South .Afr. J. Educ. Sci. Technol.2(2) (2007)

# Vegetation diversity as an indicator of human social diversity and economic inequality in Bindura mining town, Zimbabwe

http://dx.doi.org/10.4314/sajest.v2i2.39817

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**Abstract**

An assessment of planted vegetation in the residential suburbs of the mining town of Bindura was carried out to determine socio-economic variations of urban dwellers. The suburbs were categorized into low, medium, pre-independence and post-independence high-density. Spaces not covered by buildings in all the residential areas were studied at 5% sampling intensity with special attention on origin, purpose and frequency of species occurrence. Data were analysed using Univariate Analysis of Variance using SPSS 10.0 with descriptive statistics and post hoc tests. Results indicated a significant ($p<0.01$) preference for exotic species in comparison to indigenous species across the suburbs. There was a higher preference ($p<0.01$) for ornamental trees in low-density suburbs compared to fruit trees and ornamental shrubs whereas the high- and medium density suburb residents preferred fruit trees. The skew in vegetation preference from ornamentals to fruits and fruits to ornamentals in the low density and high-density residential suburbs respectively, explains a significant variation in socio-economic classes of the urban dwellers. The medium density residential areas mimic the high-density trend in most aspects as a result of cultural transfer.

**Key words:** residential suburb, species preference, socio-economic class, vegetation diversity.

## Introduction

The planting of vegetation in urban residential suburbs plays aesthetic, recreational, economic, environment and nutrition supplement roles (Dwyer, Schroeder; and Gobster, 1991; Braatz and Kuchelmeister, 1993). Urban vegetation impinges upon the physical environment by positively enhancing the micro-climate, and water quality (Emmanuel, 1997). Urban homesteads demarcate the available open spaces into vegetable gardens, orchards as well as flower gardens with scattered trees, which can either be ornamental or fruit. Vegetable gardens and fruit trees significantly contribute towards household income for a number of families. In addition to their aesthetic value, lawns and low-growing plant species prevent soil erosion.

In a different dimension, the unequal distribution of wealth in cities contributes to spatial, social and biological inequities in complex, interacting and self-reinforcing ways (Melles, 2005). Spatial variation in urban plant communities may reflect socio-economic variables and cultural differences among the human population. The physical environments as well as the socio-economic conditions of urban dwellers affect the distribution, population, health and diversity of vegetation (Emmanuel, 1997).In African towns, vegetation can be used as an indicator of cultural and social diversity manifested through preference, distribution and composition of species. The selection and establishment of trees and shrubs in residential suburbs does not strictly follow urban forestry standards, policy and institutional framework but individual household needs and preferences. To have a greater influence on urban planning and policy, human socio-economic factors must be integrated into investigations of diversity in urban areas (Dow, 2000; Grimm, Grove, Pickett and Redman, 2001).

In the past, ecologists paid little attention to urban ecosystems and focused mainly on pristine ones (Blair, 2004; Jules, 1997). Recent studies by avian ecologists have indicated the possibility of studying bird community patterns to establish human social diversity and economic inequality (Hostetler, 2001). Urban vegetational changes have as well been used to monitor urban social and demographic changes (Emmanuel, 1997). In the same context, this study aimed at establishing the historical development and social classes of the mining town through the analysis of vegetation population, diversity and distribution.

## Materials and Methods

### Description of the Study Area and Research Design

The study was carried out in the residential suburbs of the mining town of Bindura, 86km north of Harare in the Mazoe valley (1718S, 3120E). During the pre-independence period the town was characterised by low-density and high-density residential suburbs with the absence of a medium density suburbs. The sampled residential suburbs are shown in table 1.

Table 1: Description of residential suburbs

| Suburb Category | Description | Sampled suburbs | Year of Establishment |
|---|---|---|---|
| Low density | Single houses covering 3000 $m^2$ Available space for vegetation planting 3447.83 $m^2$. | Shashi Greenhill Hay | 1934 |
| Medium density | Single houses covering 1300 $m^2$. Available space for vegetation planting 687.83 $m^2$. | Aerodrome Chipindura | 1990 |
| Pre-independence High density | Single and semi -detached houses covering 300$m^2$. Available space for vegetation planting 145 $m^2$. | Chipadze | 1934 |
| Post-independence High density | Single and semi -detached houses covering 300$m^2$. Available space for vegetation planting 90 $m^2$ | Chiwaridzo | 1989 |

The residential suburbs were categorized into low, medium, pre-independence and post-independence high-density suburbs. A survey of tree and shrub composition and distribution was conducted through ground sampling. Planted trees and shrubs on spaces not covered by buildings were randomly selected at 5% sampling intensity (62 households for the low density, 40 for the medium, 113 for the pre-independence and 32 for the post independence residential suburbs), enumerated and categorized by origin (exotic or indigenous), ornamental or fruit. Species diversity and individual plant population were determined for each suburb and data expressed per hectare.

