Biodiversity, People, and Logistics: the balancing act of urban park management

Sadhbh A Horan, BSc.

A paper submitted to University College Cork as part of MSc Applied Ecology

School of Biological, Earth & Environmental Sciences,

University College Cork

Head of Department Prof. Astrid Wingler

Supervisor(s): Simon Harrison and Eoin Lettice

Year of Submission: 2023

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III. Declaration

This is to certify that the work I am submitting is my own and has not been submitted for another degree, either at University College Cork or elsewhere. All external references and sources are clearly acknowledged and identified within the contents. I have read and understood the regulations of University College Cork concerning plagiarism and intellectual property.

IV. Abstract

In a time when global populations are moving to urban centres, the need for adequate green spaces in towns and cities for the health of both people and nature is paramount. The management of such spaces in Ireland is idiosyncratic and requires investigation. Multiple studies have tried to quantify the key influences to take into consideration when managing an urban park and for this thesis it was determined that the intersection of biodiversity, people and logistics encompassed theses influences. The aim of this study was to determine how best to manage parks in terms of habitat, amenity and management choice, based on the three selected influences. Diversity of vascular plants and fungi were assessed at six parks in Cork city. In addition, park user questionnaires and SOPARC (System for Observing Play and Recreation in Communities) observations were made to quantify people's park use and opinions. Finally, in order to determine what systems were already in place, structured interviews were undertaken with individuals and organisations who manage urban parks in Ireland. Results show that dry meadow is the optimal choice of habitat for Irish parks due to it high level of biodiversity, its popularity among park visitors, and its compatibility with park amenities however the choice of habitat needs to take abiotic and social factors into account also. Basic amenities such as footpaths and litter bins were preferred over elaborate ones such as outdoor exercise equipment, while overall, recreational facilities were more popular than sports facilities. Logistically, in urban centres where a park management sector was present, it was often underfunded and understaffed, and so while the progress made by these groups is commendable, they are simply not rigorous enough to sustain the growing number and need for urban parks in Ireland. Urban green spaces require a complex understanding of each of the three influences highlighted in this study both across urban centres and within individual parks and cities in order for optimal management to take place.

1.0 Introduction

1.1 Population Growth and Migration

In the era of globalisation, the influence of mankind on the Earth's natural systems and processes including physical and chemical cycles is greater than ever before. Since 1950, the global population, energy usage and release of greenhouse gases, as well as a variety of other socio-economic and environmentally significant trends have increased beyond the range of viability of the Holocene era (Steffen *et al*., 2015; Shoshitaishvili, 2021). Together, this set of human driven accelerated trends has been dubbed "The Great Acceleration" and its occurrence aids in explaining recent climate change and ecological disturbance. The Covid-19 pandemic has only intensified these trends, widening the gap between the top and bottom of the power curve of economic profit (Bradley *et al.,* 2020). Currently, urban areas cover between one and six percent of the Earth's surface while containing 55% of the world's current population of 4.2 billion with this number only going to increase in the next 25 years by approximately 2.5 billion people. This is in stark contrast to the 751 million population that was present in urban areas in 1950 (United Nations, 2018). In Europe, one in three cities will see growth of 10% or more in the next 30 years, with more than 50% growth in functional urban areas such as Stockholm, Brussels and Luxembourg, 25-50% growth in medium sized capital cities and large regional cities such as Vienna, Prague, Budapest, Munich, and Bologna (European Commission).

In Ireland, the number of urban settlements has doubled from 104 in 1966 to 200 in 2016. The latter number consists of 97 urban areas with populations of over 1,500 at both the start and the end of the period and a further 103 places that have exceeded the threshold by then end of the period. Ireland in 1966 was predominantly rural with less than half the population of 2.88 million residing in urban areas. By 2016, the urban population had increased to just under 3 million people out of a total 4.76 million (63%). Urban populations grew most rapidly in the period between 1966 and 1981, and again between 1996 and 2011. Both of these periods show relatively strong economic growth in Ireland, with the first being the result of the *First Programme for Economic Expansion* (1958-1963) and the second corresponding to the Celtic Tiger period (Mc Cafferty, 2019).

1.2 The Biodiversity of Urban Areas

The association between urban ecosystems and biodiversity has most often concerned the impacts which urbanisation has on biodiversity. However, biodiversity concepts can be applied to urban ecosystems themselves. As the population of urban areas continues to increase, restoration, preservation, and improvement of biodiversity in urban centres becomes of increasing importance (Savard *et al.*, 2000). Also, from an ecological perspective, urban ecosystems are highly dynamic and can provide insights into the management of biodiversity in other ecosystems (McDonnell & Hahs, 2013). Urban ecosystems are characterised by a high level of heterogeneity which if often organised along a gradient which extends from the surrounding landscape to the town centre (McDonnell *et al*., 1993). The motivations for the conservation of urban ecosystems include the preservation of local biodiversity, the provision of ecosystem services, conducting environmental education, fulfilling ethical responsibilities, and the improvement of human health and wellbeing (Dearborn & Kark, 2010).

Many public urban parks in Europe and Asia have their origins in The Hanging Gardens of Babylon where the Assyrians and Babylonians planted gardens in palace courtyards, cities, and temples where fruit trees and aromatic trees were common, representing their concept of paradise (Dalley, 1993). Parks and gardens were also favoured by the Egyptians, and often divided into temple areas to which only priests and the wealthy had access (Dormidontova *et al*., 2004). The Greeks and Romans added public gardens as meeting places and markets within their cities for domestic pleasure, to exercise, to hunt, for the fine arts and to celebrate their emperors with statuary. These fine parks became the models for the Renaissance gardens of Italy and their spread in popularity throughout Europe from the 15th to the 18th century and it is within this time that Irish public parks find their origin.

The increase in urban population has highlighted the importance of improved biodiversity, access, restoration and preservation of green spaces within urban centres (Savard *et al*., 2000). Evidence has shown that access to urban green spaces contributes to one’s quality of life while simultaneously providing many environmental services (Chiesura, 2004). Both physical and mental health are positively impacted through urban access to nature. This can help address many health issues which are common in an urban lifestyle such as hypertension, while also encouraging positive health behaviours such as exercise. Nature also functions in altering the physical environment of an urban area through reducing health risks such as respiratory infections by filtering air pollutants (Shanahan *et al*., 2015).

1.3 The Widening Gap Between People and Everyday Nature

As the gap widens between the global population and the natural world, the phenomenon known as the “extinction of experience” takes effect (Pyle, 2003). The loss of contact and the subsequent alienation with everyday nature creates an inexorable cycle of apathy, disconnection, and progressive depletion. Encountering nature in one's everyday life reduces one's fear of the natural world, but the loss of this connection can result in biophobia. The widening gap between nature and humans is driven by urbanisation and seems to be an indisputable fact of modern life (Zhang *et al*., 2014). The concept of biophobia generally involves both the innate physiological response from a perceived non-human threat, for example spiders or snakes, and also a cultural attachment to material comfort (Patuano, 2020). Increasing levels of biophobia have many implications for biodiversity conservation both now and in the future, with a reduction in willingness to support conservation causes from charities, to voting representatives with green views into government (Pyle, 2003).

International efforts by ecologists and environmental scientists to preserve the natural world are most often concerned with large, species rich, untouched ecosystems which contain animal or plant species that are endangered or under threat of extinction. Far less attentions is being paid to everyday nature which is experienced where the majority of people work and live such as small-scale urban green spaces, and the benefits they provide to the urban population (Chiesura, 2004).

Though it is often thought that cities are species poor areas that can lead to the global homogenisation of biota, there is evidence to suggest otherwise, and that urban centres can in fact be centres of local and regional biodiversity (Aronson *et al*., 2014; Macadam & Bairner, 2012). Single large habitats such as national parks are not adequate on their own to protect biodiversity, so it is critically important to create species rich, smaller habitats, even those such as anthropogenically modified urban green spaces for the protection of ecological diversity in the long term (Szangolies *et* al., 2022; Venn & Kotze, 2014).

Urban green spaces can also function as barriers to invasive alien species. These ecosystems are key points of entry for invasive species which are commonly transported accidentally through global infrastructure and also function as a gateway for secondary release into surrounding countryside because of land use and other factors including impervious surfaces, distance to the city centre, affluence, human population size, and density (Gaertner *et al*., 2017).

The biotic resistance hypothesis says that during plant invasions, communities which have a higher level of diversity are less susceptible to invasions than less diverse communities (Elton, 1958). At a small spatial scale, plant diversity can provide resistance through different niche-habitat mechanisms. For instance, complementarity among species or functional groups which have non-overlapping resource strategies could lead to a better use of resources which in tune would lead to less resources available for the invader (the complementary effect) (Naeem *et al., 2000;* Byun *et* al., 2013). A higher diversity of native species could also provide biotic resistance by increasing the probability of having a better competitor or a more productive species present in a native community which is more diverse, a mechanism which is known as the sampling effect (Wardle, 2001). In temperate regions this hypothesis is largely supported where plant diversity has been manipulated experimentally (Naeem, 2000; Hector *et al*., 2001). Therefore, stable ecosystems which are diverse, complex, and have the ability to resist the changes which come with the introduction of alien species are of increasing importance (Rutledge *et al*., 1976).

1.4 The Lack of Suitable Management for Urban Green Spaces

One of the biggest issues facing urban green spaces is the lack of consistent management practices. This is often because resource management in urban green spaces requires trade-offs between biodiversity conservation and human use. The ability of urban green spaces to support biodiversity changes with different landscape configurations, land-use history, economic input, biotic interactions, human population density and management activities (Aronson *et al.,* 2017). The management and organisation of urban green spaces tends to city- or region-specific, as urban green spaces (and their management) are rarely addressed in national legislation, in contrast to agricultural land or land within national parks, for example (Randrup & Persson, 2009).

The result is that the aims and practice of urban green space management may differ greatly between parks in different cities and even within a single city. Laws and regulations have not matched pace with the need for a more specific guidance on the collaborative management of these spaces (Brown *et al*., 2015). Generally, the governance of managing urban green spaces is not purely a public or private responsibility but part of a contested and complex schemas of governance involving multiple groups of stakeholders that have varying responsibilities and interests (Bulkeley, 2010; MacKenzie *et al*., 2018). Therefore, the management of urban green spaces requires a spectrum of governance approaches, including the private sector and non-governmental organisations, and non-state actors such as community groups, with complicated overlapping systems of decision-making as opposed to discrete hierarchies (MacKenzie *et al*., 2018).

The design of urban green spaces is often influenced by competing objectives which may be incompatible with each other. These include the conservation of biodiversity, management of stormwater, human health and well-being, and aesthetics. There is, however, an increasing interest in designs of a more holistic nature, where multiple factors which take into account the environmental, logistical and social aspects of a park so that biodiversity is integrated into the desired function (Lovell & Taylor, 2013). Implementing strong multifunctional green infrastructure plans require a multi-scale approach. At the city scale, urban planning can function in establishing strategies to not only conserve existing habitats, but to develop new green spaces and connect isolated fragments (Lovell and Johnston, 2009a).

Studies by Neal (2014 ;2016), have shown that the management of urban green spaces in the UK is weakened by the reduction in maintenance and capital improvement and a lack of capital for improvements. Simultaneously, park usage is increasing with local communities having an increasing role in the management of these spaces. However, these amenities are becoming more expensive to use and there is a possibility that some green spaces may be transferred to the care of other public servants in separate departments or sold. In Sweden, it was found that almost one in two urban green space managers do not have a strategic plan for the park they manage. It was also found that there is a higher probability that even with a plan, park managers often lack a quality assurance system for the long term (Randrup *et al*., 2017).

One of the key issues of park management is the concept of "place making" versus "place keeping" (Roberts, 2009). Within the urban planning and design sector there is often a focus on the creation of high-quality public spaces, known as "place making". Large amounts of resources allocated to parks go to the creation of green spaces without thought or adequate resources to how they will be maintained and managed, known as "place keeping". Without the foresight of place-keeping, urban green spaces can tend towards disrepair. Place-keeping is often discussed as an addendum to place-making, or alternatively, it is assumed that place-keeping will automatically follow place-making, a theory that, in practice, is not realistic or feasible (Dempsey & Burton, 2012). For example, plants which are chosen for their aesthetic value or low cost during the planning stage can require a lot of maintenance such as pruning or need to be replaced because they grow annually which is not foreseen by management. This causes long term costs which can be avoided.

Management and conservation in urban spaces also requires thought into the urban matrix. Species not only use areas which are designated as parks, but a range of habitat types from intact remnant patches of native vegetation to green infrastructure habitats including wasteland areas, vacant land, green roofs, residential habitats that occur throughout urban habitats globally, and ditches in riparian areas and along canals (Frey, 1999; Jarvis & Young, 2005). Urban patches, including spaces as small as residential yards, can contribute to biological diversity in the city by supporting native vegetation and species richness (Werner, 2011). Often, population density, economic input and management intensity follow this same continuum, whereby remnant habitats at the edges of urban areas receive less management than their inner-city counterparts (Aronson *et al.*, 2017).

Many of the management practices which are currently in place in urban green spaces such as the maintenance of turf lawns, tree and shrub pruning, the application of herbicides and pesticides, and the introduction of invasive alien species, accidental or otherwise, all threaten the biodiversity of cities (Aronson *et al.*, 2017). Conventional techniques of weed control are also expensive, labour and energy intensive, and require reapplication over time which makes them highly impractical for the management of plant species. Additionally, many of the mechanical methods of controlling weed specie may disturb soil and cause erosion. Chemical herbicides have also triggered the evolution of resistance in several weed species which has the potential to cause risk to human health and wildlife alike (Culliney, 2005).

1.5 Management Methodologies

There have been several lines of research into the most suitable method of management for urban green spaces and the factors that have to be considered. It is thought that there may not be a best model practice for the management of parks and green spaces without the ability of modern park managers to adapt constantly (Randrup & Persson, 2009).

Multiple studies have tried to determine which key influences to take into consideration when managing an urban park. Miller (1996) describes the integration of environmental, political, economic and social values of the given community to create a comprehensive management plan. Grey (1995) defined six requirements for a comprehensive management plan which included knowledge of the needs of an urban forest, plans for meeting those needs, a central establishment with authority and responsibility, adequate budgets, knowledge of the total urban forest environment- biological, institutional/social and legal, and finally effective implementation. Other studies consider ecology, economy, social aspects and history or culture (Randrup & Persson, 2009). From reviewing this literature, it was determined that there were over-arching concepts under which these varying influences fell.

1.6 Aims

The management of urban green space can be seen to have three main objectives, corresponding to the three main stakeholders in park management.

Firstly, ecologists wish to manage urban green spaces for the benefit of particular species of wild plants and animals, to maximise biodiversity in general, or to enhance the naturalness of the urban environment. The first objective of this study, therefore, was to determine the biodiversity present in common park habitats, and from this, determine which habitat types are most suitable for parks in terms of biodiversity.

Secondly, the people that use urban green spaces have multiple reasons for doing so, including an aesthetic appreciation of the non-built visual, olfactory, and aural environment, a desire for solitude or peace and quiet, and a liking for wild and domesticated plants and animals. Therefore, the next objective of this study was to determine which of these aspects are most important to park users and why.

Thirdly, park managers may wish to manage the park in the most economical way possible, whilst still fulfilling the designated aims of the park (if any). The final objective of this study was to determine where park funds were being allocated and whether this was in line with the biodiversity of the park and the preferences of the public.

Reconciling these three objectives is key to sustainable urban park management, whereby biodiversity, naturalness, public satisfaction, and management costs are aligned to ensure the long-term success of urban green spaces. (Fig. 1.1). The main objective of this project was to create a base study that will help form the backbone for a national, and perhaps international park management strategy in order to help create and maintain parks which benefit all parties.

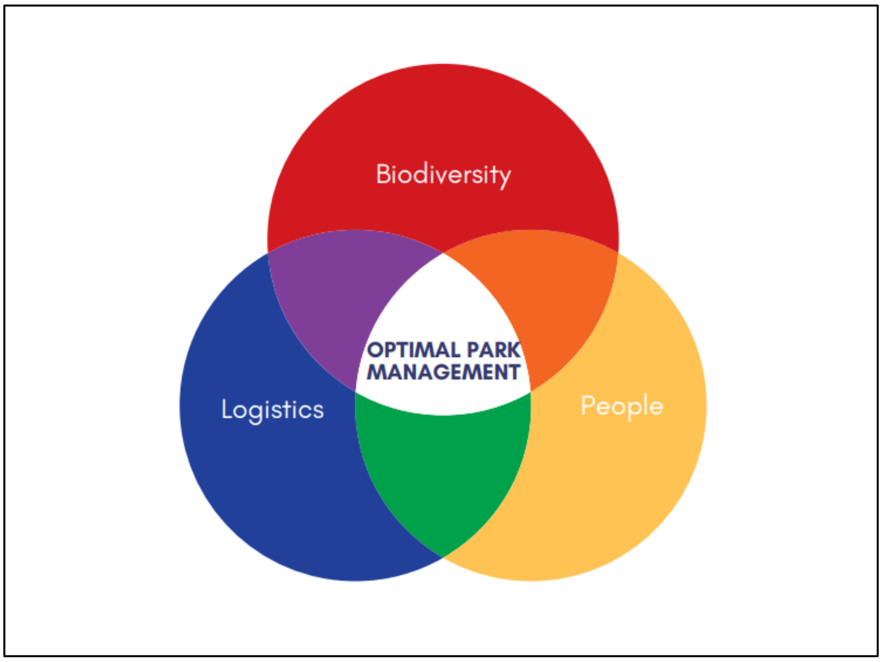

Figure 1.1. The balancing act between people, biodiversity and logistics needed to ensure optimal park management.

2.0 Methods

2.1 Site histories

This study took place in Cork city, Ireland. Cork city is located on Ireland's south coast and is Irelands second biggest city after Dublin. The city has a population of 210,853 people as of the latest census (2016). Cork City's population has grown by 5% between 2011 and 2016. This is higher than the Southern Regional area and the nation which had a 4% population increase over the same period (corkcity.ie, 2020). As with many European cities, Cork contains a variety of urban green spaces such as parks of varying sizes, graveyards, sports grounds, river corridors, allotments, walkways, historic landscapes and gardens, as seen in (Fig. 2.1).

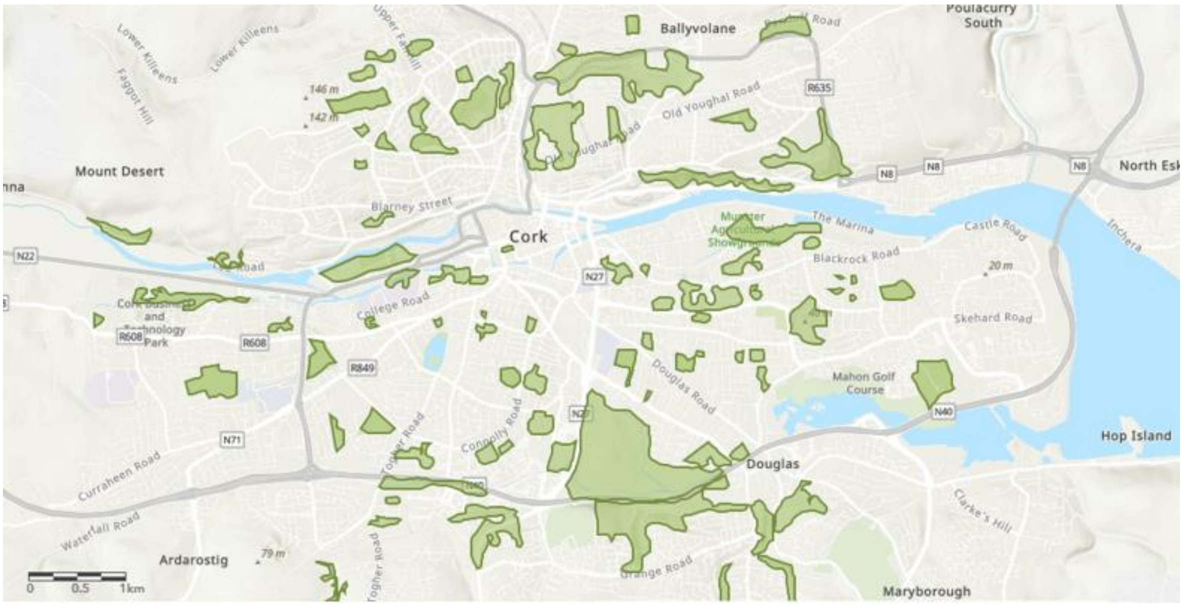

Figure 2.1. Map showing parks and green spaces within Cork City, Ireland (Generated by (Sadhbh Horan) (generated February 13th 2022); using Google Earth Pro (version 7.3. 6.9345).

Irish parks originated from diverse sources, such as hunting grounds for British gentry, military barracks, and as pleasure grounds for wealthy property owners in inner city areas. Phoenix Park in Dublin is Irelands oldest public park and was originally created in 1662 by King Charles II as a hunting ground for visiting British royals. Throughout the first half of the 18th century, it saw an ongoing military presence including British army manoeuvres, a magazine fort, and the Royal Hibernian Military School. It was opened to the public by the Earl of Chesterfield in the year 1747. Other parks such as St. Stephens Green in Dublin were created as a space for the upper class of the city living in Georgian squares. This particular park was designed by William Sheppard and was open to the public in 1880.

Cork city, in which this study takes place, was a small trading port and industrial town surrounded by farmland. Unlike Dublin, it did not have a large wealthy upper class living within its bounds. This is largely due to its location "outside The Pale" and the high presence of Irish nationalists who opposed British Rule, leading to continuous conflict within the city and surrounding county. Because of these factors, there was only one park within the city limits, with other green areas associated with religious buildings (Fig 2.2).

The results of continuous conflict between British soldiers and Irish Nationalists had considerable effect on the city. Much of the city was destroyed in "The Burning of Cork" in 1920, when British military forces set fire to hundreds of homes and business and looted several important buildings such as City Hall and Carnegie library which caused an economic loss equivalent to 155 million today. With 2000 left jobless, many more made homeless, and no reparations given by the British who ruled over Ireland at the time, parks such as the City Park on the south dock were reclaimed as a place for logging yards, shipyards and factories in order to give work to the people of the city (Fig 2.2).

Figure 2.2. Second Edition Ordinance Survey Ireland map of Cork City, Ireland with public green space shown in green, the largest of which is the City Park (1897-1913).

Five parks within Cork city and one park from a surrounding town were chosen for this study which are under the remit of Cork City Council. These are Beaumont Quarry, Ballybrack Woods, the Marina Park, Tramore Valley Park, Ballincollig Regional Park, and the Glen River Park (Fig. 2.3).

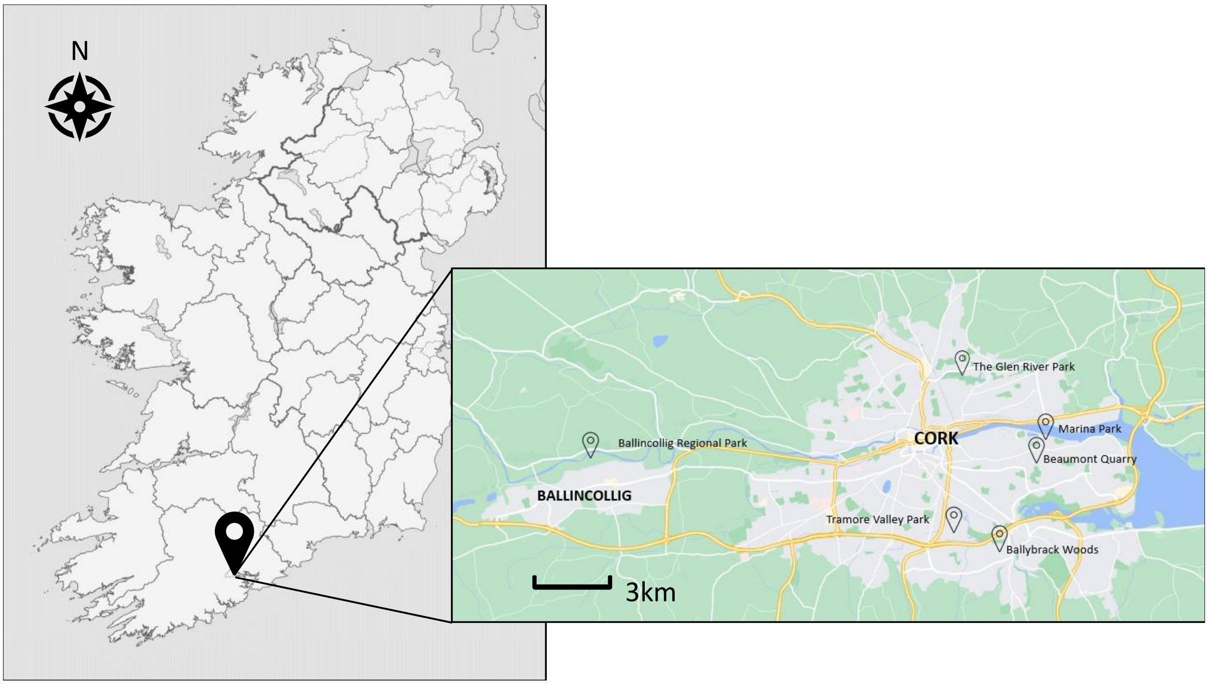

Figure 2.3. Map of Ireland on the left and Cork city on the right with the six parks which were part of this study

Cork City has a defined hierarchy of parks (Fig 2.4). This hierarchy assists in the planning of new parks which ensures that open space and recreational infrastructure is provided in accessible locations for the city's residents. Cork City Council aims to ensure that urban green spaces are able to meet the demands of the city. This involves a combination of protecting and enhancing established parks and providing new spaces. As the city intensifies this requires a more creative approach, particularly when taking into account the historic areas of the city with a tighter urban grain.

The city council recognises the need for a network of urban green spaces of varying size, scale and nature. Due to limited opportunities for large open spaces in the city centre, city parks are mainly located at the edge of the existing city and provide for active and passive recreational requirements to meet the needs of the suburban population. Neighbourhood and local parks are smaller in size to city parks and serve a smaller locale. These park types tend to be in already established areas of the city and many of them have been present for a long period of time. The final park type are pocket parks. These are the smallest type of green space and because of this they are the most common and most easily established park type. They can be located in any part of the city and generally serve a small locale (Fig. 2.4, Table 2.1).

Figure 2.4. Hierarchy of park designations in Cork City, Ireland (corkcity.ie, 2022).

Table 2.1. Summary of park histories and size of the six Cork Parks included in this study.

Summary of Park Histories and function				
Location	**Established as a park**	**Previous function**	**Park size**	**Designation**
Beaumont Quarry	2015	Limestone Quarry	$0.03km^2$	Local Park
Marina Park	1856	Ships Dock	$0.21km^2$	City Park
Ballybrack woods	Unknown	Estate grounds	$0.01km^2$	Pocket Park
Tramore Valley Park	2015-2019	Landfill	$0.65km^2$	City Park
Ballincollig Regional Park	1977	Royal Irish military gunpowder mill	$0.6km^2$	City Park
Glen River Park	1960's	Several factories	$0.47km^2$	City Park

2.1.1 Beaumont Quarry

Beaumont Quarry located at 51°53'28.18"N, 8°25' 56.36"W. Beaumont quarry was once a limestone quarry which provided stone for some of Cork's most iconic buildings and attractions including St. Finbarr's Cathedral, the Courthouse, and Berwick Fountain (Fig. 2.5, 2.6). The quarry fell out of use in the 1960's and was abandoned until it was acquired by Cork City Council in 2015. It consists of a variety of semi natural habitats which include broad-leaved woodland, scrub, calcareous grassland, and exposed rock and cave habitats (Fig. 2.7, 2.8). This park has no amenities.

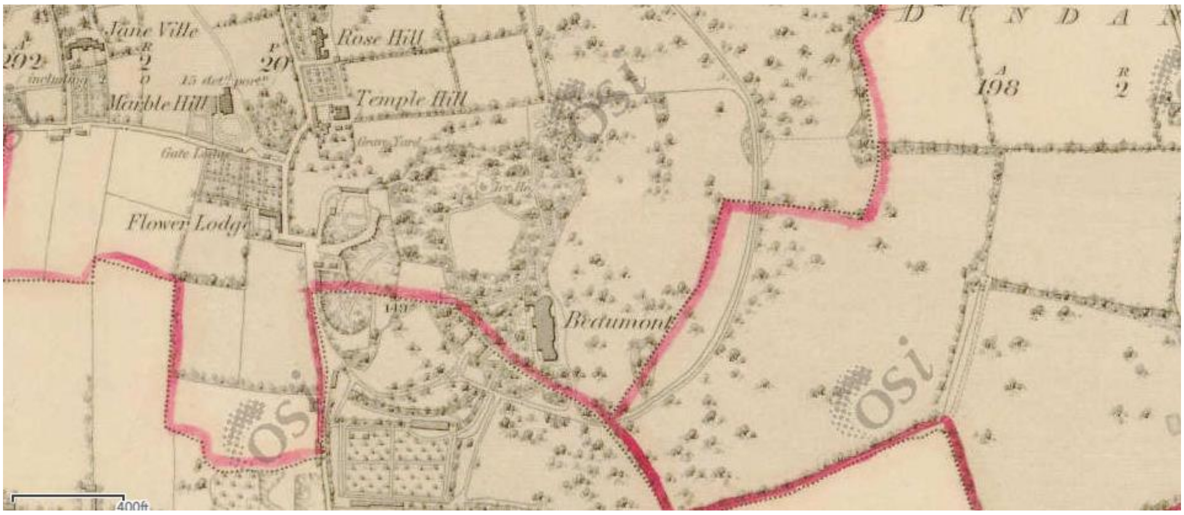

Figure 2.5. First Edition Ordinance survey Ireland map (1829-41) of Beaumont quarry while in use as a limestone quarry.

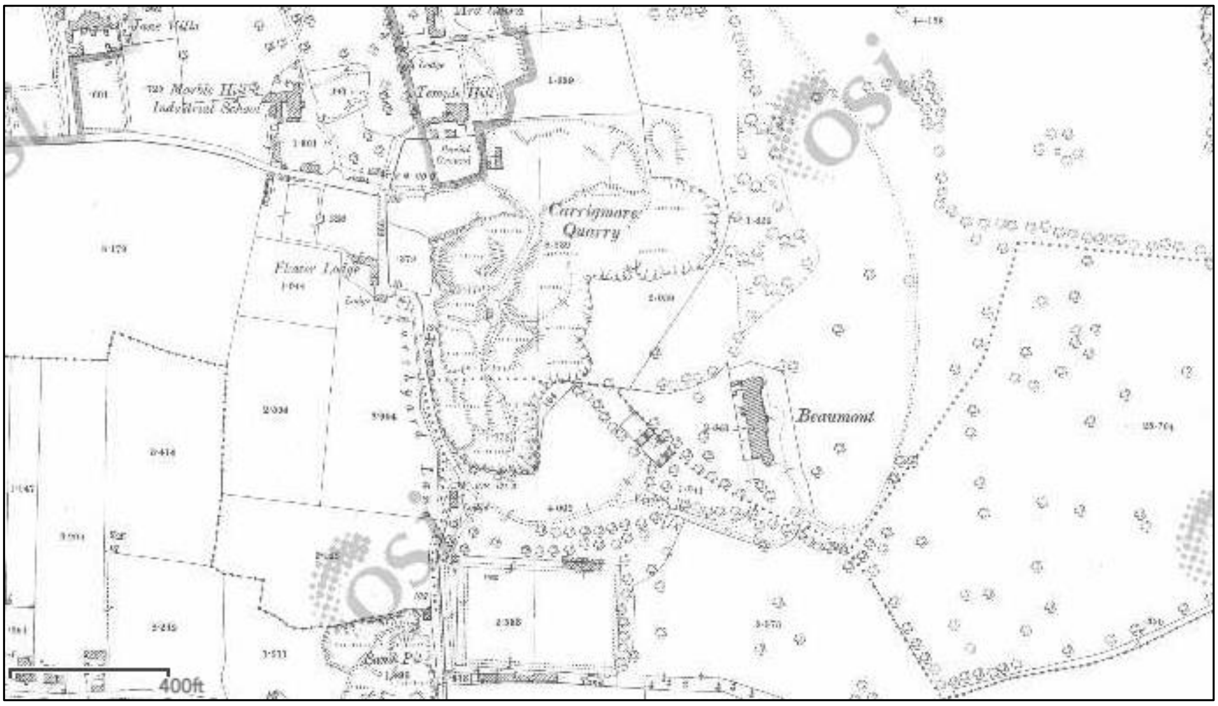

Figure 2.6. Second Edition Ordinance survey Ireland map showing Beaumont quarry in (1897-1913).

Figure 2.7. Aerial photograph of Beaumont Quarry with Beaumont Quarry park outlined in red (2011-2013). (Generated by (Sadhbh Horan) (generated February 13th 2022); using Google Earth Pro (version 7.3. 6.9345).

Figure 2.8. Image of Beaumont Quarry showing quarried limestone cliffs (left), image of woodland in Beaumont Quarry (right).

2.1.2 The Marina Park

The second park included in this study is the Marina Park, situated on the south docklands of the river Lee (51°53’57.67” N 8°25’40.48” W). This park was originally named the Navigation Wall and it served as a guidance wall to bring ships into the south dock area and was completed in 1761 (Fig. 2.8, 2.9, 2.13). After the constitution of the Cork Harbour Commissioners in 1814, silt dredged from the river was deposited behind the navigation wall. Later, during the Great Famine, a fine road was constructed to connect to the south dock with treelines added in 1856. The promenade was renamed the Marina in 1872. Historical features of the park include the Shandon boat club, the Cantillon drinking fountain, the Sebastopol Gun (a relic of the Crimean War), a nineteenth century band stand, the Lee Rowing Club, the gunpowder pier, the Atlantic Pond, Barrington's Folly, the old showgrounds among others (corkheritage.ie., n.d.).

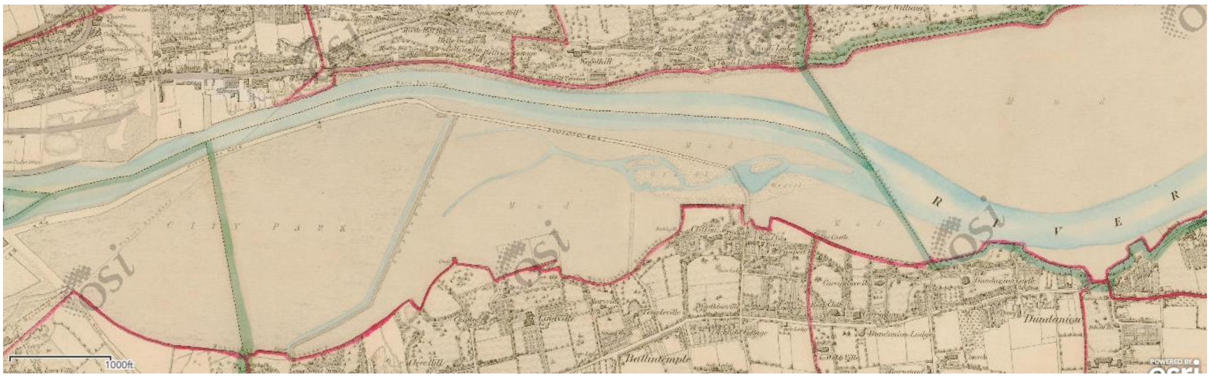

Figure 2.9. Ordinance Survey Ireland map of area which would become The Marina Park (1829-1841)

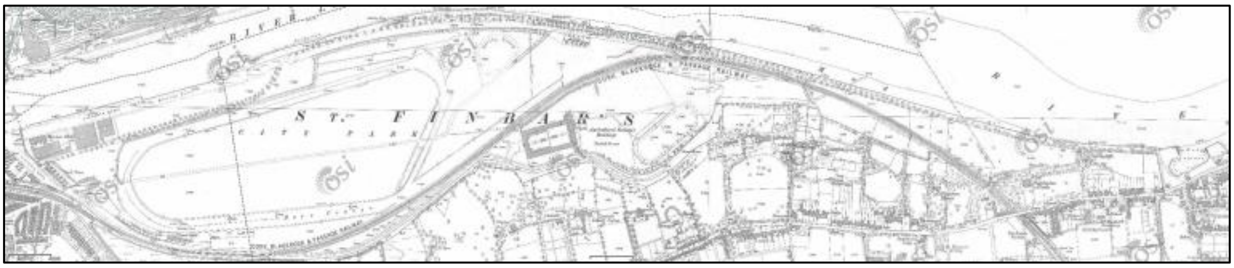

Figure 2.10. Ordinance Survey Ireland map of area which would become The Marina Park (1897-1913).

Figure 2.11. Aerial photograph of The Marina Park (2011-2013) with the park outlined in red. (Generated by (Sadhbh Horan) (generated February 13th 2022); using Google Earth Pro (version 7.3. 6.9345).

Habitats within this park include treelines, parkland, canals, an artificial lake, mixed broad-leaved woodland, and artificial surfaces (Fig. 2.11, 2.12). Amenities in this park include benches, walkways, a stadium with surrounding playing fields, and informational signs.

Figure 2.12. Images of Marina Park, Blackrock with promenade (left) and dry meadow (right).

Figure 2.13. Colourised photograph of Marina Park, then known as the Navigation Wall (French & Lawerence, 1905).

2.1.3 Ballybrack Woods

The third park is Ballybrack Woods, named for Ballybrack House, an estate built c.1820 (Fig. 2.15, 2.16). The park was once the farm which supplied this estate and is known locally as the Mangala because of its function growing mangles (*Beta vulgaris*) for livestock owned by the estate. This park is situated at 51° 52' 15.15" N, 8° 26'11.66"W in the riverine valley of the Ballybrack Stream, a tributary of the Douglas River. The valley consists mainly of established broad-leaved woodland, modified woodland, scrub, mown grass, and freshwater streams (Fig. 2.14, 2.17). Amenities within this park include paved walkways and informational signs.

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Figure 2.14. Images of Ballybrack Woods. Upper left shows the central grass area of the park, upper right shows the path leading south though the park, and lower left shows the eastern path through established woodland.

