

Humans and ornamental plants: a mutualism?

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Abstract

Since the Neolithic period, humans have surrounded themselves and their settlements with ornamental plants. Why? This paper explores this question using the theory of mutualism, which refers to a biological process where different species interact to the benefit of both. The paper first describes how ornamental plants are understood in contemporary academic thinking. Then it introduces the theory of mutualism, with particular attention to its historical roots. Discussion explores how humans and ornamental plants can indeed be conceived of as a mutualism. Two benefits are identified in adopting this approach. First, understanding the relationship as a mutualism could help to focus attention on the specific benefits provided by ornamental plants for people, and help legitimise the study of ornamental plants within the natural sciences. Mutualism potentially offers a complementary framework to existing social theory such as biophilia, that allows integration with approaches from the natural sciences to more fully understand both sides of the human-nature relationship.

Introduction

“... we have spent the last few thousand years remaking these species through artificial selection, transforming a tiny, toxic root node into a fat, nourishing potato and a short, unprepossessing wildflower into a tall, ravishing tulip. What is much less obvious, at least to us, is that these plants have, at the same time, been going about the business of remaking us.” (Pollan, 2001, p xvii)

Last year, scientists analysing a well-preserved grave in Israel discovered it was lined with flowers. Between 13,700 and 11,700 years ago, the Neolithic people lined the graves of their loved ones with mud and then a “thick cover of fresh flowering plants, thereby providing colour and aromatic fragrance” (Nadel et al., 2013, p11777). Today, ornamental plants dominate human settlements around the world. Yet surprisingly, there has been relatively little serious investigation of this relationship, particularly given that today most humans live in urban spaces. It is not the plants growing in the rainforest or the mountaintop, nor the farm or the orchard with whom humans share their lives most directly, but with those planted by humans and growing in gardens, along streets, in parks and lining rivers. Yet the ornamental plants growing in these spaces are rarely taken seriously in academic discourses on the relationship between humans and the world around them.

In *The Botany of Desire*, Michael Pollan (2001), describes the entrenched and profoundly formative relationship between plants and humans as a mutualism – a biological relationship between different species where both parties benefit from the relationship. Yet, this observation has largely remained his alone. In this paper we explore whether the concept of mutualism is a useful way of framing the relationship between ordinary people and the ornamental plants with which they dwell. First, we offer some context to the place of ornamental plants in contemporary academic thinking, and introduce the term ‘mutualism’ by

exploring not only the contemporary scientific use of this term, but also its historical roots. Then we describe the ways in which humans and ornamental plants can indeed be conceived of as a mutualism. Finally, we offer two ways in which thinking about the human-ornamental plant relationship as a mutualism is useful today.

Ornamental plants: living in the cracks of the nature-culture divide

Studies of gardens and gardening in human-settlements around the world regularly note that ornamental plants are everywhere (e.g. Kumar & Nair, 2004). Yet it is relationships with those species that provide food, medicine and firewood that dominate these academic explorations. Perhaps usefulness obscures ornamentality. If plants provide food, medicine, shade or cultural meaning, what does it matter if they also provide something more trivial like ornamentality? Trees perhaps reflect this tendency most strongly. They have a strong presence in academic literature, yet this visibility emphasizes their utility in providing wood, shade and food for human settlements. This, along with their difficult-to-ignore stature, has demanded that they be taken seriously across many disciplines (Jones & Cloke, 2002).

In the 1830s John Ruskin described gardens filled with hybridised plants as being ugly because they comprised of “an assembly of unfortunate beings, pampered and bloated above their natural size, stewed and heated into diseased growth; corrupted by evil communication into specked and inharmonious colours...” (Ruskin, 2006, p493). This idea, that the most authentic nature is that furthest from human interference, has endured. ‘Wild’ and ‘native’ natures have long dominated ecological research; ornamental plants usually only enter ecological thinking if they ‘invade’ or ‘damage’ true ‘nature’. A search of the high-impact ecological journal *Trends in Ecology and Evolution* for ‘ornamental plants’ reveals only 12 articles with titles such as “How to manage biological invasions under globalisation”,

‘Impact of biological invasions: what’s what and the way forward’ and “Addressing the threat to biodiversity from botanic gardens”. Even the discipline of urban ecology, having emerged from the realisation that ‘nature’ is not just ‘out there’ but is also in the heart of the places where humans reside, still often ignores ornamental plants and domesticated animals to seek out the ‘wild’ or ‘native’ in the city (McKinney, 2002).

