

Economic evaluation of Mont-Bellevue Park in Sherbrooke using the individual travel cost method

Abstract

The purpose of this study was to evaluate the economic worth of Mont-Bellevue Park in Sherbrooke during both summer and winter seasons, utilizing the individual travel cost approach. This study is significant as it justifies the evaluation of the park's environmental advantages, and it provides valuable information for park administrators to distribute their budget efficiently. To determine the park visitor surplus, an online survey was conducted among 1,232 summer visitors in 2021 and 707 winter visitors in 2022, and the individual travel cost method was employed. The outcomes showed that the park's annual economic value was \$ 553,168 during the summer and \$ 250,985 during the winter, revealing the park's significance in the summer months, which heavily relies on good weather conditions. These findings are consistent with previous studies indicating that the recreational value of parks or tourist sites is greater during the summer season.

Keywords: Travel cost method; Economic evaluation; Mont-Bellevue Park; Negative binomial model; Poisson model.

1 Introduction

Ecosystem services hold considerable value from economic, socio-cultural, and ecological perspectives. They offer a wide array of benefits to residents, including recreational, leisure, and provisioning services, as well as valuable socio-cultural experiences (De Groot et al. 2002). These services are evaluated by the benefits they provide, such as leisure, pleasure, sporting experiences, and activities that promote physical and mental health (Milcu et al. 2013, Andersson et al. 2015). The values attributed to ecosystem services are shaped by the preferences of the individuals who use them (Milcu et al. 2013, Kenter et al. 2011, Poder et al. 2016). However, the monetary value of recreational services is often not widely recognized by policymakers and beneficiaries, as these services are not directly integrated into the market economy (Mayer & Woltering 2018, Borzykowski et al. 2017).

The economic valuation of non-market ecosystem services is crucial in demonstrating the benefits associated with the recreational values of parks and green spaces. By estimating the willingness of users to pay for these services, it becomes possible to assign observable prices to non-market ecosystem services. Such findings can be invaluable to administrative and municipal authorities, helping them make more informed budgetary decisions. Furthermore, assessing public parks plays a significant role in shaping policies aimed at enhancing public well-being (Zandi et al. 2018, Daily et al. 2009, Ezibilo 2016). For example, park managers may decide to invest in improving cycle paths, hiking trails, closing informal paths, or enhancing the maintenance of footpaths and mountain bike trails, among other initiatives.

The valuation of recreational resources can be quite problematic, as certain non-market services (e.g. biodiversity, recreational activities) do not exist on the market and they do not have a price. (Sohngen et al. 2000). Hence the importance of non-market valuation methods that estimate the economic value of non-market goods or services. In recent years, the assessment of non-market values has become very useful in environmental economics. Various non-market valuation methods have been applied to many recreational resources in Canada (Bertram & Larondelle 2017, Habib et al. 2013, Lee et al. 2010, Idris et al. 2014).

There are two approaches to non-market valuation: stated preference (SP) methods and

revealed preference (RP) methods ([Johnston et al. 2017](#), [Adamowicz et al. 1994](#)). Stated preference (SP) methods are based on hypothetical scenarios and make it possible to determine the economic value of a good or service that is not available on the real market. They include the contingent valuation (CV) method and the choice experiment (CE) method. The contingent valuation method consists of determining the overall value of a service, whereas the choice experiment (CE) method consists of determining the unit value of improvements to the various attributes of a good or service. Revealed preference (RP) methods aim to determine the economic value of goods or services by observing the actual behaviour of individuals. These methods focus solely on use values. Revealed preference methods include the hedonic price (HP) method and the travel cost (TC) method. The hedonic pricing method estimates the value of a non-market good by observing the behaviour of a related good on the market ([Rosen 1974](#)). The travel cost (TC) method uses leisure expenditure and travel time to estimate the value individuals place on visiting a site or park ([Kheyri et al. 2020](#))

