Estimating the Health Benefits of a Proposed Rail Trail

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Abstract

This study estimates the health benefits associated with a proposed rail trail from Grand Pre to Coldbrook in Nova Scotia. A survey of 550 households living within 50 kilometers of the proposed trail provided data. Survey respondents indicated their current levels of physical activity and the impact the trail would have (if any) on these levels. A contingent trip method (CTM) was employed to estimate projected use for the proposed trail.

The trail is estimated to attract approximately 430 trips per day or 160 thousand trips per year. The monetary returns of increased physical activity are modeled after Wang et al. (2005). The total annual value of increased physical activity expected to emanate from the proposed trail is estimated to be approximately $456,000. Based on a 30 year time horizon, present value analysis indicates that a gravel surface trail would provide direct health benefits that are nine times greater than the (construction and operation/maintenance) associated costs and an asphalt surface trail will provide health benefits of seven times the costs. On an annual basis, allowing ATV access will reduce the health benefits by almost $228,000 per annum, which is equivalent to approximately $9 per household and $4 per capita for local county residents.

INTRODUCTION

Trails are becoming important recreational and transportation facilities throughout Canada. Rail corridors are, in many places, attractive locations for the development of trails. Where railroad use of the corridor has been abandoned, development of the trail is, physically, a matter of upgrading the quality of the surface material; and socially, a matter of developing mechanisms for protecting the interests of land owners adjoining the trail route. There are many examples of successful rails to trails initiatives throughout North America.

Within more developed areas, rail corridors often are still in active use for transportation. Where this is the case, using the rail corridor for trail purposes requires construction of a trail on land adjacent to the existing track. Such construction is considerably more expensive, as the existing rail bed is not available to serve as the trail bed. However, these corridors are often the only continuous corridors available for developing trail infrastructure. One added benefit of building a trail adjacent to an existing rail line is that it provides people currently walking, skiing, or otherwise using the track, an alternative pathway. A good quality pathway along a rail line can reduce the risk of people being struck by trains.

Nova Scotia has one of the highest obesity rates in Canada. The proposed trail has the potential to increase physical activity for individuals seeking recreation, as well as enhance the use of non-motorized vehicles by local commuters.

THE RESEARCH

The demand estimation will build on work by Betz, Bergstrom and Bowker (2003) and follows a contingent trip travel cost methodology. Initially, a sample of potential trail users is contacted. They are provided with a description of the proposed trail, and asked both how far they live from the proposed trail, and how frequently they expect to use it. Together with demographic and attitude data also collected as part of the survey, the distance from the proposed trail is used to impute a cost of using the trail, a 'price'. This price, together with the number of expected trips, the 'quantity', is used to estimate a demand curve. This demand curve can then be used to estimate expected trail use based on the dispersion of the population. Other questions seek to: 1) measure whether the proposed trail will serve to increase physical activity and attach a dollar value to any increase, 2) compare the health related benefits of the trail to the construction and maintenance costs, 3) estimate the impact of allowing ATV access on the volume of non-ATV trail users.

The proposed 28 kilometer trail would parallel an existing railway line between the town of Kentville on the west and the hamlet of Grand-Pre to the east (see Figure 1). The trail corridor contains a mixture of undeveloped and agriculture land, and low density urban development, with approximately 10,000 people living within one kilometer of the proposed route. West of Kentville, the now abandoned railway line serves as a multi-use trail, with only non-motorized use permitted within the town limits.

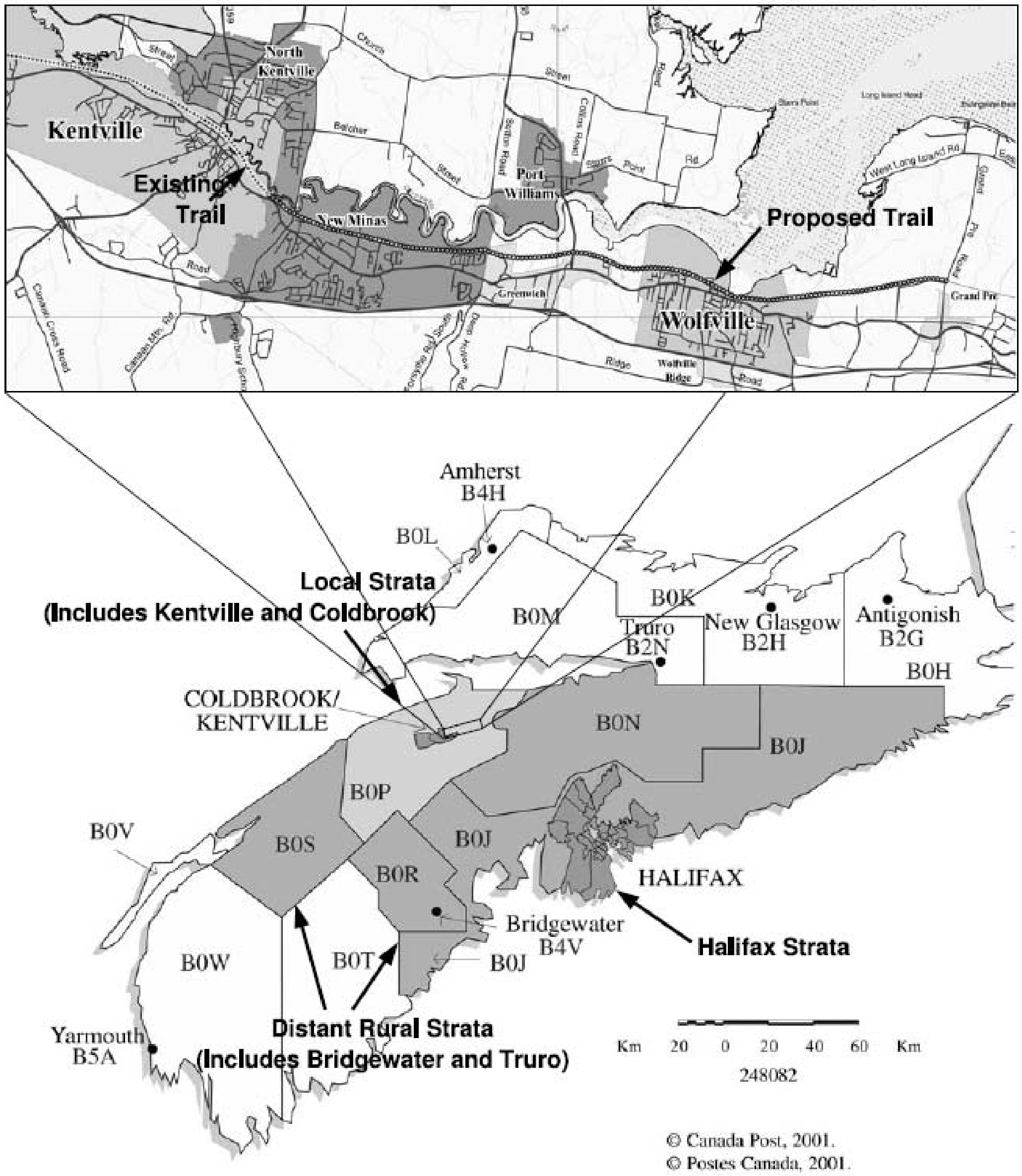

Figure 1: Proposed trail location and sample stratification. Source: Canada Post (www.canadapost.ca) and Kings County (www.county.kings.ns.ca).

