The economic value of mountain biking in the Baviaanskloof Mega Reserve, Eastern Cape, South Africa: a travel cost analysis using count data models

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Abstract

This paper reports the first formal non-market valuation of mountain biking in South Africa by applying the individual travel cost method (TCM). Due to the non-negative, integer nature of the trip data, several count data models were estimated. Mountain biking is fast becoming one of South Africa's most popular recreational sports and these estimates of economic value may assist policy-makers in managing mountain biking venues in general, and congestion conflicts, specifically. The locus of this study is the Baviaanskloof Mega-Reserve situated in the Eastern Cape Province of South Africa, part of which was declared a World Heritage Site in 2004. The reserve is a popular site for mountain biking. The economic value estimated, by employing a generalised negative binomial model, for trips taken during 2014 amounted to ZAR1 915 (US$167) per trip.

Keywords: Travel cost method, recreation demand, mountain biking, non-market valuation, consumer surplus

1 Introduction

Mountain biking (MTB) is one of the fastest growing sports in South Africa (Du Toit, 2013; Barry, 2014). One of the main reasons for the exponential growth of MTB is the fact that most of the races cater for the whole family (Du Toit, 2013). South Africa is considered a MTB 'mecca' with more than 750 races hosted annually (Barry, 2014). The Absa Cape Epic, a MTB race held over eight, day stages, is considered the most televised MTB competition of all

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time, whilst the Nedbank Sani2c is currently the world's biggest MTB stage race (Barry, 2014). South Africa also plays host to the UCI Mountain Bike World Cup. More specifically, Pietermaritzburg, KwaZulu-Natal hosted the cups from 2009 to 2014, and will do so again in 2015 (Du Toit, 2013). Another South African MTB race, the Transbaviaans held annually in the Baviaanskloof Mega-Reserve, Eastern Cape, had the title as the 'longest single stage team MTB event' in the world for six years – 400 teams comprising of two, three or four cyclists per team are allowed to enter the race (Transbaviaans, 2015).

Despite the growing popularity of MTB, economic valuations of this recreational pursuit are limited (Chakraborty and Keith, 2000). Buchanan, Morey and Waldman (1998) employed a random utility model of choice to determine a person's per-trip compensating variation as a result of changes in MTB site characteristics and/or access fees. Fix and Loomis (1998) compared the economic value of MTB estimated by employing both a revealed preference (a travel cost model) and a stated preference (a contingent valuation model) technique. Chakraborty and Keith (2000) used various count data models to determine the recreation demand and economic value of MTB in Moab, Utah. Fix, Loomis and Eichhorn (2000) applied a travel cost model to study the potential for over-estimating consumer surplus due to the use of endogenously selected travel costs – the study was carried out at Moab, Utah. Loomis, Gonzalez-Caban and Englin (2001) employed a travel cost model to test for differential effects of forest fires on hiking and MTB demand and benefits. Finally, Hesseln, Loomis, Gonzalez-Caban and Alexander (2003) applied a travel cost model to study the effects of wild and pre-scribed fires on mountain biker visitation to New Mexico.

The benefit value of MTB is important from a resource policy point of view. The increase in the popularity of MTB and the concomitant increase in the number of mountain bikers may lead to increased conflicts with other recreational users, such as hikers. Knowledge of the economic benefit of MTB could assist in resource management decisions, such as improving the allocation of resources based on an evaluation of the economic values generated by each user group (Fix and Loomis, 1998; Buchanan *et al*, 1998; Chakraborty and Keith, 2000). Monetary estimates of MTB can also be used in cost-benefit analysis of trail construction and management – the marking of designated MTB trails and the reparation of existing, eroded trails may impose costs on MTB destinations (Fix and Loomis, 1998).

To date, no formal valuation studies have been conducted to estimate the economic value of MTB in South Africa by means of non-market valuation techniques. This study aims to fill this information gap. More specifically, this paper employs a travel cost analysis to determine the economic value of MTB at one of South Africa's major MTB destinations, namely the Baviaanskloof Mega-Reserve. This method is well suited to valuing the economic benefits of MTB since the cost associated with travel is usually the main expenditure incurred by a cross-section of mountain bikers (Loomis and Walsh, 1997). Due to the non-negative, integer nature of the data, count data models were estimated in this study.

In what follows, section two describes the study area. Section three provides a short theoretical overview of the econometric methodology applied in this paper. Section four discusses data collection. Section five discusses the analyses, results and welfare calculations. Section six concludes the paper.

1.1 The study area

The Baviaanskloof or 'Valley of Baboons', a 174 400 ha Mega-Reserve, which lies 75 km north-west of Port Elizabeth in the Eastern Cape Province, South Africa was selected as the study area for estimating the economic value of mountain biking by means of the travel cost model. It falls within the smallest, most distinctive of the world's six floral kingdoms, namely the eastern Cape Floral Kingdom (CFK), and has been recognized as one of the world's 25 "biodiversity hotspots" (Boshoff, Cowling and Kerley, 2000). In addition to the rich flora, the Baviaanskloof is also considered a region of high fauna biodiversity and also harbours a rich and varied cultural heritage (Boshoff *et al*, 2000). The Baviaanskloof Wilderness Area (BWA), a World Heritage Site (declared in 2004), forms part of the greater Mega-Reserve.

