ASTONISHING PLANTS

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Abstract

Our existence depends on plants yet to many they are invisible, a phenomenon called 'plant blindness'. Addressing this is crucial in the face of unprecedented biodiversity loss and extinction. Digital engagement with astonishing plants can break the perception that they are uninteresting, and take us step forward in addressing disengagement.

Key words: plant blindness, public engagement, plants and society

Plant Blindness

Decreasing environmental awareness and disconnection with nature are symptoms of a growing societal problem described as 'nature-deficit disorder' (NDD) [1] that requires cultural examination and new communication practices [2]. Plants in particular are established to be a blind spot in the human psyche that require an additional layer of focus. Because although we owe our very existence to plants, unlike animals, many of us scarcely even notice them - a phenomenon described metaphorically as 'plant blindness' [3-4]. Two decades since the phenomenon was recognised, plant blindness is more relevant than ever in the face of anthropogenic change, for example an increasing rate of biodiversity loss and extinction. Today, one in five plant species is now threatened with extinction globally [5] and it will not be possible to course-correct this alarming trend without fostering greater environmental care and awareness of the importance of plants in particular. At the same time, tertiary education-level courses on botany and plant sciences are diminishing, exacerbating the challenge of engaging a future generation of plant scientists. In light of these significant challenges, researchers and educators must be agile and inquisitive in adopting new approaches to communication to engage people with plants. Here I build on the idea that 'unusual plants can draw a crowd' [6] and suggest that plants that astonish are an effective means of challenging people's perceptions. Now, in the Digital Era, there are new opportunities for bringing such plants to the attention of wide audiences efficiently and effectively.

Communication in botanical gardens

There are over 2,000 botanical gardens around the world, many of which are situated in cities, and are accessible to a diverse audiences [7]. They hold uniquely rich collections of plants from around

the world, including those used by researchers of plant sciences, and those used in the production of food, medicines and clothing. These collections are visited by 300 million people a year [8], so the opportunities for engaging people with the importance of plants and plant conservation are significant. Like zoos, botanical gardens use static interpretation panels for explaining the significance of displays, and for increasing awareness and education more broadly. However while 75% of botanical gardens deploy interpretation panels, fewer than 40% use online resources that are an opportunity to reach audiences beyond those who are able to visit gardens [9]. Recently, the opportunities for engaging large audiences online have mushroomed since the advent of popular social media channels. These online platforms enable all gardens - large and small - to democratise their plant collections and connect with audiences remotely, and in real time, across the globe. A clear advantage is that anyone with access to the internet is able to engage with botanical gardens and the collections they hold – a fast, efficient and cost-effective means of education.

Astonishing people with plants

A commonly-held perception is that plants are inanimate and uninteresting compared with animals. In the diverse assemblage of plants that botanical gardens hold, some are striking, unusual or dazzlingly beautiful, and often unfamiliar to people. These have the power to astonish people and challenge their notion of how plants look and behave. However they can be overlooked easily in a garden setting; moreover the complex associations some have evolved with animals cannot be appreciated there. Therefore highlighting astonishing specimens and their biology via online channels is an ideal opportunity for public engagement and an edge in to broader dialogue about plants.

The 'Darth Vader flower' (*Aristolochia salvadorensis*) and monkey-face orchid (*Dracula*) (Figure 1A & B) are cultivated frequently in botanical garden glasshouse collections. Their extraordinary face-like flowers have the capability to startle and surprise people. Other plants bloom very rarely and for a short time only, but are spectacular when they do, for example giant aroids (*Amorphophallus* spp.) and various succulents (*Pua alpestris*) (Figure 1C & D). Showing these 'botanical marvels' online is an opportunity not only to share them with larger audiences, but also to interpret them scientifically. For example tens of thousands of online spectators are able to observe the rare blossoming of the giant titan arum (*Amorphophallus titanum*), and learn about the sapromyophilous pollination syndrome (blowfly pollination in flowers that mimic carrion in appearance and smell). This is a springboard for broader discussions on pollination, upon which we depend for sustainable agriculture, for example.

Carnivorous plants – those that attract, trap and kill animal prey to obtain nutrients, have inspired generations of scientists since Charles Darwin performed the first scientific experiments on them in the 19th century. These 'green predators' turn the tables on animals, and challenge conventional concepts of plant behaviour. Some *Nepenthes* pitcher plants (Figure 1E) besides being carnivorous, have evolved complex mutualistic relationships with mammals. For example in nature, the pitchers of *Nepenthes hemsleyana* provide roosting sites for bats, that in return for accommodation, provide the plant with nutrients by defecation. This is a powerful narrative for explaining evolutionary processes and phenomena such as symbiosis, and when explained, may enable people to connect with plants in a more meaningful way.

