# Plant blindness and sustainability

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Plant blindness

Abstract

**Purpose** – The present paper aims to examine the concept of "plant blindness" in the context of current sustainability debates. "Plant blindness" was the term introduced in 1999 by the botanists and educators James H Wandersee and Elisabeth E Schussler to describe what they saw as a pervasive insensitivity to the green environment and a general neglect of plants on the part of biology education.

**Design/methodology/approach** – The fundamental importance of plants for life on Earth and the socio-educational challenges of redacted awareness of this importance are considered. Also, the diverse physiological, psychological, philosophical, cultural and geopolitical origins and consequences of indifference to plants in relation to aspects of sustainability agendas are examined with special reference to education.

**Findings** – An examination of the outcomes of a range of research and practical initiatives reveals how multidisciplinary approaches to education and public engagement have the potential to address the challenge of "plant blindness". The need for these opportunities to be reflected in curriculums is not widely appreciated, and the socio-economic forces of resistance to confronting plant neglect continue to be formidable.

**Originality/value** – Plant blindness is a relatively new field of research, and the full breadth of its implications are only gradually becoming apparent. If the present paper contributes to positioning plants as an essential element in sustainability education and practice, it will have met its objective.

**Keywords** Biology, Education, Environment, Ecology, Conservation, Biodiversity, Perception, Ethics, Culture, Globalisation, Interdisciplinary, UN SDGs

Paper type General review

#### Greenness and sustainability

A recent online search of publication databases using the term "sustainability" returned more than 4 million hits. It is quite likely that each of these records has its own variation on the definition of sustainability. It also seems that each practitioner of each discipline tends to put their own specialty at the heart of the search for answers to the sustainability crisis. As plant biologists, the present authors are no different. If there is one word that embodies reactions to the perfect storm of climate, biodiversity, environment and socioeconomic emergency it is "green" – think of green energy, Greenpeace, greenwash, green economy and so on. What is all this green stuff? Plants, of course. We argue that plants = life (Galbraith, 2003) and should be central to the sustainability debate, but the relationships between humans and plants are complicated and thus place serious obstacles on pathways to global sustainability. Here, we discuss one such disconnection of "plant blindness".



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#### IJSHE Plant blindness: a real thing and a real problem

The heading of this section is taken from a short blog by Angelique Kritzinger (2018); it captures the importance, and the paradox, of an issue that challenges the whole notion of sustainability. Without plants, there would be no life on Earth – indeed, there would have been no geochemistry and physics to provide a substrate for the origin and evolution of biology on the planet (Beerling, 2017; Flannery, 1999; Knapp, 2019; Knight, 2008). It is estimated that more than 20% of plant species are threatened with extinction; more than all described birds, mammals, reptiles, amphibians and fishes combined, but awareness of, and resources for, plant conservation is meagre (Westwood *et al.*, 2020). Why therefore are plants not taken more seriously? The term "plant blindness" was introduced in an influential paper published in 1999 by two botanical educators, Elisabeth Schussler and the late James Wandersee, Various commentators, over the past hundred years, have been concerned with the seemingly "zoocentric" nature of biology education in schools (Uno, 1994) and the undervaluing of university botany courses (Drea, 2011). Wandersee and Schussler brought the issue into sharp focus by treating the issue as a research topic. In so doing they defined a field of interest that has attracted transdisciplinary researchers for over 20 years (Sanders, 2019a).

Central to the debate concerning human appreciation of plants is the seemingly embedded notion, in much of environmental education literature and practice, that humans are increasingly alienated, and separate, from nature (Fletcher, 2017). Such perceptions are highly misleading, built upon the notion that "nature" and "culture" are detached entities, although it is certainly true that much of industrialized human society is generally egocentric, or at least zoochauvinist (Bozniak, 1994). A political ecology perspective on plants recognises that human and more-than-human life (Fletcher, 2017; Sanders, 2019b) is not a dichotomy of nature and culture but a complex assemblage of intertwined entities and actions.