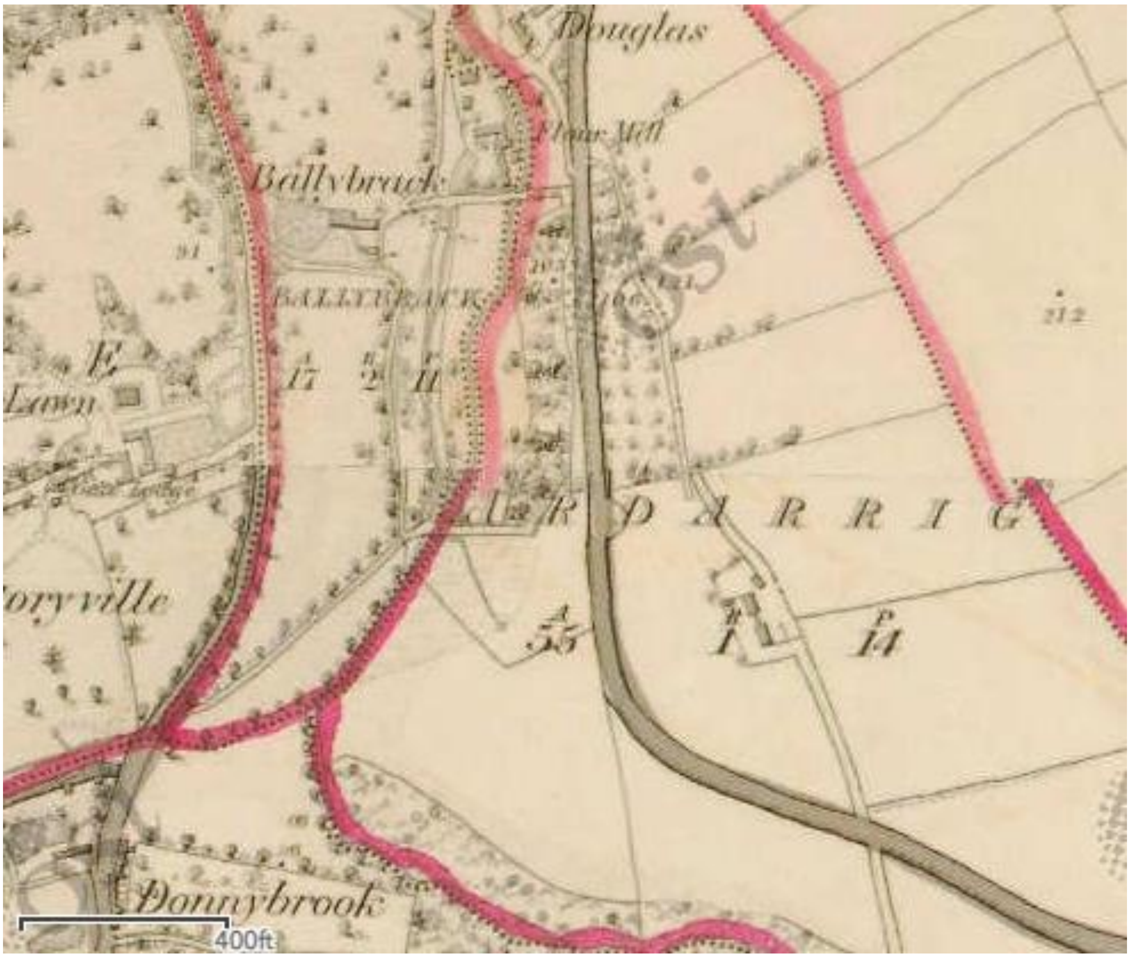


Figure 2.15. First Edition Ordinance survey Ireland map of the area, which is now known as Ballybrack Woods, Douglas (1829-1841).

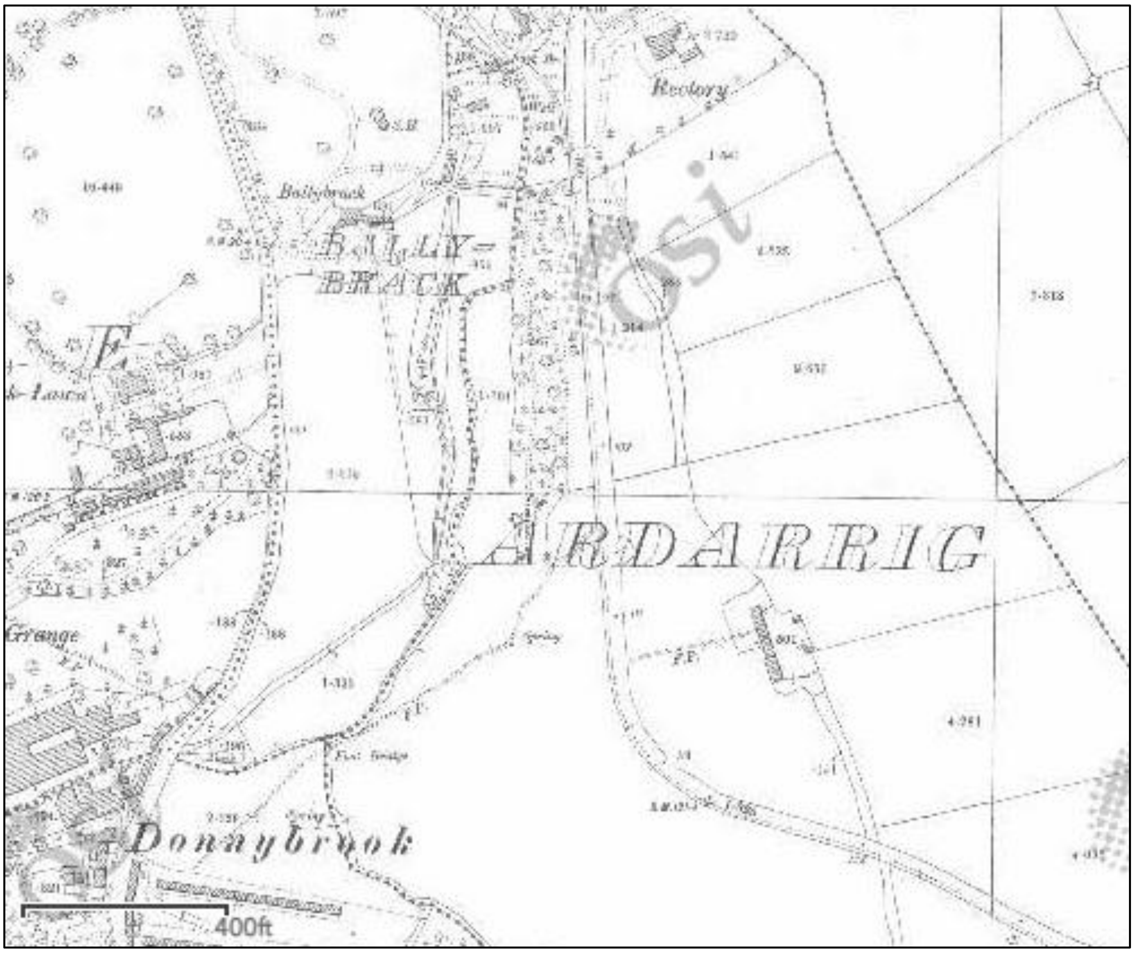


Figure 2.16. Second Edition Ordinance Survey Ireland map of area now known as Ballybrack Woods (1897-1913).

Figure 2.17. Aerial photograph of Ballybrack Woods (2011-2013) with current park outlined in red. (Generated by (Sadhbh Horan) (generated February 13th 2022); using Google Earth Pro (version 7.3. 6.9345).

2.1.4 Tramore Valley Park

The fourth park included in this study is Tramore Valley Park which is located on the south side of Cork city (51°52'41.79" N 8°27'39.40" W) (Fig. 2.18, 2.19). Tramore Valley Park was once the site of the Kinsale Road Landfill which was in use from the early 1960's until 2009 during which time over 3 million tonnes of domestic and commercial waste from the city were landfilled (Fig. 2.23). The site remains under strict licensing from the Environmental Protection Agency with ongoing monitoring. Over €40 million has been spent on the remediation of the landfill to date. The habitats in this park include amenity grassland, open parkland, flower beds and borders, mixed broad-leaved woodland, scrub, and artificial surfaces (tramorevalleypark.glencentre.ie, 2022) (Fig. 2.20, 2.21, 2.22).

Figure 2.18. First Edition Ordinance Survey Ireland map of area which would become Tramore Valley Park (1829-1841).

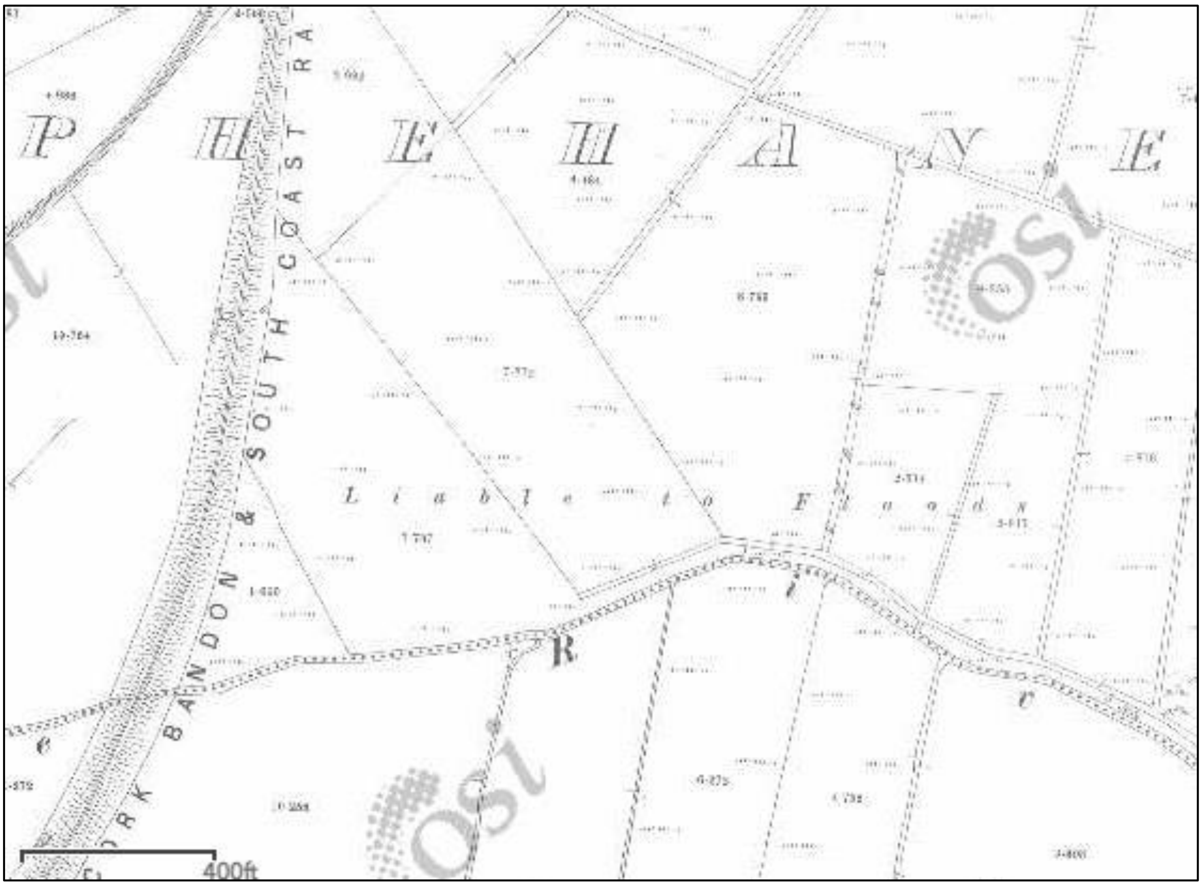


Figure 2.19. Second Edition Ordinance survey Ireland map of area which would become Tramore Valley Park (1897-1913)

Figure 2.20. Aerial photograph of Tramore Valley Park when it was in use as the Kinsale Road Dump (1999).

Figure 2.21. Aerial photograph of Tramore Valley Park (2011-2013) with park outlined in red. (Generated by (Sadhbh Horan) (generated February 13th 2022); using Google Earth Pro (version 7.3. 6.9345).

Figure 2.22. The dry meadow habitat of Tramore Valley Park.

Figure 2.23. Two images showing Tramore Valley Parks previous function as a landfill site (Photographs by Richard Mills as seen in echoloive.ie).

2.1.5 Ballincollig Regional Park

The penultimate park is Ballincollig Regional Park, located on the southern bank of the river Lee in the town of Ballincollig, 8.9km outside of Cork City (51°53'46.05" N 8°35'59.65" W). The site was used for the manufacture of gunpowder from the 18^{th} to 20^{th} century (discoveringcork.ie, 2022). Today the park consists of the now defunct gunpowder mill complex, a total of 52 structures in various stages of disrepair, and a network of sluices and canals that were installed in the grounds and are fed from the river Lee at its western end (Fig. 2.24, 2.25, 2.26).

The parks' location on the floodplain of the Lee along with its network of canals mean that wet habitats are a feature of the park. Other habitats found in the park include broadleaved woodland, mixed broadleaved-conifer plantations, scattered trees and parkland, ornamental gardens, and amenity grassland (Fig. 2.27). Amenities in this park include a playground, soccer fields, a fairy trail, a running trail, allotments, an outdoor gym, and informational signs for both historical and biodiversity aspects of the park.

Figure 2.24. First Edition Ordinance Survey Ireland map of the area which is now known as Ballincollig Regional Park (1829-1841)

Figure 2.25. Second Edition Ordinance Survey Ireland Map of area which is now known as Ballincollig Regional Park (1897-1913).

Figure 2.26. Aerial photo of Ballincollig Regional Park (2011-2013) with park outlined in red. (Generated by (Sadhbh Horan) (generated February 13th 2022); using Google Earth Pro (version 7.3. 6.9345).

Figure 2.27. Current images of Ballincollig Regional Park. Upper left shows looped path at eastern side of park, upper right shows path on the western side of the park next to the playground. Middle left shows a path through established woodland, middle right shows path through meadowland with historical military building. Lower left shows path through wet woodland with canal.

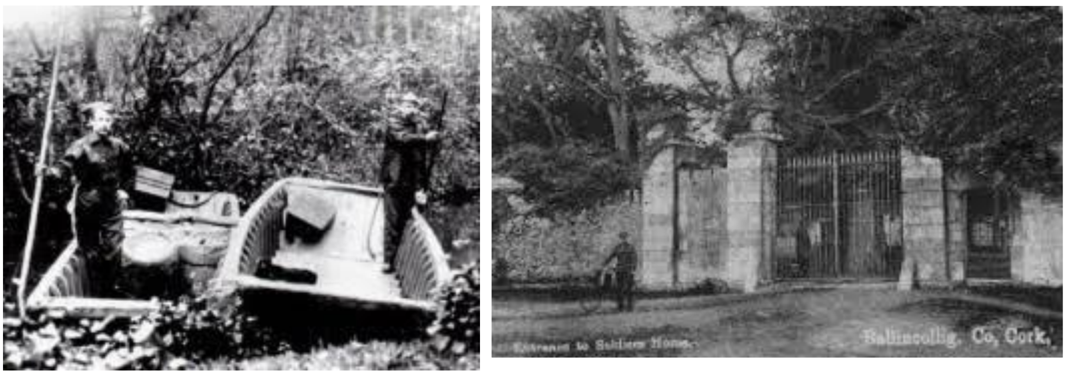


Figure 2.28. Photographs taken at Ballincollig Regional Park when it functioned as a gunpowder mill. Image on the left shows military personnel using boats in the canal, image on the right shows gate of gunpowder mill with guard.

2.1.6 The Glen River Park

The final park included in this study is the Glen River Park, on Cork city's northside. The valley has remained undeveloped due to its steep sides and waterlogged floor but the land surrounding it has been the site of several factories in the 19th and 20th century including a tannery and a factory which produced agricultural fertilizer (corknaturenetwork.ie, 2022) (Fig. 2.29, 2.30, 2.32). The land was gifted to the people of Cork in the 1960's and consists of a steep sided valley including a range of habitats including an artificial lake, amenity grassland, dense bracken, scattered trees, ornamental beds, scrub, treelines, and sandbanks. Amenities in the park include benches, a soccer field, a running trail, and art sculptures (Fig. 2.31).

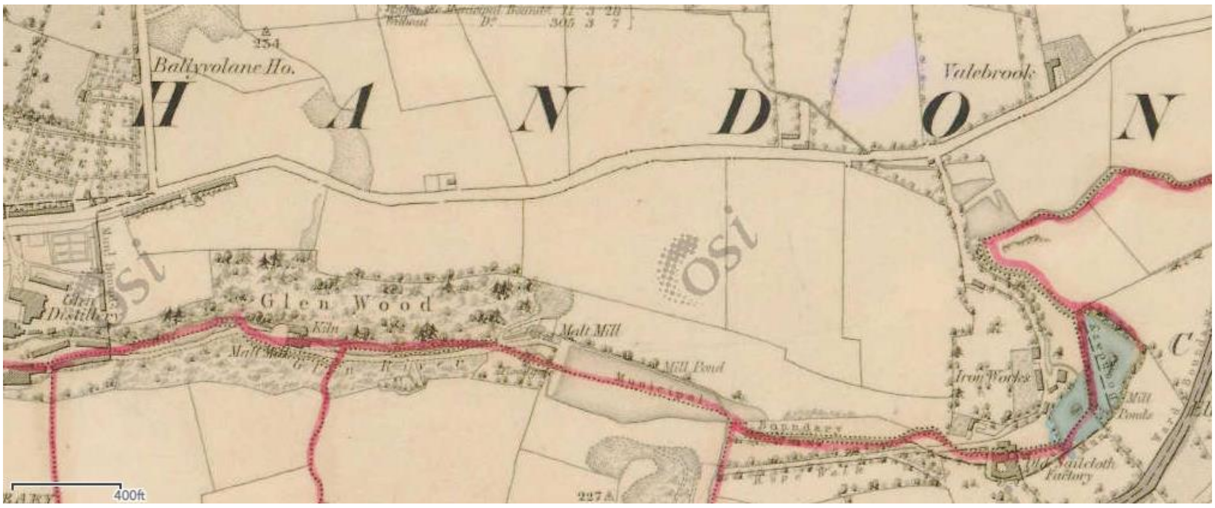


Figure 2.29. First Edition Ordinance Survey Ireland map of the Glen Wood which would eventually become the Glen River Park (1829-1841).

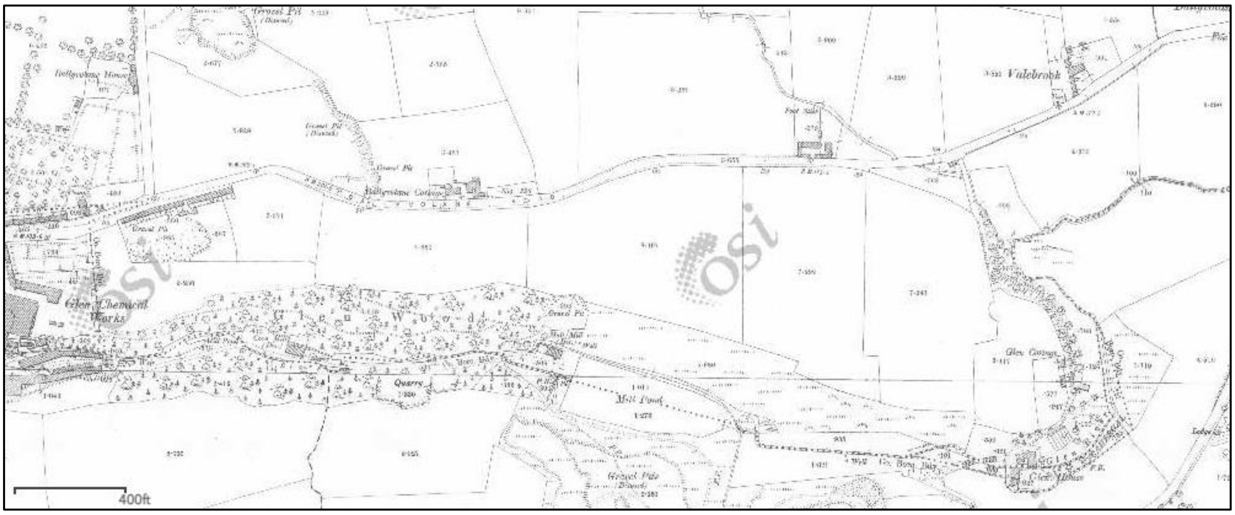


Figure 2.30. Second Edition Ordinance Survey Ireland map of the Glen Wood which would eventually become the Glen River Park (1897-1913).

Figure 2.31. Aerial photograph of the Glen River Park (2011-2013). (Generated by (Sadhbh Horan) (generated February 13th 2022); using Google Earth Pro (version 7.3. 6.9345).

Figure 2.32. Image of Goulding's factory taken in 1956 with the valley now known as the Glen River Park in the right background (left), and image of the Glen River Park today (right).

2.2 Data collection

All data was collected in the months of June, July, August, and September 2022. These months were chosen as a time when the majority of plants would be flowering and therefore easier to identify.

2.3 Biodiversity

2.3.1 Vegetation Survey

All habitat types within the parks were identified and mapped in order to determine where surveys should take place. Maps were created using a combination of aerial imagery, on-site inspection at each location, and GPS data. From these data, the percentage cover of each habitat type was determined following the Fossitt 2000 approach. The major habitats which were identified included a mixture of woodland types, amenity grassland and meadow, wetlands, ornamental gardens, and scrub. Five main habitats were selected based on how often they occurred in the six selected parks and how abundant they are across Irish parks.

The first type of habitat in which vegetation was recorded was Dry Meadow (GS2) (Fossitt, 2000). Dry meadows are defined as rarely fertilized or grazed, are mown only once or twice a year and there is little to no fertilization of grazing. This habitat type was found in all six of the parks within this study

The second habitat in which quadrats were conducted was mixed broadleaved woodland which was present in five of the six parks included in this study. Mixed broadleaved woodland (WD1) includes forested areas with 75-100% cover of broadleaved trees and 0-25% cover of conifers. Trees in this category may include native and non-native species (Fossitt, 2000).

The third habitat type in which quadrats were conducted was scrub. This habitat type was present in two of the parks in this study. Scrub (WS1) includes areas that are dominated by at least 50% cover of shrubs, brambles or stunted trees. This habitat type frequently develops as a precursor to woodland and is often found in inaccessible locations. In the absence of mowing and grazing, scrub can expand to replace heath or grassland vegetation (Fossitt, 2000).

The fourth habitat which was surveyed in this study was reed and large sedge swamps (FS1). This habitat includes species-poor stands of herbaceous vegetation which are dominated by reeds and other large grasses or large, tussock-forming sedges. The majority of reed and large sedge swamps are overwhelmingly dominated by one of two species, as in the case of reedbeds. Vegetation in this habitat type typically lacks stratification as there is little to no development of an understory (Fossitt, 2000).

The final habitat which a vegetation survey was conducted was wet pedunculate oak-ash woodland (WN2). This woodland type is associated with areas that are flooded or waterlogged in winter but dry out in summer. It occurs on periodically flooded alluvial sites that are well-above regular inundation limits, and on drumlins and other sites which have heavy, poorly drained soils that are subject to waterlogging (Fossitt, 2000).

The estimated ages of habitats were determined using the different editions of Ordinance Survey Ireland maps and aerial photographs to aid in the description of species richness and diversity (Table 3.1). In the case of Beaumont Quarry, habitats are estimated to originate between the time of the quarry's abandonment in the 1960's and the first available aerial photographs in 1995. The last available aerial photographs available are from 2013-2018 and so if a habitat is not present within this range it is assumed that this habitat originated between 2019 and 2022, the year this study took place.

Table 2.1. Estimated ages of urban park habitats based on Ordinance Survey Ireland Maps and aerial photographs where years represent the first instance where habitat was present.

Estimated ages of habitats	Beaumont Quarry	Marina Park	Ballybrack Woods	Tramore Valley Park	Ballincollig Regional Park	Glen River Park
Dry meadow	~1960-1994	2019-present	2019-present	2013-2018	1999-2003	2011-2013
Mixed broadleaved woodland	~1960-1994	1829-1841	1829-1841	~	1995	1829-1841
Scrub	2005-2012	~	2013-2018	~	~	~
Pedunculate oak-ash woodland	~	~	~	~	1897-1913	~
Reed and large sedge swamp	~	~	~	~	~	1995

Following this, all areas of each selected habitat type were numbered, and a randomiser was used to select which patch of habitat the sampling would take place in. In these chosen patches, a single 10m-by-10m quadrat was used to estimate the percentage cover of identified vascular plant species and fungi species in each of the four layers, the herb layer, the shrub layer, the understory layer and the canopy layer and the species richness and Simpsons Index were calculated.

The herb layer was determined as vegetation with a height of less than a meter, the shrub layer was determined as the stratum of vegetation between one and five meters, the understory layer was determined as trees above the shrub layer but below the canopy, while the canopy was determined as the highest layer of vegetation.

Random sampling surveys are one of the most important methods for conducting ecological research (Hao *et al*., 2020). They are widely used in studies of plant diversity, vegetation spactial pattern research, biomass estimation, species association analysis and other areas (Stohlgren *et al.*, 1995; Sanjerehei, 2011; Aune-Lundberg & Bryn, 2018). The concept of spatial scale is also one of the most fundamental concepts in ecological research, making the choice of quadrat size is a vital component of field survey design (Huenneke *et al.,* 2001; Chave, 2013). The size of the quadrat affects the variance and frequency distribution of samples. Different sample characteristics and different population estimates can result from different quadrat sizes (Chytry *et al*., 2011; Mosley *et al*., 1989). The literature dictated that smaller quadrats largely underestimate the variance of species. As the size of the quadrat increases, the range of the autocorrelation model increases, while the proportion of noise in the data and variance decrease. Larger quadrats filter out spatial variation which occurs at smaller scales than the size of sampling unites, which then increases the proportion of spatially structured component with a range that is larger than the size of the sampling units (Bellehumeur *et al*., 1997). As well as this, 10x10m quadrats were chosen for this study as habitat availability was restricted, such that a single 10x10m quadrat was logistically possible.

Indicator plant species for high quality habitats were identified from the habitats surveyed using existing lists of Irish indicator species where possible. The distribution and status of the plants and fungi were also identified and listed. Arthropod species numbers for all trophic groups strongly responds to the number of plant species, while threatened plant species richness is a key determinant for the richness of red-listed butterfly and arthropod species The richness of conservation relevant plants species provides a strong indication of arthropod diversity, which in turn underpins the potential of indicator species for monitoring habitat quality. Plant species richness along with temperature are stronger drivers of arthropod richness than the amount of surrounding natural habitat or landscape configuration. The richness of conservation-relevant plant species is a powerful indicator of arthropod diversity and reinforces the potential of high-quality habitat indicators (Tobisch *et al*., 2023).

2.3.1.1 Beaumont quarry

Figure 2.34. Images of sites of vegetation surveys at Dy meadow (top), mixed broadleaved woodland (middle), and scrub (bottom) at Beaumont Quarry.

2.3.1.2 The Marina Park

Figure 2.35. Images of Mixed Broadleaved woodland (top) and dry meadow (bottom) where vegetation surveys took place in the Marina Park, Cork.

2.3.1.3 Ballybrack Woods

Figure 2.36. Images of established woodland (top), scrub (middle), and dry meadow (bottom) where vegetation surveys took place at Ballybrack Woods, Cork.

2.3.1.4 Tramore Valley Park

Figure 2.37. Image of dry meadow where vegetation survey took place, Tramore Valley Park, Cork.

2.3.1.5 Ballincollig Regional Park



Figure 2.38. Images of locations of vegetation surveys at Ballincollig Regional Park, Cork. Top left image shows pedunculate oak-ash woodland. Top right image shows mixed broadleaved woodland. Bottom image shows dry meadow.

2.3.1.6 The Glen River Park

Figure 2.39. Three images of location of vegetation surveys at The Glen River Park, Cork. The first image (left) shows reed and large sedge swamp, the second image (middle) shows dry meadow, and the third image (right) shows mixed broadleaved woodland.

2.4 People

2.4.1 Park User Questionnaires

The first aspect of this study focused on the urban population who make use of parks. We used a questionnaire to determine the opinion of public park users on the topics of biodiversity, park facilities, and amenities of urban parks. Since the aim of this study was to obtain quantitative results, the survey method was selected as the most appropriate (De Vaus, 2005). The publics perceptions have been among the most important topics when studying the social aspects of green spaces (Ostoic & van den Bosch, 2015). The literature on the public's perception of and satisfaction with urban green spaces shows that these are influenced by physical attributes of the spaces (Schipperijin *et al*., 2010; Coles & Bussey, 2000), the presence and quality of amenities (Sanesi & Chiarello, 2006; Aspinall *et al*., 2010), the presence of quality maintenance or management (Van Herzele & Wiedemann, 2003; Lee & Kim, 2015), and socioeconomic factors and the behaviour of others (Jim & Shan, 2013; Wan & Shen, 2015). Therefore, these aspects are considered as components of the conceptual framework for this study. Based on this framework, it is assumed that park users perceived the existence of problems in urban parks, and accordingly this study aims to reveal these issues, as well as finding the level of satisfaction with the current state of urban parks.

The questions were first tested on a sample of people outside the scientific community in order to determine whether the questions were understandable to a lay person and also to determine how long the questionnaire took to complete. This was completed in a park outside of the six parks chosen for this study within the city of Cork, Ireland. It was determined that the questions which were composed were understandable to the general public.

Beaumont quarry was not used in the people aspect of this study as previous research in the park showed almost no visitors and, upon completion of vegetation surveys in the park and several other visits during the course of this research, this was confirmed. The data was collected over 8 days of fieldwork and questionnaires usually took less than 5 minutes to complete. The questionnaire was completely anonymous and did not involve any financial incentives.

The questionnaire included questions around the following topics: demographic information, park usage, the natural and built environment of parks, and social/cultural aspects of urban parks following the question pattern and wording of previous studies (Oguz, 2000). Questionnaire takers were asked to tick a box for some questions while for others they were prompted to choose a number on a Likert-type scale of 1-5 where 1 represents “not at all”, 2 represents “to a small extent”, three represents “to some extent, 4 represents “to a moderate extent”, and five represents “to a large extent” (Akpinar, 2016).

Table 2.2. Dissection of questionnaire given to members of the public in six Cork city parks.

Category	**Factor**	**Description/question**	**Scale**	**Answer method**
Demographic information	Age	How old are you	0-24	Tick box
			25-49	Tick box
			50-75	Tick box
			75+	Tick box
	Gender	What is your gender	Male	Tick box
			Female	Tick box
	Child(ren) present	Are there currently children with you in the park	Yes	Tick box
			No	Tick box
Park usage	Function of the park	What do you use the park for?	Enjoying the natural environment	On a scale of 0-5, where 0 is not at all and 5 is a lot

			Commuting	On a scale of 0-5, where 0 is not at all and 5 is a lot
			Sense of well-being	On a scale of 0-5, where 0 is not at all and 5 is a lot
			Dog-walking	On a scale of 0-5, where 0 is not at all and 5 is a lot
			Escape from crowds/city living	On a scale of 0-5, where 0 is not at all and 5 is a lot
			Place to take children	On a scale of 0-5, where 0 is not at all and 5 is a lot
			Place to exercise	On a scale of 0-5, where 0 is not at all and 5 is a lot
			Meeting people	On a scale of 0-5, where 0 is not at all and 5 is a lot
The natural environment	Likes	What aspects of the natural environment of the park do you enjoy?	Birds	On a scale of 0-5, where 0 is not at all and 5 is a lot
			Wild mammals (e.g. rabbits, otters)	On a scale of 0-5, where 0 is not at all and 5 is a lot
			Insects (e.g. bees, butterflies)	On a scale of 0-5, where 0 is not at all and 5 is a lot
			Flowers	On a scale of 0-5, where 0 is not at all and 5 is a lot
			Trees	On a scale of 0-5, where 0 is not at all and 5 is a lot
			River/pond	On a scale of 0-5, where 0

				is not at all and 5 is a lot
			Grassy areas	On a scale of 0-5, where 0 is not at all and 5 is a lot
			Woodlands	On a scale of 0-5, where 0 is not at all and 5 is a lot
			Fresh air	On a scale of 0-5, where 0 is not at all and 5 is a lot
			Peace and quiet	On a scale of 0-5, where 0 is not at all and 5 is a lot
			Natural sound (e.g. birdsong)	On a scale of 0-5, where 0 is not at all and 5 is a lot
	Dislikes	What aspects of the natural environment of the park do you dislike?	Lack of biodiversity/naturalness	On a scale of 0-5, where 0 is not at all and 5 is a lot
			Alien species (e.g. Japanese knotweed)	On a scale of 0-5, where 0 is not at all and 5 is a lot
			Pests/vermin (e.g. pigeons, rats)	On a scale of 0-5, where 0 is not at all and 5 is a lot
			Undesirable plants (e.g. weeds, nettles)	On a scale of 0-5, where 0 is not at all and 5 is a lot
			Wild, unmanaged habitats (e.g. dense wood, rank grassland, thicket)	On a scale of 0-5, where 0 is not at all and 5 is a lot
The built environment	Likes	What aspects of the built environment of the park do you appreciate	Footpaths	On a scale of 0-5, where 0 is not at all and 5 is a lot
			Public art (e.g. statues, mural)	On a scale of 0-5, where 0 is not at all and 5 is a lot

			Cycleways	On a scale of 0-5, where 0 is not at all and 5 is a lot
			Exercise equipment	On a scale of 0-5, where 0 is not at all and 5 is a lot
			Playing fields	On a scale of 0-5, where 0 is not at all and 5 is a lot
			Children's playground	On a scale of 0-5, where 0 is not at all and 5 is a lot
	Dislikes	What aspects of the built environment of the park bother you?	Lack of litter bins	On a scale of 0-5, where 0 is not at all and 5 is a lot
			Lack of dog waste bins	On a scale of 0-5, where 0 is not at all and 5 is a lot
			Lack of park benches	On a scale of 0-5, where 0 is not at all and 5 is a lot
			Lack of lighting	On a scale of 0-5, where 0 is not at all and 5 is a lot
			Lack of suitable pathways/poorly maintained pathways	On a scale of 0-5, where 0 is not at all and 5 is a lot
Wildlife/cultural information boards	Use	Do you read information boards in the park	Yes	Tick box
			No	Tick box
		Do you find them informative?	Yes	Tick box
			No	Tick box
		Are they a good use of money?	Yes	Tick box
			No	Tick box
Social/cultural environment	Dislikes	What aspects of the social/cultural environment of the park bother you?	Lack of authority figure (eg Gardai, park warden etc.)	On a scale of 0-5, where 0 is not at all and 5 is a lot
			Litter	On a scale of 0-5, where 0

				is not at all and 5 is a lot
			Graffiti	On a scale of 0-5, where 0 is not at all and 5 is a lot
			Dog faeces	On a scale of 0-5, where 0 is not at all and 5 is a lot
			Antisocial behaviour (eg drugs, alcohol, loitering)	On a scale of 0-5, where 0 is not at all and 5 is a lot
			Fear of criminal activity/people	On a scale of 0-5, where 0 is not at all and 5 is a lot
			Uncontrolled dogs	On a scale of 0-5, where 0 is not at all and 5 is a lot
			Danger from cyclists	On a scale of 0-5, where 0 is not at all and 5 is a lot

2.4.2 SOPARC

The observational methodology developed for observing users of urban space, SOPARC (System for Observing Physical Activity and Recreation in Communities), was designed to collect observational information on the number of participants, and categories of physical activity during leisure opportunities, within urban community environments (McKenzie *et al*., 2006). Similarly, it provides contextual information on the setting in which the physical activity takes place. Identifying the physical activity levels and demographics of park users can inform park promotions and programming and can be used to develop interventions to promote exercise and reduce sedentary behaviour (Evenson *et al.*, 2016). SOPARC uses the same template as SOPLAY (System for Observing Play and Leisure in Youth) that was designed to specifically assess physical activity in school settings (McKenzie et al., 2000). SOPARC improves upon this version by adapting the previous protocol to assess the more open and diverse activity environments that are found within communities, such as urban parks, and by being able to group participants into perceived race/ ethnicity and age groups, although in this instance, ethnicity/race was not taken into account. SOPARC is based upon momentary time sampling and uses Planned Activity Check recording that uses group time sampling methods (McKenzie, 2002). Planned Activity Check or Placheck has been previously used to examine aggressive behaviour of children on playgrounds and the effects of environmental intervention on the activity levels of teenagers before, during and after school in 24 middle schools (Murphy *et al*., 1983; Sallis *et al*., 2003). Previous to SOPARC, attempts to assess park user physical activity have relied upon self-reports by individuals, with no validated instruments with which to assess group physical activity in parks (Henderson & Ainsworth, 2001; Hoehner *et al*., 2005). This lack of tools had hampered investigations of exercise in "open" environments like parks and other recreational settings. Measuring activity in this type of setting can be complicated because both the number of participants and their levels of activity change frequently and because leisure activities occur in diverse locations, it is therefore, also desirable to assess contextual aspects of settings that might influence exercise levels, where relevant (McKenzie, 2006).

SOPARC is one of the most frequently used methods to assess park use and understand physical activity and the demographic composition of park users (Evenson *et al*., 2016)

While scanning a target area, an observation sweep which moves from left to right, the physical activity of every individual is coded as sedentary (ie. standing, sitting, lying down), walking, or vigorous (McKenzie, 2006). Separate scans are made for males and females. Similarly, entries are made for the time of observation and for contextual characteristics of the area such as accessibility (e.g., whether it is locked or not), usability, and whether supervision, organised events/activities, and or equipment is provided. The predominant and secondary types of activity (e.g., basketball, soccer) in areas that males and females are engaging are recorded also using a list of activities from four separate categories (fitness, sport, active game and sedentary related activities.

Adaptations were made to the original SOPARC recording sheet in order to suit the context of this study. Ethnicity was removed as a category because it was determined that it was not relevant to this study (Pleson *et al*., 2014). Sport related codes were also adjusted to reflect physical activities which are typically enjoyed by Irish people. Baseball, cheerleading, dance, American football, tetherball, and horseshoes were replaced with hurling, camogie, Gaelic football, rugby, and rounders.

Ballincollig Regional Park was the only park where this method was carried out as it contains multiple amenities, interconnected paths, and points of interest, which were observable from a single view point, whereas other parks within this study are made up largely of a single long path through the green space.

Figure 2.40 below shows the recording sheet used during fieldwork at Ballincollig regional park. Ballincollig was chosen for this method as it contains multiple amenities, inter-connected paths, and points of interest, whereas the other parks within this study are made up of a single path through a green space.

DATE___________PARK NAME______________ PERIOD: AM____ LUNCH____ AFTERNOON____ EVENING_______
TARGET AREA_______ START TIME___________

CONDTIONS OF TARGET AREA

Accessible (eg not locked or rented to others) **Yes No**
Usable (eg not excessively wet or windy) **Yes No**
Equipped (Equipment available) **Yes No**
Supervised (ie by official personnel) **Yes No Comments:**
Organised (eg Sporting event) **Yes No**
Dark (eg insuffiecient lighting) **Yes No**
Empty (ie area not occupied) **Yes No**

People	Activity	Age Group				Activity Level		
		Child	Teen	Adult	Senior	S	W	V
Participants	Primary Activity							
Female								
Male								
Participants	Secondary Activity							
Female								
Male								
Spectators	Organized Activity							
Female								
Male								

Fitness Related Codes	Sport Related Codes		Active Game Related Codes	Sedentary Related Codes
Joggiing/running	Hurling/Camogie	Basketball	Climbing/Sliding	Lying down
Strengthning exercises	Gaelic football	Tennis	Jumiping (rope, hopscotch)	Picnic
Fitness stations	Soccer	Rounders	Tag , other chasing games	Reading
Walking	Rugby		Active play	Sitting
Cycling				

Figure 2.40. SOPARC recording sheet template used in Ballincollig Regional Park, Cork to record the activities of park users at points of interest throughout the park.

All recording areas were selected prior to the collection of data, following preliminary observations on activities in the park. A total of 6 points were chosen for observation and observations were repeated 6 times at all locations. This included amenity grassland, picnic areas, a playground, outdoor gym equipment, basketball courts and multiple sports fields. These focal points were chosen as they are areas where park visitors gather to use park amenities and there are long lines of site in all directions.

