

Chapter 10

Environmental [In]Equity: Accessibility to Green Spaces in a Rapidly Urbanizing Mountain-City



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Significance Statement Open Green Spaces (OGS) provide a range of cultural ecosystems services including health benefits through recreational and tourism opportunities. Rapid and oftentimes unplanned urbanization can result in the loss of OGS, negatively affecting urban dwellers' health and wellbeing. An example is the rapidly expanding city of San Carlos de Bariloche, located in the Argentinean Patagonia, surrounded by the iconic Nahuel Huapi National Park. The study reported here sought to assess the availability and distribution equity of public OGS in Bariloche. The study found inequalities in access and distribution; 'wealthier' neighbourhoods offered more OGS than poorer neighbourhoods. Better regulation of development is required and future land use plans need to preserve and protect future OGS sites and improve access points to existing OGS to ensure more equitable access to diverse natural landscapes.

Keywords Environmental justice · Patagonia · Urban parks · Open green space

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1 Introduction

Open green spaces (OGS), including publicly-accessible parks and natural areas, provide many ecosystem services to urban dwellers (Byrne & Sipe, 2010; Byrne et al., 2009; Liu et al., 2017). Social benefits include improved health and wellbeing, social cohesion and identity, and recreation opportunities. OGS support biodiversity, provide carbon sequestration, improve air and water quality, intercept storm water, and regulate temperature, among other benefits (Konijnendijk et al., 2013). Urban residents who frequently visit OGS are reported to experience better sleep, improved mood, lower blood pressure, stronger immune systems including suppressed cancer, and reduced levels of stress and anxiety (Li, 2010; Li et al., 2011; Morita et al., 2007). OGS confer such benefits not only to individuals, but also to broader communities, making neighbourhoods safer and more liveable (Parks Canada, 2014). However, many urban dwellers lack easy access to OGS, presenting an environmental equity concern (Byrne et al., 2010). This can be especially pronounced in counties experiencing rapid urbanization.

In Latin America, more than 80% of the population lives in urban areas (ONU-Habitat, 2012). Argentina is the most urbanised country, with 92% of the population living in cities, and is more urbanised than Europe and the USA (Bolay, 2018). In recent decades, Argentinean cities, as with many Latin American cities, have experienced rapid and poorly regulated growth, often entrenching social inequalities and heightening socio-economic marginalisation and disadvantage (Rigolon et al., 2018; Sánchez et al., 2007). Such rapid and unplanned urban growth also has many negative socio-ecological consequences, including the loss of public OGS and reduced access to mountains, lakes, rivers, and coastal areas (Moretto & Zalazar, 2014). While our understanding of the benefits stemming from green and open space accessibility, including contact with nature, is now well recognised in countries such as the United States, United Kingdom and Australia, these issues are comparatively poorly understood in Latin America, presenting an important knowledge gap (Boulton et al., 2018).

A recent review of published scientific studies found only 46 articles studying urban green space accessibility in countries of the so called ‘Global South’ (Rigolon et al., 2018). From those 46 studies, eight articles assessed Latin American cities and only one article referred to an Argentinean city – Buenos Aires (Rigolon et al., 2018). Most studies conducted in Latin America have shown distribution inequities – typically, ‘wealthier’ residents live closer to open green spaces than more socio-economically vulnerable residents. Also, wealthier residents tend to have access to a greater number and higher quality of OGS (Rigolon et al., 2018). This study aimed (i) to assess the availability and distribution equity of public open green spaces in San Carlos de Bariloche, Rio Negro, Argentina and (ii) to open a discussion about the reasons behind the unequal socio-spatial distribution of these important nature spaces.