**Data Analysis**

The data were subjected to univariate analysis of variance as well as post-hoc tests to compare differences between observed means using a statistical package SPSS 10.0 for windows.

**Results**

A total of 43 species were represented in Bindura residential areas adding up to 1647 plants in the sampled area. Of the 43 species 5 were indigenous and the rest were exotics. Ornamental tree species represented across suburbs are shown in Fig. 1.

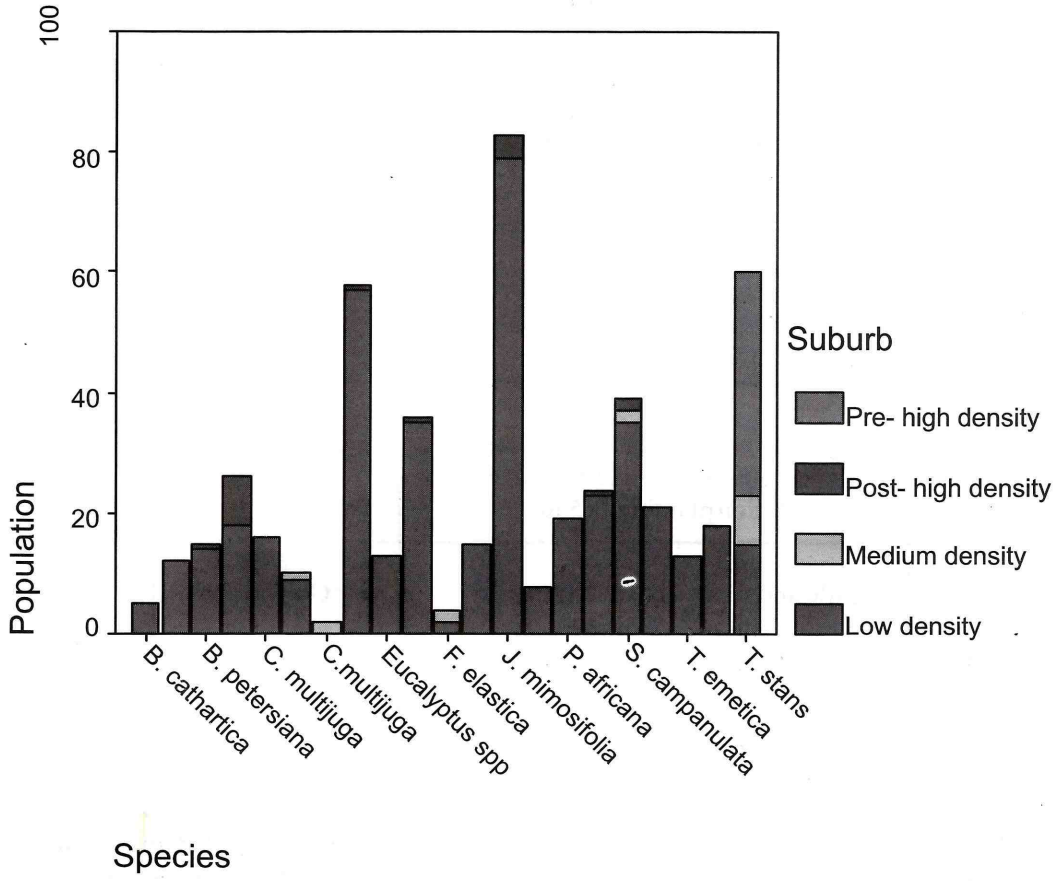


Fig. 1. Ornamental tree species across strata.

The low-density suburb had the highest species diversity comprising *Bridelia cathartica, Bauhinia galpinii, Terminalia sericea, Peltophorum africana* and *Trichillia emetica,* which are indigenous, and *Grevillea robusta, Eucalyptus spp, Juniperus spp* and *Schinus terebinthifolia* as exotics. *Spathodea campanulata* was commonly grown in low, medium and post-independence high-density suburbs whereas *Tecoma stans* was found in low, medium

In the medium and low-density suburbs, *Cassia multijuga, Callistemon viminalis* and *Ficus elastica,* which are all exotics, were preferred. Common exotic species in the low and post-independence high-density suburbs were *Delonix regia, Plumeria rubra, Jacarand mimosifolia, Casuarina cunninghamiana* and *Fraxinus americana* whereas *Bauhinia petersiana* was the only indigenous species. Ornamental shrub and fruit tree species across the suburbs are shown in Figs. 2 and 3 respectively.