The Baviaanskloof has become one of the most popular mountain biking destinations in South Africa. As mentioned above, it also plays host to the Transbaviaans MTB one-day stage race. In terms of the conditions for conducting travel cost studies (see Freeman, 2003), the Baviaanskloof site is almost ideal: many of the trips undertaken by visitors will be single-site and single-purpose ones (the site is only accessible by a dirt road and is very remote). In addition, travel times, costs and distances are likely to vary among the visitors.

2 Econometric methodology

An individual TCM analysis is used in this study to estimate a MTB recreation demand function. The latter is estimated using survey data in which travel costs, which include distance and time costs, predict the number of visits that will be undertaken by an individual to a recreational site (Caulkins *et al*, 1986; Kling, 1987; Bockstael, 1995; Ward and Beal, 2000; Pagiola *et al*, 2004; Martinez-Espineira and Amoako-Tuffour, 2008). In addition to travel costs, a vector of explanatory variables, such as income, age, gender, education and substitute sites, are also usually included in the demand function (Bockstael, 1995; Hanley and Spash, 1993 Bowker *et al,* 1996; Fix and Loomis, 1997; Bin *et al,* 2005; Martinez-Espineira and Amoako-Tuffour, 2008). The demand function estimated can then be employed to estimate the visitors' consumer surplus or non-market value of the recreational site (Bateman, 1993; Hanley and Spash, 1993; Liston-Heyes and Heyes, 1999).

The estimation of the recreation demand function by means of the ordinary least squares (OLS) method[1] may lead to biased estimators due to the zero truncated and non-negative integer nature of the trip data as well as the prevalence

[1] The OLS model is based on a continuous distribution which assigns positive probability to fractional and possibly negative occurrences (Fix & Loomis, 1998).

of over-dispersion issues (Creel and Loomis, 1990; Hellerstein and Mendelsohn, 1993; Liston-Heyes and Heyes, 1999). Count data models, such as the Poisson model, is more appropriate to use in this case since their estimators more closely reflect the data generating process (Creel and Loomis, 1991; Hellerstein, 1991; Bowker *et al,* 1996; Englin *et al,* 2003). In this study, data was gathered on-site and the number of trips was a non-negative integer. A Poisson model was thus applied since it satisfies the discrete probability density function and non-negative integers (Hellerstein and Mendelsohn, 1993; Shrestha *et al,* 2002). The general form of the Poisson model can be expressed as follows:

$$f(y_i|x_i, \beta) = \frac{e^{-m(x_i,\beta)^{y_i}}}{y_{i!}} \tag{1}$$

where: y_i = the number of trips taken

m = the mean value of trips taken

β = a vector of parameters to be estimated (Hesseln, Loomis, Gonzalez-Caban & Alexander, 2003).

The use of on-site sampling introduces two complications with the estimation of recreation demand models (Englin and Shonkwiler, 1995). First, non-users are truncated, which means that non-users' demand and the value they attach to the specific recreational site are excluded (Liston-Heyes and Heyes, 1999; Bin *et al,* 2005; Martinez-Espineira and Amoako-Tuffour, 2008). Second, there is an increased likelihood that more frequent visitors will be captured during the surveys – a situation known as endogenous stratification (Shaw, 1988; Liston-Heyes and Heyes, 1999; Martinez-Espineira and Amoako-Tuffour, 2008). If these two issues are ignored then the estimates produced will be biased and inconsistent (Shaw, 1988; Creel and Loomis, 1990). Both endogenous stratification and truncation can be corrected in the Poisson model by weighting each observation by the expected value of visits (Shaw, 1988). In the case of the standard Poisson model, this entails modifying the dependent variable by subtracting one from each of its values (Shaw, 1988; Fix and Loomis, 1997; Hesseln *et al,* 2003; Hagerty and Moeltner, 2005).