2 Methods

2.1 Case Study

San Carlos de Bariloche is one of the fastest growing Patagonian Andean cities in Argentina with a 21% intercensal growth rate surpassing provincial and national growth rates (Niembro et al., 2019). The city's urban-footprint extends over 270 km² and has an estimated population of over 136,800 people (calculated based on Niembro et al., 2019). Bariloche is also subject to important amenity migration processes (González et al., 2009), driving uncontrolled and fast-paced urban-development (Niembro et al., 2019), with concomitant social and environmental impacts, including inequalities in access to urban and peri-urban OGS.

Bariloche city is surrounded by Nahuel Huapi National Park (NHNP), the first Latin American park and one of the major parks in Argentina. Bariloche is known for its amazing mountain landscapes, natural forests, and glacier-lakes, which make it one of the main national and international tourism destinations in Argentina. Although the city is surrounded by the NHNP, public access to the park is limited as most of its boundaries neighbour private land. Similarly, although the city abuts Lake Nahuel Huapi, much of the shoreline is held in private ownership with few public beaches and access points.

These constraints to publicly accessible OGS prompted us to investigate residents' accessibility to officially created, gazetted, and publicly managed OGS. For this study we consider OGS as comprising all publicly available natural or seminatural areas within the municipal boundary (Fig. 10.1). We followed the classification used by Byrne and Sipe (2010) distinguishing between pocket/playground parks typically smaller than 1 Ha, neighbourhood parks sizing between 1 Ha and 5 Ha, community parks ranging from 5 Ha to 10 Ha, district parks sizing from 10 Ha to 25 Ha and regional parks (over 25 Ha).

2.2 Data Collection and Analysis

Data used to conduct the spatial analysis comprised: the last Argentinean 2010 georeferenced-census (INDEC, 2020) including the Unsatisfied Basic Needs Index (NBI) a measure of poverty, developed by INDEC (2020), public open green spaces (Municipalidad de Bariloche, 2021), and neighbourhoods (Open Street Maps). Because the published geo-census information did not match neighbourhood boundaries, the census information was combined with the neighbourhood layer using QGIS 3.10. The resulting layer contained census information. That information includes NBI (Unsatisfied Basic Needs) by neighbourhood, as calculated using QGIS. With the resulting neighbourhood layer, and using Hot Spot (Getis Ord Gi) analysis, we assessed the city's population distribution, highlighting areas with

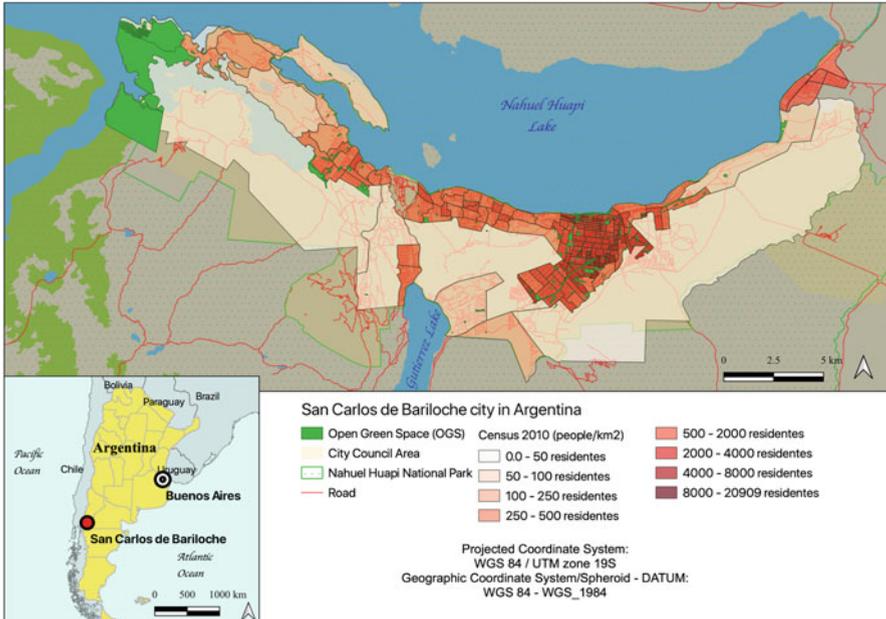


Fig. 10.1 Location of San Carlos de Bariloche city in Patagonia-Argentina showing open green spaces in comparison to the city's socio-demographic profile

higher probabilities of: (a) population concentration and (b) higher density of population with unsatisfied basic needs.