SURVEY METHODS

Following a modified Dillman (2007) approach, a mixed method survey was administered to a random sample of 1728 households, stratified to capture differences in demand from local households, distant urban households, and distant rural households. Canada Post forward sortation areas (FSAs, see Figure 1) were used as a basis for equally sampling from the area closest to the trail, from the city of Halifax, and rural areas within about 200 kilometers of the trail. The raw household counts (www.canadapost.ca) for the strata are, respectively, 24,302 households, 188,514 households, and 68,540 households.

A web site was established, through which the respondent could complete the survey on-line. A unique key was printed on the material mailed to each household, which was used on the web site to ensure that the paper and web survey were identical. Mailing addresses were purchased from a list broker. Of the 1728 original households to which letters were mailed, 248 were returned undeliverable, 39 declined to participate, and 78 completed the web survey. Subsequently, 1363 paper surveys were mailed, of which 59 were returned undeliverable. At this stage, 38 respondents completed the web survey and 175 were mailed back. Optical scanning of the returned paper surveys was managed by the Center for Organizational Research & Development at Acadia University. Overall, 286 surveys were included in the final data set, 133 local responses, 83 from Halifax, and the remaining 76 from the distant rural strata. For the total sample, the response rate was 22%, and 30% for the local strata.

In contrast to the open ended trip estimate in Betz et al.. (2003), respondents chose from a ten point scale (see Table 1). It was felt that this scale was easier for respondents to understand and more consistent with people's perceptions of their recreational activities. The midpoints on this scale are roughly consistent with a scaled logarithm of the number of days per year on which trips are taken. Two types of use, transportation and recreation, were offered.

Table 1: Contingent trip recording scale.

1 =	Daily	6 =	Almost once per month
2 =	Three or four times a week	7 =	Every other month or so
3 =	One or two times per week	8 =	Three to five times in the next 12 months
4 =	Almost every week	9 =	Once or twice in the next 12 months
5 =	Once or twice per month	10 =	Not at all in the next 12 months

DATA

Table 2 presents summary statistics for several variables from the sample. A number of variables were compared to provincial statistics to assess representativeness (Nova Scotia Finance, Economics and Statistics Division, 2006). Mean income for the sample was somewhat higher than the provincial median family income of $51,500. The sample median age was 55, higher than the provincial median for those over 20. In the sample, 88.0% were Canadian born compared to 95.1% for the province as a whole. Finally, 13.0% of the sample had not completed high school, while 32.6% report having a university degree or diploma. Provincially, the comparable numbers are 25.3% and 20.0%. The sample is older, more racially mixed, more affluent, and more educated than the average Nova Scotia citizen. To the extent that this biases the sample towards those more likely to enjoy non-motorized recreation and have a pro-environment attitude, results need to be interpreted with this in mind. For the regression analysis, zero responses were doubled as an ad-hoc means of accounting for this selection bias.

Table 2: Summary statistics for selected variables.

Variable	n	min	max	median	mean	st.dev
Distance to trail (km, from Mapquest[TM])	283	0.16	204.7	58.73	56.15	49.06
Distant rural strata	75	20.9	204.7	100.20	100.80	44.16
Halifax strata	83	67.1	119.5	88.66	87.67	10.13
Local strata	125	0.16	27.84	3.70	8.47	9.02
Distance to trail (km, as reported by respondent)	245	0	325	40.00	52.01	53.90
Distant rural strata	56	20	325	100.00	100.20	61.30
Halifax strata	72	50	250	80.00	84.22	28.00
Local strata	116	0	105	2	8.53	13.76
Prior use of rail trail (known or not, yes = 1)	274	0	1	1	0.64	
Gender (male=1)	266	0	1	0	0.45	
Age (yrs)	270	27	92	55	56.4	
Education (yrs, approx from categories)	270	10	18	13	13.84	2.54
Income ($20K steps)	194	1	11	3	3.94	
Expected number of trips (outliers removed)	565	0	9	0	1.519	2.294
Distant rural strata (recreation)	146	0	5	0	0.555	0.983
Halifax strata (recreation)	163	0	5	0	0.522	0.811
Local strata (recreation)	254	0	9	2	2.724	2.846
Local strata (transportation)	254	0	9	0	1.224	2.363

Likely physical and outdoor recreational activity impacts are shown in Figure 2. The activity scales are reported in hours per week. The self-reported level of physical activity (panel (i)) is quite high, in line with the 30 to 60 minutes of moderate physical activity per day (3 to 6 hours per week) recommended in Canada’s Guide to Healthy Eating and Physical Activity (Canada, 2006). Panel (ii) suggests that the trail’s impact on activity levels will be concentrated among those living near the trail, as expected. Panels (iii) and (iv) respectively, show the hours per week respondents participate in motorized and non-motorized outdoor recreational activities.

