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Improving quality of life for residents of biosphere reserves and nature parks: management recommendations from Switzerland

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ABSTRACT

Biosphere reserves and nature parks are protected areas that aim to combine nature conservation with human-development goals. These areas provide ideal environments for promoting and testing sustainable ways of living. The goal of this study was to determine how park management can best contribute to the quality of life of residents. The article presents the results of a survey in Switzerland of 2,409 residents of a biosphere reserve and two regional nature parks on the provision of quality of life. The results indicate that the quality of life in the parks is generally high. The identified dimensions that constitute this quality of life, their perceived importance, and the needs expressed by residents suggest that park management can help to increase and safeguard extant conditions by offering activities that improve health, social relations, and sustainable mobility. Awareness of how park management can contribute to the quality of life of park residents sustainably enables the setting of new priorities that have joint outputs that can be positive for both nature and people.

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Introduction



The objectives of most protected areas cover various aspects of sustainability which are not exclusively focused on nature conservation and tourism but include goals related to residents living within the sites, such as providing infrastructure for sports activities or co-working in the agriculture and tourism sectors (WCPA 2016). Protected areas with a wide array of sustainability goals are typically regional nature parks, biosphere reserves, and modern types of national parks. In this article, we subsume all three categories under the term “parks.” These parks bring nature protection to human environments; promote activities in nature; attempt to create appreciation and awareness of nature; involve sectors like agriculture, business, tourism, culture, and leisure in their activities; and are perceived as an advantage from the standpoint of social sustainability (Humer-Gruber 2016; UNESCO 2019a, 2019b). Such parks can, therefore, also be seen as social-ecological systems (Cumming and Allen 2017; Hammer et al. 2016).

Moreover, aligning social and ecological goals synergistically is essential to ensure the human quality of life (QoL) over generations (Brundtland 1987; United Nations 2019). These considerations led us

to the question of how park management, with the activities they initiate and implement, can best succeed in sustainably contributing to residents’ QoL.

We refer to the term QoL as a construct that encompasses several dimensions of people’s lives including their environment (e.g., infrastructure, basic services), preconditions (e.g., education, state economy), personal conditions (e.g., health, social relationships), and their subjective satisfaction with these dimensions (Wiesli et al. 2021). In this sense, QoL goes far beyond basic human needs and includes emotional and social factors, the right to participation, and capabilities to fulfill these factors (see, for example, Nussbaum 2011).

Many studies to date have investigated the effects of parks on certain aspects of QoL of visitors (Romagosa, Eagles, and Lemieux 2015; Terraube, Fernández-Llamazares, and Cabeza 2017). For example, researchers have observed positive effects on visitors’ mental, physical, and social health (Puhakka, Pitkänen, and Siikamäki 2017; Wolf and Wohlfart 2014); life satisfaction and feelings (Cini, Kruger, and Ellis 2013); and children’s physical and mental development (Lemieux et al. 2012). However, there is a general lack of literature on park residents and their QoL.

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An entry point for research on park residents is usually provided by studies on their acceptance of the region becoming a park (e.g., Stoll-Kleemann and O’Riordan 2017; von Lindern et al. 2019; Wallner, Bauer, and Hunziker 2007). The residents’ acceptance of a park is influenced by the economic (dis)benefits and hence the jobs being created in the park region, as shown in several studies. For instance, Wallner, Bauer, and Hunziker (2007) reported that a few years after the creation of the UNESCO Biosphere Entlebuch (UBE), residents hoped mainly for the increased economic development of the region to enhance their QoL. A study by Knaus, Bonnelame, and Siegrist (2017) confirmed that products carrying a label initiated by the UBE generated considerable gross added value 13 years after its introduction. Further studies at the global level, indicate significant economic effects in protected areas largely due to nature tourism (Heagney et al. 2019; Job et al. 2005). Pantić, Čolić, and Milijić (2021) claim, that tourism in a Serbian biosphere led to lower outmigration of residents and attracted investors, which in turn contributed to the preservation of the local infrastructure and services. Vivanco’s (2001) investigations in the Reserva Santa Elena in Costa Rica revealed positive effects on the economic power of women due to increased tourism which raised sales of women’s handcrafts. The results of Sundberg (1998) showed how the Maya Biosphere Reserve in Guatemala contributed to changes in women’s work roles and how this in turn led them to form alliances and networks.

Knaus and Backhaus (2014) claim that parks not only contribute to the region’s economy, but also enhance their renewable energy-production facilities, landscape, and cultural life. Trivourea’s Trivourea (2011) study indicated positive influences on the social life of residents in a Greek national marine park since the increase in tourism brought people to the region and lead to more social exchanges. The results of Humer-Gruber (2016) additionally demonstrated that farmers considered the biosphere reserve to have social advantages, such as strengthening the community and preventing the outmigration of young people. They regarded the pursuit of sustainable development throughout the biosphere reserve as an advantage for their grandchildren.

In sum, research to date has covered several social and economic impacts that have been traced back to park-management efforts. However, options for park management to sustainably and systematically improve residents’ QoL have not been robustly investigated. Therefore, this study aimed to determine how park management could best contribute to the QoL of park residents. We investigated the

following research questions in a UNESCO biosphere reserve and two regional nature parks:

1. What are nature park residents’ perceptions of their QoL?
2. What dimensions of life contribute most strongly to QoL?
3. What management needs are there in nature parks with respect to QoL, and what are residents’ wishes in this regard?

In the following section, we describe how we conducted the survey and the statistical analyses. In the results section, we present the overall life satisfaction of the residents, the main contributing dimensions to life satisfaction, the management needs, and residents’ wishes to park management. Thereafter, we discuss these results together with international literature and provide recommendations for park management. Finally, we summarize the key actions of park management and other regional management bodies.

Methods

Study areas

The three study areas are the UNESCO Biosphere Reserve Entlebuch (UBE) and two regional nature parks – the Gantrisch Nature Park (GNP) and the Jurapark Aargau (JPA) (see Figure 1). The status of biosphere reserves is internationally recognized and UNESCO biosphere reserves are developed by local stakeholders in coordination with the national UNESCO committees of the Man and the Biosphere Programme (MaB). The nomination dossier is prepared with the involvement of local stakeholders, authorities, and municipalities and reviewed by UNESCO. Biosphere reserves are finally endorsed by the MaB International Coordination Council (UNESCO 2021) and divided into core, buffer, and transition zones.