Assessing open green space availability and distribution can be done in many ways. The most common method is assessing the city's "Green Area Index" (GAI) and "Green Space Ratio" -GSR- (Garcia et al., 2020). These indexes are both a measure of OGS provision. As shown in the equations below, GSR (Eq. 10.1) represents the percentage of area covered by OGS in an urban area while GAI (Eq. 10.2) represents the amount of green space per person in squared meters (m^2 /resident). Using these measurements enables researchers and policy-makers to better assess greenspace distribution within a city, including at smaller neighbourhood scales. For instance, with the polygon layers representing the neighbourhoods and OGS we calculated, using Eq. 10.1, the GSR for the whole urban area as well as per neighbourhood individually. This approach provides valuable information to urban planners, furnishing detailed information about existing OGS's provision and accessibility, potentially enabling future planning for more equitable, sustainable and liveable neighbourhoods (Carrus et al., 2015; Wolch et al., 2014).

$$\text{Green Space Ratio (GSR)} = \frac{\sum \text{OGS}(m^2) * 100}{\text{Urban Area}(m^2)} \quad (10.1)$$

$$\text{Green Area Index (GAI)} = \frac{\sum \text{OGS}(m^2)}{\text{Population}} \quad (10.2)$$

Although these measures are widely used and generate valuable information, in some cases GAI and GSR indexes may not provide clear results. For instance, these measures may indicate that there is sufficient provision of green space when, in reality, that green space is concentrated in one sector of the city. For this reason, we also employed a standard proposed by the World Health Organization (2017), specifying that all residents should have an OGS of at least 0.5 Ha close to their home. Although the WHO used 300 m Euclidean distance from home, we used instead 500 m as COVID restrictions in some cities in Argentina allowed people to commute only that distance to access nature for recreational purposes. Using QGIS, we calculated a 500 m Euclidean buffer area computing the unserved neighbourhood areas for all OGS as well as for those over 0.5Ha. We then calculated the difference between the neighbourhood served area versus unserved area, identifying whether all residents have the same access opportunities to OGS within 500 m of their homes.

Some scholars contend that spatial analyses alone can mask as much as they reveal with respect to OGS access, because they tend to treat OGS homogeneously (Boulton et al., 2018). To address this concern, and account for potential differences in the design and character of OGS, we also assessed residents' preferences for natural settings. These settings included larger, natural landscapes, not available within the urban core. We conducted a visitor survey in peri-urban day-use areas of the Nahuel Huapi National Park. Two of the selected sites, Seccional Lago Gutierrez (16 km from Bariloche CBD) and Refugio Neumeyer (24 km from Bariloche CBD) are located on the outskirts of Bariloche, while the other two sites, Refugio Frey and Refugio Jacob are located further in the mountains. The intercept survey sought to understand people's preferences and needs for recreational opportunities in more naturalistic settings. The instrument assessed: (i) recreational activity type, (ii) landscape preferences, including from highly-natural to highly-modified green spaces, and (iii) duration of visit. The visitor survey was conducted during high visitation periods in Summer 2017, where all visitors arriving and leaving the sites were invited to participate. We distinguished between residents and tourists. The sample size resulted in 421 completed-questionnaires, exceeding the minimum sample size to represent Bariloche's population and required to ensure a 95% confidence interval for the statistical analysis (Veal, 2011).