In their work, Wandersee and Schussler considered plant blindness to be a serious and problematical type of cognitive bias, comprising an inability to recognize the importance of plants in the biosphere and in human affairs, a failure to appreciate the aesthetic and unique biological features of the life forms belonging to the Plant Kingdom, and a misguided, anthropocentric ranking of plants as inferior to animals, leading to the erroneous conclusion that they are unworthy of human consideration. The specific features of their emergent theory of the state of plant blindness are as follows:

- deficient awareness leading to treatment of vegetation as merely a backdrop;
- lack of mindfulness of plants in daily affairs;
- · failure to understand the different time scales of human and plant worlds;
- absence of encounters with and hands-on experience of plants;
- scientific illiteracy regarding basic botany and ecology;
- scant knowledge of plants in global energy and material cycles; and
- insensitivity to the aesthetic qualities of plants (Wandersee and Schussler, 2001).

What makes humans plant-blind? There is continuous debate among educators and researchers as to the relative contributions that innate tendencies, cultural conditioning and pedagogical bias make to human perceptions of plants. The following discussion considers the salient features of this discourse and seeks to identify the influences and role of education with implications for meeting sustainability objectives.

#### Human physiology and psychology: Are humans intrinsically plant blind?

Plant blindness appears to be, at least in part, a matter of perception (Figure 1), and a number of studies have attempted to understand how people see the world and where plants fit in to their experience. Researchers seek to determine to what extent plant blindness is acquired or intrinsic. Is there something about the way humans are made, physically or psychologically that predisposes them to overlook plants? Is it to do with what the novelist Annie Proulx calls "bad wiring in the human brain?" Wandersee considered it significant that, according to data on visual perception, individuals prefer to view objects that lie between 0° and 15° below the imaginary horizontal line that represents their own eye level. This led him to name his research group the 15 Laboratory (Figure 2). Even when plants occupy the  $0^{-15}$  zone, their lack of movement and the optical limitations of, for example, edge-detection render them effectively invisible. The 15° Lab was set up to put into practice principles of research and teaching developed to address plant blindness in the broad sense. The acuity with which animate and inanimate objects are distinguished is, at least partly, ancestral in origin. This is implicit in the work of New et al. (2007) and Prokop and Fančovičová (2014, 2018) on the adaptive memory and information retention of students in terms of their awareness of whether fruits are toxic or edible, and of Schussler and Olzak (2008), who evaluated students' recall of plant and animal images. Age, gender and parental influence have measurable parts to play in how students relate to plants (Strgar, 2008; Cameron-Faulkner et al., 2017; Lindemann-Matthies, 2005). Likewise cultural context matters (Kohn, 2013). The studies of Swann and Pve (2019). Tunnicliffe and Reiss (2000) and Wandersee (2005) presented evidence that understanding student preferences and exposure to the right images of aesthetic value can raise awareness of plants and demonstrated the usefulness of neuroscience and cognition studies for throwing light on how the mind creates



Figure 1. What do you see? Two birds, or the innumerable plants on which they depend?

Source: Pixabay (https://bit.ly/2CVxr4r)

	Home	Analyzing and improving biology instruction								
	The 15º Laboratory's Name	A Visual Cognition Research								
	The Laboratory's Mission	and Development Laboratory								
	Giverny Award Description	for Improving Biological and Botanical Learning								
	Giverny Award Winner List									
	2020 Giverny Award	15° Laboratory Founder: James H. Wanderse, 1945-2014 BS. MS. PhD. FAAS, FLS								
	2019 Giverny Award	Former W.H. LeBlanc Alumni Association Professor of Biology Education (LSU)								
	2018 Giverny Award	15° Laboratory Director:								
	2017 Giverny Award	BS, MS, MEJ, PAD, FAS Professor of Geocianess (MSU) E-mail: rclarvBoesci.mstate.edu								
	2016 Giverny Award									
	2015 Giverny Award									
	2014 Giverny Award	Established in 1996 at Louisiana State University,								
	2013 Giverny Award	in the USA. It yielded over 50 Ph.D. degrees. Our graduates work at such places as US research universities, international								
	2012 Giverny Award	universities, medical schools, state universities and HCBUs, NASA, private colleges, community colleges, private and public high schools & middle schools, public aquariums, nature parks, arboretums, and botanical gardens. 15 'Laboratory members continue the work and life mission of our mentor and friend,								
	2011 Giverny Winner									
Figure 2.	2010 Giverny Winner	Professor James Wandersee (1946-2014)								

## 

The 15 Laboratory

#### Source: www.15degreelab.com/

representations of the environment. In this connection, machine-learning approaches have great potential to model students' cognitive structures of the concept of life (Yorek and Narli, 2009: Yorek et al., 2016).