Regional nature parks instead are specific labels for officially recognized protected areas in Switzerland. This label, awarded by the Swiss government, implies the objective to enhance both resident’s well-being and sustainable development (FOEN 2019) and hence corresponds to International Union for the Conservation of Nature (IUCN) category VI sites (Dudley 2008). UNESCO biosphere reserves in Switzerland are subsumed in this type of regional nature park which in the country are large (at least 100 square kilometers (km²)) (38.6 square miles, m²) and typically consist of populated areas that contain several municipalities located within the boundaries of the park (FOEN 2019). The parks, thus, contain settlement areas, less

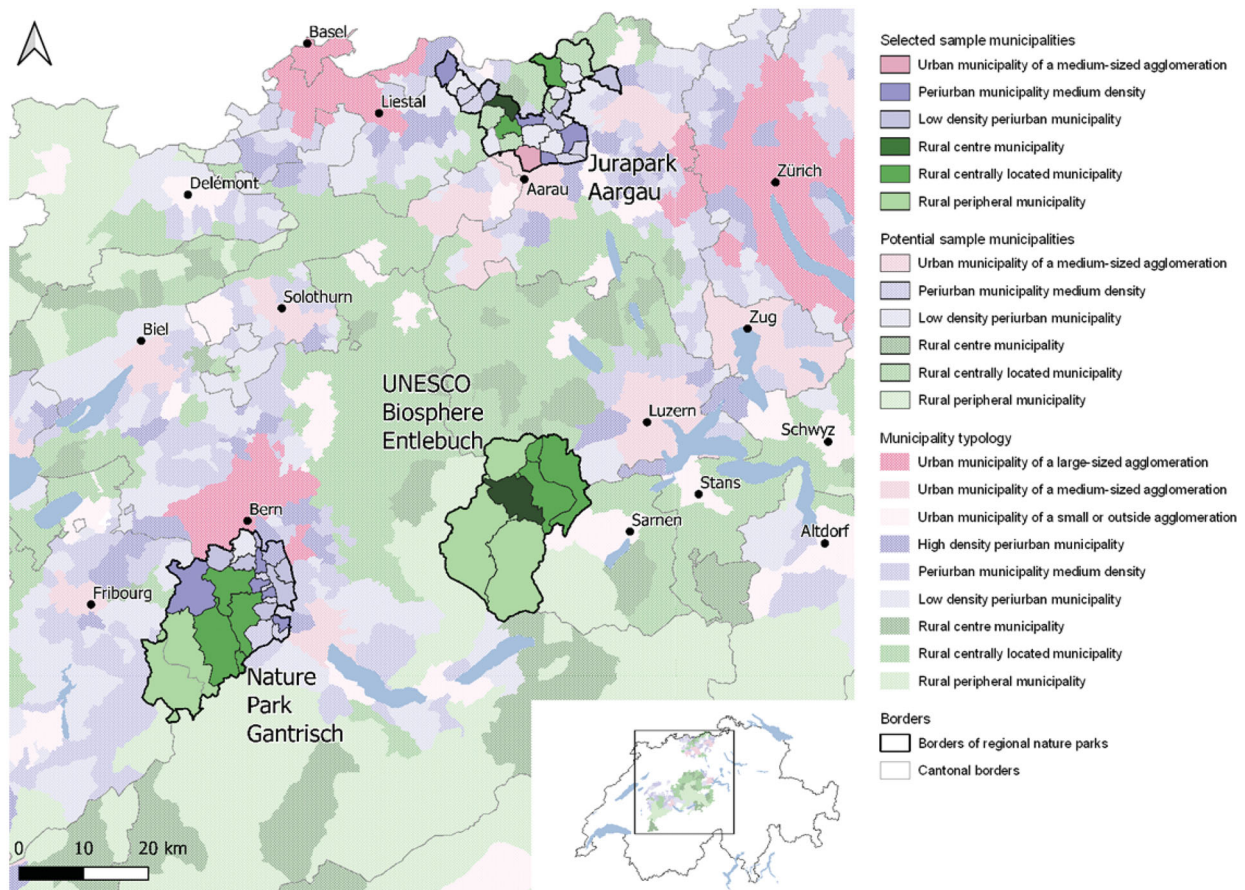


Figure 1. The three Swiss regional nature parks (UNESCO Biosphere Entlebuch, Jurapark Aargau, and Nature Park Gantrisch). Source: Open Street Map Contributors, Swisstopo, ESRI. Map: Roger Bär.

extensively protected areas, and highly protected areas. Each park's authority establishes a 10-year charter as a planning instrument with the participation of residents, interest groups, and the business community and implements the plan using funds pledged by the circumscribed municipalities, the cantonal administration, and the national government (FOEN 2019). Since the park label belongs to the park authority and the park management is responsible for the implementation of the goals, the municipalities and park management are strongly linked (FOEN 2019).

Our three selected parks encompass a total of 104,500 residents. First, UBE has the smallest population with 17,600 residents, covers an area of 394 km² (152.1 m²) and ranks second of the three parks with respect to physical size. Second, GNP is the largest of the three parks and includes 46,500 residents on an area of 414 km² (159.8 m²). Finally, JPA has a population of 40,400 people and extends over an area of 245 km² (94.6 m²). These three parks are comparable in terms of population density (e.g., 168 residents per km² in JPA), language (Swiss German), and geographical location (at the edge of the Swiss Plateau, including both lowland and mountain areas). At the same time, they are relatively far apart and widely dispersed across

Switzerland, and cover all types of Swiss rural municipalities with varying population densities (Federal Statistical Office 2012).

Data collection

We assessed QoL through an extensive questionnaire that was distributed to the residents of the three parks. We prepared the survey instrument in cooperation with park management and collected the mailing addresses of the targeted respondents from the relevant municipalities. Entitled "Quality of life in the UNESCO Biosphere Entlebuch/Jurapark Aargau/Gantrisch Nature Park," we sent the survey instrument to all households living within the boundaries of the parks (see [supplementary material](#)). We used self-reported life satisfaction as a proxy for QoL and included participants' satisfaction with their personal conditions and their environment and its infrastructure. Self-reported satisfaction is a widely used and validated concept (Diener and Suh 1999; Costanza et al. 2007; Wiesli et al. 2021). The questionnaire included 31 items with questions about several dimensions of satisfaction, the importance of these dimensions, residents' expectations about park management, and socio-economic information.