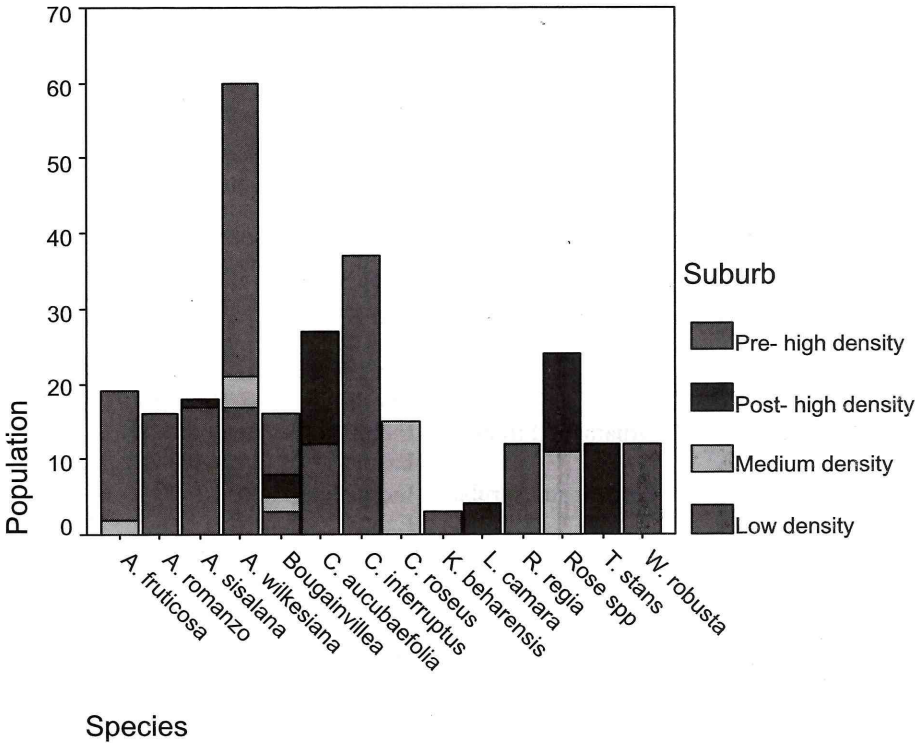


Fig. 2. Ornamental Shrub species across strata

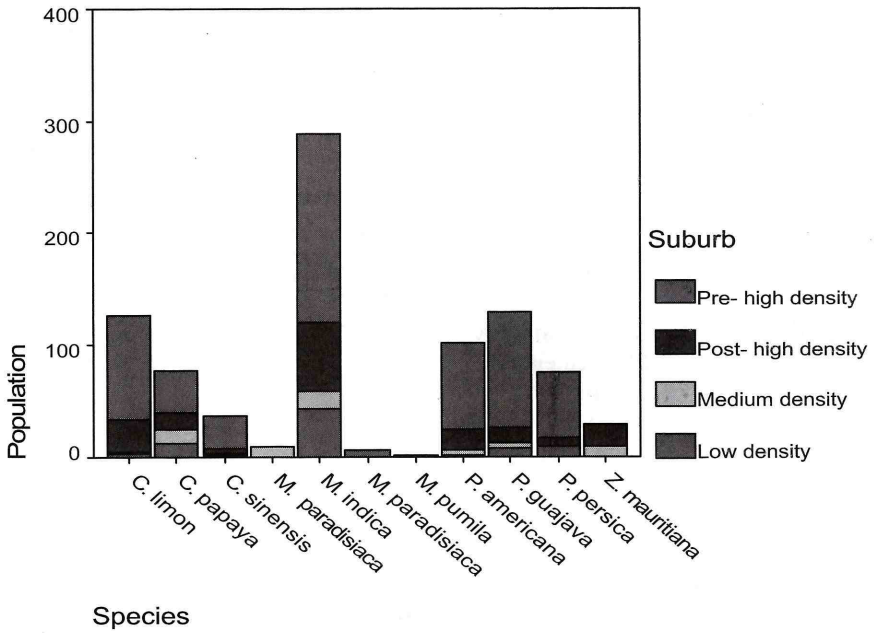


Fig. 3. Fruit tree species across strata

Variation in vegetation type, origin, species diversity and population density across the strata is shown in table 2.

