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Research Paper

Perceptions and preferences for urban trees across multiple socio-economic contexts in the Eastern Cape, South Africa

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ABSTRACT

Urban trees are vital components of urban ecosystems, and thus important for environmental quality, urban sustainability, and quality of life in cities. Regrettably, urban trees are sometimes unequally distributed both between and within towns, a pattern largely associated with differences in the social environment of cities and historical patterns of development, and the dearth in strategic management plans and systematic monitoring of the existing urban forest. Most management plans focus on ecological and arboricultural aspects at the expense of the social, and studies examining perceptions in relation urban forests are largely from developed countries. Accordingly, we conducted a study to examine the perceptions and preferences regarding urban trees of 1200 residents from 10 urban areas across multiple socio-economic contexts in South Africa. We found that most (87%) urban residents have positive perceptions of trees. This was supported by emphasis placed on the importance of urban trees for quality of life in towns by > 70% of respondents. However, > 70% of respondents were dissatisfied with both the appearance of their streets and the insufficient number of street trees. They emphasized their preference for having trees both on the street and in their private yards, highlighting an array of benefits provided by urban trees. Incorporating residents' perceptions and preferences of urban greening into plans and strategies towards urban forest establishment and management is a crucial strategy towards the reduction of disparities in urban forest distribution. Furthermore, it contributes to the establishment of an urban forest that accommodates user-needs based on user preferences, while also serving the needs of the broader natural environment.

1. Introduction

Urban trees growing in roadside verges, boulevards, parkways, tree lawn/strip, private gardens, and remnant forest patches constitute the largest component of urban greenery in most cities (Feng & Tan, 2017). Urban trees are vital components of urban ecosystems and are therefore important for environmental quality, quality of life, sustainable urban development (Duinker et al., 2015), and for the resilience of cities. The contributions of urban trees to urban residents' quality of life, and attitudes towards the trees can be established through their benefits to people and other biodiversity (Mullaney, Lukke, & Trueman, 2015). These benefits include the ecological (Gillner, Vogt, Tharang, Dettmann, & Roloff, 2015), social (Nowak & Dwyer, 2007), and economic benefits (Pandit, Polyakov, Tapsuwan, & Morand, 2013). Perceived disservices (Vogt, Hauer, & Fischer, 2015) can also become apparent, especially in cases where less importance is attached to urban trees.

Regrettably, urban trees and green spaces are sometimes unequally distributed both between and within towns (Kuruneri-Chitepo & Shackleton, 2011; McConnachie & Shackleton, 2010), a pattern partially associated with differences in the social environment of cities and historical patterns of development (Fan, Johnston, Darling, Scott, & Lia, 2019; Gwedla & Shackleton, 2017; Kendal, Williams, & Williams, 2012). This is particularly true of the South African urban landscape, which mirrors the development history and legacy of apartheid (Gwedla & Shackleton, 2017). This legacy has unfortunately left visible disparities in the distribution, diversity and variation of urban trees in the private and public spaces, both between and within towns (Gwedla & Shackleton, 2015, 2017; Kuruneri-Chitepo & Shackleton, 2011; Shackleton et al., 2014). This pattern is further exacerbated by the apparent dearth in strategic management plans, and systematic monitoring of the existing urban trees and green spaces (Chishaleshale, Shackleton, Gambiza, & Gumbo, 2015); as well as the relatively few policies that deal specifically with, and promote tree planting and maintenance in South African towns and cities (Shackleton et al., 2014). Furthermore, housing policies continuously refer to the need for

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environmental sustainability and to minimize the impacts of development and housing initiatives, but these are rarely translated into specific guides, standards or actions (Shackleton et al., 2014).

Most urban tree management plans in many cities worldwide focus on ecological and arboricultural aspects at the expense of the social (Ordóñez & Duinker, 2013). Moreover, most of the studies that examine residents' perceptions in relation to the urban forest in particular are largely from developed countries. For example, Kirkpatrick, Davison, and Daniels (2012) looked at the influence of residents' attitudes to the planting and removal of different types of trees in eastern Australian cities and found that attitudes towards trees had a direct impact on planting and removal behavior for both trees in general and specific types of trees. Zhang, Zheng, and Laband (2010) assessed preferences for and attitudes towards urban forests in Alabama, Georgia and Florida, and found that urban greening was important in residential landscapes, and that people prefer to live in houses with more trees. In South Africa, Richardson and Shackleton (2014) assessed the extent and perceptions on the vandalism of street trees, and concluded that despite the high levels of damage to new trees in most towns, many residents attached importance to and appreciated street trees and would welcome more tree planting.

The recognition of the importance of urban forestry in general, and the necessity of urban green space management plans and urban forest establishment in South Africa is slowly gaining momentum. However, a gap still exists in the diversity of urban forest research, with general perceptions of the urban forest, particularly urban trees, still lagging behind. Much focus has been on the distribution (Gwedla & Shackleton, 2015) and composition of the urban forest (Gwedla & Shackleton, 2017; Kuruneri-Chitepo & Shackleton, 2011), and the extent of (McConnachie, Shackleton, & McGregor, 2008) and unequal distribution of public urban green spaces (McConnachie & Shackleton, 2010). The few studies that looked at residents' perceptions of the urban forest, most of which have been conducted in the Eastern Cape, Limpopo, North West and Western Cape provinces, are largely focused on the benefits residents derive from the urban forest (Kaoma & Shackleton, 2014a, 2014b, 2015; Shackleton, Chinyimba, Hebinck, Shackleton, & Kaoma, 2015); people's use of public urban green spaces (Shackleton & Blair, 2013; Ward, Parker, & Shackleton, 2010); and their support for green infrastructure (Shackleton et al., 2018). Solicitation of urban residents' attitudes, perceptions and preferences regarding urban tree planting is crucial (Ng, Chau, Powell, & Leung, 2015), and provides information that will help understand what will increase residents' satisfaction, and thus contribute to the structure and distribution within the urban forest.

