Re-growth of vegetation, colour and landscape complexity: the role of design in the interpretation of natural systems in botanical gardens.

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Abstract

This paper addresses the question of how visitors' interpretation of ecosystems can be maximized based on the design of plant displays. Responses to natural landscapes were studied at the Royal Botanic Gardens Cranbourne, Australia, where fire is used to conserve remnants of indigenous ecosystems. People's preferences for, and verbal descriptions, of these landscapes were subjected to content and statistical analysis which found that three key features influence people's perceptions the most. These are the *re-growth of vegetation*, *colour* and *landscape complexity*. Results suggest a series of design strategies for improving visitors' interpretation of the processes associated with the various stages of ecological landscape change. Findings also suggest the need of integrating notions of scenic and ecological aesthetics into the display of natural systems displays.

Keywords

Botanical Gardens, Fire, Landscape design, Landscape Perception, Plant Displays

Introduction

This study was aimed at exploring visitors' experience of plant exhibits displayed in botanical gardens and their effects on environmental interpretation. A review of plant displays from over 25 botanical gardens around the world which focused on the conservation of biodiversity revealed that botanical gardens are exhibiting new types of plant displays (Villagra, in press). Plant displays were observed as being re-shaped due to a desire to improve the conservation of biodiversity and develop more positive educational experiences and people-plants relationships (Monem, 2007; Oldfield, 2007). While some botanical gardens are introducing artificial objects, such as local materials and features in their exhibits to increase people's familiarity and engagement with plants, others display plant communities in a more natural environment to assure habitat development. Indeed, more than 200 botanical gardens around the world are involved in the management of natural areas to conserve biodiversity (Oldfield, 2007).

However, unlike visitors to zoos, aquaria and other organizations with environmental education objectives, visitors to botanical gardens visit plant exhibits with an interest in recreational activities, such as reading, walking and the contemplation of nature (Neilson, 1985; Schroeder, 1991; Wringley, 2003). Enriching the understanding of the conservation of biodiversity seems not to be within visitors' aim (Ballantyne *et al.,* 2008) which raises the question of whether visitors feel attracted to botanical gardens with a conservation focus. Conservation practices maintain the health of ecosystems; however, in the process, they change the way landscapes look. Plant species grow, blossom, fruit, reseed, decay and die in a recurring cycle that shapes

the landscape in ways that visitors might find either attractive or unsightly, creating misunderstanding (Davis, 1996). This type of more naturalistic exhibit is one in which plants are displayed in their natural habitat, either naturally or artificially made and are subjected to disturbances (e.g. fire, drought and strong winds) which are part of life cycles.

What are the landscape attributes that impact people's interest in these new exhibits? What are the meanings people ascribe to these more naturalistic displays? These enquiries were addressed in a PhD study undertaken by the author of this paper in the University of Melbourne, Australia, between 2006 and 2009. This study of people's responses to plant displays confirmed the findings of many previous perception studies. Specifically, three key variables - *vegetation regrowth*, *colour* and *landscape complexity* - were identified as being especially significant, and it is the effect of these variables on visitors' perceptions that is discussed in this paper in more depth.

The Study: Royal Botanic Gardens Cranbourne, Australia

The study was focused on the display of plants in the reserve area of the Royal Botanic Gardens Cranbourne (RBGC). The RBGC is located in southeast Australia, near the city of Melbourne and since 1995 fire management practices in the form of prescribed burns, have been introduced in the reserve with the aim of preserving 363 hectares of native bush, among other purposes. In Australia, like in many other areas of the world, fire effects (e.g. smoke and heat) are necessary for the sprouting of seeds and reshooting of dormant buds, among other aspects related to the conservation of natural habitats (Bradstock *et al.,* 2002).

Biodiversity has successfully increased after the use of fire in the RBGC; indeed, various orchids which had been unseen for years are today growing on site. However, the burns have also revealed to visitors new landscape scenes. Fire effects have created a mosaic of burnt, unburnt and semi-burnt landscapes which are in constant flux. How people perceive this type of display was explored by interviewing experts in fire management practice as well as visitors to botanical gardens in different cultural settings, such as Australia and Chile (Villagra-Islas, 2009). Fourteen different sites of the RBGC were burnt in autumn 2007 and were photographed monthly for a year. This photographic material (N=84) illustrated landscape change before and after the burns, including the scenes of burnt landscapes taken days after the fire and landscape scenes in the process of regrowth during the first, second, third, sixth and twelfth months after the fire. Photographs were used to ask people (N=187) about their preferences and the similarities they observed among the depicted landscapes. A mix-method approach was used to find relationships among landscape configurations, preferences and landscape meanings. Such relationships were illustrated in 'preceptual maps', or two and three dimensional graphs used to illustrate and interpret people's responses to landscapes, obtained after subjecting the data to multivariate analyses techniques available in the SPSS software version 15.