It has been argued that "plant blindness" is itself a problematical term. A recent article by McDonough MacKenzie et al. (2019) makes the point that the term is "disenfranchising and exclusionary" and that it is "ableist" in the way it refers to disability and cures. These reservations have led some researchers and educators to seek an alternative name for the phenomenon. A recent example is the proposal by Parsley (2020) that "plant awareness disparity" (PAD) better expresses the phenomenon and avoids any ableist overtones. Online discussion of this paper has revealed polarised opinions, and it seems likely that it will take some time and argument before PAD becomes the generally agreed term. For the present work we use Wandersee and Schussler's original conception of plant blindness as metaphorical. We recognise that a better term, in relation to current published critique, is needed.

### Philosophy and "plantness"

There seems, in certain cultures, to be a philosophical disposition to undervalue plants, which some scholars have traced back to Aristotle. In his enquiries into the nature of the soul, he concluded that plants could not have anything that could be called a soul and therefore, by definition, are not alive (Gagliano, 2013; Yorek et al., 2009). The origin of the very words "animal" and "animate" is Latin *anima*, meaning breath or soul; the OED defines it as "The animating principle in living things, the soul; some part or aspect of the soul, *esp.* the irrational part of the soul as distinguished from the rational soul or mind, animus". Such is Aristotle's continued influence that the notion of animals being alive whereas plants are not persists in one form or another up to the present day and still presents educators with obstacles to addressing plant blindness. In the past,

philosophers have tended to avoid ontological and ethical engagement with vegetal life, but there are signs of growing appreciation of the need to value and respect plants in response to environmental and ecological crises. Darley (1990) refers to the essential "plantness" of plants, which renders their features as living organisms remote from and alien to human experience. Following Trewavas (2002), Hershey (2005) proposed a way to demystify this gap in understanding by defining as "intelligence" the way in which plants sense the environment and adapt accordingly (Plate 1), but Flannery (2002) and others have objected to this use of "animal metaphor". As Balas and Momsen (2014), Sanders (2019b) and Vujakovic (2021) point out,



Plant blindness

Plate 1. Plants are aware. This bean plant senses the proximity of the support and twines around it (Jones *et al.*, 2012. Original picture from Wendy Silk, reproduced with permission) plants and people have evolved fundamentally different relationships with time, with implications for how they and we interact and relate to the environment. Having surveyed the broad implications of human insensitivity to plants, Hershey (2002) concludes that, when it comes to plant blindness, "the enemy is us" and has provoked a debate on the ethical and philosophical dimensions of human–plant relationships which is ongoing (Gagliano, 2015; Gagliano *et al.*, 2017; Hall, 2011; Marder, 2013).

In relation to philosophical perspectives on plants, many now consider a critical element of this discourse to affirm the diverse relationships with plants being lived out amongst different peoples, cultures in which notions of "self-hood" and "we" are ontologically pluralised (Kohn, 2013). In this connection, the artists Snæbjörnsdóttir and Wilson (2010) have questioned how art can create "parities in meeting" between species, thus situating ideas of cultural practice in alignment with the more-than-human world.