The Poisson model, however, assumes that the variance and conditional mean of its distribution are equal, what is known as equi-dispersion. In many recreation model demand studies, however, the variance exceeds the conditional mean – a problem known as over-dispersion (Cameron and Trivedi, 1990). The negative binomial model may be employed when over-dispersion is significant (Shrestha *et al,* 2002; Bin *et al,* 2005; Martinez-Espineira and Amoako-Tuffour, 2008). The addition of an extra parameter, α, captures the unobserved heterogeneity not captured by the Poisson model (Martinez-Espineira and Amoako-Tuffour, 2008). The negative binomial model that can be applied if significant over-dispersion is present, and that has been corrected for truncation and endogenous stratification, is derived as follows:

$$Pr[Y = y|Y > 0] = y_i[\Gamma(y_i + \alpha_i^{-1})/\Gamma(y_i + 1)\Gamma(\alpha_i^{-1})]\alpha_i^{yi}\ \mu_i^{yi-1} \quad (1 + \alpha_i\mu_i)^{-(y_i+\alpha_i-1)} \tag{2}$$

where y is the count variable (Englin and Shonkwiler, 1995; Martinez-Espineira and Amoako-Tuffour, 2008). This model restricts the over-dispersion parameter to a constant, i.e. $\alpha_i = \alpha$ (Martinez-Espineira and Amoako-Tuffour, 2008). A generalised negative binomial model with endogenous stratification can also be estimated – this model allows α to vary across respondents (Martinez-Espineira and Amoako-Tuffour, 2008).

Following the example of Martinez-Espineira and Amoako-Tuffour (2008), the dependent variable in this study was taken to be the product of the size of the travelling party and the number of trips undertaken by the respondent (for mountain biking purposes) during the last five years[2]. This was done in an effort to reduce the lack of dispersion around the dependent variable – a common a- iction of the individual TCM (Bowker *et al*, 1996; Martinez-Espineira and Amoako-Tuffour, 2008).

The travel costs for each respondent comprised variable costs only and included those for distance, lodgings and airfare. The lodgings cost was taken to be the reported cost per night of staying in the Baviaanskloof. The distance costs were calculated from motor vehicle operating costs per kilometre (km) as supplied by the South African Revenue Service (SARS), which at the time of the study was ZAR3.30/km. The operating cost per km was multiplied by the roundtrip distance (to and from the Baviaanskloof) travelled to obtain the distance cost (Hesseln *et al,* 2003; Bin *et al,* 2005; Martinez-Espineira and Amoako-Tuffour, 2008). The reason why the researchers calculated the travel costs was done to avoid, as far as possible, survey overload, and recollection and response bias (Martinez-Espineira and Amoako-Tuffour, 2008)[3]. The estimated travel cost was normalised by dividing it by the size of the travelling party (Martinez-Espineira and Amoako-Tuffour, 2008).

Ideally, travel time costs should also be included in travel cost studies (Freeman, 2003; Zawacki *et al*, 2000; Hesseln *et al*, 2003; Parsons, 2003; McKean *et al*, 2003). The preferred approach is to include travel time as its own variable (Fix and Loomis, 1998) – this approach was followed in this study[4]. Many other studies employ some fraction of the wage rate to estimate the opportunity cost of time (Cesario and Knetsch, 1970; Cesario, 1976; Bateman, 1993; Bowker *et al,* 1996; Liston-Heyes and Heyes, 1999; Zawacki *et al,* 2000; Hagerty and

[2]A simplifying assumption was made that the size of the travelling party represents an average value and thus remains the same across all trips undertaken by that particular respondent over the reference period (Martinez-Espineira & Amoako-Tuffour, 2008). In other words, the group size remains constant across time, but not across respondents.

[3]In a study by Bowker *et al.* (1996), no significant dissimilarities were found when two distinct recreation demand models were estimated, one using travel costs reported by respondents and the other using travel costs calculated by the researchers.

[4]Treating the time variable separately allows for the estimation of the opportunity cost of travel time within the model (Loomis & Walsh, 1997; Shrestha *et al.,* 2002).

Moeltner, 2005; Martinez-Espineira and Amoako-Tuffour, 2008). According to this approach, the time cost is estimated as the product of the number of hours travelled and the opportunity cost of time per hour. A few studies have omitted travel time costs completely (Hanley *et al*, 2003).

Some studies have found income to have a significant, negative influence on the number of trips undertaken making them inferior goods (Liston-Heyes and Heyes, 1999; Sohngen *et al,* 2000; Loomis, 2003), whilst others have found a significant, positive influence making trips a normal good (Bin *et al,* 2005; Martinez-Espineira and Amoako-Tuffour, 2008). Despite the weak influence of income in other studies, it was decided to include it as an explanatory covariate in this study. Since the Baviaanskloof Mega-Reserve is very remote, which makes a trip expensive enough for many mountain bikers, it was expected that income would have a positive influence on the number of trips undertaken per year. Not unlike the Martinez-Espineira and Amoako-Tuffour (2008) study, income was measured as the mid-points in thousands of Rands of thirteen brackets employed in the questionnaire.

It has been shown that the omission of substitutes leads to an over-estimation of consumer surplus (Smith and Kaoru, 1990). This happens, for example, since two visitors who travel an equivalent distance to visit a recreation site may value it entirely differently due to the fact that one visitor has a substitute site available while the other does not (Bateman, 1993; Hanley and Spash, 1993; Perman *et al*, 1996). Some studies employ the per mile cost of travelling to an alternative site as their substitute site price (Fix and Loomis, 1998), whilst others use a dummy variable (a value equal to one is assigned if the individual suggested a substitute site or the distance to it) (Bowker *et al,* 1996; Martinez-Espineira and Amoako-Tuffour, 2008). Other studies omit the price of substitutes (Creel and Loomis, 1990; Liston-Heyes and Heyes, 1999). This study employs the dummy variable approach to account for the influence of substitute sites on visitation rates (see Martinez-Espineira and Amoako-Tuffour, 2008).