The dimensions of satisfaction represented in the survey were health, safety, social relations, mobility, basic services, housing and income, and employment-based on empirical studies that identified these criteria as relevant for life satisfaction (e.g., Frey and Stutzer 2018; Layard 2006). Furthermore, we included place attachment, quality of nature and landscape based on studies about identity, landscape and spatial planning, and protection of nature and biodiversity (e.g., Lemieux et al. 2012; (Lengen 2016; Terraube, Fernández-Llamazares, and Cabeza 2017; Wolf and Wohlfart 2014). In workshops together with the park management, we developed regional and park-relevant dimensions, such as sources of renewable energy, regional and seasonal food, and information on regional nature parks.

We tested a draft of the questionnaire using a three-step pre-test procedure. First, we recruited ten people to complete the survey instrument. Second, we carried out face-to-face pre-tests with ten respondents and, finally, we sent the questionnaire via postal mail to 150 people living in the parks in a standard pre-test process. Based on the feedback, we adjusted the questionnaire after each test.

When collecting the addresses of the park inhabitants, we controlled for the balance of municipalities in terms of the degree of urbanization and population density and categorized them according to the Swiss municipality typology from 2012 which differentiates between these two criteria (Federal Statistical Office 2012). We then deployed a two-stage random sampling procedure in the GNP and the JPA, first, by randomly choosing municipalities within the categories and, second, by selecting from the adult population of these municipalities. The GNP contains 20 peri-urban municipalities with medium (11% of the Swiss population) and low (5% of the Swiss population) population densities, as well as central rural and peripheral rural municipalities (Swiss Federal Statistical Office 2012). We then randomly identified 16 municipalities (see Figure 1).

The JPA includes 28 peri-urban municipalities of medium density, central rural municipalities, and medium-sized urban municipalities (22% of the Swiss population), and selected 13 municipalities on a randomized basis. The UBE contains seven central rural (4% of the Swiss population) and peripheral rural municipalities (3% of the Swiss population). Due to the small number of municipalities, in this case, we included all of them in this study and only the respondents were randomly selected.

Finally, all the randomly selected inhabitants of the three parks ($n = 13,313$), were contacted via a postal letter in 2019 in which they were given the option of filling in the enclosed paper questionnaire or an online questionnaire. One reminder was issued after three weeks. The resulting response rate was 25% ($n = 2,409$).

Sample

All respondents lived within the park boundaries. The youngest persons in the sample were 16 years old and the oldest was 94 years (see Table 1). The mean age is 50.8 and, thus, slightly higher than the mean age of 49.6 for the parks' population. The sample included slightly more female (52.8%) than male participants (46.8%), just as the overall population of the parks includes more women (50.1%) than men (49.9%). Most of the individuals in our sample had completed an apprenticeship as their highest level of education, a majority were employed, and 6.5% were retired. We cannot directly compare these characteristics with the overall population of the parks as these data for all people living in the parks and their municipalities are not available. However, 40% of people living in Switzerland have an apprenticeship as their highest qualification and 68.1% are employed (Federal Statistical Office 2020, 2016). Thus, we can assume that the sample adequately resembles the Swiss population regarding education and employment.

Table 1. Socio-economic characteristics of the samples in the selected three Swiss regional nature parks.

	UBE sample	UBE population	GNP sample	GNP population	JPA sample	JPA population	Full sample	Population of parks
Mean age in years	48.8	48.3	51.7	50.6	52.1	50	50.8	49.6
SD	18.6	17.7	17	18.7	16	10.8	17.5	7.2
<i>n</i>	867	14,058	786	29,821	756	35,060	2,409	78,939
Male %	46.2	49.0	45.8	49.4	48.4	49.7	46.8	49.9
Female %	53.5	51.0	53.6	50.6	51.1	50.3	52.8	50.1
Other %	0.23	–	0.51	–	0.40	–	0.37	–
<i>n</i>	867	14,058	786	29,821	756	35,060	2,409	78,939
Apprenticeship as highest education %	47.9	–	42.6	–	38	–	43.1	–
<i>n</i>	859	–	776	–	750	–	2,385	–
Employed %	90.5	–	88.9	–	86.8	–	88.8	–
Not employed %	9.45	–	11	–	13.2	–	11.1	–
<i>n</i>	656	–	590	–	584	–	1,830	–

UBE: UNESCO Biosphere Entlebuch; GNP: Gantrisch Nature Park; JPA: Jurapark Aargau; SD: standard deviation; *n*: number of observations.

Notes: The samples and hence also the population include only individuals aged 16 and older. The number of individuals who are not employed includes retirees. Missing values are excluded in sample sizes (*n*).

A comparison of the three subsamples in the UBE, JPA, and the GNP reveals that the respondents of the UBE have a slightly different age than the other two parks (see Table 1). The young age groups up to 45 years are more strongly represented in the UBE (42%) than in the other two parks (37% in GNP and 35% in JPA). Respondents in the JPA sample had the highest income on average ($M=5,170$ CHF per month) compared to the other parks (GNP: $M=4,708$ CHF per month and UBE: $M=4,265$ CHF per month). The highest education level, namely tertiary education, is also most widely represented in JPA (23.5%; GNP 14.6% and UBE 9.7%). As these differences between the park samples are small, we can assume that the parks are comparable with each other in terms of their socio-economic characteristics.

Overall, we can assume that the sample represents the park population adequately, not only due to its large observation number and its associated distribution ($n=2,409$) (Daniels and Minot 2019; Field, Miles, and Field 2012) but also due to the similar socio-economic characteristics to the park population (see Table 1).

Data analysis

We scanned the paper questionnaires that respondents returned using the “Remark Office” software. After checking and cleaning, the data were analyzed in the statistics software “Stata.” The questionnaire items that correspond to each research question and the analyses applied to the corresponding data are presented in Table 2. To identify the residents’ overall satisfaction and to estimate its main contributing dimensions, we used a variable representing overall satisfaction (see A1 in Table 2 and Supplementary Appendix) and ran ordinary least squares (OLS)

regressions with various dimensions relevant to people’s life satisfaction (e.g., satisfaction with health) as independent variables (see A2–A22 in Table 2 and Supplementary Appendix). To compare the three parks, we ran three pooled OLS models, including the same dependent and independent variables but as an interaction term multiplying them with the park variable (dimensions of life satisfaction \times UBE/JPA/GNP).