Our study employs the travel cost (TC) method to evaluate the monetary value of recreational services and visitor demand at Mont-Bellevue Park (MBP). This method is commonly used in studies to estimate the use values of recreational sites. The TC method was initially introduced by Hotelling in 1947 to estimate the value of parks in the USA by analyzing visitor costs and the number of visits to the park ([Hotelling 1949](#)). In 1959, Clawson further elaborated on this method ([Clawson 1959](#)). There are two primary demand functions in the TC method: the individual model and the zonal model. The zonal model, developed by [Clausen & Knetsch \(1966\)](#), is based on the assumption that visitor rates vary depending on their region of origin. This model is typically used when data is limited in a study ([Tang et al. 2009](#)). In contrast, the individual travel cost method, where the dependent variable represents the number of visits made by individuals, provides more detailed information compared to the zonal model, which uses the number of visits made by inhabitants of different zones as the dependent variable ([Alberini & Longo 2006](#)). The individual model was developed by [Brown & Nawas \(1973\)](#) and is widely applied today, offering more reliable estimates than the zonal model due to the richness of the data it can collect ([Willis & Garrod 1991](#)).

We used the individual travel cost method to construct a demand curve for recreational activities by relating the number of visits to Mont-Bellevue Park to the expenditure associated with travelling to the park. By estimating this demand function, we were able

to assess the visitor surplus, reflecting its recreational value.

Given its natural landscapes, high biodiversity, proximity to the University of Sherbrooke, and status as the largest park in the City of Sherbrooke, Mont-Bellevue Park was selected for this research. The objective of this study is to determine the economic value of Mont-Bellevue Park's recreational services in both summer and winter using the individual travel cost method. In recent years, the economic evaluation of urban parks has garnered significant attention from researchers and decision-makers. Assessing the recreational services provided by Mont-Bellevue Park across different seasons will assist park managers in effectively allocating budgets for its development throughout the year. Additionally, this study is based on original data collected from park visitors. The structure of this paper is as follows: Section 2 presents the materials and methods, Section 3 discusses the results, and Section 4 provides a discussion and conclusion.

2 Materials and methods

2.1 Study area

Mont-Bellevue Park is a natural environment in the urban area of the city of Sherbrooke. It is located in Sherbrooke in the Eastern Townships and covers an area of 200 hectares. It is one of the largest parks in the city of Sherbrooke, accounting for around 23 % of the city's total park area. Sherbrooke is the 6th largest city in Quebec in terms of population, with a population of around 173,207 in 2021. The park is owned jointly by the Université de Sherbrooke (75 % of the park's surface area) and the City of Sherbrooke (25 %). It abounds in biodiversity, with around 60 species of mammal, including 18 present and 42 potentially present species, 26 species of amphibian and reptile, including 9 present and 17 potentially present species, and 113 species of bird inventoried. It also comprises two mountains: Bellevue (327 m) and John S. Bourque (370 m). It is bounded to the south-east by chemin Dunant, to the north-east by rue des seigneurs, rue Jogues and rue Lalemant, by the property of the Petites Sœurs de la Sainte-Famille, to the north-west by the campus, by former agricultural wasteland belonging to the University and by the Mont Saint-Anne property. Figure 1 describes Mont-Bellevue Park.