In addition to the price and income variables included in the model, several other variables were also considered, namely gender, age, education, number of days spent on-site, the non-variable trip costs (such as food and other durable goods) and a heritage site variable (which captures the influence of the Baviaanskloofs World Heritage Site status) (Fix and Loomis, 1998; Martinez-Espineira and Amoako-Tuffour, 2008).

2.1 *Travel cost model*

The single-site demand function for this study was specified to predict visit frequency (trips) on the basis of a mixture of trip characteristics such as travel costs, travel time, socio-economic variables (income, gender, age, and education), a substitute site variable, a number of days spent on-site variable, a non-variable trip cost variable, and a heritage site variable. The function was estimated using count data models. It has the following form:

$$
\begin{aligned}
trips_i = \exp[\beta_0 + \beta_1(tc_i) + \beta_2(time_i) + \beta_3(income_i) + \beta_4(substitute_i) + \\
\beta_5(gender_i) + \beta_6(age_i) + \beta_7(education_i) + \beta_8(daysspent_i) \\
+\beta_9(non-variablecosts_i) + \beta_{10}(heritage_i)]
\end{aligned} \tag{3}
$$

Table 1 provides the operational definitions of the variables used in constructing the recreationdemand model.

The estimated coefficients of the travel cost covariate for each count data model were used to calculate the welfare measures. The average consumer surplus per visit estimates were calculated as the negative inverse of the travel cost coefficient (-1/$\hat{\beta}$) (Creel and Loomis, 1990).

3 Data collection

A structured questionnaire was designed to obtain the trip data required to apply the individual travel cost method. A pilot study, during which 30 respondents were approached on-site, was carried out to test the questionnaire. This pilot study was conducted about one month prior to the main survey being carried out and targeted individuals visiting the Baviaanskloof area primarily for mountain biking purposes. In response to the pre-test, the questionnaire was revised where necessary. Following the pilot study, the on-site survey was conducted by means of personal interviews during the Transbaviaans MTB event in August 2014 – this event posed a special sampling opportunity since a large number of mountain bikers (actual users) were coincidentally congregated in one place. Because of the sheer size of the Mega-Reserve, sampling over a long period, such as a year, and at many different locations, would be too time-consuming and prohibitively expensive. The enumerators intercepted individuals as they left the Town Hall in Willowmore (the starting point of the race) where registration for the event took place. The enumerator targeted every fifth person who was 18 years or older; 298 individuals were asked to complete the questionnaire, of which no-one refused, giving a response rate of 100% (this is not unusual for an in-person interview situation). Respondents who provided incomplete information were excluded from the sample, reducing the sample size to 295.

The questionnaire survey included questions about the size of the travelling party, the respondent's home location, the number of times the respondent has visited the Baviaanskloof in the last five years, the round trip distance travelled, the duration (in hours) of the round trip, duration of the visit, whether the respondent had a favourite alternative mountain biking destination, and as well as some demographic information. The descriptive statistics of the travel information, visitation, respondent characteristics and substitute site are shown in Table 2[5].

[5] There is no available socio-demographic information for the population of mountain bikers to the Baviaanskloof Mega-Reserve area. This makes it impossible to check for sample representativeness.

Briefly, respondent age ranged between 21 and 69 years, with a mean age of 40 years. The survey also revealed that respondents earn on average ZAR458 915 per year with a minimum of ZAR30 000 per annum and a maximum of ZAR R1 million per annum. The average group size was four individuals with a minimum of one and a maximum of 15. The average person spent 1.8 days on site and spent about ZAR3 187 on food and other durable goods. The majority (i.e. 77%) of the respondents are male.

4 Econometric results

It has been shown by Martinez-Espineira and Amoako-Tuffour (2008) that ignoring the multi-site and multi-purpose nature of trips leads to an over-estimation of consumer surplus by almost 50%. In order to deal with this issue, we followed Martinez-Espineira and Amoako-Tuffour's (2008) example by including the following question in the survey instrument:

"On a scale of zero (0) to 10, where 0 indicates **no influence** and 10 indicates **the main single reason**, how much influence would you say that the Baviaanskloof visit had in your decision to travel (to or in the Eastern Cape Province)?"

The resulting variable was used to weight the original travel cost estimate by means of the following transformation:

$$WTC = (UTC * w)/10 \tag{4}$$

where WTC is the weighted travel cost per mountain biker, UTC is the unweighted travel cost per mountain biker, and w is the influence factor[6]. The vast majority of the respondents, namely 83%, stated that the sole reason (a 10 score) for their trip was to mountain bike in the Baviaanskloof.