#### Religion, politics and the active elimination of plant awareness

Throughout history, certain plants have been removed from common experience for doctrinaire reasons. The story told by Jung Chang (author of *Wild Swans*) is a dramatic, but by no means rare, example of anathematising plants because of their political or religious symbolism. In an interview about life under Mao Zedong (Sethi, 2019), Jung Chang recalled "When I was in school we all had to go out and remove grass from the school lawn as he had just issued the order that cultivating flowers and grass was a bourgeois habit. In my house there was always a vase with flowers – one day it disappeared, and the parks became wastelands. When I first came to Britain and saw flowers I was beside myself with joy." It is notable that this tale has a built-in paradox. In a famous speech to the 1957 Supreme State Conference in Beijing, Mao Zedong declared "Let a hundred flowers bloom" (de Bary and Lufrano, 2000). As the Hundred Flowers Movement got out of hand, he subsequently announced that the "fragrant flowers" must be distinguished from the "poisonous weeds". There followed the Great Famine of 1958–1961 in which an estimated 30 million or more starved to death (Smil, 1999).

Darnel (*Lolium temulentum*), a widespread and noxious weed of cereal crops from prehistory to the early modern era, is an example of a plant almost completely redacted from common experience for religious, political and technological reasons (Thomas, 2019). Its poisonous and subversive nature is reflected in the biblical parable of separating the wheat from the tares. This metaphor was used in the late 14th century to denounce the Wyclif heresy, followers of which were called Lollards (Patterson, 2005; the name Lollard was probably derived from *Lolium* – Thomas *et al.*, 2016). The first edition of the Wyclif Bible referred to "dernel", but subsequent editions and the authorised King James version substituted darnel with tares, a completely different weed species, thereby suppressing any heretical connection. Darnel occurs several times, and with various names, in the plays of Shakespeare, invariably associated with treachery and sedition (Archer *et al.*, 2014a). As agriculture intensified and mechanised crop production was introduced during the industrial era, darnel was eliminated from the food chain and now it is effectively extinct in technologically advanced countries (Thomas, 2019).

Authoritarian influences conditioning attitudes to plants are common in world religions. For example, in the earliest books of the Old Testament, trees as symbols of good and evil, unrelentingly punishing dependence on plants for sustenance, and the release of pestilential weeds into the world are taught as manifestations of the Curse of Cain and resonate throughout the history of the Abrahamic religions. It was shepherds and not crop growers that attended the Nativity (Archer *et al.*, 2014b; Thomas, 2017).

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#### Plants in different cultures

Human-plant relationships are fundamentally conditioned by cultural factors. As noted earlier, the intersection between plant blindness and world cultures is multidimensional and embraces the disciplines of ethnobiology, anthropology, and political and cultural ecology. Head *et al.* (2014) and Fleming (2017) emphasise the profound cultural importance of plants at the heart of "vegetal politics". Insensitivity to plants can be seen to have origins in declining engagement with the ethical basis of the holistic interconnectedness of living things. Ellis (2018), Gibson (2018) and Head and Atchison (2009) discuss lost relationships with plants in the context of ethnobotany, geography and anthropology. Cultural aspects of such relationships are often significant, and Turner (1998) and Kimmerer (2013) explain how indigenous knowledge evolves from learning about, and through, the plants people live among.

A paradoxical aspect of the plant blindness phenomenon as it occurs in the (post-) industrialised urban and suburban context is the apparently strong culture of gardening, and of visiting botanical and show gardens for leisure. The high profile of popular gardening columns and programmes in the print and broadcast media seems at odds with the argument that plant blindness is pervasive, as does the appearance of books in the "New Nature Writing" category on the best-seller lists in recent years (Moran, 2015). Nevertheless, from the perspective of global land use over the course of human history and changing socioeconomic circumstances in a rapidly urbanising world (Ellis *et al.*, 2013), the gardening/ natural history argument against plant blindness may be considered a minor anomalous matter. As Archer *et al.* (2014b) show in their account of the literary history of relations between humans and the land, ecosystems beyond the garden wall or the field margin were long regarded as savage, untameable, hostile and fearsome, whereas gardens are, to use the words of Alexander Pope, "Nature methodised". The question of the seemingly tense evolutionary relationship between people and vegetation, of which plant blindness appears to be a deep-rooted feature, is addressed in further detail by Thomas (2017).

