

Research Paper

Attractive, climate-adapted and sustainable? Public perception of non-native planting in the designed urban landscape



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HIGHLIGHTS

- 75.3% participants positive about climate-adapted non-native planting.
- Climate change identified as major driver of acceptance of non-native plants.
- Acceptance also related to aesthetics, context, perceived invasiveness.
- Perceived attractiveness not related to perceived nativeness.
- Contradictions in perception of non-native plants identified.

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ABSTRACT

Throughout Europe climate change has rendered many plant species used in contemporary urban planting design less fit for use in public greenspaces. A growing evidence base exists for the ecological value of introducing non-native species, yet urban policy and practice guidance continues to portray non-native species negatively, focusing on their assumed invasiveness. In this context there is a lack of research focusing on the cultural relevance of non-native species in the urban landscape. To address this gap we surveyed 1411 members of the UK public who walked through designed and semi-natural planting of three levels of visual nativeness: “strongly native”; “intermediate” and “strongly non-native”, whilst completing a site-based questionnaire. Semi-structured, in-depth interviews were then carried out with 34 questionnaire participants. A majority (57.6%) of our respondents would be happy to see more non-native planting in UK public spaces, rising to 75.3% if it were better adapted to a changing climate than existing vegetation. Respondents recognised the three broad levels of nativeness, yet this was not a factor driving perceptions of the attractiveness of the planting. In addition to climate change, we identified four key factors driving acceptance and rejection of non-native planting: *aesthetics*; *locational context*; *historic factors and inevitability*; and *perceptions of invasiveness and incompatibility with native wildlife*. Our research indicates that in the context of a changing climate, focus should be placed on the potentially positive role of non-invasive, climate-adapted, aesthetically pleasing species within urban planting schemes as these could be well-received by the public.

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1. Introduction

In much of contemporary urban policy and practice non-native plant species are presented as being of little value at best or harmful at worst. These positions feed an overriding presumption within many planners, landscape architects, local authority officers and

conservation practitioners that the sustainable urban green infrastructure of the twenty first century should consist exclusively of native planting (Davis et al., 2011; Hitchmough, 2011). Policy guidance such as *BREEAM UK New Construction non-domestic buildings technical manual (2014)* reinforces this stance, advocating the exclusive use of native plant species in order to ‘minimise impact on existing site ecology’. At the local level in the UK, biodiversity action plans highlight ‘reducing the impact of non-native species’. The main argument used in defence of this position is the assumed invasiveness of all non-native exotic plant species (Pollan, 1994) yet many of the claims which drive this perception of the aggressive invasive alien are not backed by data (Davis et al., 2011).

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Scientific, and ultimately much wider public concerns about non-native plants can be traced back to Elton's (1958) *The Ecology of Invasions of Animals and Plants* that led to the discipline of Invasion Ecology, yet recent findings indicate that agriculture is profoundly more harmful to biodiversity than even the most aggressive, invasive non-native plant species (Burns et al., 2016). A clear body of evidence now exists that invasiveness is not a fundamental property of non-native plant species but rather a characteristic of both native and non-native species possessing certain ecological traits (Didham, Tylianakis, Hutchinson, Ewers, & Gemmell, 2005; Gurevitch & Padilla, 2004; Sagoff, 2005; Thomas & Palmer, 2015; Thompson et al., 2003) and a growing minority within ecology now see hostility towards non-natives as a diversion from the real issue of maintaining diversity in ecosystems, a role towards which non-native species can make a positive contribution (Davis et al., 2011). Gleditsch and Carlo (2010), Owen (1991) and Smith et al. (2006) have shown that non-native plant species are equally valuable as food sources for many native animals and more so in some cases than native species. Non-native plants can also provide specific benefits to native invertebrates such as the extension of pollen and nectar availability beyond the flowering season of native plant species (Salisbury et al., 2015).

Another important factor in hostility to non-natives is the idea that they do not belong; that they are brought here by people, are not fit for the environment and hence lie outside what is "natural". This idea is rooted in the notion that the past was like the present, which is clearly not the case. Within our own time climate change has already had a profound impact on the distribution of plant and animal species throughout the world, with species migrating polewards or to higher elevations as temperatures rise (Hickling, Roy, Hill, Fox, & Thomas, 2006; Parmesan, 2006; Parmesan & Yohe, 2003) fashioning new ecosystems. It is unrealistic and impractical to attempt the restoration of habitats to 'some "rightful" historic state' (Davis et al., 2011) consisting exclusively of currently native species, because climate change will render some of these (such as *Betula pendula* in Southern England) increasingly poorly fitted. Within designed urban landscapes there is a need to incorporate new species with potential utility in terms of 'fitness' to a warming climate, but this raises questions of what is culturally acceptable (Hitchmough, 2011).

Biological concerns about the invasiveness of non-native plants and their incompatibility with native wildlife seem to have morphed in some cases into the belief that these plants are less attractive or culturally relevant to people than native plants (Hitchmough, 2011). Indeed, attitudes to non-native plants are heavily constructed within cultures (Coates, 2006; Head & Muir, 2006; Kurz & Baudains, 2012; Zagorski, Kirkpatrick, & Stratford, 2004) and have fluctuated widely in Britain and many other countries over past centuries (Chew, 2009; Starfinger, Kowarik, Rode, & Schepker, 2003). In parts of the world most recently colonised by Europeans such as Australia and New Zealand native plants were initially viewed negatively as 'common' and 'aggressive' for the first half of the 20th century, while northern hemisphere plants from North America, Europe and Asia were valued as rare and out-of-the-ordinary (Aitken, 2016). Towards the end of the 20th century native plants became fashionable, in parallel with Australia and New Zealand's growing identity as Australasian-Pacific nations (Jay, 2004). In these parts of the world, where cultural and institutional disdain for non-natives is particularly high and attitudes to natives are politically contested due to these historic factors, non-native plants remain popular with many gardeners who are free to choose what they plant, (Kendal, Williams, & Williams, 2012; Zagorski et al., 2004). Landscape preference studies in Australia and New Zealand (Head & Muir, 2006; Jay & Stolte, 2011; Kendal et al., 2012; Kurz & Baudains, 2012; Zagorski et al., 2004) have considered 'nativeness' as a specific plant or garden trait. Kendal et al. (2012),

found clear patterns of preference for both visual plant traits such as leaf colour and flower size, and 'nativeness'. The response to native plants was polarised, however, with some people reacting very positively to them, and others strongly disliking them. In Australasia, plants imported and popular during the colonial past typically had larger flowers and more luxuriant leaves than many highly xeric native species, suggesting that preference was as much to do with morphology and fashion as nostalgia for the country of origin. Evolutionary habitat theories of landscape preference predict a lower preference for native Australian plants, as their frequently narrow leaves indicate a poor-quality habitat (Williams & Cary, 2002). Social and cultural values may, however, override this evolutionary response, with evidence that higher levels of educational attainment may promote greater acceptance of the aesthetics of native plants due to enhanced environmental knowledge (Kendal et al., 2012). These findings are broadly consistent with those from earlier studies (Head & Muir, 2006; Zagorski et al., 2004). In contrast, other studies conducted in the USA (Nassauer, Wang, & Dayrell, 2009) and in Western Australia (Kurz & Baudains, 2012) concluded that attitudes to native plants were largely related to gardening norms in the neighbourhood. Preference for native and non-native plants is likely to be most polarised where native and non-native species look very different, as in, for example the Southern Hemisphere.

In Europe, historically, non-native plants were positively perceived as novel and interesting (Shephard & Musgrave, 2014; Wulf, 2008) and widely used in landscapes and parks since the Renaissance (Steele, 1793) and in many cases long before this. Here attitudes to non-natives appear to be less polarised (Fischer et al., 2011) perhaps because it is more obvious to all that most landscapes are heavily culturally transformed (Hitchmough, 2011) and that non-native plants are important in these transformations. To date however there appear to be few studies that have examined how important notions of nativeness in landscape planting are to European citizens. An issue central to this is the capacity of lay people to distinguish between native and non-native plants in practice in the landscape. Alien plants have been important in European culture for so long, that public understanding of what is native and non-native have often become very confused (Davis et al., 2011). If this is the case then "nativeness" is little more than an abstract idea. Findings from an extensive (n = 2378) European study (Fischer et al., 2011) suggest that "nativeness" is not an identifiable visible characteristic for the general public, who are most likely to make judgements based on perceived attractiveness of species to themselves. Within this line of reasoning Rodriguez et al. (2004) have argued that plant attractiveness to the public should be a criterion used in biodiversity management. Hitchmough (2011) has suggested that landscape professionals and householders with private gardens in Britain and many other parts of the world chose plants because they found them attractive or useful, rather than because they were native or non-native. This view is supported by research conducted in 61 domestic gardens in Sheffield, (Smith, Gaston, Warren, & Thompson, 2006) which indicated that 30% of garden plants were natives (mostly unchosen garden and lawn weeds) and 70% non-natives (mostly chosen), mainly from Europe and Asia, suggesting an acceptance of and perhaps preference for the use of non-native plant species in these contexts amongst the UK population. This raises fundamental questions about why, outside of landscapes whose primary role is biodiversity conservation, non-invasive, but well-fitted non-native species should be posited as inappropriate within urban landscapes.