Consequently, this paper seeks to understand the perceptions of residents on the importance of urban trees across different suburb types, within multiple towns with differing socio-economic contexts in the urban settings of South Africa. Insights into preferences for the structure and distribution of the urban forest, and satisfaction with the current distribution were also assessed. We hypothesized that perceptions and preferences regarding urban trees differ between and within towns, and that residents from the wealthier towns (Gwedla & Shackleton, 2015), and those from more affluent suburbs will have more positive perceptions about the importance of urban trees. Furthermore, we hypothesized that residents from wealthier towns, and those from more affluent suburbs, will be more satisfied by the current distribution of urban trees than those from poorer towns and less affluent suburbs.

2. Methods

2.1. Study area

This study was conducted in 10 towns in the Eastern Cape province of South Africa (Fig. 1). The province spans an area of 169,580 km^2 (Statistics SA, 2018) and is situated on the south-eastern seaboard of the country (Gwedla & Shackleton, 2015). It borders Kwa-Zulu Natal in the north-east; Free State and Lesotho in the north; and the Western Cape in the west (Gwedla & Shackleton, 2017). The Indian Ocean borders the southern and eastern parts of the province, while the arid region of the Great Karoo is characteristic of the northern and north-western parts (Gwedla & Shackleton, 2017). The Drakensburg Mountains are along the north-eastern parts of the province, whose interior experiences rainfall that is spread evenly throughout the year (Mucina & Rutherford, 2006). Cold and clear days in winter, which become hotter and drier towards the western parts, are prevalent in this region.

The province incorporates areas formerly part of two former homelands (Ciskei and Transkei), and those that were part of the broader South African Republic pre-1994 (Stull, Bell, & Ncwadi, 2016), in line with the apartheid government's unique planning context of stark development discrepancies which promoted racial segregation through land ownership and residency (Shackleton et al., 2014). Former homelands were reserved for black South Africans, and received little economic development, remaining mired in poverty and lack of opportunity (Stull et al., 2016). The province has 6.92 million people, comprised of 53% females and 86% black Africans. It has two metropolitan municipalities, six district municipalities, and 31 local municipalities (Statistics SA, 2018). The smallest municipality has 31,692 people and the largest has 1.26 million people (Statistics SA, 2018). The sizes of the municipalities range from 1 291 km^2 to 28,653 km^2 (Statistics SA, 2018). The province is the poorest in the country, with low adult education levels, high unemployment (> 35%) and poverty (Westaway, 2012), with these being higher in the more rural municipalities and lower in the larger towns and cities (Gwedla & Shackleton, 2015).

2.2. Data collection

The sample towns (Fig. 1) were randomly selected on Microsoft Excel from the 24 previously sampled by Gwedla and Shackleton (2015), then stratified to balance population size (below 100,000 people) and the presence of three types of suburbs we were interested in sampling in each town: affluent, township, and RDP (Reconstruction and Development Programme) suburbs (Shackleton et al., 2018). Therefore, all selected towns had at least one of each suburb type. Where there were multiple suburbs in a single suburb type within one town, one suburb was randomly selected on Microsoft Excel. Affluent suburbs are residential areas ranging from middle to high income areas, typical of any city in the first world; well laid out, well-maintained, leafy suburbs, low density and adequate infrastructure (McConnachie & Shackleton, 2010). Township suburbs, on the other hand, refer to areas which were previously reserved for Black South Africans during the apartheid period (Wilkinson, 1998), and these were generally high density suburbs, poorly serviced, with limited commercial activities and widespread poverty (Shackleton et al., 2014). RDP suburbs is a colloquial term for low-cost housing suburbs, which are a result of the post-1994 democratic government's initiative to address the severe backlogs of service provision and housing created during apartheid (Wilkinson, 1998) by delivering large numbers of low cost houses consisting of a single storey on a 40 m^2 foundation to the poor and previously homeless (Gilbert, 2004).

Maps of the randomly selected towns were obtained, then a 100 m × 100 m grid was overlaid across each town and grid squares were randomly selected from it. The overlain grid was manipulated further to only cover residential areas representing the suburb types of interest (the towns had previously been visited, so there was clarity on the locations of the suburb types). The aim was to identify streets with houses. The randomly selected grids were labelled and visited, and sampling took place along a 200 m transect on the first road encountered within the grid, going forward, on either side of the road. Thirty transects were visited in each town, 10 in each suburb type, respectively.