Modern technologies, such as digital databases, machine learning and artificial intelligence, give a very different perspective on how ecological and conservation connections may be recovered or uncovered as events within the virtual world; for example, the types of floristic attributes that attract searchers to specific plants. Ladle *et al.* (2016, 2017) refer to this field of study as "culturomics". Another cultural-historical factor underlying plant blindness is the history of colonisation and imperialism, which has generally unleashed overwhelming forces that are at best dismissive and at worst destructive of multiple webs of interdependence between people, vegetation and the environment. Even many of the plant collections on which hopes of addressing the question of plant blindness are placed – botanic gardens, herbaria, museums, for example – are themselves products of imperialistic and utilitarian histories. See, for example, the complex sociopolitical origins of the Economic Botany collection of Kew Gardens in utilitarian colonialism as discussed by Carroll (2018).

#### Industrialisation, urbanisation and globalisation

In an era when more than half the world's population now lives in cities, people have become distanced from the more-than-human world and detached from the sources of their food, fuel and fibre. In the globalised neo-liberal contexts in which much of the world now exists, plant ecology must give way to business and profit – as the issue of SSSIs on the route of the UK's major new railway line HS2 (Parliament UK, 2019) and renewed assaults on green belts currently show. Plant blindness is a particular feature of urban life, but many studies emphasise how urban green spaces can have a beneficial counteractive effect (Colli-Silva *et al.*, 2019) and

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environmental design can offset the tendency for plants to be overlooked in favour of animals (Nyberg *et al.*, 2019b). Sachdev (2019) has described the promotion of plant awareness in Indian cities through street arts and crafts, and Wyner and Doherty (2019) report that students' perception of plants is raised by observations of urban trees.

The international trade in plants and plant products of agricultural and wild origin is an underappreciated aspect of globalisation. Plant blindness is a factor in unsustainable practices and deteriorating biodiversity. The international legal framework covering how exploitation of and trade in living organisms operates is set by the CITES convention and there is a variety of further regimes and initiatives that give clear guidance on legal and sustainable behaviour for responsible consumers, importers, manufacturers, and retailers of wild plants and their products (lenkins *et al.*, 2018). But generally speaking, the relatively low status of plants at the level of global instruments that formalise conservation policy and legal oversight in connection with trade is a kind of institutionalized plant blindness (Margulies et al., 2019). Zoocentrism pervades the illegal international trade in endangered species and their products. There is widespread awareness of the plight of animals such as elephants and pangolins. And vet green crime (illicit trade in plants and plant products; Ngoc and Wyatt, 2013) is just as serious (Figure 3) and has a devastating effect, both on biodiversity and, through the global movement of pests and diseases, on food security (Oliveira et al., 2020). Underlying these examples of collapsing sustainability (not to mention downright criminality) is a systemic failure of education.

#### Transdisciplinary approaches addressing plant blindness

Plants are in danger of fading from the western imagination (Lewis-Jones, 2016). Sanders (2019a) and Rabanus-Wallace (2020) argue the case for research into plant blindness that transcends disciplinary boundaries. In the early years after the concept of evolution entered



#### Figure 3.

Proportion of different types of endangered wildlife among total seizures, 2005–2014 (data from United Nations Office on Drugs and Crime)



the mainstream, representations of the flourishing of the first life on land acknowledged and celebrated the place of plants in pictorial tableaux of "deep time". But zoocentricity and plant blindness increasingly changed the focus, at least in part under the influence of human- and animal-centred popularisers of evolution (Vujakovic, 2019). Cross-disciplinary initiatives promise to be among the most effective measures for raising awareness and the status of plants (Rodgers and Kremar, 2017; Snæbjörnsdóttir et al., 2020). Art-based research practice is now seen as a key partner in making plants public (Snæbjörnsdóttir *et al.*, 2020) and contemporary commentators are reviewing previous artworks in the light of "plantness" (see for example Aloi's discussion of Freud's botanical works; Aloi, 2019a) In contrast, however, we recognise that major European movements, such as *De Stijl* and *Der Blaue Reiter*, explicitly rejected the colour green and anything associated with it (Figure 4). Nevertheless, as shown earlier, the picture is radically shifting. All aspects of the arts – visual, literary and performance – are being actively explored in relation to botanical and eco-awareness. As concern about the state of the world's environment grows, there is evidence of an increase in the significance of plants in cultural politics and the curation of works with vegetal themes in art galleries (Aloi, 2019b). Insights from children's drawings (Comeau *et al.*, 2019), the value of museums and galleries, the significance of aesthetics (Jakobson and Wickman, 2008), and even the philosophical basis of architecture (Lee, 2014) have all been explored through education and public outreach as facets of the human-plant relationship.