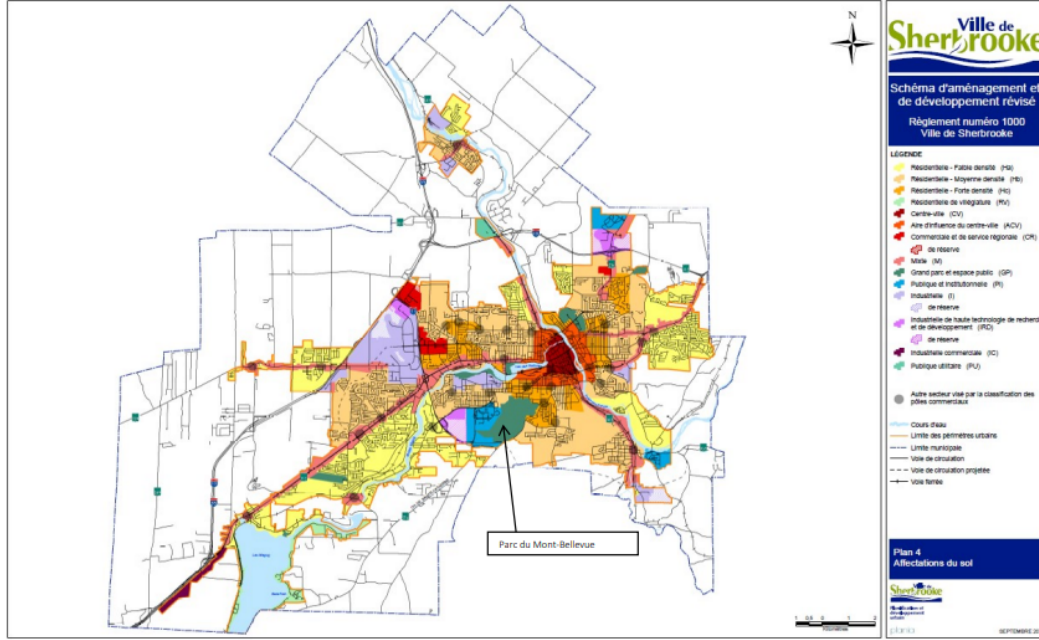


Figure 1: Map describing the Mont-Bellevue park in Sherbrooke (Quebec, Canada)

3 Research methodology

The travel cost (TC) method is a non-market valuation approach used to estimate the use value of a park or site based on observed market behavior. In this method, the cost of travel to the park serves as the price, while the number of annual visits represents the quantity demanded. The underlying assumption is that individuals are sensitive to travel costs, meaning that as the cost of reaching the destination increases, the number of visits to the park or site decreases (Hailu et al. 2005, Liston-Heyes & Heyes 1999). This assumption implies that the expenses incurred during travel are directly proportional to the distance each visitor must travel to reach the location. Formally, this leads to the following demand function:

$$v_i = f(p_i, z_i) \quad (1)$$

Where v_i is the number of visits taken by an individual i to the site during a year, p_i is the cost of access to the site composed of the travel cost and the distance traveled to the site, and z_i is a vector of sociodemographic variables of individuals that can influence the number of visits. In our study, the travel cost was calculated by multiplying the distance traveled to reach the site by the unit cost, which is 0.61 \$ CAD/km (Canadian Automobile

Association, 2022).

To determine the demand function, we used the Poisson model and the negative binomial model given the following function:

$$\lambda_i = \exp(x_i \beta) \quad (2)$$

Where the parameter λ_i is both the mean and the variance of the random variable and takes strictly positive values. λ_i varies as a function of the explanatory variables x_i and the parameter vector β .

In this context, the individual i is consumer surplus resulting from accessing the site is represented by :

$$cs_i = \int_{p_0}^{p_1} \lambda_i dp = -\frac{\lambda_i}{\beta} \quad (3)$$

The research methodology for this study involved the collection of both quantitative and qualitative data through visits to Mont-Bellevue Park and the administration of a questionnaire during both summer and winter seasons. Statistical analysis of the results was conducted using STATA and EXCEL software. A random sampling method was employed, and a pre-test was performed with 30 individuals who had previously visited the park during both seasons. This pre-test helped in refining and reformulating the questionnaire. Subsequently, the final versions of the questionnaire were distributed online to resident park visitors in Sherbrooke. In summer 2021, we collected 1,232 responses, while in winter 2022, we received 707 responses.

4 Results

Table 1 presents the socio-demographic characteristics and visiting habits of Mont-Bellevue Park visitors during summer and winter. On average, visitors make 20.96 visits per year in summer and 17.91 visits per year in winter, suggesting that visitation increases during the summer months, likely due to favorable weather conditions. In summer, 37.2 % of visitors are women, while this figure rises to 48.7 % in winter. The average age of visitors is 39.62 years in summer and 41.96 years in winter. Concerning changes in park visitation since the outbreak of the COVID-19 pandemic, 24.7 % of visitors reported increased

frequency in summer, compared to 21.9 % in winter. Additionally, approximately 24.4 % of visitors are households with children in summer, whereas this figure increases to 32.7 % in winter.

