Original article

Public perceptions and preferences for wildflower meadows in Beijing, China☆

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ABSTRACT

Wildflower meadows have been planted in China over several years; however, there is a lack of research on public perceptions and preferences with respect to their acceptance and design. We distributed a questionnaire survey and photographs to evaluate the responses of students and non-professionals to wildflower meadows. We selected 15 photographs of five types of herbaceous vegetation to assess preferences. There were significant differences among vegetation types; natural grassland was better appreciated by students and non-professionals, whereas urban meadows received the lowest satisfaction rating compared to lawns, monocultures, and flowerbeds. This study also demonstrated that Chinese respondents were familiar with wildflower meadows, although they believed that the meadows can only be maintained for short periods. The establishment of wildflower meadows was welcomed in parks, residential districts, accessory greenbelts, rural areas, and roadsides. Gender, age and botanical knowledge influenced aesthetic preferences for herbaceous vegetation and urban meadows to varying degrees. Students were more concerned with costs, whereas non-professionals valued the aesthetical appearance of wildflower meadows more highly. Both groups valued wildflower meadows with long flowering periods, a natural look, and low maintenance.

1. Introduction

Wildflower meadows are species-rich vegetation communities that imitate natural types of grassland, typically meadows in China (Fang et al., 2015), and prairie in America (Diboll, 2004; Hitchmough and De La Fleur, 2006). Depending on species composition, they can last for one year (annual meadows) or 5–7 years (Haaland and Gyllin, 2011). Wildflower meadows are inexpensive to install and can be maintained with minimal resources, while still meeting expectations for colour and seasonal change and providing a valuable habitat for native animal biodiversity (Hitchmough, 2008). They were first planted in amenity areas in Britain in the mid-1990s (Dunnett, 2011); in recent years, wildflower meadows have increasingly replaced traditional, well-maintained and intensively mown lawns in green spaces in European countries (Diboll, 2004; Lindemann-Matthies and Bose, 2007).

In China, vast natural grasslands extended over the Tibetan Plateau, temperate semi-arid area, high mountains, lowlands, and beaches, composing over 40% of the national territory, an important part of the Eurasian Steppe Region (Editorial Board of Chinese vegetation, 1995; Chen, 2001). Over these natural grasslands, the people migrated to wherever water and grass were available, forming a nomadic culture that was distinct from the farming culture of Central China (Liu et al., 2007; Chen, 2008). The description and expression of 'natural grassland' was eulogised in thousands of ancient poems, many famous among the Chinese people (Xia and Li, 2009; Li, 2010).

The earliest forage planting began in ancient times under the rule of Emperor Fuxi (Hong, 2011). Then, *Zoysia japonica* and *Medicago sativa* were planted and grassland was initially used for hunting by royals in Shanglin Imperial Park, the largest royal garden of the Han Dynasty (Zhu, 2003; Zhou, 2011; Ren, 2014). Grasslands were existed during the Wei-Jin period and the Yuan dynasty for hunting and enjoyment (Zhu, 2003; Ma and Qi, 2004). Moreover, a large area of natural grassland was reserved and wildflowers were planted in the Tree Garden and at Shima Dam, two gardens within the Chengde Mountain

Resort, during the Qing Dynasty (Zhou, 2011). During the 30 years following the founding of China, urbanisation experienced many setbacks, and China's landscaping became a long-term low priority (Liu, 1984; Gao, 2005). However, following reform, Chinese urbanisation leapt forward, and monocultures, modern lawns, and flowerbeds were established as part of an urban greening process (Ma and Qi, 2004; Gao, 2005; Ji, 2009). In the early 1990s, the Asian Games were successfully held in Beijing, and a 'city beautiful' movement spread to improve urban environments nationwide (Yu, 2006). During this period, decorative lawns and flowerbeds developed further and wildflower meadows were first planted in China by landscaping companies in the late 20th century, and gradually increased in popularity (Wang and Peng, 2002; Dan et al., 2013; Tan, 2013).

The novel characteristics of wildflower meadows were recognised by horticulture technicians (Tan, 2012), and rapidly followed by enlarged planting areas, and constant renewal of varieties planted in China (Zhou, 2009). Flower mixes were sown in many parks (Jiang, 2009; Lu, 2009). Despite the continuous turnover of mixtures, wildflower meadows still comprise only a tiny fraction of urban green spaces, in China and other countries (Hitchmough and De La Fleur, 2006; Zhou, 2009; Loder, 2014), occurring rarely in lower-tier cities and rural areas. Flower mixtures in China are typically composed of commercial seeds, mainly annuals, with few grasses or indigenous species (Jiang et al., 2016a,b). The success of wildflower meadows appears to lie in the construction of a variety of attractive communities for different ornamental purposes and conditions (Lu and Du, 2008; Xue, 2013).

