Exploring the Driving Factors that Influence the Design, Function, and Use of Urban Wetlands in the United Kingdom

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Abstract

This paper aimed to investigate the driving factors for the creation of urban wetlands and their functions and uses. A mixed methods approach was used, comprising an online survey for the general public and structured interviews with four urban wetland 'experts'. Quantitative data was obtained from the survey, and cross tabulation was used to analyse relationships between variables. Thematic analysis was used for the qualitative data from the interviews. It was found that one of the urban wetlands was created for flood control and to create an amenity space, whilst the driving factors for the other three urban wetlands were associated with biodiversity and habitat creation, which was also perceived as the most important function of an urban wetland from the survey participants. Three themes emerged from the thematic analysis: 'wildlife conservation interest'; 'landscape character development'; and 'urban wetland as an amenity space'. The survey found that participants perceived climate resiliency as an important function of wetlands, despite this not being a driving factor for the four wetlands in the interviews. Survey participants would be willing to invest time in visiting a non-local wetland landscape to encounter nature and contribute to their quality of life and wellbeing. The results of this research may be useful to inform the planning, design and management of urban wetlands as they evolve towards being a multi-use spaces. More education and awareness are needed about the benefits of these landscapes to wildlife, the environment and local communities.

Keywords Wetland design · Entrance fee · Ecosystem services · Climate resiliency · Urban design · Biodiversity

Introduction

The benefits of wetlands to wildlife and the environment have been widely reported (Xu et al. 2020; Lambert et al. 2021; Rutter et al. 2022). Wetlands are among the most valuable ecosystems on the planet because they have long provided humanity with ecosystem services (Mitsch et al. 2015; Convention on Wetlands 2021), but it is only recently that the magnitude of these benefits, as well as the costs of their loss or degradation, has been recognised (Convention on Wetlands 2021). The Ramsar Convention recently released a report that looked at the period 1970 to 2015 and found that wetlands are being destroyed and disappearing three times faster than forests around the world (Convention on Wetlands 2021). On the other hand, the Royal Society for the Protection of Birds (RSPB) states that wetland habitats have declined in recent decades but are now seeing a revival (RSPB 2022). At national level, wetlands are important areas of the UK landscape and need to be created, preserved and managed appropriately (McInnes 2013; Dehnhardt et al. 2019). The Wildfowl and Wetlands Trust (WWT) is currently campaigning for the creation of 100,000 hectares of wetlands in the UK. With support from the public, they aim to encourage the UK government to prioritise wetland creation, to address the environmental and social crises that exist today (WWT 2021). In the context of COVID-19 or potential future pandemics, urban wetlands have recently been promoted as a means of promoting public health (Zhai and Lange 2021). In particular, urban wetlands, as a key urban biodiversity space, can provide recreation while also promoting residents' mental and physical health and making cities more livable (Andreucci et al. 2019; Russo and Cirella 2020; Russo and Holzer 2021; Rojas et al. 2022). Large numbers of wetlands may survive in metropolitan areas, both as natural remains and as an unintended consequence of human activity (for example, fringing wetlands on dredge spoil deposits) (Ehrenfeld 2000). Because of their continued existence within gray infrastructure, these wetlands continue to provide vital biological functions and may be especially beneficial to both people and wildlife (Ehrenfeld 2000).

The literature review has highlighted that previous research has focused on environmental themes such as urban wetlands providing long term CO_2 storage and having a high cooling effect (Haase 2017; Xue et al. 2019; Bera et al. 2021; Rogerson et al. 2021). Creating wetlands in urban environments can not only mitigate the effects of climate change but can also reverse the damage that has been caused directly by urbanisation. For example, Hong Kong's Wetland Park was one of the world's earliest conservation and museum initiatives, aiming to conserve the wetlands from rapid urbanisation (Xue et al. 2013).

Urban wetland design can be carefully incorporated with other urban development initiatives to increase cities' resilience to extreme weather events (Ahn and Schmidt 2019; Rojas Quezada and Jorquera 2021). Rogerson et al. (2012)

examined how urban wetlands can contribute to the net-zero targets of carbon sequestration in urban environments. Further research is necessary on whether combatting climate change and creating resilient spaces is an important objective or driving factor for the creation of urban wetlands and whether this has been successful. Other environmental themes that have been addressed include water management through sedimentation, filtration, absorption, and uptake by vegetation, which helps to improve water quality by removing pollutants (Birch et al. 2004; Woodcock et al. 2010; Malaviya and Singh 2012; Lucas et al. 2015).

