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INVESTIGATION OF THE PLANT SPECIES DIVERSITY, DENSITY, ABUNDANCE AND DISTRIBUTION IN GRAHAMSTOWN, SOUTH AFRICA

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ABSTRACT

The plant species play very important role as they are not just planted to make the streets look beautiful but are a vital part of the ecosystem. They are a major source of the oxygen, help control, stabilise the climate and feed animals. The choice of planting alien trees instead of indigenous trees on the street was a big mistake. Therefore there is a need to pay attention on it now that there is high growth of urbanisation. This research has the primary objectives to investigate the plant species diversity, density, abundance and distribution in the Grahams town streets and identify the key challenges faced by local forestry officials concerned with the provision of street trees. Streets were randomly sampled in the Grahams town area. A total of 1467 plants were sighted in 17 streets comprising of only 15 indigenous species and 20 alien species. This means the 57% of trees were alien species and only 43% of the trees were indigenous. Significant differences in tree density and species richness were evident across suburbs (Grahamstown West), differences being more significantly different in the more affluent suburbs and poorly represented in the township (Grahamstown East area).

Keywords: Plant species diversity, abundance and distribution

INTRODUCTION

Street trees provide critical ecosystem services which contribute to human health and environmental quality (Kuruneri-Chitepo and Shackleton, 2011). From an aesthetic perspective, tree-lined streets are frequently regarded as important in providing "visual relief in concretized city settings" (Nagendra and Gopal, 2010). Street trees are also beneficial to street vendors through the provision of shade and thereby some protection from the sun and rain (Nagendra and Gopal, 2010). Urban landscapes planted with trees can minimize many of the environmental impacts of urban growth by improving the chemical and physical environment: moderating urban heat; improving urban hydrology and air quality; reducing noise levels and the energy requirements of the city (Pauleit and Duhme, 2000; Fang and Ling, 2005; Konijnendijk*et al.*, 2005).

Trees in the urban context can increase biodiversity and afford numerous other benefits of an aesthetic, psychological and socio-economic nature (Schoeder and Cannon, 1983; Ulrich, 1985; Kaplan and Kaplan, 1989; Huang *et al.*, 1992; Kaplan, 1992; McPherson *et al.*, 1994; Sullivan and Kuo, 1996; Wolf, 1999; Nowak, 2001).There has been an argument that securing the biodiversity, ecological, social and economic benefits offered by street trees is particularly challenging in developing countries because of rapid development and urbanization (Jim and Chen,2009). Plant species diversity, abundance and distribution of street trees in the Grahams town area were investigated as an important step towards plant conservation in the Grahams town area.

METHODOLOGY

Sampling method

The stratified random sampling method was used to select the streets sampled in the research. Data was generated by physically counting and recording plant species in the selected streets. Unknown species were assigned an interim name and a specimen collected and photograph taken

for later identification at the Selmar Schonland herbarium (GRA, Grahamstown). Names of indigenous species follow Germishuizen *et al.* (2006) and alien species follow Glen (2002). Total number of each plant species gives the frequency distribution of plant species counted from all 17 sampled streets. The probability in percentage tells the chances of getting the plant species in sampled Grahamstown streets. It was done by dividing the frequency of occurrence of tree species on all the streets by the overall number of trees on all the streets and multiply by 100 which is percentage occurrence of the species in the entire study area.

The surface area of Grahamstown composed of central business district (CBD) and residential area which is called Grahams town west and the township and Reconstruction and Development Program (RDP) area is called Grahams town east. The sampling was carried out over three months periods (October, November and December because most of these street plants then bore flowers and that made it easier to correctly identify them.

The research study area

This study was conducted in Grahamstown area of Makana Municipality in the Eastern Cape, South Africa. Grahams town is located at -33.3042 [latitude in decimal degrees], 26.5328 [longitude in decimal degrees] at an elevation/altitude of meters. The average elevation of Grahamstown, South Africa is 507 meters. According to Stats SA (2011) the population of the Makana Municipality is 80390 of which 62702 were black, 9725coloured, 6974 white, 525 Asian and other group 464. There are clear socio-economic demarcations (Grahams town West and Grahams town East), which are the result of South Africa's apartheid past.

Analysis of results in table 1

Table1 above has a total of 1467 trees 35 plant species recorded from 17 streets Grahamstown area. It is comprised of only 15 indigenous species and 20 alien plant species. This means 57% of trees were alien species and only 43% of trees were indigenous.