Five types of econometric specifications were used in this study to estimate a recreational mountain biking demand model, namely a standard Poisson specification, a Poisson specification adjusted for truncation and endogenous stratification (TES Poisson), a standard negative binomial model (NB), a negative binomial model adjusted for truncation and endogenous stratification (NBTES), and a generalised negative binomial with endogenous stratification (GNBES). The same covariates were employed in each of the abovementioned estimations. The results of applying various count data models in Stata: Release 11.1 are shown in Table 3.

All of the models of recreational demand presented in Table 4, except the Poisson and the NB ones, account for endogenous stratification and truncation. It was expected that most mountain bikers would undertake a few trips and a few would undertake many trips, which means significant over-dispersion is present. This is confirmed by the over-dispersion parameter, α, in the NB model

[6] Not unlike the Martinez-Espineira and Amoako-Tuffour (2008) study, we expected the inclusion of a weighting factor to reduce the estimated consumer surplus per trip as well as increase the estimated total consumer surplus since the predicted number of trips would have been corrected upwards.

– it's statistically significant. More specifically, a likelihood-ratio test of alpha=0 based on the NB model results in a$\overline{\chi}^2$ (01) = 1156.51 with $Prob >= \overline{\chi}^2 = 0.000$. Thus, both the recreation demand models based on the Poisson distribution (i.e. Poisson and TES Poisson) are overly restrictive because they do not take into account that a small number of mountain bikers undertake many trips while a large number of mountain bikers undertake only a few trips. The presence of over-dispersion is also confirmed by the better fit of the NB and NBTES models compared to the Poisson ones (see Table 3). Goodness-of-fit improves further, as indicated by the value of the log-likelihood, when the over-dispersion parameter, α, is allowed to vary across respondents in the GNBES model (see Table 3) – the coefficients of the explanatory variables[7] in the equation whose dependent variable is α are statistically significant, except for the constant, which serves as confirmation that setting $\alpha_i = \alpha$ for all observations would be overly restrictive (Martinez-Espineira and Amoako-Tuffour, 2008).

As expected, the estimated coefficient for the travel cost variable is negative and significant in all five models. The negative sign of this variable's coefficient suggests a downward-sloping demand curve for trips – thus, mountain bikers undertake fewer trips as travel costs rise. In addition to the price variable, the recreation demand model also includes *income*, *substitute*, *gender*, *age*, *education*, *daysspent*, *non-variable costs* and *heritage*.

The sign of the income coefficient is positive for all models estimated, which suggests that visits are a normal good for mountain bikers. This could be due to the fact that the Baviaanskloof is a remote mountain biking destination, which makes visiting and mountain biking at the site expensive enough for visits to be a normal good. The estimated coefficient is, however, only significant in the Poisson (at the 5% level), TES Poisson (at the 5% level) and GNBES (at the 10% level) models. Martinez-Espineira and Amoako-Tuffour (2008) found a similar result in their study.

The sign of the coefficient of the dummy variable *substitute* is negative for the two Poisson models estimated, which accords with *a priori* expectations that those mountain bikers with higher round trip travel times to substitute sites undertake more visits to the Baviaanskloof, *ceteris paribus*, but the coefficient is positive for all the negative binomial models estimated. The coefficient is, however, statistically insignificant in all models estimated. Betz, Bergstrom and Bowker (2003), and Martinez-Espineira and Amoako-Tuffour (2008) also found the effect of this variable non-significant.

The coefficient of the *gender* variable presents the expected positive sign: males tend to undertake more mountain biking trips compared to their female counterparts. The coefficient of the *gender* variable is significant in all models, except for the GNBES model. The coefficient of the *age* variable is significant at the 1% level and presents the expected positive sign in all the models estimated: those who are older tend to undertake more mountain biking trips to the Baviaanskloof. The education variable's (*educ*) coefficient is significant (at the 1% level) and positive for the Poisson, TES Poisson, NB and NBTES models, which

[7] These are age, education, and the number of days spent on-site.

accords with *a priori* expectations: mountain bikers with more educational attainment undertake more trips to the Baviaanskloof. The GNBES model, however, presents a negative and non-significant coefficient. This result is similar to the one achieved by Martinez-Espineira and Amoako-Tuffour (2008) – their education variable presented alternate and non-significant signs since income and education were too collinear. While their study revealed clear collinearity, this does not appear to be the problem in this case as there is minimal correlation between the education and income variables (22%).