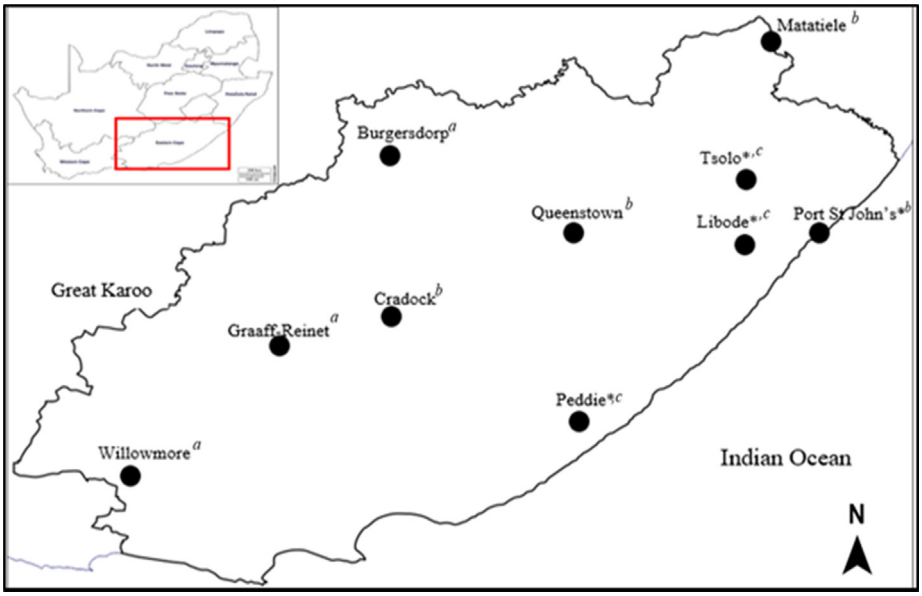

Fig. 1. Location of study towns within the Eastern Cape province (* = former homeland towns; *a* = high street tree density; *b* = medium street tree density; *c* = low street tree density).

Within each transect, four randomly selected households were visited. Each randomly selected household was approached with a greeting and an introduction of the visit was made. Thereafter, requests were made to speak to the head of the household, or any other member of the family above the age of 18 (or below if consent was given by the elderly member) who was willing to participate in a short, in person survey for research purposes. One-thousand two hundred questionnaires were completed across all towns. The survey interviews were 0.25–0.50 h long and conducted either in IsiXhosa, English or Afrikaans according to the respondent's preference. Transcription of the interviews took place during the interview, and responses were filled on to the questionnaire sheet. Where a household was found to be unoccupied or the members of the household were unwilling to participate, the next available household was sampled.

The questionnaire consisted of questions relating to perceptions, preferences and attitudes towards urban trees (Appendix A). Questions related to what residents perceived as an ideal street for them both in terms of appearance and content were also included, following Basolo and Strong (2002)'s neighbourhood quality indicators. In this study, the general appearance of a street was taken as referring to anything that has to do with either the size of the street, its cleanliness, its physical condition and its appeal to the eye. Most questions were closed-ended, and open-ended clarifications in that regard were required (Appendix A). Questions relating to respondent's profile, including age and employment status, were asked for the purpose of data analyses.

2.3. Data analysis

All questionnaire data were translated into English before analysis began. Data obtained were of both qualitative and quantitative nature. Preliminary data analyses were conducted using Microsoft Excel 2013. All subsequent statistical quantitative data analyses were executed in Statistica 13, and the qualitative data were initially analysed using content analysis. A previous classification of towns according to low, medium and high tree density developed by Gwedla and Shackleton (2015) was adopted during analysis.

Based on the hypothesis, crucial variables include perceptions on urban trees between and within towns, and preferences for the location of planted trees between and within towns. The relationships between some of the dependent variables such as the perceived importance of street trees and importance of trees for quality of life, and satisfaction with both the appearance of streets and the number of street trees were also of interest. Data of this nature (proportional data) were analysed via Chi-square analysis or 2 × 2 contingency tables.

After checking for normality, differences in perceptions between suburbs, and between tree density classes were analysed using Kruskal-Wallis tests, while differences between former homeland towns' perceptions and non-former homeland, and genders were analysed using Mann-Whitney U-tests. Likert scale data relating to urban trees and quality of life were directly summarised, and chi-square tests were used to analyse the relationship between importance of street trees and their importance for quality of life. Regression was used to analyse the relationships between related continuous variables, such as education levels and rating of the importance of street trees.

Answers from open-ended questions were grouped using thematic analysis. Thereafter, counts were used to analyse how many times certain variables (e.g. reasons for satisfaction or reasons for preference) within these answers were mentioned to rank them in order of popularity, both within towns and between suburbs.

3. Results

3.1. Respondent profile

The demographics of respondents who participated in this study, most (70%) of whom were female, are presented in Table 1. The most represented age group were the middle-aged between 30 and 39 years of age (Table 1).

3.2. Perceptions and preferences for urban trees between towns

3.2.1. General importance of street trees

In examining the perceived importance of street trees to urban residents (Appendix A, Q6), there was a general positive perception on the importance of having trees on the street among 67% of respondents across all towns (Table 2). No significant differences in this perception between residents from the former homeland and non-former homeland towns ($Z = 0.11$; $p > 0.05$) were apparent. The importance of having trees on the street was recognised by significantly more respondents from the medium ($\chi^2 = 14.3$; $p < 0.05$) and high tree density towns ($\chi^2 = 12.9$; $p < 0.05$) than those from the low tree density towns.

Both females and males across all towns equally acknowledged the

Table 1
Profile of respondents surveyed in this study (n = 1200).

Age Structure & Gender Distribution					Employment Status		Education Attainment	
Age grouping	Age (years)	Number of Respondents = n (%)			Description	Respondents = n (%)	Highest education	Respondents = n (%)
		Females	Males	Total				
Young	13–17	42 (81%)	10 (19%)	52 (4%)	Full-time	454 (38%)	None	54 (5%)
	18–29	158 (62%)	96 (38%)	254 (21%)	Unemployed	338 (28%)	Junior School	127 (11%)
Middle-aged	30–39	232 (73%)	86 (27%)	318 (27%)	Part-time	85 (7%)	High School	401 (33%)
	40–50	184 (67%)	90 (33%)	274 (23%)	Retired	150 (13%)	Grade 12/Higher Certificate	521 (43%)
Elderly	51–60	99 (65%)	53 (35%)	152 (13%)	Student	110 (9%)	Undergraduate Degree/Diploma	89 (7%)
	61 +	121 (81%)	29 (19%)	150 (12%)	Self-employed	63 (5%)	Postgraduate	8 (1%)
Total	836 (70%)	364 (30%)	1200					

Table 2
Respondents' perceived importance of trees for quality of life in towns based on their perceived importance of having trees on the street (n = 1200).

