Understanding community participation in urban conservation

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Acknowledgments

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Statement of Ethical Approval

Ethical approval was gained from the University of Queensland Human Research Ethics Committee to conduct a questionnaire; application ID: JS00548.

Abstract

Urban conservation activities can provide a diverse range of wildlife with much needed resources in a hostile environment. Small environmental groups promote conservation activities to urban residents in order to attract wildlife and benefit biodiversity in their homes. Engaging with these communities to perform conservation activities can be challenging for these groups. Here I show that analysing the demographic, motivations and challenges of existing urban conservationists allows us to inform environmental groups how to tailor their marketing and engagement strategies to reap greater conservation outcomes. It is currently unknown as to why people decide to actively perform these activities in their backyard and thus will be a helpful tool to inform engagement with the wider community. Using these results we are able to inform environmental groups on how to engage with the wider community to ultimately improve their conservation outcomes. This research aims to conserve the natural environment through engaging with communities to participate in gardening for wildlife, in particular, pollinators.

Introduction

The world's human population is increasingly concentrated in urban areas, and by 2050 up to 66% of the world's population will be living in cities (UNDESA 2014). Urbanisation has profound impacts on natural environments (Webb et al., 2018), where the built environment dominates and fragments natural landscapes. With natural ecosystems being cleared and densely occupied by people, increases in exotic plant introduction will inevitably occur and continue to have negative impacts on biodiversity (Goddard et al., 2010). Some exotic plant species have the potential to damage not only biodiversity but cultural, economic and recreational values of native vegetation (Adair, 1995). Native pollinators are particularly disadvantaged by not only urbanisation but increased exotic flora because they have evolved alongside native vegetation and rely on these resources to survive (Batley and Hogendoorn, 2009, Henríquez-Piskulich et al., 2018).

A number of pollinator conservation projects have emerged in urban areas because of the importance native pollinators have in maintaining pollination services in places where natural vegetation has been cleared (Dickinson et al., 2012, Lowenstein et al., 2015). Batley

and Hogendoorn (2009) suggested a number of measures to conserve native bees, such as raising public awareness, protection of existing natural habitat, more research and expertise to aid education, and using native bees in commercial applications (using native pollinators in crop pollination) (Graham, 2014). Several native pollinator species have declined to such an extent that they are considered at risk of imminent global extinction (Simaika and Samways, 2018).

Native solitary bees provide an interesting topic when engaging with the public and are the focus of many urban pollinator conservation projects. Limited nesting and foraging sites, spread of exotic plants, and climate change are three major threats to native bee populations (Batley and Hogendoorn, 2009), and at least the first two of these can be readily addressed through interventions by individual householders, suggesting that community initiatives could be used to conserve native pollinators in urban areas. A number of projects have focused on conserving native solitary bees in urban settings, typically addressing the lack of floral and nesting resources. Graham et al. (2014) reported on a citizen science project for people in the US, where participants supplied artificial nesting sites for solitary bees and monitored the inhabitants. This allowed entomologists to recruit "non-scientist" citizens to collect data on solitary bees and amass data from a large geographical area. Researchers in Sydney, Australia, used trap nesting of bees in urban community gardens to understand the variables that increase pollinator richness and abundance, aiding agricultural food production and pollinator conservation (Makinson et al., 2017). The UK MasonBee "Guardian Project" focuses on conserving red mason bees (*Osmia bicornis*) by engaging citizen scientists (Whittles, 2018). Initiative leader, Chis Whittles is an agronomist who applied his knowledge of enhancing agricultural production to mason bee research. The project has gradually moved from being a pollination services provider to the agricultural industry, to the conservation of red mason bees in the UK. The MasonBee project is essentially 'farming' these bees using well designed artificial nesting units and distributing brood cells of the red mason bees to new volunteers and repeating the cycle. The project started in 2016, ending the season with 514 guardians participating and consistently rising to the present, now with 1404 guardians who have supplied MasonBees with over 73,495 cocoons of red mason bees to distribute across the UK. Other solitary bee species are also found in the tubes as 'bycatch' meaning they are not the target species (red

mason bees) however, they account for a healthy diversity of solitary bee species. This programme focuses on the conservation of one species and is a useful example of how pollinator conservation programmes can be effectively designed.

These examples show that well-designed citizen science programmes addressing the lack of flora and nesting resources can create broad scale change in the design and maintenance of urban gardens that promote pollinators. However, achieving that major shift in human behaviour requires engagement of a broader community demographic. Yet the dimensions of these behavioural choices by a wide range of householders are poorly understood. This is a critical information gap since understanding participants' motivations is vital to empower local people to implement conservation activities (Wright et al., 2015). In this study focus will be put on understanding the motivations of a group of urban residents that actively participate in pollinator enhancement actions, and determining the barriers and challenges that they face to achieve even greater participation. This will also aid environmental groups in engaging a wider community. My results will be useful for suggesting ways in which environmental groups can approach future community engagement and citizen science projects. I will study the participants in Pollinator Link®, a Brisbane based non-profit social enterprise that facilitates urban residents to encourage pollinators and wildlife in their gardens by undertaking a series of specific habitat and management interventions.