The study discussed in this paper focuses on public reaction to actual woodland, shrub and herbaceous planting in designed urban landscapes composed of native and non-native plant species, in an attempt to unpick these complex ideas. The environment is experienced rather than simply looked at (Ittleson, 1973) so in order to inform sustainable and culturally relevant landscape

design our study was conceived at the scale of assemblages of plants, rather than that of individual plant species. A method was devised whereby participants walked through areas of planting as an immersive experience. Planting was characterised as possessing one of three *species characters*: *strongly non-native*, *intermediate* or *strongly native*. This gradient of character was derived from the specific morphology or visual traits of the species present within the planting in terms of their similarity to common native species. The structure of the planting or way in which the individual plants were assembled was also considered, although this is the focus of another publication. For the purpose of the research we hypothesised that species–plantings that resemble native UK species and vegetation are seen as more familiar to UK citizens. We then proceeded to ask: 1) **How accepting are people of non-native planting in the designed urban landscape?** 2) **Can people distinguish between native and non-native planting in these settings?** 3) **What are the key factors that drive acceptance and rejection of native and non-native planting in these settings?** 4) **Do these perceptions change when seen against a background of climate change?**

2. Methods

Our study involved a well-established (e.g. Jorgensen, Hitchmough, & Dunnett, 2007) two-stage mixed methods approach. A large sample of 1411 site users were guided to walk through woodland, shrub and herbaceous planting of strongly non-native, intermediate or strongly native species character at 31 sites throughout England (Fig. 1) whilst participating in a questionnaire survey. Semi-structured, in-depth interviews were then carried out with 34 of these original questionnaire participants.

2.1. Selection of case study sites

Specific case study sites (Figs. 2–4) were selected to represent the three species characters: strongly non-native, intermediate and strongly native. In the UK strongly native vegetation is exemplified by deciduous woodland, shrubby woodland edge and herbaceous communities of tall grasses and forbs, all composed of native species. For example, in the case of woodland, broadleaved deciduous trees represent a ‘strongly native’ species character, whereas broadleaved evergreen species such as *Eucalyptus* and *Cordyline australis* are ‘strongly non-native’ in species character (Fig. 2). In the case of woodland (Fig. 2) and herbaceous (Fig. 4) planting all three characters were represented. In the case of shrub planting (Fig. 3) two were represented, with the ‘intermediate’ character omitted.

Nine sites were in public parks or gardens: The Botanical Gardens and Bole Hills, Sheffield (2), Fairlands Valley Park, Stevenage (5), Princess Gardens and Kings Gardens, Torquay (2) and twenty-two were in large semi-public gardens: Beth Chatto’s Garden, Colchester, Essex (3), RHS Wisley, Surrey (9), Savill and Valley Gardens, Crown Estate, Surrey (3), Harold Hilliers Garden and arboretum, Hampshire (3), and Abbotsbury Subtropical Gardens, Dorset (4). Sites were selected to capture the broad range of species character ranging from the strongly native (more common in public park settings), to strongly non-native (more common in institutional gardens).

2.2. On-site questionnaires

2.2.1. Questionnaire design and procedure

The questionnaire largely took the form of attitudinal and belief statements, using a five point Likert scale from +2 (agree strongly) to –2 (disagree strongly), following established methodology (e.g.

Ives & Kendal, 2013), (Table 1). Three questions involved participants answering within the categories: ‘many’, ‘some’ ‘few’ or ‘none’. Statements referring to participants’ aesthetic reactions to the planting and the degree to which they found it restorative to walk through were used to identify the key factors driving the acceptance and rejection of non-native species. Perception of familiarity with the planting was assessed to gauge whether people did in fact find planting in the category ‘strongly native’ the most familiar. The questionnaire also captured participants’ beliefs about non-native species and climate change. A section focusing on the respondents’ demographic characteristics was included.

After ethical clearance, the questionnaire was piloted in April and May 2012 in woodland areas at RHS Wisley, Surrey and at Fairlands Valley Park Stevenage. Walks (approximately 30 m) were established through sections of planting at the case study sites (Figs. 2–4). Site users were invited to walk through the planting whilst completing the self-guided questionnaire. All site-users walking through or adjacent to the marked section of planting were approached as potential participants. Participants were allowed the opportunity to walk independently and to engage fully with the planting. All walks were carried out in relatively comparable weather; dry days with low wind speeds. The limitations of this method are that specific light or weather conditions, or the exact configuration of plants cannot be controlled as in photographs, (Purcell & Lamb, 1998; Purcell, Peron, & Berto, 2001), digital manipulation of photographs (Jorgensen, Hitchmough, & Calvert, 2002; Todorova, Asakawa, & Aikoh, 2004), or videos (Van den Berg, Jorgensen, & Wilson, 2014), yet we concluded that for the purposes of this study the three-dimensional multi-experiential benefits of the immersive approach outweighed these disadvantages. The approach has been used previously (Martens, Gutscher, & Bauer, 2011; Qiu, Lindberg, & Nielsen, 2013).

All (n = 1411) on-site walks and questionnaires were completed during spring, summer and autumn 2012 and 2013. This comprised 595 questionnaires at 13 different woodland sites, 348 at 8 different shrub sites and 486 at 10 different herbaceous sites.

2.2.2. Data analysis

All questionnaire data were analysed using SPSS version 20. In order to address research questions (2) **Can people distinguish between native and non-native planting in these settings?** and (3) **What are the key factors that drive acceptance and rejection of native and non-native planting in these settings?**, Principal Components Analysis (PCA) with a varimax rotation was applied to questionnaire items relating to these questions (Table 1). The PCA identified items which varied in a consistent pattern and loaded onto single components, each measuring a specific dimension of participants’ perceptions (Table 4). ANOVA techniques were used to explore these components’ relationship to *species character*. Firstly, one-way ANOVA was conducted with the emergent perceptual principal components as dependent and *species character*, other planting variables (*planting structure* and *% flower cover and vegetation community*) and demographic variables as independent, to identify all significant variables. Multi-factor ANOVA was then conducted with the emergent components as dependent and all planting and demographic variables identified as significant in the first analysis as independent. This ascertained the residual independent main effect of *species character*, adjusting for demographic variables and other planting variables. Post hoc multiple comparisons using the Sidak correction (Table 5) distinguished significant differences between groups or categories.

Pearson correlations were then carried out between perceived attractiveness, and four separate indicators of plant or invertebrate biodiversity (Table 6) to establish if the perception of specifically ‘native’ biodiversity had a role in influencing people’s perceptions of attractiveness. The measure of perceived attractiveness was that

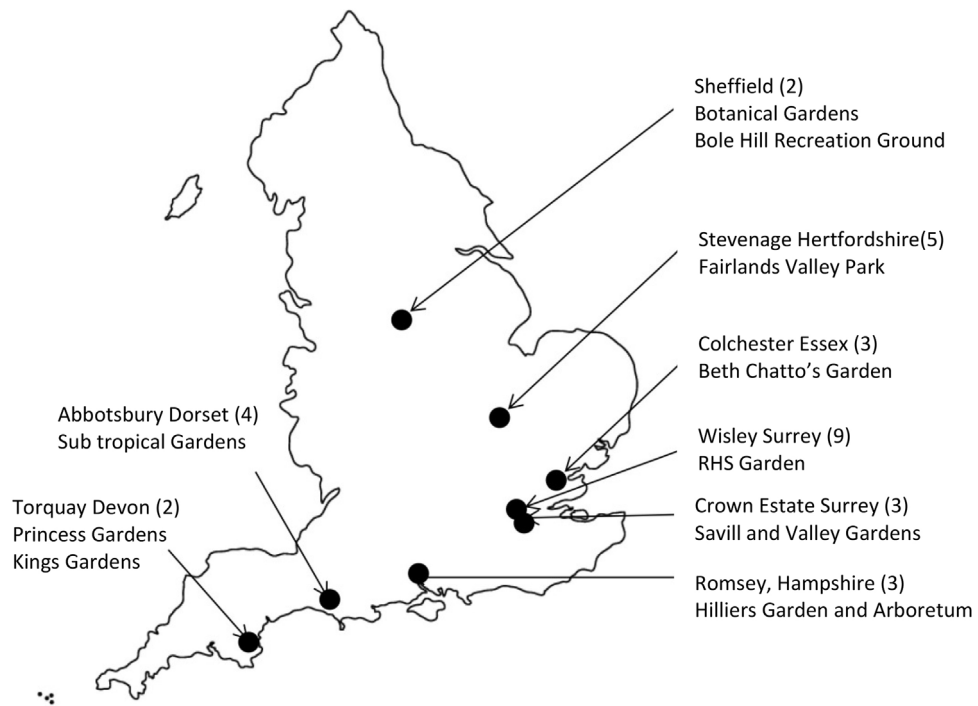


Fig. 1. The geographical distribution of case study sites, England UK.