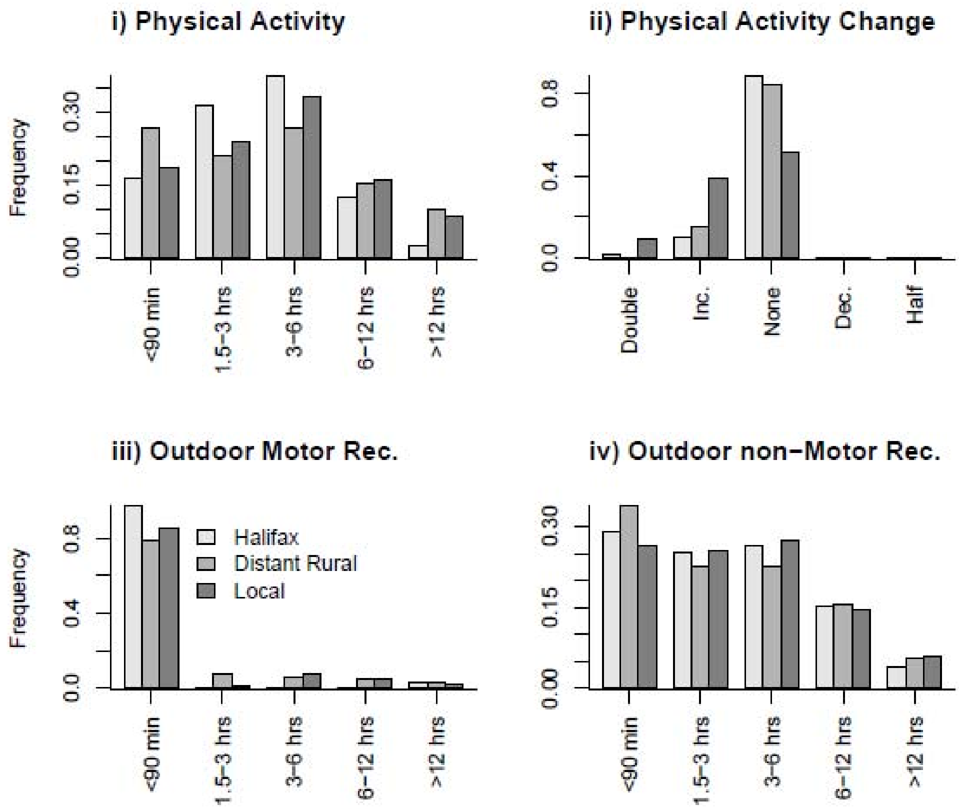

Figure 2: Physical activity and outdoor recreation of survey respondents, hours per week.

ESTIMATING TRAIL DEMAND

Regression results for three negative binomial regressions (see Cameron and Trivendi, 1986, for a theoretical development) are reported in Table 3: expected recreation trips; expected transportation trips; and the total expected trips. All estimation and graphing was done using R (R Development Core Team, 2006), and the extension library MASS (Venables and Ripley, 2002). Since the conventional R2 is not applicable to count data models, two alternatives suggested by McFadden (1974) and by Cameron and Windmeijer (1996) are calculated. The former compares the results to an intercept only model, while the latter to a fully saturated model. The estimated models explain 7.5-18.6% more than a null model, and 26.0-50.9% of a saturated model. A likelihood ratio test also indicates that the models significantly improve on the intercept only alternative. Tests of overdispersion indicated that the negative binomial was preferred to a Poisson regression. If the selection bias offset of doubling the zeros was not performed, explanatory power declined. A range of distance weights, to capture the possibility that non-response was related to distance, also reduced explanatory power. Subjects' own distance estimate tended to improve predictive power, but at the loss of a number of observations, and obvious rounding on the part of the subjects. Objective distance was therefore used, and measured using maps.yahoo.com.

Table 3: Regression results for recreation, transportation, and total trip demand. Zero responses have been duplicated to offset selection bias. Regressions use objective distance, and outliers have been removed. The goodness of fit measures are the McFadden R^2_{MCF} (McFadden, 1974) and the deviance R^2_{DEV} (Cameron and Windmeijer, 1996). Asterisks indicate significance levels of 0.10, 0.05 and 0.01. Likelihood ratio statistics are reported with P values rather than standard errors.

	Recreation		Transportation		Total	
Variable	Estimate	St. Error	Estimate	St. Error	Estimate	St. Error
Intercept	-1.1211	1.3699	-1.0986	1.2012	-1.0527	1.4035
Age	-0.0024	0.0054	-0.0244^{*}	0.0136	-0.0053	0.0055
Gender (male = 1)	-0.4710^{***}	0.1260	0.4040	0.3293	-0.3475^{***}	0.1306
Income	0.0481^{*}	0.0283	0.0908	0.0761	0.0516^{*}	0.0293
EDUC2 (college)	0.2529	0.1719	-0.9838^{**}	0.4362	0.2636	0.1766
EDUC3 (university)	0.4111^{**}	0.1689	-0.4231	0.4281	0.4111^{**}	0.1730
Trail_user	0.7027^{***}	0.1358	1.2222^{***}	0.3439	0.6955^{***}	0.1391
Outdoor_non-ATV	0.7777	0.4819	1.4287	1.0313	0.8796^{*}	0.4830
ATV_user	1.1290^{***}	0.2455	1.3303^{***}	0.4845	1.1334^{***}	0.2442
ATV_L (limited)	-0.4452^{**}	0.1898	0.4731	0.5718	-0.4164^{**}	0.1967
ATV_O (open)	-0.4527^{*}	0.2581	0.7221	0.7193	-0.4069	0.2653
ATV_user*ATV_L	0.3996	0.3757	-0.1320	1.0007	0.4033	0.3847
ATV_user*ATV_O	0.3095	0.4586	-0.3659	1.1360	0.2926	0.4713
Paved	0.0710	0.1388	0.3511	0.3765	0.0763	0.1423
ATV_user*Paved	0.0312	0.3378	-0.2159	0.8483	-0.1491	0.3439
Distance (km)	-0.0119	0.0145	-0.0261	0.0193	-0.0116	0.0148
Strata2 (dist. rural)	-0.5965	1.3025			-0.5303	1.3329
Strata3 (local)	1.0533	1.2461			1.2375	1.2785
Distance*Strata2	0.0039	0.0146			0.0061	0.0150
Distance*Strata3	-0.0156	0.0166			-0.0150	0.0171
Substitute (km)	0.0787^{***}	0.0180			0.0705^{***}	0.0176
ATV_user*Substitute	-0.0222	0.0211			-0.0226	0.0210
Outdoor_non-ATV*Substitute	-0.0562^{***}	0.0182			-0.0557^{***}	0.0180
ORD_LB (lim->ban)	-0.2512	0.2083	0.6798	0.6124	-0.2095	0.2156
ORD_OL (open->lim)	-0.3130	0.2302	-0.3427	0.5707	-0.3141	0.2348
ORD_LO (lim->open)	-0.2255	0.2764	-0.6098	0.6706	-0.2115	0.2810
Neg Bin theta	2.31	0.5168	0.40	0.0826	1.75	0.3397
Likelihood ratio (Poisson), P	53.23	0.0000	173.94	0.0000	88.99	0.0000
n	447.00		170.00		447.00	
Likelihood ratio (null), P	263.29	0.0000	38.30	0.0035	255.49	0.0000
R^2_{MFD}, R^2_{DEV}	0.1866	0.5091	0.0753	0.2599	0.1707	0.5010

The variables in the regression capture demographics, other recreational activities, and features of the proposed trail. As in Betz et al., (2003), distance and income together account for the opportunity cost of using the trail -travel time and opportunity cost of that time - so that no explicit travel cost value is included.