Analysis of results in plates 1 and 2

Plate 1 shows the residential area which is dominantly occupied by whites and some very few blacks due to its socio economic high standards and there are more trees compared to plate 2 which is the residential area occupied by blacks. Plate 1 show pictures of schools and the play grounds where some of the school buildings could hardly be seen but trees and play grounds with children play freely no animals around them. These play grounds are surrounded by green trees which provide shade and conducive environment for the spectators. Plates 2 show pictures residential area, schools and play grounds with no trees and there are children with animals in play grounds which look less conducive.

RESULTS

Table 1: Sighted plant species in sampled streets with alien species marked by *

Nanes of Plants	Bathurst street	Hill street	Lawrence street	Prince Alfred street	West street	Chase street	High street	Milner street	Somerset street	New street	African street	Allen street	Market street	Donkin street	Beaufort street	Drosdy street	Artilery street	Total frequency of each tree	Probability (%)
*Brachychiton populneum**	0	0	0	0	5	0	11	0	3	0	0	0	0	0	0	0	0	19	1.3%
*Callistemon rigidus**	0	0	0	0	0	0	0	0	5	0	2	0	0	0	0	0	0	7	0.5%
Calodendron capensis	2	0	0	0	0	0	11	0	1	0	0	0	1	0	3	0	1	19	1.3%
Celtis africana	0	0	2	9	0	0	43	0	3	6	2	0	13	3	16	32	13	142	9.7%
*Cordylineaustralis**	0	32	12	0	0	0	0	0	0	0	10	0	0	0	0	0	8	62	4.2%
Dais cotinifolia	0	0	3	3	0	0	0	1	2	0	0	0	0	0	0	4	0	13	0.9%
Ekebergia capensis	0	0	0	0	0	0	5	2	2	2	0	0	2	0	12	1	4	30	2.0%
Encephalartos attenteinii	4	0	1	8	0	0	15	6	4	0	4	0	2	0	0	0	0	44	3.0%
Erythrina caffra	0	11	1	27	0	0	7	2	2	0	1	0	6	1	3	5	0	66	4.5%
Eucalyptus sp.*	6	13	0	0	0	0	10	24	0	1	0	0	0	0	58	0	1	113	7.7%
*Ficus macrophylla**	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	6	0.4%
Gardenia thunbergii	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0.2%
*Grevillea robusta**	29	47	0	0	1	0	0	0	2	0	1	0	27	45	12	0	0	164	11.2%
Harpephyllum cafram	0	16	4	11	0	2	0	1	22	0	0	0	3	1	0	9	0	69	4.7%
*Jacaranda mimosifolia**	17	21	3	4	1	4	1	17	31	5	4	17	20	16	14	1	35	211	14.4%
*Melia azerdarach**	0	11	1	0	0	0	0	2	1	0	2	0	5	0	0	0	0	22	1.5%
Olea europaea	0	0	0	0	0	0	2	0	0	0	0	0	1	0	0	0	0	3	0.2%
Phoenix reclinata	0	4	0	0	0	0	0	0	0	0	3	0	0	0	0	0	2	9	0.6%
Pinus sp.*	0	8	0	9	0	0	7	4	12	0	3	0	15	0	6	0	0	64	4.4%
*Platanus occidentalis**	2	12	1	0	2	0	2	0	0	0	0	0	0	0	0	0	0	19	1.3%
Podocarpus sp.	0	2	2	13	0	0	0	0	0	0	0	0	2	0	0	10	4	33	2.2%
Ptaeroxylon obliquum	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	2	4	9	0.6%
*Pyracantha coccinea**	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	2	0.1%
*Quercus coccinea**	0	0	1	0	0	0	0	0	0	2	0	0	0	0	0	0	0	3	0.2%
*Quercus nigra**	0	0	0	0	0	0	0	0	0	9	0	0	0	0	0	0	0	9	0.6%
*Quercus robur**	6	13	4	17	0	1	11	12	40	5	4	0	19	2	4	0	0	138	9.4%
Rauvolfia caffra	0	0	0	3	0	0	0	0	0	0	1	0	0	0	0	0	0	4	0.3%
*Schinus molle**	0	0	3	0	0	1	0	0	0	0	0	0	0	0	0	0	0	4	0.3%
*Schinus terebinthifolius**	0	2	1	1	0	0	0	0	0	0	18	0	18	0	0	0	0	40	2.7%
*Senna didymobotrya**	0	2	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	4	0.3%
*Sterculia acerifolia**	9	25	0	10	4	0	21	3	22	4	0	0	1	0	0	0	0	99	6.8%
*Tecoma stans**	2	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	6	0.4%
*Tipuana tipu**	0	0	0	7	0	0	0	0	0	0	0	0	2	0	0	0	0	9	0.6%
Trichilia emetica	0	0	0	14	0	0	0	0	0	0	0	0	2	0	0	0	0	16	1.1%
Vepris undulata	0	0	1	0	0	0	0	0	0	0	0	0	0	5	0	0	0	6	0.4%
Total no. of trees per street	77	219	40	139	13	8	152	74	156	34	60	17	141	73	128	64	72	1467	100%