To check whether multicollinearity was present in the overall and pooled OLS models, we first carried out correlations with Spearman and computed the variance inflation factor (VIF) after the regressions ($M=1.38$). According to Spearman’s correlation, the two independent variables of satisfaction with cycle routes and satisfaction with footpaths have the highest correlation ($r=0.535$). However, since all correlations are below 0.8 and VIF values below 10, we can assume that there is no danger of multicollinearity (Field, Miles, and Field 2012). We, moreover, tested for the normality of residuals by a kernel-density plot and a numerical test by Shapiro Wilkinson. Based on these tests, there is no violation of the normality of residuals.

To combine the individual’s satisfaction with their opinion on the importance of the same dimensions, we developed an index using items C1 and A2–A22 (see Table 2). We multiplied a variable containing the individual’s satisfaction with one of the 20 dimensions (A2–A22), and a variable containing the corresponding individual’s opinion of the importance of the same 20 dimensions (C1). The index is based on the following equation:

$$Index_i = importance_i \times (10 - satisfaction_i)$$

We think that multiplication makes the most sense as it considers relative increments of

Table 2. Research questions, questionnaire items (see Supplementary Appendix), and statistical analysis tools that were applied.

Research question	Item in questionnaire	Item number	Statistical analysis
What are nature park residents’ perceptions of their QoL?	“How satisfied are you in general with your life?” Answer scale from zero (“not at all satisfied”) to ten (“completely satisfied”)	A1	Mean value; Kruskal–Wallis test; Dunn–Bonferroni test; Multiple OLS regression (see Table 3)
What dimensions contribute most strongly to QoL?	For example, “How satisfied are you with the leisure facilities in your region?” Answer scale from zero (“not at all satisfied”) to ten (“completely satisfied”)	A2–A22	Spearman’s correlation; Shapiro Wilkinson test, kernel-density plot; multiple OLS regression (see Table 3); pooled OLS regression (see Table 4)
What management needs are there in nature parks with respect to QoL?	“How important are these areas to you personally in your life?” e.g., “Availability of public transport”; Answer scale from zero (“not at all important”) to ten (“very important”)	C1	Index from zero (“completely satisfying but not at all important”) to 100 (“very important but not at all satisfying”) (see Figure 2)
	For example, “How satisfied are you with the leisure facilities in your region?” Answer scale from zero (“not at all satisfied”) to ten (“completely satisfied”)	A2–A22	Kruskal–Wallis test; effect size according to Cohen
What are residents’ wishes to park management regarding their QoL?	“In which areas do you think management of the UNESCO Biosphere Entlebuch could improve?” e.g., “Leisure, recreational and cultural activities” Answer options: “... could be improved by the park,” “... is satisfying,” or “Don’t know”	D2	Mean percentage (see Figure 3)

satisfaction and importance systematically equally. The higher the index value, the more important and the less satisfactory is the dimension. From this, we interpret a higher value means a greater need for management and call this index “management need” (see Figure 2).

A further result is based on a descriptive analysis of another item (D2), in which participants evaluated 20 dimensions of life satisfaction in the park area (see Table 2 and Supplementary Appendix). These results obtain insights into respondents’ wishes and perceptions concerning whether a park is responsible and able to improve certain dimensions in the region (see Figure 3).

Results

Overall life satisfaction

On average, on a scale of 0 (“not at all satisfied”) to 10 (“completely satisfied”), survey participants rated their overall life satisfaction at 8.37 (95% CI [8.11, 8.62]). Comparing the three parks, respondents in the UBE reported the highest level of satisfaction, with a mean of 8.48 (95% CI [8.22, 8.73]), followed by respondents in the GNP with a mean of 8.39 (95% CI [8.14, 8.73]) and in JPA with a mean of 8.25 (95% CI [7.92, 8.58]). A Kruskal–Wallis test ($\chi^2 = 17.67, p < 0.001$) and a Dunn-Bonferroni test

($z = -4.05, p < 0.001$) indicate a significant difference between the UBE and JPA. However, the effect size ($d = 0.13$) according to Cohen (1992) is small; accordingly, the difference between the parks in overall satisfaction can be considered small.

Estimation of the main contributing dimensions

The regression models for all three parks indicate that satisfaction with health, social relations (such as family and friends), leisure offers, housing situation, income, and financial situation, fulfilling employment, equality, and the quality of road infrastructure are significantly associated with the estimated overall satisfaction (see Table 3). The overall explanatory power of the models ranges from 0.38 to 0.39 (see adjusted R^2 in Tables 3 and 4). The eight significant variables show a range of correlation coefficients (see Table 3). By improving residents’ satisfaction with their health, the parks can potentially have the greatest influence on the residents’ overall satisfaction ($b = 0.22$). A similar effect is estimated if the parks manage to positively influence residents’ satisfaction with their social relations ($b = 0.20$).¹ The other dimensions score substantially lower coefficients, which indicates a weaker influence on overall satisfaction.

There are differences between the three parks regarding the significance of the various dimensions’