Most of the parameter estimates have the expected sign. Age has a negative effect, consistent with younger people being more interested in outdoor recreation. Expected trail use is a normal good, increasing in income. Recreational use is increasing in education, while transportation use is negatively related. This may reflect an absence of facilities for cleaning up after using the trail. Being either a user of trails or one who enjoys outdoor recreation increases expected trail use.

A paved surface has a positive, but insignificant, effect, which is strongest for transportation uses. Distance, strata, and their interactions have the expected signs, although none are significant. However, likelihood ratio tests show that removing either of these variables significantly changes the model. Increasing distance to substitutes significantly increases the expected use of the proposed trail, as expected. Finally, question order effects are not individually significant but are included as they are jointly significant.

Figure 3 shows the trip demand curve for an individual, as a function of distance. The quantity demanded is in the reversed categories from the survey scale. As such, 0 is no trips and 9 is daily use. For someone living immediately adjacent to the trail, they are forecast to use the trail about twice per week. The impact of distance depends on the strata, with those farther away showing less sensitivity to distance. The combination of selection bias and low forecast trip numbers suggests that this trail will have relatively little value to people outside the local strata. As a consequence trail demand is calculated only for those persons living within 50 kilometers of the trail.

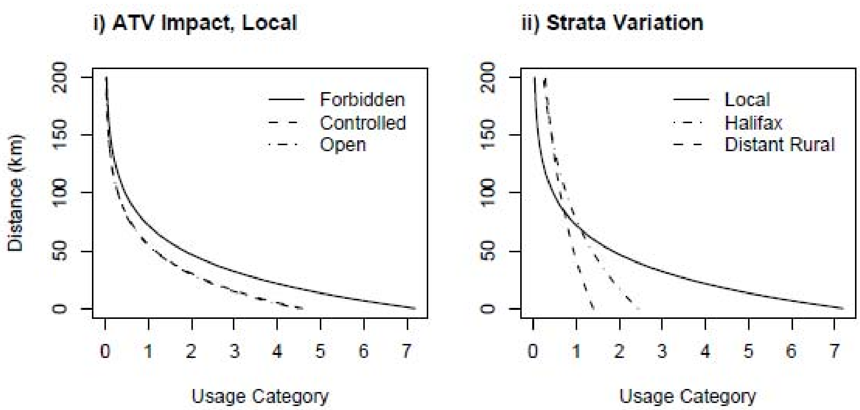

Figure 3: Individual trip demand by distance, forecast using regression results. Expected usage ranges from not at all in the next year (0) to once or twice per week (7).

The spatial distribution of population was taken from the Canada Post household counts (www.canadapost.ca), together with distance information from Yahoo Maps (maps.yahoo.com). Households were assumed to be located at the post office, for distance purposes. Only households within 50 km of the proposed trail were considered, as few others would likely travel for the exclusive purpose of this trail. About 12,000 households were within 5 kilometers of the trail, and 4,000 within 2.5 kilometers.

Figure 4 plots the total demand for trips, as a function of distance, up to 50 km from the trail. Trip demand category was translated into trip number by linear interpolation between the midpoints of the categories. A distance measure rather than a price measure is used. The 'average' individual for which this demand is estimated is 57.15 years old with a before tax income of

$67,000 per year. They have some college education, live in the local strata, are not physically active, and do not engage in any outdoor recreational activities to a great extent.

The regression results are used to estimate demand for two trail types: 1) a gravel surface trail and 2) a paved trail without ATV access. Total trip demand for the gravel surface trail is estimated at 434 persons per day and an annual total of 158 thousand trips. Total trip demand for a paved trail was estimated to be about ten percent greater with daily demand of 485 persons and a total annual demand of 177 thousand trips.

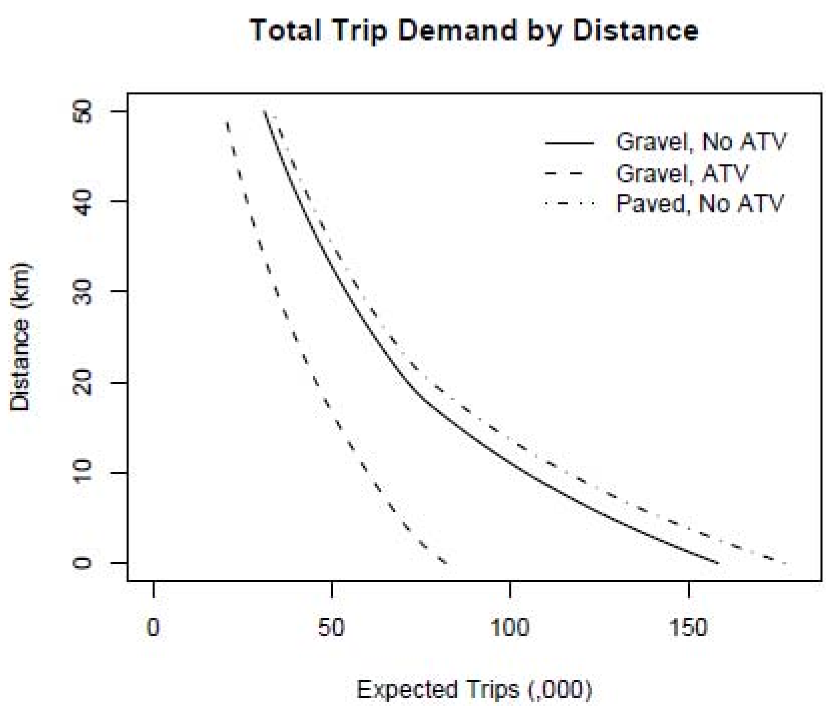

Figure 4: Aggregate trip demand by distance.