Fig. 2. Images of the woodland sites used in the study, showing the gradient of species character from strongly native to strongly non-native.

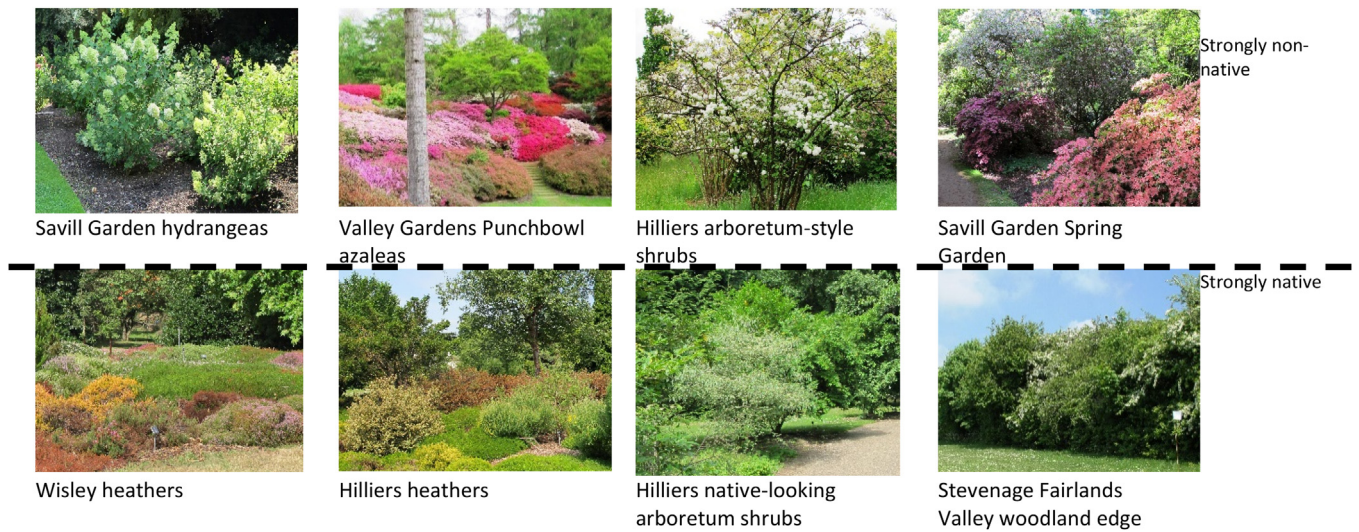


Fig. 3. Images of the shrub sites used in the study, showing the two levels of species character: strongly native and strongly non-native.

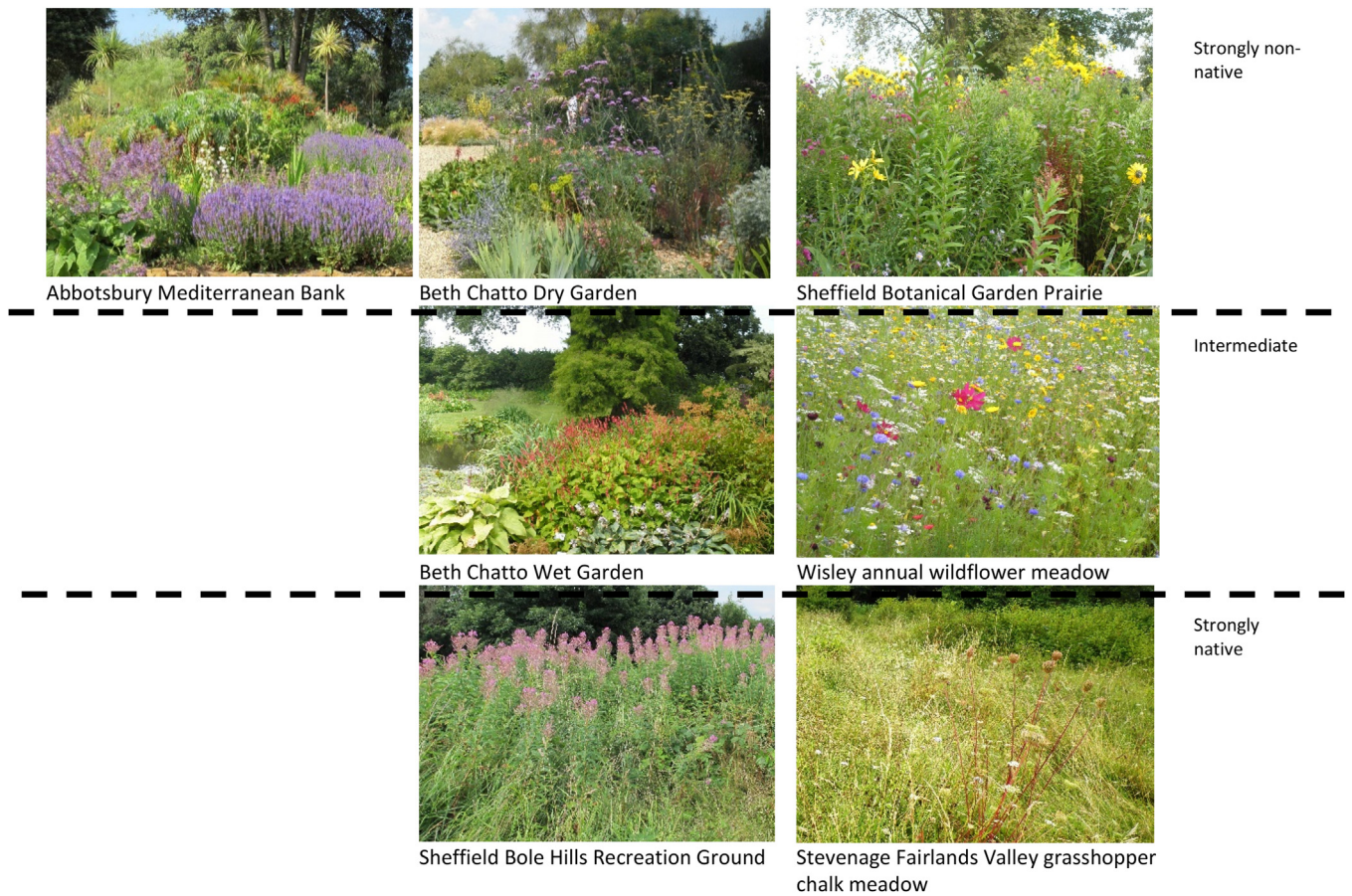


Fig. 4. Images of the herbaceous sites used in the study, showing the gradient of species character from strongly native to strongly non-native.

derived from responses to the attitudinal statement, ‘the planting on this walk is attractive’. The two variables used to measure perceived native plant and invertebrate diversity were those related to the questions ‘How many native UK plant species do you think there are in this planting?’ (Perceived number of native UK plant species), and ‘How many species of native UK insects (flies, butterflies, bees) do you think this planting will support?’ (Perceived number of native UK insects). The two variables used to measure

perceptions of overall plant diversity and invertebrate abundance corresponded to the question ‘How many different plant species in total do you think there are here?’ (Perceived number of different plant species) and the statement ‘The planting along this walk appears good for butterflies, bees and other insects’. (Perceived suitability of planting for insects).

Table 1
Research questions and corresponding questionnaire attitudinal and belief statements and questions. Items in bold were included in the Principal Components Analysis (PCA).