Themes regarding biodiversity were also highlighted in the literature, including habitat protection and creation to benefit wildlife (Hassall 2014; Palta et al. 2017; Alikhani et al. 2021; Wang et al. 2022). However, many studies suggest that there are conflicting interests in habitat conservation and recreational use of urban wetlands (Hettiarachchi et al. 2014; Rojas et al. 2022), thus, more research on urban wetlands as a multi-use, functional space should be encouraged, to determine whether conservation and recreation opportunities can succeed in tandem. Recreational themes associated with leisure have also been discussed (Zedler and Leach 1998). Several studies highlighted that urban wetlands can support the health and wellbeing of individuals, contributing to a better quality of life and reduced stress levels (Pedersen et al. 2019; Maund et al. 2019). The opportunities provided by urban wetlands have also resulted in increased residential property values in areas close to the associated spaces or ecosystems (Mahan et al. 2000; Du and Huang 2018). However, good quality urban wetlands are unequally distributed throughout neighbourhoods, which is something that needs to be addressed. Much of the research presented in the literature was based on individual case studies, making the results not as generalisable as if many urban wetlands were used in one research study. As well as this, there is limited guidance and policies on wetland creation and management for optimal design for specific types of wetland. Different policies for different wetlands that have specific objectives should be available to ensure prosperous wetland landscapes.

It is therefore important to conduct research on people's experiences of wetlands and how they might use wetlands, particularly in urban areas. It is also important to link the use of wetlands to the objectives in the design and construction of a wetland. Many organisations have set up initiatives and projects to restore and maintain wetlands. In the past, scholars from various UK institutions developed the WetlandLIFE project, which used an interdisciplinary approach to investigate cultural, historical, and ecological factors to better understand the multiple values of urban wetland areas (Hawkes et al. 2022). However, there is limited research on the use and design of urban wetlands. The research is more limited on the driving factors for the design of wetlands and the experiences and benefits of wetlands to humans.

To address several research gaps highlighted in this paper, the overarching aim of this research project is to investigate the driving factors for the design and use of urban wetlands and how wetland landscapes are experienced. Driving factors for the design and use of urban wetlands were investigated using interviews with professionals and managers of wetlands. An online survey was conducted to assess how urban wetlands are utilised and experienced by various individuals in the UK.

Materials and Methods

This research was a mixed-method study which merged qualitative and quantitative methodologies using a triangulation design to obtain results. Methodological triangulation uses more than one method and is usually both qualitative and quantitative (Creswell and Piano Clark 2008). This research study used interviews and questionnaires via an online survey, to address and answer the research questions, and to ensure the strengths of each method were utilised (Creswell and Piano Clark 2008). Whilst the data collection and data analysis for each method took place separately, the results from these methods have been compared and discussed together.

Pilot Study

A small pilot study was conducted prior to the main research. A pilot study is a way to validate the feasibility of the research, and is often conducted as a way to improve the quality and efficiency of the research (In 2017). The researchers decided to conduct a pilot study to assess whether the questions in the survey were clear and unambiguous, to ensure results were as valid and reliable as they could be.

Online Questionnaires

The predominant method used for this research project was a questionnaire, completed via an online survey (see

Appendix 1). Given the current climate and the ongoing COVID-19 pandemic, a snowball sampling method was used to acquire participants to complete the online questionnaire. The questionnaire was distributed initially by sending an online link to the Google Forms survey to the researchers' contacts. The link and invitation to take part was also posted on various social media accounts belonging to the researchers (Instagram, Facebook, LinkedIn), and on a local website known to the researchers. These messages or posts included an invitation to send the link on to other contacts known by the participants, to encourage the snowball sampling effect. The results submitted by the participants were automatically collected in Google Forms and could be accessed only by the researchers.

Using an online calculator (https://www.surveymonkey.co.uk/mp/sample-size-calculator/), a suggested sample size was calculated assuming a 95% confidence level, 10% margin of error and the population size being the number of individuals over the age of 18 in the United Kingdom. The ideal sample size was suggested to be 97 participants.

Interviews

The main purpose of interviewing urban wetland 'experts' was to gain a more professional understanding on how different urban wetlands across the UK have been designed, the main driving factor behind the creation, how they operate, and the future plans of the site. A convenience sampling method was used for selecting the urban wetland 'experts' to interview. The researcher initially searched online for urban wetlands in the UK, which led to eight individuals, companies or charities whom have associations with urban wetlands, being contacted via email. The eight 'chosen' contacts were contacted based on: the relevance of the wetland operating as an 'urban wetland'; the prominence of the urban wetland when researching (i.e. the top results in the search engine that fit the criteria); and the availability of the urban wetland manager or director (i.e. those that had contact details available to the researcher on a reputable website). In total, four interviews with urban wetland 'experts' took place. The focus of the five interview questions is available in the supplementary material (Appendix 2).