Estimating the Health Benefits

<u>Defining Fitness</u>

Canada’s federal government publication "Canada's Guide to Healthy Eating and Physical Activity" recommends between 30 and 60 minutes of moderate physical activity daily (three to six hours per week). Moderate physical activity includes brisk walking, bicycling, or swimming. About half as much vigorous activity (such as jogging, aerobics, or fast swimming) or about twice as much light activity (such as easy walking, light gardening, or stretching) are expected to have the same health impact. Survey respondents were asked- “How many hours of physical activity do you participate in each week?” - to indicate their current level of physical activity based on the scale shown in Table 4. Each categorical response was quantified as the mid-point of the selected range (converted to minutes). The open-ended “More than 12 hours” category was truncated at the lowest level equal to 720 minutes.

Moderate Physical Activity Per Week	Percent of Respondents
1) Less than 90 minutes	17.7
2) 90 minutes to 3 hours	24.2
3) 3 to 6 hours	33.1
4) 6 to 12 hours	16.9
5) More than 12 hours	8.1
Total	**100.0**

Table 4 Current Level of Moderate Physical Activity Per Week

Survey respondents viewed a map and a description of the trail and were asked, “If the Kentville to Grand Pré rail trail is built, how would you expect it to affect your overall level of physical activity?” The base case scenario is for a gravel surface trail with no all terrain vehicle (ATV) access. The results of this question are summarized in Table 5. No respondents chose categories 4 (decrease somewhat) or 5 (decrease to half or less). Slightly less than 50 percent of the respondents indicated the trail would have no impact on their physical activity.

If the Kentville to Grand Pré rail-trail is built, how would you expect it to affect your overall level of physical activity?	**Percent of Respondents**
1. AT LEAST DOUBLE	9.6
2. INCREASE SOMEWHAT	43.2
3. NO CHANGE	47.1
4. DECREASE SOMEWHAT	0.0
5. DECREASE TO HALF OR LESS.	0.0
Total	**100.0**

Table 5 Impact of Proposed Trail on Overall Level of Physical Activity

<u>Operationalizing the Fitness Effect of the Proposed Trail</u>

The approach is modelled after Wang et al. (2005), where the direct health benefits of a trail are measured by estimating the direct medical cost for active persons and inactive persons (excluding those with physical limitations). Wang et al. (2005) used the United States National Medical Expenditure Survey which found that, on average, active persons spent less on medical care than did active persons in 1997. The figure was adjusted for inflation (Nova Scotia consumer price index) to give a 2007 value of $521.40. No exchange rate adjustment was made. In the (US)

National Medical Expenditure Survey, moderate physical activity was defined as spending at least 30 minutes in moderate physical activity three or more times per week. Wang et al. (2005) gathered bicycle/pedestrian trail use data in Lincoln, Nebraska, and compared trail costs with estimated health benefits. The authors assumed that all trail users who used the trail three or more times per week met the criteria of moderate physical activity as previously described. All those trail users who met this criterion were credited with health benefits accruing from the trail.

In apportioning health benefits to trail users, Wang et al. (2005) made no determination of whether the physical activity (and resulting health benefits) from using a trail represented an actual increase from existing levels of physical activity or simply a substitute for physical activity that previously took place elsewhere. To the degree that physical activity derived from the studied trails represents a substitution by users with no actual increase in the overall level of physical activity, the measured health benefits would be over-stated.

This study attempts to advance the efforts of Wang et al. (2005) in two respects. Firstly, it addresses the issue of incremental physical activity (activity over and above current levels) as it relates to trail use. It does so by gathering data, not only on how much survey respondents would use a proposed trail, but to what degree would the proposed trail increase their level of physical activity. Secondly, this paper assigns a value for all incremental physical activity resulting from the trail, subject to truncation for individuals who have an initial or post trail use level of physical activity in the highest (more than 12 hours per week) category. Excluding individuals who are already at the top of the activity scale is predicated on the notion and that they are extremely fit regardless of incremental activity derived from the trail. Similarly, individuals moving from a lower level of physical activity to the highest level of activity based on trail use have their "post trail" activity capped at the low end of the highest category. Again, the notion being that trail related activity beyond the low end of the extreme range is undertaken by individuals who are all ready very fit and trail induced activity has no incremental health benefits.

Calculating the Health Impact of the Proposed Trail

The negative binomial regression model, described earlier, forecasts total trail use of 158,405 trips per year or 434 trips per day (for those living within 50 kilometers of the trail). Trail users are expected to average 47.9 trips per year. Dividing the total trips by the average number of trips per user, provides an estimate for the number of different trail users (158,405/47.9), which is calculated to be 3,307. Approximately 58 percent of the survey respondents (1905) who would use the trail indicated a level of physical activity that categorized them as "fit," while about 42 percent (1402) were categorized as "unfit." Unfit is defined as having a level of physical activity that is less than that recommended by Canada's federal government of three hours or more of moderate physical activity per week.

The categorical nature of the "trail effect" question in this study necessitates transformation in order to quantify the impact of the trail. The "no effect" response clearly indicates a zero percent change in physical activity. The "at least double" response is conservatively measured as a 100 percent increase (doubling). The "increase somewhat "category therefore ranges from greater than zero to one 100 percent, and was divided into low/medium/high case scenarios with increases of 25%, 50% and 75% respectively.

Each respondent's initial value for current physical activity (minutes) was subsequently adjusted to capture the impact of the trail on physical activity. Each respondent who indicated "increase somewhat" therefore has three values (one for each scenario) indicating the impact of the trail. The responses are then summed to get an aggregated low/medium/high scenario. Respondents who indicated that the trail "would double" their physical activity are incorporated into each scenario. Each aggregate scenario accounts for responses indicating that the trail had “no effect” on their level of physical activity.

All increases in physical activity generated from the trail are included in estimating the benefits regardless of whether the increase is sufficient to transform the respondent from “unfit” to “fit.” In other words there is no “threshold” level of physical activity that must be attained for the value of such physical activity to be included as a benefit generated from the trail. This approach includes all trail users (both “fit” and “unfit”) and (with one exception) gives monetary values to all increases in physical activity generated by the trail. The exception relates to increased physical activity emanating from individuals who had existing levels of “More than 12 hours” which are excluded. Persons whose increased activity pushed them into this range had their total activity level capped at the lowest level included in the uppermost range, (12 hours which is equivalent to 720 minutes).

Physical Activity Impact For Users	Percent of Respondents	Projected Total Number of Individual Trail Users
No Impact	47.1	1.559
Will Double	9.6	319
Will Increase Somewhat	43.2	1,429
Total	100.0	3,307

Table 6 Impact of Trail on Physical Activity

The change in physical activity is measured in minutes. The value of a one minute per week increase in physical activity is derived by taking the value of being “fit” (equal to $521.40 per year or $10.3 per week) divided by the necessitated number of minutes per week to be “fit” (the mid-point of the 3-6 hour range, equal to 270 minutes per week), which gives 3.7 cents per minute per week. The current number of minutes per week of physical activity for each respondent is obtained by taking the midpoint of the chosen category as indicated in Table 7.