3 Results

3.1 Spatial Analysis of Urban OGS

Bariloche city has 409 OGS, including plazas, coastal areas and parks. Most of these OGS (86%) are pocket parks, smaller than 0.5 Ha (68%), or parks smaller than 1 Ha

(18%). Also present are 47 neighbourhood parks (11%). These OGS are mainly managed landscapes, with some lawn area and recreation equipment, including playgrounds for children and some sports facilities (e.g., football pitch, skate park). Bariloche also has five community parks, located mostly within the city proper, which are managed for recreation and tourism, three district parks, located in the peri-urban area of the city and four regional parks, all located in the peri-urban western side of the city, where fewer people live. In total, Bariloche has over 1514 ha of OGS with a 16% Green Space Ratio (GSR) and a Green Area Index (GAI) of approximately 111 m²/person. However, 84% of the total green space area is located exclusively in the peri-urban area, 26 km west of the city centre. What this means, is that most residents lack everyday access to these larger OGS; instead, they may only have access to smaller, highly modified OGS within the urban core. Excluding those seven big peri-urban parks, the GAI index is just 17 m²/person and the GSR is 2.5%.

Moreover, parks in Bariloche are not evenly spatially distributed, meaning residents lack adequate access to OGS. For instance, 52% of all 113 neighbourhoods have no OGS at all, while those neighbourhoods with OGS have an average 6.3% GSR per neighbourhood, with 12 neighbourhoods presenting under 1% GSR, 34 presenting between 1% and 10% GSR and only 8 neighbourhoods presenting over 10% GSR. In addition, calculations based on a 500 m Euclidean distance show that 39% of all neighbourhood areas lack easy access to OGS, and this percentage increases to 57% when considering access to OGS over 0.5 Ha (Fig. 10.2).

These inequalities are more evident in vulnerable neighbourhoods, where the likelihood of people having unsatisfied basic needs increases dramatically (Fig. 10.3b). For instance, we counted 27 parks -of which 18 are small parks and only nine have more than 0.5 Ha- where the spatial hotspot Getis Ord Gi cluster analysis significantly indicated a likelihood concentrated poverty. Many residents in those neighbourhoods live further than 500 m to any OGS (Figs. 10.2 and 10.3). Exacerbating such inequalities, in Bariloche, is the fact that many residents in those under-served neighbourhoods have limited ability to travel to natural areas, leaving them with few options for nature access. In contrast, wealthier residents have both the means to travel (transport, money and time) and access to a larger amount of OGS near their homes – a salient environmental inequality.

Compounding the OGS availability issue is another problem – as suggested earlier, design of OGS matters. Our findings suggest OGS design seldom accounts for residents' needs. Much of the existing OGS in the city fails to provide opportunities for accessible non-modified nature-contact, presenting an important policy shortcoming. In planning OGS, many planners use provision standards designed for a homogeneous population (Boulton et al., 2018). Planners here, and elsewhere, have seemingly failed to account for the differential needs of children, older people, teenagers and people with disabilities, among others (Byrne et al., 2010). For example, and not surprisingly, in Bariloche most citizens are concentrated near the inner core and Central Business District (CBD), where larger OGS (i.e. district or regional scale parks) are uncommon. Although larger OGS provide opportunities for everyday nature-contact and active recreation, their spatial distribution is skewed towards comparatively advantaged populations (Figs. 10.2 and 10.3). Most residents