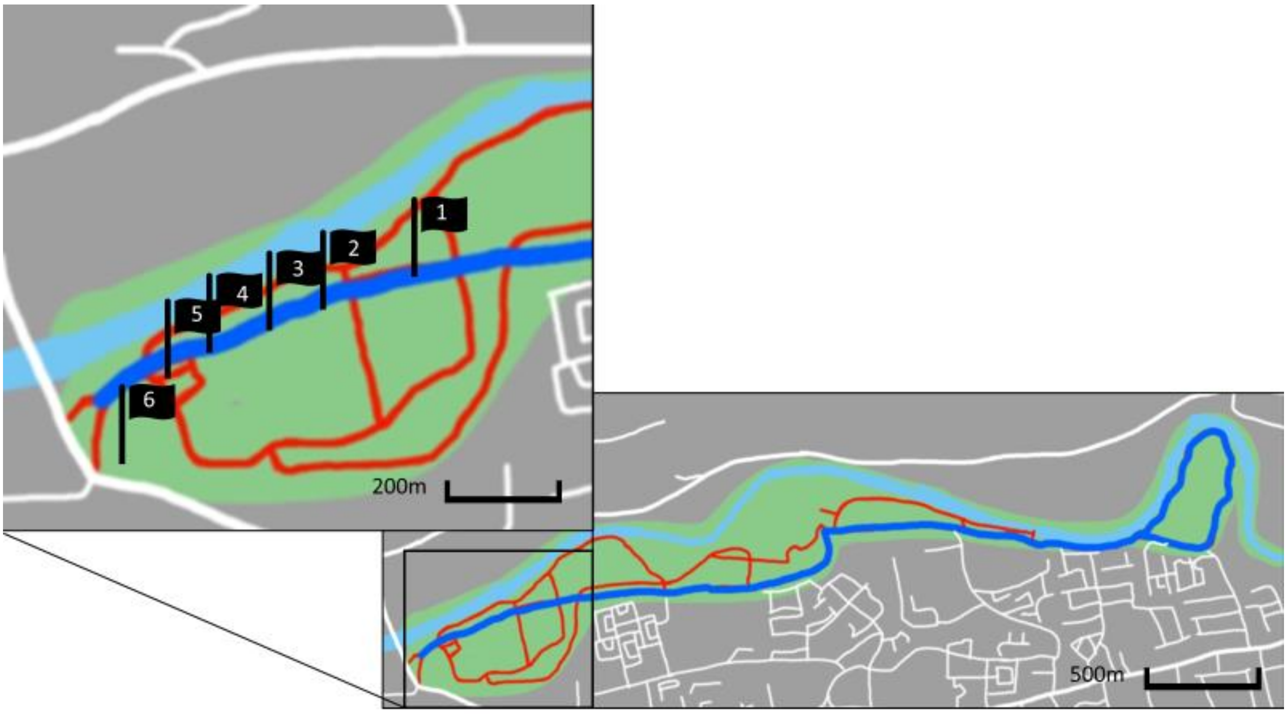


Figure 2.41. Map of Ballincollig Regional Park (right) with close-up of western side of park showing locations of SOPARC observations.

Figure 2.42. Images of locations of SOPARC observations in Ballincollig Regional Park, Cork. Locations include playground (top left), basketball court (top right), playing fields (middle left), picnic area (middle right), and outdoor exercise equipment (bottom left).

2.4.3 Human habitat Use Observational Study

A modified version of SOPARC was also used to observe human habitat use in Ballincollig Regional Park. This was used to determine which habitats were more favoured by park users. Instead of a single observational sweep over an area with long lines of site, three scans of ten minutes were conducted as site lines were limited in forest habitats (Temple *et al*., 2011). Activity levels and ethnicity were also excluded as they were not relevant to this study (Chung-Do *et al., 2011).*

Observation sites were selected prior to the collection of data in four habitats. These habitats included mixed broadleaved woodland, dry meadow, pedunculate oak-ash woodland, and amenity grassland.

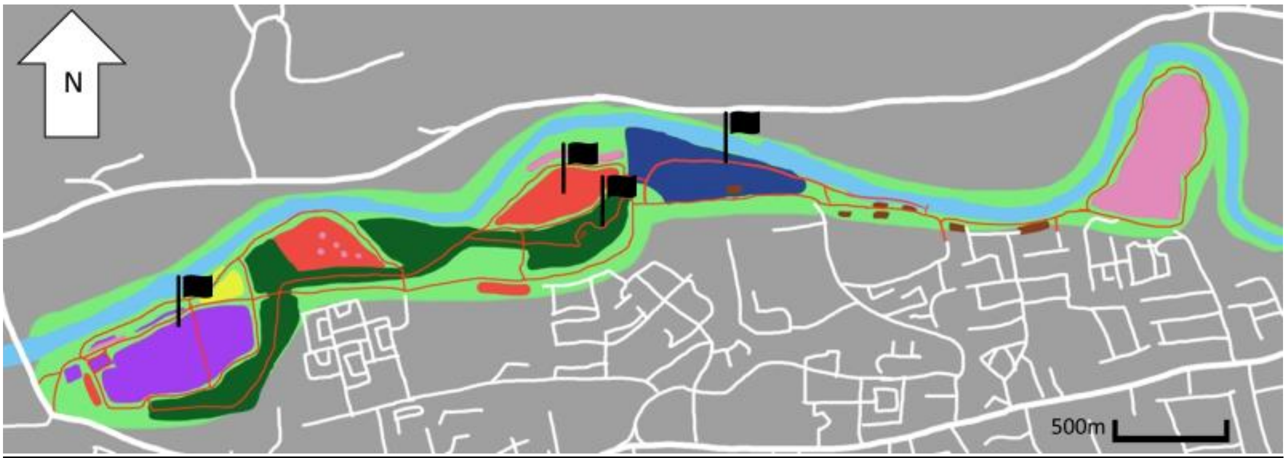


Figure 2.43. Map of Ballincollig Regional Park showing locations of human habitat use observational study.

DATE___________ PARK NAME_____________ PERIOD: AM___MID__AFT__EVE__ TARGET AREA____________________
START TIME______________ HABITAT TYPE_________________ _

PEOPLE	AGE GROUP				COMMENTS
	CHILD	TEEN	ADULT	SENIOR	
MALE					
FEMALE					

Figure 2.44. Template of observational study data collection sheet.

2.5 Logistics

2.5.1 Park Manager Interviews

As there is no literature surrounding the management of urban parks in Ireland, a series of questions was developed and given to those who are currently in charge of managing urban parks across Ireland. Similar studies on this topic have place in Northern Europe (Randrup *et al.,* 2017; Fongar *et al.,* 2019), and the United Kingdom (Nam & Dempsey, 201; Van Der Jagt & Lawerence, 2019), from which questions included in this study were modelled after. In total, seventeen individuals and organisations were asked to participate in the interview. These included institutions such as county and city councils, non-governmental organisations who are involved in park upkeep, and government funded groups such as the office of public works.

While this study was designed to capture several park manager perspectives, it is not a complete survey of park managers in Ireland and may not be representative of all Irish park managers.

The interview questions were sent with instructions to answer either via email, phone call, or videocall. The questions covered several topics as can be seen below:

Table 2.3. Questions given to individuals and organisations who manage parks.

1. Within the urban parks under your control, what resources are allocated to individual parks? How do you decide which individual parks to allocate resources to (e.g.,

	decisions based on numbers of park users (if so, how are these numbers gathered), size of park, its location, cultural importance, existing facilities?)
2.	Within individual parks, what proportion of resources do you allocate to the different aspects of the park (e.g., park infrastructure, amenities, vegetation management, anecdotal information, citizen-led information, national/regional urban park guidelines)? Is the funding you receive sufficient in your opinion?
3.	How are the urban parks under your control managed for the public? (e.g., provision of playgrounds, playing fields, outdoor exercise equipment, information boards, constructed pathways, lighting etc?). What information do you use to make these decisions (e.g., consultants reports, anecdotal information from park managers, citizen-led information, national/regional urban park management guidelines)?
4.	Within the urban parks under your control, how (if at all) is biodiversity managed? (e.g., native tree planting, bat boxes, bird nesting boxes, wildflower meadows, pond/stream management). What information do you use to make these decisions (e.g., consultants' reports, anecdotal information from park managers, citizen-led information, national/regional urban park guidelines)?
5.	Lastly, within the urban parks under your control, are management decisions essentially pro-active or reactive? For example, are there long-term management plans for the individual parks or are decisions for individual parks taken based on events or circumstances at any one time (or a combination of these)?

2.6 Data Analysis

We undertook a mixed methods research approach, and all statistical analyses were performed using IBM SPPS Statistics 28.0.0.0 at the 95% confidence interval with graphs produced in Microsoft Excel and maps drawn using Krita.

To gain quantitative information on the plant biodiversity of Cork's urban parks the species richness and Simpson's Index of recorded vegetation was calculated to measure the numbers of species present as well as the relative abundance of each species across habitats and parks. The species richness of repeated habitats was compared using a Wilcoxon signed rank test.

For the park user questionnaire, a Chi-Square test was used to determine which types of landscapes and amenities are liked and disliked among park users and what social issues were of most and least concern. This data was also divided by gender and age to determine if these factors effect responses.

SOPARC observations of amenity use, were used to compare the usage of sport and recreational facilities among different age groups and genders using Independent-Samples Kruskal-Wallis and Mann-Whitney U tests. This was then used to determine if observed use of park amenities was similar to that of questionnaire responses.

The final analysis of the “People” section determined what habitats were preferred in the park by using the SOPARC method to compare the number of people who visit selected park habitats along with the age and gender of these visitors using Independents-Samples Kruskal-Wallis tests. These results were then compared to responses given in the park user questionnaire to determine if observed results were similar to results expected.

Finally, the qualitative data gathered in the structured interviews with park managers and organisations was analysed and interpreted to determine how parks are currently managed for biodiversity, people, and logistics, if these practices can be improved and how they compare to the data gathered in previous sections.

3.0 Results

3.1 Biodiversity

3.1.1 Vegetation

Overall, 80 species were identified across 5 habitat types in 6 Cork City parks covering 1500m^2 of urban park habitats.

Table 3.1. The percentage of each sub-habitat within their respective parks surveyed in this study where BQ represents Beaumont Quarry, MP represents the Marina Park, BB represents Ballybrack Woods, TVP represents Tramore Valley Park, BRP represents Ballincollig Regional Park, and GRP represents the Glen River Park.

	BQ	MP	BB	TVP	BRP	GRP
Dry meadow	4.6%	4.3%	24%	40%	13.6%	0.15%
Mixed broadleaved woodland	29%	4.28%	35%	~	14%	0.13%
Scrub	4.3%	~	21%	~	~	~
Pedunculate oak-ash woodland	~	~	~	~	13%	~
Reed and large sedge swamp	~	~	~	~	~	3.1%

For individual parks, vegetation across all sub-habitats was dominated by species generally common throughout Ireland. In some parks, several sub habitats were dominated by both native and invasive alien plants species.

Species richness and Simpsons Index for diversity for all vegetation layers (H, S, U/S, C) for each sub-habitat across the six study parks showed that there were marked differences both between sub-habitats and between individual parks (Fig. 3.2)

Meadow was the only habitat that occurred in all six parks. Woodland occurred in five parks, scrub in two parks, and pedunculate oak-ash woodland and reed and large sedge swamp in a single park each. When species richness data was combined it showed that scrub habitat had the highest species richness in Ballybrack woods but lowest in Beaumont Quarry. Although woodland habitat had greater species richness than meadow in four of the five parks where both sub-habitats occurred (Fig 3.2), there was no significant difference in species richness between the two sub-habitats (Wilcoxon signed rank test Z=-1.084, p<0.279).

Table 3.2. Summary of species richness and Simpsons Index of diversity for six Cork City parks where H stands for herb layer, S stands for shrub layer, U/S stands for understory, and C stands for canopy.

Park	Measurement	Dry Meadow				Mixed Broadleaved Woodland				Scrub				Pedunculate Oak-Ash Woodland				Large Reed and Sedg Swamp			
		H	S	U/S	C	H	S	U/S	C	H	S	U/S	C	H	S	U/S	C	H	S	U/S	C
Beaumont	Simpsonindex of diversity	0.7846 68779	0	0	0	0.149 985	0.28	0	0.58	0	0	0	0	0	0	0	0	0	0	0	0
	Species richness	19	1	0	0	15	4	0	2	1	0	1	0	0	0	0	0	0	0	0	0
Ballybrack	Simpsonindex of diversity	0.5666 48199	0	0	0	0.536 777	0.64	0	0.46	0.778 207	0.585	0.345 679	0.567 901	0	0	0	0	0	0	0	0
	Species richness	9	0	0	0	4	3	1	3	9	4	2	3	0	0	0	0	0	0	0	0
Glen	Simpsonindex of diversity	0.815	0	0	0	0.72	0.5	0	0	0	0	0	0	0	0	0	0	0.733 564	0.542 936	0	0
	Species richness	9	0	0	0	4	2	0	1	0	0	0	0	0	0	0	0	5	4	0	0
Marina	Simpsonindex of diversity	0.5666 48199	0	0	0	0.517 003	0	0.375	0.567 901	0	0	0	0	0	0	0	0	0	0	0	0
	Species richness	18	0	0	0	19	1	18	3	0	0	0	0	0	0	0	0	0	0	0	0
Tramore	Simpsonindex of diversity	0.8111 11111	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Species richness	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ballincollig	Simpsonindex of diversity	0.8220 69943	0	0	0	0.695 592	0.614 749	0.545 225	0.656 25	0	0	0	0	0.709 247	0.623 488	0	0.62	0	0	0	0
	Species richness	12	0	0	0	5	7	4	4	0	0	0	0	8	4	0	3	0	0	0	0

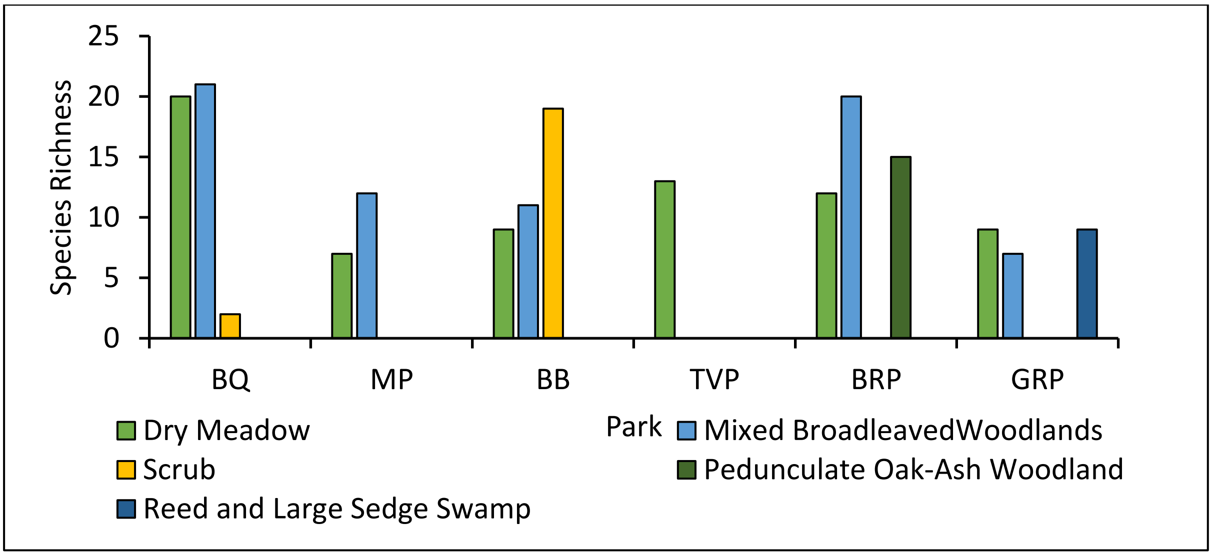


Figure 3.1. Species richness per unit area in five habitats across six urban parks in Cork, Ireland where BQ is Beaumont Quarry, MP is Marina Park, BB is Ballybrack Woods, TVP is Tramore Valley Park, BRP is Ballincollig Regional Park and GRP is the Glen River Park.

3.1.1.1. Beaumont Quarry

Three sub-habitats occurred in Beaumont Quarry- dry meadow, mixed broadleaved woodland, and scrub. Dry meadow comprised only 4.6% of the total park (Table 3.1) and is located in the centre of the park (Fig.3.2, 3.3). Two of the three habitats were characterised by plant species common throughout Ireland, while the third sub-habitat was dominated by invasive alien species (Table 3.3). The dry meadow habitat was dominated by dense growth of bramble (*Rubus fruticosis*) interspersed with sparse patches of meadow grasses in clearings and were highly diverse (Table 3.3). The woodland which comprises almost a third of the park was clearly secondary in nature, originating from the cessation of quarrying in the 1960's. It was dominated by two species of deciduous tree- Ash (*Fraxinus excelsior*) and sycamore (*Acer pseudoplatanus*) in the canopy layer. These species were also present in the shrub layer along with a high presence of bramble. The herb layer of this habitat type had the highest amount of diversity and had a high presence of ash saplings, bramble, ivy (*Hedera helix*) and Herb Robert (*Geranium robertianum*). Another notable species in this sub-habitat is St. Georges mushroom (*Calocybe gambosa*) which is infrequent in Ireland (Table 3.3). Finally, the scrub habitat was entirely composed of the non-native and highly invasive Japanese knotweed (*Fallopia japonica*) and Winter heliotrope (*Petasites fragrans*) and therefore has extremely low diversity (Table 3.3).

Figure 3.2. Map of Beaumont Quarry showing habitat types, trails, and locations of vegetation surveys.

Figure 3.3. Aerial photograph (2011-2013) of Beaumont Quarry with colour overlay of habitats present.

Table 3.3. Vegetation species recorded at Beaumont Quarry, with their distribution in Ireland and the percentage cover recorded across four habitat layers and invasive alien species highlighted. Simpson's Index and species richness are also calculated.

Scientific name	Common name	Distribution	Dry meadow				Mixed broadleaved woodland				Scrub			
			H	S	U/S	C	H	S	U/S	C	H	S	U/S	C
Fraxinus excelsior	Ash	Common and widespread	0	0	0	0	10	30	0	70	0	0	0	0
Acer pseudoplatanus	Sycamore	Common and widespread	0	0	0	0	0	30	0	30	0	0	0	0
Alopecurus pratensis	Foxes tail	Common and widespread	10	0	0	0	0	0	0	0	0	0	0	0
Anagallis arvensis	Scarlet pimpernell	Common and widespread	0.5	0	0	0	0	0	0	0	0	0	0	0
Anthriscus sylvestris	Cow parsely	Common and widespread	0	2	0	0	0	0	0	0	0	0	0	0
Arrhenatherum elatius	Fasle oatgrass	Common and widespread	10	0	0	0	0	0	0	0	0	0	0	0
Brachypodium sylvaticum	Wood false brome	Common and widespread	0	0	0	0	0.5	0	0	0	0	0	0	0
Calocybe gambosa	St Georges mushroo	Infrequent	0	0	0	0	0.5	0	0	0	0	0	0	0
Calystegia sepium	Bindweed	Common and widespread	5	0	0	0	0	0	0	0	0	0	0	0
Cirsium vulgare	Thistle	Common and widespread	10	0	0	0	0	0	0	0	0	0	0	0
Dactylis glomerata	Cocksfoot	Common and widespread	10	0	0	0	0	0	0	0	0	0	0	0
Dryopteris filix-mas	Male fern	Common and widespread	5	0	0	0	0	0	0	0	0	0	0	0
Elymus repens	Scutch grass	Common and widespread	0	0	0	0	0.5	0	0	0	0	0	0	0
Epilobium parviflorum	Hoary willowherb	Common and widespread	0.5	0	0	0	0	0	0	0	0	0	0	0
Fallopia japonica	Japanese knotweed	Established	0	0	0	0	0	0	0	0	0	0	70	0
Ficaria verna	Lesser cellandine	Common and widespread	2	0	0	0	1	0	0	0	0	0	0	0
Galium aparine	Sticky backs	Common and widespread	0	0	0	0	5	0	0	0	0	0	0	0
Geranium robertianum	Cranes bill	Common and widespread	0	0	0	0	20	0	0	0	0	0	0	0
Geum urbanum	Wood avens	Common and widespread	0	0	0	0	11	0	0	0	0	0	0	0
Hedera helix	Ivy	Common and widespread	0	0	0	0	20	0	0	0	0	0	0	0
Holcus lanatus	Yorkshire fog	Common and widespread	10	0	0	0	0	0	0	0	0	0	0	0
Lathyrus pratensis	Meadow vetchling	Common and widespread	10	0	0	0	0	0	0	0	0	0	0	0
Petasites fragrans	Winter heliotrope	Established	0	0	0	0	0	0	0	0	30	0	0	0
Plantago lanceolata	Narow leaf plantain	Common and widespread	0.5	0	0	0	0	0	0	0	0	0	0	0
Ranunculus acris	Meadow buttercup	Common and widespread	0	0	0	0	0.5	0	0	0	0	0	0	0
Rubus fruticosus	Bramble	Common and widespread	60	0	0	0	20	30	0	0	0	0	0	0
Rumex obtusifolius	Dock	Common and widespread	0.5	0	0	0	1	0	0	0	0	0	0	0
Stachys sylvatica	Hedge woundwort	Common and widespread	0	0	0	0	1	0	0	0	0	0	0	0
Stellaria graminea	Lesser stitchwort	Common and widespread	5	0	0	0	0	0	0	0	0	0	0	0
Trifolium pratense	Red clover	Common and widespread	0.5	0	0	0	0	0	0	0	0	0	0	0
Trifolium repens	White clover	Common and widespread	0.5	0	0	0	0	0	0	0	0	0	0	0
Urtica dioica	Nettle	Common and widespread	0	0	0	0	10	10	0	0	0	0	0	0
Veronica chamaedrys	Germander speedwe	Common and widespread	0.5	0	0	0	0	0	0	0	0	0	0	0
Vicia sativa	Vetch	Common and widespread	0.5	0	0	0	0	0	0	0	0	0	0	0
Simpsons Index			0.7846688	0	0	0	0.850015	0.72	0	0.42	0	0	0	0
Species Richness			19	1	0	0	15	4	0	2	1	0	1	0

3.1.1.2 Marina Park.

Two sub-habitats were present in the Marina Park- dry meadow and mixed broadleaved woodland (Fig. 3.4, 3.5). Meadow comprised of 4.3% of the park, located on the east end of the park, while woodland was present on the west end of the park and made up 4.28% of the park (Table 3.1). Both sub-habitats consisted largely of plant species which are common and widespread throughout Ireland (Table 3.4). The dry meadow habitat consisted of a small number of meadow grasses and plants with a moderate degree of diversity (0.56) (Table 3.4).

In the woodland habitat of the park, ash and sycamore were common in the canopy layer along with blackthorn (*Prunus spinosa*). These tree species were also present in the understory layer with beech (*Fagus sylvativa*). The herb layer consisted mainly of the invasive species winter heliotrope, followed by common woodland species including nettle, bramble, ivy, and fern (*Dryopteris filix-mas*). All layers of this habitat type had a low to medium degree of diversity ranging between 0.375 and 0.517 (Table 3.4).

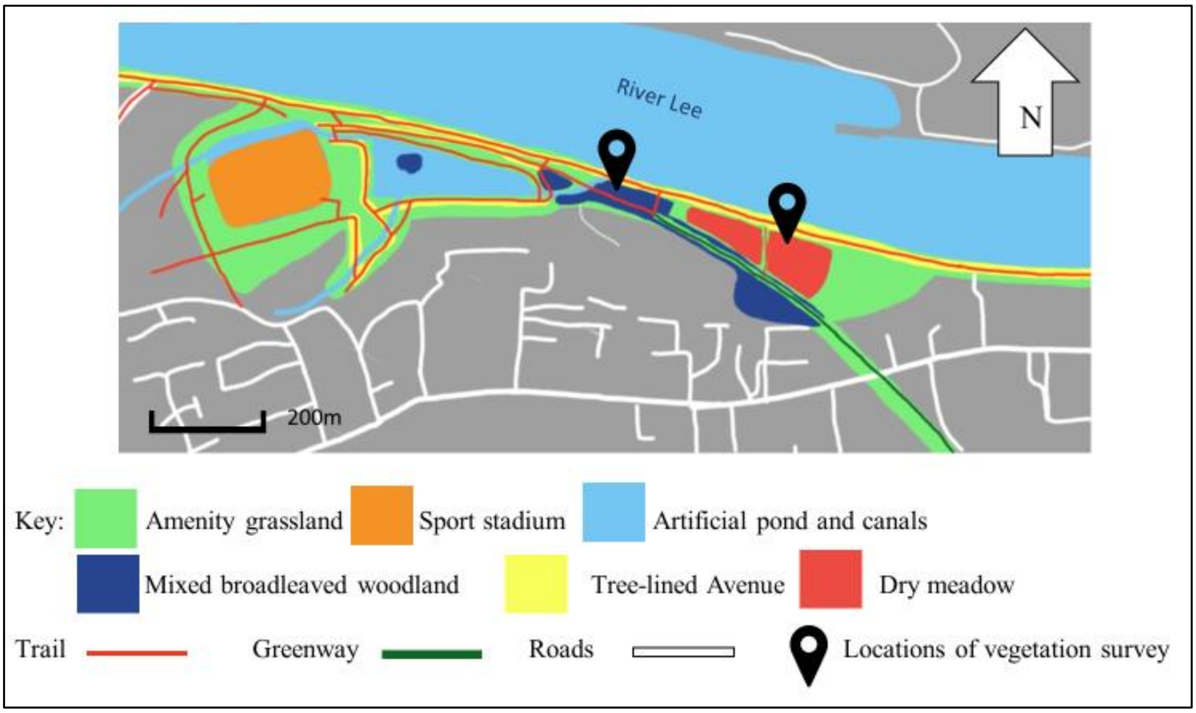


Figure 3.4. Map of The Marina Park showing habitats, trails and the locations of vegetation surveys.

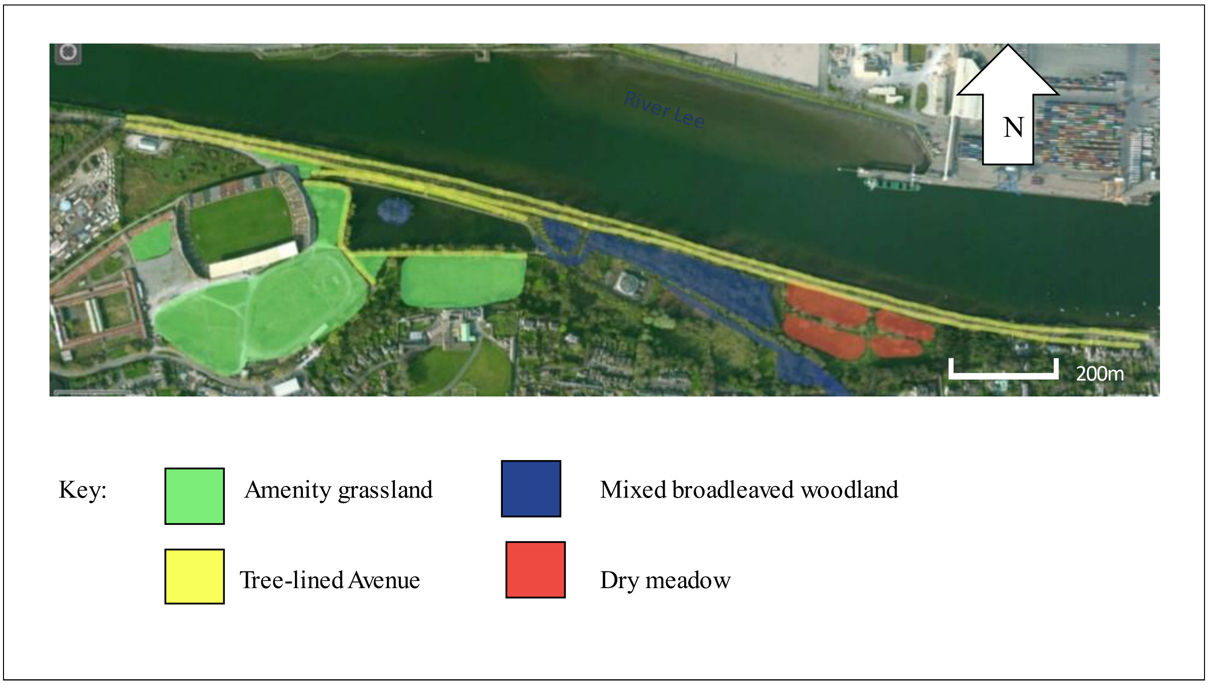


Figure 3.5. Aerial photograph (2011-2013) of The Marina Park with colour overlay of habitats present (OSI).

Table 3.4. Vegetation species recorded at the Marina Park, with their distribution in Ireland and the percentage cover recorded across four habitat layers with invasive alien species highlighted. Simpson's Index and species richness are also calculated

Scientific name	Common name	Naming authority	Distribution	Dry meadow				Mixed broadleaved woodland			
				H	S	U/S	C	H	S	U/C	C
Petasites fragrans	Winter heliotrope	Presl	Established	0	0	0	0	75	0	0	0
Urtica dioica	Nettle	L	Common and Widespread	0	0	0	0	10	0	0	0
Hedera helix	Ivy	L	Common and Widespread	0	0	0	0	10	0	0	0
Rubus fruticosus	Bramble	L	Common and Widespread	0	0	0	0	10	0	0	0
Dryopteris filix-mas	Male Fern	Schott	Common and Widespread	0	0	0	0	5	0	0	0
Geranium robertianu	Herb Robert	L	Common and Widespread	0	0	0	0	1	0	0	0
Fraxinus excelsior	European Ash	L	Common and Widespread	0	0	0	0	0	5	0	0
Acer pseudoplatanu	Sycamore	L	Common and Widespread	0	0	0	0	0	0	30	0
Fagus sylvatica	Beech	L	Common and Widespread	0	0	0	0	0	0	10	0
Prunus spinosa	Blackthorn	L	Common and Widespread	0	0	0	0	0	0	0	10
Fraxinus excelsior	European Ash	L	Common and Widespread	0	0	0	0	0	0	0	50
Acer pseudoplatanu	Sycamore	L	Common and Widespread	0	0	0	0	0	0	0	30
Holcus lanatus	Yorkshire Fog	L	Common and Widespread	60	0	0	0	0	0	0	0
Arrhenatherum elati	False Oatgrass	L	Common and Widespread	10	0	0	0	0	0	0	0
Dactylis glomerata	Cocksfoot	L	Common and Widespread	10	0	0	0	0	0	0	0
Ficaria verna	Lesser Cellandine	Huds	Common and Widespread	3	0	0	0	0	0	0	0
Plantago lanceolata	Narrowleaf Plantain	L	Common and Widespread	1	0	0	0	0	0	0	0
Lolium perenne	Ryegrass	Gaudin	Common and Widespread	10	0	0	0	0	0	0	0
Anthriscus sylvestris	Cow Parsely	L	Common and Widespread	1	0	0	0	0	0	0	0
Simoson index of diversity				0.566648	0	0	0	0.517003	0	0.375	0.567901
Species richness				18	0	0	0	19	1	18	3

3.1.1.3 Ballybrack Woods

Three sub-habitats occurred in Ballybrack Woods which were dry meadow, mixed broadleaved woodland, and scrub (Fig. 3.6, 3.7). Meadow comprised 24% of the park and was located mainly at the northern end of the park. Woodland comprised of 35% of the park and is present in two locations, the first at the northeast side of the park, and the second at the southern-most section of the park (Fig. 3.6,3.7, Table 3.5). The woodland in Ballybrack is long established and may have been a part of Ballybrack Estate's original grounds (Table 2.1) Ballybrack had the most non-native species present in its sub-habitats with laurel (*Laurus nobilis*), winter heliotrope, and European Hornbeam (*Carpinus betulus*), the last of which is an ornamental species that was purposely planted in the park.

The dry meadow habitat of the park consisted mostly of smooth meadow grass (*Poa pratensis*) along with other common meadow species (Table 3.5). This sub-habitat had a moderate degree of heterogeneity with a relatively low species richness (Table 3.5). The canopy of the mixed broadleaved woodland is dominated by beech, while the invasive species, laurel was the only species present in the understory layer. Beech and holly were also common in the shrub layer, while the herb layer was dominated by ivy and fern. The diversity of this sub-habitat type was moderate (0.53 and 0.46, respectively) in the herb and canopy layers, and was relatively high (0.64) in the shrub layer (Table. 3.5) while species richness was low across layers.

Finally, in the scrub sub-habitat, the canopy layer consisted of mainly of beech, followed by sycamore while European Aspen (*Populus tremula*) and hornbeam (*Carpinus betulus*) characterised the understory layer. Both aspen and hornbeam were purposely planted by park managers. The shrub layer of the scrub habitat was dominated by bramble and nettle while the herb layer consisted mostly of Yorkshire fog (*Holcus lanatus*) and the invasive alien species, winter heliotrope. The herb layer of Ballybrack's scrub habitat had the highest species richness and Simpson's Index among all layers and habitat in Ballybrack (9, 0.78) (Table 3.5).

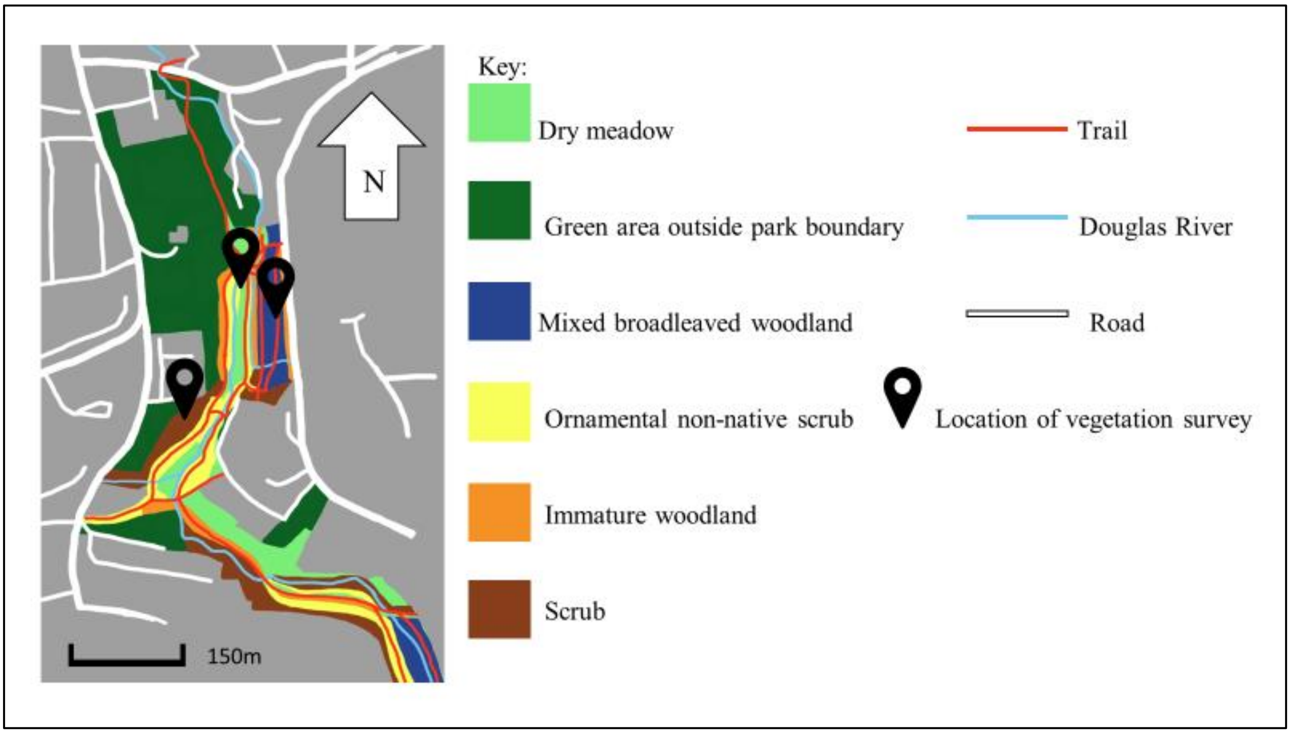


Figure 3.6. Map of Ballybrack Woods showing habitats, trails, and locations of vegetation surveys.

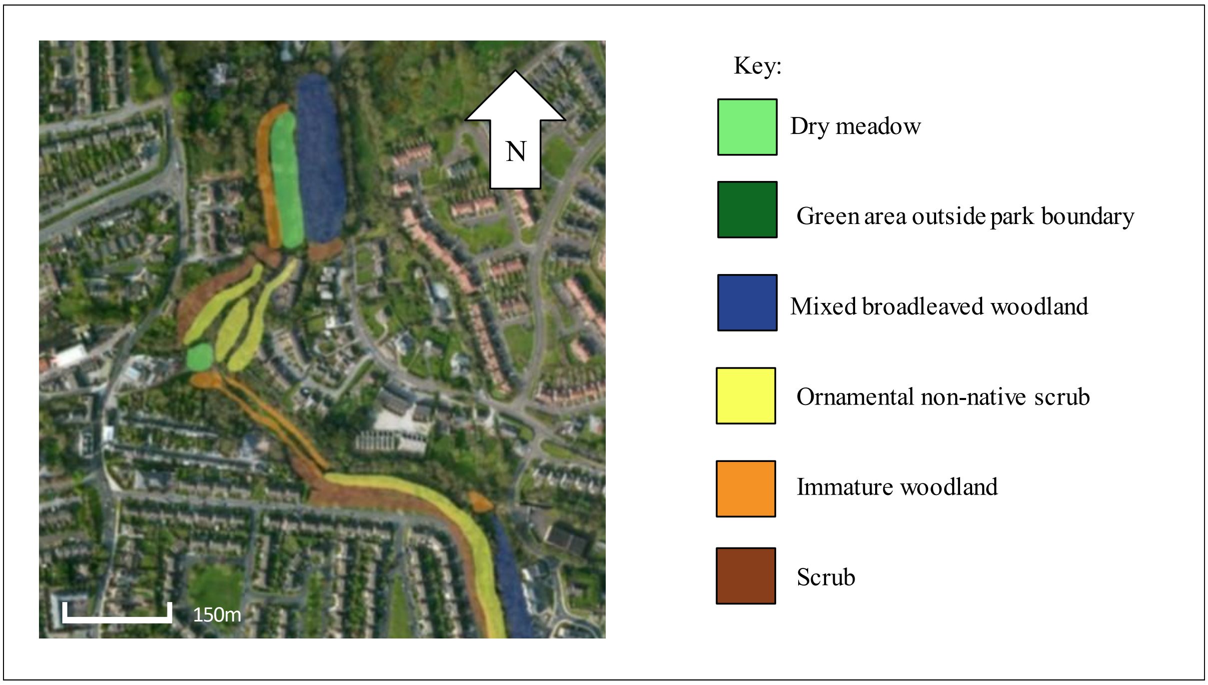


Figure 3.7. Aerial photograph (2011-2013) of Ballybrack Woods with colour overlay of habitats present (OSI)

Table 3.5. Vegetation species recorded at Ballybrack Woods, with their distribution in Ireland and the percentage cover recorded across four habitat layers with invasive alien species highlighted. Simpson's Index and species richness are also calculated.