Question number	Research Question	Attitudinal statements/questions
1	How accepting are people of non-native planting in the designed urban landscape?	Planting in parks and gardens should be restricted to native species Native plants support more native butterflies, bees and other insects than non-native plants I would be happy to see more non-native species like those below (Fig. 5) growing in UK parks and gardens
2	Can people distinguish between native and non-native planting in these settings?	How many different plant species in total do you think there are here? How many native UK plant species do you think there are in this planting? How many species of native UK insects do you think this planting will support?
3	What are the key factors that drive acceptance and rejection of native and non-native planting in these settings?	The planting along this walk appears familiar The planting along this walk is attractive The planting along this walk is interesting The planting on this walk is colourful The combination of colours is attractive in this planting The planting along this walk is good for butterflies, bees and other insects The planting on this walk looks tidy The planting on this walk looks designed The planting on this walk looks cared for This walk reveals a special unique place I feel relaxed on this walk I feel comfortable along this walk This walk allows me to escape from more mundane routines and work
4	Do these perceptions change when set against a background of climate change?	I believe global climate change is happening I believe that global climate change will have serious consequences I think global warming will change the plant species most suited to grow in UK parks and gardens over the next 50 years I would accept non-native species like those (Fig. 5) in UK parks and gardens if they were better suited to the climate than present day species

2.3. Semi-structured interviews

2.3.1. Interview design and procedure

Semi-structured interviews were conducted with a self-selecting subset of the original questionnaire participants who provided their contact details at the end of the questionnaire. The original intention was to conduct one interview per 'walk site' (31 in total), but this proved impossible, as did sampling across the age range whilst still achieving a gender balance. Questionnaire participants' contact details were obtained for all 31 sites, yet many were unavailable for interview on the appointed dates. Interviews were conducted to explore the key factors driving acceptance and rejection of non-native species in the designed landscape, against a background of climate change. Themes addressed were *attractiveness, restorative effect and relaxation, native invertebrate diversity, tidiness, climate change and attitudes to the use of non-native planting*. These were defined by the original research questions and were confirmed as meaningful by the exploratory principal components analysis (PCA) of the questionnaire data (Tables 4 & 5). Interviews were semi-structured and flexible (after Bryman, 2012) allowing participants to diverge from the themes identified by the interviewer. An interview 'guide' was used (after Bryman, 2012) allowing the interviewer flexibility in the ordering and exact wording of questions. Participants were presented with a range of 8 photographs of planting of varying species character of the same vegetation community as they had originally walked through during the questionnaire phase, i.e., either woodland, shrub or herbaceous (Figs. 2–4), to act as a cue to discussions, as well as a photograph of Abbotsbury Garden "Mediterranean Bank" (Fig. 4) during discussion of non-native planting. Following ethical clearance and participant consent, 34 interviews representing walks at 24 sites (9 woodland, 8 shrub and 17 herbaceous interviewees) were conducted from 20th March to 31st July 2014. With the exception of three pilot interviews (included in the data set) which took place in the University, all interviews were conducted at the original walk sites. It was thought that this would help interviewees to

recall and remember their original walk through the planting. All interviews were audio-recorded and later transcribed in full.

2.3.2. Data analysis

Interview data were analysed via qualitative content analysis (after Saldana, 2013) using the interview themes above as initial deductive coding categories (after Mayring, 2014). Emergent themes were also coded and extracts taking a particular standpoint were grouped together using an indexing system to categorise data (after MacQueen, McLellan, Kay, & Milstein, 1998).

3. Results and discussion

3.1. Participants' socio-demographic characteristics

There were more female than male questionnaire participants (n = 1411). They were drawn from the older age groups (Table 2). Most were White British/Irish from a wide range of educational backgrounds. A sub-sample of this larger group, the much smaller interviewee sample (n = 34), was similar in profile (Table 3) yet contained a higher percentage of participants from landscape or environmental professions. The strongly biocentric (nature-centred, after Ives & Kendal, 2014) focus of the interviewee sample is evident (Table 4). Participants all showed some interest in the environment, landscape or horticulture.

3.2. Questionnaire participants' perceptions of the planting: The role of species character

Five components were extracted from the PCA of questionnaire items relating to research questions 2 and 3 (determined by parallel analysis, (Watkins, 2005)), together accounting for 65.33% variability in our participants' responses (Table 4). These were interpretable as: Colour, attractiveness, interest and invertebrate presence (30.56% variance); Restorative effect, (12.36% variance); Neatness, (9.75% variance); Native plant and invertebrate biodi-

Table 2
Questionnaire participants' (n = 1411) demographic profile (valid%).

Gender (Overall missing values = 29 respondents)				
	Woodland walks	Shrub walks	Herbaceous Walks	Overall
M	232 (39.9%)	114 (33.4%)	178 (37.4%)	524 (37.5%)
F	349 (60.1%)	227 (66.6%)	298 (62.6%)	874 (62.5%)
Age (Overall missing values = 34 respondents)				
	Woodland walks	Shrub walks	Herbaceous Walks	Overall
18–24	38 (6.5%)	19 (5.6%)	33 (6.9%)	90 (6.5%)
25–34	35 (6.0%)	28 (8.3%)	43 (9.1%)	106 (7.6%)
35–44	54 (9.3%)	29 (8.6%)	53 (11.2%)	136 (9.8%)
45–54	95 (16.4%)	48 (14.2%)	95 (20.0%)	238 (17.1%)
55–64	172 (29.6%)	82 (24.3%)	114 (24.0%)	368 (26.4%)
65+	187 (32.2%)	131 (38.9%)	137 (28.8%)	455 (32.7%)
Ethnicity (Overall missing values = 187 respondents)				
	Woodland walks	Shrub walks	Herbaceous Walks	Overall
White British/Irish	413 (90.8%)	285 (88.0%)	405 (87.9%)	1103 (89%)
White (other)	30 (6.6%)	25 (7.7%)	35 (7.6%)	90 (7.3%)
Mixed white/black Caribbean	2 (0.4%)	1 (0.3%)	1 (0.2%)	4 (0.3%)
Mixed white/black African	0	0	0	0
Mixed white/Asian	1 (0.2%)	0	4 (0.9%)	5 (0.4%)
Mixed other	1 (0.2%)	3 (0.9%)	1 (0.2%)	5 (0.4%)
Asian Indian	0	5 (1.5%)	5 (1.1%)	10 (0.8%)
Asian Pakistani	0	1 (0.3%)	0	1 (0.1%)
Asian Chinese	4 (0.9%)	0	4 (0.9%)	8 (0.6%)
Asian other	3 (0.7%)	0	5 (1.1%)	8 (0.6%)
Black African	0	1 (0.3%)	0	1 (0.1%)
Black Caribbean	0	1 (0.3%)	0	1 (0.1%)
Black other	1 (0.2%)	2 (0.6%)	0	3 (0.2%)
Arab	0	0	1 (0.2%)	1 (0.1%)
Educational Qualifications (Overall missing values = 123 respondents)				
	Woodland walks	Shrub walks	Herbaceous Walks	Overall
None	87 (16.3%)	39 (12.3%)	66 (14.6%)	192 (14.7%)
GCSE/O' level (or equiv)	183 (34.3%)	76 (23.9%)	115 (25.4%)	374 (28.7%)
A level (or equiv)	86 (16.1%)	61 (19.2%)	83 (18.3%)	230 (17.6%)
Degree	127 (23.8%)	104 (32.7%)	128 (28.3%)	359 (27.5%)
Masters' degree	36 (6.8%)	28 (8.8%)	49 (10.8%)	113 (8.7%)
Doctorate	14 (2.6%)	10 (3.1%)	12 (2.6%)	36 (2.8%)
Landscape professional? (Overall missing values = 482 respondents)				
	Woodland walks	Shrub walks	Herbaceous Walks	Overall
Yes	11 (3%)	10 (3.9%)	11 (3.4%)	32 (3.4%)
No	353 (97%)	246 (96.1%)	314 (96.6%)	913 (96.6%)

versity, (6.39% variance) and Unfamiliarity and complexity, (6.27% variance). The individual attitudinal statements loading onto specific components are shown (Table 4).

The multi-factor ANOVA identified that *species character* had a significant main effect on all four factors referring to participants' aesthetic perceptions of the planting: Colour, attractiveness, interest and invertebrate presence, (2.8% variance explained, $F = 16.70$, $P < 0.001$), Neatness, (1.3% variance explained, $F = 4.19$, $P < 0.05$), Native plant and invertebrate biodiversity, (4.0% variance explained, $F = 22.40$, $P < 0.001$), and Unfamiliarity and complexity, (2.0% variance explained, $F = 10.35$, $P < 0.001$), but not on their perceptions of the Restorative effect of walking through the planting (Table 5). These effects were the residual individual main effects once the statistical effect of % Flower cover had been removed.