		Importance of street trees [n (%)]			
		Greatly Important	Moderately Important	Not Important	Total
Trees and quality of life	Strongly agree	715 (80%)	124 (14%)	56 (6%)	895 (75%)
	Agree	87 (37%)	105 (44%)	45 (19%)	237 (20%)
	Neutral	2 (8%)	8 (32%)	15 (60%)	25 (2%)
	Disagree	3 (10%)	6 (19%)	22 (71%)	31 (3%)
	Strongly disagree	0 (0%)	1 (8%)	11 (92%)	12 (1%)
	Total	807 (67%)	244 (20%)	149 (12%)	1200

importance of street trees ($Z = 0.3$; $p > 0.05$). Significantly more middle-aged respondents than both younger ($\chi^2 = 18.3$; $p < 0.05$) and elderly people ($\chi^2 = 28.6$; $p < 0.05$), which were also significantly less than young people ($\chi^2 = 50.7$; $p < 0.05$) acknowledged the great importance of street trees. There was a significant, positive relationship between the education attainment of the respondents and their perception of the importance of having trees on the street ($r^2 = 0.27$; $p < 0.05$); the more educated the respondents, the more they appreciated the importance of street trees.

3.2.2. Urban trees and quality of life

In response to whether respondents (dis)agreed with the statement that: "*Trees are important for quality of life in towns*" (Appendix A, Q7), most (74%) respondents strongly agreed (Table 2). This sentiment varied across towns, but only 4% of respondents were in disagreement (Table 2). There was a significant positive association between the perceptions on the importance of having street trees and perceptions on the importance of trees for quality of life in towns ($\chi^2 = 19.8$; $p < 0.05$) (Table 2). Most (80%) respondents who felt that it is important to have trees on the street also strongly agreed that "*trees are important for quality of life in towns*".

The most cited reasons (Appendix A, Q8) why respondents agreed with this statement alluded to the various benefits provided by trees, such as shade and fruit provision. Although oxygen production by trees in urban areas is insignificant to the global atmospheric content, a sizeable proportion (46%) of respondents rated it as one of the reasons they believe trees are important for quality of life. Neutral responders identified that trees are good and sometimes bad, while others did not know how trees contribute to quality of life. Disagreement was largely associated with the negative nuances associated with trees, including that "*trees provide hiding places for criminals*" or "*the fallen leaves and fruits make a mess*".

3.2.3. Satisfaction with general appearance of street and number of street trees

Residents' perceptions of street trees can influence how they perceive their street and their overall satisfaction with its condition (Appendix A, Q16; Q18). Most respondents (75%) were dissatisfied with the general appearance of their street (Table 3), citing problems such as that the street "*was not tarred*" or "*it was not clean*" (Table 4).

Table 3
General (dis)satisfaction with street (appearance and trees); and preference for location of planted trees.

Situated in former homeland	Tree density class	Town	Dissatisfaction with street		Preferred location for tree planting			
			Number of street trees	General appearance	Yard & Street	Yard Only	Street Only	Nowhere
Yes	**Low**	Libode	88 (73%)	104 (87%)	51 (43%)	44 (37%)	20 (17%)	5 (4%)
	Low	Peddie	111 (93%)	108 (90%)	71 (59%)	36 (30%)	12 (10%)	1 (1%)
	Low	Tsolo	89 (74%)	101 (84%)	45 (38%)	52 (43%)	18 (15%)	5 (4%)
	Medium	Port St John's	68 (57%)	107 (89%)	71 (59%)	31 (26%)	16 (13%)	2 (2%)
	Mean ± SE		**89 ± 7 (74%)**	**105 ± 1.6 (88)**	**60 ± 6.8 (50%)**	**41 ± 3.8 (34%)**	**17 ± 1.7 (14%)**	**3 ± 1.0 (3%)**
No	**Medium**	Cradock	73 (61%)	87 (73%)	87 (73%)	27 (23%)	6 (5%)	0 (0%)
	Medium	Matatiele	81 (68%)	72 (60%)	69 (58%)	31 (26%)	14 (12%)	6 (5%)
	Medium	Queenstown	75 (63%)	90 (75%)	68 (57%)	25 (21%)	26 (22%)	1 (1%)
	Medium	Willowmore	66 (55%)	71 (59%)	71 (59%)	33 (28%)	13 (11%)	3 (3%)
	High	Burgersdorp	67 (56%)	91 (76%)	50 (42%)	49 (41%)	15 (12%)	7 (6%)
	High	Graaff-Reinet	81 (68%)	74 (62%)	79 (66%)	24 (20%)	14 (12%)	3 (3%)
Mean ± SE			**74 ± 2.7 (62%)**	**81 ± 3.9 (67%)**	**71 ± 5.1 (59%)**	**32 ± 4.6 (26%)**	**15 ± 2.6 (12%)**	**3 ± 1.1 (3%)**
Total across all towns			**799 (67%)**	**905 (75%)**	**662 (55%)**	**352 (29%)**	**153 (13%)**	**33 (3%)**

Table 4
Common reasons for satisfaction and dissatisfaction with the general appearance of streets (n = 1200).

Reason for satisfaction	Number of mentions			Reason for dissatisfaction	Number of mentions		
	Suburb Type				Suburb Type		
	Affluent (n = 400)	Township (n = 400)	RDP (n = 400)		Affluent (n = 400)	Township(n = 400)	RDP (n = 400)
Tar road	101	60	0	No tar road	69	107	326
Clean	89	57	14	Not clean	119	148	198
Well maintained	116	30	6	Dusty/Muddy	58	103	277
Many trees	95	11	3	No drainage system	26	82	162
Looks fine	42	31	17	No trees	39	77	113
Other: I like the way it is; wide road; proper drainage system; everyone else is satisfied; clear street view; lot of grass; proper gravel road.				Other: potholes; no paving/pavement; narrow road; not appealing and dull; smelly water all over; not maintained; no variety of trees; no flowers.			