The *daysspent* variable has a positive coefficient and is significant in the Poisson models (at the 1% level) and the NB and NBTES models (at the 1% level). This is similar to what was found in the Bowker *et al* (1996) and Martinez-Espineira and Amoako-Tuffour (2008) studies. The GNBES model, however, produces an insignificant and negative *daysspent* coefficient – this result accords with those of the Creel and Loomis (1990), Bell and Leeworthy (1990), and Shrestha *et al* (2002) studies. The *non-variable costs* variable has a positive coefficient in all models. It is significant at the 1% level in the two Poisson models and significant at the 10% level in the NB and GNBES models. This result is at odds with *a priori* expectations – one would expect those who tend to spend more to visit the Baviaanskloof to visit less often. As expected, the *heritage* variable has a positive coefficient and is significant at the 1% level for all models. Thus, mountain bikers who regard the World Heritage Status of the Baviaanskloof wilderness area as a major draw card are likely to undertake more frequent trips to the Baviaanskloof.

4.1 Consumer surplus

Table 4 presents the estimation results of the welfare measures at the mean of the data. Confidence intervals for the welfare estimates were constructed by employing the following formula:

$$WTP_L = 1/[\beta_1 + 1.96(SE)] \; and \; WTP_U = 1/[\beta_1 - 1.96(SE)] \qquad (5)$$

The TES Poisson model yielded the smallest consumer surplus per trip, ZAR1 695 with a 95% confidence interval of ZAR1 534 to ZAR1 894, while the standard NB model produced the largest consumer surplus per trip, ZAR2 326 with a 95% confidence interval of ZAR1 861 to ZAR3 098. It is useful to compare these welfare estimates with those derived in other mountain biking studies. Consumer surplus estimates from other mountain biking travel cost studies are provided in Table 5.

Table 5 shows that the consumer surplus per trip for mountain biking, estimated by five studies, ranges from US$30 to US$922 (Fix and Loomis, 1998; Chakraborty and Keith, 2000; Fix *et al*, 2000; Loomis *et al*, 2001; Hesseln *et al*, 2003). The wide range of values can partly be explained by the fact that the study locations differed (Utah, Colorado, New Mexico), the study sites differed (all trails considered versus only one trail considered), and that certain contingencies were imposed on the mountain bikers (such as, fires of differing ages).

When converted[8] into US$ terms, the welfare estimates derived as part of this study range between US$147 and US$202 per person per trip. Taking into account that the studies listed in Table 5 were conducted between 11 and 16 years ago, the consumer surplus estimates derived in this study appear reasonable in magnitude.

4.2 Conclusion

This paper estimated consumer surplus for mountain bikers per trip to the Baviaanskloof Mega-Reserve to be ZAR1 915 in 2014 (US$167) with a 95% confidence interval of ZAR1 560 and ZAR2 479 (using the preferred generalised negative binomial model). Aggregating this value (assuming a mean visitation rate of 2.84 visits per mountain biker) across the sampled population of bikers (i.e. 295 individuals) and the actual population of bikers (i.e. 2 800), yields total consumer surplus of ZAR1 604 370 and ZAR15 227 912, respectively.

While the welfare estimates calculated in this study are conditional upon the survey sample, they do show the substantial benefit of the MTB resource. This benefit value is important from a resource policy point of view. Monetary estimates of the MTB in the Baviaanskloof Mega-Reserve can assist in management decisions, such as the allocation of land for mountain biking trails. These estimates can also be of use in comprehending the benefits associated with tourism quality improvement projects in this area (McConnell and Strand, 1994).

It is, however, important to note that the total consumer surplus estimated here is not to be equated to the total economic value of the Baviaanskloof Mega-Reserve since a host of other recreational and commercial activities take place in the Mega-Reserve (Fix and Loomis, 1998). In addition, the estimated economic benefits of mountain biking in the Baviaanskloof cannot be simply transferred to other mountain biking venues. The Baviaanskloof Mega-Reserve is a remote and unique destination, which attracts mountain bikers from far and wide. Thus, adopting the economic benefit of mountain biking in the Baviaanskloof in a benefit transfer exercise would violate some of the requirements for a legitimate benefit transfer, namely absolute equivalence in terms of the non-market commodity, study site, and population of users (Boyle and Bergstrom, 1992; Fix and Loomis, 1998).

References

[1] Barry, H. (2014). Cycling is the new golf. Available at: www.moneyweb.co.za/archive/cycling-is-the-new-golf/ (Date accessed: 6 March 2015).

[2] Bateman, I.J. (1993) Valuation of the environment, methods & techniques: revealed preference methods, in: R. K. Turner (Ed.) *Sustainable Environmental Economics & Management* (London, Belhaven Press).

[8] At an exchange rate of ZAR11.50 = US$1.

[3] Bell, F.W. & Leeworthy, V.R. (1990). Recreational demand by tourists for saltwater beach days, *Journal of Environmental Economics & Management*, 18(3), pp. 189 – 205.

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

[5] Bin, O., Landry, C.E., Ellis, C. & Vogelsong, H. (2005) Some consumer surplus estimates for North Carolina beaches, *Marine Resource Economics,* 20(2), pp. 145 – 161.

[6] Bockstael, N., McConnell, K. & Strand, I. (1991) Recreation, in: J. Braden & C. Kolstad (Eds.) *Measuring the Demand for Environmental Quality* (Amsterdam, Elsevier).