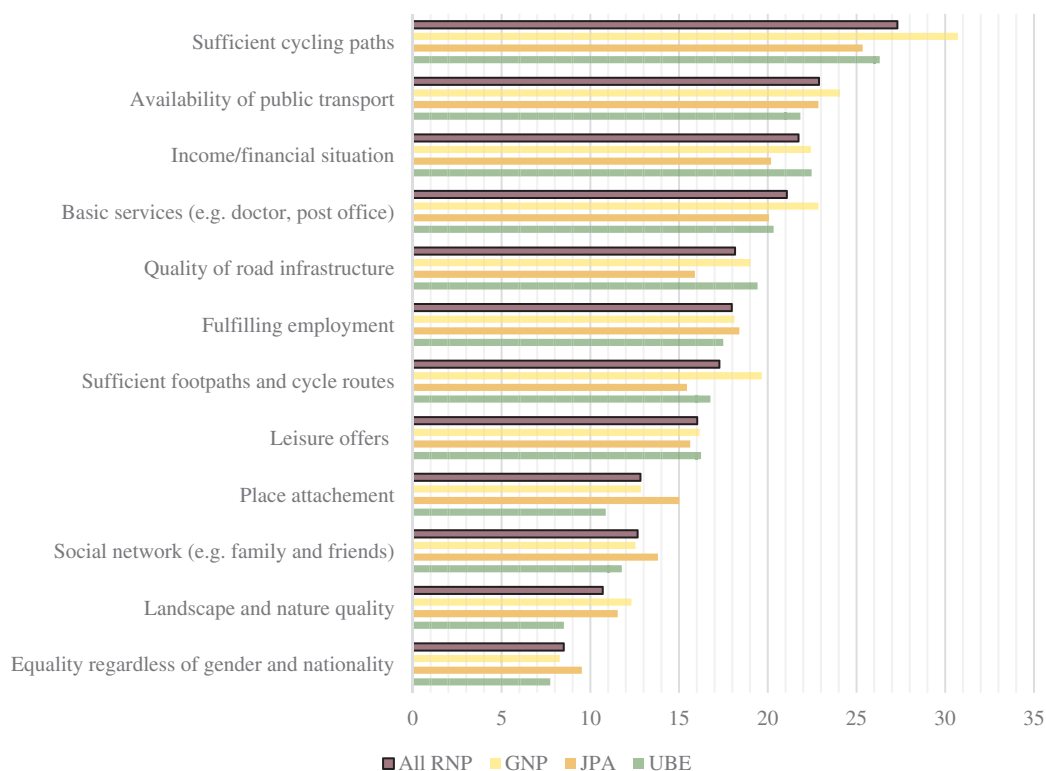


Figure 2. Management-needs indices for selected variables. *Notes:* Scale: zero = fully satisfactory but not important, 100 = very important but not at all satisfactory. Purple = all parks, yellow = GNP, orange = JPA, green = UBE. Number of observations = 2,223 (missing values excluded). The figure contains fewer variables than the regression models in Tables 3 and 4 because the variables concerning satisfaction and importance were not fully congruent in the survey.

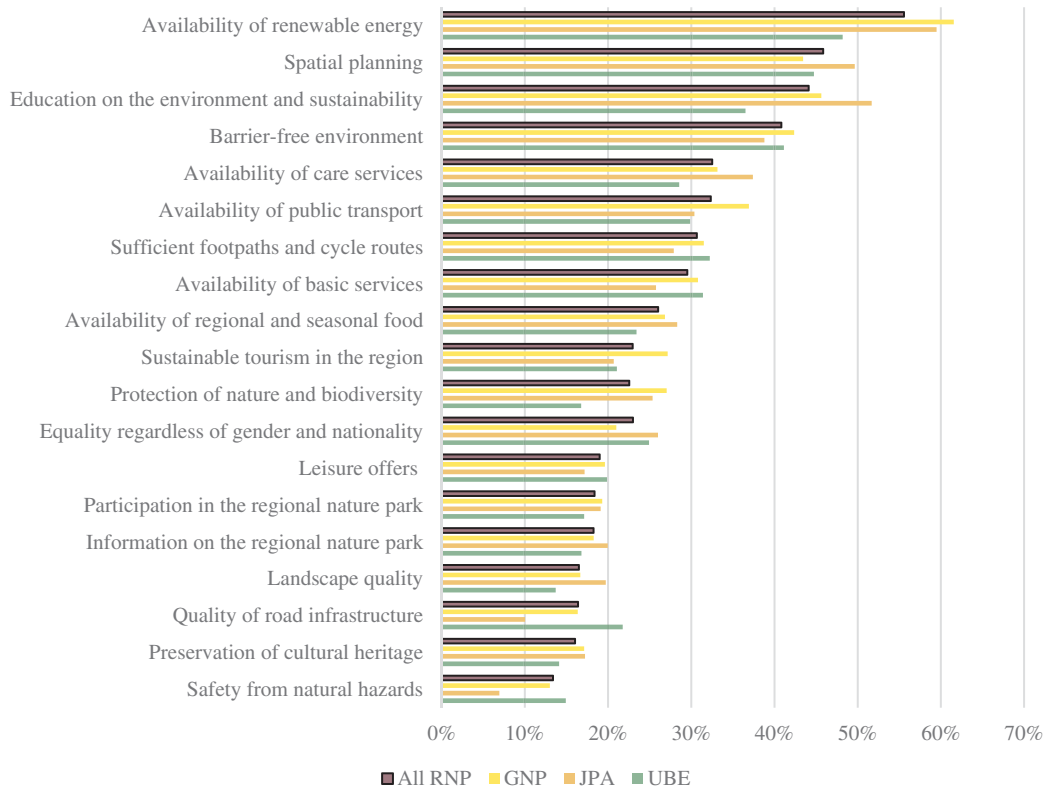


Figure 3. Areas that park management could improve in the park region according to residents, in percent of respondents. Notes: Purple = all parks, yellow = GNP, orange = JPA, green = UBE. Number of observations = 956 (missing values and “don’t know” responses excluded).

Table 3. OLS regression models for overall satisfaction and specific dimensions of satisfaction in all three parks.

	Overall satisfaction
Health	0.220*** (9.85)
Social relations (e.g., family and friends)	0.201*** (9.42)
Leisure offers	0.100*** (5.24)
Housing situation	0.077*** (3.43)
Income/financial situation	0.070*** (4.02)
Fulfilling employment	0.058*** (3.43)
Equality regardless of gender and nationality	0.043** (2.88)
Quality of road infrastructure	0.33** (2.10)
Sufficient footpaths and cycle routes	0.022 (1.31)
Place attachment	0.012 (0.84)
Absence of noise from neighbors	0.004 (0.27)
Political participation	-0.025 (-2.01)
Housing costs	-0.033 (-1.95)
Safety from violence	0.004 (0.37)
Absence of traffic noise	0.019 (1.50)
Quality of nature and landscape	-0.008 (-0.39)
Availability of public transport	-0.004 (-0.34)
Absence of air traffic noise	-0.016 (-1.26)
Safety from traffic accidents	0.019 (1.50)
Constant = 1.902*** (10.80)	
Number of observations	1,345
Adjusted R ²	0.382

Notes: The table lists coefficient estimates of the relevant OLS regression models (*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$), with t values in brackets.

contributions to overall satisfaction, as the pooled OLS models show (see Table 4). In the UBE, the satisfaction dimensions of social environment, health, leisure offers, road infrastructure, and gainful employment are significantly associated with overall satisfaction, whereas in the GNP this association is made with dimensions of income and financial situation, equality regardless of gender and nationality,

and housing situation. Road infrastructure and fulfilling employment are not significant dimensions in the GNP. In JPA, satisfaction with road infrastructure is also not significantly associated with overall satisfaction, whereas fulfilling employment is. Here, unlike in the other two parks, satisfaction with leisure offers is not significant; however, satisfaction with political participation and the absence of traffic noise is significant. The strength of the coefficients of the individual dimensions of life satisfaction also varies depending on the park. However, as in the model including all three parks (see Table 3), the dimensions of health and social relations have the strongest coefficients in all three parks, even though the values differ considerably: in the UBE, social relations contribute most to overall satisfaction ($b = 0.261$), more so than health ($b = 0.213$). In the GNP and JPA, health has the highest coefficients ($b = 0.230$ and 0.239 , respectively), while social relations contribute substantially less to satisfaction ($b = 0.165$ and 0.137). There are other relatively important dimensions with coefficients between 0.1 and 0.15 for which values vary among the three parks (Table 4).