Data Analysis

Statistical Analysis

Cross-tabulation was used to investigate the relationship between some of the variables from the online survey. Variables were chosen for cross-tabulation based on the results and the relevance to the research questions. Data from the cross-tabulations was analysed using the Chi-squared test of independence, using an online calculator (Preacher 2001). The level of significance chosen was 0.05.

Thematic Analysis

Thematic analysis was used to analyse the qualitative data acquired from the interviews that took place with the urban wetland 'experts'. The coding process was completed manually by the researcher and involved organising the raw qualitative data by labelling interview transcript extracts with relevant codes. Potential patterns and connections were also noted during the coding process (Kiger and Varpio 2020). These initial codes were then compared and combined to identify and construct themes. The codes were then reviewed and re-examined under each theme, and each theme was defined and named.

Results and Discussions

Demographics of Participants

There were 114 responses to the survey. 50% of participants were in the 18 to 30-year-old age group. There was only one participant in the over 80 age group (1%). The majority of participants (39%) live in semi-rural areas, while 32 per cent live in urban areas and the rest in rural areas.

Visiting an Urban Wetland and Uses

59 per cent of the participants visited a wetland, including WWT and RSPB wetlands to small nature reserves and lakes as well as some participants mentioned examples of wetlands overseas, for example in Bali and Hong Kong.

When asked how much participants would be willing to spend on an entrance fee, the most popular answer was up to £5 (45.6%). Only 2% would be willing to pay more than £15. It is difficult to compare the willingness to pay an entry fee with similar studies because recent studies have been conducted in upper-middle-income and low-income countries (Lamsal et al. 2016; Yang 2021; Hu et al. 2022).

The relationship between age range and the amount to spend on an entrance fee was investigated using cross-tabulation. From the cross-tabulation, it appeared that the 31 and over age group were more likely to spend up to £10 (37%), compared to the 18 to 30-year-olds (21%) Table 1). A Chi-squared test of independence was performed on the data with the null hypothesis: 'There is no relationship between age group and amount willing to spend on an entrance fee for an urban wetland'. The Chi-squared test gave a *p*-value of 0.43, which is non-significant and therefore the null hypothesis was accepted that there was no relationship between the two variables of age and entrance fee, in other words, there was no difference between the two age groups in terms of the amount willing to spend.

The majority of participants would travel to an urban wetland by car (69%). The least popular mode of transport was bike and bus (4% and 3%).

Table 1 Cross-tabulation of age group and entrance fee

What age range do you fit in?	How much would you be willing to spend on an entrance fee to an urban wetland?				
	Free entry	Up to £5	Up to £10	Up to £15	More than £15
18 – 30 (*n* = 57)	9 (16%)	30 (52%)	12 (21%)	5 (9%)	1 (2%)
31 – 40 (*n* = 16)	2	8	5	1	0
41 – 50 (*n* = 8)	1	5	2	0	0
51 – 60 (*n* = 17)	5	3	8	0	1
61 – 70 (*n* = 7)	1	3	2	1	0
71 – 80 (*n* = 8)	0	3	3	2	0
Over 80 (*n* = 1)	0	0	1	0	0
31 and over (57)	9 (16%)	22 (38%)	21 (37%)	4 (7%)	1 (2%)
Totals (114)	18 (16%)	52 (45%)	33 (29%)	9 (8%)	2 (2%)
p-value	0.43				

The majority of participants would be willing to travel from 5 miles (8.05 km) to 20 miles (32.19 km) to visit an urban wetland, with 28 per cent of participants choosing each of the categories 'up to 10 miles' and 'up to 20 miles'. The most popular answer for total time spent visiting an urban wetland was 1 to 2 h (46%). The least popular answer was more than 4 h (5%).

The second investigation using cross-tabulation was the relationship between location of participants (urban, semi-rural and rural) and how far they would be willing to travel to an urban wetland (Table 2). For this analysis, the distance willing to travel was grouped into fewer categories than offered in the survey, in order to meet the assumptions of the Chi-squared test (values 1 or higher in each cell of the table). From the table, it appeared that participants living in urban environments were less willing to travel up to 20 miles (14%), compared to the semi-rural participants (32%) and the rural participants (40%). The *p*-value provided by the Chi-squared test was 0.09, which is not significant, and therefore the null hypothesis was accepted: 'There is no relationship between location of participants and the distance willing to travel to an urban wetland'.