Figure 1 – Landscape changes observed over time at the Royal Botanic Gardens Cranbourne

Some of the photographs used in the study. The three lines of photographs show three types of landscape changes that occurred over time after the landscape was burnt. From left to right: before the fires, three days, six and 12 months after the fires. From top to bottom: the effects of high fire intensity, low fire intensity and moderate fire intensity.

The interpretation of the perceptual maps suggested nine key variables that impact people´s responses; one was associated with the intensity of the burns; two variables were associated with people's familiarity with the site and their knowledge of the effects of fire in fire-dependant environments; and six were linked to the characteristics of landscapes that change. In the following paragraphs three of these characteristics, the *regrowth of vegetation*, *colour* and *landscape complexity*, are further discussed.

Regrowth of Vegetation

This variable is associated with the amount of vegetation observed in landscape scenes, particularly that observed in the understorey. Most scenes which before the fire were closed due to overgrown vegetation which impeded the view of the background were least preferred by visitors, along with those scenes which after the fire depicted a bare ground. In contrast, landscape configurations which after fire and over time had a visible ground cover were highly preferred.

Previous studies have also observed that characteristics of the vegetation such as presence of undergrowth, age and growth rate are more influential on people's responses than other types of landscape elements (Anderson *et al.,* 1982; Daniel, 2006; Vining & Merrick, 2006). Similarly

in this study, several landscape scenes received a different preference value over time due to visual changes in the undergrowth. Highly preferred scenes with artificial elements such as a fire track - most probably seen by people as reference to human presence within a natural setting – were least preferred over time. After the vegetation grew back and covered the middle and upper storey, the view of the background and of such artificial elements was obstructed; hence, these landscapes were less preferred. Such decrease in preference values most probably occurred because the track was not visible anymore; thus, landscape legibility, related to people's capacity of finding their way in the landscape, might have been lost. Legibility can highly increase preference for landscapes and arises when the landscape has distinctive elements, such as a track in this case, that allows people to create a memorable image and understand the environment (Kaplan *et al.,* 1998). The opposite situation occurred in this case after the vegetation grew over the track in large amounts.

Colour

Colour was a key variable in understanding people's responses, specifically in relation to its effects on the meanings landscapes convey. Previous studies have found that green, yellow and red colours, lighter over darker tones, and colour compositions without black colours can evoke positive feelings in people (Kaufman & Lohr, 2004; Da Pos & Green-Armytage, 2007). The same studies explain these results as being due to an evolutionary predisposition to prefer landscape aesthetics that are associated with productive seasons (Orians, 1980), and that was probably the case here.

Recently burnt landscapes which are achromatic, meaning that they depict only black and white colours associated with the ash and charcoal of the burns, were described as 'dead' and 'ugly'. In contrast, landscapes with a diversity of colours including a predominant amount of green and yellow colours of the vegetation and a light blue colour of the sky received a high preference value. Indeed, six to twelve months after the burns, in several scenes a large amount of dark and brown colours as well as the bright green and yellow colour of new leaves could be seen, and as a consequence, preference values increased dramatically. This type of effect suggests that the amount and type of colour as well as the distribution of colours needs to be of consideration in plant displays. Colourful types of landscape configurations, with predominant bright green colours conveyed 'pleasure' to most of the respondents. Landscapes with high sky visibility in a light blue colour additionally conveyed 'calmness' and 'peace' and scenes with predominant bright yellow colours in the understorey were also associated with 'happiness'.

Figure 2 - Colour Changes over One Year Time Frame.

This photograph was manipulated using the Photoshop software to illustrate changes in colour that occurred over one year in the most preferred landscape scene. The view at the centre depicts the characteristics of the most preferred colour configuration.

Landscape Complexity

In this particular study, landscape complexity was associated with the amount and distribution of elements observed in the scene and its effects on accessibility. Landscapes with overgrown vegetation and lack of openings were preferred the least. For those who had knowledge about fire practices these landscapes restricted the capacity to undertake management practices as well as increased fire danger. For those with less expertise, such as visitors from Australia, complex landscapes restricted the scenic view. For those who had less knowledge about fire ecology and less familiarity with the site, complex landscapes additionally restricted the development of recreational activities; for the Chileans, complex landscapes impeded the capacity to 'walk' through the gardens, to 'take photographs' and to 'lie down'. Overall, landscapes which over time showed a semi-open configuration, depth of view and at the same time a semi-enclosed space in the foreground area from where to observe the background scene were the most preferred of all.