This separation of nature and culture has been heavily critiqued by environmental historians and human geographers. A world separated into clear categories of nature and culture leave no place for understanding and valuing some of the most important relationships and processes that exist in this world, such as between humans and street trees, genetically modified organisms or their own stomachs. This social research is embracing a ‘more-than-human’ approach (Whatmore, 2006), where the perspective of non-human actors are given comparable weight with those of humans (Latour, 1991). A few studies have used this approach in thinking about human relations with ornamental plants, seeing them as active participants in the lives of urban dwellers and gardens (Hitchings, 2003). George Gessert explores the role human aesthetics has played in the evolution of ornamental plants and has argued that ornamental plant breeders have a profound influence upon urban environments by “producing, in the form of living organisms, imagery of nature for our culture” (Gessert, 1993, p37). Yet Gessert’s work has largely been ignored; Google Scholar shows that his four papers on ornamental plants in combination have only been cited 14 times in the 20 years since their publication.

Evolutionary and eco-psychology provide some theory which can be used when thinking about the relationship between humans and ornamental plants. The concept of biophilia, that humans have an evolved affinity with natural environments, provides the basis for many

studies on the effects of nature on humans (Kahn, 1997). Landscape preference studies have consistently shown that people prefer natural scenes over scenes of built form (Kaplan & Kaplan, 1989) and some suggest that humans have evolved to prefer landscapes that are structured like the African savannah landscapes that their species evolved in (Balling & Falk, 1982), or coarse green foliage that indicates habitat with high nutrient and water availability (Kendal, Williams, & Williams, 2012a). These evolutionary theories largely focus on the utilitarian provision of food and shelter rather than ornamentality, although several authors have noted the strong appeal of flowers and have suggested that evolutionary approaches could be used explain this appeal (Orians & Heerwagen, 1992).

A variety of other psychological frameworks, largely underpinned by biophilia, have been developed to explain various aspects of people's cognitive, affective and behavioural responses to 'nature' broadly, including connectedness to nature (Mayer & Frantz, 2004), sense of place (Lewicka, 2010), attention restoration theory (S. Kaplan, 1995) and stress reduction theory (Ulrich et al., 1991) While these theories usefully explain a lot about humans, they do not provide a particularly useful framework for understanding the 'nature' end of the relationship, or ornamental plants in particular.

To facilitate this, a new frame is needed that legitimises thinking about humans and ornamental plants, as both nature and culture, and takes both humans and ornamental plants seriously.

Humans and ornamental plants: A mutualism?

“We suggest that cultivated flowers are rewarding because they have evolved to rapidly induce positive emotion in humans, just as other plants have evolved to induce varying behavioral responses in a wide variety of species leading to the dispersal or propagation of the plants” (Haviland-Jones et al., 2005, p104)

“the rose, geraniums and lilies surrounding our dwellings seem to compete to see which may give us the greatest delight. But, is it not because we have made it easy for them to live and to thrive? Is it not because we have relieved them of the responsibility of defence and reproduction that they have rewarded our kindly care by blooming and fruiting, not for their own selfish ends, but for us?... Their strongest efforts now that we have become predominant in their lives, is to lure with their blossoms and their fruit – to enchant us with their odours and colours and lusciousness, as they formerly enchanted only the bees – to win and hold our appreciation and merit our kindly attention and care”.

(Burbank, 1921, p5)

Haviland Jones *et al.* and Burbank are in fact describing a well-known biological relationship – the mutualism. The notion of mutualism is a potentially useful way to broadly describe human-ornamental plant relations that takes both humans and nature seriously. It allows exploration of both sides of the relationship – how do humans benefit from their relationship with ornamental plants, and how do ornamental plants benefit from their relationship with humans? It is inherently interdisciplinary; the human side of the equation needs the humanities and social sciences as participants, while the ornamental plant side needs the natural sciences; recognising the relationship as a mutualism needs all disciplinary perspectives.