[7] Bockstael, N.E. (1995) Travel cost methods, in: D. W. Bromley (Ed.) *The Handbook of Environmental Economics* (Oxford, Blackwell).

[8] Boshoff, A., Cowling, R. & Kerley, G. 2000. *The Baviaanskloof Conservation Area: A conservation & tourism development priority.* Terrestrial Ecology Research Unit, University of Port Elizabeth. Report No. 27.

[9] Bowker, J.M., English, D.B.K. & Donovan, J.A. (1996) Toward a value for guided rafting on southern rivers, *Journal of Agricultural & Applied Economics,* 28(2), pp. 423 - 432.

[10] Boyle, K.J. & Bergstrom, J.C. (1992). Benefit transfer studies: myths, pragmatism, & idealism, *Water Resources Research*, 28(3), pp. 657 – 663.

[11] Buchanan, T., Morey, E. & Waldman, D.M. (1998). Happy (hypothetical) trails to you: the impact of trail characteristics & access fee on a mountain biker's trail selection & consumer's surplus. Discussion Paper. Boulder, CO: Department of Economics, University of Colorado.

[12] Cameron, A.C. & Trivedi, P.K. (1990) Regression-based tests for overdispersion in the Poisson model, *Journal of Econometrics,* 46(3), pp. 347 – 364.

[13] Caulkins, P.P., Bishop, R.C. & Bouwes, N.W. (1986) The travel cost model for lake recreation: a comparison of two methods for incorporating site quality & substitution effects, *American Journal of Agricultural Economics,* 68, pp. 291 – 297.

[14] Cesario, F.J. & Knetsch, J.L. (1970) Time bias in recreation benefit estimates, *Water Resources Research,* 6(3), pp. 700 -704.

[15] Cesario, F. (1976) Value of time in recreation benefit studies, *Land economics,* 52, pp. 32 – 41.

[16] Chakraborty, K. & Keith, J.E. (2000). Estimating the recreation demand & economic value of mountain biking in Moab, Utah: an application of count data models, *Journal of Environmental Planning & Management*, 43(4), pp. 461 -469.

[17] Clark, F. 1999. Greater Baviaanskloof Wilderness Area. A regional development proposal. Rationalisation & consolidation of the western sector. Executive summary. Department of Economic Affairs, Environmental & Tourism. Eastern Cape Provincial Administration.

[18] Creel, M. & Loomis, J.B. (1990) Theoretical & empirical advantages of truncated count data estimators for analysis of deer hunting in California, *American Journal of Agricultural Economics,* 72, pp. 434 – 441.

[19] Creel, M. & Loomis, J.B. (1991) Confidence intervals for welfare measures with application to a problem of truncated counts, *The Review of Economics & Statistics,* 73(2), pp. 370 – 373.

[20] Du Toit, N. (2013). Did the African cycling dream impact on the cycling trade? Available at: www.sportstrader.co.za/pages/issue%20articles/2013OctNov/ cyclingimpactonsales.php (Date Accessed: 6 March 2015).

[21] Englin, J. & Shonkwiler, J. (1995) Estimating social welfare using count data models: An application under conditions of endogenous stratification & truncation, *Review of Economics & Statistics,* 77, pp. 104 – 112.

[22] Englin, J.E., Holmes, T.P. & Sills, E.O. (2003) Estimating forest recreation demand using count data models, in: E.O. Sills (Ed.) *Forests in a Market Economy* (Dordrecht, Kluwer Academic Publishers).

[23] Fix, O. & Loomis, J. (1997) The economic benefits of mountain biking at one of its meccas: An application of the travel cost method to mountain biking in Moab, Utah, *Journal of Leisure Research*, 29(3), pp. 342 – 352.

[24] Fix, O. & Loomis, J. (1998) Comparing the economic value of mountain biking estimated using revealed & stated preference, *Journal of Environmental Planning & Manangement,* 41(2), pp. 227 – 236.

[25] Fix, P., Loomis, J. & Eichhorn, R. (2000). Endogenously chosen travel costs & the travel cost model: an application to mountain biking at Moab, Utah, *Applied Economics*, 32, pp. 1227 – 1231.

[26] Freeman, A.M. (2003) *The Measurement of Environmental & Resource Values: Theories & Methods* (Washington DC, Resources of the Future).

[27] Hagerty, D. & Moeltner, K. (2005) Specification of driving costs in models of recreation demand, *Land Economics,* 81(1), pp. 127 – 143.

[28] Hanley, N. & Spash, C. (1993) *Cost-benefit Analysis & the Environment* (Vermont, Edward Elgar).

[29] Hanley, N., Bell, D. & Alvarez-Farizo, B. (2003) Valuing the benefits of coastal water quality improvements using contingent & real behaviour, *Environmental & Resource Economics,* 24(3), pp. 273 – 285.