3.3. How accepting are people of non-native species in the designed urban landscape?

The majority (57.6%, 804/1397) of our questionnaire participants either agreed strongly (20.2%), or agreed (37.4%) that they



Fig. 5. 'Non-native' planting with visual 'cues' such as spiky xeric leaves as shown in the questionnaire.

would be happy to see more non-native plant species (as Fig. 5) in

Table 3
Interviewees' (n = 34) demographic profile.

Gender				
	Woodland walks (n = 9)	Shrub walks (n = 8)	Herbaceous Walks (n = 17)	Overall (n = 34)
M	5 (56%)	4 (50%)	5 (29%)	14 (41%)
F	4 (44%)	4 (50%)	12 (71%)	20 (59%)
Age				
	Woodland walks (n = 9)	Shrub walks (n = 8)	Herbaceous Walks (n = 17)	Overall (n = 34)
25–34	0	1 (12.5%)	2 (12%)	3 (9%)
35–44	1 (11%)	0	2 (12%)	3 (9%)
45–54	3 (33%)	2 (25%)	2 (12%)	7 (21%)
55–64	5 (56%)	2 (25%)	4 (23%)	11 (32%)
65+	0	3 (37.5%)	7 (41%)	10 (29%)
Ethnicity				
	Woodland walks (n = 9)	Shrub walks (n = 8)	Herbaceous Walks (n = 17)	Overall (n = 34)
White British/Irish	9 (100%)	7 (88%)	15 (88%)	31 (91%)
White (Swedish)	0	1 (12%)	0	1 (3%)
Mixed White/Asian	0	0	1 (6%)	1 (3%)
Asian Indian	0	0	1 (6%)	1 (3%)
Educational Qualifications				
	Woodland walks (n = 9)	Shrub walks (n = 8)	Herbaceous Walks (n = 17)	Overall (n = 34)
None	2 (22%)	0	1 (6%)	3 (9%)
GCSE/O' level (or equiv)	1 (11%)	3 (37.5%)	2 (12%)	6 (18%)
A level (or equiv)	0	1 (12.5%)	7 (41%)	8 (23%)
Degree	6 (67%)	3 (37.5%)	4 (23%)	13 (38%)
Masters' degree	0	1 (12.5%)	2 (12%)	3 (9%)
Doctorate	0	0	1 (6%)	1 (3%)
Landscape or Environmental professional?				
	Woodland walks (n = 9)	Shrub walks (n = 8)	Herbaceous Walks (n = 17)	Overall (n = 34)
Yes	1 (11%)	2 (25%)	3 (18%)	5 (15%)
No	8 (89%)	6 (75%)	14 (82%)	29 (85%)
Landscape/Environmental/Horticultural interests?				
	Woodland walks (n = 9)	Shrub walks (n = 8)	Herbaceous Walks (n = 17)	Overall (n = 34)
Yes	9 (100%)	8 (100%)	17 (100%)	34 (100%)
No	0	0	0	0

Table 4
Component loadings from principal components analysis with varimax rotation for the walk participants' questionnaire items relating to research questions 2 & 3 (All vegetation communities). Item loading values >0.5 are shown.

Item	Component loading
Component 1: Colour, attractiveness, interest & invertebrate presence	
The planting on this walk is colourful	0.85
The combination of colours is attractive in this planting	0.85
The planting along this walk is attractive	0.72
The planting along this walk is interesting	0.72
The planting along this walk appears good for butterflies, bees and other insects	0.59
Component 2: Restorative effect	
I feel relaxed on this walk	0.84
I feel comfortable along this walk	0.79
This walk allows me to escape from more mundane routines and work	0.76
Component 3: Neatness	
The planting on this walk looks tidy	0.84
The planting on this walk looks cared for	0.78
The planting on this walk looks designed	0.78
Component 4: Native plant & invertebrate biodiversity	
How many native UK plant species do you think there are in this planting?	0.80
How many species of native UK insects (flies, butterflies, bees) do you think this planting will support?	0.72
Component 5: Unfamiliarity & complexity	
The planting along this walk looks familiar to me	–0.69
How structurally complex would you describe this planting	0.58
How many different plant species in total do you think there are here?	0.56

Table 5
All vegetation communities: Marginal mean (MM) scores on five PCA components as a function of Species Character.

PCA components	Species Character		
	Strongly non-native MM	Intermediate MM	Strongly native MM
Colour, attractiveness, interest & invertebrate presence	-0.020 _a	-0.291 _b	-0.441 _b
Restorative effect	ns	ns	ns
Neatness	0.023 _a	-0.511 _b	-0.216 _{ab}
Native plant & invertebrate biodiversity	-0.277 _b	-0.028 _a	0.184 _a
Unfamiliarity & complexity	-0.259 _a	-0.486 _a	-0.904 _b

Note. Means on a row with different subscripts are significantly different from each other.

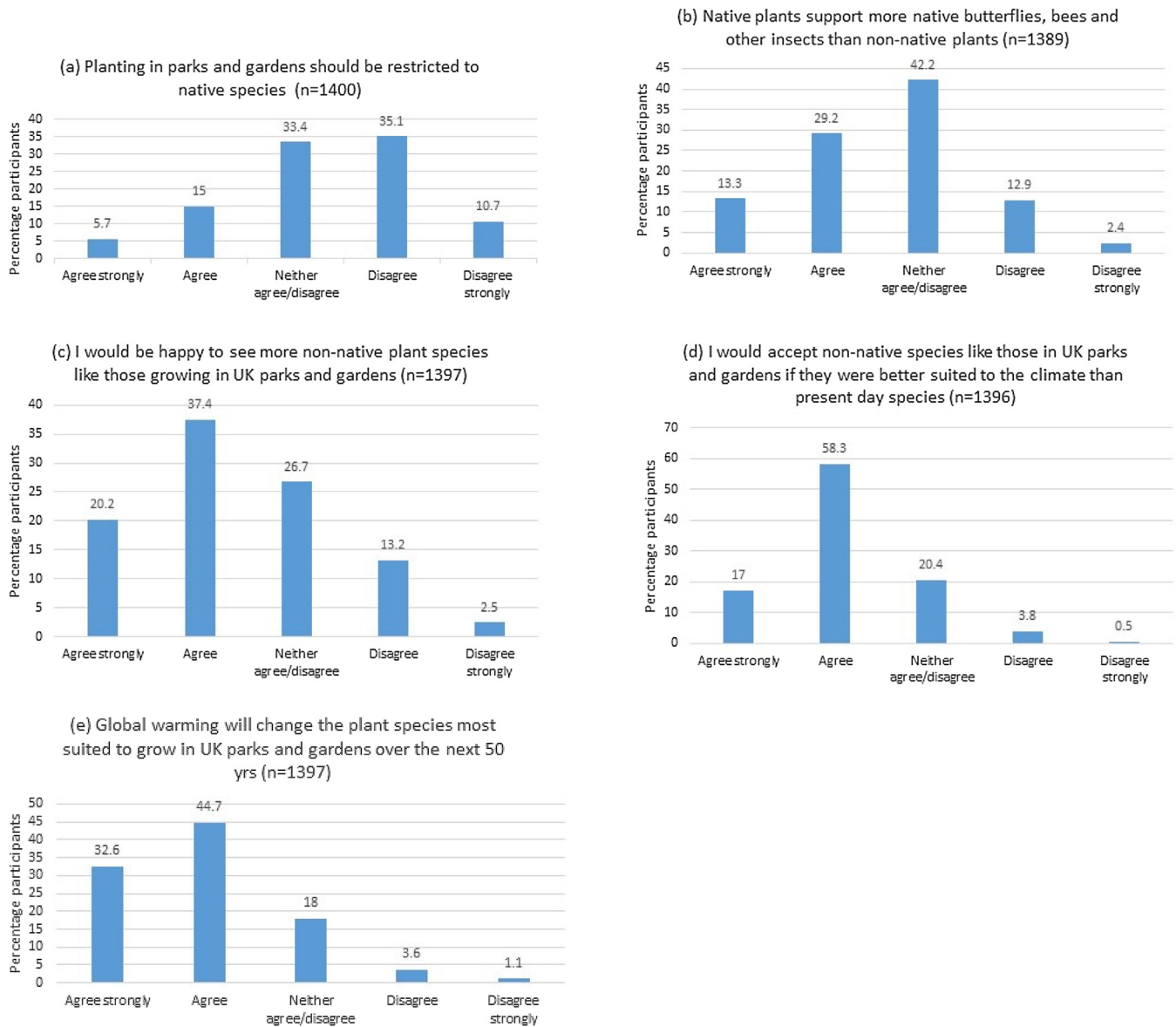


Fig. 6. Walk participants' thoughts about non-native plant species and climate change.