The two most popular activities are cycling and walking. 91.6 % of visitors cycle/mountain bike at least 2 to 3 times a month in summer and 98.9 % in winter. On the other hand, 81.6 % practice walking/hiking/running, jogging in summer and 59.5 % in winter. In addition, 13.2 % of cyclists spend an average of at least 2 hours cycling in the park in summer, compared with 7.2 % in winter. 28 % of pedestrians spend an average of at least 2 hours walking in summer and 22.8 % in winter. Around 10.9 % of people surveyed visited the park at midday on weekdays in summer and 8.9 % in winter. 18.9 % visited in the evening during the week in summer and 27 % in winter. At the weekend, 19.6 % of visitors visited the park in the morning in summer and 21.8 % in winter.

Table 1: **Socio-economic characteristics of park visitors**

Variable	SUMMER		WINTER				χ^2
	Residents		Residents		Min	Max	
	Mean	Std. Dev.	Mean	Std. Dev.			P-Value
Number of annual visits	20,968	27,758	17,917	22,022	0	200	0.36
Distance traveled (km)	13,611	9,034	14,031	8,734	4,8	82,6	0.77
Travel cost	8,302	5,511	8,559	5,327	2,928	50,386	0.7
Woman (1 = Woman; 0 = Man)	0,372	0,483	0,487	0,5	0	1	0.31
Age (expressed in number of years)	39,62	14,441	41,961	13,324	24	76	0.89
University level	0,446	0,497	0,464	0,499	0	1	0.11
In couple (1 = in couple; 0 = alone)	0,45	0,498	0,53	0,499	0	1	0.31
Household with children	0,244	0,43	0,327	0,469	0	1	0.94
Full-time worker	0,358	0,48	0,505	0,5	0	1	0.64
Annual household income/1000	94,297	34,09	102,9	37,986	5	175	0.85
Household income squared	10053	7077	12029	8388	25	30625	0.85
Urban	0,446	0,497	0,571	0,495	0	1	0.52
Frequents the park more often	0,247	0,431	0,219	0,414	0	1	0.43
Cycling	0,916	0,278	0,989	0,106	0	1	0.91
Walking	0,595	0,491	0,816	0,388	0	1	0.93
Time spent cycling	0,132	0,339	0,072	0,259	0	1	0.56
Time spent walking	0,28	0,449	0,228	0,42	0	1	0.84
Weekday morning	0,109	0,311	0,089	0,285	0	1	0.20
Midday on weekdays	0,051	0,22	0,044	0,205	0	1	0.24
Weekday afternoon	0,141	0,348	0,133	0,34	0	1	0.29
Weekday evening	0,189	0,392	0,27	0,444	0	1	0.47
No specific time during the week	0,192	0,394	0,144	0,352	0	1	0.86
Weekend mornings	0,196	0,397	0,218	0,413	0	1	0.31
Midday at the end of the week	0,011	0,106	0,016	0,124	0	1	0.006
Afternoon at the end of the week	0,256	0,436	0,246	0,431	0	1	0.05
Weekend evening	0,015	0,123	0,021	0,144	0	1	0.6
No specific time at the end of the week	0,255	0,436	0,197	0,398	0	1	0.03
Other park visited in Sherbrooke	0,666	0,472	0,639	0,481	0	1	0.55
Number of visitors	1232		707				

Visitors travel an average of 13.61 km to the park with a round trip in summer and 14.03

km in winter. The relationship between the distance traveled and the number of annual visits is illustrated in figure 2. It shows that when the distance traveled is low, the number of annual visits is high.