Current Activity Category (Fit/Unfit)	Equivalent Minutes	Mid- Point Value (Minutes)
1) Less than 90 min (unfit)	0 to 90	45
2) 90 min to 3 hours (unfit)	90 to 180	135
3) 3 to 6 hours (fit)	180 to 360	270
4) 6 to 12 hours (fit)	360 to 720	540
5) More than 12 hours	More than 720	Truncated at 720

Table 7 Converting Categorical Current Activity to Minutes

A range is created where respondents indicated the existence of the trail would "increase somewhat" their level of physical activity. The category ranges from greater than 0 to less than 100 percent, and was delineated into low/medium/high case scenarios with increases of 25%, 50% and 75% respectively. For example a respondent who chose current activity category of 2) 90 min to 3 hours would be given a mid-point value of 135 minutes. If respondents indicated the trail would increase his physical activity by 100 percent, activity would increase by 135 minutes, times the monetary value of a minute of physical activity per week, times 52 weeks (135*3.7*52) which is $260.70 per year. If the same respondents had indicated the trail will "increase somewhat the level of physical activity," the response is given low/medium/high scenarios corresponding to percentage increases of 25, 50 and 75 percent. This translates into low/medium/high monetary values of $65.18, $130.35 and $195.53 respectively.

The survey responses are extrapolated over the number of predicted individual users to calculate the total dollar value of increased physical activity emanating from the trail. This is shown in Table 8. Respondents who indicated their physical activity “would double” (100 percent increase) are included in each of the low/medium/high cases. Approximately seven percent of users were excluded based on the premise that such individuals are “very fit” (had an initial level of physical activity in the highest range) and that additional physical activity does not reduce medical costs. Less than one percent of cases started at fitness level four (6-12 hours), indicated the trail would increase their level of fitness, and had their total activity level capped at the lower end of the uppermost range (12 hours which is equivalent to 720 minutes).

Physical Activity Impact of Trail	Yearly Value of Increased Physical Fitness 2007$	Yearly Value Per Household in Kings County	Yearly Value Per Capita for Kings County
Low Case Where “increase somewhat” equals a 25% increase (plus those who indicated “at least double").	$321,813	$13.30	$5.36
Medium Case Where “increase somewhat” equals a 50% increase (plus those who indicated “at least double").	$455,680	$18.83	$7.59
High Case Where “increase somewhat” equals a 75% increase (plus those who indicated “at least double").	$558,613	$23.09	$9.30

Table 8 Total Yearly Value of Increased Physical Activity from Proposed Trail

The total annual value of increased physical activity expected to emanate from the proposed trail ranges from approximately $322,000 in the low case, to $559,000 in the high case, with a medium case value of approximately $456,000. Based on the 2006 census, there are just over 60 thousand households in Kings County (60,035) and approximately 24,000 households (24,195). Kings County approximates the 50 km radius (for residents) for which trail use was estimated. The yearly health benefits from the trail would range from $13.30 to $23.09 per household with a base case value of $18.83. The yearly health benefits from the trail would range from $5.36 to $9.30 per capita with a base case value of $7.59.

Trail Benefit/Cost Ratios

The benefits of a trail have to be examined relative to the costs. Wang et al. (2005) assumed a 30 year time horizon for the trails and compared the annual benefits and costs. The accuracy of such an approach is diminished, however, when the benefits and costs have distinctly different time profiles. Trail development is such a case, given that the majority of the costs are borne in the beginning based on the construction of the trail (there is of course ongoing annual maintenance and operation costs but they are typically small relative to the initial costs of construction) and the benefits accrue into the future. The differing time profiles can be accounted for by looking at the present values of the benefits and costs over the 30 year time horizon.

The cost estimates for construction of the proposed trail done by CBCL Consulting Engineers Ltd. for The Kieran Pathway Society (a local trail group) who commissioned the cstudy. The operational costs (adjusted for inflation and characteristics of the proposed trail) are based on Poole (2005) who compiled a survey of 100 rail trails in northeastern United States for the Rails-To Trails Conservancy, Northeastern Office.

The initial construction cost of a 3 meter width, gravel surface is estimated to be $10,000 per kilometre which totals $280,000 for the 28 kilometer trail. Note that the portion of the trail which currently exists through the town of Kentville (which has a gravel surface) is included in the above totals in order to get relevant costs of the trail in its entirety. All construction costs are assumed to occur in the first year. Annual maintenance and operation costs are estimated at $940 per kilometer or $26,320, with additional re-surfacing costs of $3,000 per kilometer ($84,000) in year 10, 20 and 30. The annual health benefits are assumed to start in year 2.

A 3 meter asphalt surface trail is estimated to cost $32,000 per kilometre to construct. Therefore, total construction costs for the 28 kilometres Kentville to Grand Pré rail-trail is estimated at $952,000. Annual maintenance and operation costs are the same as the gravel trail, estimated at $940 per kilometer or $26,320 in total. Re-surfacing is assumed to be required in year 17, costing $8,250 per kilometer for a total of $231,000. A paved trail increases usage and health benefits by 10 percent (relative to the gravel surface).

Table 9 gives the present value of costs and benefits and the benefit/cost ratios for the 30 year time horizon for the trail. The discount rate is 5 percent. The present value of the trail costs is approximately $750,000 for the gravel surface and approximately $1.4 million for the paved surface. The present value of the health benefits for the gravel surface ranges from $4.6 million to $8.1 million with a base case value of $6.6 million. The present value of the health benefits for the paved surface ranges from $5.1 million to $8.9 million with a base case value of $7.2 million. The benefit cost ratios for the gravel surface range from 6.2 to 10.8, with a base case value of 8.9. The benefit cost ratios for the paved surface range from 3.7 to 6.4, with a base case value of 5.2. It is important to note that the lower benefit cost ratios associated with the paved surface are not a function of reduced health benefits (usage) compared with the gravel surface. While the paved trail benefits exceed the gravel surface benefits by 10 percent, the paved trail costs about twice that of the gravel surface trail.