Describing a post-humanist, post-wilderness world is limited by language and we argue that mutualism offers an accessible way to address these divisions across disciplines. In ecology, mutualisms have been used as a framework for understanding inter-species relationships for well over a hundred years. In environmental psychology, the term mutualism was adopted in the 1970s to describe an approach where humans (or other organisms) cannot be treated independently of their environment (Still & Good, 1992). Mutualism, in both the nature of what it describes and in its original historical conception, is a word that sits easily in this interdisciplinary place, and as a concept can offer great depth to interdisciplinary discussions.

For contemporary ecological scientists, ‘mutualism’ has quite a precise meaning, describing a fundamental biological interaction where members of different species interact to provide evolutionary fitness benefits, where an individual’s genes are more likely to be passed on to future generations (Herre, Knowlton, Mueller, & Rehner, 1999). There are many well-known plant-animal mutualisms including many ant and *Acacia* sp. (Janzen, 1966) and fig wasps and fig trees (Herre, Jand, & Machado, 2008). The interactions between humans and ornamental plants is consistent with some aspects of this modern definition, which includes relationships where the interaction is behavioural rather than physiologically integrated, where species are able to survive independently, where many species are involved and where species have not necessarily co-evolved (Boucher, 1985). However, like much of modern ecology, mutualisms are often only considered valid where fitness can be quantified (Boucher, James, & Keeler, 1982). This is difficult as ethically, the fitness of humans cannot be experimentally tested (Borgerhoff Mulder, 2003). Interactions between humans and ornamental plants are especially challenging as there are so many species of ornamental plants involved in the relationship with humans, and it is difficult to empirically explore the fitness benefits for all species.

Yet the term mutualism has historically had a broader meaning, focussed on understanding benefits rather than measuring fitness, and with political origins that explicitly incorporated humans (Sapp, 1994). The concept of mutualism emerged at a moment when ecology, culture and politics were intertwined in the latter half of the nineteenth century, as a counterbalance to the idea of ‘survival of the fittest’ as being the best way to understand both evolution and social progress. Peter Kropotkin’s best-selling book, *Mutual Aid*, was inspired from his observations of animals in Siberia in the late 19th century, where he found that “even in those few spots where animal life teemed in abundance, I failed to find – although I was eagerly looking for it – that bitter struggle for the means of existence, among animals belonging to the same species, which was considered by many Darwinists (though not always by Darwin himself) as the dominant characteristic of struggle for life, and the main factor of evolution” (Kropotkin, 1902, p xxxv). Instead, he saw “Mutual Aid and Mutual Support carried on to an extent which made me suspect in it a feature of the greatest importance for the maintenance of life, the preservation of each species and its further evolution” (Kropotkin, 1902, p2). Mutualism thus became talismanic of a political movement, embraced by communists and anarchists as a way to demonstrate the value of collective over individual land ownership and a world dominated by communal cooperation rather than individual competition (Sapp, 1994).

Humans were at the heart of the original conception of mutualism. An essay in the *American Naturalist* in 1893, described a mutualism between man and wheat. “Wheat is cultivated by man and enabled to grow in quantities and in localities, which, under ordinary conditions, would be impossible. It gains partial exemption from the struggle for existence only at the expense of an immense number of individuals sacrificed, but it is, nevertheless, a great

advantage which it gains” (Pound, 1893, p34). Using this broader definition of mutualism, it seems possible that humans and ornamental plants are also in a mutualistic relationship. So, what evidence exists to support this notion?

The temporal and spatial extent of the relationship

Humans and ornamental plants have had widespread and continuous interactions that are evident across disparate cultures and throughout since Neolithic times. As well as Neolithic graves, ornamental trees, shrubs or flowers have appeared in Cretian frescos, Sumerian reliefs, Egyptian pyramid murals and early Chinese poems and paintings; distinctive ornamental plants and landscape styles are associated with periods of Japanese, Chinese, Islamic and European history (Hyams, 1971). Archaeological digs have found evidence of ornamental gardens and gardening in association with early human settlements in Britain (Johnston, 2005).