The survey showed that most participants would be likely to visit an urban wetland in Spring (80.7%), Summer or Autumn, with less than half of participants likely to visit in the winter.

Most participants reported that they would visit an urban wetland to encounter nature, meet friends and family, and for exercise and wellbeing (Fig. 1). Fewer participants selected educational reasons, refreshments and shopping. Additional reasons given in the free text were photography, dog walking and to support the wetlands.

The relationships between age range and two different uses of an urban wetland were explored: educational activities and physical exercise (Table 3). It was clear from the cross-tabulation that there were no differences between the age groups and the use of an urban wetland for educational activities (32% and 33%, $p = 0.84$). However, there was a difference between the age groups and the use of urban wetlands for physical exercise. Counter to expectations, the younger age range were less likely to use urban wetlands for physical exercise (54%), compared to the older age range (74%). This was significant ($p = 0.03$), and therefore the null hypothesis: 'There is no relationship between age range and

using urban wetlands for physical exercise', was rejected. The alternative hypothesis: 'There is a relationship between age range and using urban wetlands for physical exercise', was accepted.

During interactive talks or guided walks in an urban wetland, most participants would be interested in learning about biodiversity and wildlife in the wetland landscape, and how they were constructed. Fewer participants would be interested in the history of the wetland, water management and the materials used on site. In the free text responses, two participants mentioned they would be interested to hear about urban wetlands and climate mitigation, and two participants mentioned future plans for the wetland.

Function of Wetlands

The five most important functions of an urban wetland selected by the participants were: biodiversity and habitat conservation; flood control; water quality improvements; a space for conducting research; and a carbon store (Fig. 2). The least important functions were: a space for shopping and a space for eating and drinking.

This result is consistent with that of Yang (2021), who reported that biodiversity is the far more preferred attribute in an urban wetland park in China.

Three themes emerged from the thematic analysis: 'wildlife conservation interest'; 'landscape character development'; and 'urban wetland as an amenity space'.

The outcomes of the interviews revealed that biodiversity and habitat creation were the driving factors for the creation of three out of four of the urban wetlands in question, which was also perceived by the general public as the most important function of an urban wetland.

Three out of five of the most important functions of an urban wetland selected by the online survey participants were related to mitigating climate change and resiliency. These were flood control, water quality improvements and carbon capture. Flood control was perceived as the second most important function of an urban wetland. However, only one out of four of the interviewees highlighted that the urban wetland of interest was created for flood mitigation purposes.

The relationship between age range and social activity as an important function of an urban wetland was explored (Table 4). As before, the age groups were divided into 18 to 30-year-olds (n = 57) and 31 and over (n = 57). Interestingly, the cross-tabulation table suggested that the 18 to 30-year-old age group was less likely to think that social activity is in the top 5 most important functions of an urban wetland (23%), compared to the 31 and over age group (35%). However, the p-value from the Chi-squared test was 0.15, which is not significant and the null hypothesis can therefore be accepted: 'There is no relationship between age range and perception of social activity being an important function of an urban wetland'.

The relationship between age range and carbon storage as an important function of urban wetlands was also investigated using cross-tabulation (Table 4). Similarly, the 18 to 30-year-old age group were less likely to think that

Table 2 Cross-tabulation of participant location and willingness to travel

What best describes where you live the majority of the time?	How many miles would you be willing to travel to visit an urban wetland?					
	Up to 0.5 mile	Up to 1 mile	Up to 5 miles	Up to 10 miles	Up to 20 miles	More than 20 miles
Urban (37)	0	2 (5%)	13 (35%)	11 (30%)	5 (14%)	6 (16%)
Semi-rural (44)	1 (2%)	3 (7%)	7 (16%)	10 (23%)	14 (32%)	9 (20%)
Rural (33)	0	0	4 (12%)	11 (33%)	13 (40%)	5 (15%)
Totals (114)	1 (1%)	5 (4%)	24 (21%)	32 (28%)	32 (28%)	20 (18%)
p-value	0.14					

Grouped table to meet chi-squared assumptions (1 or above in each cell)