[30] Hellerstein, D.M. (1991) Using count data models in travel cost analysis with aggregate data, *American Journal of Agricultural Economics,* 73, pp. 860 – 866.

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

[32] Hesseln, H., Loomis, J.B., Gonsalez-Caban, A. & Alexander, S. (2003) Wildfire effects on hiking & biking demand in New Mexico: A travel cost study, *Journal of Environmental Management*, 69(4), pp. 359 – 368.

[33] Joubert, A., Smith, B. & Neke, K. 1999. *Preliminary assessment of the proposed consolidation & expansion of the Western sector of the Baviaanskloof wilderness area.* Cape Town: University of Cape Town.

[34] Kling, C.L. (1987) A simulation approach to comparing multiple site recreation demand models using Chesapeake Bay survey data, *Marine Resources Economics,* 4, pp. 95 – 109.

[35] Liston – Heyes, C. & Heyes, A. (1999) Recreational benefits from the Dartmoor National Park, *Journal of Environmental Management*, 55(2), pp. 69 – 80.

[36] Loomis, J.B. & Walsh, R.G. (1997) *Recreation Economic Decisions: Comparing Benefits & Costs* (2^{nd} ed.) (State College, PA, Venture Publishing, Inc).

[37] Loomis, J.B., Rosenberger, R. & Shrestha, R.K. (1999) *Updated Estimates of Recreation Values for the RPA Program by Assessment Region & Use of Meta-Analysis for Recreation Benefit Transfer* (Fort Collins, Colorado State University, Final Report for the USDA Forest Service).

[38] Loomis, J., Gonzalez-Caban, A. & Englin, J. (2001). Testing for differential effects of forest fires on hiking & mountain biking dem& & benefits, *Journal of Agricultural & Resource Economics*, 26(2), pp. 508 – 522.

[39] Loomis, J. (2003) Travel cost demand model based river recreation benefit estimates with on-site & household surveys: Comparative results & a correction procedure, *Water Resources Research*, 39(4), pp. 1105.

[40] Martinez-Espineira, R. & Amoako-Tuffour, J. (2008) Recreation demand analysis under truncation, overdispersion, & endogenous stratification: An application to Gros Morne National Park, *Journal of Environmental Management,* 88(4), pp. 1320 – 1332.

[41] Martinez-Espineira, R. & Amoako-Tuffour, J. (2008) *Multi-destination & Multi-purpose Trip Effects in the Analysis of the Demand for Trips to a Remote Recreational Site* (Brussels, Economics & Econometrics Research Institute EERI Research Paper Series No. 19/2008).

[42] McKean, J.R., Johnson, D. & Taylor, R.G. (2003) Measuring demand for flat water recreation using a Two-Stage/Disequilibrium travel cost model with adjustment for overdispersion & self-selection, *Water Resources Research*, 39(4), pp. 1107.

[43] Pagiola, S., Ritter, K. & Bishop, J. (2004) *Assessing the Economic Value of Ecosystems* (Washington DC, World Bank).

[44] Parsons, G.R. (2003) The travel cost method, in: P.A. Champ, K.J. Boyle & T.C. Brown (Eds.) *A Primer on Nonmarket Valuation* (Boston, Kluwer Academic Publisher).

[45] Perman, R., Ma, Y. & McGilvray, J. (1996) *Natural Resource & Environmental Economics* (New York, Longman).

[46] Sarker, R. & Surry, Y. (1998) Economic value of big game hunting: The case of moose hunting in Ontario, *Journal of Forest Economics,* 4(1), pp. 29 – 60.

[47] Shaw, D. (1988) On-site sampling regression: Problems of non-negative integers, truncation, & endogenous stratification, *Journal of Econometrics,* 37, pp. 211 – 223.

[48] Shrestha, R.K., Seidl, A.F. & Moraes, A.S. (2002) Value of recreational fishing in the Brazilian Pantanal: a travel cost analysis using count data models, *Ecological Economics,* 42(1-2), pp. 289 – 299.

[49] Smith, V.K. & Kaoru, Y. (1990) Signals or noise? Explaining the variation in recreation benefit estimates, *American Journal of Agricultural Economics*, 70, pp. 147 – 162.

[50] Sohngen, B., Lichtkoppler, F. & Bielen, M. (2000) *The value of day trips to Lake Erie beaches* (Columbus OH, Ohio Sea Grant Extension Technical Report TB-039).

[51] Transbaviaans. (2015). Transbaviaans homepage. Available at: www.transbaviaans.co.za/page/home (Date accessed: 6 March 2015).

[52] Ward, F.A. & Beal, D.J. (2000) *Valuing Nature with Travel Cost Models: A Manual* (Cheltenham, Edward Elgar).

[53] Zawacki, W.T.A.M. & Bowker, J.M. (2000) A travel cost analysis of non-consumptive wildlife-associated recreation in the United States, *Forest Science,* 46(4), pp. 496 – 506.