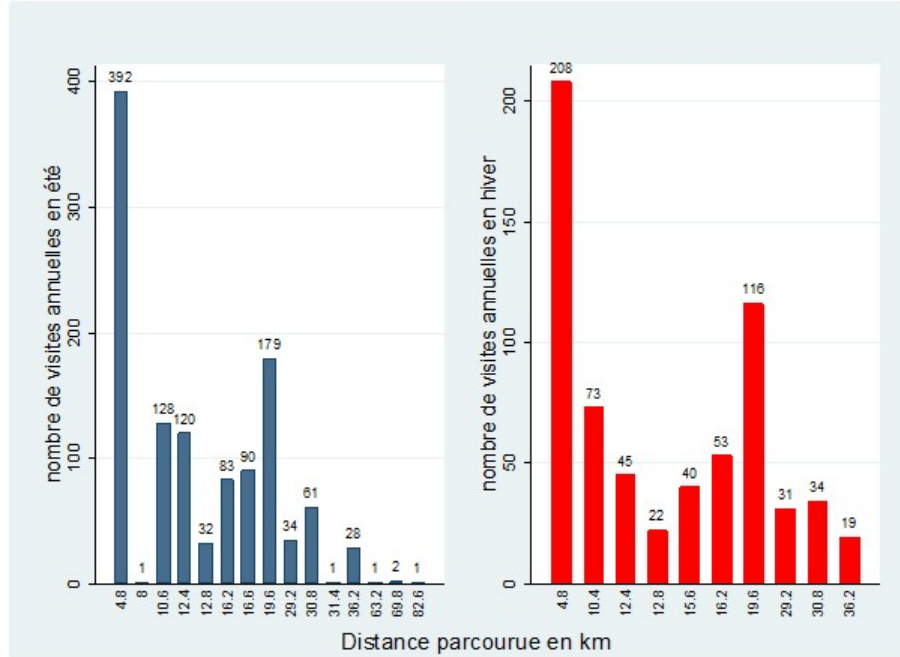


Figure 2: Number of visits per year based on distances travelled in winter and summer

Discussion

First, we carried out a test to see what is appropriate in our study. We note that there is a significant dispersion of the values of the variable “number of annual visits” since the variance ($(27.76)^2$) is greater than its empirical average (20.97) in summer and in winter ((mean (17.91) and variance $(22.02)^2$) (Table 1). There is therefore the presence of over-dispersion. Additionally, by analyzing Table 2, goodness-of-fit measures such as Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC) are lower for the negative binomial (NB) model in both samples, indicating that the data is over-dispersed and therefore the NB model is more appropriate for analysis. The coefficient of travel cost is negative and significant at 1 % in summer and winter. This cost is estimated at -0.047 in summer and -0.0505 in winter. This implies that with a CAD \$ 1 increase in travel cost, the number of annual visits per visitor to the park decreases by 4.7 % in summer and 5.05 % in winter holding all other variables constants. Therefore, if the cost of traveling from a visitor’s home to the park increases, the demand for visits

to the park decreases and vice versa.

Looking at the data by gender, the results show that in summer, the coefficient related to female is negative and significant at 1 % (-0.0.208***), indicating a strong negative relationship. Women are likely to visit the park less often than men in summer. On the other hand, in winter, the coefficient linked to women is not significant (0.0723).

In summer, the coefficient linked to “Over 70 years” is positive and significant at 5 %. This indicates that visitors aged over 70 are more likely to undertake a greater number of visits. This result is consistent with the result observed in Alberta in 1994. Indeed, [Boxall et al. \(1996\)](#) found that visitors aged over 65 visited the forest more often. A possible explanation is that older people are already retired and spend more time visiting tourist sites. In summer, the coefficient linked to university level (0.152*) is positive and significant at 5 %. This reveals that university-educated visitors are likely to undertake a greater number of visits. On the other hand, in winter there is no significant difference in education. [Boxall et al. \(1996\)](#), [Martínez-Espiñeira & Amoako-Tuffour \(2008\)](#) also observed the same result. The couple coefficient is negative and significant in both summer and winter. This indicates that visitors in couples visit the park less often. This result is similar to the result of [Mäntymaa et al. \(2021\)](#).