Today, ornamental plants are not just a luxury, but a human necessity, sought after in situations of poverty just as often as edible and medicinal plants (e.g. Gopal & Nagendra, 2014). Humans cultivate ornamental plants across all inhabited continents in both developed and developing countries, across the globe, and in all climatic zones (Kendal, Williams, & Williams, 2012b). As well as being widespread, ornamental plantings within human settlements are also extensive and diverse. In lower density western cities, ornamental plants are found in public and private green space, which can cover more than half the total urban area (Loram, Tratalos, Warren, & Gaston, 2007). Scientific studies have found a curious pattern in the few ecological analyses that include ornamental plants: species diversity is often much higher in gardens, parks and streets than in native vegetation, largely due to ornamental plantings (Kendal, Williams, & Williams, 2012c)

Benefits of the relationship to ornamental plants

“How do you spread your genes around when you are stuck in one place?” asked Michael Pollan. “By tricking animals, including us, into falling in love”, he answered (Pollan, 2009, p21). Humans have long been lured into falling in love with plants. Their flowers, perhaps evolved for attracting the bees and birds that pollinate them, have also enticed humans. There is evidence of very early transportation of ornamental plants, and increasing trade through colonialism and globalisation has spread tens of thousands of species of ornamental plant around the world (Hyams, 1971). The extent of the dispersal is obvious from empirical studies of cultivated floras in gardens, streetscapes and parks. Non-native Roses (*Rosa* sp.) have been recorded as dominant garden plants from Turkey to the United Kingdom to Nicaragua and the London Plane Tree (*Platanus ×acerifolia*), a human-created hybrid, is a dominant street tree from London to Nanjing to Melbourne (Kendal et al., 2012b).

To facilitate this spread, humans ease many of the chief burdens of the plants they most love: “We select and improve, and plough and harrow the ground for our plants; we water them when they are dry; we surround them with shade trees if they need shade; we cut down shade trees if they prefer the sun; we plant their baby seedlings under glass and give them every favouring condition in which to mature; we remove what for ages have been the chief problems of their lives – we take over their two prime burdens, the burdens of self-defence and reproduction” (Burbank, 1921, pp. 3-4). Like ants gardening fungus (Weber, 1966), humans create the perfect environment for the growth of ornamental plants, weeding and tending their gardens to ensure the survival of desired species. In fact, if it were ants rather than humans gardening ornamental plants, their relationship would undoubtedly be recognised as a mutualism and one of the wonders of the natural world.

Ornamental plants have clearly evolved in response to their relationship with humans. Centuries of deliberate selection and hybridisation by humans for desirable traits such as large flowers or tolerance of urban conditions have resulted in cultivated plants that differ significantly from their wild ancestors (e.g. Hernández Bermejo & Garcia Sánchez, 2009). And as with many mutualisms, there can also be costs associated with these evolutionary changes; it is likely that some ornamental plants are now less able to reproduce and disperse without human assistance. Desirable ornamental characteristics can reduce fitness in the wild, such as foliage variegation which reduces photosynthetic potential (Downton & Grant, 1994), and double flowers, where the reproductive organs fail to develop and instead look like petals (Gorer, 1970).

Benefits of the relationship to humans

“It is unnecessary to descant on the healthfulness of gardening, the attractiveness of flowers, the delightful pleasure in watching the tiny bud gradually unfolding beneath the genial touch of spring...” declared the writers of a horticultural society in 1887 (Anon, 1887, p2). In the nineteenth century, the belief in the health (moral and physical) humans gained from access to flowers and gardens was so strong that it was not necessary to explain or justify such a statement any further. It was considered common-sense that people needed access to the fragrance and blooms of flowers and the shade and majesty of trees, in order to be mentally and physically healthy. This was necessary, not just for the health of people as individuals, but also in the enduring modern quest to ‘improve’ the nature of humanity.

More recently, scientists have been gathering empirical evidence of the nineteenth century intuitive belief in the benefits humans gain from access to plant-rich places. Large scale

studies have found significant relationships between the amount of vegetation in residential areas and lower rates of morbidity and mortality (Mitchell & Popham, 2007). Many smaller studies have shown specific positive effects of exposure to nature; people recover faster from surgery in the presence of vegetation (Ulrich, 1984), have increased cognitive functioning after 40-second views of vegetation (Lee, Williams, Sargent, Williams, & Johnson, 2015), and have increased self-esteem from participation in green-exercise programs (Barton, Griffin, & Pretty, 2012). The study by Haviland-Jones *et al.* (2005) found that flowers elicit positive emotions from both men and women. A number of comprehensive reviews of the health benefits of nature have recently been published (e.g. Bratman, Hamilton, & Daily, 2012; Van Den Berg *et al.*, 2015). However, these scientific studies rarely tell us about the specific health and wellbeing benefits of different kinds of vegetation, such as ornamental plants, or how different people respond to nature. A more nuanced understanding of both humans and ornamental plants is needed to more fully understand the relationship.