One fundamental aspect of measuring the performance and reach of a citizen science project is to understand the demographic profile of the participant group. This can shed light on which individuals have decided to participate in the conservation activities, and where future expansion of the programme might be directed. A study by Mumaw and Bekessy (2017) explored the demographics of wildlife gardeners in Melbourne, Australia, finding little evidence of similarities in demographics as the group was small and diverse. Their study focused on collaboration between private and public sectors and the benefits this has for wildlife gardening initiatives. Crucially, demographic studies help identify those individuals that would not normally participate in wildlife gardening, and could be engaged to maximise biodiversity conservation outcomes (Shaw and Miller 2016). A comprehensive survey was completed by customers of a garden centre in the UK which details the demographics of these 'shoppers' (Wignall et al., 2019). While this audience is not the same

as people gardening for pollinators the survey recipients responded 96.7% “Yes” to the question, “Do you do anything in your garden or outside space to help wildlife?” (Wignall et al., 2019). Given this result it is evident that many people are performing conservation activities in their gardens but are not necessarily a part of a specific conservation initiative/group. Socio-demographic and psychographic variables, along with environmental attitudes, have an effect on individual adoption of pro-environmental behaviour (van de Ven et al., 2018), suggesting there is a link with the motivations behind pro-environmental behaviour. The focus of this research will be to fill the knowledge gap of the specific demographic of Brisbane residents gardening for pollinators.

Discovering the demographic and psychographic profile of subscribers within Pollinator Link® will help similar environmental groups to understand their target audience and how to better engage that group of people in gardening for pollinators. It may also identify groups of people who are absent from participation and allow the environmental groups to assess whether to engage with these people. In addition to obtaining demographic attributes, the wildlife habitat resources that people are providing will be measured. Knowing this will allow us to understand who is providing what and let us to make inferences around why certain people are supplying these things and what resources are especially appealing.

Understanding what motivates a group of individuals gardening for pollinators will allow environmental groups to market pollinator conservation activities that appeal to the motivations of members and thus achieve greater conservation outcomes in participant gardens. For example, Shaw et al. (2013) showed that wildlife gardeners had a stronger connection to nature than the general public. Four motivational factors for individuals to make pro-environmental choices were identified by Steg and Vlek (2009). First, the value-basis of environmental beliefs refers to the important role of intrinsic or biospheric values in prompting someone to engage in pro-environmental behaviours (Osbaldiston and Sheldon, 2003). Second, environmental concerns can arise from fear about the state of species and the environment and can be a powerful motivator for pro-environmental action. Some marketing strategies can engender fear to persuade individuals to act pro-environmentally (Kothe et al., 2019). Third, many people feel a moral obligation to act pro-environmentally, even though they might not strongly value the environment personally. Fourth, social norms

can strongly influence behaviour, and refers to a process where people act based on perception or observation of what others are doing. For example, social norms might be associated with a tidy garden and mown lawn, but complying with this social norm may prevent individuals from having a wildlife friendly garden (Goddard et al., 2013). Steg and Vlek (2009) provide a brief overview of why individuals make pro-environmental choices. More research attention has focused on the attitude-action gap that can limit the expression of pro-environmental behaviours, even where individuals may have certain beliefs and motivators but still do not act accordingly (Siegel et al., 2018). Environmental attitudes are "influenced by environmental awareness and risk perception and also by personal and social values" (van de Ven et al., 2018). Although elements such as environmental attitudes may not necessarily 'motivate' individuals to make pro-environmental choices, they may be an underlying/subconscious factor that individuals use to make decisions. A "fear appeal component that emphasises threat to individuals and/or society" has been observed in marketing strategies to influence environmental behaviours and actions (Kothe et al., 2019). A drastic example of such a fear appeal strategy could focus on the effects of climate change and the potential to cause damage to one's livelihood. Theoretically, this would encourage listeners to make pro-environmental choices out of fear. Gifford and Nilsson (2014) identify 18 personal and social factors influencing pro-environmental behaviours, noting that understanding pro-environmental behaviour is far more complex than previously thought. Kollmuss and Agyeman (2002) agree that the complexity of what shapes pro-environmental behaviour is such that it cannot be visualised through a single framework or diagram. Osbaldiston and Sheldon (2003) show that internalised environmental motivation of a 'high quality' has the potential to mitigate environmental issues. This form of motivation expands on intrinsic values, which means individuals are rewarded or gain enjoyment out of acting pro-environmentally.