High preferences for semi-open landscapes have been a recurrent finding in the literature on landscape perception (Gobster, 1994; Sommer & Summit, 1995; Kaplan *et al.,* 1998). Appleton's and Orians' theories suggest that characteristics of savannah-type environments, semi-open areas with scattered trees, such as those observed in this study, are highly preferred. Orians' (1980) habitat theory suggests that humans prefer these landscape types because they provided our ancestors advantages for survival, and several scholars support Orians' premise by explaining that landscape preferences for such type of landscapes have been maintained over time. Savannah landscape types seem to be preferred by contemporary humans due to an innate predisposition for life and life-like processes (Kellert & Wilson, 1993).

According to the prospect and refuge theory of Appleton (1996), people prefer savannah-lands which provided possibilities to see and to hide. The complexity of landscapes was also associated in the study discussed in this paper with the distribution of acacia-like trees, or trees with branches spreading from the bottom, observed in savannah-environments and used by our ancestors to hide from predators and guard their territory. Landscapes with acacia tree shapes placed on the side of the view were the most preferred regardless of respondent's personal values, cultural backgrounds and interests.

Key Findings

The study provides two key ideas that can extend our understanding of visitors' perceptions of plant displays in botanical gardens with a focus on habitat conservation. First of all, the study suggests that the characteristics of certain landscapes with vegetation on the ground cover, depth of view, brighter and contrasted colours (especially green and yellow) and semi-open areas are more preferred by people regardless of their previous knowledge and experiences of those landscapes. Second, visitors to botanical gardens include a wide range of people with different interests and experiences, therefore, their verbal responses to landscape vary according to their socio-cultural backgrounds. Visitors' descriptions of landscapes in the RBGC were found to vary with respect to aesthetic, ecological and utilitarian values. On the whole, although certain landscape configurations can be equally preferred by people with different personal values, both the most and less preferred settings convey different meanings, mostly depending on peoples' familiarity with landscapes and their expertise in landscape management practices.

A Dynamic Mosaic: Scenic and Ecological Aesthetics

The need of integrating both scenic and ecological aesthetics into natural systems displays is proposed here with the viewpoint of making botanical gardens more sustainable. According to Gobster (1999), scenic aesthetic is that which appeals to the pleasure of looking at nature and elicits positive emotions in people, in contrast, an ecological aesthetic reveals the dynamics and life stages associated with natural processes and arises from knowing the landscape is ecologically fit. The study discussed here suggests that plant displays within botanical gardens with a conservation focus sometimes look 'ugly', sad and unpleasant to the eyes of unexperienced visitors. These settings can be seen as 'messy', 'dull' and 'old' creating in visitors, aesthetics which are far from suggesting a scenic aesthetic. Hence, the experience in these landscapes can elicit negative responses in visitors with the possible subsequent effect of reducing their interest in the gardens and therefore limiting the interpretation process (Tilden, 1977).

To overcome this situation, a dynamic mosaic for botanical gardens which mixes a scenic and ecological aesthetic, is proposed. This mosaic derives from the skills and collaborative work of botanical garden managers and landscape designers. The layout of such dynamic mosaic should be defined with respect to the effects of ecological management practices and include a flexible pathway system. This scheme can provide a diverse circulation system which can vary while the gardens grow and change. This system will also have resting areas such as lookouts where colour diversity and high colour contrast can be assured. If it is not feasible to add colour by using natural elements, artificial colourful elements could be integrated into the display with the aim of making the landscape more attractive, less complex and more legible. A set of complementary and temporary displays can contribute in this case. These exhibits should also be considered throughout the garden with the objective of educating visitors about landscape change. Visitors should be aware, for example, that the process of making attractive landscapes

includes the death and decay of plants as well as the blossoming of flowers and growth of fruits. Finally, it is relevant to include in the gardens a series of environmental education tools. Signs, workshops and guided tours should be incorporated with the aim of increasing familiarity and knowledge with both the management activities taken on site and the life cycle of natural systems under exhibit.