The coefficient associated with “cycling” is positive and significant in winter, indicating that cyclists visit Mont-Bellevue Park more frequently during this season. Conversely, the coefficient is not significant in summer, suggesting no distinct pattern for cyclists during this time. Pedestrians, however, show increased visitation in both summer and winter, meaning they are more likely to visit the park more frequently. Cyclists who spend more than two hours at the park tend to visit it more often in both summer and winter compared to those who spend less time there. In contrast, pedestrians who spend more than two hours at the park visit it less frequently than those who spend less time in the summer. Additionally, visitors are more likely to frequent the park around midday during weekdays in the summer, likely due to the pleasant weather. This trend may be influenced by employees and students from the University of Sherbrooke, who might use their lunch breaks to visit the park and enjoy the outdoors.

Table 2: Results of estimation of negative binomial (NB) and Poisson (POIS) models for resident visitors

	SUMMER		WINTER		WINTER	
	SUMMER		SUMMER		WINTER	
	NB		POIS		NB	
	Model I		Model II		Model III	
	Model IV		Model I		Model II	
Travel cost	-0.0471***	[0.00543]	-0.0597***	[0.00157]	-0.0505***	[0.00717]
Woman	-0.208***	[0.0755]	-0.188***	[0.0161]	0.0723	[0.0847]
Age 18-30 years	0.304**	[0.138]	0.277***	[0.0302]	-0.527**	[0.212]
Age 30 - 40 years	-0.00283	[0.168]	-0.0134	[0.0354]	-0.795***	[0.233]
Age 40 - 50 years	0.157	[0.174]	0.117***	[0.0382]	-0.629***	[0.227]
Age 50 - 60 years	0.138	[0.173]	0.0544	[0.0379]	-0.599**	[0.244]
Age 60 - 70 years	0.0709	[0.185]	-0.00446	[0.0420]	-0.491**	[0.243]
Over 70 years old	0.477*	[0.263]	0.488***	[0.0540]	-0.0409	[0.441]
University level	0.152*	[0.0820]	0.0398**	[0.0175]	0.0422	[0.0848]
Couple	-0.164*	[0.0850]	-0.138***	[0.0185]	0.196**	[0.0935]
Household with children	0.143	[0.0952]	0.153***	[0.0208]	0.104	[0.0963]
Full-time worker	0.148	[0.0945]	0.0929***	[0.0205]	0.0533	[0.105]
Household income	-0.00199	[0.00325]	-0.000938	[0.000652]	0.00359	[0.00427]
Household income squared	0.0000137	[0.0000154]	0.00000737**	[0.00000316]	-0.0000180	[0.0000191]
Urban	0.00887	[0.0805]	0.0782***	[0.0175]	-0.218**	[0.0956]
Frequents the park more often	0.256***	[0.0699]	0.218***	[0.0147]	0.252***	[0.0847]
Cycling	0.168	[0.107]	0.252***	[0.0258]	0.559*	[0.340]
Walking	0.914***	[0.0656]	0.786***	[0.0157]	0.219**	[0.0915]
Time spent cycling	0.753***	[0.0901]	0.652***	[0.0174]	0.507***	[0.141]
Time spent walking	-0.172**	[0.0697]	-0.108***	[0.0161]	-0.0670	[0.0886]
Weekday morning	0.806***	[0.116]	0.861***	[0.0276]	0.877***	[0.172]
Midday on weekdays	0.851***	[0.145]	0.691***	[0.0335]	0.874***	[0.194]
Weekday afternoon	0.487***	[0.113]	0.420***	[0.0286]	0.553***	[0.150]
Weekday evening	0.470***	[0.102]	0.414***	[0.0266]	0.776***	[0.134]
No specific time during the week	0.729***	[0.0998]	0.638***	[0.0268]	0.565***	[0.150]
Weekend mornings	0.164	[0.109]	0.126***	[0.0248]	-0.0990	[0.146]
Midday at the end of the week	0.352	[0.281]	0.580***	[0.0517]	-0.251	[0.294]
Afternoon at the end of the week	-0.0652	[0.106]	-0.0568**	[0.0248]	-0.364**	[0.142]
Weekend evening	-0.480*	[0.263]	-0.335***	[0.0726]	-0.456*	[0.262]
No specific time at the end of the week	0.0849	[0.108]	0.162***	[0.0245]	-0.0981	[0.145]
Other park visited in Sherbrooke	0.0370	[0.0811]	0.0387**	[0.0176]	-0.157	[0.103]
Constant	1.781***	[0.238]	1.932***	[0.0529]	2.391***	[0.467]
ln(alpha)	-0.137***	[0.0445]			-0.418***	[0.0627]
Alpha	.871***	.038			.658***	.041
N	1232		1232		707	707
Test LR	1.5e+04				5730.96	
AIC	8239.9		23184.0		4210.6	9939.6
BIC	8404.1		23343.2		4352.9	10077.5
Log lik.	-4087.0		-11560.0		-2072.3	-4937.8
Chi-squared	476.6		10037.2		155.3	2155.2

