

Exploring the potential for plant based enrichment

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Introduction

Plants form the fabric within and around which animals live their lives. As the ultimate source of food to fuel their lives, to the provision of structures that make a safe home. Plants or plant derivatives determine much of the natural behaviour of animals in the wild. But what of plants in captive environments? Plants form a major part of all terrestrial animals' environments, yet their inclusion in the field of environmental enrichment, has not been recognised to date (Field, 1998; Reinhardt, 2008; Stark, 1999; Young, 2003). Overlooked and undervalued plants have certainly not been utilised to their full capacity. Approaches will be revealed in this paper which explores how zoos might look to optimise the potential of plants to enrich the lives of captive animals.

Background to plant based enrichment

Enrichment has been well defined elsewhere as a dynamic process for improving or enhancing animal environments in the context of their behavioural biology and natural history (AZA/BAG 1999). Requiring changes to be made to structures and / or husbandry practices to help increase behavioural choices and draw out species-appropriate behaviours and abilities in captive animals. The core aim of enrichment is to enhance animal welfare, while improving the physical health and psychological well-being of captive animals (<http://www.animalenrichment.org/Welcome.html>).

In such a context, psychological well-being is said to be influenced by whether the animal can undertake certain functions such as;

- performing its highly motivated behaviours
- responding to environmental conditions using its evolutionary adaptations
- develop and use its cognitive abilities
- effectively cope with challenges (change) in its environment.

While this description of enrichment provides the academic with a framework to consider research within, it does little to help the practitioner enrich the lives of captive animals. To provide a framework to help inform practical environmental enrichment programmes, enrichment can be split into two broad groups that can help inform the practitioner develop a plant use strategy.

Young (2003) summarises these two approaches as follows:

1. creating a wild environment in captivity to provide stimulation and
2. using behavioural engineering to provide devices and machines that the animals' operate to receive some form of reward, usually food.

We can use Young's (2003) framework when we consider two broad plant based approaches: which can be adopted in a *landscape approach* to exhibitory design and improvement (1) and adoption of a *plant based approach* to providing an opportunity for activity using living or recently harvested or preserved plant material (2).

Although crude this division into 2 approaches is a useful tool for the horticulturalist looking to support their fellow zoo professional whose focus is usually on animals. Greater progress could be made, using a more developed and even better framework, where these two broad

categories are revised further into five types of enrichment which, relate more broadly to areas of animal behavioural biology that can be influenced in captivity. These categories are widely accepted by enrichment practitioners and promoted by Shape of Enrichment, Inc. and have been defined as follows (Anon, 2007, Hosey et al, 2009);

- Social
- Cognitive.
- Physical.
- Sensory.
- Food.

It is these five categories, that more specifically align the roles of environmental enrichment to animal behavioural biology which it is believed could provide a more refined framework to consider practical plant use in zoos in support of environmental enrichment. It is within this context that the following definitions and explorations are suggested.

The need for defining plant based enrichment

Plants can be said to enrich animals in all 5 suggested and can be developed into a plant use strategy where plant based enrichment can be defined as 'the use of plants or their derivatives to stimulate natural behaviour in captive animals'. Together with the use of designed landscapes they provide a horticultural approach to supporting captive animal enrichment. The justification for such a definition is based upon the observation that the full potential of plants has not been explicitly recognised in the broad definitions of enrichment outlined previously. While enrichment itself as a term within zoo biology is well defined and has a growing body of research and applied literature supporting it, it can be argued that without such overt consideration, the potential of plants is not currently being realised. But how can this be? Plants can fulfil every enrichment category...even social enrichment can be achieved through the use of plants, as demonstrated by the observational learning which took place in a captive group of chimpanzees which learnt to swallow leaves, a behaviour which was promulgated through the group (Huffman & Hirata, 2004)! Have all animals not evolved with plants? Surely we should explore this relationship in the captive environment as a means to enrich the lives of captive animals...

Plants have been used in various ways to enrich the lives of captive animals. This work is currently being captured in the BIAZA plant wiki (Seiffert, 2009). While recognising that plant based enrichment can support all five categories of enrichment, for the purposes of this paper sensory stimulation will be explored from the perspective of the newly defined plant based enrichment.

The sensory basis of plant based enrichment

Six sensory ways can be defined in which plants can be used to stimulate natural behaviours in captive animals:

- Auditory
- Visual
- Olfactory (2 sub-categories; smell and taste)
- Tactile plus...
- Equilibrium (orientation in space and time)

The following table explores the potential of plant based enrichment through listing applied examples of how a broad group of animals' senses can be stimulated:

INSERT TABLE 1 HERE

Table 1 provides a crude review of the potential of plants to stimulate natural behaviour in animals through via their senses modalities. This information supports the fact that plants, on

their own or as part of a wider designed landscape, can be used to enhance enrichment warrants them being considered as part of any enrichment programme. An example of where this potential is routinely overlooked is in the field of structural enhancement to a physical space such as in building a climbing frame for an exhibit.

Taking a considered view of the choice of materials, an engineer's view of the structure will look first at the structural material properties and spatial placement of a rigid structure. Once placed this fixture will start to degenerate, as it is exposed to natural elements, never being as good as it was on the day of opening and at best having an operational life that lasts for duration of the exhibit.