Conclusion

The approach to understand people's perceptions of plant displays which was presented here can provide useful information about the physical attributes of landscapes that impact people's responses positively or otherwise. These can be used in the landscape design of plant displays with a conservation focus and with the aim of making landscapes more appealing. Creating attractive and interesting displays can be seen as the first step in achieving the environmental education goals of botanical gardens. Plant displays which elicit a positive response from visitors can assure attracting visitors to the gardens and thereon, further strategies can be explored to educate them about plant-people relationships and the process involved in ecological landscape change.

References

Anderson, L., levi, D., Daniel, T. & Dieterich, J. (1982) Esthetic effects of prescribed burning: a case study. *Research Note RM-413 USDA Forest Service Rocky Mountain Forest and Range Experiment Station.* US, USDA Forest Service.

Appleton, J. (1996) *The Experience of Landscape,* England, John Wiley & Sons.

Ballantyne, R., Packer, J. & Hughes, K. (2008) Environmental awareness, interest and motives of botanic gardens visitors: Implications for interpretative practices. *Tourism Management,* 29**,** 439-444.

Bradstock, R. A., Williams, J. E. & Gill, M. A. (2002) *Flammable Australia: The Fire Regimes and Biodiversity of a Continent,* NY, Cambridge University Press.

Dapos, O. & Green-Armytage, P. (2007) Facial Expressions, Colours and Basic Emotions. *Colour: Design & Creativity,* 1**,** 1-20.

Daniel, T. C. (2006) Public Preferences for Future Conditions in Disturbed and Undisturbed Northern Forest Sites. IN McCaffrey, S. (Ed.) *The Public and Wildland Fire Management: Social Science Findings for Managers.* PA, United States Department of Agriculture, Forest Service.

Davis, P. (1996) *Museums and the Natural Environment: The Role of Natural History Museums in Biological Conservation,* London, Leicester University Press.

Gobster, P. (1994) The Urban Savanna. Reuniting Ecological Preferences and Function. *Restoration and Management Notes,* 12**,** 64-71.

Gobster, P. H. (1999) An Ecological Aesthetic for Forest Landscape Management. *Landscape Journal,* 18**,** 54-64.

Kaplan, R., Kaplan, S. & Ryan, R. L. (1998) *With People in Mind: design and management of everyday nature,* Washington DC, US, Island Press.

Kaufman, A. J. & Lohr, V. I. (2004) Does Plant Color Affect Emotional and Physiological Responses to Landscapes? IN RELF., D. (Ed.) *XXVI IHC - Horticulture, Human Well-Being and Life Quality.* Cant. Int. Dev. Agency (CIDA).

Kellert, S. & Wilson, E. (1993) *The Biophilia Hypothesis,* Washington DC, Island Press.

Monem, N. K. (2007) *Botanic Gardens A Living History,* London, Black Dog Publishing Limited.

Neilson, M. (1985) Botanic gardens: their potential for recreation. *Landscape Research,* 10**,** 18-21.

Oldfield, S. (2007) *The Great Botanic Gardens of the World,* London, New Holland Publishers Ltd.

Orians, G. H. (1980) Habitat Selection: General Theory and Applications to Human Behavior. IN Lockard, J. S. (Ed.) *The Evolution of Human Social Behavior.* NY, Elsevier North Holland Inc.

Schroeder, H. W. (1991) Preference and meaning of arboretum landscapes: Combining quantitative and qualitative data. *Journal of Environmental Psychology,* 11**,** 231-248.

Sommer, R. & Summit, J. (1995) An exploratory study of preferred tree form. *Environment and Behavior,* 31**,** 540-557.

Tilden, F. (1977) *Interpreting Our Heritage,* Chapel Hill, The University of North Carolina Press.

Villagra-Islas, P. (2009) Concerning fire management of ecosystems: Relationship between perceived aesthetic and ecological values in the Australian bush. IN Chapin, M., bissell, J., L'Heureux, M. A., Moore, K. D., Rashid, M. & Spreckelmeyer, K. (Eds.) *Proceedings of the Environmental Design Research Association 40th Conference (EDRA40) Re: The Ethical Design of Places.* Kansas City.

Vining, J. & Merrick, M. (2006) Characteristics People Consider When Evaluating Forest Landscape Attractiveness: Fuel Management Implications. IN McCaffrey, S. (Ed.) *The Public and Wildland Fire Management: Social Science Findings for Managers.* Newtown Square, PA, US Department of Agriculture, Forest Service, Northern Research Station.

Wringley, S. (2003) Customer Satisfaction Research Report. Melbourne, Royal Botanic Gardens Melbourne.