A significantly higher proportion of respondents from the former homeland towns (88%) than the non-former homeland towns (67%) were dissatisfied with the general appearance of their street (Table 3) ($Z = 4.9$; $p < 0.05$), while no significant differences in the proportion of respondents dissatisfied with the number of trees on their street were observed ($Z = 1.9$; $p > 0.05$). Whilst the regression of the proportion of dissatisfied respondents against classified street tree density was not significant ($r^2 = 0.1$; $p > 0.05$), significantly more respondents (80%) from classified low tree density areas (the majority of which are former homeland towns) were dissatisfied with the number of trees on their street than those from medium (61%) ($\chi^2 = 16.6$; $p < 0.05$) or high tree density towns, most of which were not previously part of the former homelands (62%) ($\chi^2 = 14.4$; $p < 0.05$) (Table 3).

Overall, there was low satisfaction with both the general appearance of the street and the number of street trees present (Table 3). However, significantly more respondents were satisfied with the general appearance of their street than with the number of street trees ($t = 2.3$; $p < 0.05$).

3.2.4. Preferences for the location and distribution of existing and new tree plantings

The acknowledged importance of trees and general dissatisfaction with the overall condition of the street suggests preference for neighbourhoods with abundant tree distribution. In response to where respondents would most like to have trees planted within their town and suburbs (Appendix A, Q4), most respondents (55%) would prefer to have trees both in their yards and on the street, while 29% opted to have trees planted only in their yards (Table 3).

Most respondents from the non-former homeland (59%) and former homeland towns (50%) would like to have trees both in their yards and on the streets, while slightly more from the former homeland towns (34%) would prefer to have trees only in their yards than those from the non-former homeland towns (26%) (Table 3). No significant differences ($\chi^2 = 3.8$; $p > 0.05$) in preferences between respondents from the former homeland and non-former homeland towns were observed.

Comparisons across the three levels of classified tree density revealed significant differences in preferred location between the low and medium tree density towns ($\chi^2 = 8.7$; $p < 0.05$), with none between the high and low ($\chi^2 = 3.2$; $p > 0.05$), or medium tree density towns ($\chi^2 = 4.6$; $p > 0.05$). Most respondents from the low (46%), medium (61%) and high (54%) tree density towns would prefer to have trees both in their yards and on the street.

The majority of both males (56%) and females (55%) would prefer to have trees both on the street and in their yards, and no significant differences were established in this regard ($Z = 0.2$; $p > 0.05$). Similarly, no significant differences in the proportion of males compared to females who would prefer to have trees in their yards only ($Z = 0.5$; $p > 0.05$). When comparing across the different age groups, significantly more middle-aged respondents than the young ($\chi^2 = 38.3$; $p < 0.05$) and elderly ($\chi^2 = 27.3$; $p < 0.05$) preferred to have trees both on the yard and on the street. However, no significant differences between the younger and elderly were observed ($\chi^2 = 68.0$; $p < 0.05$).

An alignment of the perceptions on the importance of street trees and the preferences for the location of planted trees revealed a significant association ($r^2 = 0.8$; < 0.05). The differences in the perceived importance of having trees on streets between respondents who would prefer to have trees both on the street and in the yard and those who would prefer not to have trees at all were significant ($\chi^2 = 235.09$; $p < 0.05$).

There were various reasons why respondents preferred to have trees planted in specific locations (Table 4) (Appendix A, Q5). There were also some overlaps in the reasons, and some respondents mentioned more than one reason.

3.3. Perceptions and preferences for urban trees within towns

3.3.1. General importance of street trees

Compared to the two other suburb types, respondents from the RDP suburbs (60%) were least supportive of the position that it is greatly important to have trees on the street (Fig. 2). Significantly more respondents from both the affluent and township suburbs than the RDP suburbs believed that it is greatly important to have trees on the street ($\chi^2 = 35.0$; $p < 0.05$).

3.3.2. Satisfaction with general appearance of street and number of street trees

RDP residents were the most dissatisfied with both the general appearance of their street (83%) and the number of street trees (74%) compared to the affluent (73% and 55% respectively) and township residents (71% in both instances). Altogether, there were no significant differences in the proportions of respondents from the various suburbs who were dissatisfied with both the general appearance of their street ($H = 2.09$; $p > 0.05$) and the number of street trees ($H = 5.1$; $p > 0.05$).

According to Table 4, respondents from the RDP and township suburbs were more concerned about the physical infrastructure and cleanliness of their streets than those from the affluent and township suburbs. Most respondents from the affluent suburbs were happy about the maintenance of their streets.

3.3.3. Preferences for the location and distribution of existing and new tree plantings in suburbs

Most respondents (65%) who would like to have trees both in their yards and on the street were from the affluent suburbs, while less than half of those from RDP suburbs had similar preferences (Fig. 2). Significant differences were observed in respondents' preferences for tree location among residents from the affluent and RDP suburbs ($\chi^2 = 16.5$; $p < 0.05$), while no significant differences were observed in the preferences for tree location among those from the RDP and township suburbs ($\chi^2 = 5.6$; $p > 0.05$), and between those from