Writing as an educational tool, as textual criticism, and as literary creativity revealingly interrogates the nature of human awareness of and engagement with the world of plants (White, 2019). Among the more unusual perspectives on plant-human relations are the works by Keetley (2016), who argues that vegetal nature is horrifying because it reminds us too acutely of mortality, and Sullivan (2019), who considers the ways in which plants are central to, but overlooked in, the history of industrialization and ecology in the Anthropocene. The changing face of human interaction with plants and the natural environment is reflected in the applied arts, as exemplified by trends in motion picture animation (Ebedes, 2018; Prévot-Julliard *et al.*, 2015; Lima, 2016). Moreover games and role-playing have growing potential to capture student and public interest in plant life (for example Borsos, 2019; Friedersdorff *et al.*, 2019; Van Nuland *et al.*, 2019).



## Trees! How ghastly!

Piet Mondrian

Figure 4. Colour green is noticeably absent from the artworks of modernist movements such as *De Stijl* 

**Notes:** According to Wassily Kandinsky: "As a picture painted in yellow always radiates spiritual warmth, or as one in blue has apparently a cooling effect, so green is only boring"

#### IJSHE State of botanical and ecological education

Education might be expected to provide answers to the plant awareness question; but education appears, in some contexts, to be part of the problem to a considerable degree. Wandersee and Schussler originally addressed plant blindness in the context of the American education system, but subsequent studies have identified multiple aspects of the question of plants and their position in educational contexts. In 1955, S.S. Greenfield expressed concern that botanical education was falling behind other sciences (Greenfield, 1955), and Uno (1994) reported that no US undergraduates wanted to major in botany. The last botany degree course in British Universities was withdrawn in 2010 (Drea, 2011). The academic discipline of botany became plant science, which became subsumed into life science, and eventually submerged in environmental and biomedical science. In addition, plants appear to have an image problem. Students show strong preferences for animals over plants as objects of study (Kinchin, 1999), often regarding plants as boring. This is reflected in, and often at least in part results from, curriculum materials, in which plants are generally underrepresented and introduced in less engaging ways than animals (Wandersee, 1986; Schussler et al., 2010; Sanders and Jenkins, 2018). Gender has been found to play a part in students' interest in plants (Fritsch and Dreesmann, 2015) although by no means can it be said to be universally true. One of the issues in this area is the research methods and tools by which we evaluate what the educational challenges are (Balas and Momsen, 2014), which disciplines are engaged in the research (e.g. psychology, education, biological science, philosophy) and indeed, how populations vary in their connections with plants, particularly when considering emotional and aesthetic relationships (Nyberg et al., 2019a) in diverse cultural and climatic contexts. Several studies have confirmed that curriculum representations and coverage are a factor in the challenges teachers face when endeavouring to make the importance of plants more public (Amprazis and Papadopoulou, 2018). It follows that research into the place of plants *across* the curriculum is critical in the current socio-environmental climate. Likewise, characteristics of plants that appear to draw people into their life narratives are needed. Recent work by Thorogood (2020) and Sanders (2019a) demonstrate that not all plants are considered to be boring. One of the key elements of this work is to challenge perceptions of plants by offering a broader diversity of plant narratives within educational contexts. Such a move was advocated by Honey (1987) when he suggested that teachers needed to draw attention to "varied and interesting aspects" of plant-life. This, of course, requires teachers themselves to have a good education in "Life as Plant". Thus we can argue that the pedagogical challenge is both an "epistemological obstacle" (Bachelard, 1938), in which everyday life knowledge inhibits perceptions, and a "didactic obstacle" (Clement, 2007), where previous science teaching experiences appear to disengage learners (Uno, 2009). In the former, plant blindness is very much an obstacle; the latter obstacle arises from an iterative cycle of zoocentric curricula and limited subject content knowledge, which is perceived to impede teachers' teaching and learners' learning (Hershey, 2002; Uno, 2009; Nyberg and Sanders, 2014).