What best describes where you live the majority of the time?	How many miles would you be willing to travel to visit an urban wetland?			
	Up to 5 miles	Up to 10 miles	Up to 20 miles	More than 20 miles
Urban (37)	15 (40%)	11 (30%)	5 (14%)	6 (16%)
Semi-rural (44)	11 (25%)	10 (23%)	14 (32%)	9 (20%)
Rural (33)	4 (12%)	11 (33%)	13 (40%)	5 (15%)
Totals (114)	30 (26%)	32 (28%)	32 (28%)	20 (18%)
p-value 0.09	0.09			

Fig. 1 Potential uses of urban wetlands

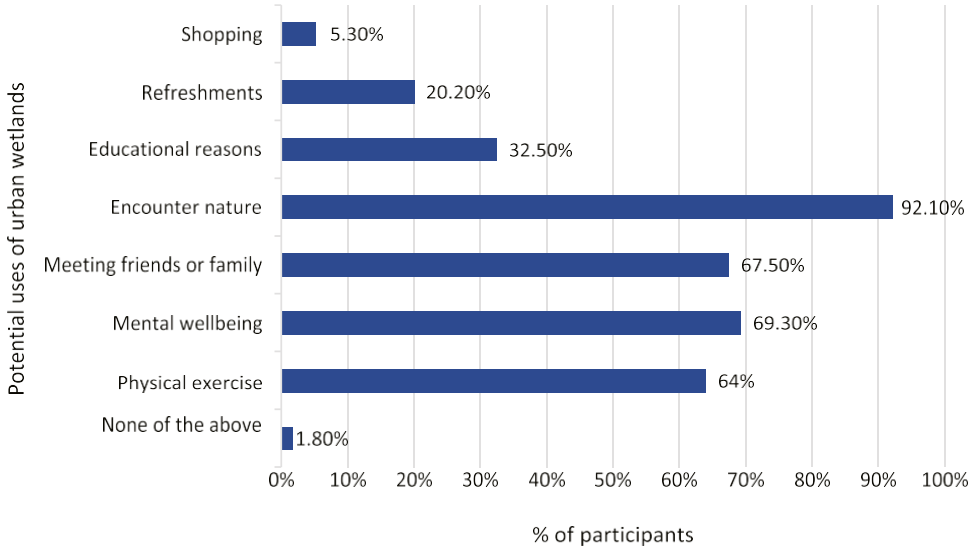

Table 3 Cross-tabulation of age group and urban wetland use

Use	Would you use a wetland for educational activities?		Would you use a wetland for physical exercise?	
What age range do you fit in?	Yes	No	Yes	No
18 – 30 (*n* = 57)	18 (32%)	39 (68%)	31 (54%)	26 (46%)
31 and over (57)	19 (33%)	38 (67%)	42 (74%)	15 (26%)
Totals (114)	37 (33%)	77 (67%)	73 (64%)	41 (36%)
p-value	0.84		**0.03**	