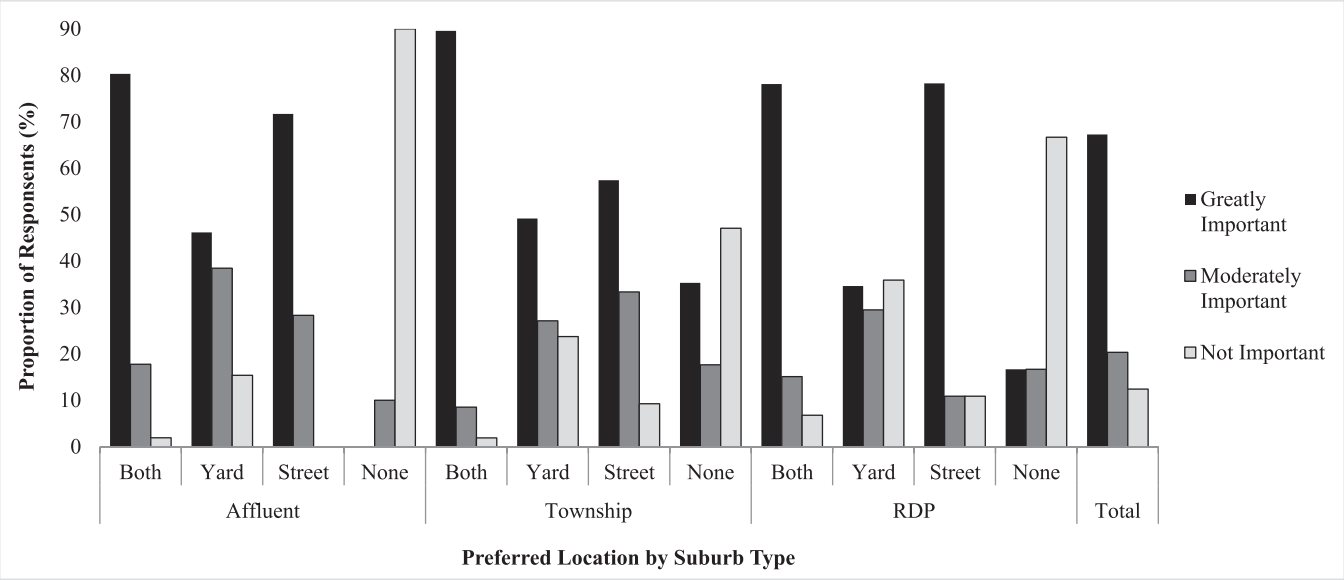

Fig. 2. Residents' perceived importance of street trees based on their preferences for the location of planted trees, by residents' suburb of residence.

affluent and township suburbs (($\chi^2 = 6.84$; $p > 0.05$). Fig. 2 further illustrates that only 12% respondents regarded street trees as not important, and the majority of that proportion would also prefer not to have trees planted anywhere in their yards or on the streets.

Respondents from the RDP suburbs associated their preference for the location of planted trees with the potential tangible benefits of urban trees (Table 5). On the other hand, those from the affluent and township suburbs recognised the intangible benefits (aesthetics and oxygen provision) more in their preference for the location of planted trees.

4. Discussion

4.1. Perceptions and preferences for urban trees between and within towns

This study contributes to an understanding of the perceptions and preferences for urban trees across multiple socio-economic contexts varying from affluent to low income within a South African region. This was achieved through an investigation of urban residents' perceived importance of street trees, their satisfaction with their streets, and their preference for the location of planted trees.

4.1.1. General importance of street trees and urban trees for quality of life

This study has revealed that urban residents generally have positive perceptions of urban trees and perceive them as greatly important, as demonstrated through their assertion that *"trees are important for quality*

Table 5
Common reasons for the various preferences for the location of planted trees.

Location preference	Reason for preference	Number of mentions (n = 1200)			
		Suburb Type			Total
		Affluent (n = 400)	Township(n = 400)	RDP(n = 400)	
Yard & street	Shade	176	131	137	462
	Fruit	90	103	112	305
	Beautiful yards & streets	117	90	68	275
	Wind buffering	31	36	49	116
	Oxygen provision	29	25	14	68
Yard Only	Vandalism of trees on the street	28	38	41	107
	Criminals hide behind trees	13	22	24	60
	Shade for house	16	18	25	59
	Directly benefit from all trees	9	18	28	55
	Limited space on street	8	13	29	50
Street Only	Limited space in yard	10	26	26	62
	Trees will make the yard look messy	12	20	6	38
	Tree roots will crack house walls	8	13	10	31
	Shade for passers-by	3	12	14	29
	No responsibility to care for them	5	8	9	22
Nowhere	I do not like trees	4	6	7	17
	No space for trees anywhere	2	2	4	8
	Criminals hide behind trees	1	3	2	6
	Trees more dangerous than beneficial	1	2	3	6
	Allergies and sickness	2	1	1	4

of life in towns". The findings on the importance of street trees corroborate previous studies (i.e. Kirkpatrick, Davison, & Daniels, 2013; Schroeder, Flannigan, & Coles, 2006; Shackleton et al., 2015; Zhang & Zheng, 2011) that most urban residents have a positive attitude towards trees and appreciate them. Zhang, Hussain, Deng, and Letson (2007) found that 90% of respondents from Alabama appreciated urban trees in choosing their residential location and community.

Corroborating our hypothesis, the importance of having trees on the street was recognised more by residents from towns with medium and high density tree distribution, which, according to Gwedla and Shackleton (2015) can be categorised as wealthier than those with low density trees distribution. Similarly, residents from the low income RDP suburbs were in least support of the importance of having trees on the street. This could be attributed to them generally not having experience to refer to as they have no trees in close proximity, while those from the more affluent areas understand this importance more because they are surrounded by trees anyway.