In China, over 90% of natural grassland has degraded at different levels, and this degradation accelerates at a rate of 2% per year (Meng and Gao, 2002). Biological habitat loss and fragmentation, habitat deterioration, overexploitation of natural resources, and invasive species are among the ecological problems leading to the number of endangered or nearly endangered species increasing to 4000–5000, approximately 15% of the total species of China (Zhang et al., 2003). About 500 vertebrates and 400–500 plant species have been threatened (Zhao et al., 2016). Intensive human activities and inappropriate land use put significant strain on the fragile urban ecological environment (Yu and Ji, 2000). Approximately two-thirds of the cities in China have experienced drought; the water resource is reaching its limit (Yuan and Wang, 2001; Yu, 2010). Conversely, urban greening is expensive and wasteful (Yu and Li, 2003). During the 2008 Olympics, millions of money were spent on flowerbeds (Kuang, 2012). Annual irrigation in Beijing green spaces was approximately $2.19 \times 10^8 \, m^3$, accounting for 16% of the city's total water use (Wei et al., 2003). Common components of anthropogenic greenspaces, such as ornamental lawns, are biodiversity-poor and ecologically insensitive (Smith et al., 2015). Meanwhile, low-carbon city construction was extensively attentioned in China since 2007 (Hou and Guo, 2011; Li and Zhao, 2015) and the beauty of wild weeds was widely promoted by Kongjian Yu during this period (Yu, 2001, 2011; Jiang, 2010). Without doubt, wildflower meadows were becoming useful. Sowing flower seed mixtures has been proved an effective strategy for establishing grassland (Ren, 2014; Pam, 2015), and has been introduced in several European countries to enhance biodiversity and amenities in intensively used agricultural areas (Woodcock et al., 2008; Haaland and Gyllin, 2011; Pam, 2015), as well as to enhance pest control and crop yield (Tschumi et al., 2016).

Previous studies have examined public perceptions and preferences for meadows and herbaceous vegetation. Liao et al. (2011) surveyed the people in Beijing Olympic Forest Park and determined levels of satisfaction with the landscape (flowerbeds: 39.8%, monocultures: 38.6%, lawns: 30.3%). Experiments in Britain demonstrated that meadows were generally preferred to herbaceous borders and formal bedding plants (Southon et al., 2017). Site evaluations indicated positive attitudes among women and respondents between the ages of 31 and 60 years towards ecological planting (García-Albarado and Dunnett, 2009). Similarly, Swiss people strongly approved of the establishment

of improved field margins (Junge et al., 2009) and diverse meadows consisting of a green matrix with colourful flowers (Lindemann-Matthies and Bose, 2007). Negative perceptions were often strongest in response to vegetation dominated by tall grasses or lacking colourful flowers (Barro and Bright, 1998; Hitchmough and De La Fleur, 2006). Public preference for grass-dominated vegetation declined sharply with increasing height (Dai, 2000). However, no systematic, comprehensive study has examined favoured characteristics of meadows in China. Researchers have focused on the multiple benefits of wildflower meadows, as well as on techniques for their establishment (Zhao, 2011; Jiang et al., 2016a,b); to date, people's degree of acceptance of this new type of plantation is uncertain.

To examine people's recognition and acceptance of features of wildflower meadows, we posed the following questions: (1) do students and non-professionals prefer meadows relative to alternative vegetation styles commonly used in cities; (2) have people living in Beijing seen wildflower meadows before and what do they know about the potential sites and replacement cycle of wildflower meadows; and (3) which factors are considered important when designing a wildflower meadow?

2. Methods

2.1. Participants and surveys

The survey has separate categories for students and non-professionals, since students with a background in landscape had a stronger ability to distinguish vegetation styles and were influenced little by confounding factors in photographs (Xiong and Liu, 2015), and probably, most of them were the future landscape designers (Beijing Forestry University, 2016). Data were collected from 227 respondents; their demographic data are presented in Table 1. Respondents were aged between 15 and 63 years; the mean age of the students was 21.97 years, and that of non-professionals was 36.05 years. Participants were asked to self-estimate their botanical knowledge according to a 5-point Likert scale (1 = very poor, 2 = rather poor, 3 = neither poor or good, 4 = rather good, 5 = very good).

The students were interviewed in the library at Beijing Forestry University, where all of them required to learn botany and thus have a good foundation of botanical knowledge. Volunteers willing to finish the questionnaire were selected randomly and completed the questionnaires in three reading rooms; the questionnaires were presented to one person at a time, which ensured good opportunities for feedback. Overall, 136 questionnaires were completed (return rate = 95%).

Questionnaires were also undertaken by passengers in three waiting rooms of Beijing West Railway Station, where seats were available that provided comfortable and leisurely conditions. Furthermore, these respondents had wide-ranging ages and backgrounds. Ninety-six questionnaires were completed (return rate = 96%).

Table 1
Demographic data.

Gender		Age (years)	
Students	Non-professionals	Students	Non-professionals
Male (42)	Male (55)	15–18 (8)	15–18 (3)
Female (94)	Female (36)	19–30 (127)	19–30 (40)
		31–40 (1)	31–40 (15)
			41–50 (20)
			51–60 (9)
			61–70 (4)

Note: Values in parentheses indicate n (total N for each column was 227).