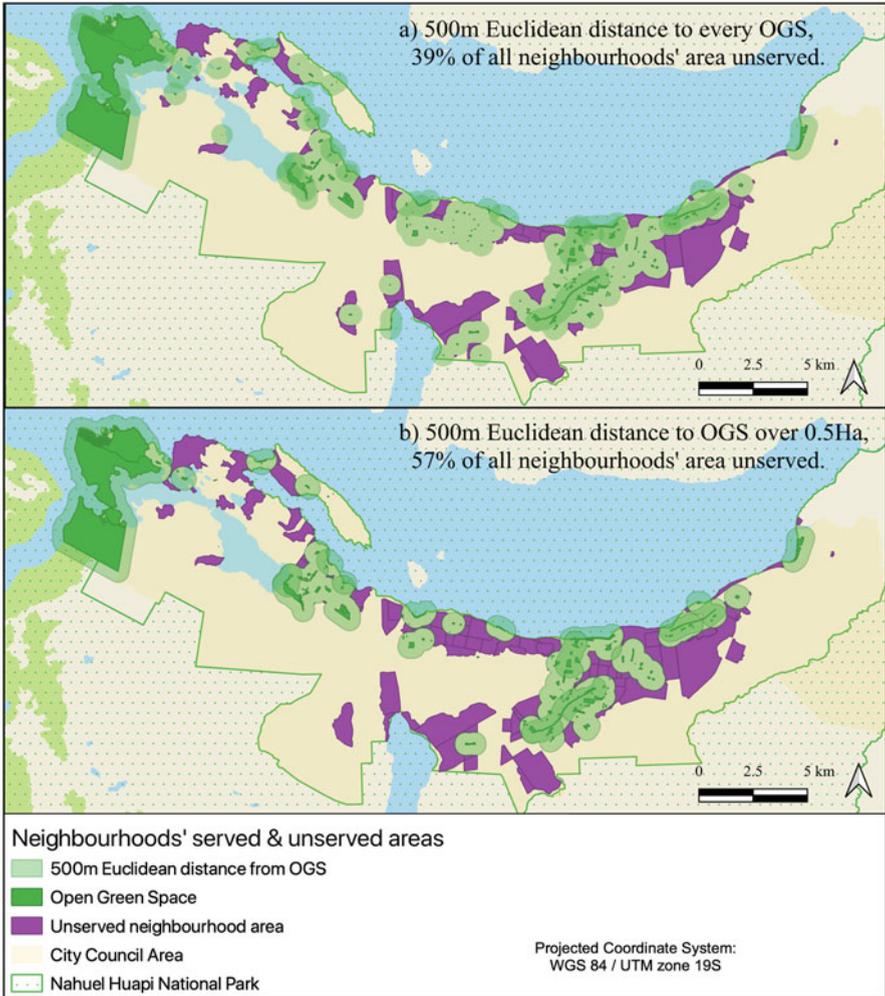


Fig. 10.2 Open Green Space (OGS) distribution in Bariloche city showing the neighbourhood lacking OGS as well as the areas within the neighbourhoods falling outside the 500 m linear distance from (a) any OGS and (b) OGS larger than 0.5 Ha

in higher density neighbourhoods appear to have ready access to very-small parks, but are precluded from accessing nature-based recreation opportunities on the peri-urban fringe, such as running, hiking or mountain biking.