Based on 30 Year Time Horizon for Trail. All Figures are in 2007$	**Trail Cost**	**Health Benefits Low Case**	**Health Benefits Medium Case**	**Health Benefits High Case**
Gravel Surface *Present Value*	*$748,866*	$4,640,566	$6,570,937	$8,055,238
Gravel Surface Benefit/Cost Ratio		6.20	8.77	10.76
Paved Surface Present Value	$1,385,978	$5,104,623	$7,228,031	$8,860,762
Paved Surface Benefit/Cost Ratio		3.68	5.22	6.39
ATV Access *Gravel Surface Present Value*	$1,128,402	$2,320,283	$3,285,469	$4,027,619
ATV Access *Gravel Surface* Benefit/Cost Ratio		2.06	2.91	3.57

Table 9 Benefits/Costs of Proposed Trail

The Impact of All Terrain Vehicle (ATV) Access

Each survey offered one of two access level combinations related to ATV use – complete ban and restricted access or restricted access and unrestricted access – asking the respondent to predict their trail use for each one. To control for order effects, half of each access level followed one order, with the other half the opposite. The pairing ensured that if an ATV user received a survey, the respondent would have an option that involved access to the trail. These four survey types were interacted with two surface options, paved and unpaved, totaling eight unique surveys.

A gravel surface trail is assumed to have the same construction cost regardless of ATV use. However, allowing ATV use is expected to double the operation costs due to the necessity of increased maintenance and monitoring costs. Allowing ATV access to the trail reduced use by approximately 50 percent (from an annual total of 158,405 to 82,083). Over the 30 year time horizon, the present value of the health benefits under the ATV access scenario ranges from $2.2 million to $4.2 million, with a base case value of $3.5 million. The decline in the present value of health benefits if ATV access is allowed is $2.2 million (low case), $3.1 million base case and $3.8 million in the high case. The cost benefit ratios associated with ATV access (gravel surface) are subsequently reduced given increased maintenance costs and reduced benefits and equal 2.1 for the low case, 2.9 for the medium case and 3.6 for the high case. On an annual basis, allowing ATV access will reduce the health benefits by between $160,000 and $280,000 per year, with a medium case decline of almost $228,000. A reduction in health benefits of $228,000 per year is equivalent to approximately $9 per household and $4 per capita for Kings County.

CONCLUSION

Trails are a recreational resource of growing importance. This paper reports on a contingent trip travel analysis of a proposed trail in the Annapolis Valley of Nova Scotia. Following a modified Dillman (2007) approach, a mixed method survey was administered to a random sample of 1728 households. Respondents were asked to provide socio-economic data, to project their use of the proposed trail, to estimate the impact the proposed trail would have on their level of physical activity, and to indicate the impact that ATV access would have on their projected trail use. The demand for the trail was estimated using a negative binomial regression. The trail is estimated to attract 434 trips per day or approximately 158,000 trips per year.

The method of estimating the health benefits of the trail is modeled after Wang et al. (2005). The direct health benefits are measured by estimating the direct medical costs for active persons versus inactive persons, which is calculated to be $541 in 2007. Survey respondents were asked their current level of physical activity and how the existence of the trail would influence their future level of physical activity. The responses were converted from categorical changes to minutes with the value of an additional minute (per week) of physical activity based on reduced medical costs associated with persons reaching a certain level of physical activity.

The total annual value of increased physical activity expected to emanate from the proposed trail is estimated to be approximately $456,000. Kings County approximates the 50 km radius (for residents) for which trail use was estimated. The yearly health benefits accruing to Kings County residents from the trail were estimated at $18.83 per household and $7.59 per capita.

The health benefits of the trail are compared with the construction and maintenance cost under a number of scenarios. The trail is assumed to have a 30 year time horizon. The construction costs are assumed to occur in year one with operational costs occurring in all subsequent years. The proposed trail provides an effective return on investment under all the scenarios examined. Under a gravel surface scenario, the (base case) net present value of benefits to costs is 8.8. A paved surface trail is projected to increase use (and corresponding health benefits) by about 10 percent (relative to the gravel surface) but at nearly twice the cost. The (base case) present value of benefits to costs for the paved surface is 5.2. Allowing ATV access will reduce overall use (and corresponding health benefits) by approximately 50 percent (relative to the base case gravel surface). The (base case) present value of benefits to costs for the (gravel surface) trail with ATV access is 2.9. On an annual basis, allowing ATV access will reduce the health benefits by almost $228,000 per annum, which is equivalent to approximately $9 per household and $4 per capita for Kings County residents.

DISCUSSION

From an economic perspective, building recreational infrastructure such as trails is a welfare enhancing investment if the benefits generated from the built infrastructure exceed the cost of doing so. An argument made in support of trails is that it is expected to increase physical activity. Studies of the impact of trail construction on physical activity are mixed. In one study of trail users in Indiana, 70 percent of interviewed trail users report an increase in physical activity (Wolter and Lindsey, 2001). In contrast, a before and after trail construction survey of neighboring households finds no significant increase in physical activity (Evenson et al.., 2005). In the latter case, the neighborhood was already fairly well equipped with sidewalks and trails, so that the new trail was more of a substitute for existing trails than a new recreational resource.

The projected use of the proposed trail at 158,405 trips per year will produce health benefits far in excess of the costs regardless of surface type. Indeed the health benefit to cost ratio is 8.8 for the gravel surface and 5.2 for the paved surface. The gravel surface (base case) will produce health benefits in the neighborhood of one half million dollars per year. For the proposed trail, there are few substitutes nearby, particularly for cycling. As such, where the proposed trail will increase the quality of the recreational experience for many of its users and bring about increased physical activity.

An additional health benefit relates to trails serving as a transportation route. As noted by Peden, M at al. (2004) the World Health Organisation considers the danger and the health burden of walking and biking on highways to be pandemic. If active commuters are able to substitute riding on highways with motor vehicle free pathways, even if this doesn't increase their net physical activity, that could reduce motor vehicle/pedestrian/cyclist accidents, with resulting health care cost reductions. Insufficient data prevents calculating such benefits for the proposed trail being examined.

Several options for trail development emerge from the study results. Firstly, a gravel surface is more cost effective given that projected use and corresponding health benefits are only 10 percent less than that of the paved surface but the gravel surface costs are only 54 percent of the paved trail. On the other hand, a paved trail would encourage walking/cycling transportation use of the trail and increase overall use by about 10 percent. While the benefit cost ratio (return of investment) for the paved trail is lower for the paved trail than for the gravel trail, the total net benefits are maximized under the paved scenario. This occurs because the increase in the net present value of benefits associated with the paved surface trail (over the gravel surface), is greater than the increase in the net present value of the costs. Further, the survey results suggest that a paved trail would tend to discourage use by ATV riders.