Management needs

Looking at the three parks overall, the most urgent needs expressed by the residents concern sustainable forms of mobility: cycle routes (by 27.3 scale points)

Table 4. Pooled OLS regression models for overall satisfaction and specific dimensions of satisfaction in each of the three parks.

	UBE	GNP	Overall satisfaction JPA
Interaction of each satisfaction variable with parks variable			
Health × parks	0.213*** (6.22)	0.230*** (6.16)	0.239*** (5.59)
Social relations × parks	0.261*** (8.06)	0.165*** (4.26)	0.137*** (3.28)
Leisure offers × parks	0.153*** (4.98)	0.094** (2.67)	0.032 (0.93)
Income/financial situation × parks	-0.006 (-0.23)	0.131*** (4.14)	0.103*** (3.24)
Housing situation × parks	-0.004 (-0.15)	0.129*** (4.39)	0.1054*** (3.11)
Equality × parks	0.015 (0.58)	0.055* (1.99)	0.043 (1.63)
Fulfilling employment × parks	0.113*** (2.10)	-0.003 (-0.13)	0.076** (2.42)
Sufficient footpaths and cycle routes × parks	-0.045 (-1.88)	0.037 (1.33)	0.005 (0.17)
Quality of road infrastructure × parks	0.054* (2.10)	0.008 (0.31)	0.021 (0.68)
Place attachment × parks	0.015 (0.54)	-0.008 (-0.30)	0.018 (0.82)
Absence of noise from neighbors × parks	0.019 (0.69)	-0.021 (-0.75)	0.026 (1.00)
Political participation × parks	0.013 (0.44)	0.035 (1.20)	-0.051* (-2.48)
Housing costs × parks	-0.029 (-0.94)	-0.017 (-0.57)	-0.048 (-1.67)
Safety from violence × parks	0.014 (0.65)	0.001 (0.08)	-0.004 (-0.21)
Absence of traffic noise × parks	-0.018 (-0.77)	0.012 (0.50)	0.047* (2.32)
Quality of nature and landscape × parks	-0.039 (-1.02)	0.024 (0.71)	-0.009 (-0.25)
Availability of public transport × parks	-0.004 (0.21)	-0.033 (-1.49)	0.012 (0.53)
Absence of air traffic noise × parks	-0.024 (-1.32)	-0.030 (-1.13)	-0.003 (-0.13)
Safety from traffic accidents × parks	0.007 (0.34)	-0.011 (-0.52)	-0.005 (-0.27)
Constant = 1.995*** (7.41)			
Number of observations = 1,345			
Adjusted $R^2 = 0.394$			

UBE: UNESCO Biosphere Entlebuch; GNP: Gantrisch Nature Park; JPA: Jurapark Aargau.

Notes: The table lists coefficient estimates of pooled OLS regression models (*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$), with t values in brackets. Each independent variable is a multiplied term, i.e., the variables of the satisfaction dimensions are multiplied with the variables of the respective park study regions (UBE, GNP, JPA).

and public transport (by 22.8 scale points) rank as the two highest management needs. Income and satisfactory financial situation (by 21.7 scale points) rank as the third-highest management need, followed by availability of basic services, such as doctors, grocery stores, post offices, and so forth. These dimensions are of high importance for the inhabitants but are also the least satisfying. Equality regardless of gender and nationality is the lowest management need (see Figure 2). The second-lowest management need is the beauty and integrity of the landscape.

A comparison of the management need indices between the three parks reveals several differences (see Figure 2). In the UBE, the results for equality regardless of gender and nationality indicate a lower management need (by 1.8 scale points) than in JPA ($\chi^2 = 5.83$, $p < 0.01$). In JPA, there is a significantly lower management need for income and financial situation (by 2.25 scale points) than in the other two parks ($\chi^2 = 6.24$, $p < 0.05$). In the GNP, there seems to be a much higher need (by 4.4 scale points) for cycle routes than in the other two parks ($\chi^2 = 13.52$, $p < 0.05$).

Residents' wishes with regard to park management

Most respondents (56%) across all three parks wanted the availability of renewable energy to be

improved (see Figure 3). Almost half (46%) of the respondents wanted the park managers to tackle spatial planning and prevent the loss of green spaces, and 44% wanted more education on the environment and sustainability. At the other end of the scale, the least mentioned wishes, and therefore relatively satisfactory dimensions were safety from natural hazards (13%), preservation of cultural assets (16%), and quality of road infrastructure (16%).

Residents' wishes differed to some extent between the three parks (see Figure 3). These differences were substantial in the desire for more education on the environment and sustainability. In the UBE, which has a long history of park activities in this domain, only 37% of respondents stated this desire, while in JPA it was reported by 52% of respondents, and in the GNP by 46%. Spatial planning was the second most mentioned desire in the UBE (45%) but not in the other two parks (JPA 50%, GNP 43%). Also, given the dispersed settlements in the UBE, 22% of respondents wanted the quality of road infrastructure to be improved, but this was only mentioned by 10% of respondents in JPA and 17% in the GNP.

Looking at the least mentioned wishes, the share of respondents who wanted improvements in landscape quality was the lowest in the UBE (14%; JPA 20%, GNP 17%). In JPA and the GNP, the share of respondents who wanted improved safety from natural hazards was the smallest (JPA 7%, GNP 13%, UBE 15%).

Discussion

Overall, our results show that health and social relations are most strongly associated with QoL. Cycling paths, public transport, and road infrastructure are, in the opinion of the inhabitants, important yet not sufficiently developed in the investigated parks. Management needs thus relate to various kinds of sustainable mobility. Fulfilling employment, adequate income, and provision of basic services are further areas that require management efforts. At the same time, fulfilling work, adequate income, and road infrastructure influence QoL significantly. Finally, residents want to see improvements in renewable energy, spatial planning, and education on the environment and sustainability on the part of park management. The core of these main findings is in line with recommendations from the literature on sustainability challenges in rural areas. In particular, the state of infrastructure (e.g., Bosworth et al. 2020), social life aspects influenced by distance and remoteness (e.g., De Koning, Stathi, and Richards 2017), and structural changes (e.g., Junquera et al. 2022) are areas that pose challenges in rural areas internationally.