Besides showcasing digitally the unusual plants that are held in botanical gardens' collections, online communication is also an avenue for shining a spotlight on elusive plants that *cannot* be seen in cultivation, and which are rarely encountered by people at all. A recent series of articles in the series *Flora Obscura,* in the journal Plants People Planet, examine the biology of unusual and poorly known plants and those that are new to science. Featured in this series are extraordinary-looking parasitic plants such as *Hydnora* and *Langsdorffia*, and mycoheterotrophs (plants that are parasitic on a fungus) such as *Oxygyne* and *Rhizanthella* (Figure 2) all of which lack chlorophyll, functional leaves and roots, and therefore challenge people's very perception of what comprises a plant existentially. Some of these species are of extreme conservation concern. Promoting awareness of them and the need for their conservation beyond a conventional academic readership, may be a catalyst for lobbying local conservation action. Each *Flora Obscura* article is accompanied by an 'infographic' – a visually engaging summary that breaks the mould of conventional paper formats, and engages a wider audience with accessible science. Altmetric scores (a measure of online activity and engagement) for these papers reached the 99th percentile of research outputs tracked, showing significant promise for this subject matter and format in the plant science arena.

Demonstrating relevance to people

Botanical gardens invite inquiry into the relationships between nature and culture. Cultural influences can catalyse children's relationships with plants in particular. For example so-named 'Pokemon plants' (carnivorous plants that bear a resemblance to fictional characters), and mandrakes (which feature in popular Harry Potter books by J. K. Rowling), have been observed to stimulate children's interests in plants at the Chelsea Physic Garden in London, and are a platform from which they can develop their botanical knowledge [7]. Meanwhile a live re-enactment of 'how

to harvest a mandrake safely' at the University of Oxford Botanical Garden was viewed by 92,000 people online, many of whom were unaware that a mandrake is in fact a real plant. Another means of raising the awareness of the importance of plants in our everyday lives is to highlight 'plants that changed the world' – for example, coffee, tobacco, cotton and various medicinal and food plants. Similarly biomemitics (the synthesis of materials that mimic biological processes) shows significant promise for the technological applications in plants. For example, droplet-based fluidic devices inspired by the slippery surfaces of carnivorous pitcher plants, have the potential to infiltrate various industries and technologies from medical devices to household products [10]. The ca. 400,000 vascular plants that exist on our planet represent a living library for scientists to explore, of which we have barely scratched the surface. Sharing the scientific wonder of these myriad plants with innovators and technologists has never been simpler than it is today.

Concluding remarks

The importance of plants to life on earth needs to make sense to people. Currently there is a shortfall in public engagement with plant sciences at a time when it is needed urgently. If part of the problem is the way in which humans perceive plants—due to the inherent constraints of their visual information processing systems [11] — then part of the solution must be to break this perception. While no single means of communication can achieve this, putting a spotlight on astonishing plants using new media may be one powerful approach to equip researchers and educators in breaking the perception that 'plants are boring', and take us step forward in tackling plant blindness.

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Figure legends

Figure 1. A. The unusual and macabre 'Darth Vader flower' (*Aristolochia salvadorensis*); B. The peculiar 'monkey-face orchid' (*Dracula psittacina*). C. The spectacular inflorescence of *Pua alpestris*. D. The large inflorescence of *Amorphophallus konjac* that smells of carrion to attract pollinating flies. E. Pitchers of *Nepenthes hemsleyana* provide roosting sites for bats, that in return for accommodation, provide the plant with nutrients by defecation – an example of plant-animal mutualism.

Figure 2. An assortment of 'botanical oddities' in the genera *Hydnora, Langsdorffia, Oxygyne* and *Rhizanthella* that have featured in a series of *Flora Obscura* articles in the journal Plants People Planet. All lack chlorophyll, functional leaves and roots, and challenge people's very perceptions of what a plant is. Figures adapted from Thorogood, 2018 https://doi.org/10.1002/ppp3.9; Thorogood, 2019 https://doi.org/10.1002/ppp3.26; Thorogood et al, 2019 https://doi.org/10.1002/ppp3.45 and Thorogood and Carlos Santos, https://doi.org/10.1002/ppp3.10102.