The importance of urban trees, and thus their contribution to the quality of life of urban residents can be established through the contributions they make to people and other biodiversity. In emphasising the importance of street and other trees for quality of life in towns, the majority of respondents in this study affirmed the importance, noting their provision of shade, oxygen, and fruit. Lo and Jim (2015) found that respondents in Hong Kong expressed general recognition of the main ecosystem services provided by urban trees, including providing shade and mitigating the greenhouse effect in their perceived importance of urban tree functions. Gorman (2004) also found that the majority of respondents from State College, Pennsylvania, emphasised the importance of having street trees by recognising that they provide shade, have flowers, are pleasing to the eye, and render the neighbourhood more liveable.

4.1.2. Satisfaction with general appearance of street and number of street trees

This study also reported on residents' satisfaction with the general appearance of their streets and with the number of trees on their streets. Satisfaction refers to the extent to which needs are met (Lovejoy, Handy, & Mokhtarian, 2010). In this context, this study sought to understand what residents perceived as an ideal street for them both in terms of appearance and content. Most respondents were dissatisfied with the general appearance of their street, pointing to the undesirable state of the street infrastructure, cleanliness and absence of drainage systems.

Being a developing country, South Africa faces massive backlogs in urban infrastructure with blatant development discrepancies where some urban areas are more developed than others (Shackleton et al., 2014). Respondents from the former homeland towns were the least satisfied with the general appearance of their street compared to those from the non-former homeland towns, and this can be attributed to their towns having historically been neglected under the apartheid regime in South Africa (Shackleton et al., 2014). This is also true for the number of trees on the streets. The majority of respondents in this study were dissatisfied with the number of trees on their streets, and most dissatisfaction was expressed by respondents from towns with a classified low density of urban trees, and those from homeland towns. This further supports the hypothesis that residents from wealthier towns will be more satisfied by the current distribution of urban trees than those from poorer ones. The exception in this was Port St John's. Port St John's had previously been classified as a medium tree density town (Gwedla & Shackleton, 2015), and is a coastal town characterised by natural coastal evergreen forests. As such, while residents might not have tree-lined streets, there is an abundance of large trees (Gwedla & Shackleton, 2017) in the private spaces and some patches around the public spaces.

Similar patterns were also observed between the affluent, township and RDP suburbs. Residents from RDP suburbs were more dissatisfied with both the general appearance and the number of trees than both the affluent and township suburbs. The immediate focus in the establishment of these RDP suburbs is the provision of housing for the indigent at as low a cost as possible (Gwedla & Shackleton, 2015), with little regard for broader aesthetics and environmental services. The high levels of dissatisfaction with general appearance of streets among township and RDP suburbs is plausible as, according to Ellis, Lee, and Kweon (2006), the availability of nearby trees, well-landscaped grounds, and places for walking are some of the most important factors in neighbourhood satisfaction. According to Gerstenberg and Hofmann (2016), the design of green spaces that considers human tree perceptions and preferences may increase residential satisfaction and strengthen the positive physical and psychological effects of trees in urban environments. Similar to respondents from South Bronx, New York, who agreed that more trees were needed in their neighbourhood (Broussard-Allred et al., 2010), most respondents in this study were dissatisfied with the low number of trees on their streets and suggested more vigorous tree planting. The dissatisfaction with the number of street trees among township and RDP suburbs residents comes as no surprise as these suburbs have very few to no street trees compared to the affluent suburbs (Gwedla & Shackleton, 2017; Kuruneri-Chitepo & Shackleton, 2011), as well as less green space (McConnachie & Shackleton, 2010).

Martínez, Shirt, and Ortíz (2015) found that residents from the richer neighbourhoods in Cali, Colombia, were more satisfied with public space in their neighbourhoods compared to those from the poorer neighbourhoods, corresponding to the results of this study. Qin, Zhou, Sun, Leng, and Lian (2013) suggested that people are more satisfied by attractive natural environments, as observed where overall satisfaction by respondents was highest in a more vegetated and colourful garden. Most of the respondents in this study who showed satisfaction with the general appearance of their streets did so because they have many trees, and were mostly from the affluent suburbs. Most people generally prefer environments that have trees more than those dominated by inanimate objects (Lo, Byrne, & Jim, 2017). Lovejoy et al. (2010) found that northern Californian residents' perceptions of the attractive appearance and safety of their neighbourhoods were the most important predictors of neighbourhood satisfaction.

Overall, the results of this study in relation to residents' satisfaction do not corroborate those by Jorgensen, Hitchmough, and Dunnett (2007) in Warrington New Town, UK. They reported that "Birchwood respondents appeared to be very satisfied with the landscapes of their residential streets, although they had powerful positive and negative attitudes towards the tree and shrub planting used by the designers to structure and decorate spaces on the street". The results of our study suggest that on average, residents across all suburb types were dissatisfied with both the general appearance of their street and the number of trees on them. Despite these differences, neither of these two studies were outliers because Birchwood residents responded to satisfaction with the appearance of a landscape that is already mostly surrounded by trees and shrubs, and no apparent concerns with neighbourhood infrastructure. Residents in our study, on the other hand, were basing their satisfaction on landscapes that hardly had any trees or shrubs present, coupled with the evident infrastructural backlogs, especially in the less affluent areas. This was evidenced by the common reasons for dissatisfaction with the general appearance of streets given by residents from the township and RDP suburbs (less affluent) compared to those popular among residents from the more affluent suburbs. Furthermore, the developmental contexts (developing and developed) and socio-economic differences between both of these study regions can account for these different perceptions as developmental priorities differ between these two regions. Regardless of this general dissatisfaction, these results support the hypothesis that the more affluent suburbs exhibited more satisfaction than the poorer ones.