Secondly, it is appropriate to think of the entire trail as one unit, and that ATV use and surface type decisions are made for the whole trail. Permitting ATVs to use the trail is expected to reduce the number of trips taken by almost 48 percent and health benefits by almost $228,000 per annum. However, even with the negative impact of ATV access on trail use, the present value of the benefits still exceeds the costs by a ratio of 2.9 to 1 (base case).

Finally, the low percentage of survey respondents that are ATV users and local geography suggests that this proposed trail may not attract many ATV users. However, the tension between ATV enthusiasts and those who wish to limit the use of these machines is such that the political atmosphere around this idea is highly charged. While only 10 percent of the survey respondents indicated frequent ATV use, this represents 1200 household within 5 km and 4000 households within 2.5 km of the trail. It appears that respondents' perception of actual ATV use on the proposed trail is sufficient to impact demand by non-ATV users. In this case, the results suggest that ATV use should be banned, given the negative impacts on trip demand and corresponding reductions in health benefits.

REFERENCES

Bateman, I. J., Day, B. H., Dupont, D. P., Georgiou, S. (2006). Incentive compatibility and procedural invariance testing of the one-and-one-half-bound dichotomous choice elicitation method: Distinguishing strategic behaviour from the anchoring heuristic. In: 16th Canadian Resource and Environmental Economics working group meetings.

Betz, C. J., Bergstrom, J. C., Bowker, J. M. (2003). A contingent trip model for estimating rail-trail demand. *Journal of Environmental Planning and Management,* 46 (1), 79–96.

Cameron, A. C., Trivendi, P. K. (1986). Econometric models based on count data: Comparisons and applications of some estimators and tests. *Journal of Applied Econometrics,* 1 (1), 29–53.

Cameron, A. C., Windmeijer, F. A. G. (1996). R-squared measures for count data regression models with appliations to health-care utilization. *Journal of Business & Economic Statistics,* 14 (2), 209–220.

Canada, H. (2006). Canada's guide to healthy eating and physical activity. Queens Press, Ottawa.

Carothers, P., Vaske, J. J., Donnelly, M. P. (2001). Social values versus interpersonal conflict among hikers and mountain bikers. *Leisure Sciences* 23, 47–61.

Delaney, G., Groups not on same path on proposed rail trail. *The Halifax Chronicle-Herald Newspaper*, December 27, 2006

Dillman, D. A. (2007). Mail and internet surveys: the tailored design method, 2nd Edition. Wiley, Hoboken, N.J.

Englin, J., Shonkwiler, J. S. (1995). Estimating social welfare using count data models: an application to long-run recreation demand under conditions of endogenous stratification and truncation. *The Review of Economics and Statistics,* 77 (1), 104–112.

Evenson, K. R., Herring, A. H., Huston, S. L., 2005. Evaluating change in physical activity with the building of a multi-use trail. *American Journal of Preventive Medicine,* 28, 177–185.

Gardner Pinfold Consulting Economists Limited, (1999). A survey of nova scotia hiking trail users. Tech. rep., Nova Scotia Department of Economic Development and Tourism, Nova Scotia Sport and Recreation Commission, Human Resources Development Canada.
URL http://www.gov.ns.ca/hpp/physicalactivity/publications/trails.pdf

Haider, W., Anderson, C., Beardmore, B., Anderson, D. A. (2004). Recreational trail use of residents in Jasper National Park, Canada. Working Paper 2, Finnish Forest Research Institute. URL http://www.metla.fi/julkaisut/workingpapers/2004/mwp002.htm

Hellerstein, D., Mendelsohn, R. (1993). A theoretical foundation for count data models. *American Journal of Agricultural Economics,* 75 (3), 604–611.

Herriges, J., Shogren, J. (1996). Starting point bias in dichotomous choice valuation with follow-up questioning. *Journal of Environmental Economics and Management,* 30, 112–131.

Jackson, E. L., 1986. Outdoor recreation participation and attitudes to the environment. *Leisure Studies,* 5, 1–23.

Keiran Pathway Society, http://www.valleycycling.ca/Kieran%20Pathways%20Society.html

Marcouiller, D., Scott, I., Prey, J. (2006). Compatibility and conflict as a conceptual basis for outdoor recreation planning.
http://www.urpl.wisc.edu/people/marcouiller/publications/06litreview.pdf.

McFadden, D., 1974. Conditional logit analysis of qualitative choice behaviour. In: Zarembka, P. (Ed.), Frontiers in Economics. Academic Press, New York, pp. 105–142.

Morey, E. R., Buchanan, T., Waldman, D. M., 2002. Estimating the benefits and costs to mountain bikers of changes in trail characteristics, access fees, and site closures: choice experiments and benefits transfer. *Journal of Environmental Management* 64, 411–422.

Nova Scotia Finance, Economics and Statistics Division, (2006). Nova Scotia statistical review.
http://www.gov.ns.ca/finance/statistics/agency/publications/publications.asp?id=Pub21

Peden, M et al.. (2004). The *World Report on Road Traffic Injury Prevention* Geneva: World Bank/World Health Organization.

Pool, Tim (2005), Rail-Trail Maintenance and Operation: Ensuring the Future of Your Trail- A Survey of 100 Rail Trails, Rail Trail Conservancy, Northeast Regional Office.
http://www.railtrails.org/resources/documents/resource_docs/maintenance_operations_report.pdf

R Development Core Team, 2006. R: A Language and Environment for Statistical Computing. R Foundation for Statistical Computing, Vienna, Austria, ISBN 3-900051-07-0.
URL http://www.R-project.org

Siderelis, C., Moore, R., Fourth (1995). Outdoor recreation net benefits of rail-trails. *Journal of Leisure Research,* 27 (4), 344-352
.
Venables, W. N., Ripley, B. D., 2002. Modern Applied Statistics with S, 4th Edition. Springer, New York, ISBN 0-387-954570.
URL http://www.stats.ox.ac.uk/pub/MASS4

Voluntary Planning, November (2004). Final report of the voluntary planning off-highway vehicle task force. Tech. rep., Government of Nova Scotia.

Wang, Guijing, et al. (2005). A Cost-Benefit Analysis of Physical Activity Using Bike/Pedestrian Trails. *Health Promotion Practice*, 6 (2), 174-179.

Wolter, S. A., Lindsey, G. (2001). Summary report: Indiana trails study. Tech. rep., Eppley Institute for Parks & Public Lands, Indiana State University, Bloomington, Indiana.