Table 2: Vegetation distribution and composition by plant category.

| **Stratum** | **Vegetation type** | **Origi** | **Species diversity** | **Mean plant population/Ha ± SE** |
|---|---|---|---|---|
| Low Density | Ornamental trees | Indigenous | 5 | 3.18±0.13 |
| | | Exotic | 15 | 16.79±0.16 |
| | Ornamental shrubs | Indigenous | 0 | 0 |
| | | Exotic | 9 | 6.03±0.10 |
| | Fruit trees | Indigenous | 0 | 0 |
| | | Exotic | 8 | 3.98±0.16 |
| Medium Density | Ornamental trees | Indigenous | 0 | 0 |
| | | Exotic | 5 | 7.78±0.55 |
| | Ornamental shrubs | Indigenous | 0 | 0 |
| | | Exotic | 5 | 17.64±2.02 |
| | Fruit trees | Indigenous | 0 | 0 |
| | | Exotic | 10 | 31.64±1.64 |
| Pre-Independence High Density | Ornamental trees | Indigenous | 0 | 0 |
| | | Exotic | 1 | 22.58±1.36 |
| | Ornamental shrubs | Indigenous | 0 | 0 |
| | | Exotic | 3 | 39.06±1.43 |
| | Fruit trees | Indigenous | 0 | 0 |
| | | Exotic | 7 | 344.83±4.29 |
| Post-Independence High density | Ornamental trees | Indigenous | 1 | 2.76±1.24 |
| | | Exotic | 6 | 47.01±8.06 |
| | Ornamental shrubs | Indigenous | 0 | 0 |
| | | Exotic | 6 | 132.74±4.71 |
| | Fruit trees | Indigenous | 0 | 0 |
| | | Exotic | 8 | 486.72±13.415 |
| Significance | Suburb category | | | ** |
| | Plant category | | | ** |
| | Origin | | | ** |
| | Species | | | ** |
| | Plant population | | | ** |

** denotes significant difference at $p<0.01$

A comparison of the means of the exotic and indigenous species representation showed significant difference (P=0.001) both within and across the residential sites. For all the

plant categories, there was a significant difference ($P<0.01$) in number of plants per hectare across all residential areas except for ornamental trees that had no significant ($P>0.01$) difference in plant population between the low and high-density suburbs.

The low-density suburb had a significantly higher ($P=0.001$) representation of ornamental trees than ornamental shrubs and fruit trees. The medium density, pre- and post-independence high-density suburbs had more ($P=0.001$) fruit tree populations than ornamental trees and shrubs. However, there was no significant ($P>0.01$) difference in preference between ornamental trees and ornamental shrubs

**Discussion**

Vegetation species and population diversity in urban set-ups indicate variations in culture, demography and socio-economic status of the residents (Emmanuel, 1997). Urban residential sites in a number of models for instance Hoyt, 1939, Ullmann and Harris, 1945, and Mann, 1965 (cited in Waugh, 1995) stratify residential areas into low, medium and high-income where the facilities made available to the inhabitants differ depending upon affordability. Normally the low-income earners have cheap communal social facilities whereas the high-income earners tend to have individual ownership. High-density residential areas established as service quarters for the high-income earners as well as general workers for the mines and other industries characterise the urban poor. Differences in income levels give rise to perception and time value variability within society leading to diverse vegetation preferences by the social classes (Henderson and Musil, 1984).

Vegetation diversity as shown by species and population variability indicates that the low-density residential sites have higher species diversity represented mostly by ornamental trees than fruits and ornamental shrubs. This results from the individual attention to each plant that can be afforded by the high-income earners. The emphasis on ornamentals signifies their need for relaxation at home (Dwyer et al., 1991). Fruit tree species diversity is higher even though the populations are lower indicating that this class does not grow the fruits for income generation but mostly as a hobby, since they can afford to purchase quality fruit from specialised producers.

On the other hand fruit tree species diversity is lower in the high-density residential sites due to problems associated with individual tree maintenance. Ornamental tree and shrub plantings are limited by the available space and utilitarian priority to fruit trees (Profous and Rowntree, 1987; FAO, 1990). The low-income earners supplement their income through the sale of fruits, which also make a significant component of their diet (Henderson and Musil, 1984). Low-income earners only plant fruit trees that are less demanding in terms of management. High density suburb dwellers, the extreme end of the socio-economic gradient, have lower levels of involvement in tree planting and community green-up efforts than better-off citizens probably because they are more concerned with the immediate issues of day to day survival (Melles, 2005). The lack of variation in fruit trees between the medium density and high-density residential sites shows a culture of income and dietary supplementing, transferred from the high density areas by middle class earners who had the opportunity of moving to the newly established medium density areas after independence.