* p < 0.10, ** p < 0.05, *** p < 0.01. The dispersion parameter, α , is such that $\alpha > 0$.

4.1 Estimates of well-being

Consumer surplus (CS) measures the non-market benefits of recreational use of the park in monetary terms. To determine the confidence intervals, we calculated the second order variance of β_1 (Englin & Shonkwiler 1995) as follows:

$$Var(\beta_1) = \frac{s^2}{\beta_1^4} + 2 \frac{s^4}{\beta_1^6} \quad (4)$$

Where s is the standard deviation of β_1 . Table 3 presents visitor well-being estimates

The total annual visitor surplus is \$ 553,168 CAD in summer and \$ 250,985 CAD in winter.

Table 3: Well-being estimates for resident visitors

Estimates of well-being	Values	95 % confidence interval
CS/visit per summer visitor	\$ 21.23	[16.54 26.28]
CS/visit per winter visitor	\$ 19.801	[14.18 25.41]
CS annual/visit/summer	\$ 449	[346.81 551.03]
CS annual/visit/winter	\$ 355	[254.06 455.27]
Total annual summer visitor surplus	\$ 553 168	[427 270 678 869]
Total annual winter visitor surplus	\$ 250 985	[179 620 321 876]

5 Conclusion

This study assessed the economic value of Mont-Bellevue Park in Sherbrooke during the summer and winter seasons. The findings estimate the park's annual recreational value at \$553,168 in summer and \$250,985 in winter using the individual travel cost method. These results align with existing literature Khosravi Mashizi & Sharafatmandrad (2023), Kubo et al. (2020), which suggests that visitors value recreational activities more in summer due to favorable weather conditions. This study provides park managers with a crucial basis for budget allocation. The high recreational value of the park in summer may support decisions by the City of Sherbrooke and park managers to invest in enhancing formal paths and activities during the summer season. Although the travel cost method is employed in this study and many others, it has several limitations that should be considered when interpreting the results. One major limitation is that it only captures usage values and does not account for other types of values Loomis (2006). Additionally, our study's composition of travel costs is incomplete. Specifically, maintenance and wear-and-tear costs of vehicles used for transport, as well as the opportunity cost (time), are

not considered. The opportunity cost reflects the potential earnings or activities an individual foregoes by visiting the park [Randall \(1994\)](#), [Johnson \(1966\)](#). Accurately assessing these costs requires detailed knowledge of individual preferences and behaviors. Furthermore, the samples collected during the summer and winter may not be fully representative of the population of Sherbrooke, as the survey was distributed through social media, which may not encompass the entire demographic spectrum.

Data Availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

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Author contributions

Kpanoga Kolombia carried out the literature review, designed the questionnaire, collected and processed the data, conducted the analysis, interpreted the results, and drafted the manuscript. Jie He assisted in designing the questionnaire, revising the manuscript, and enhancing the interpretation of the results.

Ethics statement

This research was approved by the Université de Sherbrooke's Social Sciences and Humanities Research Ethics Committee and was conducted in accordance with the guidelines set forth by this ethics committee, as stated in the ethics declaration.

6 Consent to participate

Informed consent was obtained from all individual participants included in the study. The participants were all aged 18 and over, residing in Sherbrooke, and had previously

visited Mont-Bellevue Park.

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