UK parks and gardens (Fig. 6(c)). Only 20.7% questionnaire participants agreed or agreed strongly, that 'Planting in parks and gardens should be restricted to native species', whereas 45.8% disagreed or disagreed strongly with this statement (Fig. 6(a)). This shows that in contrast to the strong nativism paradigm which persists in current policy and practice guidance on biodiversity management, most people in our study see a role for non-native species in public places.

The factors driving this acceptance or rejection were explored in the interviews.

3.4. Can people distinguish between native and non-native species in these settings?

Each questionnaire participant walked through just one area of planting, yet findings indicate that our participants recognised

the three levels on the gradient from strongly native to strongly non-native species character. Post hoc analysis (Table 5) indicated that strongly non-native planting was associated with the lowest level of perceived native plant and invertebrate biodiversity, significantly lower than planting intermediate or strongly native in species character. Strongly native planting was associated with the highest perceived level of native biodiversity. The same pattern was repeated in the case of perceptions of unfamiliarity and complexity (Table 5). In this case participants perceived strongly non-native planting as the most unfamiliar and complex. Planting of intermediate species character was perceived as less unfamiliar and complex. Strongly native planting was perceived as the least unfamiliar and complex, significantly less so than the other two categories. This confirmed that overall, our participants expressed the greatest familiarity with strongly native planting located predominantly in local greenspaces.

Our participants demonstrated the ability to recognise this gradient involving degrees of 'nativeness' at the experiential scale of walking through an area of planting. In contrast, earlier studies (Dallimer et al., 2012; Fuller et al., 2007) generated conflicting evidence about people's ability to assess biodiversity accurately and concluded that in a European context, 'nativeness' was not visible to the general public (Fischer et al., 2011). The divergence in outcomes probably relates to the survey design and methodology and the different scales at which the participants engaged with the planting. The previous UK studies (Dallimer et al., 2012; Fuller, Irvine, Devine-Wright, Warren, & Gaston, 2007) involved participants' estimating specific numbers of different species of birds, butterflies and plants at a study location. Fischer et al. (2011) also focused on individual species. In contrast, we chose sites to represent three distinctive levels of 'visual nativeness', and asked people to walk through one area in an immersive manner. When we asked participants questions such as *How many native UK plant species do you think there are in this planting?* participants were asked to respond within a broad category: 'many', 'some', 'few', and 'none'. Participants in a previously cited Swedish study (Qiu et al., 2013) engaged with planting at a similarly broad scale, recognising differences in overall biodiversity between 4 visually distinctive habitat types. It may be that the public can perceive this more general resolution of biodiversity or 'nativeness', but is less-equipped to identify 'nativeness' at a species-specific level. In addition, people probably responded to contextual cues. A high proportion of the strongly non-native planting was found within institutional gardens such as Abbotsbury, which describes itself as "sub-tropical". Visiting participants had deliberately gone out to seek "sub-tropical" non-native planting which offered novelty. In contrast, local parks were associated with more familiar forms of planting perceived as 'native'.

3.5. What are the key factors that drive acceptance and rejection of native and non-native species in these settings?

In addition to climate change, four key factors emerged as drivers of our participants' reactions: i) *aesthetics*; ii) *locational context* in relation to existing planting and habitats; iii) *historical factors and inevitability*; and iv) *perceptions of invasiveness and incompatibility with native wildlife*.

3.5.1. Aesthetics

Questionnaire data (Post hoc analysis, Table 5) indicate that in the case of our participants, planting strongly non-native in character such as the "subtropical" woodland at Abbotsbury, *Cordyline australis* planting in Torquay, and Punchbowl at the Valley Gardens was perceived as significantly more colourful, attractive and interesting than planting of strongly native or intermediate character. This strongly non-native planting was perceived as having a significantly higher invertebrate suitability than planting of

a strongly native or intermediate character. In contrast, planting strongly native in character dominated by species such as oak, (*Quercus*) hawthorn (*Crataegus monogyna*) and rose bay willow herb (*Chamaenerion angustifolium*) which form the familiar background planting in public outdoor spaces such as Fairlands Valley Park in Stevenage and Bole Hills, Sheffield, (Figs. 2–4) was perceived as the least colourful, attractive and interesting of the three levels of species character, and associated with the lowest perceived invertebrate suitability. Strongly non-native planting was also considered the neatest of the three levels of species character (Table 5). These findings suggest that in the UK, people actually find non-native species more attractive and interesting than native ones, in urban environments. The loading of attitudinal statements relating to colour, attractiveness interest and perceived invertebrate suitability onto the same component (Table 4) means that the planting people viewed as the most colourful, attractive and interesting was also perceived as the most beneficial to insects. Although colour and invertebrate presence were likely to have been related to the amount flower cover present, with flowers attracting pollinators, the statistical effect of % flower cover was adjusted for in the analysis, thereby indicating that *species character* itself had an independent main effect.

A moderate positive correlation was identified between the perceived attractiveness of the planting, and perceived value of planting for butterflies, bees and other insects (Table 6) confirming that people liked plants they perceived to support high levels of overall invertebrate diversity. In contrast, the correlation between perceived attractiveness and perceived number of native UK insects present was significant but weak. People associated native UK insects with native UK planting (these statements loaded onto the same factor, Table 4), and strongly native planting was viewed as the least attractive (Table 5). There was a significant but weak correlation between the perceived attractiveness of the planting and the perceived number of different plant species present overall, yet the correlation between perceived attractiveness of the planting and the perceived number of native UK plant species present was even weaker. This indicates that although our participants recognised broad categories of 'nativeness', this was not a factor driving their perceptions of the attractiveness of the planting. This is illustrated by the comment made by one interviewee:

No, no, I like plants for what they are..where they come from I don't think really matters..(M7)

Interviewees' responses to the aesthetic qualities of non-native planting varied according to vegetation community and at the species-specific level. When shown images of planting of all three levels of nativeness, 5/9 interviewees in woodland sites selected strongly non-native woodlands as those they would find the most attractive to walk through, with the remaining four choosing strongly native (Table 7). Interviewees in shrub sites were shown images of strongly native and strongly non-native planting. The majority (8/9) chose strongly non-native as the most attractive walk. In the case of interviewees in herbaceous sites, the majority (12/17) chose planting of intermediate nativeness as the more attractive walk, with only 3 selecting strongly non-native and 2 strongly native. When shown Fig. 5 and asked if they would be willing to accept this type of non-native planting in UK parks and public spaces, 8/21 very positive interviewees gave reasons related to the aesthetic qualities of the planting when accounting for their willingness to accept it (Table 7).

At the species-specific level, in the case of woodlands, positive reactions were confined to the *Eucalyptus* planting at Wisley and Abbotsbury Jungle Ride (Fig. 2). Four of the five interviewees who selected strongly non-native woodlands as potentially the most

Table 6Correlations between Perceived attractiveness and perceived biodiversity by vegetation community ** $p < 0.01$, *** $p < 0.001$.

Perceived attractiveness	Perceived biodiversity measures			
	Perceived no. different plant species	Perceived no. native UK plant species	Perceived value of planting for insects	Perceived no. native UK insects
Woodland	0.218***	ns	0.462***	0.278***
Shrub	0.170**	ns	0.416***	0.185**
Herbaceous	0.200***	ns	0.373***	0.279**

attractive to walk through those the eucalypt groves at Wisley. Interviewees appreciated the form of branches, bark and foliage:

Indeed, and I think these tree shapes and these bark patterns and the way the light plays upon the bark. . . and through the foliage is absolutely beautiful. (F2)

This interviewee seemed to appreciate the eucalypts specifically because their appearance was unfamiliar:

This has got a strange. . . almost an eeriness about it. . . it's just a bit different, isn't it? It's something we're not accustomed to seeing, and I would find this interesting. (F2)

The strongly non-native herbaceous planting that generated most comment was the Mediterranean Bank (Fig. 4). Although not selected by all as the most attractive walk, (Table 7) 8 interviewees expressed the opinion that this was attractive, and appropriate for planting in UK public parks.