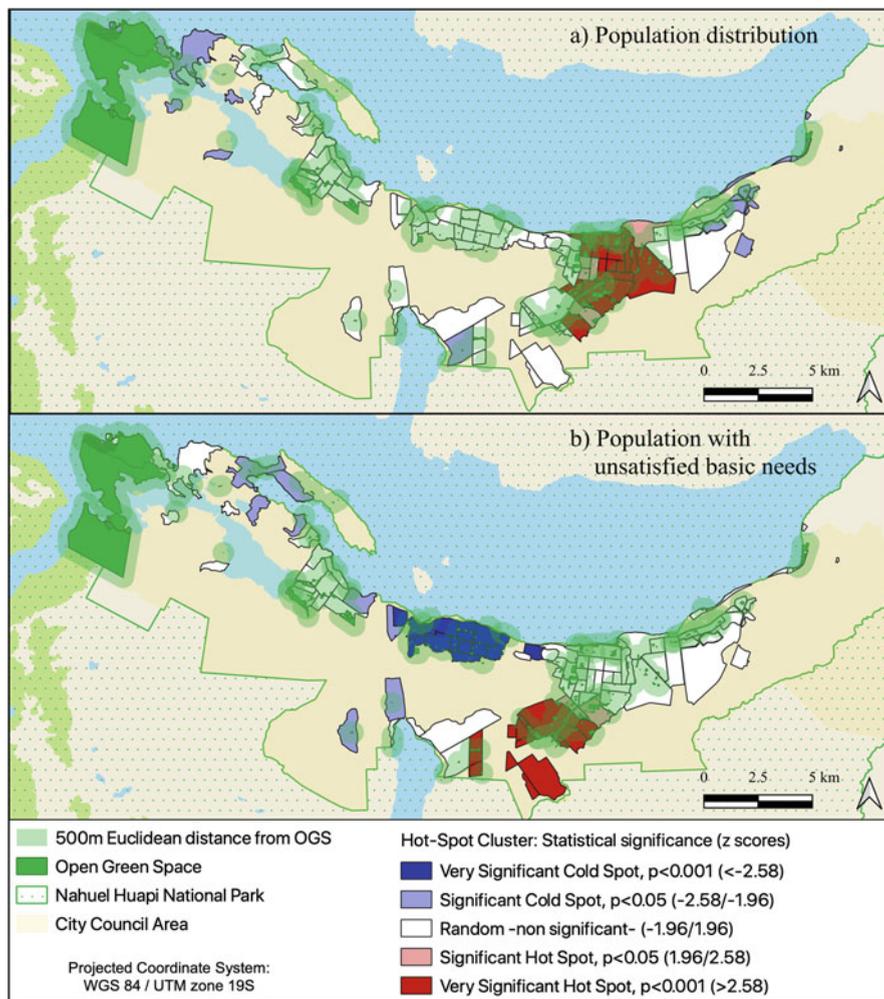


Fig. 10.3 Urban green spaces distribution in Bariloche's city and 500 m linear distance (Euclidean) from parks compared with the city's population concentration and the places where most people present unsatisfied basic needs. The spatial Hot Spot (Getis ord Gi) analysis indicates a) neighbourhoods with significantly high population density (red[s]) and vice versa in blue[s] and b) neighbourhoods where it is significantly more likely that people have unsatisfied basic needs (red [s]) and vice versa in blue[s]

3.2 Natural Areas' Visitors' Survey

To validate the results of the GIS analysis, we conducted a survey within larger, peri-urban OGS areas in Bariloche. This intercept survey showed that most users – both tourists and locals – prefer unmodified landscapes (96%), whereas only 4% reported

liking “highly modified landscapes” such as urban-parks. Hiking was the most common recreational activity, representing 60% of large OGS usage, followed by trekking (26%). Most users tended to spend between 2 and 4 h (39%) or over 5 hours (22%) in the larger OGS, while under a fifth (19%), spent less than 2 h. These results indicate that residents with the ability to access larger OGS have strong preferences for natural spaces and opportunities for active recreation.

4 Discussion

Since the creation of the first public parks, OGS have been recognised as the ‘green lungs’ of the city. Paradoxically, on occasions such as the COVID-19 pandemic, when people’s needs for fresh air are especially evident, OGS access remains out of reach of many city dwellers in Bariloche, presenting an environmental inequality. Although Bariloche is surrounded by Nahuel Huapi National Park, not all residents have easy access to that natural landscapes – a common issue in relatively large cities, even those in close proximity to protected areas, such as Los Angeles, USA or Lavras, Brazil (Byrne et al., 2009; Garcia et al., 2020). In Bariloche, this phenomenon could be related in part to the city’s “proximity” to the National Park, with urban planners possibly assuming that this large protected area to some extent compensates for fewer nature spaces in the city. For instance, Bariloche’s urban planning policies indicate that the totality of the urban area footprint is developable, failing to set aside land for OGS (Rodriguez, 2022). Planning policies seemingly fail to account for residents needs for accessing nature-based recreation opportunities.