				Mixed broadleaved woodland				Scrub				Dry meadow			
Scientific name	Common name	Naming authority	Distribution	H	S	U/S	C	H	S	U/S	C	H	S	U/C	C
Hedera helix	Ivy	L	Common and Widespread	50	0	0	0	0	0	0	0	0	0	0	0
Dryopteris filix-mas	Male Fern	Schott	Common and Widespread	30	0	0	0	0	0	0	0	0	0	0	0
Rubus fruticosus	Bramble	L	Common and Widespread	5	0	0	0	0	0	0	0	0	0	0	0
Carex slyvatica	Wood Sedge	Hornem	Common an d Widespread	1	0	0	0	0	0	0	0	0	0	0	0
Fagus sylvatica	Beech	L	Common and Widespread	0	10	0	0	0	0	0	0	0	0	0	0
Ilex aquifolium	Holly	L	Common and Widespread	0	10	0	0	0	0	0	0	0	0	0	0
Hedera helix	Ivy	L	Common and Widespread	0	5	0	0	0	0	0	0	0	0	0	0
Laurus nobilis	Laurel	L	Established	0	0	5	0	0	0	0	0	0	0	0	0
Fagus sylvatica	Beech	L	Common and Widespread	0	0	0	70	0	0	0	0	0	0	0	0
Acer pseudoplatanus	Sycamore	L	Common and Widespread	0	0	0	10	0	0	0	0	0	0	0	0
Ilex aquifolium	Holly	L	Common and Widespread	0	0	0	20	0	0	0	0	0	0	0	0
Veronica beccabung	European Brooklime	L	Common locally	0	0	0	0	1	0	0	0	0	0	0	0
Holcus lanatus	Yorkshire Fog	L	Common and Widespread	0	0	0	0	40	0	0	0	0	0	0	0
Phleum pratense	Timothy	L	Common and Widespread	0	0	0	0	10	0	0	0	0	0	0	0
Calystegia sepium	Bindweed	L	Common and Widespread	0	0	0	0	5	0	0	0	0	0	0	0
Rubus fruticosus	Bramble	L	Common and Widespread	0	0	0	0	10	0	0	0	0	0	0	0
Galium aparine	Sticky Back	L	Common and Widespread	0	0	0	0	10	0	0	0	0	0	0	0
Ficaria verna	Lesser Cellandine	Huds	Common and Widespread	0	0	0	0	5	0	0	0	0	0	0	0
Lathyrus pratensis	Meadow Vetchling	L	Common and Widespread	0	0	0	0	1	0	0	0	0	0	0	0
Veronica chamaedry	Germander speedwe	L	Common and Widespread	0	0	0	0	1	0	0	0	0	0	0	0
Petasites fragrans	Winter Heliotrope	Presl	Established	0	0	0	0	20	0	0	0	0	0	0	0
Rubus fruticosus	Bramble	L	Common and Widespread	0	0	0	0	0	50	0	0	0	0	0	0
Urtica dioica	Nettle	L	Common and Widespread	0	0	0	0	0	40	0	0	0	0	0	0
Rumex obtusifolius	Dock	L	Common and Widespread	0	0	0	0	0	5	0	0	0	0	0	0
Anthriscus sylvestris	Cow Parsely	L	Common and Widespread	0	0	0	0	0	5	0	0	0	0	0	0
Populus tremula	European Aspen	L	Common and Widespread	0	0	0	0	0	0	70	0	0	0	0	0
Carpinus betulus	European Hornbeam	L	Non-native, ornamental	0	0	0	0	0	0	20	0	0	0	0	0
Laurus nobilis	Laurel	L	Established	0	0	0	0	0	0	0	10	0	0	0	0
Acer pseudoplatanus	Sycamore	L	Common and Widespread	0	0	0	0	0	0	0	30	0	0	0	0
Fagus sylvatica	Beech	L	Common and Widespread	0	0	0	0	0	0	0	50	0	0	0	0
Ficaria verna	Lesser Cellandine	Huds	Common and Widespread	0	0	0	0	0	0	0	0	10	0	0	0
Trifolium repens	White Clover	L	Common and Widespread	0	0	0	0	0	0	0	0	5	0	0	0
Vicia sativa	Vetch	L	Common and Widespread	0	0	0	0	0	0	0	0	1	0	0	0
Lathyrus pratensis	Meadow Vetchling	L	Common and Widespread	0	0	0	0	0	0	0	0	5	0	0	0
Stellaria media	Common Chickweed	L	Common and Widespread	0	0	0	0	0	0	0	0	10	0	0	0
Galium palustre	Common marsh bed	L	Common and Widespread	0	0	0	0	0	0	0	0	20	0	0	0
Poa pratensis	Smooth Meadow Gra	L	Common and Widespread	0	0	0	0	0	0	0	0	40	0	0	0
Holcus lanatus	Yorkshire Fog	L	Common and Widespread	0	0	0	0	0	0	0	0	10	0	0	0
Rumex obtusifolius	Dock	L	Common and Widespread	0	0	0	0	0	0	0	0	25	0	0	0
Simoson index of diversity				0.536777	0.64	0	0.46	0.778207	0.585	0.345679	0.567901	0.566648	0	0	0
Species richness				4	3	1	3	9	4	2	3	9	0	0	0

3.1.1.4 Tramore Valley Park

Only one sub-habitat was present in Tramore Valley Park, dry meadow, which makes up 40% of the park (Table 3.1, Fig. 3.8, 3.9). The majority of species identified in the park are common and widespread with the exception of Lucerne (*Medicago sativa*), which is nationally scarce in Ireland. This habitat is characterised by two species- red clover (*Trifolium pratense*) and Yorkshire Fog (Table 3.6). This sub-habitat had a high degree of heterogeneity overall, and a high species richness when compared to the other dry meadow habitats (Table 3.6).

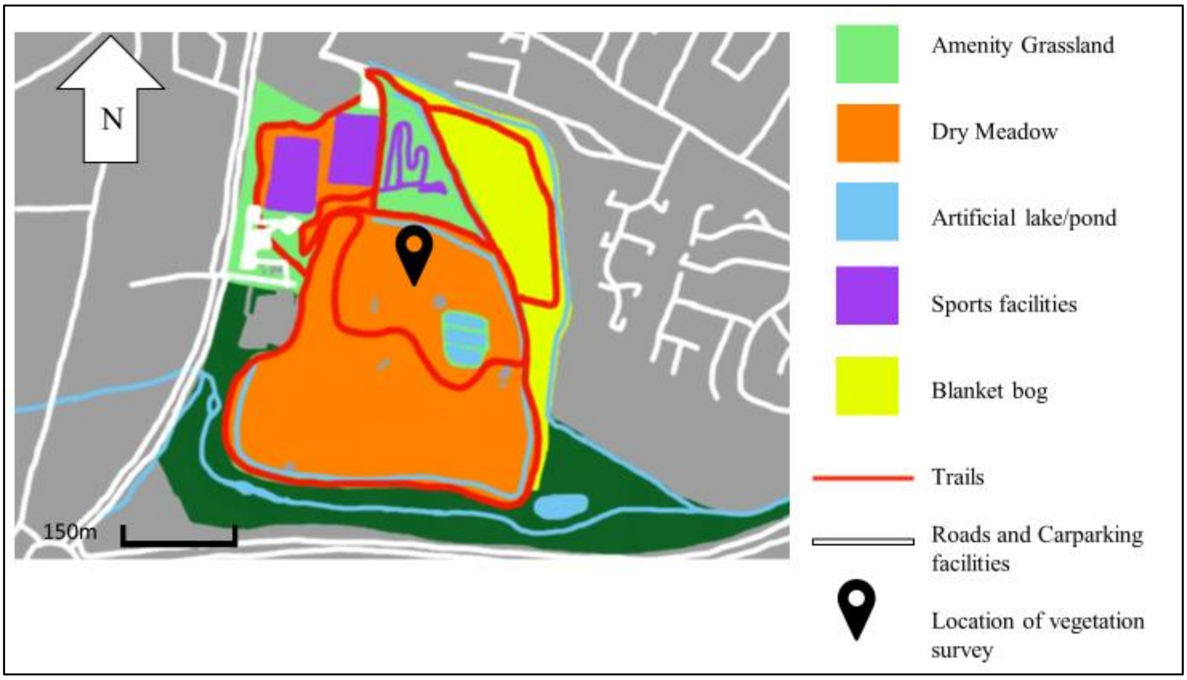


Figure 3.8. Map of Tramore Valley Park showing habitats, trails, and locations of vegetation surveys.

Figure 3.9. Aerial photograph (2011-2013) of Tramore Valley Park with colour overlay of habitats present (OSI)

Table 3.6. Vegetation species recorded at Tramore Valley Park, with their distribution in Ireland and the percentage cover recorded across four habitat layers. Simpson's Index and species richness are also calculated.

Scietific name	Common name	Naming authority	Distribution	Dry meadow			
				H	S	U/S	C
Trifolium pratense	Red Clover	L	Common and Widespread	30	0	0	0
Lotus corniculatus	Birdsfoot Trefoil	L	Common and Widespread	5	0	0	0
Ficaria verna	Lesser Cellandine	Huds	Common and Widespread	5	0	0	0
Medicago lupulina	Black Medic	L	Common and Widespread	1	0	0	0
Daucus carota	Wild Carrot	L	Common and Widespread	1	0	0	0
Ranunculus acris	Meadow Buttercup	L	Common and Widespread	1	0	0	0
Leontodon hispidus	Rough Hawkbit	L	Common locally	5	0	0	0
Holcus lanatus	Yorkshire Fog	L	Common and Widespread	20	0	0	0
Plantago lanceolata	Narrowleaf Plantain	L	Common and Widespread	5	0	0	0
Agrostis capillaris	Common Bent	L	Common and Widespread	5	0	0	0
Centaurea nigra	Common Knapweed	L	Common and Widespread	10	0	0	0
Cynosurus cristatus	Crested Dogs Tail	L	Common and Widespread	1	0	0	0
Medicago sativa	Lucerne	L	Nationally scarce	1	0	0	0
Simoson index of diversity				0.811111	0	0	0
Species richness				13	0	0	0

3.1.1.5 Ballincollig Regional Park

Three sub-habitats were surveyed in Ballincollig which were dry meadow, mixed broadleaved woodland, and pedunculate oak-ash woodland. Dry meadow habitat makes up 13.6% of Ballincollig regional park (Table 3.1), which is mostly present in two locations. This study took place in the meadow in the centre of the park, close to the river Lee (Fig 3.10, 3.11). Mixed broadleaved woodland was present in a single location in the centre of the park (Fig. 3.10, 3.11) and covers 14% of Ballincollig's 0.6km^2 (Table 2.1, 3.1). Pedunculate oak-ash woodland is located throughout the western end of the park and made up 13% of the park. This habitat was present where canals which were built while the park was used as a gunpowder mill. The vegetation survey took place at the southwest end of the park (Fig. 3.10,3.11).

Dry meadow habitat in the park is characterised by a number of species which are common and widespread in Ireland including meadow sweet (*Filipendula ulmaria*), sweet vernal grass (*Anthoxanthum odoratum*), and Yorkshire fog. Species richness was comparatively high for this sub-habitat type and the Simpson's diversity index showed that the degree of diversity was high (Table 3.7).

The canopy of the mixed broadleaved woodland sub-habitat was characterised by ash and whitethorn (*Crataegus monogyna*) with whitethorn and holly making up much of the understory layer (Table 3.7). The shrub layer consisted mostly of male fern and young holly trees, with the notable presence of the invasive species laurel. Finally, the herb layer of this sub-habitat comprised of ivy and Hart's tongue fern (*Asplenium scolopendrium*). Simpson's index was moderate to high across this sub-habitat while species richness was relatively low (Table 3.7).

Pedunculate oak-ash woodland's canopy was dominated by pussy willow (*Sallix caprea*) along with ash and white thorn. This layer had a low species richness but a moderately high degree of heterogeneity (0.62). No species were present in the understory layer, while the shrub layer consisted of just four species, the most common which was great wood rush (*Rubus odoratus*). Notably, purple flowering raspberry (*Rubus odoratus*) was identified in this layer and is most likely a garden escape. This layer had a similar diversity index to the canopy layer (Table 3.7). Finally, the herb layer consisted mostly of remote sedge (*Carex remota*) and had the highest diversity in this sub-habitat (0.7) (Table 3.7).

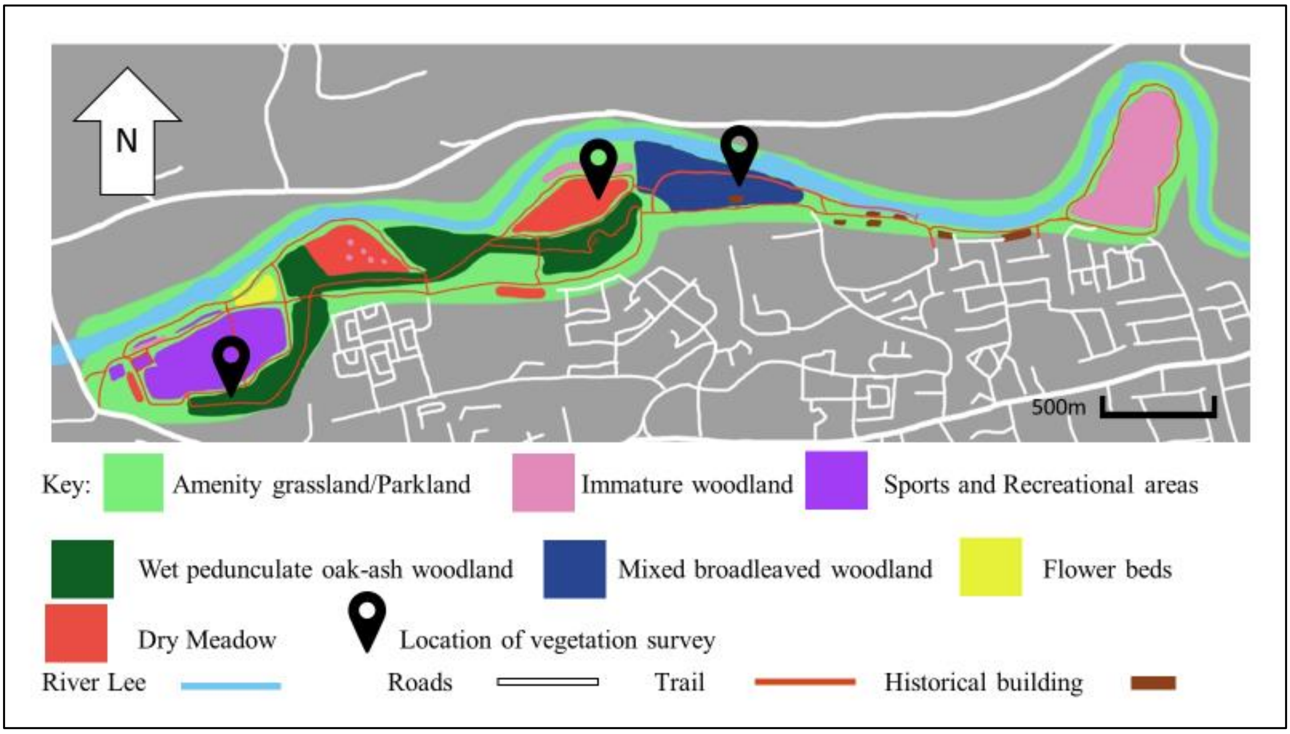


Figure 3.10. Map of Ballincollig Regional Park showing habitats, trails, and locations of vegetation surveys.

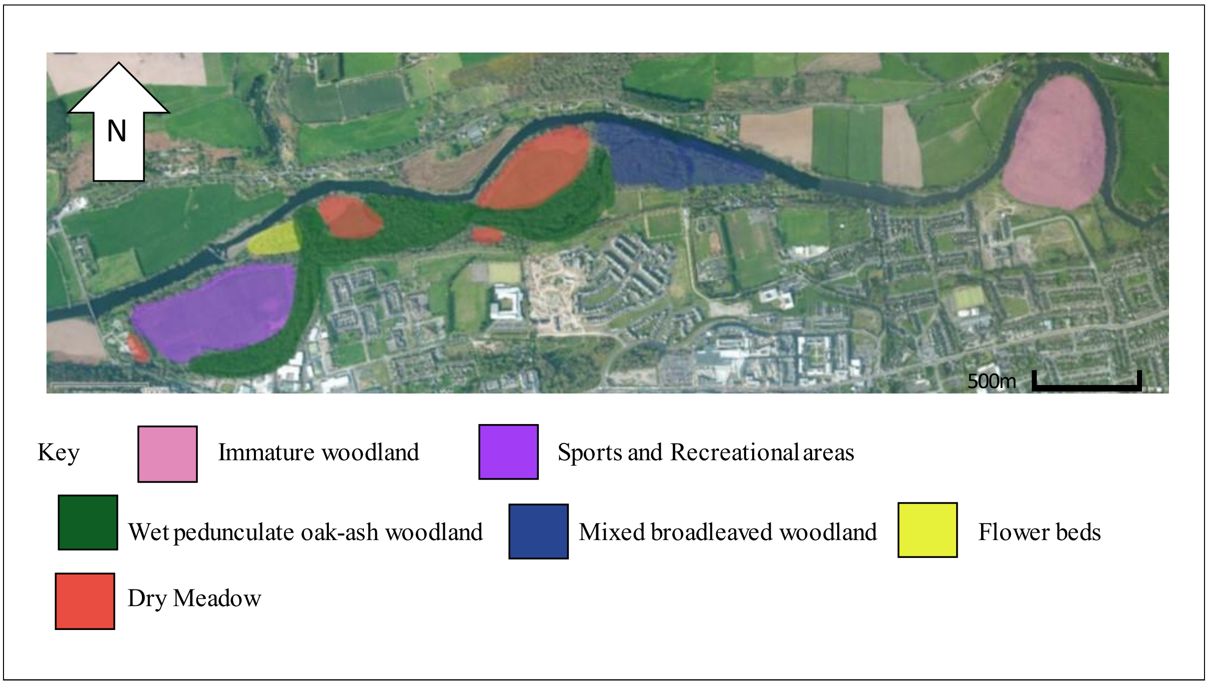


Figure 3.11. Aerial photograph (2011-2013) of Ballincollig Regional Park with colour overlay of habitats present (OSI).

Table 3.7. Vegetation species recorded at Ballincollig Regional Park, with their distribution in Ireland and the percentage cover recorded across four habitat layers with invasive alien species highlighted. Simpson's Index and species richness are also calculated.

Scietific name	Common name	Naming authority	Distribution	Mixed broadleaved woodland				Dry meadow				Pedunculate oak-ash woodland			
				H	S	U/S	C	H	S	U/S	C	H	S	U/S	C
Rubus fruticosus	Bramble	L	Common and Widespread	10	0	0	0	0	0	0	0	0	0	0	0
Asplenium scolopend	Hart's Tongue Fern	L	Common and Widespread	20	0	0	0	0	0	0	0	0	0	0	0
Hedera helix	Ivy	L	Common and Widespread	30	0	0	0	0	0	0	0	0	0	0	0
Geum urbanum	Wood Avens	L	Common and Widespread	1	0	0	0	0	0	0	0	0	0	0	0
Ilex aquifolium	Holly	L	Common and Widespread	5	0	0	0	0	0	0	0	0	0	0	0
Dryopteris filix-mas	Male Fern	Schott	Common and Widespread	0	40	0	0	0	0	0	0	0	0	0	0
Ilex aquifolium	Holly	L	Common and Widespread	0	20	0	0	0	0	0	0	0	0	0	0
Acer pseudoplatanus	Sycamore	L	Common and Widespread	0	5	0	0	0	0	0	0	0	0	0	0
Crataegus monogyn	Whitethorn	Jacq	Common and Widespread	0	5	0	0	0	0	0	0	0	0	0	0
Anthriscus sylvestris	Cow Parsely	L	Common and Widespread	0	1	0	0	0	0	0	0	0	0	0	0
Ulmus glabra	Elm	Huds	Common and Widespread	0	1	0	0	0	0	0	0	0	0	0	0
Laurus nobilis	Laurel	L	Established	0	1	0	0	0	0	0	0	0	0	0	0
Crataegus monogyn	Whitethorn	Jacq	Common and Widespread	0	0	30	0	0	0	0	0	0	0	0	0
Ilex aquifolium	Holly	L	Common and Widespread	0	0	30	0	0	0	0	0	0	0	0	0
Acer pseudoplatanus	Sycamore	L	Common and Widespread	0	0	2	0	0	0	0	0	0	0	0	0
Ulmus glabra	Elm	Huds	Common and Widespread	0	0	1	0	0	0	0	0	0	0	0	0
Fraxinus excelsior	European Ash	L	Common and Widespread	0	0	0	40	0	0	0	0	0	0	0	0
Crataegus monogyn	Whitethorn	Jacq	Common and Widespread	0	0	0	20	0	0	0	0	0	0	0	0
Acer pseudoplatanus	Sycamore	L	Common and Widespread	0	0	0	10	0	0	0	0	0	0	0	0
Ilex aquifolium	Holly	L	Common and Widespread	0	0	0	10	0	0	0	0	0	0	0	0
Centaurea nigra	Common Knapweed	L	Common and Widespread	0	0	0	0	1	0	0	0	0	0	0	0
Plantago lanceolata	Narrowleaf Plantain	L	Common and Widespread	0	0	0	0	10	0	0	0	0	0	0	0
Rhinanthus minor	Yellow Rattle	L	Common and Widespread	0	0	0	0	10	0	0	0	0	0	0	0
Ranunculus acris	Meadow Buttercup	L	Common and Widespread	0	0	0	0	1	0	0	0	0	0	0	0
Trifolium pratense	Red Clover	L	Common and Widespread	0	0	0	0	1	0	0	0	0	0	0	0
Filipendula ulmaria	Meadow Sweet	L	Common and Widespread	0	0	0	0	20	0	0	0	0	0	0	0
Lathyrus pratensis	Meadow Vetchling	L	Common and Widespread	0	0	0	0	1	0	0	0	0	0	0	0
Taraxacum officinale	Dandelion	Porter	Common and Widespread	0	0	0	0	1	0	0	0	0	0	0	0
Agrostis capillaris	Common Bent	L	Common and Widespread	0	0	0	0	10	0	0	0	0	0	0	0
Anthoxanthum odor	Sweet Vernal Grass	L	Common and Widespread	0	0	0	0	20	0	0	0	0	0	0	0
Holcus lanatus	Yorkshire Fog	L	Common and Widespread	0	0	0	0	20	0	0	0	0	0	0	0
Odontites vernus	Red Bartsia	Dumort	Common and Widespread	0	0	0	0	1	0	0	0	0	0	0	0
Carex remota	Remote Sedge	L	Common and Widespread	0	0	0	0	0	0	0	0	40	0	0	0
Ranunculus repens	Creeping Buttercup	Kurtz	Common and Widespread	0	0	0	0	0	0	0	0	10	0	0	0
Poaceae spp	Grass	L	Common and Widespread	0	0	0	0	0	0	0	0	10	0	0	0
Lysimachia nummula	Creeping Jenny	L	Common and Widespread	0	0	0	0	0	0	0	0	10	0	0	0
Solanum dulcamara	Climbing Nightshade	L	Common and Widespread	0	0	0	0	0	0	0	0	10	0	0	0
Polypodium vulgare	Polypody Fern	L	Common and Widespread	0	0	0	0	0	0	0	0	1	0	0	0
Chrysosplenium opp	Opposite-Leaved Go	L	Common locally	0	0	0	0	0	0	0	0	1	0	0	0
Dryopteris filix-mas	Male Fern	Schott	Common and Widespread	0	0	0	0	0	0	0	0	1	0	0	0
Equiseteum arvense	Horsetail	L	Common and Widespread	0	0	0	0	0	0	0	0	0	1	0	0
Luzula sylvatica	Great Wood Rush	Huds	Common and Widespread	0	0	0	0	0	0	0	0	0	30	0	0
Rubus odoratus	Purple Flowering Ra	L	Occasional, ornamental	0	0	0	0	0	0	0	0	0	10	0	0
Fraxinus excelsior	European Ash	L	Common and Widespread	0	0	0	0	0	0	0	0	0	20	0	0
Salix caprea	Pussy Willow	L	Common and Widespread	0	0	0	0	0	0	0	0	0	0	0	50
Fraxinus excelsior	European Ash	L	Common and Widespread	0	0	0	0	0	0	0	0	0	0	0	30
Crataegus monogyn	Whitethorn	Jacq	Common and Widespread	0	0	0	0	0	0	0	0	0	0	0	20
Simoson index of diversity				0.695592	0.614749	0.545225	0.65625	0.82207	0	0	0	0.709247	0.623488	0	0.62
Species richness				5	7	4	4	12	0	0	0	8	4	0	3

3.1.1.6 The Glen River Park

Three sub-habitats were present in the Glen River Park- dry meadow, mixed broadleaved woodland, and reed and large sedge swamp. Dry meadow was present at the eastern end of the park and comprised 0.15% of the total park area (Table 3.1, Fig. 3.12, 3.13). Mixed broadleaved woodland was present along the northern border of the park and made up 0.13% of the total park area (Table 3.1, Fig. 3.12, 3.13). Lastly, reed and large sedge swamp is present in the centre of the park around the Glen River. Surveying took place at the southernmost part of this sub-habitat which comprises 3.1% of the park (Table 3.1, Fig. 3.12, 3.13).

Dry meadow habitat in the park was mostly comprised of unknown grass species. These were unidentifiable due to being recently mown while other species present included meadow buttercup (*Ranunculus acris*), white clover (*Trifolium repens*) and common plantain (*Plantago major*). Species richness for this sub-habitat was comparatively low to other meadows survey, however the degree of heterogeneity was high (0.82) (Table 3.8)

The mixed broadleaved woodland sub-habitat canopy was completely homogenous, consisting of sycamore alone, while no species were present in the understory layer (Table 3.8). The shrub layer was composed of just two species, cow parsley and male fern while the herb layer consisted of four species including meadow buttercup, ivy, and grass species. Though the herb layer had a low species richness, species evenness was high (Table 3.8).

Finally, reed and large sedge habitat consisted mostly of Bulrush (*Typha latifolia*) in the shrub layer followed by bush grass, a species which is classified as threatened: vulnerable in Ireland. This habitat layer had a moderate degree of diversity (0.54) and a low species richness. Common and widespread species were present in the herb layer of the sub-habitat in small quantities with a species richness of 5 and diversity index of 0.73, indicating a moderately high degree of heterogeneity in this layer (Table 3.8).

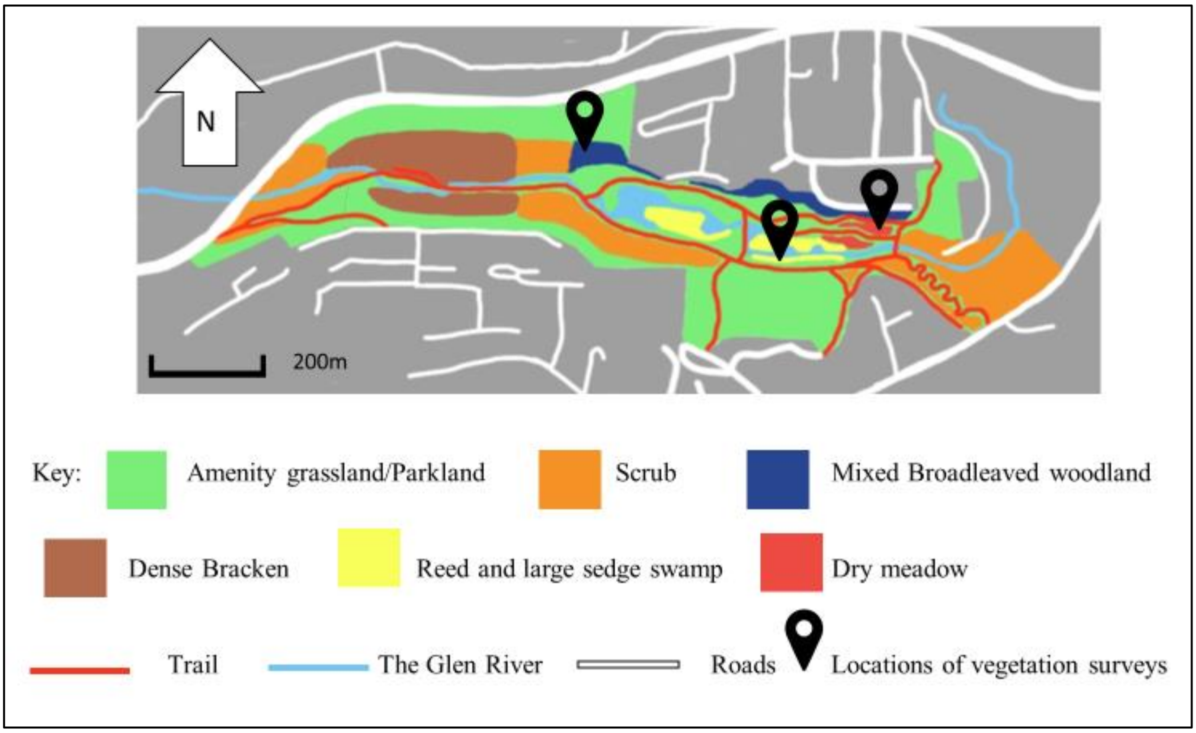


Figure 3.12. Map of The Glen River Park showing habitats, trails and locations of vegetation surveys.

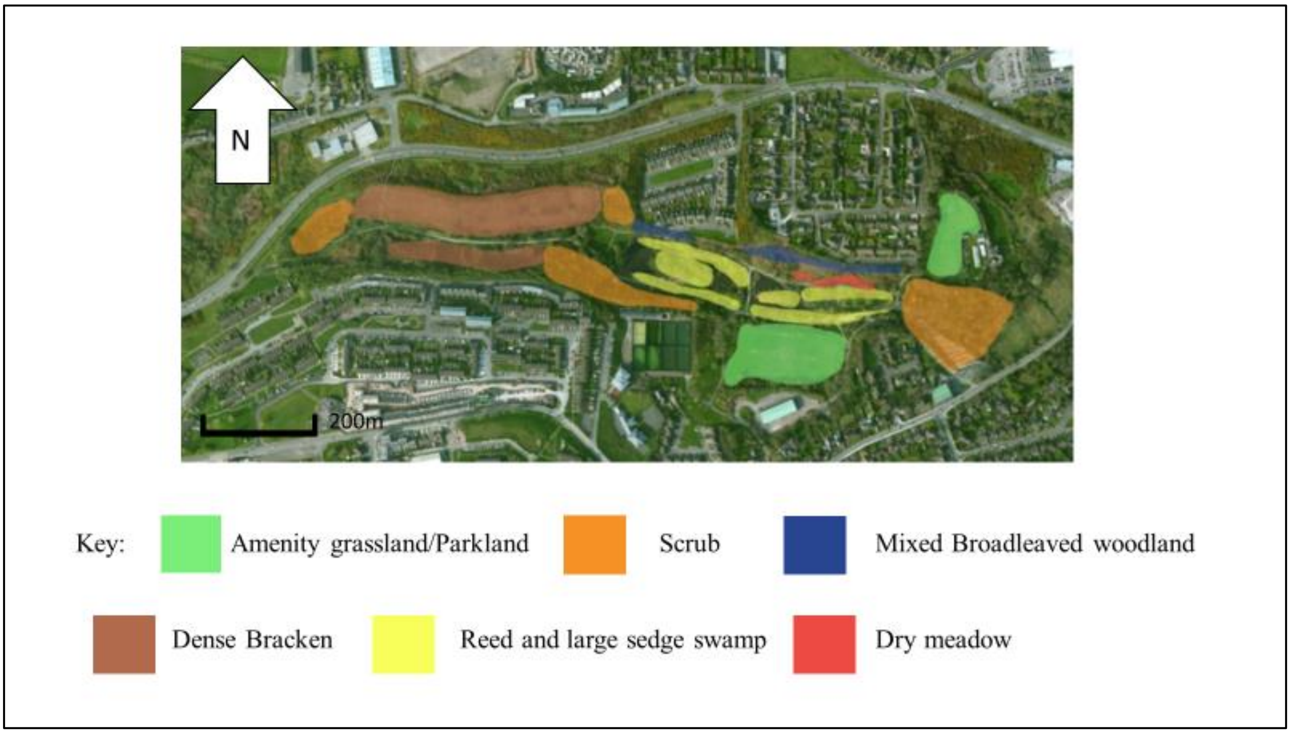


Figure 3.13. Aerial photograph (2011-2013) of The Glen River Park with colour overlay of habitats present (OSI)

Table 3.8. Vegetation species recorded at Beaumont Quarry, with their distribution in Ireland and the percentage cover recorded across four habitat layers. Simpson's Index and species richness are also calculated.

				Dry meadow				Mixed broadleaved woodland				Reed and large sedge swamp			
Scientific name	**Common name**	**Naming authority**	**Distribution**	H	S	U/S	C	H	S	U/S	C	H	S	U/S	C
Ranunculus acris	Meadow Buttercup	L	Common and Widespread	0	0	0	0	0	0	0	0	5	0	0	0
Stachys palustris	Marsh Woundwort	L	Common and Widespread	0	0	0	0	0	0	0	0	5	0	0	0
Mentha arvensis	Corn Mint	L	Common and Widespread	0	0	0	0	0	0	0	0	5	0	0	0
Urtica dioica	Nettle	L	Common and Widespread	0	0	0	0	0	0	0	0	1	0	0	0
Plantago major	Common Plantain	L	Common and Widespread	0	0	0	0	0	0	0	0	1	0	0	0
Phleum pratense	Timothy	L	Common and Widespread	0	0	0	0	0	0	0	0	0	5	0	0
Calamagrostis epige	Bush Grass	L	Threatened: Vulnerable	0	0	0	0	0	0	0	0	0	20	0	0
Epilobium hirsutum	Great Hairy Willow H	L	Common and Widespread	0	0	0	0	0	0	0	0	0	10	0	0
Typha latifolia	Bulrush	L	Common and Widespread	0	0	0	0	0	0	0	0	0	60	0	0
Ranunculus acris	Meadow Buttercup	L	Common and Widespread	15	0	0	0	0	0	0	0	0	0	0	0
Trifolium repens	White Clover	L	Common and Widespread	10	0	0	0	0	0	0	0	0	0	0	0
Anthriscus sylvestris	Cow Parsely	L	Common and Widespread	5	0	0	0	0	0	0	0	0	0	0	0
Plantago major	Common Plantain	L	Common and Widespread	10	0	0	0	0	0	0	0	0	0	0	0
Holcus lanatus	Yorkshire Fog	L	Common and Widespread	10	0	0	0	0	0	0	0	0	0	0	0
Rumex obtusifolius	Dock	L	Common and Widespread	5	0	0	0	0	0	0	0	0	0	0	0
Rubus fruticosus	Bramble	L	Common and Widespread	5	0	0	0	0	0	0	0	0	0	0	0
Urtica dioica	Nettle	L	Common and Widespread	5	0	0	0	0	0	0	0	0	0	0	0
Poaceae spp	Grass	L	Common and Widespread	35	0	0	0	0	0	0	0	0	0	0	0
Ranunculus acris	Meadow Buttercup	L	Common and Widespread	0	0	0	0	30	0	0	0	0	0	0	0
Poaceae spp	Grass	L	Common and Widespread	0	0	0	0	30	0	0	0	0	0	0	0
Hedera helix	Ivy	L	Common and Widespread	0	0	0	0	30	0	0	0	0	0	0	0
Holcus lanatus	Yorkshire Fog	L	Common and Widespread	0	0	0	0	10	0	0	0	0	0	0	0
Anthriscus sylvestris	Cow Parsely	L	Common and Widespread	0	0	0	0	0	5	0	0	0	0	0	0
Dryopteris filix-mas	Male Fern	Schott	Common and Widespread	0	0	0	0	0	5	0	0	0	0	0	0
Acer pseudoplatanu	Sycamore	L	Common and Widespread	0	0	0	0	0	0	0	100	0	0	0	0
Simoson index of diversity				0.815	0	0	0	0.72	0.5	0	0	0.733564	0.542936	0	0
Species richness				9	0	0	0	4	2	0	1	5	4	0	0

Table 3.9. Summary of species richness and Simpsons Index of diversity for six Cork City parks where H stands for herb layer, S stands for shrub layer, U/S stands for understory, and C stands for canopy.

Park	Measurement	Dry Meadow				Mixed Broadleaved Woodland				Scrub				Pedunculate Oak-Ash Woodland				Large Reed and Sedg Swamp			
		H	S	U/S	C	H	S	U/S	C	H	S	U/S	C	H	S	U/S	C	H	S	U/S	C
Beaumont	Simpson index of diversity	0.784668779	0	0	0	0.149985	0.28	0	0.58	0	0	0	0	0	0	0	0	0	0	0	0
	Species richness	19	1	0	0	15	4	0	2	1	0	1	0	0	0	0	0	0	0	0	0
Ballybrack	Simpson index of diversity	0.566648199	0	0	0	0.536777	0.64	0	0.46	0.778207	0.585	0.345679	0.567901	0	0	0	0	0	0	0	0
	Species richness	9	0	0	0	4	3	1	3	9	4	2	3	0	0	0	0	0	0	0	0
Glen	Simpson index of diversity	0.815	0	0	0	0.72	0.5	0	0	0	0	0	0	0	0	0	0	0.733564	0.542936	0	0
	Species richness	9	0	0	0	4	2	0	1	0	0	0	0	0	0	0	0	5	4	0	0
Marina	Simpson index of diversity	0.566648199	0	0	0	0.517003	0	0.375	0.567901	0	0	0	0	0	0	0	0	0	0	0	0
	Species richness	18	0	0	0	19	1	18	3	0	0	0	0	0	0	0	0	0	0	0	0
Tramore	Simpson index of diversity	0.811111111	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Species richness	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ballincollig	Simpson index of diversity	0.822069943	0	0	0	0.695592	0.614749	0.545225	0.65625	0	0	0	0	0.709247	0.623488	0	0.62	0	0	0	0
	Species richness	12	0	0	0	5	7	4	4	0	0	0	0	8	4	0	3	0	0	0	0

3.1.1.7 Qualitative vegetation data

From the species identified it was also possible to determine the quality of some of the chosen habitats using indicator species. Indicator species are species which have niche preferences and therefore can be used as ecological indicators for environmental changes, community types, or in this case, habitat conditions (Niemi & McDonald, 2004). For example, in the dry meadow habitat Birdsfoot Trefoil (*Lotus corniculatus*) and Yellow Rattle (*Rhinanthus* minor) were identified. Both of these plants are indicators of high-quality dry meadow and were identified in Tramore Valley Park and Ballincollig Regional Park respectively. Other species which were identified such as Meadow Foxtail (*Alopecurus pratensis*), Common Knapweed (*Centaurea nigra*), Wild Carrot (*Daucus carota*), Meadowsweet (*Filipendula ulmaria*), Meadow Vetchling (*Lathyrus pratensis*), Narrowleaf Plantain (*Plantago lanceolata*), Meadow Buttercup (*Ranunculus acris*), and Red Clover (*Trifolium pratense*) are positive indicator species of this habitat type and were identified in every dry meadow habitat surveyed (Hamilton *et al.*, 2020).

In the pedunculate oak-ash woodland, species such as Remote Sedge (*Carex remota*), Creeping Buttercup (*Ranunculus repens*), Climbing Nightshade (*Solanum dulcamara*), European Ash (*Fraxinus excelsior*), Pussy Willow (*Salix caprea*), and Whitethorn (*Crataegus monogyna*) were identified. These species are all positive indicators of a high quality pedunculate oak-ash woodland (O'Neill & Barron, 2013).

Finally, all of the mixed-broadleaved woodland habitats surveyed contain indicator species for high quality woodland. Natural or 'ancient' woodland is very rare in Ireland and most tree stands have been managed or modified to some extent by humans over time and so the term semi-natural is used for stands that resemble potential natural woodland cover (Fossit, 2000). Indicator species identified included Aspen (*Populus tremula*), Elm (*Ulmus glabra*), Wood False Brome (*Brachipodium sylvaticum*), Herb Robert (*Geranium robertarium*), Wood Avens (*Geum urbanum*), Ivy (*Hedera helix*), and Blackthorn (*Prunus spinosa*). Beaumont Quarry had the most indicator species for ancient woodland with four, followed by Ballincollig Regional Park and the Marina Park with three, Ballybrack woods with 2 and the Glen River Park with 1.

There were no habitat quality plant species indicator lists for Scrub or wetland.

Several of the species identified across the six parks are also less common across Ireland including the threatened Bush grass (*Calamagrostis epigejos*), Wood sedge (*Carex remota*) which is very rare, Lucerne (*Medicago sativa*) which is nationally scarce, and St. Georges Mushroom (*Calocybe gambosa*) which is infrequent. Other species identified such as Rough Hawkbit (*Leontodon hispidus*), European Brooklime (*Veronica beccabunga*), and Opposite-leaved Golden Saxifrage (*Chrysosplenium oppositifolium*) are all locally common but not widespread.