Going back to the overarching research question of how protected areas can improve inhabitants' QoL, current literature indicates that health and protected areas are brought together mainly through conservation measures (Terraube, Fernández-Llamazares, and Cabeza 2017): parks can influence mental and physical health by safeguarding and promoting the high quality of nature in the area, as studies in Canada (Lemieux et al. 2012), Finland (Puhakka, Pitkänen, and Siikamäki 2017), Australia (Wolf and Wohlfart 2014), and Poland, Austria, and Italy (Jiricka-Pürerer et al. 2019) indicate. The parks investigated in this study were chosen because they have particularly valuable landscapes and nature and are all required to implement conservation activities (FOEN 2019). In contrast to most of the literature, our results show that such conservation measures are not the main line of action in improving the QoL of residents. Park management could make more of their conservation measures by combining them synergistically with the encouragement of physical activity in nature, leading to positive health impacts. This could be done by offering volunteering programs for residents where specific habitats, such as alpine meadows, are maintained by physical work or by specific outdoor activities, such as hiking tours and sports competitions, leading to an appreciation of nature and landscape (Björk et al. 2008; Stolton et al. 2015). Another option is to improve infrastructure, for instance by identifying high-quality landscapes and furnishing them with an adequate quantity of footpaths, hiking and running trails, and

cycle routes (Wolf and Wohlfart 2014). Guided excursions could also be used to integrate educational aspects, for example, nature and sustainability (Schultz et al. 2018). Furthermore, by promoting green spaces and high landscape quality, park management can improve and maintain the quality of residents' housing situation—a further important aspect of QoL.

Health challenges in rural areas mainly concern elderly age groups: due to their high share of the population, limited mobility, and typically remote places of residence with lower access to public transport and greater distance from utilities, such as medical care, they are at particular risk (Bosworth et al. 2020). Accordingly, it is crucial for park management to identify group-specific measures that support residents' health (Jiricka-Pürerer et al. 2019; Puhakka, Pitkänen, and Siikamäki 2017). In the case of elderly people, this includes the promotion of mobility offers (e.g., calling taxicabs, car-sharing) and infrastructure if possible (Bosworth et al. 2020). It will be key to implement such measures sustainably to fulfill conservation goals (e.g., no negative impacts on biodiversity). However, by addressing such issues, park management could increase acceptance among residents, which in turn would help in implementing other measures (e.g., conservation projects) that face stronger resistance.

Satisfaction with social relations was another key dimension influencing QoL in our study. Social relations in rural areas, including the investigated regional nature parks, have been shown to be at risk (see e.g., Besser, Jurt, and Mann 2017; Bjornestad, Brown, and Weidauer 2019; Skaalsveen, Ingram, and Urquhart 2020). Increased structural changes, for example, the rationalization and automation of agriculture, have led to a loss of social contact, and farmers on remote farms increasingly suffer from loneliness (Bosworth et al. 2020; Forney and Häberli 2017; Junquera et al. 2022). Elderly widowed people in remote rural areas are also at risk of loneliness (Bosworth et al. 2020; De Koning, Stathi, and Richards 2017; Kelly et al. 2011). These risks of loneliness could also apply in our investigated remote rural areas. Park management can influence social structures (Jones, McGinlay, and Dimitrakopoulos 2017; Pinheiro, Triest, and Lopes 2021) and aim to strengthen social relations by initiating or co-creating local spatial plans, advising local authorities to revise construction legislation, and implementing options for social interaction within their offers of leisure infrastructure (e.g., visitor centers, hiking trails). Appropriate and careful spatial planning and architecture provide ways of supporting social contact among residents, for example by designing welcoming leisure spaces in

the villages that can host social meetings and discussions (Abass and Tucker 2018; Afshar et al. 2017; Eslami et al. 2019; Zhang, Matsuoka, and Huang 2018). In addition, scenically beautiful places in nature encourage people to spend time there, enable groups to come together, and strengthen social exchanges and relationships (Pinheiro, Triest, and Lopes 2021). Thus, infrastructure that allows people to sit together by the water, in the forest, or at other special (view)points can be offered and maintained by park management. Our findings show that residents want improvements in spatial planning. Park management can also organize events for social exchanges, such as neighborhood, youth, and senior citizen get-togethers, as well as initiating associations and festivals in their municipalities. Support of rural social enterprises and tailored interventions at the local level are further opportunities to support social relations in rural areas (Kelly et al. 2011).

Our results revealed the management needs that are perceived by residents regarding their income and financial situation. Residents' economic situation is, to a large extent, dependent on the (inter)-national economy, global events (e.g., pandemics, conflicts), and socio-economic factors (e.g., out-migration, structural changes in agriculture). The contribution of parks to the regional economy is mainly driven by generating and promoting tourism offers (do Val Simardi Beraldo Souza et al. 2019; Job et al. 2016; Knaus and Backhaus 2014; Mayer 2014; Naidoo et al. 2019; Serenari et al. 2017). This income from tourism indirectly affects the economics of other sectors (Pham 2020), such as local infrastructure and services (Pantić, Čolić, and Milijić 2021), cultural and leisure offers and institutions (Hogg et al. 2019; Rees et al. 2013), and education and off-farm jobs (Dang et al. 2020). It is thus important for park management to be aware of both direct and indirect impacts on the local economy and to find potential pathways for improving the economic situation. In addition, parks can contribute to residents' financial situation by enabling better human health and lowering health costs (Buckley et al. 2019), achieving larger yields of products through healthier soil conditions (Coad et al. 2008; Hogg et al. 2019; Rees et al. 2013; Vivanco 2001), and marketing their own park labels (Knaus, Bonnelame, and Siegrist 2017).