That would be appropriate. Again, a good variety of colours on display; whites, purples, reds, oranges. I like it. (M12)

For one interviewee, the image of the Mediterranean Bank evoked warmer climates:

There are sort of hot things going on. It makes you think more of warmer climates. It would be nice to be in a climate where it was permanently. . . lovely and warm! (F18)

In the case of shrub planting where interviewees responded very positively to a strongly non-native character (Table 7), most of the planting of strongly non-native character was flowering prolifically. Interviewees may have been responding to the flowers rather than species character per se. Flowers can induce powerful positive emotions (Haviland-Jones, Hale, Wilson, & McGuire, 2005). Appreciation of colourful flowers has also been explained by evolutionary theories (Heerwagen & Orians, 1995) as indicators of a resource-rich environment. In the case of the interviews, participants reacted to the photographs of the planting in a holistic way: the colour, form and overall appearance, and it was impossible to separate the specific role of individual factors such as the percentage of the shrubs covered in flowers and species character. In direct contrast to the majority of interviewees (8/9) one landscape professional chose shrub planting strongly native in character as the most attractive, referring to “nativeness” repeatedly in the justification of his preference.

They're typical, maybe native plants, (Native Woodland Edge Stevenage, Hilliers mounding shrubs) and they look quite natural. It's mainly because they look like native species.' (M6)

This divergence of aesthetic preference from that of the other interviewees reflects findings from previous research: professionals (Ozguner, Kendle, & Bisgrove, 2007) or students (Zheng, Zhang, & Chen, 2011) in fields such as conservation and environment exhibit learnt positions on native plants that lead to higher preference levels for these in urban planting.

In contrast to the generally positive reactions to the character of non-native species, where the morphology of the planting was very different to typical native species, some interviewees expressed

negative perceptions. The four interviewees who believed strongly that non-native planting should not be introduced in UK parks and public spaces all objected to it on aesthetic grounds (Table 7). The Torquay palms, (*Cordyline australis*) (Fig. 2) and Mediterranean Bank (Fig. 4), xeric planting with narrow, spiky leaves, were perceived as aggressive and provoked some very strong negative reactions:

Twenty years ago I developed this dislike of what I call 'unnatural' foreign species. . . the whole azalea, rhododendron thing, which seems to have gathered momentum in a number of places, in France as well, I find slightly incongruous, particularly where they spring up. . . these spiky..palms.. I just find that incongruous..and they just stand out. (M2)

One interviewee was particularly emphatic in her criticism of the *kniphofia* (red hot pokers) and 'spiky' planting in the Mediterranean Bank:

Yeah it looks spikier somehow and harsher, not as inviting looking. . . I can imagine that these. . . are those poisonous kind of ones if you ate them. . . is it devil's poker or something? . . . the sort of jaggedy look of all those plants makes me think they might be a little bit toxic. . . it looks more rocky and spiky. I kind of dismiss plants that I think are spiky and cactusy looking and aren't English and are there for display, and they won't thrive. (F12)

3.5.2. Locational context

Eight interviewees expressed very definite ideas about which locations would be appropriate for the introduction of non-native planting, (Table 7). The Torquay *Cordyline australis* “palms”, were rejected mainly because they appeared out of context in the UK landscape and some of the interviewees opposed to the *Cordyline* perceived more familiar woodlands intermediate or strongly native in species character (the Wild Garden at Wisley and Monk's Wood Stevenage) as the most attractive, ‘in keeping with our current countryside and climate’.

I've travelled around the world and one of the things that I've always enjoyed about coming home to England is the English countryside. . . and dislike is perhaps too strong a word, but I don't like palms and pampas grass and those things that I regard as so artificial as to be unattractive in our native environment. (M2)

Some interviewees saw Mediterranean planting more suited to particular regions of the UK than others, again making references to familiarity:

I think we already see that in places like Cornwall. We do see that, which to me is fine in places like Cornwall and Tresco in the Isles of Scilly. . . Certainly I couldn't see it in Scotland. I think in Sheffield it'd sort of be a bit of a step too far at the moment. (F16)

In the case of the *Cordyline* (Torquay palms) the two Torquay residents interviewed were extremely positive about the appearance of this seafront planting, yet perceptions were also related to positive memories and place attachment (Manzo, 2005) as well as an aesthetic of ‘care’ (Nassauer, 2011).

Table 7
Interviewees' attitudes and beliefs about non-native species and climate change.

			Interviewee response													
			Aesthetic preference to walk through			Beliefs about non-native species in the designed urban landscape			Beliefs about climate change							
			Strongly native (7)	Intermed (12)	Strongly non-native (15)	Acceptance (& justification) (21)	Rejection (& justification) (4)	Reservations (invasive, context & scale) (20)	Its happening (34)	Causes						
											Human (8)	Natural: earth self-regulating (6)	Cause not important (1)	God is in charge (1)		
Interviewees by vegetation community (n = 34)																
ID	gender	age														
Woodland (n=9)			(4)	(0)	(5)	(5)	(2)	(6)	(9)	(2)	(2)	(0)	(0)			
M1	M	55–64			yes	yes (aesthetic)			yes		yes					
F1	F	45–54			yes	yes (aesthetic)			Yes	No comments	yes					
M2	M	45–54	yes				Yes (aesthetic)		Yes	yes						
F2	F	55–64			yes	Yes (ecological)		Yes (context & scale)	yes		yes					
F3	F	55–64			yes	Yes (inevitability)		Yes (invasive)	yes	No comments						
M3	M	55–64			yes	Yes (aesthetic)		Yes (context & scale)	yes	yes						
M4	M	55–64	yes					Yes (invasive)	yes	No comments						
M5	M	35–44	yes					Yes (invasive)	yes	No comments						
F4	F	45–54	yes				Yes (aesthetic)	Yes (invasive)	yes	No comments						
Shrub (n=8)			(1)	No category	(7)	(5)	(0)	(5)	(8)	(5)	(1)	(0)	(0)			
F5	F	45–54		X	yes	Yes (aesthetic)		Yes (context & scale)	yes	yes						
M6	M	25–34	yes	X		Yes (aesthetic)			yes		yes					
F6	F	65+		X	yes	Yes (ecological)		Yes (invasive)	yes	yes						
M7	M	65+		X	yes	Yes (inevitability)		Yes (context & scale)	yes	yes						
M8	M	65+		X	yes	Yes (aesthetic)			yes	No comments						
F8	F	55–64		X	yes	Yes (ecological)		Yes (invasive)	yes	No comments						
M9	M	55–64		X	yes	Yes (ecological)			yes	yes						
F9	F	45–54		X	yes	Yes (inevitability)		Yes (invasive)	yes	yes						
Herbaceous interviewees (n=17)			(2)	(12)	(3)	(11)	(2)	(9)	(17)	(1)	(3)	(1)	(1)			
M10	M	65+		yes				Yes (invasive)	yes	No comments						
F11	F	35–44		yes		Yes (aesthetic)		Yes (invasive)	yes	No comments						
F12	F	25–34		yes		Yes (ecological)	Yes (aesthetic)	Yes (context & scale)	yes	No comments						
M11	M	45–54		yes		Yes (ecological)		Yes (invasive)	yes	yes	yes					
F13	F	25–34		yes			Yes (aesthetic)	Yes (invasive)	yes	No comments						
M12	M	35–44		yes		Yes (aesthetic)	Yes (aesthetic)	Yes (invasive)	yes	No comments						
F14	F	65+			yes	Yes (ecological)			yes	No comments						
F15	F	65+		yes		Yes (ecological)		Yes (invasive)	yes					yes		
F16	F	45–54		yes		Yes (inevitability)		Yes (invasive)	yes	No comments						
						Yes (reservations)		Yes (context & scale)	yes							
F17	F	65+		yes		Yes (ecological)			yes		yes					
F18	F	55–64		yes		Yes (ecological)		Yes (invasive)	yes	No comments						
F19	F	65+		yes		Yes (inevitability)			yes	yes						
						Yes (ecological)			yes			yes				
M13	M	55–64	yes			Yes (ecological)			yes							
F21	F	55–64			yes				yes	No comments						
F22	F	65+			yes	Yes (ecological)			yes	No comments						
F23	F	65+		yes				Yes (invasive)	yes	No comments	yes					
M15	M	55–64	yes					Yes (invasive)	yes	No comments						
								Yes (context & scale)	yes							

I like that one, it's bright and cheerful, you know, and the council looks after the greenery and everything, and my granddaughter used to like coming down here to feed the ducks, so that's why I chose that one! (F4)

The positive reaction from local Torquay residents might suggest that people are more able to accept unfamiliar planting with a species character with increasing exposure to it. They were familiar with these tree forms because they saw them regularly, and had contextualized their southern hemisphere strangeness, whereas the other interviewees were not able to do this. This argument is supported by comments from another interviewee who had moved from the Midlands to the south coast:

I've changed a bit over the last two years because I used to not like palm trees in the UK but now I quite do. . . I might plant one myself. I grew up in the Midlands, and you don't see palm trees in the Midlands, but when you are by the sea it seems to fit in. . . (F11)

Many of these responses also seem to involve implicit thoughts on the appropriateness of non-native species to the English countryside, rather than within a designed urban context, as was suggested by the researcher.