3.2 People

3.2.1 Park User Questionnaire

3.2.1.1 Demographic Information

There were a total of 82 questionnaire participants across the five parks involved in this study. The majority of users were under the age of 50, female, and did not have children with them at the time of participation (Table 3.10).

Table 3.10. Demographic information of park users who answered park user questionnaire with further breakdown of age and gender of users.

Demographic information of park users (n=82)							
Age				Gender		Children Present	
0-24	25-49	50-74	75+	Male	Female	Children present	No children present
31	30	18	3	31	51	20	62

Demographic information of park users (n=82)				
	Age			
Gender	0-24	25-49	50-75	75+
Male	6	13	10	2
Female	25	17	8	1

3.2.1.2 Park Usage

We tested the hypotheses that the distribution of park use for the selected categories was the same across the Likert scale (1 = not at all, 2 = to a small extent, 3 = to some extent, 4 = to a moderate extent, 5 = to a large extent).

Participants' park use for the enjoyment of the natural environment was compared using a Chi square test. The test showed that there was no significant difference between levels of enjoyment (X^2 (16) = 20.00, p = 0.220). Five, "use to a large" extent was most commonly selected by participants and responses follow a right-skewed distribution (Fig 3.14). Responses were not statistically different when divided by gender and age (X^2 *Users under 50* = (16) = 20.00, p = 0.220, X^2 *Users over 50* = (16) = 20.00, p = 0.220, X^2 *male users* = (12) = 15.00, p = 0.241), X^2 *female users* = (16) = 20.00, p = 0.220) however, an outlier was present for female users under the age of 50 at 3, "use to some extent" (Fig. 3.15).

Next, commuting data was tested to determine if there was a significant difference across the Likert scale. The test showed that the distribution of commuters was the same across the scale however, the majority of participants chose 1, indicating that they do not use the at all for commuting (X^2 = (12) = 15.00, p = 0.241) (Fig 3.14). When this dataset is divided by gender and age, responses showed no significant differences (X^2 *Users under 50* = (16) = 20.00, X^2 *Users over 50* = (8)= 10.00, p=0.265, X^2 *female users*= (12) = 15.00, p = 0.241, X^2 *male users*= (12) = 15.00, p = 0.241) however, an outlier was present female users under the age of 50 who notably chose "use to a moderate extent" frequently (Fig. 3.15).

Thirdly, the distribution of participant responses for using the park for their sense of well-being was determined to not be significant across the Likert scale (X^2 = (16) = 20.00, p = 0.220). Use to a large extent was chosen most frequently by participants with data distributed negatively (Fig 3.14). Further testing showed that there was no significant difference in responses when age and gender were considered (X^2 *Users under 50* = (16) = 20.00, p = 0.220, X^2 *Users over 50*= (12) = 15.00, p = 0.241, X^2 *female users* = (16) = 20.00, p = 0.220, X^2 *male users* = (12) = 15.00, p = 0.241). No non-significant differences were present in this data (Fig. 3.15).

Responses for dog walking were tested to determine if there was a significant difference in the distribution of results across the Likert scale and it was determined that there was not (X^2= (16) = 20.00, p = 0.220). The histogram which represents this dataset has a non-symmetrical bimodal distribution with peaks at 1, which is most commonly chosen by users, and 5, which is the second most chosen option (Fig 3.14). Responses were not significantly different when divided by age and gender (X^2 *users under 50*= (16) = 20.00, p = 0.220, X^2 *Users over 50*= (12) = 15.00, p=0.241, X^2 *female users* = (16) = 20.00, p = 0.220, X^2 *male users* = (12) = 15.00, p = 0.241), however, when this data is represented graphically, the second mode at 5 was shown to be representative of a cohort of female users under the age of 50 (Fig. 3.15).

Participants' park use for escaping crowds and city living was compared using a Chi-Square test and it was determined that there was no significant difference in the participants responses across the Likert scale (X^2= (16) = 20.00, p = 0.220). The distribution of this dataset was negatively distributed with a non-significant majority of users choosing 5, use to a large extent (Fig 3.14). Gender and age had no effect on the distribution of this dataset (X^2 *users under 50*= (16) = 20.00, p = 0.220, X^2 *users over 50* = (8) = 10.00, p = 0.265, X^2 *female users* = (16) = 20.00, p = 0.220, X^2 *male users* = (16) = 20.00, p = 0.220) (Fig. 3.15).

The distribution of participant responses for taking children to the park showed no significant variation across the Likert scale (X^2 = (12) = 15.00, p=0.241) represented as a histogram with a positive skew (Fig 3.14). Gender and age was found to have no effect on the distribution of these results (X^2 *users under 50*= (16) = 20.00, p = 0.220, X^2 *users over 50* (12) = 15.00, p=0.241, X^2 *female users* = (12) = 15.00, p=0.241, X^2 *male users* = (16) = 20.00, p = 0.220) (Fig. 3.15).

The distribution of participants responses in regard to use of the park as a place to exercise showed no significant difference across the Likert scale (X^2= (16) = 20.00, p = 0.220). This dataset was represented by a symmetric bimodal histogram, with the majority of users choosing 2 and 5 respectively (Fig. 3.14). The two modes present in this figure reflect the gender and age of users, where the first mode, located at 2 represents the majority of females under 50 years of age, while the second mode located at 5, is representative of a mixture of all users (X^2 *users under 50*= (12) = 15.00, p=0.241, X^2 *users over 50* = (8) = 10.00, p = 0.265, X^2 *female users* = (12) = 15.00, p=0.241, X^2 *male users* = (16) = 20.00, p = 0.220) (Fig. 3.15).

Finally, Chi-Square test showed that there was no significant difference in the distribution of participants who use the park as a place to meet people across the Likert scale (X^2= (16) =

20.00, p = 0.220). "Use to a small extent" was chosen most frequently by participants and the distribution across the scale is random (Fig 3.14). When this dataset is divided by age and gender it shows that the peak of data at 2 is representative of female users under the age of 50, while the majority of male users over the age of 50 chose 3, use to some extent. Female users over the age of 50 most commonly chose 1, therefore not using the park at all as a meeting place while male users most commonly chose 4, to a moderate extent, however none of these results were statistically significant (X^2 *users under 50*= (12) = 15.00, p=0.241, X^2 *users over 50* = (8) = 10.00, p = 0.265, X^2 *female users* = (16) = 20.00, p = 0.220, X^2 *male users* = (12) = 15.00, p=0.241).

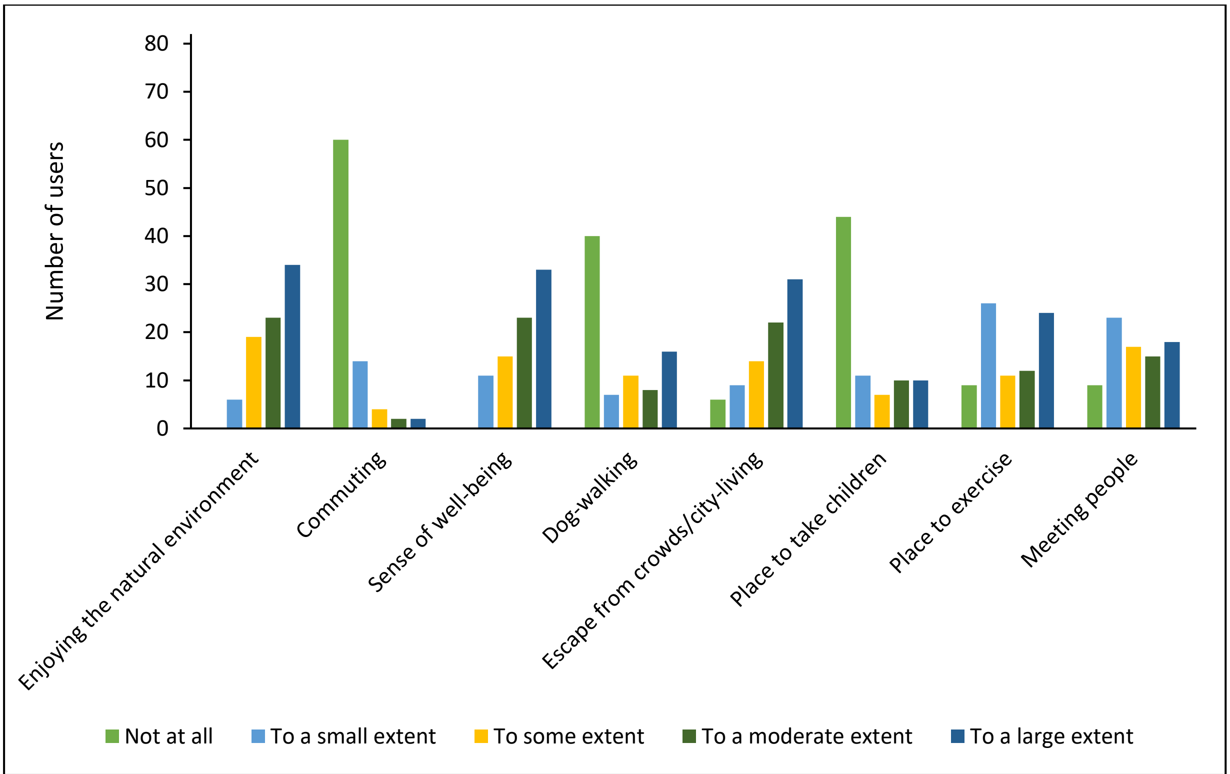


Figure 3.14. Reasons for park usage with activities on the x-axis and the number of users on the y-axis (n=82).

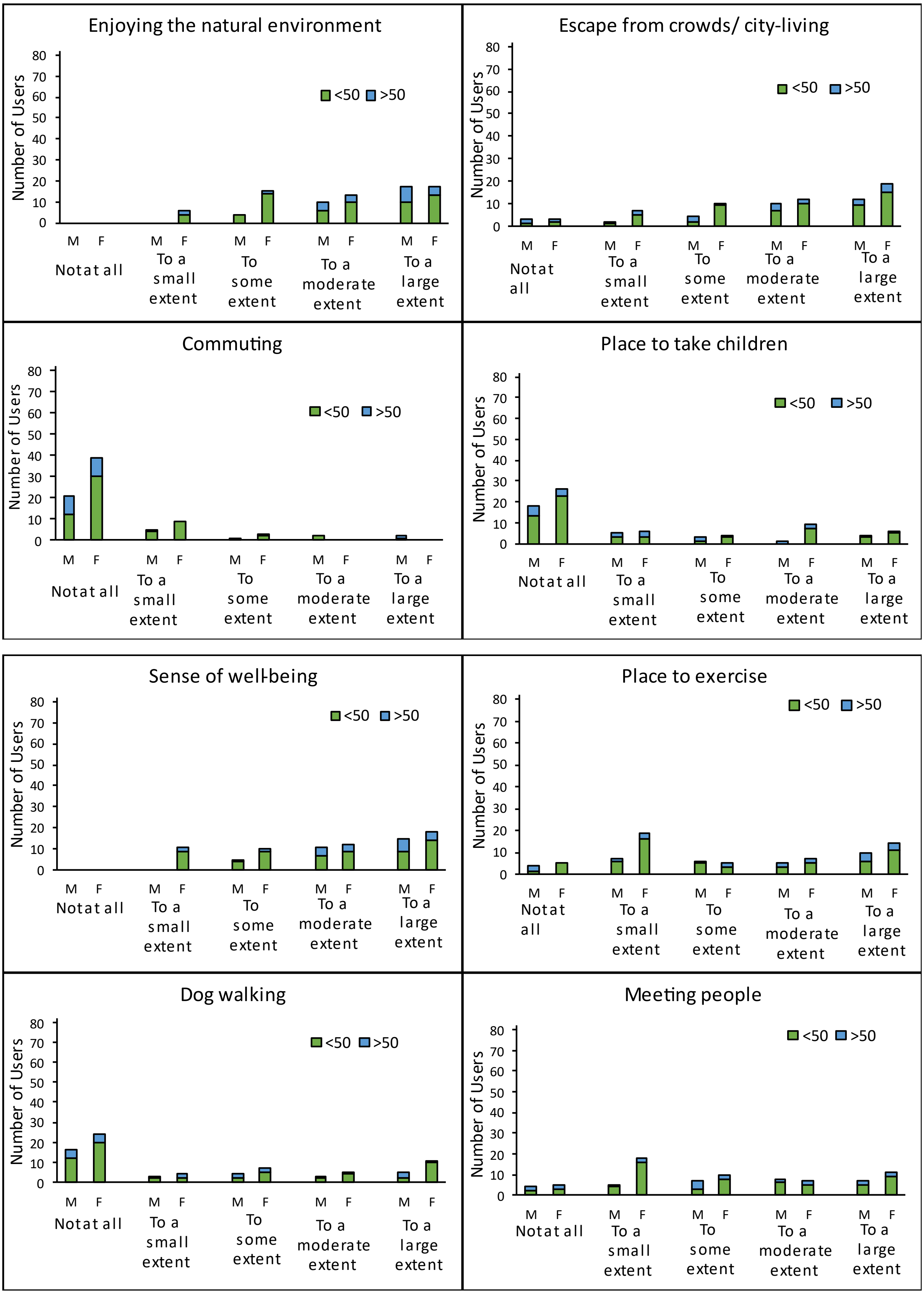


Figure 3.15. Reasons for use of urban parks with participants responses broken down by gender and age.

3.2.1.3 The Natural Environment

A chi-square test was used to determine if there was a significant difference in the distribution of answers regarding enjoyment of birds in urban parks. No significant difference was present in the distribution of the dataset across the Likert scale (X^2= (16) = 20.00, p = 0.220). This dataset has a negative distribution, and therefore the majority of users chose 5, enjoy to a large extent. (Fig. 3.16). Dividing this dataset by gender and age has no significant impact on the results (X^2 *users under 50*= (16) = 20.00, p = 0.220, X^2 *users over 50*= (12) = 15.00, p = 0.241, X^2 *female users*= (16) = 20.00, p = 0.220, X^2 *male users*= (12) = 15.00, p = 0.241) (Fig 3.17).

The distribution of responses regarding the enjoyment of wild mammals was tested for significant differences using a Chi-Square test. The test showed that there was no significant difference in the distribution of responses (X^2= (16) = 20.00, p = 0.220), with a non-significant majority of responders choosing 5, enjoy to a large extent which was represented graphically as a positively skewed histogram. A notable outlier was present at 1, enjoy not at all (Fig. 3.16). When this dataset was divided by the gender and age of responders, this outlier was representative of a cohort of female users under the age of 50 (Fig 3.17), however this difference was not significant (X^2 *users under 50*= (16) = 20.00, p = 0.220, X^2 *users over 50*= (12) = 15.00, p = 0.241, X^2 *female users* = (16) = 20.00, p = 0.220, X^2 *male users* = (12) = 15.00, p = 0.241).

Park user opinions on insects were tested to determine if the distribution of responses varied across the Likert scale. The test showed that there was no significant difference between responses for insects (X^2= (16) = 20.00, p = 0.220). A non-significant majority of users chose 5, enjoy to a large extent as represented by the negatively skewed histogram (Fig. 3.16). Gender and age were found to have no influence on user's opinions (X^2 *users under 50*= (16) = 20.00, p = 0.220, X^2 *users over 50*= (12) = 15.00, p = 0.241, X^2 *female users* = (12) = 15.00, p = 0.241, X^2 *male users* = (12) = 15.00, p = 0.241).

Park user's enjoyment of flowers was the next element of the natural environment to be tested. A chi square test determined that there was no significant difference in the distribution of answers given by questionnaire participants in regard to flowers (X^2= (16) = 20.00, p = 0.220). The distribution of this dataset peaks at 5 with a clear negative skew (Fig. 3.16). Gender and age has no effect in this dataset (X^2 *users under 50* = (12) = 15.00, p = 0.241, X^2 *users over 50* = (12) = 15.00, p = 0.241, X^2 *female users* (12) = 15.00, p = 0.241, X^2 *male users* (12) = 15.00, p = 0.241) (Fig. 3.17).

The distribution of responses from participants regarding trees was the next element of the natural environment to be tested. A chi-square test determined that there was no significant in the distribution of responses from park visitors across the Likert scale (X^2= (12) = 15.00, p = 0.241). This dataset has a strong negative skew and is the element of the natural environment that showed the most consensus among participants (Fig. 3.16). When this dataset is divided by the gender and ages of users it showed that users over 50 and male users were only present at the end of the scale with increasing levels of enjoyment of trees while the data at the lower end of the scale represented a cohort of female users under the age of 50 (Fig. 3.17), however these results were not statistically significant (X^2 *users under 50*= (16) = 20.00, p = 0.220, X^2 *users over 50* = (12) = 15.00, p = 0.241, X^2 *female users* = (16) = 20.00, p = 0.220, X^2 *male users* (12) = 15.00, p = 0.241).

Water features such as rivers and ponds were the next element of the natural environment of urban parks to be tested for significant differences in the distribution of responses. A chi-square test determined that there was no significant difference in responses from park users (X^2= (16) = 20.00, p = 0.220). Graphically this data is represented by a negatively skewed histogram (Fig. 3.16) with the majority of users enjoying this element "to a large extent". Male users and users over the age of 50, are entirely represented by the data in the cohort of responses between 3 and five, while female users under the age of fifty are represented across the entirety of the Likert scale (X^2 *users under 50* = (12) = 15.00, p = 0.241, X^2 *users over 50* = (12) = 15.00, p = 0.241, X^2 *female users* = (16) = 20.00, p = 0.220, X^2 *male users* (12) = 15.00, p = 0.241). (Fig. 3.17).

The enjoyment of areas of grassland were determined to have no significant differences in the responses of users across the Likert scale (X^2= (16) = 20.00, p = 0.220) and this dataset is represented by a randomly distributed histogram with the majority of users choosing 5, enjoy to a large extent (Fig. 3.16). When responses for this dataset are divided by age and gender, results show that users over the age of fifty are represented by scale options 3, 4, and 5 with the majority of female users over 50 choosing "to a large extent" and the majority of male users over 50 chose 3, to some extent. Male users under the age of 50 most commonly chose "enjoy to a large extent", and while female users under 50 chose this option most often too, their responses are more spread across the scale (Fig. 3.16). These results were not statistically significant (X^2 *users under 50* = (16) = 20.00, p = 0.220, X^2 *users over 50* = (12) = 15.00, p = 0.241, X^2 *female users* = (16) = 20.00, p = 0.220, X^2 *male users* = (16) = 20.00, p = 0.220).

The distribution of responses from questionnaire participants regarding woodlands in urban parks also showed no significant difference across the Likert scale (X^2 = (12) = 15.00, p = 0.241). This data is represented by a negatively skewed histogram (Fig. 3.16) with the majority of users choosing 5, enjoy to a large extent. When this dataset is divided by the age and gender of users, it shows that male users and users over 50 are entirely represented by the scale options 3, 4, and 5, with the majority of both choosing 5, enjoy to a large extent. Female users under the age of fifty are present at all stages of the scale and are the only users present at options 1 and 2, though in small amounts (Fig. 3.17). However, these results are not statistically significant (X^2 *users under 50* = (8) = 10.00, p = 0.265, X^2 *users over 50*= (12) = 15.00, p = 0.241, X^2 *female users* = (8) = 10.00, p = 0.265, X^2 *male users* (12) = 15.00, p = 0.241). (Fig. 3.17).

The ninth element of the natural environment was the enjoyment of fresh air in urban parks. It was determined that there was no significant difference in responses from participants across the Likert scale (X^2 = (16) = 20.00, p = 0.220). This dataset is represented by a randomly distributed histogram with the majority of users choosing 5, enjoy to a large extent (Fig. 3.16). When this dataset is divided by gender and age, options 3 and 4 are almost exclusively chosen by users under the age of 50, while most users over 50 chose options 2 and 5 (Fig. 3.17) however, these results were not of statistical significance (X^2 *users under 50* = (16) = 20.00, p = 0.220, X^2 *users over 50*= (12) = 15.00, p = 0.241, X^2 *female users* = (16) = 20.00, p = 0.220, X^2 *male users* (12) = 15.00, p = 0.241).

The penultimate element in this section, peace and quiet, was determined to show no significant difference in distribution across the Likert scale (X^2 = (16) = 20.00, p = 0.220). This data is represented by a negatively skewed histogram (Fig. 3.16). Age and gender had no significant effect on the distribution of this data (X^2 *users under 50* = (16) = 20.00, p = 0.220, X^2 *users over 50*= (12) = 15.00, p = 0.241, X^2 *female users* = (16) = 20.00, p = 0.220, X^2 *male users* (12) = 15.00, p = 0.241) (Fig. 3.17).

Finally, the distribution of responses for enjoyment of natural sounds were tested using a chi-square test. It was determined that there was no significant difference in the distribution of responses across the Likert scale (X^2 = (16) = 20.00, p = 0.220). This dataset is represented by a negatively skewed histogram (Fig. 3.16). Aside from the majority of users of all cohorts choosing 5, enjoy to a large extent, male users over the age of 50 chose “enjoy to some extent” (3) often, while female users over 50 often chose “enjoy to a moderate extent”. Options 1 and

2 were chosen most commonly by users under 50 (Fig. 3.17) however, these results were not statistically significant (X^2 *users under 50* = (16) = 20.00, p = 0.220, X^2 *users over 50*= (12) = 15.00, p = 0.241, X^2 *female users* = (16) = 20.00, p = 0.220, X^2 *male users* = (16) = 20.00, p = 0.220).

All elements of the natural environment of the park are enjoyed by the majority of urban park users, with no differentiation between elements (Fig 3.16).

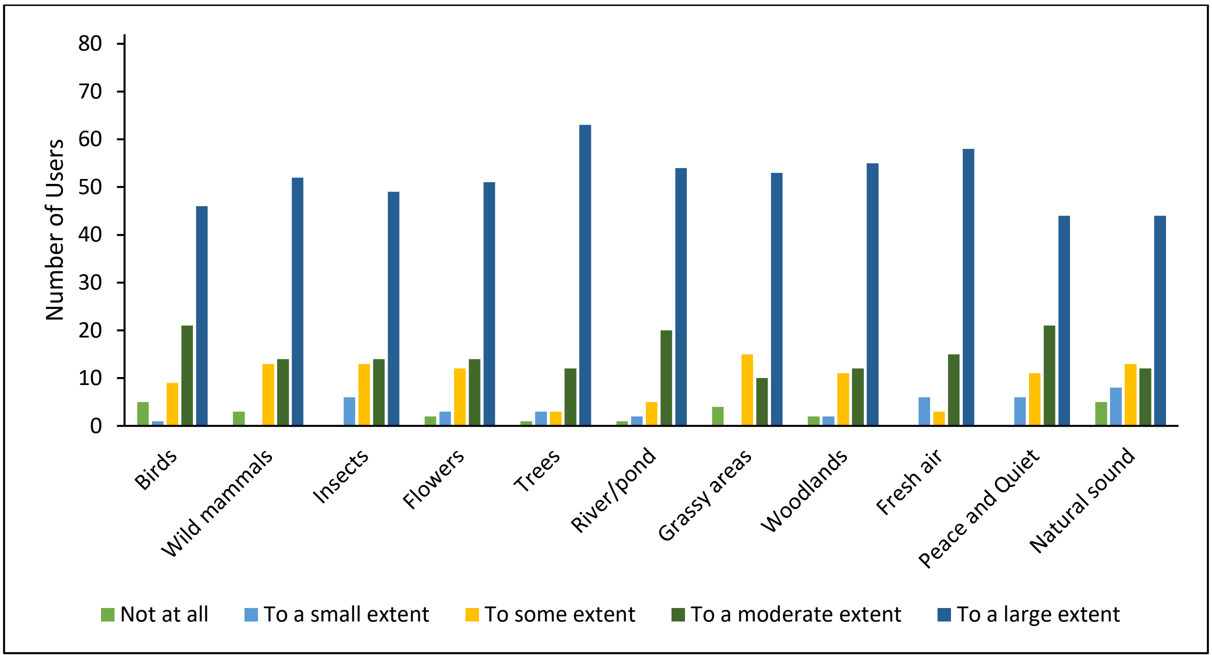
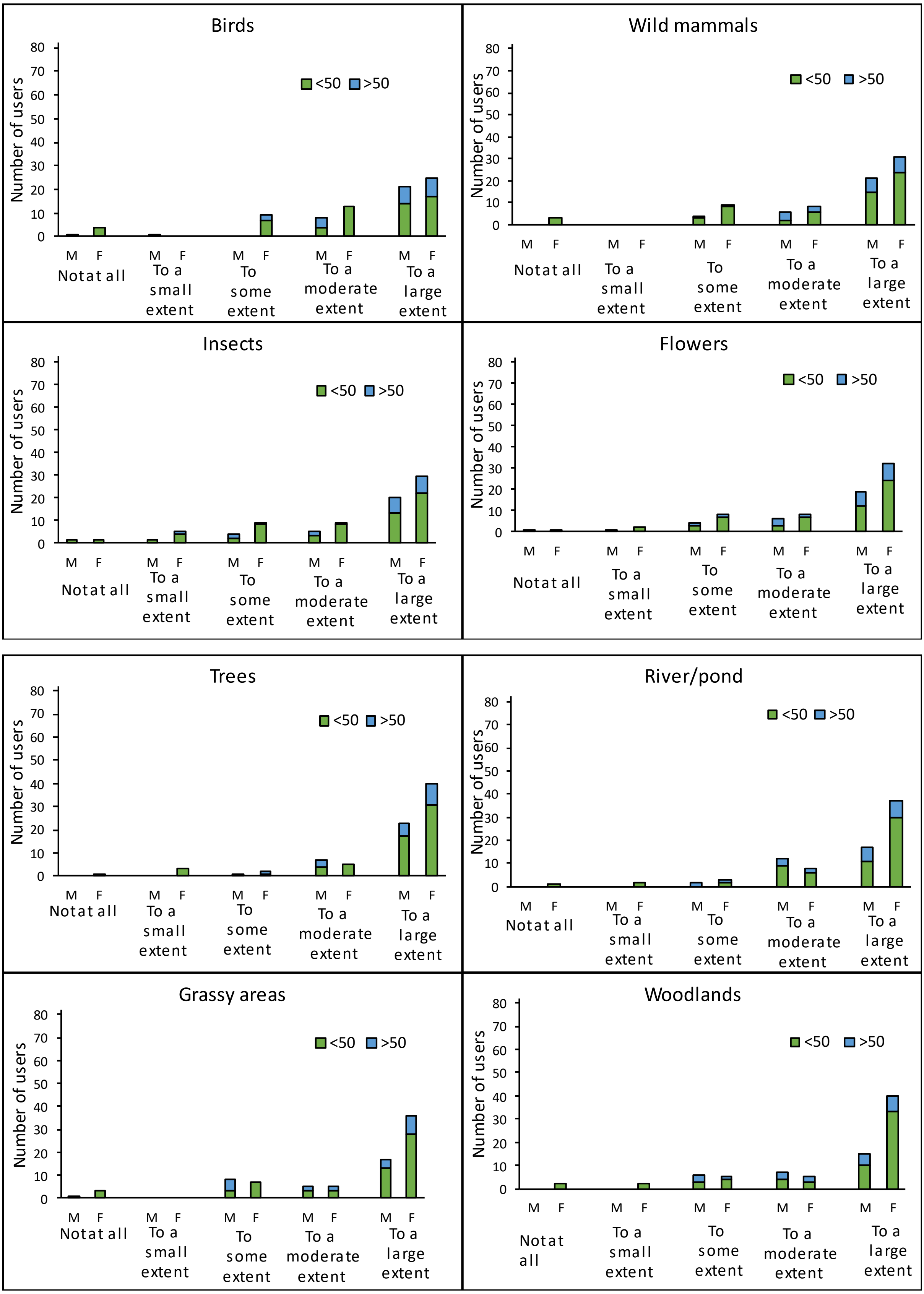


Figure 3.16. Elements of the natural environment of the park which were enjoyed by park user questionnaire participants with the elements of the natural environment of parks on the x-axis and the number of participants on the y-axis (n=82).


Birds
Number of users
0
10
20
30
40
50
60
70
80
<50
>50
M F
Notat all
To a small extent
To some extent
To a moderate extent
To a large extent
Wild mammals
Insects
Flowers
Trees
River/pond
Grassy areas
Woodlands
Notat all

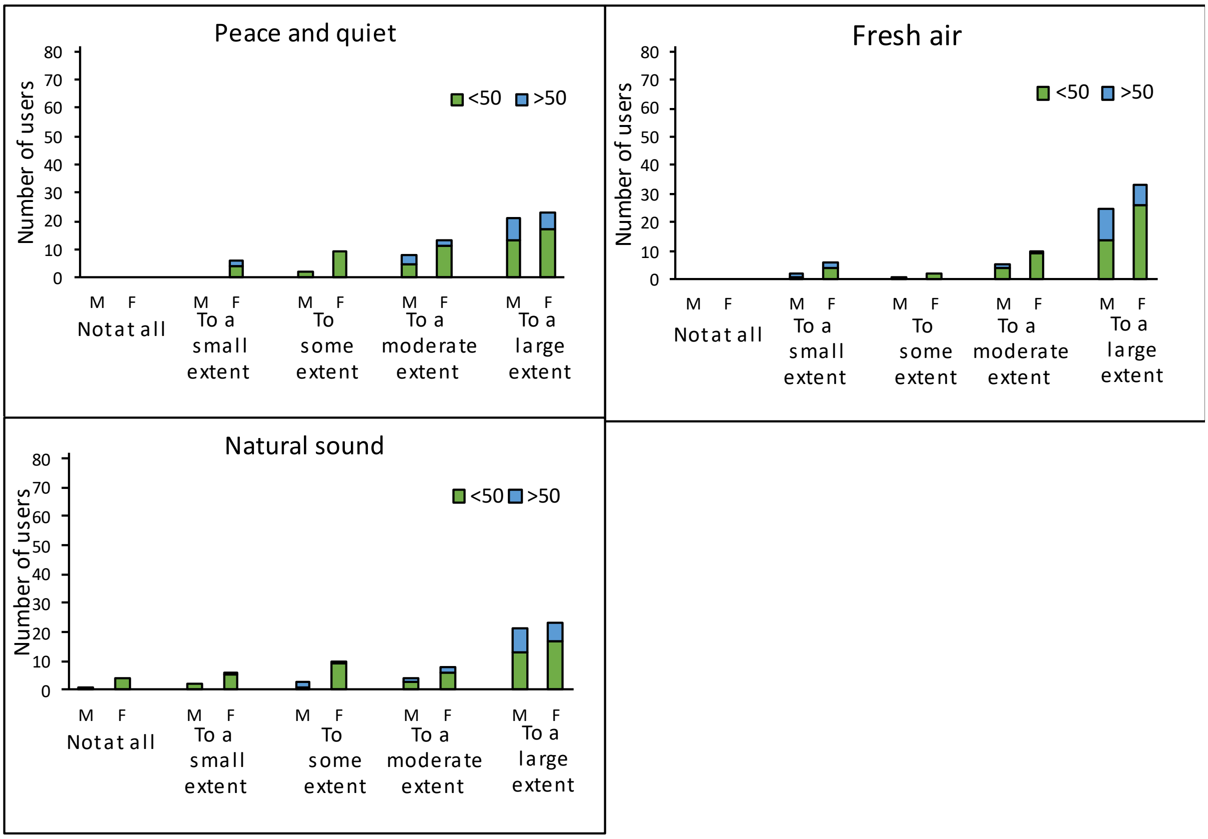


Figure 3.17. Elements of the natural environment of the park which were enjoyed by park user questionnaire participants broken down by the gender and age of participants.

3.2.1.4 The Built Environment

The first element of the built environment, footpaths was tested to determine if there was a significant difference in the distribution responses. A chi-square test showed that there was no significant difference in responses (X^2 = (16) = 20.00, p = 0.220) with a non-significant majority of users choosing 5, “enjoy to a large extent” (Fig. 3.18). When this dataset is divided by the age and gender of participants, the cohort who chose 2 (enjoy to a small extent) is entirely made up of female users under 50 while male users and users over 50 are distributed between options 3 to 5 but these results were not statistically significant (X^2 *users under 50* = (12) = 15.00, p = 0.241, X^2 *users over 50*= (12) = 15.00, p = 0.241, X^2 *female users*= (16) = 20.00, p = 0.220, X^2 *male users* =(12) = 15.00, p = 0.241) (Fig. 3.19).

Secondly, user responses for public art in parks were tested using a chi-square test to determine if their distribution differed across the Likert scale. It was determined that there was no significant difference in the distribution of responses (X^2 = (12) = 15.00, p = 0.241) which is represented by a normal distribution, with the majority of users choosing scale options 3, 4, and 5 (Fig. 3.18). The majority of male users over the age of 50 chose “enjoy (public art) to a small extent" while female users over 50 chose options 4 and 5 most often. Male users under 50 responses were equally distributed across the 5 scale options while female users under 50 are represented by the normal distribution of the overall histogram (X^2 *users under 50*= (16) = 20.00, p = 0.220, X^2 *users over 50*= (12) = 15.00, p = 0.241, X^2 *female users* = (12) = 15.00, p = 0.241, X^2 *male users* = (16) = 20.00, p = 0.220) (Fig. 3.19).

The third element of the built environment of the park we tested was user opinions on cycleways. A chi-square test was used, and it was determined that there was no significant difference in responses across the Likert scale (X^2= (16) = 20.00, p = 0.220). This dataset was represented by a non-symmetric bimodal distribution with peaks at 3, the most commonly chosen, and 5, the next most commonly chosen option on the Likert scale (Fig. 3.18). The first mode of the dataset at 3 consists mostly of female users under the age of 50 with no females over 50 present at this point. All other options on the scale are representative of all four cohorts of gender and age (Fig. 3.19) however this was not statistically significant (X^2 *users under 50* = (8) = 10.00, p = 0.265, X^2 *users over 50*= (12) = 15.00, p = 0.241, X^2 *female users* = (8) = 10.00, p = 0.265, X^2 *male users* = (16) = 20.00, p = 0.220).

The distribution of questionnaire responses regarding the enjoyment of exercise equipment was determined using a chi-square test and it was concluded that there was no significant difference in responses across the Likert scale (X^2= (16) = 20.00, p = 0.220). This dataset is represented by a positively skewed histogram with the majority of park users choosing 2, "enjoy to a small extent (Fig. 3.18). The age of responders did have an effect on the distribution of the results with users under 50 mostly represented at the lower end of the scale, while users over 50 are relatively evenly distributed across all five scale options. Gender has no effect on the distribution of responses (Fig. 3.19) however gender and age results were not of statistical significance (X^2 *users under 50* = (16) = 20.00, p = 0.220, X^2 *users over 50*= (8) = 10.00, p = 0.265, X^2 *female users*= (16) = 20.00, p = 0.220, X^2 *male users* = (16) = 20.00, p = 0.220).

The penultimate element in this section was playing fields which was determined to have no significant differences in the distribution of responses across the Likert scale (X^2= (16) = 20.00, p = 0.220). The majority of questionnaire participants chose scale option 2, use to some extent, while other responses were distributed relatively evenly across other scale options (Fig. 3.18). Age and gender have both effected the distribution of this data with male users over 50 mostly present at the lower end of the scale, most commonly choosing scale option 2, enjoy to a small extent. Meanwhile female users over the age of 50 were mostly present at the higher end of the

Likert scale most commonly choosing 4 and 5, enjoy to a moderate/large extent. Male and female users under the age of 50 are evenly distributed and share the same distribution as the overall histogram (Fig. 3.19), however these results were not statically significant (X^2 *users under 50* = (16) = 20.00, p = 0.220, X^2 *users over 50*= (8) = 10.00, p = 0.265, X^2 *female users*= (16) = 20.00, p = 0.220, X^2 *male users* = (12) = 15.00, p = 0.241).

The final element in this section, children's playground, was found to have no significant difference in the distribution of responses across the Likert scale (X^2= (16) = 20.00, p = 0.220). Responses for this element of the built park are randomly distributed (Fig. 3.18) with the majority of users choosing 3, to some extent. Gender and age had no significant effect on the distribution of responses for this element (X^2 *users under 50* = (16) = 20.00, p = 0.220, X^2 *users over 50* = (16) = 20.00, p = 0.220, X^2 *female users*= (8) = 10.00, p = 0.265, X^2 *male users* = (16) = 20.00, p = 0.220) (Fig. 3.19).

Footpaths were the most important element of the built environment for questionnaire participants while outdoor exercise equipment was of least importance (Fig 3.18),

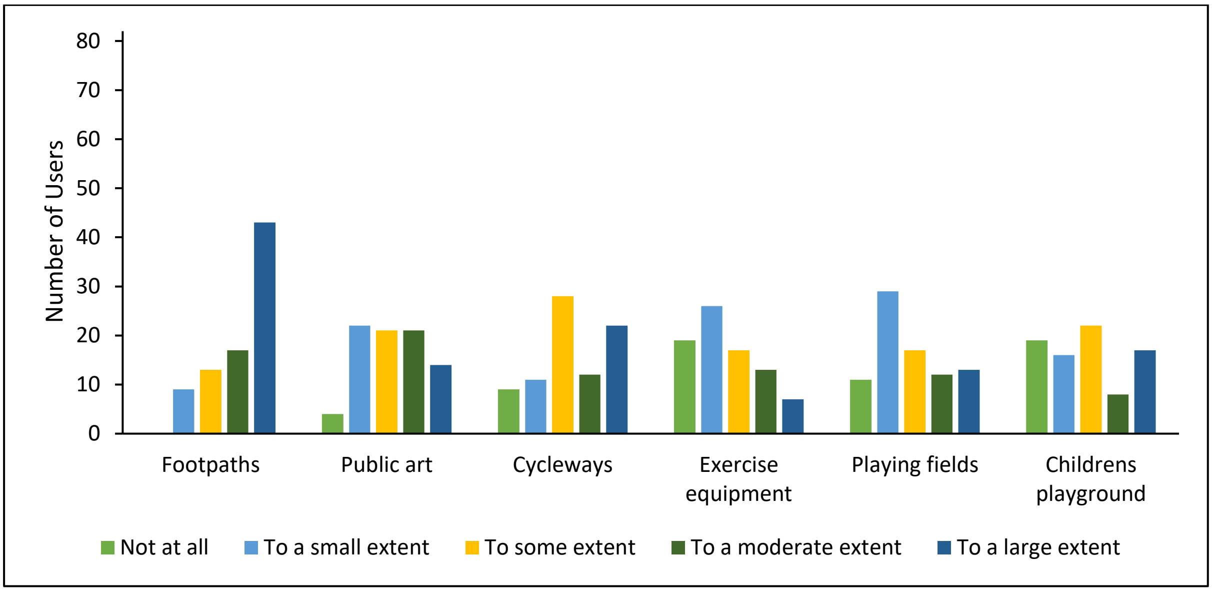


Figure 3.18. Elements of the built environment which are enjoyed by park user questionnaire participants with amenities enjoyed by participants on the x-axis and number of users on the y-axis (n=82).