Bold text indicates statistical significance at $p < 0.05$

Fig. 2 Functions of an urban wetland

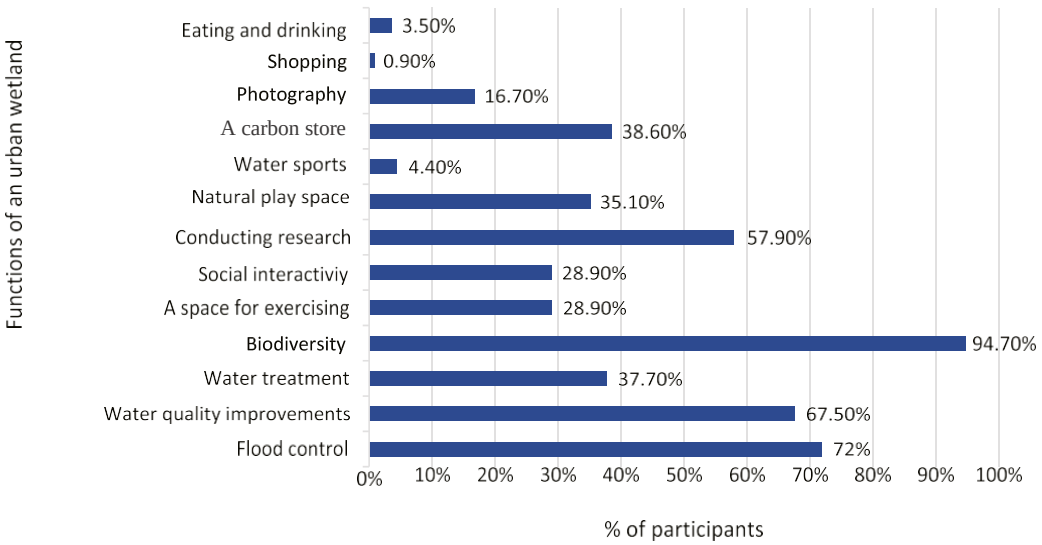

Table 4 Cross-tabulation of age group and urban wetland function

Function	Is social activity an important function of a wetland?		Is a carbon store an important function of a wetland?	
What age range do you fit in?	Yes	No	Yes	No
18 – 30 ($n = 57$)	13 (23%)	44 (77%)	20 (35%)	37 (65%)
31 and over (57)	20 (35%)	37 (65%)	24 (42%)	33 (58%)
Totals (114)	33 (29%)	81 (71%)	44 (39%)	70 (61%)
p-value	0.15		0.44	

carbon storage is in the top 5 most important functions of an urban wetland (35%), compared to the 31 and over age group (42%). However, this difference was not significant. The *p*-value determined by the Chi-squared test was 0.44, so the null hypothesis was accepted: 'There is no relationship between age range and the view that carbon storage is an important function of an urban wetland'.

The general public is aware of the importance of flood mitigation as the effects from climate change are predicted to worsen and flooding is becoming a global issue, thus more research is needed in this area to determine the importance of this function of urban wetlands to guarantee resilient landscapes.

The third most important function perceived by the participants in the online survey was water quality improvements. Lucas et al. (2015) highlighted the importance of using urban wetlands as a way to protect natural water sources and improve water quality by removing pollutants and nutrients from stormwater runoff. Despite this, the majority of interviewees did not discuss stormwater management and water quality improvements as objectives and driving factors for the creation of the urban wetlands or in future plans for the evolution of the landscape. One of the interviewees, who was speaking on behalf of Newport Wetlands Nature Reserve, stated that an objective for the creation of the urban wetland was to improve water quality by ensuring that farmers no longer used artificial fertilizers or pesticides. However, this objective did not include particular stormwater management techniques, but rather changing the behaviours of locals.

Previous research has shown that processes including sedimentation, filtration, adsorption and uptake by vegetation to manage stormwater are not fully understood. This may explain why the interviewees did not discuss these processes for the urban wetlands in question. Most of the literature in this area focusses on constructed wetlands which were created primarily for the purpose of water management. However, the urban wetlands discussed in the interviews were not constructed for this purpose and focused on other objectives. Dong et al. (2013) and Malaviya and Singh (2012) both suggested that specific plans and policies are needed as a way to approach optimal design to manage stormwater. Until these policies are in place, it will be difficult for urban wetland managers to incorporate water management systems as part of the overall design.

The importance of urban wetlands facilitating carbon storage was perceived to be the fifth most important function overall by the online survey participants. As above, none of the interviewees mentioned carbon storage as a driving factor for the creation of the urban wetlands in question.

The most important function of an urban wetland selected by the online survey participants was biodiversity and habitat conservation, with 94.7% of participants selecting this option. Three out of four of the interviewees stated that the urban wetlands in question (Drakelow Nature Reserve, Willington Wetlands and Newport Wetlands NNR) were created primarily for wildlife conservation, with a focus on habitat creation. The primary driving force for the creation of Drakelow Nature Reserve and Willington Wetlands was to develop and improve habitats for local wildlife, whereas Newport Wetland NNR was created to provide breeding habitats for specific water birds. Palta et al. (2017) and O'Brien et al. (2018) highlighted how urban wetland landscapes have the opportunity to support the creation and protection of habitats, that may not be present elsewhere in nearby urban spaces.

Design and Policies of Urban Wetlands

The majority of participants think that urban wetlands should be incorporated into urban design (60%), and 30 per cent of the participants were unsure whether they should be a necessity in urban design.

The majority of respondents (80.7%) thought that local communities should be consulted about the design of urban wetlands, whereas only 6% thought that they shouldn't be consulted. The following question was for participants who thought communities should be consulted about urban wetlands, regarding urban wetland design involvement. From this question, 70 per cent said they would like to be involved in walkways and visitor accessibility.

The majority of participants thought that all green infrastructure in urban design are all equally important. Over 25% of participants thought that urban wetlands are more important than green roofs in urban design, and 22% of participants thought that street planting is not as important as wetlands in urban spaces.

Future use of urban wetlands was the subject of the last checkbox question in the questionnaire. Interactive talks or guided walks, art exhibitions and food and drink amenities, would most likely encourage participants to visit an urban wetland. In the free text box, 3 participants mentioned that wildlife and certain species would encourage them to urban wetlands, and 3 participants specified that seasonal events would encourage future visits. 2 participants noted that none of the above options would encourage them to visit an urban wetland as they would prefer a more 'natural' environment, with limited noise and people.