3.5.3. Historical factors and inevitability

Six interviewees expressing a positive view about the wider introduction of Mediterranean planting in public parks and gardens in the UK demonstrated an awareness that many of the plants in the UK that we now view as 'native' have either migrated or been brought into the country over hundreds or even thousands of years, seeing it as inevitable that species would migrate into the UK in the future (Table 7):

Victorian botanists went out and they collected everything they could find. . . and some of what we term as our 'British' species are in fact imports from abroad (M9),

We've got loads of parakeets round our way now. It's just the way the world goes, with transport nowadays, everything can get round the world, and the same with seeds and plants. (M7)

3.5.4. Perceptions of invasiveness and incompatibility with native wildlife

Our questionnaire participants were generally positive about the aesthetic qualities of planting with a strongly non-native character (Table 5) and 79.3% questionnaire participants agreed that planting in parks and gardens should not be restricted to purely native species, (Fig. 6), yet 20/34 expressed reservations about introducing non-natives (Table 7) with the majority of these (16/20) basing their concerns almost entirely on perceptions of the invasiveness of non-native species and the likelihood that they would out compete and oust native plants. This included many interviewees who were generally very positive about non-native species:

I mean obviously there's been a problem with some things like Himalayan balsam, there's one or two things that have become too invasive, but I think now we probably know which ones they are, so as long as we have got that knowledge of what we can plant that is not going to take over or invade and come up through the pavements, we'll be alright. (F3)

The combination of questionnaire responses and in-depth interview comments shows how respondents can be simultaneously very positive about the appearance of planting with a strongly non-native character, and concerned about potential invasiveness. It is possible that during the questionnaires people reacted to plants they walked through in the urban landscape on aesthetic grounds and liked them, yet were not aware they were non-native. They

therefore scored the planting highly aesthetically, whilst holding beliefs influenced by the policy discourse stating that non-natives are detrimental to native biodiversity due to inherent invasiveness. This seems unlikely, because our evidence (Table 5) suggests that our participants could recognise at least the three broad categories on the scale from strongly native to strongly non-native. In addition, many participants walking through areas of strongly non-native planting did so within institutionally owned gardens such as Abbotsbury sub-tropical gardens, and had made a conscious choice to visit sites advertised for planting which diverged from familiar native UK species character. Our interviewees were more biocentric than the average UK resident, as described earlier, and may have been more aware of the policy discourse highlighting the invasiveness of non-natives than people in the larger questionnaire sample, explaining the large number of interviewees (20/34) expressing reservations. On balance, the combination of questionnaire responses and in-depth interview comments suggests that lay people can recognise and reconcile the positive and negative aspects of non-native plants. In spite of reservations about invasiveness, our interviewees often had a sophisticated understanding of these issues; for example, some understood that non-native plant species are not by definition invasive (Didham et al., 2005; Gurevitch & Padilla, 2004; Sagoff, 2005) and that non-native plants potentially add to the richness of the British flora without negative consequences for native diversity (Thomas & Palmer, 2015).

Many questionnaire participants openly expressed ambivalence and uncertainty about the relationship between non-native plant species and native invertebrates. 42.5% agreed/agreed strongly with the statement 'native plants support more native butterflies, bees and other insects than non-native plants', with only 15.5% either disagreeing/disagreeing strongly (Fig. 6) Three interviewees (3xF) referred to what they perceived as the potentially negative impact of non-native plant species on native wildlife:

I don't know, I mean it depends on whether they introduce..how that relates to butterflies, bugs everything..what happens with that. (F6)

Obviously it does have an impact on native wildlife..because I don't know what feeds on Echinacea..that may make it difficult for other things that live in the undergrowth..if it's not part of the normal food chain. . . (F18)

A few interviewees expressed an explicit awareness of the discourse of the policy agenda, with its emphasis on the compatibility of native plants and native invertebrates, yet they were unable to accept this because of the counter evidence derived from their observations in their own gardens:

Insects like non – native plants as well, not just the natives. People always think, 'You've got to plant native plants', but you don't, because they are also attracted to non-native plants. There is an awful lot of misunderstanding. Yes, when I look at my own garden and I see the plants with butterflies and things on them, they're not always natives! I mean, wasn't buddleia introduced? (F22)

3.6. Do these perceptions change when seen against a background of climate change?

The majority of questionnaire participants agreed or agreed strongly that climate change was happening, agreed or agreed strongly that it would have serious consequences (77.2%), and agreed/agreed strongly that global warming would change the plant species most suited to grow in UK parks and gardens over the next 50 years (77.3%), (Fig. 6(e)). This indicates that the majority of our large sample of over 1400 members of the public was already aware of at least some of the ecological implications of cli-

mate change described in the introduction (Hickling et al., 2006; Parmesan, 2006; Parmesan & Yohe, 2003). They were able to apply broader understandings of the consequences of climate change to the specific implications for plant species growing in urban public spaces. Further questionnaire evidence indicated an increase in acceptance of non-native species in UK parks and gardens to 75.3% (17% agreed strongly, 58.3% agreed to statement), when participants were asked if they would accept these species if they were better suited to the climate than present day species (Fig. 6(d)). This is convincing evidence that climate change is a major driver of acceptance of non-native plant species amongst the general public.

All interviewees accepted that climate change was happening. Fourteen interviewees referred to climatic or ecological reasons for their acceptance of and often preference for non-native planting (Table 7). They referred repeatedly to increasing aridity and the need to produce more sustainable urban planting:

I think I'm more concerned that our parks and gardens are more sustainable, so we grow plants that grow happily and look after themselves, rather than having lots of bedding or stuff that needs loads of resources. So if that's what was going to work, you know, fine. (F11)

I think it's essential that we adjust our planting so that we don't have to use fresh water to sustain our green areas. So yes, I'd accept variation in planting because its evolution in action. (M9)

Because our self-selected interviewees were particularly bio-centric, demonstrating high levels of interest in plants or the environment (Table 4) they were probably more aware of the implications of these changes than the wider public.

4. Conclusions and implications for policy and practice

This is the first large scale study of UK public attitudes to non-native planting in the context of a changing climate. Our findings show that when walking through an area of planting at the human experiential scale people recognised broad categories of “nativeness” relating to the three levels we established on the gradient from strongly native to strongly non-native. In contrast to the discourse of urban biodiversity conservation policy the majority of our participants said they would be happy to see an increase in non-native planting in UK parks and gardens. Aesthetically, strongly non-native planting was perceived as the most colourful, attractive and interesting of the three levels of “nativeness” on our gradient. It was perceived as offering the greatest benefit to invertebrates. Immediate reactions to planting appeared to be driven by species specific aesthetics and “nativeness” per se was not a consideration when people assessed the attractiveness of an area of planting. There appeared to be some tension between dominantly positive aesthetic reactions and beliefs about the potential invasive risks of strongly non-native planting. Reservations about the potential invasiveness of non-native species and their assumed incompatibility with native invertebrates were expressed clearly by interviewees who held strongly biocentric values and might have been more aware of policy discourse than the public at large. Climate change was, however, identified as a powerful force driving people's acceptance of climate-adapted Mediterranean planting.

Most of the original walks took place in publicly accessible but institutionally owned gardens where visitors had an existing interest in horticulture and cultivated non-native plants, or in public spaces where local residents and site users enjoyed spending time in outdoor green spaces. The questionnaires and interviews were carried out exclusively with the users of these spaces. Self-selecting interviewees were particularly biocentric, so generalisation of their views to those of the wider population requires a measure of caution.

Our work suggests that there is a schism between sustainable urban policy that sees a future involving only native plant species and what members of the public believe and value. Far from expressing hostility to non-native species, in a UK context most people appear to welcome the use of non-invasive non-native planting in urban public spaces, whilst at the same time having some understanding of the risks as well as the benefits. If key long term goals of sustainable urban planting are to increase human well-being and to maximise support value for native animal biodiversity, at a time of climate change, this will not be best achieved by policy which appears to be at odds with the beliefs and values of the average urban citizen. There is a need to reflect these values more conspicuously in more nuanced urban landscape policy and practice.

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