#### Sustainability in an era of plant blindness is unsustainable

We have recently published a bibliography of plant blindness (Sanders *et al.*, 2020) and can certainly agree with Amprazis and Papadopoulou (2020) that the topic is a highly active, possibly even a "faddish", field of research and publication. The latter authors address an important issue: "while sustainable development is a top priority for every modern society, it has not yet been established whether plant blindness can be a substantive impediment towards this direction." They then go on to analyse how plant blindness relates to the *United Nations Sustainable Development Goals* (SDGs). Plant blindness and sustainability are

connected through conservation and biodiversity. As Balding and Williams (2016) point out, insensitivity and perceptual bias are possible reasons for the disadvantage experienced by plant conservation initiatives compared with animal conservation projects. A number of reports by international bodies have placed plants at the heart of strategies to achieve sustainability goals. For example, the *Global Partnership for Plant Conservation* has mapped the actual and potential contributions of flora to meeting the 17 SDGs (Sharrock and Jackson, 2017). Delegates at the 2017 International Botanical Congress in Shenzhen, China, issued the *Shenzen Declaration*, which describes how plant science research and education should contribute to a sustainable future (Raven, 2019; seven priorities).

The Shenzhen call for action: seven priorities given as follows:

- (1) To become responsible scientists and research communities who pursue plant sciences in the context of a changing world.
- (2) To enhance support for the plant sciences to achieve global sustainability.
- (3) To cooperate and integrate across nations and regions and to work together across disciplines and cultures to address common goals.
- (4) To build and use new technologies and big data platforms to increase our exploration and understanding of nature.
- (5) To accelerate the inventory of life on Earth for the wise use of nature and the benefit of humankind.
- (6) To value, document, and protect indigenous, traditional, and local knowledge of plants and nature.
- (7) To engage the power of the public with the power of plants through greater participation and outreach, innovative education, and citizen science.

The clear and consistent message from the global community of educators and scientists is that poor awareness of, or indifference to, the fundamental significance of the phytosphere is a persistent obstacle to environmental balance, and consequently the achievement of SDGs. This makes the need to address disdain of plants a vital issue for the scientific community and policy makers, and confirms education as the main social process for bringing about the necessary changes in perception and understanding; although with a caveat, as Nyberg *et al.* (2019a) note:

"In our study student teachers expressed a greater diversity of plants nominated as favourite than animals. This suggests that, rather than bemoaning the fact that flowers do not have faces and forward-facing eyes, our teacher students are drawn to a rich range of plant forms, albeit most of which are seed plants with conspicuous flowers. Our findings thus show that there is much potential for building human-plant relationships. However, critically, these findings demonstrate that the majority of the answers stem from either culturally or personally shaped experiences: few students recall an educational experience or setting when presenting motivation for their favourite specimen, be it animal or plant... This finding clearly calls for a closer examination of teacher education to investigate the extent to which we prepare our teacher students for the specific task of understanding the biological importance of plants."

In conclusion, we can see how plant blindness maps onto the sustainability landscape. Confronting it has certainly faced much resistance, and continues to do so. The trajectory of remediation is nothing if not slow. The status of humans and other vertebrates in the "tree," or "pie," of life is barely significant in numerical or biomass terms (Miralles *et al.*, 2019; Larsen *et al.*, 2017; Bar-On *et al.*, 2018). Nevertheless pressure from societies preoccupied with human wants and needs is driving global crises in biodiversity (Balding and Williams, 2016; Brummitt *et al.*, 2015;

Havens *et al.*, 2013) and climate change (Heywood, 2017; Legagneux *et al.*, 2018). Education is essential in responding to these challenges, by valuing and respecting the "plantness" of plants, thereby confronting the exigency of plant blindness; only education will allow us to recover and discover the knowledge we urgently need to create a sustainable future for the planet (Sanders *et al.*, 2015). In this, the training of teachers, as noted in our discussion, will be critical.

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