In the free text box for final comments at the end of the survey, four participants noted how the general public should be more aware of urban wetlands and the importance of them in the landscape. One participant said '*People need educating about what a wetland does and (should be) encouraged to visit to learn about them'*. They went on to say how urban wetlands should be advertised more prominently and should be accessible to all communities. Another participant said how there should be '*more publicity about the positives (of urban wetlands) and how they contribute to health of the planet'*. Many other participants left comments about how the online survey increased their awareness and interest towards urban wetlands, as the survey prompted the participants to research urban wetlands. One participant left the comment *'I didn't really know urban wetlands existed so this was interesting, thank you!'.*

Some participants commented on the location (where they live) and how likely they would visit an urban wetland. For example, one participant mentioned that due to them living in a rural area, they would *'stick to going for a walk by the river, and would do something different if visiting an urban area'*, rather than being inclined to visit a wetland. They went on to say that they *'would probably value (and visit) urban wetlands more if (they) lived in an urban area'.* Another participant who lives in an urban environment noted that they would *'love to see wetland areas being incorporated into larger parks and open areas in towns and cities',* which can be accessed easily by local residents.

Some participants also expressed their concerns in the free text box over developing urban wetlands into a *'commercial experience'*, with lots of amenities, due to the *'continued poor habits of people regarding rubbish disposal* etc*.'.* They continued by saying that the management of the urban wetlands would need to be carefully considered '*to avoid damaging the environments and habitats'.* Another participant similarly noted that they were worried about urban wetlands potentially focusing too much on the business and marketing side of things in the future, rather than on the environment and biodiversity.

It was highlighted in the interviews with wetland experts that the landscape character of the wetlands had been carefully designed to protect wildlife by controlling and screening visitor access. 'Landscape character development' was a theme from the thematic analysis, showing that this was an important theme throughout the interviews. It was thought to be necessary to design these urban wetlands to ensure effective protection to wetland habitats and to support the associated biodiversity. Thus, encouraging visitors to the landscape is perceived as a lower priority than biodiversity protection, which may explain why visitor amenities have been limited in these particular urban wetlands in the past. Zedler and Leach (1998) discovered that the location of visitor amenities in urban wetland landscapes should be carefully considered to ensure minimal disruption to wildlife. An expert highlighted that Drakelow Nature Reserve has developed a trail to facilitate leisurely exercise and encourage visitors to the wetland landscape, but with this development, it was important to implement sinking paths and screened areas to ensure maximum protection of biodiversity. The vegetation associated with this urban wetland was also selected to benefit the water birds.

However, it was highlighted from McKinstry and Anderson's (2002) research that there are limited guidelines on how wetlands can be improved by design for the benefit of waterfowl. Another expert interviewee recognised that the driving forces behind the creation of the urban wetland were dual: extraction of gravel creating wet and damp areas, and wildlife conservation.

It was found from the online survey that during interactive talks or guided walks in an urban wetland, most participants would be interested in learning about biodiversity and wildlife in the wetland landscape. Therefore, a balance will have to be achieved between protecting biodiversity and habitats and allowing visitors to view and learn about wildlife. Many studies have suggested that there are conflicting interests between habitat conservation and recreational use of

urban wetlands. According to Rojas Quezada and Jorquera (2021), neighbourhoods in urbanised areas need to be modified to "eco-friendly" designs in order to guarantee wetland existence and to regain their functions for the benefit of future generations. Despite the primary objective for Newport Wetland NRR, Willington Wetlands and Drakelow Nature Reserve being biodiversity protection, the landscapes are now experiencing increased visitor numbers due to improved amenities and new wetland facilities. Thus, more research on urban wetlands as a multi-use, functional space should be encouraged. Specifically, future study should focus on top-down thinking that considers the whole community as well as sustainable management of urban wetlands.

Mixed Methods Approach

Previous studies show that multiple research methods have been used by different researchers to investigate the use and experiences of wetlands, from using Community Voice documentaries, to postal questionnaires, and wearable technologies (Pedersen et al. 2019; Hawkes et al. 2022). If similar results are obtained from multiple methods, this strengthens the robustness of the results (Caruth 2013). The research presented in this paper aimed to contribute to the international literature on the use and potential experience of wetlands by using two further methods: interviews and an online survey.

