knowledge of the different market segments allows State policy makers and winter recreation site managers the option of managing areas for specific user groups. It also provides the necessary benefit estimates to conduct cost-benefit analysis for projects that will only impact specific locations or groups of snowmobilers. Understanding the reasons that the snowmobilers participate in the sport allows for better management of the resource to meet those expectations. Moreover, given the paucity of research on snowmobiling this study should also provide information to winter recreation managers regarding the possible economic benefits associated with, and motivations for, snowmobiling.

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[1]Since the clustering procedure has already found significant differences across groups, further testing of the travel cost models to corroborate the clustering procedure is not pursued in this analysis.

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