4.1.3. Preferences for the location and distribution of existing and new tree plantings

While residents have positive perceptions about urban trees predominantly because of their benefits (Shackleton et al., 2015), they have varying preferences of where they would most like to have trees planted. Preferences are usually based on how people perceive the environment around them (Zhang et al., 2010), and peoples' preferences regarding the landscape surrounding them are an important part in the assessment of landscape quality (Poudyal, Hodges, Tonn, & Cho, 2009). Tree location is a key element in landscape design (Wu, Xiao, & McPherson, 2008). Most respondents in this study reported preference for trees to be planted both on the street and in their yards. This highlights that they are aware of the "multi-functionality of trees in urban landscapes with varying uses, benefits and values attached to them, depending on whether they are in public or private space" (Shackleton et al., 2015). This preference corroborates Zhang and Zheng (2011) who concluded that "people like to have trees on their property and in the community, an observation that is not based on their gender, age, race, income, and family background". Our results also support that preferences for the location of planted trees were in the most part not based on gender or age.

In their preferences for tree location, respondents in this study demonstrated inclination towards a location that would promote maximum benefits, such as shade and fruit provision, beautification and wind buffering; and one that would support the protection of trees. These findings also resonate those of Camacho-Cervantes, Schondube, Castillo, and MacGregor-Fors (2014), who found that most residents in the city of Morelia, Mexico, thought there should be trees near their houses and in green areas because there would be "more oxygen". Other reasons (shade) were also reported by Ng et al. (2015), who reported that > 80% of respondents surveyed in Hong Kong favoured trees because they could provide shade.

Mullaney et al. (2015) also alluded to this preference, noting that "high importance is placed by residents on the aesthetic and practical attributes of street trees such as beautification, shade provision, increased property values, added privacy and noise reduction". Locally, Richardson and Shackleton (2014) found that approximately 80% of respondents from Grahamstown and Adelaide preferred to have trees along their street because they thought that street trees added value to the neighbourhood. The findings of this current study do not corroborate these findings as respondents hardly made any reference to the value of neighbourhoods or any related characteristics. This could be attributed to the differences in which the questions regarding preferences for tree planting locations were phrased, or the contexts of sampling locations. Richardson and Shackleton (2014) sampled households in close proximity with newly planted street trees in the broader urban areas, while this study sampled households from different suburbs with differing socio-economic attributes.

Similar to Shackleton et al. (2015), respondents from the RDP suburbs were more appreciative of the regulating and provisioning services of trees, which could account for why they would prefer that trees be planted in their yards. On the contrary, Alvio et al. (2015) reported that wealthier residents and those located at higher elevations thought trees were more important in their yard than residents at lower elevations and with lower income. This was not apparent in our study, as the majority of respondents who preferred trees for their yards more were those from the low income RDP suburbs and the township suburbs.

The preference for trees to be planted only in the yards was also apparent in this study. This preference was mostly associated with the idea that the trees would be vandalised on the streets and criminals would hide behind them. There is evidence to support that streets trees are more prone to vandalism than those in private yards (Pauleit et al., 2002). Richardson and Shackleton (2014) assessed the extent of vandalism of street trees across seven small towns in South Africa, and people and livestock were identified as the major agents of this vandalism. As such, the reservation for tree planting on the street is plausible.

There have been contrasting schools of thought in studies on the relationship between crime and urban trees (Shackleton et al., 2015). While some studies indicate increased incidences of crime due to urban trees (i.e. Sreetheran & Konijnendijk van Den Bosch, 2014), others show that tree planting could be used as a crime-prevention measure (Kondo, Han, Donovan, & MacDonald, 2017). Respondents in this study mentioned a fear of criminal activity in their preference for trees not to be planted on the street. This is a crucial consideration, considering the high crime rates in South Africa (Grabrucker & Grimm, 2018). This concurs with findings by Pincetl (2010) that "residents in areas with high criminal activity often do not want trees planted in front of their properties as they fear that criminals will be able to hide in the trees.

Overall, the alignment between the perceived importance of urban trees and the preferences for the location of planted trees suggests a direct link with what people hope to get from trees. Respondents in this study associated their perception on the importance of trees with the benefits they get from trees, and their preferences for location was largely influenced by the benefits and disservices associated with urban trees.

5. Conclusion

The purpose of this study was to examine the perceptions of residents on the importance of urban trees across different suburb types, within multiple towns with differing socio-economic contexts within the urban settings of South Africa. Most respondents had positive perceptions about urban trees and attach a great deal of importance to these elements of the urban ecosystem, regardless of the socio-economic context in which they live. However, intrinsic details in the results support our hypothesis that residents from the wealthier towns, and more affluent suburbs recognise the importance of street trees more than those from poorer towns, and suburbs. The benefits of urban trees are the main drivers of the positive perceptions about trees, as evidenced by the various benefits mentioned by respondents in this study. While no correlation was established between residents' satisfaction with the number of trees on their streets and the affluence of both their towns and suburb types, people recognise the absence of trees in their neighbourhoods, and attribute a lot of their dissatisfaction with the current appearance of their street to its infrastructural and physical condition, as well as the absence of attractiveness in the form of trees and green spaces. Most people generally prefer to be surrounded by trees or any form of nature, as expressed by respondents in this study, most of whom would prefer to have trees planted both on the street and in their private yards. While the socio-economic, developmental, political and governance contexts in which this study was undertaken may be unique to South Africa, the results in this study can be applied broadly as they accommodate perspectives from groups with different developmental priorities at micro-scale, and are comparable to others that have been conducted elsewhere. Recognising and incorporating residents' perceptions and preferences of urban greening into any plans and strategies towards urban forest establishment and management is crucial for identifying key priorities for improving urban forest structure and distribution, which are useful in efforts to reduce disparities in urban tree distribution. This strategy also has the potential to cater for user needs and thus encourage residents to use, protect and be stewards of the urban green infrastructure surrounding them, in line with their preferences.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.landurbplan.2019.05.001.

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