Plate 1:

a) Residential area in the Grahamstown West

b) School buildings in the Grahamstown West

c) Play grounds in the Grahamstown West

Plate 2:
a) Residential area in the Grahamstown East
b) School buildings in the Grahamstown East
c) Play grounds in the Grahamstown East

DISCUSSION

There are other streets that have diverse tree species as they have different distribution of plant species. This provides forage for a variety of insect and vertebral species and promote biodiversity. In a mixture there are some plants that can survive drought, insect plagues, and disease outbreaks so that the site will have some soil protection. It also contains a variety of genetic material that may be useful in long-term survival. The lack of diversity of tree species in some other streets (such as Allen Street) is a warring factor because tree pests and diseases tend to be selective, a landscape with a variety of species will typically suffer fewer losses when an outbreak does occur. Some other tree species have high percentage of abundance in the streets of Grahamstown area and enjoy high level of distribution for example *Jacaranda mimosifolia.*

Street trees play a vital role in the enhancement of human well-being given the social benefits and recreational opportunities they offer for inhabitants (Tyrväinen*et al*., 2005). Trees increase the value of houses that are in close proximity (Georgi and Dimitriou, 2010).Biodiversity enables people to interact with nature, thereby enhancing appreciation and understanding of the important ecological, social and psychological functions green areas perform (Kuruneri-Chitepo and Shackleton, 2011). Therefore lack of trees in the streets, school grounds and residential area of Grahamstown east has compromised the quality and denied them this opportunity.

The idea of planting trees is good for the environment but planting such a high number of alien trees does not encourage biodiversity preservation. According to table1 there are more alien plant species than indigenous plant species in Grahamstown streets. Invasive plants are a problem because they alter the invaded ecosystem and species composition to such an extent that they threaten native flora and fauna. There are ways in which biological invasions alter ecosystems according to D'Antonio and Vitousek (1992). Invasive alien plants alter rates of resource supply, trophic level relationships, and the disturbance regime.

The introduction and subsequent use of alien tree species in South Africa has negative impacts and South Africa is the worst affected by alien tree species (Nyoka, 2002). Unfortunately alien tree species are in almost every street in Grahamstown area and they outnumber the indigenous trees. Literature review revealed that similar results were observed in Leicester, a large city in the East Midlands which was one of the first LAs to adopt a city-wide ecology strategy (Moughtin and Shirley, 2005). These also tended to emphasise the value of indigenous species of trees and shrubs and advocate the limitation of aliens.

CONCLUSION

These human-induced alien trees need to be minimised to maintain the ecological diversity and balance. Some of these alien trees are invasive plants and compete with native plants for resources, thereby becoming dominant. More importantly they can out-compete plants that are

food supplies for animals in the ecosystem. This may result in animals depending on non-native plants for food or, if they are specialists, losing their food source entirely. Invasive plants normally lack predators and may more easily out-compete natives with their natural predators.

Grahamstown East like any South Africa's black township is the direct product of apartheid. Even the RDP built houses that provide shelter to most previously disadvantages people cannot bridge the gap between whites and blacks. The socio economic imbalances need no introduction. In fact they create an environment that is very hard, challenging and almost not possible in Grahams town East to effectively educate the community about plant conservation without addressing socio economic issues. Stoffberg *et al*. (2008) and Stoffberg *et al.* (2010) complained of limited literature on greening especially urban forestry greening including street trees. Lubbe *et al*. (2010) blamed the legacy of the colonial and apartheid era under which land ownership and occupation was racially segregated (McConnachie and Shackleton, 2010). The fact that in Grahams town there is Grahamstown West which is dominantly white and Grahamstown East which is dominantly black confirms that during apartheid era black Africans were restricted to living in racially defined suburbs locally termed 'townships' (Wilkinson, 1998), which were poorly serviced.

Recommendations

There is a need for initiatives to protect indigenous plant species and habitats since it has become clear that the introduced alien plant species can lead to diminishing biodiversity. There is also a need to develop a basic re-vegetation, rehabilitation and landscaping plan with comment on the most suitable species and approach to landscape.

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