In all cases, exotics were more represented than indigenous species. Indigenous tree species are normally not planted, as they are difficult to raise. They also have a slower growth rate and do not yield immediate benefits (Kadzere and Jackson, 1997). Most species quickly give in to harsh urban environmental conditions (Bernatzky, 1978). However, indigenous trees in urban centers can result in increased numbers of native birds in the area, many birds and other fauna are adapted to using native trees and prefer to feed and rest in these plants. Indigenous vegetation plays a vital role in supporting biodiversity and ecosystem function (Niemela, 2004). The plantings should represent an appropriate range of species in order to create as natural an ecosystem as possible and to avoid the replacement of a heterogeneous multispecies community, with a monotonous single species community, as is the case in most urban settings (Kaplan and Ryan, 1998). In the low-density suburbs where land is available, the planting of indigenous species could have been possible but the process of urbanization endangers species by directly replacing native habitats with exotics (Czech, Krausman and Devers, 2000). However exotic vegetation preferences of mostly the formerly European inhabited low-density residential suburbs showed a cultural attachment to their countries of origin thereby trying to recreate a similar environment.

## Conclusion

The study indicates that urban vegetation distribution and diversity could be a valid proxy for social classes in cities. The skew in vegetation preference from ornamentals to fruits and fruits to ornamentals in the low density and high-density residential suburbs respectively, explains a significant variation in socio-economic classes of the urban dwellers. The medium density residential areas in most cases mimic the high-density trend resulting from cultural transfer.

**References**

Bernatzky A. 1978. Tree ecology and preservation. Elsevier Scientific Publications, Amsterdam.

Blair R. 2004. The effects of urban sprawl on birds at multiple levels of biological organisation. Ecology and Society 9: 5.

Braatz S. and Kuchelmeister G. 1993. Urban forestry. Unasyvla 173 (44): 13-18

Czech B, Krausman PR and Devers PK. 2000. Economic associations among causes of species endangerment in the United States. Bioscience 50: 593-601

Dow, K. 2000. Social dimensions of gradients in urban ecosystems. Urban Ecosystems 4: 255-275.

Dwyer, J.F, Schroeder, H.W and Gobster, P.H. 1991. The Significance of Urban trees and Forests: Towards a deeper understanding of values. J. Arboriculture 17 (10): 276-284

Emmanuel, R. 1997. Urban vegetational change as an indicator of demographic trends in cities: The case of Detroit. Environment and Planning 24: 415-426.

FAO. 1990.Urban and peri-urban forestry. Forestry Department, Rome. Italy.

Grimm, N. B, Grove, , J. M, Pickett, S. T. A and Redman, C. L. 2001. Integrated approaches to long-term studies of urban ecological systems. BioScience 50:571-584.

Henderson, L and Musil, K.J. 1984. Exotic Woody Plant Invaders of the Transvaal. Bothalia 15(2): 297-313.

Hostetler, M. 2001. The importance of multi-scale analyses in avian habitat selection studies in urban environments. Avian ecology in an urbanising world 139-154.

Jules, E.S. 1997. Dangers in dividing conservation biology and agroecology. Conservation Biology 11: 1272-1273.

Kadzere, I and Jackson, J.E. 1997. Indigenous fruit trees and fruits in Zimbabwe: Some preliminary results from a survey in 1993-94. University of Zimbabwe publications. Zimbabwe p. 61-66.

Kaplan, R.S and Ryan, R.L. 1998. With people in mind: design and management of every day nature. Island Press, Washington

Melles, S.J. 2005. Urban bird diversity as an indicator of human diversity and economic inequality in Vancouver, British Columbia. Urban habitats 3: 25-40.

Niemela, J. 2004. Ecology and Urban Planning (Ecoplan). Department of Ecology and systematics. Helsinki , Finland.

Profous, G and Rowntree, R. 1987. Structure and management of the urban forest in Prague, Czechoslovakia. New York, North Eastern Forest Experiment Station, USDA.

Waugh, D. 1995. Geography. An integrated approach. Second edition. Thomas Nelson and Sons Ltd, Victoria Australia 387-391