Contrast this with the use of a tree to provide an interesting alternative to the need for a fixed wooden structure. This option may not always be the most convenient or feasible but where possible can provide several additional enrichment benefits that might not always be considered when looking at the pure engineering of the structure. These added values include the provision of flower, fruit and shade in summer which might offset the time required to plan and establish a living structure or additional funds required to protect it against intense use. Again for simplicity a tabulated format is followed:

INSERT TABLE 2 HERE

Sensory enrichment fits in with existing planning tools

When looking to integrate plant based enrichment into a routine programme, the best approach is to consider how plants can benefit and then be integrated into accepted practice. In the case of enrichment this is can be achieved through the use of enrichment planning tools. The Shape of Enrichment Planning Tool forms one example which is fully compatible with considering the benefit and any key performance measures that will be used to evaluate its success when integrating landscape and plant based enrichment when considered as part of the enrichment plans (see planning tools at http://www.enrichment.org/miniwebfile.php?Region=About_EE&File=overview.html&NotFlag=1).

Exploring the potential of plant based enrichment

At Paignton Zoo Environmental Park the use of plants within enrichment programmes is being currently explored following an evidence based approach, whereby their use is being incorporated and monitored to inform future use; thus scientific research has been initiated to explore the potential for plant based enrichment. The use of plants within enrichment programmes should be considered part of an integrated approach to zoo horticulture, first highlighted in Frediani (2009); essentially this recognises that the sourcing, growing and placement of plants as part of a multiple site objective can benefit animal management if integrated appropriately. Enrichment provision forms one of the main avenues whereby horticulture can influence animal management within zoos, and yet the ability and efficacy of plant use to significantly improve captive animal welfare has been largely unexplored from a scientific field of applied research.

Conclusion

Plant based enrichment is a valid area of exploration which can support the already active field of providing animal environmental enrichment in other forms. By not recognising the potential overtly plants are being used covertly to provide enrichment for captive animals. Further, because plant use has not been previously defined, it has not been considered as a valid area for study and thus there is a lack of information about the potential plants can have to support this important zoo activity. It is proposed that the functionality of plant based enrichment could go beyond that currently provided through other enrichment media, it just needs time and effort to realise this potential. A review of enrichment, suggested that the focus to date has mainly been on tactile, olfactory and visual methods of sensory stimulation

(Wells, 2009). Additional sensory modalities which could be stimulated through plant enrichment include auditory and equilibrium (orientation in space and time). Animals (and their keepers) can gain a lot from enlightened plant use through exploring physical and psychological stimulation and maintaining systematic records that are shared to enable study and replication elsewhere.

In summary, the author believes that landscapes and the plants that are grown within them can enhance enrichment programmes and enable the ultimate objective of stimulating natural behaviour in captive animals through: the provision of herbs; creation of naturalistic landscapes; provision of food and browse to supplement diets; and stimulation of the senses.

Word count: 1481 plus tables

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Potential of plant based 'sensual' enrichment		
Sense	Rationale behind	Application of plants to achieve objective
Auditory	Change is constant in naturalistic enclosures due to dynamic nature of plants	Plants can change the dynamics of sound <ul style="list-style-type: none"> • Wind rustling through the leaves • Muffle sound of visitors • Interaction of rain on leaves • Softening the acoustics of man made structures • green roofs & living walls • Welfare tool... Perfume sound...
Visual	Plants have form, colour, and texture (defined by leaf size; coarse being large leaved and fine being small leaved)	Engender temporal and spatial change <ul style="list-style-type: none"> • they grow, develop & move as season and as the years progress • Landscapes can be designed or allowed to evolve <ul style="list-style-type: none"> - Successional plantings - Paddock management (arresting succession by mowing or grazing) - Bare ground & colonisation by seed rain - You can plan for a happy accident
Olfactory	This includes taste and smell	Herbs & spices are used in zoos Whole plants or extracts as sprays or scent trails <ul style="list-style-type: none"> • Potential for seasonal enrichment through living succession of flower, fruit, leaf fall etc.
Introduction of choice		Grassland areas can be managed in order to provide choice as to when the animals harvests the plants or the insects they attract. The introduction of berry bearing plants that ripen in situ and add seasonal choice. <ul style="list-style-type: none"> • The introduction of gum producing trees to support natural behaviour.

Tactile		<ul style="list-style-type: none"> • Textural use of bark has been used to mark trail's for blind humans... • More can be done for captive animals in this area <ul style="list-style-type: none"> - Leaf size, shape and texture - Bark stems and (thorny) projections - Whole plants including roots can be provided - Fruits, flowers and fungi
Equilibrium	<ul style="list-style-type: none"> • Orientation in space and time 	<ul style="list-style-type: none"> • They form part of mixed species exhibits (plants and animals). They provide a natural structure • Plants are dynamic natural structures <ul style="list-style-type: none"> ○ They exhibit sizemorphogenesis (secondary thinking when exposed to external stimuli that causes movement) • They grow, modify their shape to their environment, decline and die (all useful for enrichment...) every year changing scenery

Table 1: Exploring the potential of plant based enrichment through examples of how a captive animal's senses might be stimulated.

Natural	Engineered
<ul style="list-style-type: none">• Regenerative	<ul style="list-style-type: none">• Degenerative
<ul style="list-style-type: none">• Dynamic	<ul style="list-style-type: none">• Static
<ul style="list-style-type: none">• Soft	<ul style="list-style-type: none">• Hard
<ul style="list-style-type: none">• Rel. inexpensive	<ul style="list-style-type: none">• £\$E...

Table 2: Comparison between the use of natural verses engineered structures as potential climbing features.