In line with the literature on rural areas, our results indicate that sustainable forms of mobility require greater management efforts in parks (Berg and Ihlström 2019; Eckhardt et al. 2018; Wierenga 2021; Yu and Zhao 2021). More astonishingly, however, it turns out that footpaths and cycle routes are not considered satisfactory in the investigated parks. This echoes other studies in Europe, such as that of

Bosworth et al. (2020), who found that residents in the UK wanted separate paths that provided safety from fast and large vehicles. The safety provided by these measures could enhance people's motivation to travel to public transport stations on foot or by bicycle (Bosworth et al. 2020), which also seems conceivable in our study areas. In addition, a wide range of digital and smart innovations, such as apps for car sharing and hiking routes (Shaker et al. 2021), self-driving small buses, collective taxis (Imhof, Vogel, and Ruiz 2009), electric mobility (such as e-scooters, electric bicycles, and electric rental cars) (Martín et al. 2019) can further promote rural mobility (Bosworth et al. 2020; Eckhardt et al. 2018; Porru et al. 2020; Sieber et al. 2020). Accordingly, we propose that park management advise municipalities with a view to introducing alternative, sustainable, and digital mobility options, and seek cooperation with providers of electric vehicles and digital solutions, for example. Members of park-management bodies could also use their political connections to lobby for expanding public transport. Moreover, sustainable mobility requires sustainable energy provision, and our results show that the availability of renewable energy in parks is a prominent desire of residents. Thus, it would be worthwhile for parks to follow this line of activity, either through their own projects or through collaborations with energy providers.

In summary, the dimensions that proved important in park residents' QoL are also essential for sustainable development and hence relate to the two main goals of parks (FOEN 2019; UNESCO, 2019b; WCPA 2016). The wishes expressed by residents regarding the various fields of activity also imply that, in their view, these goals have not yet been achieved in the investigated parks. Hence, we propose that park management evaluate their activities more closely against residents' wishes and benefits (McNeely 1994) and find synergies for simultaneously promoting sustainable development and QoL for residents. It is also essential that they communicate these activities and the direct and indirect impacts they have on residents' QoL (Shields, Moore, and Eagles 2016). Information and opportunities for participation helps to build acceptance and identification with the park and open up opportunities for a common trajectory and collaboration toward sustainable development and QoL (Mashizi and Sharafatmandrad 2020; Stoll-Kleemann and Welp 2008; von Lindern et al., 2019). To reach these goals, park management can take up various roles and activities, including the provision of information, consulting with companies and private individuals, networking between various actors, project

development and implementation, sourcing funding, and liaising with political actors and authorities.

The differences found between the three parks point to the importance of considering the regional contexts of parks when tackling issues of QoL: while we found that health and social relations are generally the main components in shaping QoL, there are still important differences in the strength of the signals. Furthermore, there are also differences between the needs of management and the wishes expressed by residents regarding the various dimensions of QoL. For example, while noise reduction could lead to a significantly higher QoL in JPA, these measures would have no effect in the other two parks. We assume that the traffic situation in JPA is different from the other two parks and leads to more noise. However, to confirm this further investigation would be required. More importantly, the differences in the parks show that if parks aim to improve their residents' QoL, it is imperative that they first investigate which components of QoL are important and require improvement in their specific region.

Despite these specificities, we believe that our analyses and suggestions can be broadly extended to other parks facing similar challenges typical of rural regions, and where similar effects and issues have been identified, such as health impacts (e.g., Bonet-García et al. 2015; Lemieux et al. 2012; Puhakka, Pitkänen, and Siikamäki 2017; Romagosa, Eagles, and Lemieux 2015), sustainable mobility (e.g., Buongiorno and Intini 2021; Imhof, Vogel, and Ruiz 2009; Mounce, Beecroft, and Nelson 2020), availability of basic services and infrastructure (e.g., Hogg et al. 2019; Oikonomou and Dikou 2008), structural changes in agriculture (e.g., Nguyen et al. 2019; Sroka et al. 2019; Trachsel et al. 2021), and QoL in general (e.g., Dahlberg and McKee 2018; Oguzturk 2008; Shucksmith et al. 2009).

At the same time, it is important to state that our study has its limitations. It does not make use of objective indicators that also describe dimensions of QoL, such as life expectancy, distance from public transport or schools, and the number of leisure facilities. We measured QoL based on the self-reported satisfaction of individuals, which is subjective by nature. It would be interesting to contrast perceived QoL with other existing data. This would also be interesting for park-monitoring schemes and should therefore be addressed in future research. Furthermore, our results are based on cross-sectional data and provide a snapshot of present satisfaction and management needs. We cannot prove the extent to which the QoL of park residents is affected by influences other than park-management activities. Moreover, we cannot predict or infer the causality of the effects of park management on residents' QoL. In future studies, it would be

interesting to use longitudinal data and survey measures with direct and indirect impacts on QoL to investigate how resident satisfaction changes when park management focus their efforts on areas shown to be important in this study. This would be a crucial component in elucidating the role that park management can play in improving QoL for residents and finding out which measures prove efficient. Overall, we believe that parks adopting such measures would benefit strongly with regard to achieving their sustainability goals.

Conclusion

In this study, we addressed the question of how park management can best contribute to park residents' QoL. We identified the most promising approaches by addressing the personal, social, and infrastructural dimensions of QoL. When they take the QoL of human populations in parks seriously, park management has various options for directly and indirectly improving the QoL of residents. Our results show that there are four lines of action through which park managements can synergistically tackle the improvement of park inhabitants' QoL and make use of efficient pathways to make a difference for local people. These are: (1) offers that directly or indirectly improve residents' health, for example encouraging them to be active outdoors and safeguarding a healthy, inspiring, and beautiful environment; (2) measures that improve social relations for residents, for example organizing events or supporting municipal spatial planning; (3) activities that create meaningful jobs in the region, for example certifying local products and fostering nature-based tourism; and (4) promotion of sustainable mobility, infrastructure, and renewable energy, for example by collaborating with energy providers and political lobbying. By providing places in nature and planning landscapes with the aim of improving inhabitants' QoL, park management can contribute to both inhabitants' health and social life. Sustainable mobility, infrastructure, and renewable energy are prerequisites for enabling many other essential dimensions of high QoL in the long term. These lines of action overlap in many ways and offer great synergistic potential. Thus, defining goals and adopting measures to improve QoL for residents can generate multiple positive outcomes in parks, for both nature and people. This opens up pathways for achieving sustainable development.

Note

1. The coefficient of the independent variable of political participation is negative. In the bivariate model, however, the correlation is positive [$b=0.117$,

$p < .001$, $F(1, 2344)$, $R^2 = 0.41$]. This indicates that the negative effect in the multivariate model results from the influence of the other independent variables. We, therefore, consider the effect as an artefact of the multivariate regression and refrain from any further interpretations.

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Ethical approval

All required ethical standards were respected. Informed consent was obtained from all subjects involved in the study.

Disclosure statement

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