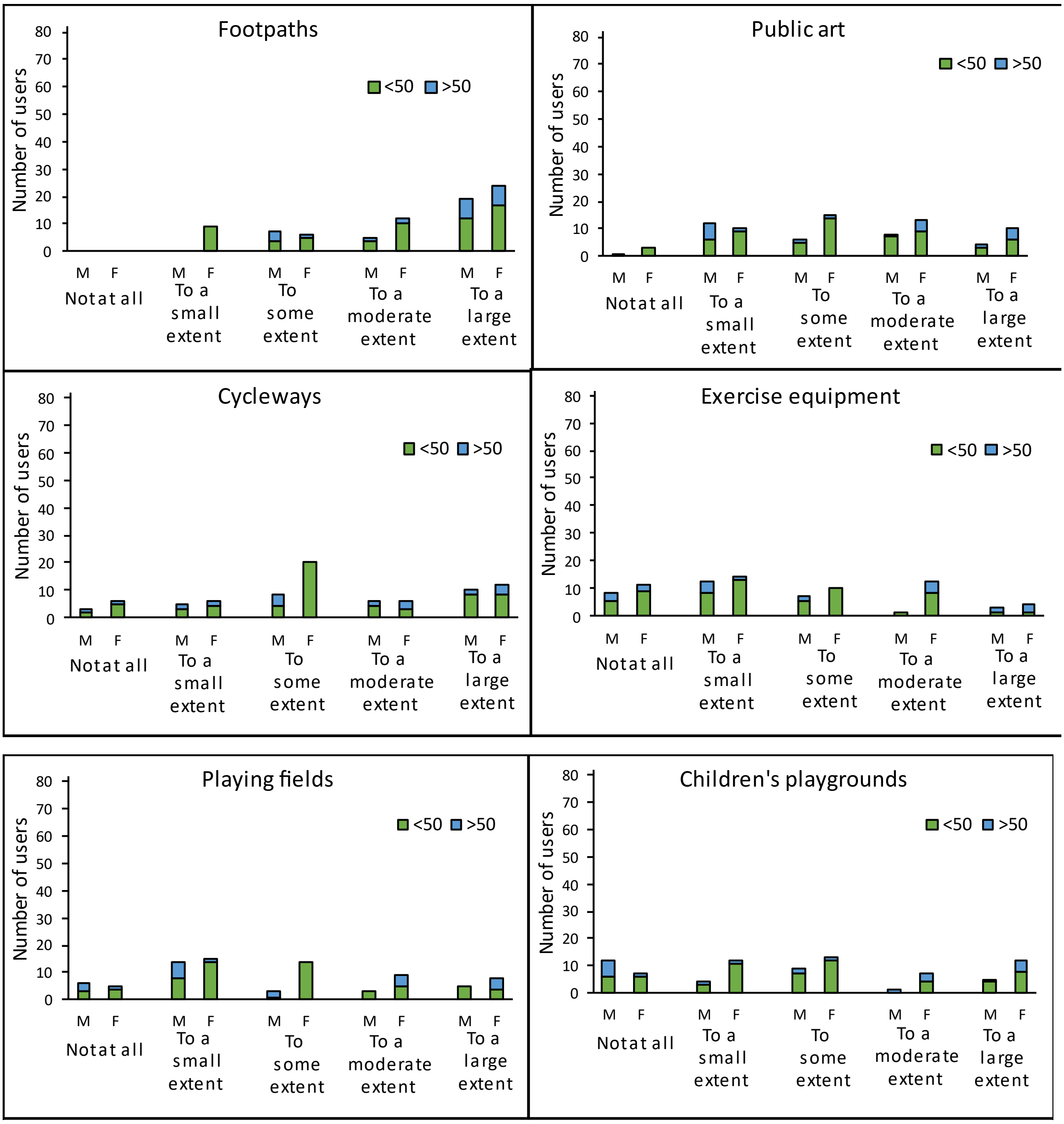


Figure 3.19 Elements of the built environment which are enjoyed by park user questionnaire participants broken down by the gender and age of participants.

3.2.1.5 Wildlife and Historical Information Boards

A chi-square test was used to determine if there was a significant difference in the distribution of answers across three possible options, yes, no, and maybe. The test determined that there was no significant difference in the distribution of responses (X^2 = (4) =6.00, p = 0.199) with the majority of users reading information boards in the park (Table 3.11). The gender and age of users did not affect their responses (X^2 *users under 50* = (4) =6.00, p = 0.199, X^2 *users over*

50 = (4) =6.00, p = 0.199, X^2 *female users* = (4) =6.00, p = 0.199, X^2 *male users* = (4) =6.00, p = 0.199) (Fig. 3.20).

Secondly, the distribution of responses with regard to finding information boards informative was found to have no significant difference in responses across the three options (X^2 = (4) =6.00, p = 0.199) with the majority of users finding boards informative (Table 3.11). Gender and age had no significant affect in the distribution of responses (X^2 *users under 50* = (4) =6.00, p = 0.199, X^2 *users over 50* = (4) =6.00, p = 0.199, X^2 *female users* = (4) =6.00, p = 0.199, X^2 *male users* = (4) =6.00, p = 0.199) (Fig. 3.20).

Finally, the majority of users agreed that information boards were a good use of park funds (Table 3.9), however this result was not statistically significant (X^2 = (4) =6.00, p = 0.199). The gender and age of users had no effect on responses (X^2 *users under 50* = (4) =6.00, p = 0.199, X^2 *users over 50* = (4) =6.00, p = 0.199, X^2 *female users* = (4) =6.00, p = 0.199, X^2 *male users* = (4) =6.00, p = 0.199) (Fig. 3.20).

Table 3.11. Park user questionnaire responses regarding wildlife and historical information boards (n=82).

	Yes	No	Maybe
Do you read information boards in parks?	**49**	**10**	**23**
Do you find them informative?	**60**	**7**	**15**
Are they a good use of money?	**52**	**6**	**24**

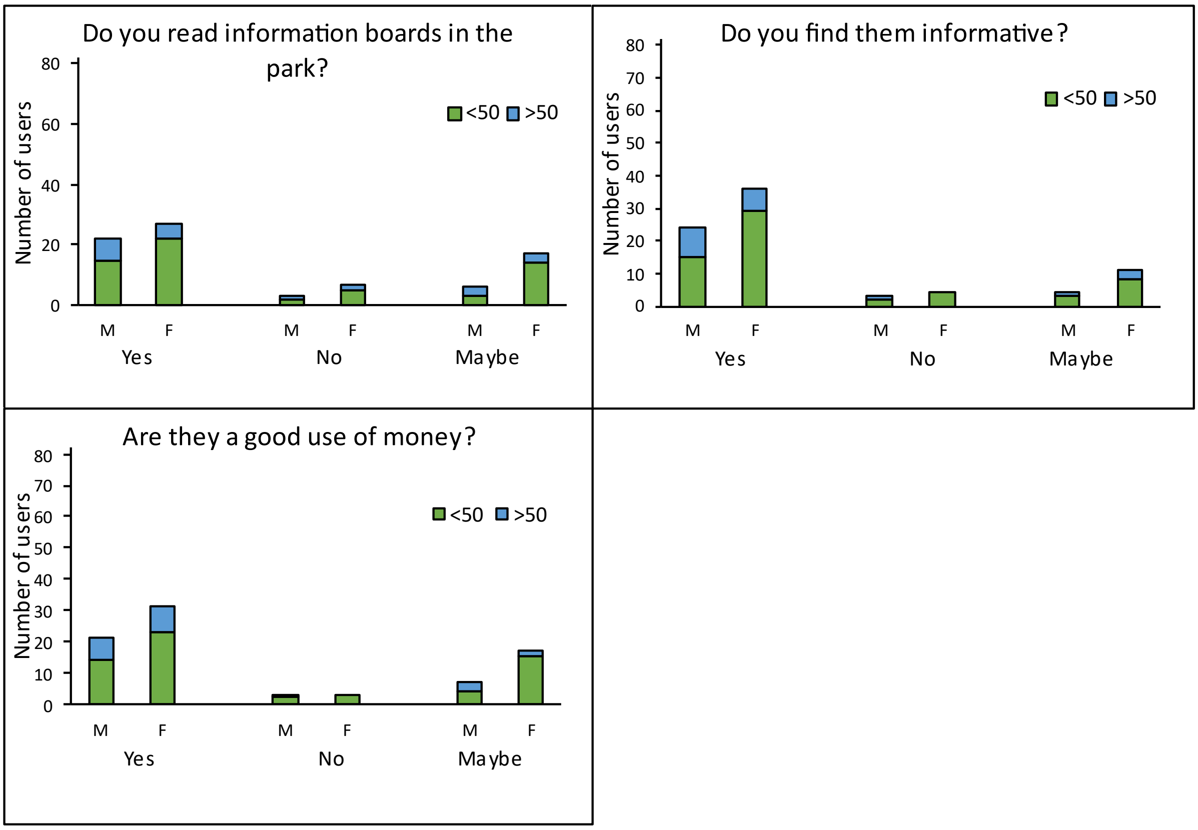


Figure 3.20. Park user questionnaire responses regarding wildlife and historical information boards broken down by the gender and age of users.

3.2.1.6 Disliked Elements of the Natural Environment

The first element of the natural environment disliked by participants; a lack of biodiversity was tested to determine if there was a significant difference in the distribution of responses. It was determined that there was no significant difference in the distribution of answers by participants across the Likert scale (X^2= (16) = 20.00, p = 0.220), however the majority of users disliked a lack of biodiversity in urban parks "to a large extent". This is represented as a histogram with a negative skew (Fig. 3.21). The gender and age of responders had no significant effect on the distribution of responses (X^2 *users under 50* = (16) = 20.00, p = 0.220, X^2 *users over 50* = (16) = 20.00, p = 0.220, X^2 *female users* = (16) = 20.00, p = 0.220, X^2 *male users* = (16) = 20.00, p = 0.220) (Fig. 3.22).

Secondly, a chi-square test was used to determine if there was a significant difference in the distribution of user responses regarding invasive alien species across the Likert scale. The test showed that there was no significant difference (X^2 = (12) = 15.00, p = 0.241), with disliking "to a large extent" chosen by the majority of participants, as represented by a negatively skewed histogram (Fig 3.21). The gender and age of responders did not affect the distribution of responses (X^2 *users under 50* = (16) = 20.00, p = 0.220, X^2 *users over 50* = (16) = 20.00, p = 0.220, X^2 *female users* = (12) = 15.00, p = 0.241, X^2 *male users* = (12) = 15.00, p = 0.241) (Fig. 3.22).

Pests and vermin such as rats in urban parks were disliked “to a large extent” by participants however we determined that these responses were not statistically significant (X^2 = (16) = 20.00, p = 0.220). The histogram which represents this data set has a negatively skewed distribution (Fig. 3.21). When these results are divided by the age and gender of the responders, it showed that female users most commonly chose “use to a moderate extent” while few male users chose this option. Male users under 50 chose dislike to a large extent most frequently while male users over the age of 50 chose dislike to a small extent most often (Fig. 3.22). These results were also not of statistical significance (X^2 *users under 50* = (16) = 20.00, p = 0.220, X^2 *users over 50* = (12) = 15.00, p = 0.241, X^2 *female users* = (16) = 20.00, p = 0.220, X^2 *male users* = (12) = 15.00, p = 0.241).

Fourthly, we tested participants dislike for undesirable plants such as brambles and nettles to determine if there were significant difference in the distribution of user responses. The results showed that there was no significant difference in the distribution of answers across the scale used (X^2 = (16) = 20.00, p = 0.220). The majority of users did not dislike undesirable plants “at all”, receiving a majority of “1” answers as represented in the positively skewed histogram (Fig. 3. 21). The age and gender of users does not affect their responses (X^2 *users under 50* = (12) = 15.00, p = 0.241, X^2 *users over 50* = (12) = 15.00, p = 0.241, X^2 *female users* = (12) = 15.00, p = 0.241, X^2 *male users* = (16) = 20.00, p = 0.220) (Fig. 3.22).

Wild and unmanaged habitats were the final element in this section to be tested for differences in the distribution of responses. Statistical analysis showed that there was no significant difference in answers across the Likert scale (X^2 = (12) = 15.00, p = 0.241), with the majority of users choosing 1, dislike not at all. This is represented in a positively skewed histogram (Fig 3.21). The gender and age of users had no significant effect on responses given (X^2 *users under 50* = (16) = 20.00, p = 0.220, X^2 *users over 50* = (12) = 15.00, p = 0.241, X^2 *female users* = (12) = 15.00, p = 0.241, X^2 *male users* = (12) = 15.00, p = 0.241) (Fig. 3.22).

Overall, a lack of biodiversity, invasive alien species and pests/vermin were the most disliked elements of the natural environment while undesirable plant species and unmanaged habitats were of least concern (Fig 3.21).

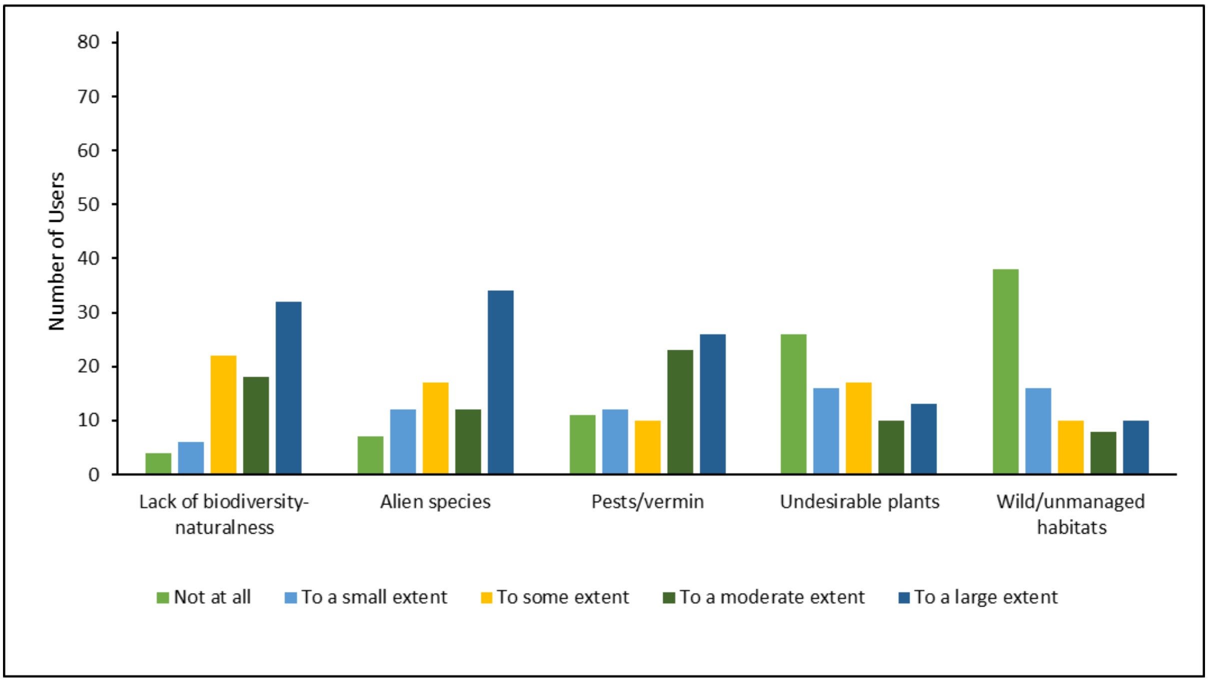


Figure 3.21. Aspects of the natural environment of urban parks which were disliked by participants from the park user questionnaire with aspects disliked by users on the x-axis and number of users on the y-axis (n=82).

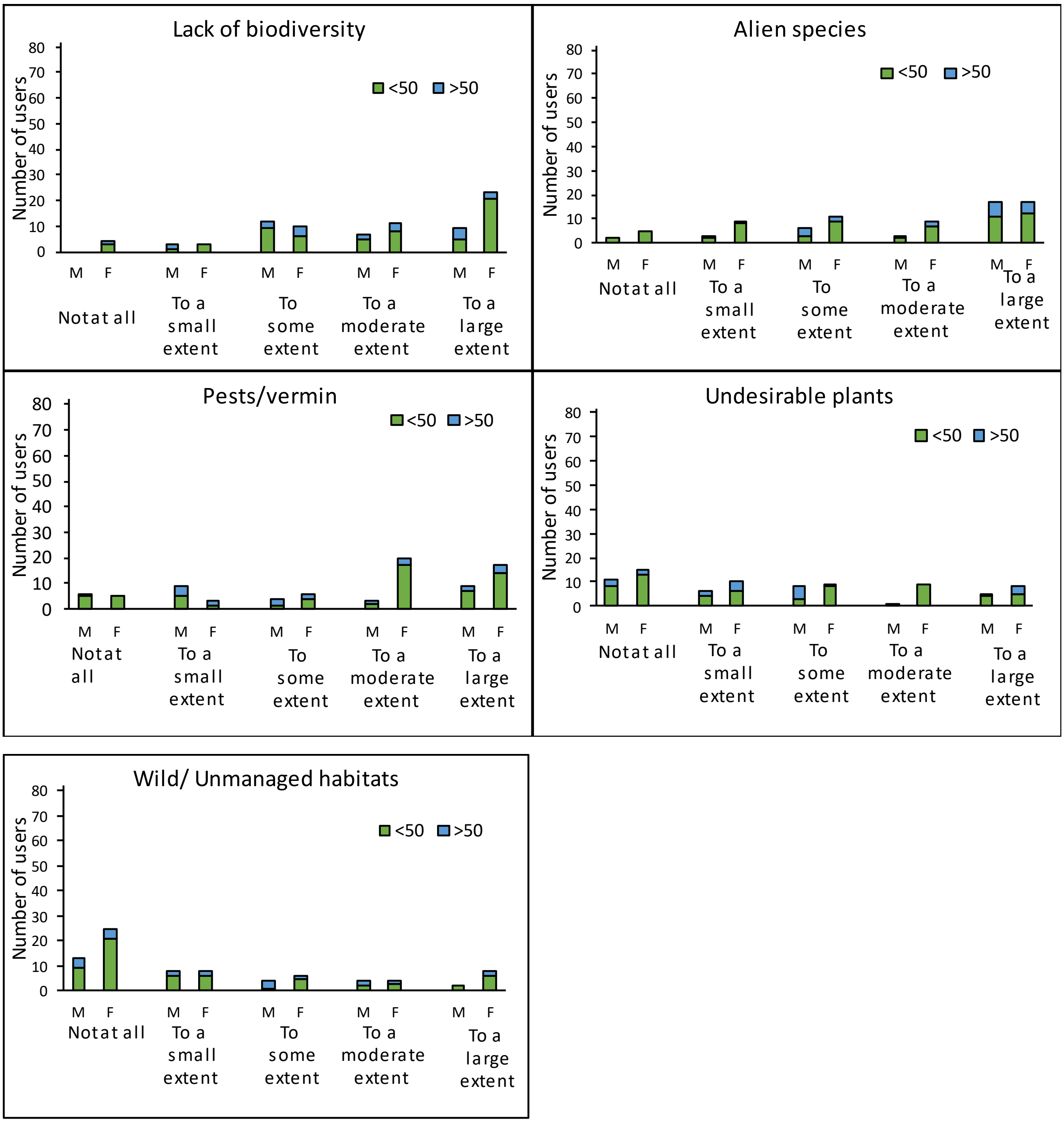


Figure 3.22. Aspects of the natural environment of urban parks which were disliked by participants broken down by the gender and age of park user questionnaire participants.

3.2.1.7 Disliked Aspects of the Built Environment

A chi-square test was used to determine if there were significant differences in the distribution of user responses regarding a lack of litter bins in urban parks. It was determined that there were no statistically significant difference in the distribution of responses (X^2 = (16) = 20.00, p = 0.220) with the majority of users choosing 5, dislike to a large extent (Fig. 3.23). The gender and age of responders did not affect their answers (X^2 *users under 50* = (16) = 20.00, p

= 0.220, X^2 *users over 50* = (12) = 15.00, p = 0.241, X^2 *female users* = (16) = 20.00, p = 0.220, X^2 *male users* = (16) = 20.00, p = 0.220) (Fig. 3.24).

A lack of dog waste bins was determined to have no significant difference in the distribution of responses across the Likert scale (X^2 = (16) = 20.00, p = 0.220) with the majority of users choosing 5, dislike to a large extent (Fig. 3.23). The age and gender of users had no significant effect on the distribution (X^2 *users under 50* = (16) = 20.00, p = 0.220, X^2 *users over 50* = (12) = 15.00, p = 0.241, X^2 *female users* = (16) = 20.00, p = 0.220, X^2 *male users* = (12) = 15.00, p = 0.241) (Fig. 3.24).

Thirdly, the distribution of responses for a lack of park benches was determined to have no significant difference across the Likert scale (X^2 *users under 50* = (16) = 20.00, p = 0.220). This dataset has a negative distribution with the majority of users disliking a lack of park benches "to a large extent" (Fig. 3.23). The gender and age of users did not affect their responses (X^2 *users under 50* = (12) = 15.00, p = 0.241, X^2 *users over 50* = (8) = 10.00, p = 0.265, X^2 *female users* = (12) = 15.00, p = 0.241, X^2 *male users* = (16) = 20.00, p = 0.220) (Fig. 3.24).

A chi-square test was used to determine if there were significant differences in the responses given by users regarding a lack of lighting in the park. The test showed that there was no significant difference in responses across the Likert scale (X^2 *users under 50* = (16) = 20.00, p = 0.220). This data is represented by a non-symmetrical bimodal distribution with the majority of users choosing 3, dislike to some extent, and 5, dislike to a large extent, respectively (Fig. 3.23). When the age and gender of users is taken into account is showed that male users and female users under the age of 50 most commonly chose 3 (to some extent) while female users over the age of 50 chose 5 (to a large extent) most often (Fig. 3.24), however these results are not statistically significant (X^2 *users under 50* = (16) = 20.00, p = 0.220, X^2 *users over 50* = (16) = 20.00, p = 0.220, X^2 *female users* = (16) = 20.00, p = 0.220, X^2 *male users* = (12) = 15.00, p = 0.241).

Finally, a chi-square test determined that there was no significant difference in the distribution of responses across the Likert scale regarding a lack of suitable pathways or pathways which are poorly maintained in the park (X^2 *users under 50* = (16) = 20.00, p = 0.220). The majority of users chose 5, dislike to a large extent while the distribution of responses for other scale options were relatively even (Fig. 3.23). The gender and age of users had no significant effect on how they responded (X^2 *users under 50* = (12) = 15.00, p = 0.241, X^2 *users over 50* = (16)

= 20.00, p = 0.220, X^2 *female users* = (16) = 20.00, p = 0.220, X^2 *male users* = (16) = 20.00, p = 0.220) (Fig. 3.24).

Overall, a lack of litter bins and dog waste bins were the most disliked elements of the built environment of urban parks (Fig 3.23).

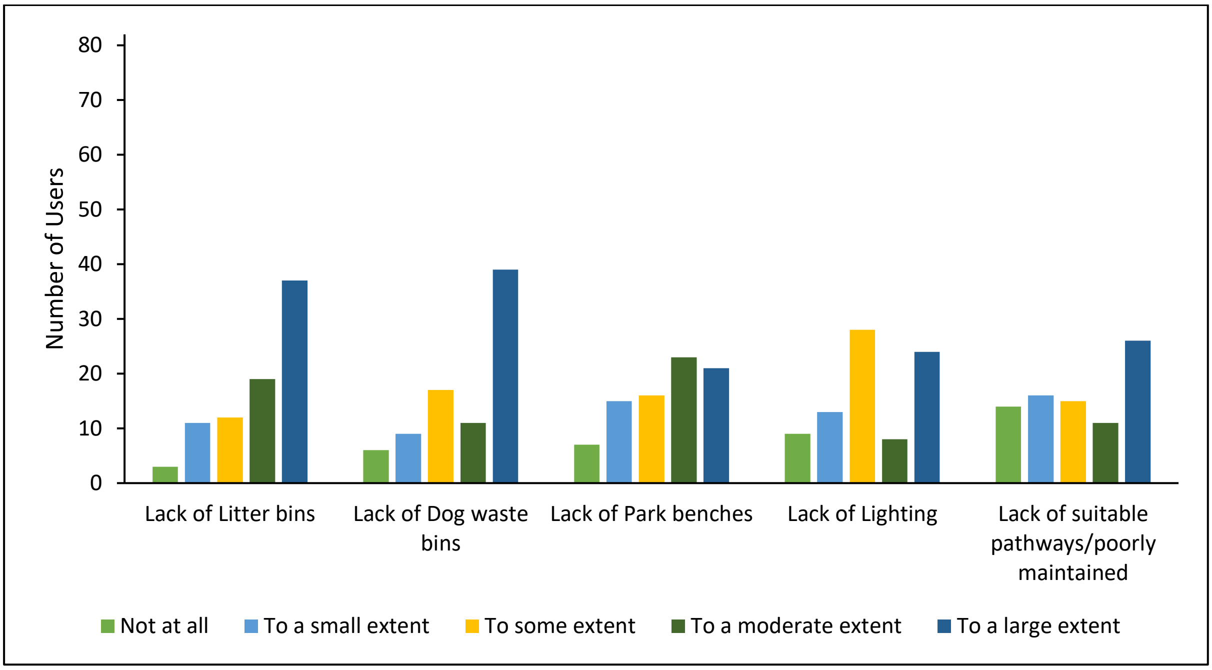


Figure 3.23. Aspects of the built environment of urban parks which are of concern to park user questionnaire participants with aspects of the built environment on the x-axis and number of users on the y-axis (n=82).

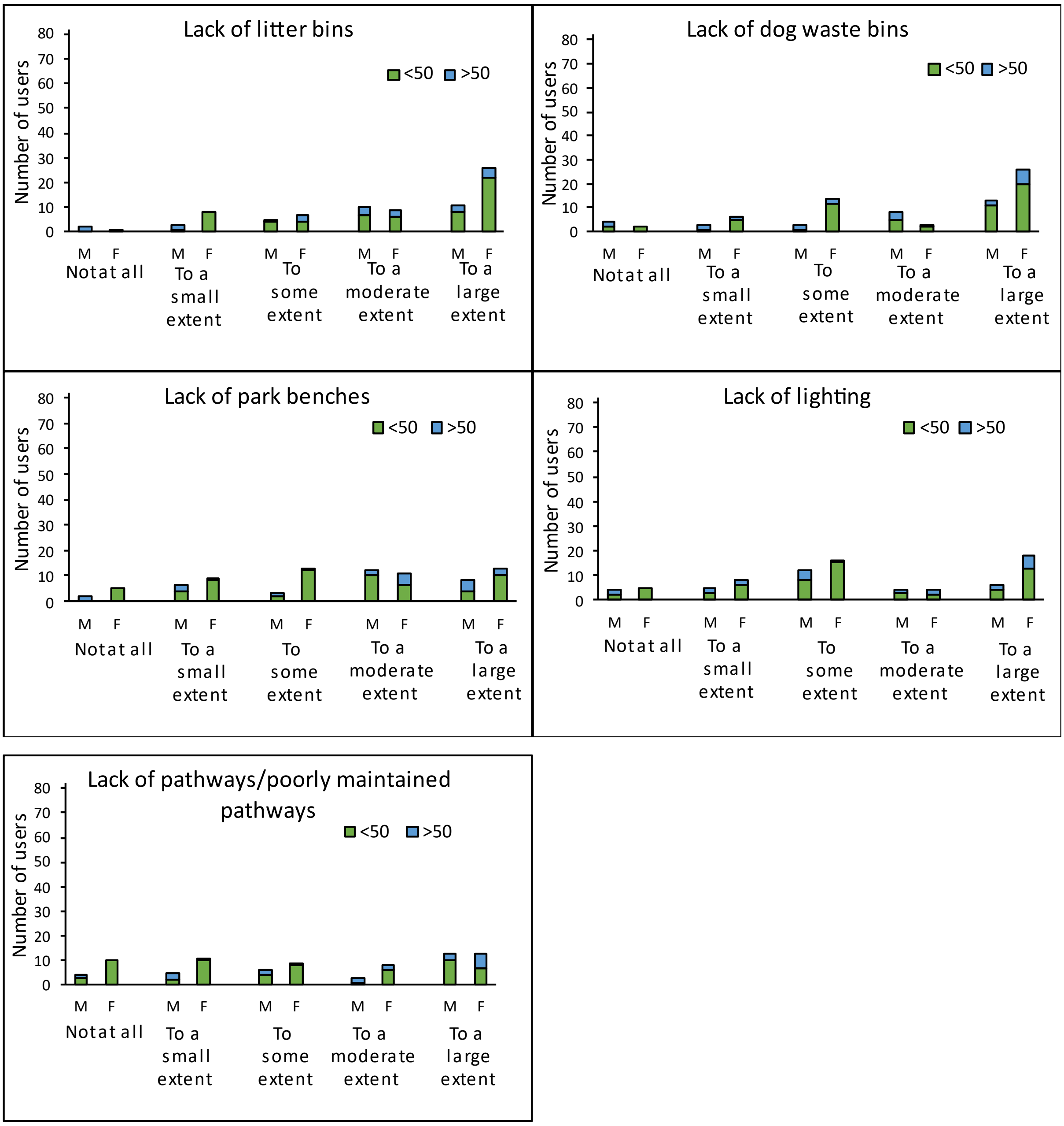


Figure 3.24. Aspects of the built environment of urban parks which are of concern to park user questionnaire participants broken down by the gender and age of participants.

3.2.1.8 Disliked Elements of the Social-Cultural Environment

A lack of authority figures in urban parks were tested using a chi-square test to determine if there were significant difference in the distribution of responses. Results showed that there were no significant differences in responses across the Likert scale X^2 = (12) = 15.00, p = 0.241). This dataset is represented by a positively skewed histogram with the majority of users choosing 2 and 3, dislike to a small/some extent (Fig. 3. 25). The gender and age of participants had no significant effect on the distribution of responses (X^2 *users under 50* = (16) = 20.00, p

= 0.220, X^2 *users over 50* = (16) = 20.00, p = 0.220, X^2 *female users* = (16) = 20.00, p = 0.220, X^2 *male users* = (16) = 20.00, p = 0.220) (Fig. 3.26).

A chi-square test was used to determine if there were significant differences in user responses regarding the dislike of litter in the park. It was determined that there no significant difference in the distribution of responses across the Likert scale (X^2 = (16) = 20.00, p = 0.220). This dataset has a negative distribution with the majority of users choosing 5, dislike to a large extent (Fig, 3.25). The gender and age of users had no significant effect on the distribution of user responses (X^2 *users under 50* = (16) = 20.00, p = 0.220, X^2 *users over 50* = (12) = 15.00, p = 0.241, X^2 *female users* = (16) = 20.00, p = 0.220, X^2 *male users* = (16) = 20.00, p = 0.220) (Fig. 3.26).

The distribution of user's responses regarding the dislike of graffiti in the park was determined to have no significant differences across the Likert scale (X^2 = (16) = 20.00, p = 0.220). This dataset has a relatively even distribution across scale options with the majority of users choosing 3, dislike to some extent (Fig. 3.25). Though gender does not have an effect on results, the majority of users over 50 dislike graffiti "to a large extent" (Fig. 3.26), however this result was not statistically significant (X^2 *users under 50* = (12) = 15.00, p = 0.241, X^2 *users over 50* = (12) = 15.00, p = 0.241, X^2 *female users* = (16) = 20.00, p = 0.220, X^2 *male users* = (16) = 20.00, p = 0.220) (Fig. 3.26).

The distribution of responses for the dislike of dog waste in the park was determined to have no significant differences in participant responses across the Likert scale (X^2 = (16) = 20.00, p = 0.220). This dataset has a negative distribution with the majority of responders choosing 5, dislike to a large extent (Fig. 3.25). The gender and age of users was found to have no significant effect on the distribution of responses (X^2 *users under 50* = (16) = 20.00, p = 0.220, X^2 *users over 50* = (12) = 15.00, p = 0.241, X^2 *female users* = (16) = 20.00, p = 0.220, X^2 *male users* = (12) = 15.00, p = 0.241) (Fig. 3.26).

A chi-square test showed that there was no significant difference in the distribution of answers regarding antisocial behaviour across the Likert scale (X^2 = (12) = 15.00, p = 0.241), with the majority of users disliking antisocial behaviour in the park "to a large extent". The histogram which represents this dataset has a negatively skewed distribution (Fig 3.25). The age of users had an effect on responses with older users found towards the end of the scale while younger users are spread throughout (X^2 *users under 50* = (12) = 15.00, p = 0.241, X^2 *users over 50* =

(12) = 15.00, p = 0.241, X^2 *female users* = (16) = 20.00, p = 0.220, X^2 *male users* = (16) = 20.00, p = 0.220) (Fig. 3.26).

Statistical analysis on users' responses regarding the dislike of criminal activity revealed that there was no significant difference in the distribution of answers across the Likert scale (X^2 = (16) = 20.00, p = 0.220) with the majority of participants fearing criminal activity in urban parks "to a small extent". This is represented by a non-symmetric, bimodal distribution where the second mode represents 5 "dislike to a large extent" (Fig. 3.25). The age and gender of participants was found to have no significant effect on the distribution of responses (X^2 *users under 50* = (16) = 20.00, p = 0.220, X^2 *users over 50* = (12) = 15.00, p = 0.241, X^2 *female users* = (16) = 20.00, p = 0.220, X^2 *male users* = (16) = 20.00, p = 0.220) (Fig. 3.26).

A chi-square test showed that there was no significant difference in responses given across the Likert scale for the dislike of uncontrolled dogs in the park (X^2 = (16) = 20.00, p = 0.220) with the majority of users choosing 1"not at all" as represented by a positively skewed histogram (Fig 3.25). Gender and age had no effect on the distribution of responses (X^2 *users under 50* = (12) = 15.00, p = 0.241, X^2 *users over 50* = (8) = 10.00, p = 0.265, X^2 *female users* = (16) = 20.00, p = 0.220, X^2 *male users* = (12) = 15.00, p = 0.241) (Fig. 3.26).

Finally, we tested the distribution of user responses fear of danger from cyclists. The test showed that there was no significant difference in responses across the Likert scale (X^2 = (16) = 20.00, p = 0.220) with the majority of users "not at all" fearing danger from cyclists, contradicting our original hypothesis (Fig 3.25). The age and gender of participants had no significant effect on the distribution of results (X^2 *users under 50* = (12) = 15.00, p = 0.241, X^2 *users over 50* = (8) = 10.00, p = 0.265, X^2 *female users* = (12) = 15.00, p = 0.241, X^2 *male users* = (16) = 20.00, p = 0.220) (Fig. 3.26).

Litter, dog waste and antisocial behaviour were the social aspects of the park most disliked by questionnaire participants while uncontrolled dogs and danger from cyclists were of least concern (Fig 3.25).

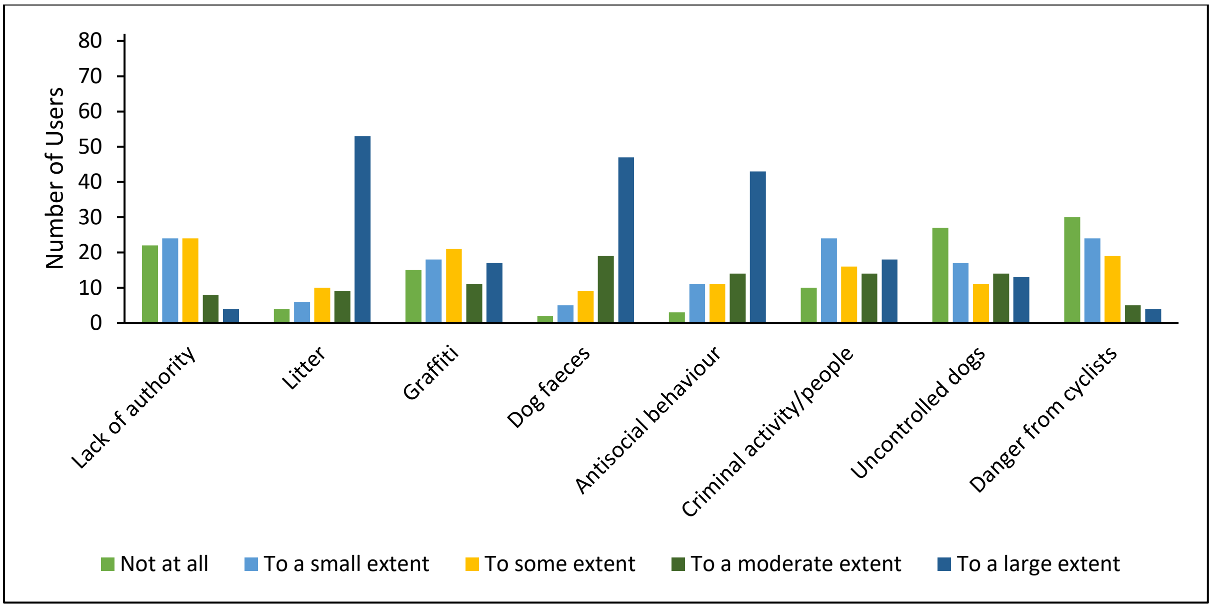


Figure 3.25. Social aspects of urban parks that are disliked by park user questionnaire participants with social aspects on the x-axis and number of users on the y-axis (n=82).

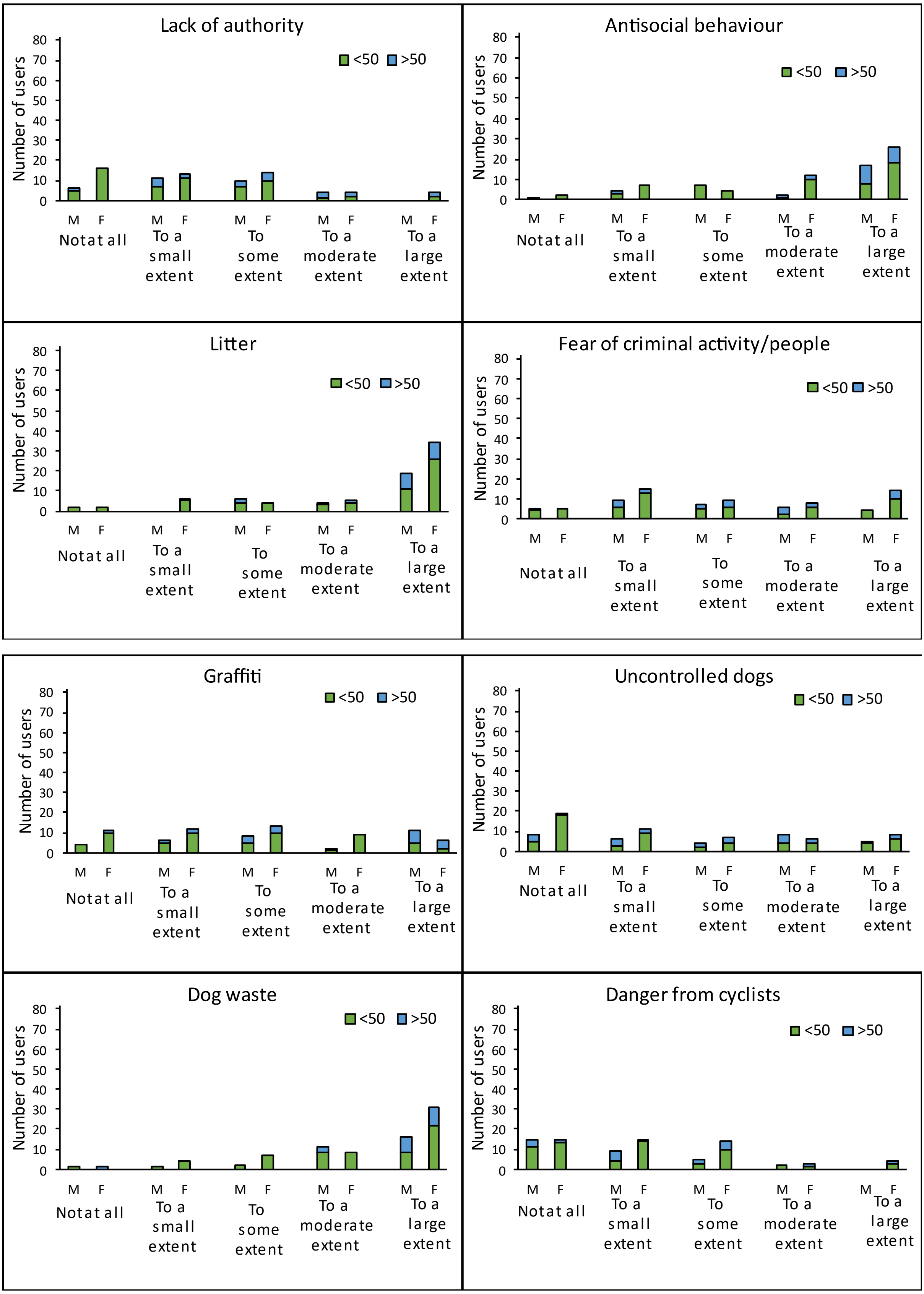


Figure 3.26. Social aspects of urban parks that are disliked by park user questionnaire participants broken down by the gender and age of participants.