Implications of characterising the relationship as a mutualism

We argue that characterising the relationship between humans and ornamental plants as a mutualism has subtle yet important implications for thinking about humans and plants separately, and the way together they make the places they share today.

Firstly, characterising the relationship as a mutualism may help the development a mechanistic understanding of *how* benefits are conferred by ornamental plants on humans. Studies of the health and wellbeing benefits of nature and green space are largely correlative, and the mechanisms that underpin these benefits poorly understood. Recent reviews have highlighted that most research has focussed on humans with relatively little focus on how

different kinds of ‘green’ confer benefits (Bratman et al., 2012; Jorgensen & Gobster, 2010). The theories in evolutionary and cognitive psychology currently used to explain benefits of nature are poorly equipped to provide this focus. Mutualism is a complementary framework that allows existing social theories to coexist with theories and techniques from the natural sciences that could together shed light on this relationship. For example, the study of plant traits is increasingly used to understand the physiological, morphological and anatomical responses of plants to different evolutionary drivers. Perhaps a trait-based approach can be used to better understand how ornamental plants respond to human selection, and in turn shed light on the mechanisms that underpin the relationship between humans and ornamental plants.

Secondly, characterising the relationship as a mutualism legitimises the ecological study of ornamental plants and humans. Cultivated plants were instrumental in the development of vegetation sciences such as botany and plant taxonomy (e.g. Li, 1974). Yet they have been largely excluded from modern plant ecology, where ornamental plants are often characterised as ‘anthropogenic’ and contrasted with ‘natural’ plants. Yet this dualism fails to acknowledge that humans are part of the system being studied and that all urban vegetation is now both natural and cultural (Head, 2007). While not denying the negative ecological impacts of some ornamental plants, they can also make positive ecological contributions through the biological diversity present in ornamental plantings and providing food and habitat for other species. Recognising the relationship between humans and ornamental plants as a biological mutualism suggests that ornamental plants will be inevitable in human settlements wherever space and tenure allow. Including ornamental plants in the ecological study of ‘nature’ will allow much more meaningful understanding of the ecosystems associated with humans and their settlements.

Current debates within conservation biology are grappling with the realisation that preservation of historical biota is no longer the sole mission of this discipline (e.g. Kareiva & Marvier, 2012). The net of conservation is being cast wider to include more human-centred ecosystems and organisms (Marris, 2011). This creates an opportunity for the natural sciences to incorporate new ways of thinking about the natures that have been obscured by a focus on ‘pure’ nature. Mutualisms that incorporate humans may contribute to the development of a ‘more than non-human’ ecology that values humans and ornamental plants, in the way the geography has become ‘more than human’ by giving agency to plants and animals (Braun, 2005); giving them a legitimate space in the realm of the living world worthy of protection, love and care.

Conclusion

Recent calls to move past the emphasis on human relationships wild and utilitarian plants as subjects of research are not the first. In 1923, a paper was published in the journal *Ecology* declaring that an “inventory of the natural resources and underlying facts of the world” had been successfully compiled and that “knowledge of the earth’s geography” was now complete and ecologists must “turn to gardening and landscape operations to find the full exemplification of the multitudinous ways in which ecology can be applied to the matters which interest such a large number of persons in our midst today” (Harshberger, 1923, p297). We make this call again, nearly 100 years later, in the belief that taking seriously the nature closest to us allows us new insights into the ecological and social underpinnings of twenty-first century human life. Mutualism potentially provides a useful framework to do this, as it

allows existing social theory to coexist and integrate with approaches from the natural sciences to more fully understand both sides of the human-nature relationship. The enduring relationship between humans and ornamental plants provide an ideal place to apply the mutualism framework; it could facilitate a better understanding of the reciprocal benefits of the relationship, and help legitimise the study of ornamental plants in ecology.

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