Another phenomenon to consider is that rapid and poorly regulated urban growth has been characterised by informal neighbourhoods intruding into what were once natural areas (Niembro et al., 2019; Rigolon et al., 2018). Such patterns of urban growth are typical in the developing world, and can deliver land-access equity of a sort. The most vulnerable groups meet their housing needs through informal settlements, but these are very precarious settlements with a range of challenges, including exposure to natural hazards, waste management issues and urban service provision (Byrne, 2021). It is usually beyond the capacity of urban authorities to regulate these settlements, resulting in disparities not only in housing quality, but also in access to ecosystem service benefits.

Typically, once informal settlements have gained empowerment and social-recognition, the authorities have no other option than formalising the situation, eventually providing infrastructure and services to those “new neighbourhoods”. Not only does this result in the incremental loss of OGS, it also means disparities related to access to nature’s service benefits become formalised and locked in to the city’s morphology. In Bariloche, this has been happening for some decades (Niembro et al., 2019), making proper urban planning and especially OGS planning almost impossible. Bariloche is recognised nationally, and also promotes itself, as a ‘beautiful-landscape’ and ‘very-natural’ city, where local residents and visitors ‘can enjoy’ contact with nature in every corner and as easily as ‘just going out’

(Patagonia, 2021), yet our research suggests that for many residents, the lived experience is different.

Our analysis of OGS' distribution shows greenspace equity in Bariloche is not just a matter of the city having too few parks. The GSR per neighbourhood analysis highlights diverse inequalities related to distribution, access and socio-ecological benefits. This situation was aggravated during the COVID-19 pandemic, when city lockdown restrictions to prevent the spread the virus SARS-CoV-2 confined residents to their immediate neighbourhoods. In some cases, authorities restricted people's travel to a maximum of 500 m from their residence. As with other cities, the mental health and physical wellbeing implications of being confined to greenspace-deprived neighbourhoods are still to be fully understood. Given that in Bariloche about 39% of the neighbourhoods do not have access to UGSs within 500 m Euclidean distance, and that existing parks do not provide for the diverse needs of citizens, it is likely that there will be medium to long term negative health effects (Ives et al., 2018; Pouso et al., 2020).

The study reported here has analysed the availability and distribution of public OGS using spatial information. However, the study presents some limitations. For instance, the geo-census data published as "census-radius" do not match the neighbourhoods' shapes, necessitating the generalisation of results per neighbourhood. Therefore, results reported should be interrogated more robustly through future research, such as surveys to determine the nature preferences of residents in the urban core.

5 Conclusion and Final Remarks

Urban and peri-urban open green spaces play an important role in urban dwellers' daily routines, recognised for their ability to improve and maintain physical and mental health. It is imperative then, that greater efforts are made to protect extant OGS and to remedy disparities in access and distribution. The methods and results of this study can help identify under-served neighbourhood areas, prioritising the authorities' efforts to remedy socio-spatial disparities in OGS access. Future urban-plans for mountain cities like Bariloche should consider alternative mechanisms for setting aside a wider variety of greenspace areas, suitable for providing urban dwellers with the opportunity to access diverse natural landscapes within walking distance of where they live. Traditional planning mechanisms are clearly not working, especially in the case of informal settlements. Innovative practices might include using informal greenspaces alongside infrastructure such as pipelines and railroads to create linear natural corridors, joining different neighbourhoods and parks, larger natural areas, and even long accessible coastal areas. Other more controversial approaches could include working with squatters to set aside land in informal settlements for urban nature – potentially as multi-functional spaces for stormwater management, food-growing, silviculture and eco-tourism.

Future research could test some of these ideas and new techniques for OGS provision, aiding developing countries where informal housing and land ‘taking’ is a major issue. This may include traditional planning approaches, such as working with the authorities to strategically plan future growth areas, based on current information such as population trends, to include OGS in planning and associated recreational activities and health benefits. Alternative approaches might also entail working with vulnerable group leaders, to help minimise the impacts of informal neighbourhoods, and work with, rather than against, the ‘problem’, knowing that at some stage those ‘informal-settlements’ will become formalised and thus require proper consideration for future OGS needs and nature’s service benefits.

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