3.2.2 SOPARC

All target areas included in the SOPARC study accessible to park users, equipped to a moderate extent (i.e., goal posts and basketball hoops are provided while users brought balls from home). At the time of recording there were no supervised or officially organised events occurring. A total of 504 individuals were observed performing a variety of different activities including walking, jogging, picnicking, hurling/camogie, Gaelic football, and soccer, basketball and active play. Table 3.12 provides a summary of the demographic composition and activity levels of park users. The majority of users were male (58%), primarily children (38%) engaged in walking (moderate) activity (51%) (Table 3.10).

Table 3.12. Demographics of users of sports and recreational facilities gathered during SOPARC in Ballincollig Regional Park, Cork.

Variable	Number of people recorded	(n%)
Gender		
Female	210	42
Male	294	58
Age		
Child	192	38
Teen	114	23
Adult	144	29
Senior	54	10
Activity Level		
Sedentary	120	24
Walking	258	51
Vigourous	126	25

The first statistical analysis performed with the SOPARC data aimed to determine whether there was a significant difference in the ages of users using the sports facilities such as the basketball courts, soccer fields and outdoor gym equipment in Ballincollig Regional Park. As there were no users on the outdoor gym equipment during data collection, this was not featured in the sample. An Independent samples Mann-Whitney U test determined that there was no significant difference in the age of sport facility users, with the highest number of users among teenagers and the lowest among seniors ($U = 0.00$, $p = 0.121$) (Fig. 3.27).

The second statistical analysis was used to determine whether was a significant difference in the ages of park goers using the recreational facilities such as the playground and picnic areas at the park. An Independent-Samples Kruskal-Wallis test showed that there was no significant age difference in users of the recreational facilities. The majority of users are children and adults while teens and seniors use these facilities the least (H (2) = 5.687, p = 0.58) (Fig 3.27.).

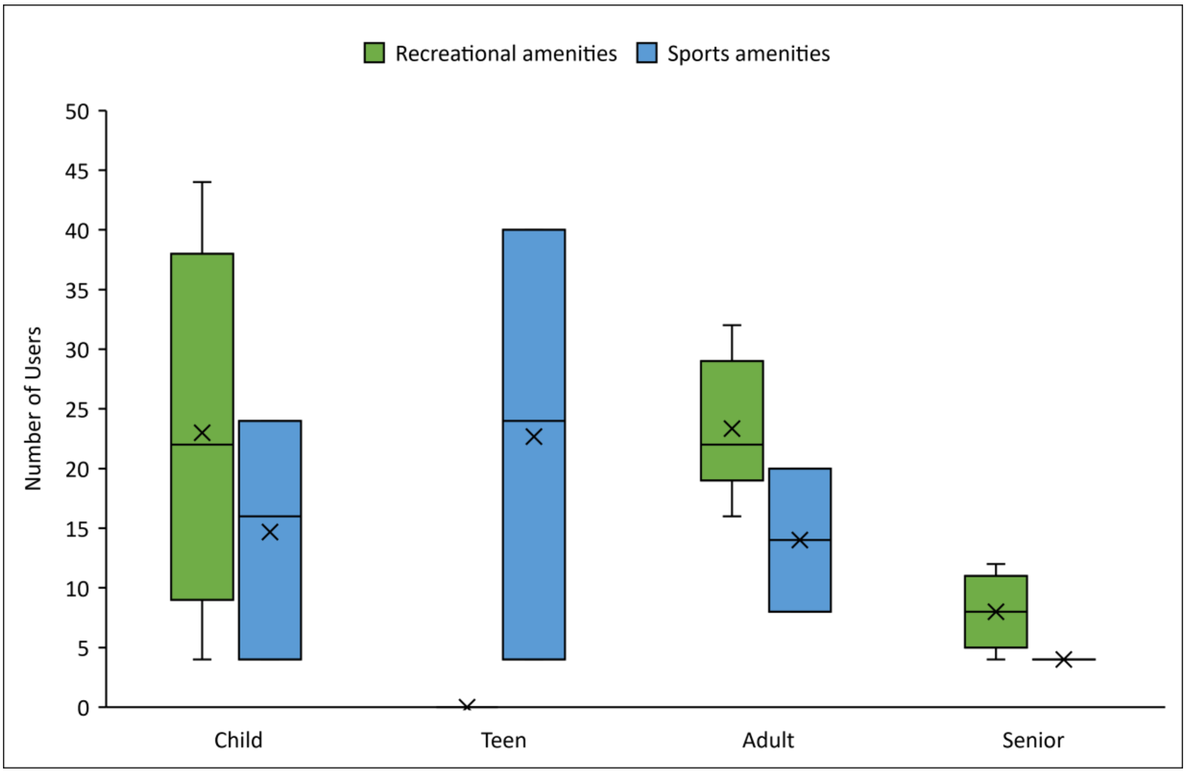


Figure 3.27. The distribution of age across recreational and sports facilities in Ballincollig Regional Park, Cork

Finally, we determined if there was a statistically significant difference in the distribution of users across sports and recreational facilities. An Independent-Samples Mann-Whitney U test determined that there was no statistically significant difference across the distribution of users of recreational and sports facilities in Ballincollig Regional Park however (U = 115.0, p = 0.355), the majority of park goers were observed using recreational facilities over sports facilities (Table 3.13).

Table 3.13. The number of male and female users of sports and recreational amenities in Ballincollig Regional Park, Cork.

Amenity type	Female	Male
Sports amenity	66	186
Recreational amenity	144	96

Qualitative observational data was also collected. It was noted that people using the soccer pitches were not using the goal posts, only the open space. Instead, they used personal items to create a new goal. Other sports and fitness activities taking place at this time included jogging, walking, cycling, Gaelic football, and hurling. There were also people sitting on benches at the edge of the pitch. At the playground, adults were supervising children during active games, some at the edge of the area and others participating with the children. The basketball courts featured a number of people actively playing basketball while others were observing while the picnic area included a group of people taking part in sedentary related codes like picnicking and sitting.

3.2.3 Human-Habitat Use Observational Study

A total of 88 individuals were observed across the four habitats included in this study. All areas were open and accessible to the general public.

The first statistical analysis ascertained whether the number of users of the four park locations was the same across four age groups: child, teen, adult, and senior. An Independent Samples Kruskal-Wallis determined that the number of users of the four habitats was not the same across categories of age with the number of observed adult park users significantly higher than other age groups ($H(3) = 29.698$, $p = <0.001$) (Fig. 3.28).

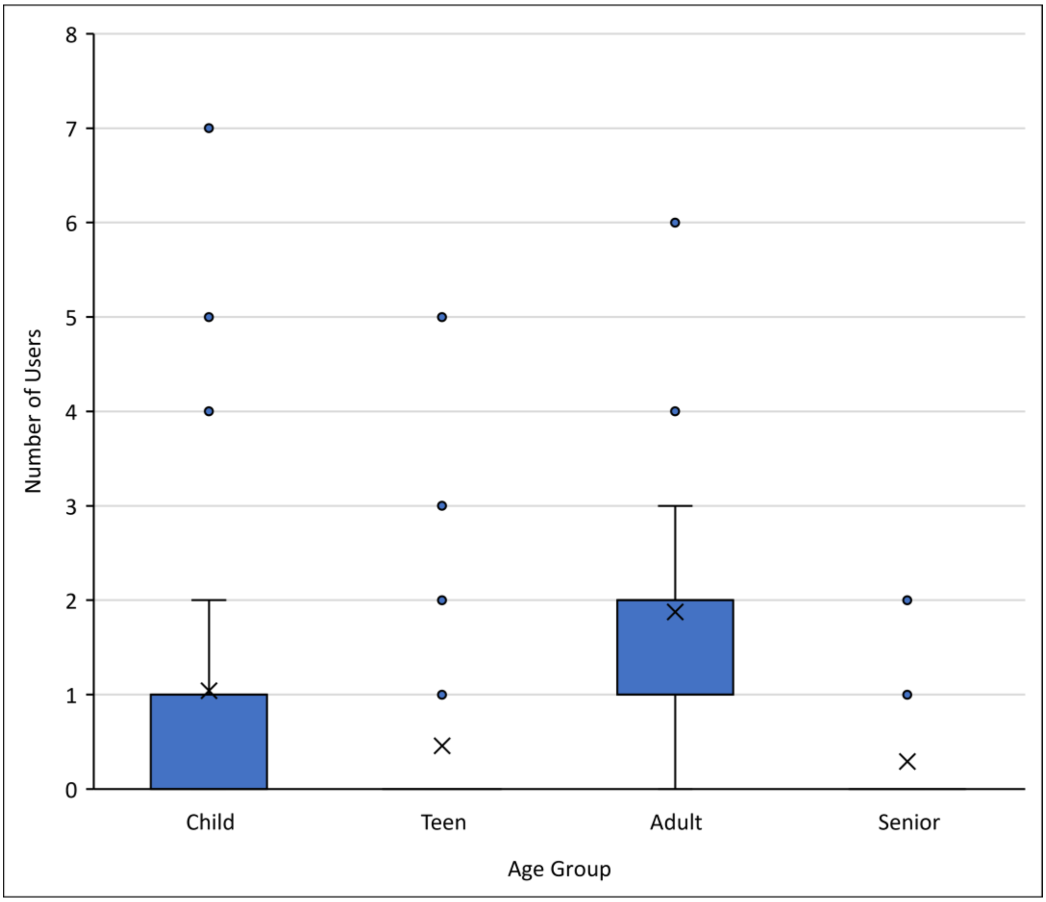


Figure 3.28. The distribution of park users across age in four habitats of Ballincollig Regional Park, Cork.

Secondly, we used an Independent-Samples Kruskal-Wallis test to determine if certain selected habitats were visited more often than others. Results show that a significantly significant number of habitat visitors were observed in the amenity grassland of Ballincollig Regional Park (H (3) = 14.007, p = 0.003) (Fig. 3.29).

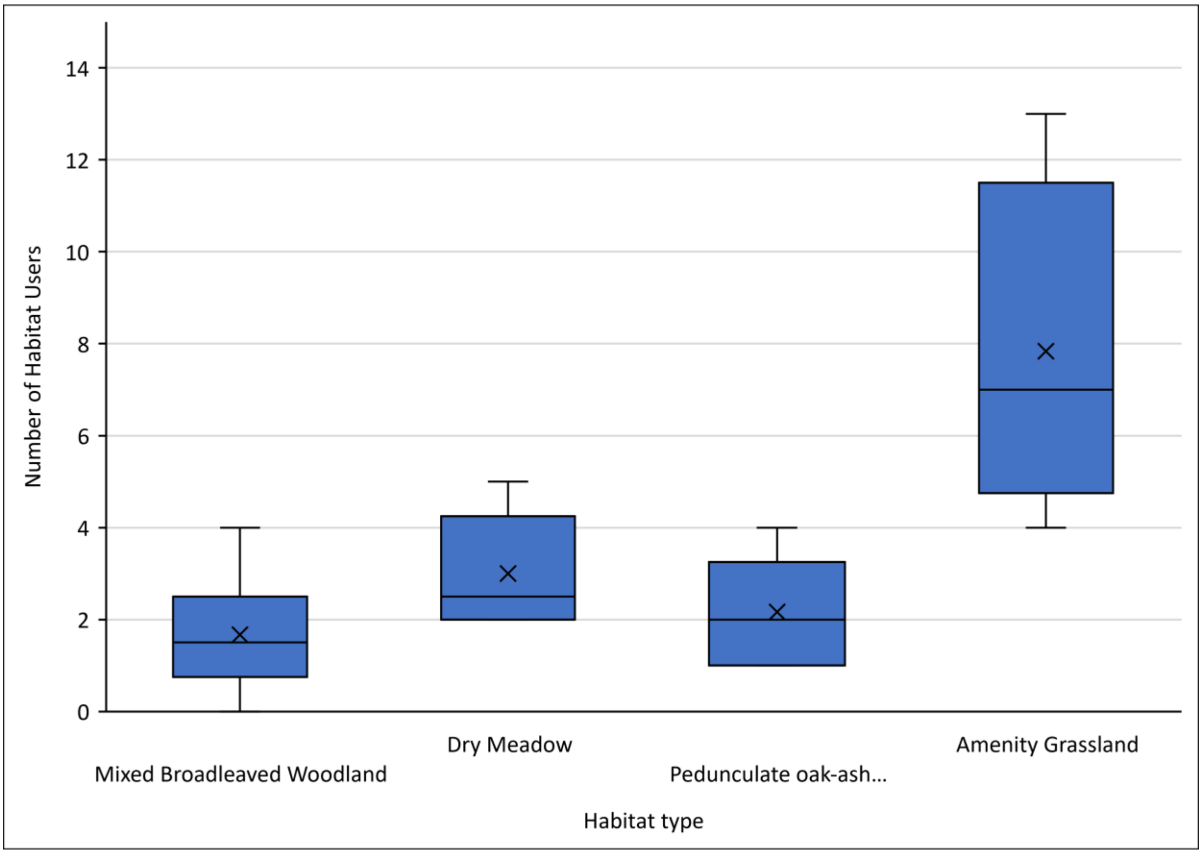


Figure 3.29. The number of habitat users across four habitats in Ballincollig Regional Park, Cork.

Next, the distribution of observed male users across four habitat types was determined using an Independent-Samples Kruskal-Wallis test. The null hypothesis that the distribution of male visitors was the same across the four habitat types was rejected (H (3) = 8.920, p = 0.030). A post hoc analysis determined that amenity grassland was used by a significant majority of male park users when compared to mixed broadleaved woodland (p = 0.004) and pedunculate oak-ash woodland (p = 0.036), but results were not significantly different between dry meadow and amenity grassland (p = 0.102) (Fig. 3.30).

An Independent-Samples Kruskal-Wallis test was used to determine if the number of observed female park users was the same across the four chosen habitat types. The test ascertained that there was a statistically significant difference in the number of female users in amenity grassland when compared to the other three habitats (H (3) = 13.831, p = 0.003) (Fig 3.30).

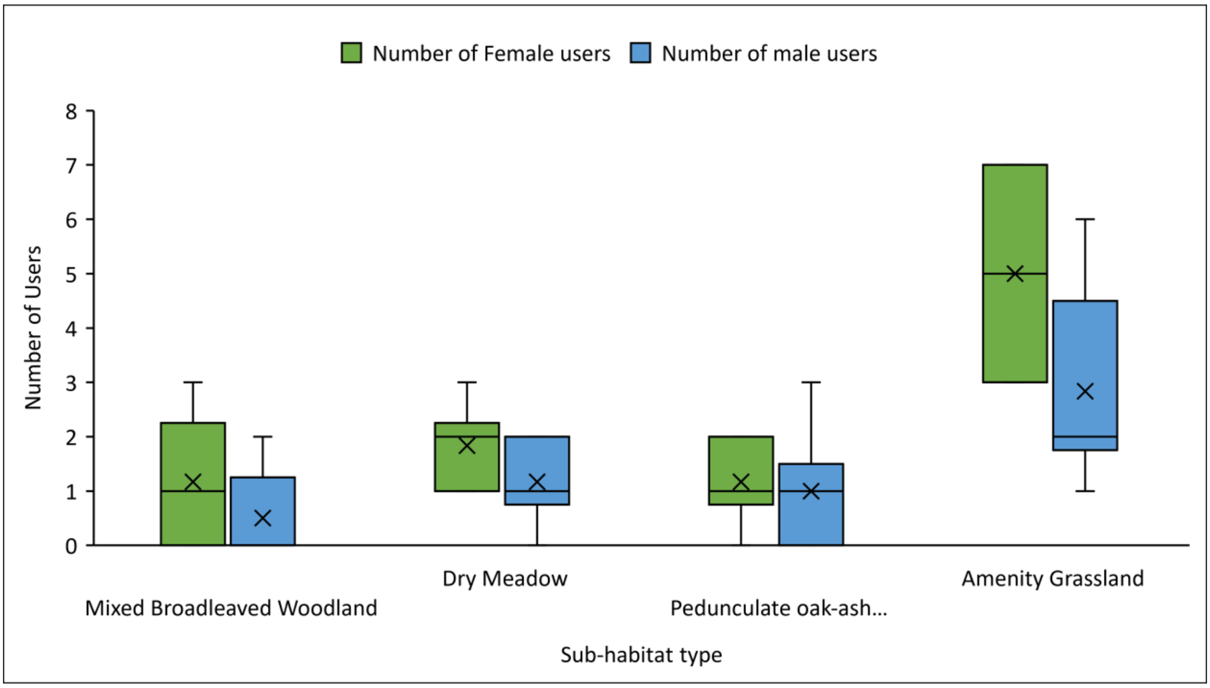


Figure 3.30. The distribution of gender of park users across four habitat types in Ballincollig Regional Park, Cork

Next, the distribution of age of users of mixed broadleaved woodland was determined using an Independent-Samples Kruskal-Wallis test. The results of this test showed that there was no significant difference in the distribution of age of users in mixed broadleaved woodland ($H(3) = 6.735$, $p = 0.081$). The majority of users were adults and seniors while no children were recorded along with a single teen user (Fig 3.31).

Next, the distribution of age of users across dry meadow was ascertained using an Independent-Samples Kruskal-Wallis test. It was determined that the distribution of users was not the same across the four categories of age ($H(3) = 15.959$, $p = 0.001$). A post-hoc analysis revealed that the number of adult users of dry meadow was significantly higher compared to children ($p = <0.001$), teens ($p = 0.002$), and seniors ($p = <0.001$) (Fig. 3.31).

Thirdly, the distribution of age across users of pedunculate oak-ash woodland was determined using an Independent-Samples Kruskal-Wallis test. The test concluded that the number of observed users was not the same across the four age groups ($H(3) = 13.883$, $p = 0.003$). A post hoc analysis determined that the number of adults visiting this habitat type was significantly higher than other age groups (children ($p = 0.011$), teens ($p = <0.001$), senior ($p = 0.005$) (Fig. 3.31).

The final analysis compared the number of users of amenity grassland across four age categories. An Independent-Samples Kruskal-Wallis test determined that the distribution was not the same across the four age categories (H (3) = 8.783, p = 0.032). A post hoc analysis concluded that number of senior users of amenity grassland was significantly less than number of children (p = 0.007) and adult users (p = 0.035) (Fig 3.31).

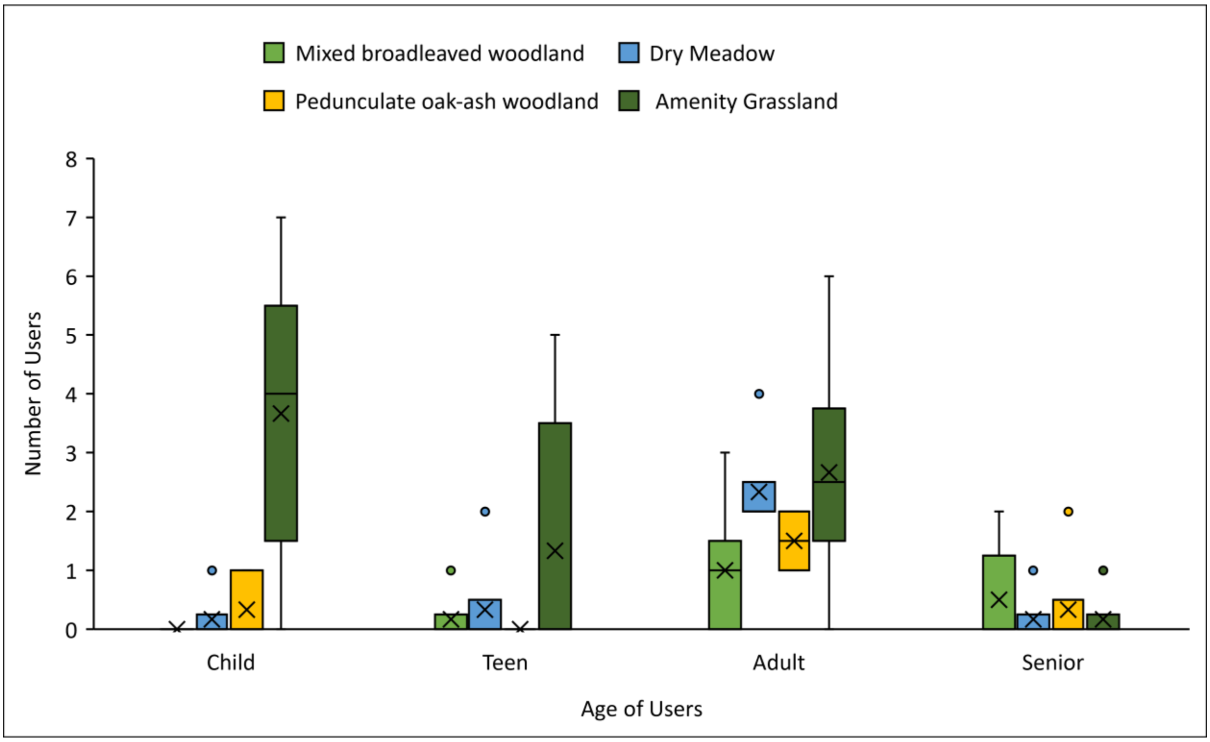


Figure 3.31. The distribution of age of users across four habitat types in Ballincollig Regional Park, Cork.

3.3 Logistics

3.3.1 Structured Interviews with Park Managers

A total of three groups who received structured interviews for park managers responded, the first of which was Cork City Council (CCC). CCC presides over the 6 parks which were included in this study as well as several others within the city limits and its commuter towns. Originally Cork city was divided into five management areas within the city limits, later expanding to include the commuter towns Blarney, Douglas and Ballincollig which were previously under the remit of CCC. An in-person interview was conducted with the city horticulturalist who is second in command in Cork City's Parks Department and an ecologist also working in this department.

The second response to this interview was provided by the Office of Public Works (OPW). The OPW's responsibilities include managing the State's property portfolio, the care of over 700 heritage sites and providing an engineering service to the Estate Portfolio Management and Flood Risk Management functions of the OPW as well as to other government departments (Office of Public Works, 2020). They also care for several parks and gardens including Phoenix Park, St. Stephen's Green, Garnish Island, and Fota Arboretum and Gardens.

The third responder was Cork Nature Network (CNN). CNN is a non-profit wildlife conservation organisation which aims to restore healthy, functioning ecosystems for both human populations and wildlife in Ireland. While they do not function in the managing of parks directly, they are involved in many biodiversity projects around Cork City (Cork Nature Network, 2022). Some of their ongoing projects include Beaumont Quarry and Tramore Valley Park, both of which are included in this study.

It should be noted that though many interviews sent to park management organisations got an initial response from a customer service level, with assurances that they would be forwarded to relevant employees, they did not go beyond this point.

Some responses have been edited for clarity.

Q. Within the urban parks under your control, what resources are allocated to individual parks? How do you decide which individual parks to allocate resources to (e.g., decisions based on numbers of park users, size of park, its location, cultural importance, existing facilities?)

CCC: The city's parks department currently works from an annual budget which is combined with grants from other departments which are then matched by the City Council. Parks within the original five management areas do not have specific budgets allocated to them but rather work from an annual budget with a separate emergency fund. Meanwhile those which were previously part of the County Council's remit do have specific budgets allocated to them.

OPW: The OPW is funded by the Department of Finance from the national budget. The OPW then allocate a budget to each individual park (1) to cover payroll and (2) to cover non-pay items.

CNN: We co-manage areas with Cork City Council. Cork Nature Network took on Beaumont Quarry in 2015 and have worked with Cork City Council on this. They fund some of the work and we look for grants for other parts. It is used for wildlife and recreation. We are also *working on the Tramore Valley Park where we are developing a biodiversity action plan. This has just started.*

Q. Within individual parks, what proportion of resources do you allocate to the different aspects of the park (e.g., park infrastructure, amenities, vegetation management, biodiversity management?). What are the decisions based on (e.g., consultants reports, anecdotal information, citizen-led information, national/regional urban park guidelines)?

CCC: Cork city council representatives noted that the public are vocal in what they want in their parks and that equipment such as playgrounds are always in high demand. Playgrounds in parks are often funded by a combination of grants from the Department for Children which are then matched by the city council. They are also involved in green flag programmes for a number of their parks which require them to hold events for the public and also initiatives such as the Kinship Project which is being funded by the Creative Climate Action Fund through Creative Ireland. This project works to empower communities to change how they interact with the environment. In Tramore Valley Park a durational public artwork will provide a programme of artistic residencies, a series of creative and knowledge exchanges and the design and building of a sustainable Ecolab (Cork City Council, 2022).

OPW: each superintendent and site manager use their budget to carry out the day to day running cost of the park. Consultant's reports may be used in assessing building etc. on site. Any works from these reports come from a separate structural repair fund.

CNN: Not relevant to us. We work to a management plan. Funding is always an issue.

Q. How are urban parks under your control managed for the public? (e.g., provision of playgrounds, playing fields, outdoor exercise equipment, information boards, constructed pathways, lighting etc.?) What information do you use to make these decisions (e.g., consultants reports, anecdotal information, citizen-led information, national/regional urban park guidelines)?

CCC: Often, the public make their desires for amenities known to the city council, especially playgrounds, which are highly requested. The council often decide on the style of amenity based on the socio-economic factors of the area and evolve parks to suit the local people. For example, areas with higher levels of antisocial behaviour have metal benches as opposed to wood, so they cannot be set on fire and the number of amenities present is limited to the bare minimum. In areas where there is little to no anti-social behaviour, the style of amenities can *be catered to the specific style of the park. For example, Tramore Valley Park is managed with a "rural" theme in mind and so amenities are chosen with this in mind (wooden benches with classic designs etc.).*

OPW: The OPW parks are managed as historic landscapes so not all are suitable for playgrounds/pitches. Information panels are provided on most sites. Lighting is not provided on sites as most are closed overnight.

CNN: We work to a management plan. We are not landowners. We have information boards up which are based on volunteer surveys.

Q. Within the urban parks under your control, how (if at all) is biodiversity managed (e.g., native tree planting, bat boxes, bird nesting boxes, wildflower meadows, pond/stream management)? What information do you use to make these decisions (e.g., consultants reports, anecdotal information, citizen-led information, national/regional urban park guidelines)?

The biodiversity of Cork City Council parks is currently managed by a combination of people within in the department, but they will be hiring a specific Biodiversity Officer within the next year. They are currently in the process of testing non-chemical vegetation management, with the majority of it being replaced with manual labour. This is in an attempt to follow the All-Ireland Pollinator Plan.

The All-Ireland Pollinator Plan is a 5-year roadmap beginning in 2021 with the aim to help bees, other pollinators and our wider biodiversity. This voluntary project consists of 186 actions across 6 objectives and was developed by a steering group who provide oversight while its implementation is co-ordinated by the National Biodiversity Data Centre. In terms of urban land, the plan aims to encourage more land to be made pollinator friendly, provide more training for managers, expand the plan into further public sectors such as the health sector, establish a "Pollinator Trail" in order to celebrate areas of restored habitat across the island of Ireland, to strengthen links with other initiatives such as health and climate, and to track changes and monitor pollinators on public land (Fitzpatrick *et al*., 2021). The City Council are also evaluating invasive alien species, mapping them over a temporal scale and taking note of reductions and expansions. Cork city council also employs a tree officer whose work involves inspecting trees and making recommendations about planting and felling trees.

Vegetation in Cork city parks is managed with the socio-economic background of the area in mind. For example, in parks where antisocial behaviour is prevalent, vegetation in the main body of the park is kept low so that users have long lines of site while any high vegetation is kept to the perimeters of the park with low growing plants underneath to inhibit access.

OPW: The OPW has its own biodiversity plan and is preparing surveys of its parks by independent consultants. Wildflower meadows are now a part of most parks. We have started using some battery-operated machinery, reduced the use of chemicals for weed control and reduced peat use by mixing (compost) with recycled materials.

CNN: We work to a management plan for Beaumont Quarry. For Glentrasna Park (located on Cork's north side) the plan is to create a wildflower meadow. We will leave an area unmown and survey and observe. We tend to encourage leaving sites rather than reseeding them. We have volunteer biologists on board.

Q. Lastly, within urban parks under your control, are management decisions essentially pro-active or reactive? For example, are there long-term management plans for the individual parks or are decisions for individual parks based on events or circumstances at any one time (or a combination of these)?

CCC: As previously stated, the city council do have an emergency budget as there are always certain scenarios that they cannot account for. The parks department is often called away to deal with emergencies outside of their department such as flooding and storms.

OPW: We would like to think we are proactive in planning ahead on projects for each park so we can apply for funding, but there will always be situations we have to react to.

CNN: Yes, Beaumont Quarry has a management plan.

4.0 Discussion

When taking into account the three aspects of park management biodiversity, people and logistics, dry meadow is the optimal habitat type for urban parks among those selected for this study. This habitat type was species rich and had a high overall level of diversity while also creating habitat for threatened plant species and limiting invasive species. Biodiversity aspects of parks such as grassy areas, insects and flowers were viewed positively among all park visitors, especially female users and users over the age of 50.

Because of Cork City Council's involvement in the All-Ireland Pollinator Plan, there has been an increase in unmanaged grassland in parks and other infrastructure around the city, many of which have evolved into dry meadows. This habitat type was once widespread throughout the island of Ireland but as agriculture has become more intensive with the increased use of fertilisers and reseeding fields with cash crops, plant communities which were once common in this form of habitat in the 1960's are now absent or rare (O' Sullivan, 1969; Sullivan *et al.*, 2010). Because land management in this semi-improved habitat has been less intensive in recent years, it would be reasonable to expect a measurable increase in species richness as this habitat type ages (Sullivan *et al*., 2010). We have shown that dry meadow had consistently high species richness and diversity among habitats in this study. The predicted age of meadow habitats in Cork parks is also beneficial to park managers, as they yield high biodiversity in a limited number of years with limited management. This is further solidified by the indicator species identified in these urban grasslands. The quantity and quality of indicator species identified suggests that both planted native meadow and grassland which was previously managed and now abandoned yield a high quality of dry meadow.

The carabid fauna of urban meadows contain species which are sensitive to different levels of urbanisation pressure, some of which are dependent on the presence of dry meadow habitats in rural environments. One study identified 3428 individuals which belonged to 78 carabid species caught in urban grasslands (Venn & Kotze, 2013). Spider species also make use of urban grasslands with rare and protected spider species present in this habitat type (Szmatona-Turi *et al*., 2019). Spiders have multiple life strategies and different habitat preferences due to their species richness and therefore are considered to be ecological indicators (Blandin, 1986).

Previously these areas of dry meadow would have been amenity grassland and whilst this habitat is favourable for some species of foraging birds and carabids, in general they are considered to be ecological deserts that have very little biodiversity value (Shwartz *et al.*, 2008;

Blubaugh *et al*., 2011; Gilbert, 2012). Both intensive management such as grass mowing and recreational use over a long period of time exerts strong selective pressure on vascular plant communities, resulting in assemblages dominated by stress-tolerant species (Hamberg *et al*., 2008). In particular, lawn mowing selects for species which disperse vegetatively, are low growing, possess a rosette, flower early and are annual or biennial (Pykala, 2001).

Dy meadows are also optimal for urban park visitors. For example, meadow habitat limits levels of antisocial behaviour, littering and criminal activity, because of long lines of sight and possibility for the installation of CCTV if desired. Several amenities are also compatible with this habitat type such as playgrounds, footpaths, and litter bins because of its generally flat topography. Though the observational study found more users in amenity grassland, it should be noted that the meadow habitats in Ballincollig Regional Park are present off the main path through the park and this could have affected the number of visitors observed. Though amenity grassland was preferred overall, male users have showed no preference for it over meadow, and this could be the case for all users, when the meadow is present along the main pathway.

Logistically, this habitat type is also optimal because of the limited amount of maintenance it requires. Dry meadow needs only to be cut once or twice a year and vegetation removed meaning that the cost of equipment and manpower needed is small and therefore cost effective.

Mixed broadleaved woodland was also determined to be a suitable habitat type for urban parks. This habitat type had a similar species richness and diversity to dry meadow, and biodiversity elements such as trees, wooded areas, and birds were viewed positively among questionnaire participants. Though urban parks are often perceived as species poor habitats they are integral in maintaining plant and animal species as land use changes from natural to urban.

The connection between the enjoyment of trees and fresh air along with visitors' use of the park for a sense of well-being, enjoyment of the natural environment, and escaping city-life links urban park use to practices such as *Shinrin-yoku*, a Japanese term which can be defined as making contact with and taking in the atmosphere of the forest. This practice has been proven to promote lower concentrations of cortisol, lower blood pressure, lower pulse rate, greater parasympathetic nerve activity and lower sympathetic nerve activity (Park *et al*., 2010).

Overall, the greatest number of species was found in Ballincollig Regional Park, while the forest habitat in Beaumont quarry was the individual habitat with the highest number species. Both of these parks have spent a large period of time abandoned which is being increasingly recognised as a valuable ecological resource through the provision of ecosystem services which address both environmental degradation and support a high richness of flora and fauna (Herrmann *et al*., 2016; Delgado de la Flor *et al.,* 2017). Results for mixed broadleaved woodland in particular suggests that abandonment may be a stronger influence on diversity than the age of the habitat and this is further solidified by the number of indicator species for high quality woodland found in these parks.

Urban forests are a habitat for carabid species and can help sustain and improve the species diversity of ground beetles. Owing to their heterogeneity, urban forests provide for the presence of various ecological groups of Carabidae. A study which took place in Poland collected 4400 individuals representing 70 species across 3 urban forest habitats (Kosewska *et al*., 2013). Spider species are also abundant in urban forests and studies have found that overall, spider species richness was significantly higher in urban sites compared to rural and suburban ones (Magura *et al.,* 2010). It was found that increased diversity was due to a significantly greater number of open-habitat species in the assemblages at urban sites suggesting that species from the surrounding countryside had penetrated the disturbed urban sites.

The most common plant species which occurred in Cork parks were as one might expect for a temperate climate, however, the high instance of winter heliotrope is of concern. Winter heliotrope is an invasive species in Ireland and creates a low-growing, compact leaf canopy which excludes light and supresses native species (Booy *et al.,* 2015). Invasive species in general were of concern to questionnaire participants, and so the eradication of these was recommended for both the benefit of the habitats themselves and for park users. Secondly, the high presence of ash is of concern due to the recent surge of ash dieback (*Hymenscyphus fraxineus*) which was first identified in Ireland in 2012 (McCracken *et al*., 2017), however, Cork City Council are actively replacing ash trees in parks around the city. Woodland are also a cost-effective habitat type due to the low maintenance required after their initial establishment.

Because mixed broadleaved woodland is largely an enclosed habitat it can potentially create safety issues, and this is where is begins to fall behind dry meadow in terms of its optimality. Because of short site-lines, urban forests can become centres for antisocial behaviour and littering which were concerning to visitors. This negative aspect of woodlands in parks is also visible in questionnaire data regarding trees in which males are only present at the end of the Likert scale whereas young females are present at all stages of the scale, suggesting some are uncomfortable in wooded areas. Woodland habitats were also the least visited habitats overall.

Though scrub habitats are often viewed negatively because of their untidy visual, there is emerging evidence that scrub habitat and urban wastelands can contribute to urban biodiversity, generally harbouring more species than other urban green spaces such as amenity grassland (Bonthoux *et al.*, 2014). Scrub habitats such as these can also be perceived positively when their importance and uses are understood by the public (Mathey *et al.*, 2018). This was evidently the case in Cork City, where questionnaire participants responded positively to wild unmanaged habitats. The frequent presence of information boards in Cork City parks could be a contributing factor to this with boards positively viewed in terms of the information they provide and their cost to park management.

An example of a diverse scrub habitat can be seen in Ballybrack woods, which had high species diversity and richness. In contrast to this, the scrub in Beaumont quarry had a low diversity and richness, dominated by the invasive species winter heliotrope and Japanese knotweed. When the background of these habitats is taken into account it suggests that age is a contributing factor to the diversity of scrub vegetation. This is perhaps due to the fact that this type of scrub in Ireland is a precursor to the climax vegetation, woodland, and therefore as the scrub gets older, taller species begin to shade out ground-dwelling invasives such as winter heliotrope as well as native scrub such as bramble, allowing for more species at all levels of the habitat. Because scrub is often a transitional habitat between grassland and woodland, it does not have indicator species associated with it, however, indicator species for high quality woodland and grassland were present as well as species which are less widespread in Ireland, indicating that while scrub habitat may be often perceived as a low quality habitat, it can act as a refuge for plant species.

Scrub habitats can also be viewed negatively because of their association with social aspects such as antisocial behaviour, criminal activity and litter. However, they can also be used as a tool to combat these negative aspects, as can be seen in The Glen River Park where low growing shrubs are used to deter antisocial and criminal behaviour. The logistical nature of such habitat is also a positive as it requires practically no upkeep.

Pedunculate oak-ash woodland had a high amount of heterogeneity despite its relatively low species richness. Several of the species identified were also indicator species of high quality pedunculate oak-ash woodland suggesting that this habitat type meets the key factor of biodiversity quite well. Urban pedunculate oak-ash woodland habitats are rich with invertebrate species as found in English parks similar in composition to the one in Ballincollig

Regional Park. A number of spiders associated with wet or waterlogged habitats have been identified along with species of soldier fly and cranefly (Gregory, 2013).

Water features such as rivers were enjoyed to a large extent by users and this may influence visitation by park users, which was higher than that of mixed broadleaved woodland, a similar habitat. There were, however, a small number of female users under the age of 50 who did not enjoy water features, perhaps due to perceived danger for themselves or children. A significant number of adults were also found to use this habitat type, further suggesting a possibly danger for younger park goers.

Logistically, this park has a slightly higher requirement for maintenance due to the need for solid, raised pathways so that users can successfully traverse this habitat, as opposed to in dry woodlands where uses can walk on bare soil.

A viable option for tree planting that is overlooked in Irish parks is the planting of fruit trees (Efendi & Budiarto, 2021; Santosa *et al*., 2021). Fruit trees have several attributes that are beneficial to park visitors. A case study in Montreal, Canada studied the impacts that planting fruit trees in an urban park had on four types of social phenomena (Colinas *et al*., 2019). These were the connections between residents and between residents and the local administration also known as social capital, the residents' sense of place (place attachment), people's knowledge of food and the food system, and people's knowledge of the environment as a whole. It was found that even in a short period of time, fruit trees had a positive influence on three of the four social phenomena studied, namely social capital, place attachment, and food knowledge. There were no impacts found on certain aspects of social capital (linking social capital, sense of community and neighbouring), knowledge of the food system and environmental knowledge. This suggests that the current level of usage and appreciation is relatively high, with the majority of visitors having already tasted fruit from the park and looking forward to the time when the trees are more productive. Most participants had not previously foraged for fruit and so public orchards have the potential to introduce non-foragers to fruit picking. Some participants also noted their enjoyment of the scent and beauty of fruit trees while others were hesitant to pick fruit because of their fear of worms, lack of knowledge or lack of habit. This was found to be influenced by a lack of fruit picking experience in childhood (Collinas *et al*., 2019).