The findings from the online survey and interviews, combined with previous literature associated with resilient landscapes, helped to answer 3 out of 4 of the research questions. These were: ‘What are the main driving factors in the design of urban wetlands?’; ‘What are the important functions of urban wetlands?’; and ‘How does the use and design of urban wetlands evolve over time?’. The online survey highlighted that many of the most important functions of urban wetlands perceived by the participants were associated with mitigating climate change. However, in the thematic analysis from the interviews, resilient landscapes was not identified an overarching theme. It was found that environmental resiliency in the form of flood control was a driving factor for only one of the urban wetlands discussed in the interviews. This particular urban wetland also addressed the effects of climate change and plans to incorporate increased resiliency in the landscape’s evolution, which is important to ensure sustainable development.

Limitations of Research Study

A potential disadvantage of opportunity sampling is that it may not produce results which represent the target population. This is because participants are recruited based on availability, proximity and accessibility. For example, results may be biased towards one particular age group or demographic known to the researcher. In this research study, 50% of the online survey participants were in the age category 18–30 years. The use of snowball sampling in this research study mitigated this bias to some extent as the survey was sent to a wider population from the initial contacts of the researcher, and the percentage of participants in the age category of 18–30 years could have been much higher if this sampling was not used. However, snowball sampling is still criticised for its selection bias and lack of generalisability and representativeness (Parker et al. 2019).

The answers to the question ‘What best describes where you live the majority of the time?’ were fairly evenly spread across the three options. However, the largest percentage of participants choose the semi-rural option as their location. Due to differences in green space types, locations, and usage, urban and rural populations have different experiences with green spaces and wetlands (Crossley and Russo 2022). Urban and rural communities have also different preferences for wetland conservation (Hassan et al. 2019). Future research should use different methods of recruiting survey participants to ensure a more diverse cross-section of the population. This research study, however, brings together the experience and knowledge of urban wetland experts with the perceptions of the general public, who did not necessarily have prior knowledge or experience of these landscapes. This should help to inform plans and policies for the design, use and management of urban wetlands in the future. Using structured interviews as a method means that there is limited opportunity for further discussion and spontaneity regarding themes that interviewees are more passionate or knowledgeable about. It also means that it is less likely that rapport between the interviewer and the interviewee will be established, suggesting that participants may be more reserved or unlikely to discuss specific topics or feelings (Rashidi et al. 2014). In this research study, the interview questions were designed to gather factual information rather than personal experiences, therefore the lack of face-to-face interaction was not thought to be important.

A limitation of this research study was that a number of urban wetland managers could not participate in the interview due to the ongoing COVID-19 pandemic, limited staff members and busy working hours.

Conclusion

This study sought to determine the driving factors for the design and use of urban wetlands and how the spaces are utilised and experienced. The findings from the interviews showed that the driving factors for the creation of three out of four of the urban wetlands in question were associated with biodiversity and habitat creation, which was also perceived as the most important function of an urban wetland from the general public. Aside from biodiversity and habitat creation, the majority of the most important functions perceived by the general public were related to mitigating climate change and resiliency. However, only one out of four of the urban wetlands of interest in the interviews was created for flood mitigation purposes.

This research project also showed that members of the public would be willing to invest time in visiting a non-local wetland landscape to encounter nature and contribute to their quality of life, reducing stress levels and enhancing positive feelings. The survey revealed that some participants lacked knowledge about wetlands, therefore more education and awareness is needed of the benefits of these landscapes and how they can benefit local communities and urban developments. However, residents in semi-rural and urban locations may have different perceptions and knowledge (Hassan et al. 2019). Our findings show that more research on urban wetlands as a multi-use, functional space should be encouraged, to ensure minimal disturbances to wildlife, but also to encourage individuals into these landscapes. Further research is needed using a wider range of wetlands as case studies, to compare the objectives of wetlands in different climatic conditions.

Acknowledgements This research does not infringe the ethical principles set out in the University of Gloucestershire's Handbook for Research Ethics.

Author Contributions All authors contributed to the study conception and design. Material preparation, data collection and analysis were performed by Chloe Andrews. The first draft of the manuscript was written by Alessio Russo and all authors wrote, edited and commented on previous versions of the manuscript. All authors read and approved the final manuscript.

Funding The authors declare that no funds, grants, or other support were received during the preparation of this manuscript.

Data Availability The datasets generated during and/or analysed during the current study are available from the corresponding author on reasonable request.

Declarations

Competing Interests The authors have no relevant financial or non-financial interests to disclose.

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