To ensure that fruit tree planting in urban parks is successful, the trees should be welcomed at all stages and their fruit should be harvested, since littering (in this case, fruit on the ground), can negatively affect visitors' perception and usage of the trees. To ensure this, the nature, location, and density of the fruit trees planted should match park visitors' prior openness to fruit trees, and if necessary, the production density should be increased gradually. In terms of the nature of these trees, some species might be more readily accepted than others, such as plants which produce berries, over large hard fruits such as apples. It is also not sufficient for the trees to be completely harvested, trees must be harvested by the greatest proportion of people and in a fair manner. Providing information to citizens and organising participatory events also increases appreciation of fruit trees (Collinas *et al*., 2019).

The final habitat, reed and large sedge swamp was found to contain a moderate to high heterogeneity of plant species and even contained a species that is classified as vulnerable in Ireland. Additionally, elements of the natural environment which are found in wetlands such as birds and insects were positively viewed among all interviewees. Urban wetlands and ponds such as those in The Glen River Park are also important habitats for invertebrates in cities. Urban ponds provide a diverse range of habitats for both rare and common aquatic macroinvertebrate taxa and represent a valuable biodiversity asset within human dominated landscapes (Hill, *et al*., 2015).

While logistically this habitat type can require more capital and maintenance than others due to the need for infrastructure such as bridges or raised walkways, it also has benefits that out-weigh these costs. Because Irish wetlands have been severally depleted in the past due to drainage for agriculture and turf-cutting, so has their potential for carbon sequestration and flood control (Bullock *et al*., 2012). Therefore, the presence of this habitat type and the potential creation or restoration of similar parks in the future not only benefits visitors and biodiversity, but also climate as a whole. The service of flood prevention also has the potential to save management bodies such as Cork City Council capital and criticism.

In terms of park amenities, this study found that basic facilities such as footpaths and litter bins were preferred over more complex facilities such as outdoor exercise equipment. This is evident from both the park user questionnaire and SOPARC observations, the first of which showed users appreciation of pathways and strong dislike when they were not present, a strong dislike of litter, and a disinterest in outdoor exercise equipment, as confounded by the absence of use during observations. Logistically, this is a positive for park management as beyond initial cost, pathways and litter bins require little capital and maintenance while exercise equipment is costly to install and requires weekly and monthly evaluations and maintenance.

Similar maintenance is required for children's playgrounds however, observations of use of this amenity type were extremely high with one momentary time sample recording a total of 41 users. This is supported through the interviews performed with Cork City Council, who said that playgrounds were the publics most requested facility. In the park user questionnaire, playgrounds were not as highly appreciated, however it should be noted that numerous individuals who were approached to take this questionnaire who had children refused to, on the grounds that they were in the park alone and could not take their eyes of their child for the period of time required to partake. This lack of parents in the park could also be the result of the postponement of having children in modern couples due to increasing education levels in women, housing conditions and economic uncertainty (Mills *et al*., 2011).

Other amenities such as park benches were positively viewed by park users and are especially important to older users, who commented on their requirement for a place to rest. This is supported by SOPARC which recorded many members of the public using picnic areas. Lighting in the park is also important to older users who thought it should be a requirement so that the park could be enjoyed, even during winter. From these results it can be inferred that the age of park users' effects which amenities are preferred and so the demographics of a parks catchment area should be taken into account during the planning process.

Recreational facilities such as those previously mentioned were overall, more popular than sports facilities as well as using the park specifically as a place to exercise. Areas associated with exercise such as playing fields and cycleways were less appreciated when compared to other amenity types and had less users during park observations and so logistically, should not be a high priority item for park managers.

Antisocial behaviour was also highly disliked by park users, and this was echoed by Cork City Council as a large contributor to how they manage parks. For example, the Glen River Park is managed with antisocial behaviour in mind, as it is located in an area that has had incidences of antisocial behaviour in the past. The valley floor is planted with low growing shrubs and pathways have large grass margins, so sightlines are long and clear. The sides of the valley are planted with trees and thick undergrowth to prevent people from loitering (Fig. 4.1).

Amenities in the park are also carefully chosen. They are limited to the bare minimum and those which are included, such as benches are metal to prevent arson. The park is also located next to a council depot (a building from which employees operate) to discourage potential antisocial behaviour.

Figure 4.1. Image showing pathway in the Glen River Park, Cork showing wide margins and long lines of site to prevent anti-social behaviour.

However, these measures are not one hundred percent effective. Multiple parks included in this study including The Glen River Park have been victims of such behaviour (Fig.4.2).

Figure 4.2. Six images of litter and antisocial behaviour at Cork city parks. On the top left is an image of a firefighter controlling an intentionally set fire at Ballincollig Regional Park (O'Callaghan, 2022). *The top middle image shows the remains of a picnic bench set on fire at Ballincollig Regional Park* (*Bohane, 2022). The top right image shows domestic waste at the Glen River Park (O'Neill, 2017). The lower left image shows firefighters fighting an intentionally set gorse fire at the Glen River Park (English, 2022). A second fire was also set in the same week at the opposite side of the valley. The bottom middle image shows domestic waste dumped at Ballincollig Regional Park (O'Shea, 2020). The image on the lower right shows a public toilet at Ballincollig Regional Park which was set on fire (Graham, 2020).*

From the structured interviews, it is clear that the parks sector is underfunded and unappreciated. In fact, many local authorities outside of larger Irish cities such as Cork do not have a specific parks department, but are instead, a part of the roads or heritage department. Meanwhile in urban areas which do have parks departments, employees are regularly removed from their department to work on emergency relief situations. Furthermore, many park managers are constantly struggling to find compromises between policy and public opinion and advocating for funds which are simply not there.

This study has also highlighted the importance of understanding the abiotic factors which influence the park and how they should be taken into account when managing an urban space. Though dry meadow was selected as the optimal habitat type for urban parks, it is not suitable for waterlogged soil or elevated topographies. In the case where soil has a high water content or is low lying, reed and large sedge swamp or pedunculate oak-ash woodland would be more suitable, depending on the vegetation already present and whether social aspects such as antisocial behaviour need to be taken into account. Where slopes are present there are several different management typographies depending on the amount of maintenance desired. Options such as one-off engineering (e.g., rock armour), intensive management (e.g., mowing), or ecological engineering (e.g., selective planting for scrub) are all viable for this topography. Social aspects such as antisocial behaviour should also be taken into account when choosing the type of slope management. If selective planting is chosen, there are several possible plant species which are viable, including blackthorn, hawthorn and holly, all of which are densely growing and can also be very aesthetically pleasing. Table 4.1 below give a summary of this information.

Table 4.1 Summary of recommendations for park managers in relation to habitat selection and maintenance.

	Dry meadow	Mixed Broadleaved Woodland	Scrub	Pedunculate oak-ash woodland	Reed and large sedge swamp
Elevation	Low	Low-Medium	Low-High	Low	Low
Soil moisture content	Low	Low	Low	High	High
High possibility of antisocial behaviour	No	Yes	No	Yes	No
Maintenance required	Medium	Low-Medium	Low	Medium-High	Medium-High

Despite the obvious need for adequate green spaces in cities, parks are still at risk. Over the course of this study alone, two Cork City parks have been either reduced in size or will potentially be destroyed completely. Ballybrack Woods, which was included in this study, is set to become the site of a new link road. The scheme will involve the construction of an 82m bridge over Ballybrack woods at the height of the valley sides. The local community recently met to discuss this new development (Fig. 4.3). A politician present at the meeting described "*Anger at the lack of information, anger at the lack of reasons for such a proposal and anger at the disrespect shown to the people of Douglas and surrounding area"* (thecork.ie, 2022).

Figure 4.3. Image (left) of notice to meet at Ballybrack woods (The Mangala) to discuss the construction of a bridge over the park and image (right) of members of the Douglas community attending the meeting (Cllr. McCarthy, 2022).

A second park, Bishop Lucey Park which is located in Cork City centre, was reduced in size this year to allow for an extension of the Freemason's Hall (Fig. 4.3). This decision was met with some criticism. A local university lecturer said, "*this decision allows for the piecemeal erosion of public green space in the city centre for purposes which are of no real benefit for* *the public at large"* while a local politician said, *"this is a bad precedent to set in a city like Cork and opens the doors for further encroachments on green spaces"* (echolive.ie, 2022).

Figure 4.4. Photograph of Freemason's Hall on the left and a section of Bishop Lucey Park on the right.

Management organisations for parks need to do more than just operate. If dynamic systems like urban green spaces are just maintained, over time they will start to de-generate. Much of the literature on management has proposed that in order for park management plans to survive against other organisations, for example other departments within the governing body, efficient action is a must, or at the very least, action that is more efficient than that of the least efficient competitor (Randrup & Persson, 2009).

As competition for space in urban areas heightens with growing populations, so does the need for advocacy of the protection of urban parks. Not only are they vital to the lives of urban people, but also to the future biodiversity of this planet and so finding the compromise between biodiversity, people, and logistics is paramount.

5.0 Limitations

As with the majority of studies, the design of this study is subject to limitations. The first of these is present in the biodiversity section. Because of time limitations, only plants and fungi were surveyed, but in order to get a full perspective on the biodiversity of urban parks, invertebrates and birds would also be appropriate for this study with mammals also a viable option in larger parks. Secondly, only vascular plants were identified in this study due to the difficulty in identifying non-vascular plants species when compared to vascular species. Non-vascular species are good biological indicators especially lichens and mosses for the quality of woodlands. For the qualitative vegetation data some habitats surveyed like the wetland do not currently have a list of plant indicator species in an Irish context due to the absence of systematic site survey data for example species lists or relevés and the corresponding environmental data (Kilroy *et al*., 2008). This could be combatted again by conducting invertebrate surveys in the water to help determine water quality. Including such patterns and mechanisms as beta and gamma diversity would also help in the development of strategies and measures for understanding species diversity within and across urban green spaces and whether a single large of several small parks are a better means of creating parks. Including these options would also allow results to be equivalent to the questions asked about the natural environment in the questionnaire, giving a more rounded result.

In terms of the aspect, people, the park user questionnaire shows some unconscious bias as well as an insufficient sample size. The majority of participants in this study are females under the age of 50, similar to that of the main researcher. The sample size was also small because of time restrictions and lack of human resources. More samples of various ages and genders would not only aid in ensuring that the sample obtained were representative of park visitors, but also reduce age and gender bias in the sample. Future studies could also expand to include several Irish urban centres, including Dublin, to determine if there are cultural differences between post-industrial city-residents and those which have had parks present for long periods of time. It would also be advantageous to see if there is a variation in public opinion across different parks within the same city to determine if factors such as the socioeconomics of a given area effect the result. For this particular study it was determined that Cork city was too small an urban centre to have clear delineations between parks and the populations that use them and so this was excluded from the study. In terms of the human habitat use observational study, the sample size is also insufficient because of time limitations. Repetitious observations at different times of the day and across several months would give a more representative sample of habitat users.

Finally, in the logistics sections, more responses from park managers would give a more a representative insight into how Irish parks are managed. Though interviews were sent repeatedly over the course of several months, response rates were low. This was, in part, due to limited access to respondents beyond generic customer service email accounts.

6.0 Recommendations

The following section lists recommendations for urban park managers based on the results obtained in this study.

Vegetation

- Park user questionnaire results and observational studies showed that grassy areas were very popular among users. Dry meadows also showed high species richness among habitats and therefore this habitat type is optimal for Irish parks. A lack of biodiversity was also a concern among users, and so choosing meadow over mown grass is preferred. This habitat type also requires little maintenance and so is optimal for logistics. However, keep in mind abiotic factors such as slope and soil moisture content (See Fig.
- Trees were the most popular vegetation type in the park user questionnaire, however the observational study of habitats showed that users preferred grassland to forest habitats. A compromise to this could be parklands or a combination of habitats. Trees require little maintenance after initial installation and so are optimal for managers.
- Flowers were the least popular vegetation type among users. As they require high maintenance, they are not the first recommendation for managers, however, after other vegetation types have been established, they may be included.
- Invasive alien species were of biggest concern to users in regards to the natural aspect of the park. As invasive species are also detrimental to biodiversity, it is preferred that they are eradicated where possible.

Amenities and facilities (in descending order)

- Adequate pathways are the most important park amenity for users, and they dislike when they are not adequately maintained. As after installation, maintenance is minimal, it is advised that pathways are a high priority for managers.
- Wildlife and historical information boards are also popular among users. These require little management after initial installation and so are recommended to park managers. The lack of bins, both regular and dog waste bins, is an issue among users. Litter and dog waste in the park are also of high concern to them. As they require little maintenance, they are recommended to managers.

Playgrounds for children are important for users. Though questionnaire data refutes this, biases in this study along with SOPARC data showed their popularity among users, while the park manager interview also supported this. Despite the fact that they require high levels of management and weekly inspections, they are still recommended to managers, though previously mentioned amenities should take priority.

- Public art is enjoyed by users as shown in the park user questionnaire. As it requires little maintenance after initial installation, it is recommended to users
- Outdoor exercise equipment should not be of high priority to park managers. Park user questionnaires showed that they are not highly appreciated by park users, and this was supported by SOPARC data which recorded no use during observation

Social/Cultural

- Combatting antisocial behaviour is the most important social aspect of the park to users. However, they do not wish for there to be authority figures in the park. Purposeful planting may be a solution to this problem.

7.0 References

Akpinar, A., 2016. How is quality of urban green spaces associated with physical activity and health? *Urban forestry & urban greening*, *16*, pp.76-83.

Aronson, M.F., La Sorte, F.A., Nilon, C.H., Katti, M., Goddard, M.A., Lepczyk, C.A., Warren, P.S., Williams, N.S., Cilliers, S., Clarkson, B. and Dobbs, C., 2014. A global analysis of the impacts of urbanization on bird and plant diversity reveals key anthropogenic drivers. *Proceedings of the royal society B: biological sciences*, *281*(1780), p.20133330.

Aronson, M.F., Lepczyk, C.A., Evans, K.L., Goddard, M.A., Lerman, S.B., MacIvor, J.S., Nilon, C.H. and Vargo, T., 2017. Biodiversity in the city: key challenges for urban green space management. *Frontiers in Ecology and the Environment*, *15*(4), pp.189-196.

Aspinall, P.A., Thompson, C.W., Alves, S., Sugiyama, T., Brice, R. and Vickers, A., 2010. Preference and relative importance for environmental attributes of neighbourhood open space in older people. *Environment and Planning B: Planning and design*, *37*(6), pp.1022-1039.

Aune-Lundberg, L. and Bryn, A., 2018. Spatial transferability of vegetation types in distribution models based on sample surveys from an Alpine region. *Journal of Geographic Information System*, *10*(01), p.111.

Bellehumeur, C., Legendre, P. and Marcotte, D., 1997. Variance and spatial scales in a tropical rain forest: changing the size of sampling units. *Plant Ecology*, *130*(1), pp.89-98.

Blandin, P., 1986. Bioindicators and diagnosis of ecological systems [French]. *Bulletin d'Ecologie*.

Blubaugh, C.K., Caceres, V.A., Kaplan, I., Larson, J., Sadof, C.S. and Richmond, D.S., 2011. Ground beetle (Coleoptera: Carabidae) phenology, diversity, and response to weed cover in a turfgrass ecosystem. *Environmental entomology*, *40*(5), pp.1093-1101.

Bohane, J., 2022. “No concept of community and respect”: Anger following vandalism in Cork town (echolive.ie). Available at https://www.echolive.ie/corknews/arid-40848107.html (Accessed 04/01/2023)

Bonthoux, S., Brun, M., Di Pietro, F., Greulich, S. and Bouché-Pillon, S., 2014. How can wastelands promote biodiversity in cities? A review. *Landscape and urban planning*, *132*, pp.79-88.

Booy, O., Wade, M. and Roy, H., 2015. Field guide to invasive plants and animals in Britain.

Bradley, C., Hirt, M., Hudson, S., Northcote, N. and Smit, S., 2020. The great acceleration. *McKinsey Quarterly*, pp.1-7.

Brown, G., de Bie, K. and Weber, D., 2015. Identifying public land stakeholder perspectives for implementing place-based land management. *Landscape and Urban Planning*, *139*, pp.1-15.

Bulkeley, H., 2010. Cities and the governing of climate change. *Annual review of environment and resources, 35*, pp.229-253.

Bullock, C.H., Collier, M.J. and Convery, F., 2012. Peatlands, their economic value and priorities for their future management–The example of Ireland. *Land use policy*, *29*(4), pp.921-928.

Byun, C., de Blois, S. and Brisson, J., 2013. Plant functional group identity and diversity determine biotic resistance to invasion by an exotic grass. *Journal of Ecology*, *101*(1), pp.128-139.

Chave, J., 2013. The problem of pattern and scale in ecology: what have we learned in 20 years? *Ecology letters*, *16*, pp.4-16.

Chiesura, A., 2004. The role of urban parks for the sustainable city. *Landscape and urban planning*, *68*(1), pp.129-138.

Chung-Do, J.J., Davis, E., Lee, S., Jokura, Y., Choy, L. and Maddock, J.E., 2011. Peer Reviewed: An Observational Study of Physical Activity in Parks in Asian and Pacific Islander Communities in Urban Honolulu, Hawaii, 2009. *Preventing chronic disease*, *8*(5).

Chytrý, M., Schaminée, J.H. and Schwabe, A., 2011. Vegetation survey: a new focus for Applied Vegetation Science. *Applied Vegetation Science*, *14*(4), pp.435-439.

Coles, R.W. and Bussey, S.C., 2000. Urban forest landscapes in the UK—progressing the social agenda. *Landscape and urban planning*, *52*(2-3), pp.181-188.

Colinas, J., Bush, P. and Manaugh, K., 2019. The socio-environmental impacts of public urban fruit trees: A Montreal case-study. *Urban Forestry & Urban Greening*, *45*, p.126132.

Collin, T., 2022. Douglas: Public need more information on proposed bridge over Mangala a.k.a Ballybrack woods. Available at: https://www.thecork.ie/2022/07/16/douglas-public-need-more-information-on-proposed-bridge-over-mangala-a-k-a-ballybrack-woods/ (Accessed:18/09/2022).

Cork City Council, 2020. Cork City Socio-Economic Profile. Available at: https://www.corkcity.ie/en/media-folder/cork-city-development-plan/socio-economic-summary-profile.pdf (Accessed 04/10/2022).

Cork City Council, 2022. KinShip. Available at https://www.corkcity.ie/en/kinship/ (Accessed 04/10/2022).

Cork City Council, 2022. Green and Blue Infrastructure, Open Space and Biodiversity. Available at https://consult.corkcity.ie/en/consultation/draft-cork-city-development-plan-2022-2028/chapter/6-green-and-blue-infrastructure-open-space-and-biodiversity (Accessed 04/01/2023).

Cork Nature Network, 2022. About Us. Available at: https://corknaturenetwork.ie/about-us/ (Accessed 04/10/2022).

Cork Nature Network, 2022. Wild Walks: The Glen River Park. Available at https://corknaturenetwork.ie/wild-walks-the-glen-river-park/#:~:text=The%20Glen%20River%20Park%20is,the%20Glen%20River%20amenity%20park. (Accessed 04/01/2023).

Culliney, T.W., 2005. Benefits of classical biological control for managing invasive plants. *Critical Reviews in Plant Sciences*, *24*(2), pp.131-150.

Dalley, S., 1993. Ancient Mesopotamian gardens and the identification of the hanging gardens of Babylon resolved. *Garden History*, pp.1-13.

Dearborn, D.C. and Kark, S., 2010. Motivations for conserving urban biodiversity. *Conservation biology*, *24*(2), pp.432-440.

Delgado de la Flor, Y.A., Perry, K.I., Turo, K.J., Parker, D.M., Thompson, J.L. and Gardiner, M.M., 2020. Local and landscape-scale environmental filters drive the functional diversity and taxonomic composition of spiders across urban greenspaces. *Journal of Applied Ecology*, *57*(8), pp.1570-1580.

Dempsey, N. and Burton, M., 2012. Defining place-keeping: The long-term management of public spaces. *Urban Forestry & Urban Greening*, *11*(1), pp.11-20.

De Vaus, D. and de Vaus, D., 2013. *Surveys in social research*. Routledge.

Discovering Cork, 2022. Gunpowder Mills, Ballincollig. Available at http://www.discoveringcork.ie/gunpowder-mills-ballincollig/ (Accessed 04/01/2023).

Dormidontova V. V. Istoriya sadovo-parkovykh stiley [History of gardening styles.] / V. V. Dormidontova. – M.: Arkhitektura-S, 2004. – 208 p.

Efendi, D. and Budiarto, R., 2021, July. Benefit and challenges of using tropical fruits as ornamental trees for green city. In *II International Symposium on Tropical and Subtropical Ornamentals 1334* (pp. 369-378).

Elton, C.S., 2020. The ecology of invasions by animals and plants. *Springer Nature.*

English, E., 2022. Cork park decimated by two suspected arson attacks in 48 hours, (irishexaminer.com). Available at https://www.irishexaminer.com/news/munster/arid-40842470.html (Accessed 04/01/2023).

Evenson, K.R., Jones, S.A., Holliday, K.M., Cohen, D.A. and McKenzie, T.L., 2016. Park characteristics, use, and physical activity: A review of studies using SOPARC (System for Observing Play and Recreation in Communities). *Preventive medicine*, *86*, pp.153-166.

Fitzpatrick, U., Stout, J., Bradley, K., Campbell, P., Carmichael, N., Conway, R., Denniston, H., Fox, E., Hill, S., Keena, C., Lynch, A., Montaut, M., Murchie, A., Murray, A., Phelan, S.J., Quinn, M., 2021). All-Ireland Pollinator Plan, 2021-2025. Available at: https://pollinators.ie/wp-content/uploads/2021/03/All-Ireland-Pollinator-Plan-2021-2025-WEB.pdf (Accessed 04/10/2022).

Fongar, C., Randrup, T.B., Wiström, B. and Solfjeld, I., 2019. Public urban green space management in Norwegian municipalities: A managers' perspective on place-keeping. *Urban Forestry & Urban Greening*, *44*, p.126438.

Fossitt, J.A., 2000. *A guide to habitats in Ireland*. Heritage.

French, R., and Lawerence, W. (1905) [Photograph]. The Lawerence Photograph Collection: National Library of Ireland.

Frey, J., 1999. Practical aspects of biotope mapping in cities: methods, problems and solutions. An example of Mainz. *Deinsea*, *5*(1), pp.41-56.

Gaertner, M., Wilson, J.R., Cadotte, M.W., MacIvor, J.S., Zenni, R.D. and Richardson, D.M., 2017. Non-native species in urban environments: patterns, processes, impacts and challenges. *Biological Invasions*, *19*(12), pp.3461-3469.

Gilbert, O., 2012. *The ecology of urban habitats*. Springer Science & Business Media.

Graham, B., 2020. Fire damage to Ballincollig Regional Park 'far too common for comfort' (echolive.ie). Available at https://www.echolive.ie/corknews/arid-40111769.html (Accessed 04/01/2023).

Gregory, S., Report of a survey of the terrestrial invertebrates of trap grounds, Oxford, 2013.

Grey, G.W., 1995. *The urban forest: Comprehensive management*. John Wiley & Sons.

Hamberg, L., Lehvävirta, S., Minna, M.L., Rita, H. and Kotze, D.J., 2008. The effects of habitat edges and trampling on understorey vegetation in urban forests in Helsinki, Finland. *Applied Vegetation Science*, *11*(1), pp.83-98.

Hao, L., Qingdong, S., Imin, B. and Kasim, N., 2020. Methodology for optimizing quadrat size in sparse vegetation surveys: A desert case study from the Tarim Basin. *Plos one*, *15*(8), p.e0235469.

Hector, A., Dobson, K., Minns, A., Bazeley-White, E. and Hartley Lawton, J., 2001. Community diversity and invasion resistance: an experimental test in a grassland ecosystem and a review of comparable studies. *Ecological Research*, *16*(5), pp.819-831.

Henderson, K.A. and Ainsworth, B.E., 2001. Researching leisure and physical activity with women of color: Issues and emerging questions. *Leisure sciences*, *23*(1), pp.21-34.

Herrmann, D.L., Schwarz, K., Shuster, W.D., Berland, A., Chaffin, B.C., Garmestani, A.S. and Hopton, M.E., 2016. Ecology for the shrinking city. *Bioscience*, *66*(11), pp.965-973.

Hill, M.J., Mathers, K.L. and Wood, P.J., 2015. The aquatic macroinvertebrate biodiversity of urban ponds in a medium-sized European town (Loughborough, UK). *Hydrobiologia*, *760*(1), pp.225-238.

Hoehner, C.M., Ramirez, L.K.B., Elliott, M.B., Handy, S.L. and Brownson, R.C., 2005. Perceived and objective environmental measures and physical activity among urban adults. *American journal of preventive medicine*, *28*(2), pp.105-116.

Huenneke, L.F., Clason, D. and Muldavin, E., 2001. Spatial heterogeneity in Chihuahuan Desert vegetation: implications for sampling methods in semi-arid ecosystems. *Journal of Arid Environments*, *47*(3), pp.257-270.

Jarvis, P.J. and Young, C.H., 2005. The mapping of urban habitat and its evaluation. *Wolverhampton, University of Wolverhampton*, *19*.

Jim, C.Y. and Shan, X., 2013. Socioeconomic effect on perception of urban green spaces in Guangzhou, China. *Cities*, *31*, pp.123-131.

Kilroy, G., Dunne, F., Ryan, J., O'Connor, A., Daly, D., Craig, M., Coxon, C., Johnston, P., Henning, M., 2008. A Framework for the Assessment of Groundwater-Dependent Terrestrial Ecosystems under the Water Framework Directive. *Environmental Research Centre Report*, pp.10-13.

Kosewska, A., Nietupski, M. and Damszel, M., 2013. Role of urban forests as a source of diversity of carabids (Coleoptera: Carabidae) in urbanised areas. *Baltic J. Coleopt*, *13*, pp.27-39.

Lee, Y.C. and Kim, K.H., 2015. Attitudes of citizens towards urban parks and green spaces for urban sustainability: The case of Gyeongsan City, Republic of Korea. *Sustainability*, *7*(7), pp.8240-8254.

Lovell, S.T. and Taylor, J.R., 2013. Supplying urban ecosystem services through multifunctional green infrastructure in the United States. *Landscape ecology*, *28*(8), pp.1447-1463.

Macadam, C.R. and Bairner, S.Z., 2012. Urban biodiversity: Successes and challenges: Brownfields: Oases of urban biodiversity. *The Glasgow Naturalist*, *25*(4).

MacKenzie, A., Pearson, L.J. and Pearson, C.J., 2018. A framework for governance of public green spaces in cities. *Landscape Research*.

Magura, T., Horváth, R. and Tóthmérész, B., 2010. Effects of urbanization on ground-dwelling spiders in forest patches, in Hungary. *Landscape Ecology*, *25*(4), pp.621-629.

Mathey, J., Arndt, T., Banse, J. and Rink, D., 2018. Public perception of spontaneous vegetation on brownfields in urban areas—Results from surveys in Dresden and Leipzig (Germany). *Urban Forestry & Urban Greening*, *29*, pp.384-392.

McCafferty, D., 2019. Fifty years of urbanisation in Ireland: Structural and spatial evolution of the urban hierarchy since Buchanan. *Administration*, *67*(3), pp.65-89.

McCarthy, K., n.d. Cork Heritage. History Trail, The Marina. Available at http://corkheritage.ie/?page_id=5989#:~:text=Cork%27s%20Marina%20was%20originally%20called,It%20was%20completed%20in%201761. (Accessed 04/01/2023).

McCarthy, K., 2022. Save Ballybrack Woods (Facebook). Available at https://www.facebook.com/cllrkieranmccarthy/posts/save-ballybrack-woodsits-a-gathering-of-minds-but-mostly-to-make-sure-if-people-/1180890752753873/ (Accessed 04/01/2023).

McCracken, A.R., Douglas, G.C., Ryan, C., Destefanis, M. and Cooke, L.R., 2017. Ash dieback on the island of Ireland. Swedish University of Agricultural Sciences.

McDonnell, M.J., Pickett, S.T. and Pouyat, R.V., 1993. The application of the ecological gradient paradigm to the study of urban effects. *Humans as components of ecosystems*, pp.175-189

McKenzie, T.L., Marshall, S.J., Sallis, J.F. and Conway, T.L., 2000. Leisure-time physical activity in school environments: an observational study using SOPLAY. *Preventive medicine*, *30*(1), pp.70-77.

McKenzie, T.L., 2002. Use of direct observation to assess physical activity. *Physical activity assessments for health-related research*, *179*, p.195.

McKenzie, T.L., Cohen, D.A., Sehgal, A., Williamson, S. and Golinelli, D., 2006. System for Observing Play and Recreation in Communities (SOPARC): reliability and feasibility measures. *Journal of Physical Activity and Health*, *3*(s1), pp.S208-S222.

Miller, R.W., Hauer, R.J. and Werner, L.P., 2015. *Urban forestry: planning and managing urban greenspaces*. Waveland press.

Mills, M., Rindfuss, R.R., McDonald, P. and Te Velde, E., 2011. Why do people postpone parenthood? Reasons and social policy incentives. *Human reproduction update*, *17*(6), pp.848-860.

Mosley, J.C., Bunting, S.C. and Hironaka, M., 1989. Quadrat and sample sizes for frequency sampling mountain meadow vegetation. *The Great Basin Naturalist*, pp.241-248.

Murphy, H. Allen, J. Michael Hutchison, and Jon S. Bailey. "Behavioural School Psychology Goes Outdoors: The Effect Of Organized Games On Playground Aggression." *Journal of Applied Behaviour Analysis* 16, no. 1 (1983): 29-35.

Naeem, S., Knops, J.M., Tilman, D., Howe, K.M., Kennedy, T. and Gale, S., 2000. Plant diversity increases resistance to invasion in the absence of covarying extrinsic factors. *Oikos*, *91*(1), pp.97-108.

Nam, J. and Dempsey, N., 2019. Place-keeping for health? Charting the challenges for urban park management in practice. *Sustainability*, *11*(16), p.4383.

Neal, P., 2016. *State of UK Public Parks*. Research Report to the Heritage Lottery Fund. London: Heritage Lottery Fund.

Neal, P., Hurley, B., Harnik, P. and Hobson, E., 2014. The State of UK Public Parks 2014.

Niemi, G.J. and McDonald, M.E., 2004. Application of ecological indicators. *Annu. Rev. Ecol. Evol. Syst.*, *35*, pp.89-111.

Nolan, A., 2022. Mixed views on approval of Freemasons' Hall extension into Cork Park. Available at: https://www.echolive.ie/corknews/arid-40888190.html (Accessed: 18/09/2022).

O'Callaghan, G., 2022. Cork City Fire Brigade called to huge blaze in Ballincollig Regional Park overnight (corkbeo.ie). Available at https://www.corkbeo.ie/news/local-news/cork-city-fire-brigade-called-24261421 (Accessed 04/01/2023).

Office of Public Works, 2020. History of the Office of Public Works. Available at: https://www.gov.ie/en/organisation-information/aaa301-history-of-the-office-of-public-works/ (Accessed: 18/09/2022)

Oguz, D., 2000. User surveys of Ankara's urban parks. *Landscape and urban planning*, *52*(2-3), pp.165-171.

O'Neill, F.H. and Barron, S.J., 2013. *Results of Monitoring Survey of Old Sessile Oak Woods and Alluvial Forests*. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht.

O'Neill, K., 2017. Residents hot out at fires and rubbish in the scenic Glen River Park (echolive.ie). Available at https://www.echolive.ie/corknews/arid-40178688.html (Accessed 04/01/2023).

Ostoić, S.K. and van den Bosch, C.C.K., 2015. Exploring global scientific discourses on urban forestry. *Urban forestry & urban greening*, *14*(1), pp.129-138.

O'Shea, J., 2020. Vandals burn rubbish and benches in one of Cork's best loved parks, (corkbeo.ie). Available at https://www.corkbeo.ie/news/local-news/vandals-burn-rubbish-benches-one-17969169 (Accessed 04/01/2023).

O' Sullivan, A.M., 1969. Grassland: a fresh look. In: Biatas (Ed.), The Tillage Farmer. An Foras Talúntais. Johnstown Castle Research Centre, pp. 586–589.

Patuano, A., 2020. Biophobia and urban restorativeness. *Sustainability*, *12*(10), p.4312.

Park, B.J., Tsunetsugu, Y., Kasetani, T., Kagawa, T. and Miyazaki, Y., 2010. The physiological effects of Shinrin-yoku (taking in the forest atmosphere or forest bathing): evidence from field experiments in 24 forests across Japan. *Environmental health and preventive medicine*, *15*(1), pp.18-26.

Pleson, E., Nieuwendyk, L.M., Lee, K.K., Chaddah, A., Nykiforuk, C.I. and Schopflocher, D., 2014. Understanding older adults' usage of community green spaces in Taipei, Taiwan. *International journal of environmental research and public health*, *11*(2), pp.1444-1464.

Pykälä, J., 2001. Perinteinen karjatalous luonnon monimuotoisuuden ylläpitäjänä.

Pyle, R.M., 2003. Nature matrix: reconnecting people and nature. *Oryx*, *37*(2), pp.206-214.

Randrup, T.B., Östberg, J. and Wiström, B., 2017. Swedish green space management–The managers perspective. *Urban forestry & urban greening*, *28*, pp.103-109.

Randrup, T.B. and Persson, B., 2009. Public green spaces in the Nordic countries: Development of a new strategic management regime. *Urban Forestry & Urban Greening*, *8*(1), pp.31-40.

Roberts, P., 2009. Shaping, making and managing places: creating and maintaining sustainable communities through the delivery of enhanced skills and knowledge. *The Town Planning Review*, pp.437-453.

Rutledge, R.W., Basore, B.L. and Mulholland, R.J., 1976. Ecological stability: an information theory viewpoint. *Journal of Theoretical Biology*, *57*(2), pp.355-371.

Sallis, J.F., McKenzie, T.L., Conway, T.L., Elder, J.P., Prochaska, J.J., Brown, M., Zive, M.M., Marshall, S.J. and Alcaraz, J.E., 2003. Environmental interventions for eating and physical activity: a randomized controlled trial in middle schools. *American journal of preventive medicine*, *24*(3), pp.209-217.

Sanesi, G. and Chiarello, F., 2006. Residents and urban green spaces: The case of Bari. *Urban Forestry & Urban Greening*, *4*(3-4), pp.125-134.

Sanjerehei, M.M., 2011. Determination of an appropriate quadrat size and shape for detecting association between plant species. *Ecological modelling*, *222*(10), pp.1790-1792.

Santosa, E., Susila, A.D., Widodo, W.D., Nasrullah, N., Ruwaida, I.P. and Sari, R., 2021. Exploring fruit tree species as multifunctional greenery: A case of its distribution in Indonesian cities. *Sustainability*, *13*(14), p.7835.

Savard, J.P.L., Clergeau, P. and Mennechez, G., 2000. Biodiversity concepts and urban ecosystems. *Landscape and urban planning*, *48*(3-4), pp.131-142.

Schipperijn, J., Stigsdotter, U.K., Randrup, T.B. and Troelsen, J., 2010. Influences on the use of urban green space–A case study in Odense, Denmark. *Urban forestry & urban greening*, *9*(1), pp.25-32.

Shanahan, D.F., Fuller, R.A., Bush, R., Lin, B.B. and Gaston, K.J., 2015. The health benefits of urban nature: how much do we need?. *BioScience*, *65*(5), pp.476-485.

Shoshitaishvili, B., 2021. From Anthropocene to Noosphere: The Great Acceleration. *Earth's Future*, *9*(2), p.e2020EF001917.

Shwartz, A., Shirley, S. and Kark, S., 2008. How do habitat variability and management regime shape the spatial heterogeneity of birds within a large Mediterranean urban park?. *Landscape and Urban Planning*, *84*(3-4), pp.219-229.

Steffen, W., Broadgate, W., Deutsch, L., Gaffney, O. and Ludwig, C., 2015. The trajectory of the Anthropocene: the great acceleration. *The Anthropocene Review*, *2*(1), pp.81-98.

Stohlgren, T.J., Falkner, M.B. and Schell, L.D., 1995. A modified-Whittaker nested vegetation sampling method. *Vegetatio*, *117*(2), pp.113-121.

Sullivan, C.A., Skeffington, M.S., Gormally, M.J. and Finn, J.A., 2010. The ecological status of grasslands on lowland farmlands in western Ireland and implications for grassland classification and nature value assessment. *Biological Conservation*, *143*(6), pp.1529-1539.

Szangolies, L., Rohwäder, M.S. and Jeltsch, F., 2022. Single Large AND Several Small habitat patches: A community perspective on their importance for biodiversity. *Basic and Applied Ecology*.

Szmatona-Túri, T., Vona-Túri, D., Urbán, L., Weiperth, A. and Magos, G., 2019. How grassland management methods affect spider diversity. *Acta–Universitatis–Sapientiae, Agriculture and Environment*, *11*, pp.23-37.

Temple, V., Rhodes, R. and Higgins, J.W., 2011. Unleashing physical activity: an observational study of park use, dog walking, and physical activity. *Journal of Physical Activity and Health*, *8*(6), pp.766-774.

Tramore Valley Park, 2022. History of Tramore Valley Park. Available at https://tramorevalleypark.glencentre.ie/history/ (Accessed 04/01/2023).

Tobisch, C., Rojas-Botero, S., Uhler, J., Kollmann, J., Müller, J., Moning, C., Redlich, S., Steffan-Dewenter, I., Benjamin, C., Englmeier, J. and Fricke, U., 2023. Conservation-relevant plant species indicate arthropod richness across trophic levels: Habitat quality is more important than habitat amount. *Ecological Indicators*, *148*, p.110039.

United Nations, Department of Economic and Social Affairs (2018) United Nations Department of Economic and Social Affairs. Available at: https://www.un.org/development/desa/en/news/population/2018-revision-of-world-urbanisation-prospects.html (Accessed 12/11/2021)

Van Der Jagt, A.P. and Lawrence, A., 2019. Local government and urban forest governance: insights from Scotland. *Scandinavian Journal of Forest Research*, *34*(1), pp.53-66.

Van Herzele, A. and Wiedemann, T., 2003. A monitoring tool for the provision of accessible and attractive urban green spaces. *Landscape and urban planning*, *63*(2), pp.109-126.

Venn, S. and Kotze, D.J., 2014. Benign neglect enhances urban habitat heterogeneity: Responses of vegetation and carabid beetles (Coleoptera: Carabidae) to the cessation of mowing of park lawns. *European Journal of Entomology*, *111*(5), p.703.

Wan, C. and Shen, G.Q., 2015. Salient attributes of urban green spaces in high density cities: The case of Hong Kong. *Habitat International*, *49*, pp.92-99.

Wardle, D.A., 2001. Experimental demonstration that plant diversity reduces invasibility–evidence of a biological mechanism or a consequence of sampling effect?. *Oikos*, *95*(1), pp.161-170.

Werner, P., 2011. The ecology of urban areas and their functions for species diversity. *Landscape and Ecological Engineering*, *7*(2), pp.231-240.

Zhang, W., Goodale, E. and Chen, J., 2014. How contact with nature affects children's biophilia, biophobia and conservation attitude in China. *Biological Conservation*, *177*, pp.109-116.

Acknowledgements

Ba mhaith liom buíochais a tabhairt go dtí cúpla daoine cé a cabhraigh mé. Go raibh maith agaibh go Dr. Simon Harrison agus Dr. Eoin Lettice mar d’obair deacair agus moladh. Go raibh maith agaibh go dtí an Comhairle Cathrach Chorcaí, an Oifig na nOibreacha Poiblí, agus Gréasán Nádúr Corcaigh mar mo cheisteanna a freagairt. Deireanach, go raibh maith agaibh go dtí an Scoil Eolaíochtaí Bitheolaíochta, Domhaneolaíochta agus Comhshaoil, agus go Coláiste na hOllscoille Corcaigh mar lán bhliana deasa.

Sadhbh Ní hÓráin.