As well as increasing motivation to enhance participation in conservation activities, another approach is to reduce the barriers or challenges around participation (Mumaw, 2017). Discovering the challenges that individuals face when gardening for pollinators will allow us to make recommendations to environmental groups regarding their conservation activities, programs and engagement with their members and the wider community. Some challenges have been discovered in the literature by various researchers. One common challenge

within any emerging field is creating a common language. A number of researchers have identified barriers for the public when faced with scientific or Latin species names (Shwartz et al., 2014, Zoller et al., 2015), suggesting care should be taken around communicating about ecological topics to a target audience. Saunders (2020) explains the need for common names for native bee conservation, stating “Common names have a very important part to play in making scientific information more accessible to non-scientists”. This is important for the engagement of the wider community in making information about pollinators user-friendly and accessible to the public and not just scientists.

A study by Wignall et al. (2019) found another barrier of wildlife gardeners was to plant pollinator friendly species because of allergic reactions to bee stings and also price could dissuade them if these plants were more expensive (Shaw and Miller, 2016). A lack of information about pollinator friendly plants has shown to be a barrier for many wildlife gardeners in previous studies (Goddard et al., 2013, Campbell et al., 2017, Wignall et al., 2019). Although it is crucial that any information resources are developed in a manner that avoids unnecessary technical jargon. Social norms within neighbourhoods and communities can form barriers for wildlife gardeners, for instance leaving an untidy garden to attract insects might engender some degree of social cost for a household if neighbours do not approve (Goddard et al., 2013). Access to space and private gardens in dense cities can also be a barrier to participants (Gaston et al., 2007). A solution for environmental groups to this would be tailoring activities to different space requirements of participants, such as movable gardens, especially for renters. Some wildlife gardeners in a study by Mumaw and Bekessy (2017) found that major tasks such as removal of weed trees was easier once funding became available, meaning costs can be a barrier for more challenging tasks. Bernardini and Irvine (2007) describe the ability to learn from challenges in the garden, for example identifying plant and animal species not only increased knowledge but connection with nature. Understanding the challenges that Brisbane residents who garden for pollinators are facing will fill a knowledge gap allowing Brisbane environmental groups to address these limitations and improve conservation outcomes.

The aim of this study is to understand the demographic profile, motivations and challenges of Brisbane residents gardening for pollinators. Resulting data could help non-profit

environmental groups to increase their conservation activities in urban areas by working with particular sections of the community most likely to be receptive to gardening for pollinators, and helping them overcome the challenges. Recently, there are an increasing number of publications and public resources becoming available around appropriate artificial nesting habitats for solitary bees (Graham et al., 2014, Prendergast, 2018, Prendergast, 2019, Mason, 2018). Measures to incorporate pollinator conservation into a citizen science project will be critically analysed whilst determining the motivations for individuals to actively garden for pollinators and how to better engage the community in these activities.

The study addresses three specific gaps in current knowledge of enhancing urban pollination through community engagement. First, the demographic and psychographic profile of individuals that undertake conservation activities in their backyard is not well understood, yet knowing who is participating in such activities will help target future activities (Cartwright, 2016). The habitat resources that people are supplying for pollinators will be recorded to analyse any correlations with other variables. Past studies have not focused on the topic of urban pollinator conservation activities in Brisbane gardens. Thus, this study aims to fill this gap expanding on the past literature to better understand the socio-demographic profile of participants engaged in urban pollinator enhancement activities in Brisbane.

Second, uncovering the motivations of people participating in conservation activities in their garden is important to further our ability to effectively engage the wider community. However, the motivations of individuals who are actively gardening for pollinators and participating in specific practical conservation activities are not well studied. One useful study showed that activities such as watching and protecting local wildlife were important motivators for wildlife gardeners in the UK (Goddard et al., 2013). I aim to document the full range of motivators for engaging in pollinator conservation activities in backyards in Brisbane.

Third, studying the challenges urban gardeners face when managing their gardens to encourage pollinators will identify, from the perspective of homeowners, what makes it

difficult to maintain conservation activities consistently (Mumaw and Bekessy, 2017). Focusing on this gap will expand the literature around challenges and barriers faced by people gardening for wildlife in general. Uncovering the full range of barriers to Brisbane residents gardening for pollinators will allow us to make recommendations so environmental groups can target future behavioural interventions and citizen science projects.

Methods

I focused on a non-profit environmental group in Brisbane, Australia called Pollinator Link®. The subscribers of Pollinator Link® formed a survey population for the study to gather and analyse data on the demographic profile of participants, what wildlife resources they are providing, and motivations and challenges faced by these participants when gardening for pollinators. The nature relatedness scale was included in the questionnaire to measure the strength of participants' connection to nature. Participation was voluntary, consent was sought, and full UQ ethics approval was granted (JS00548).

There were four main sections to the questionnaire (Appendix) including the three main topics (demographics, motivations and challenges) and the nature relatedness scale designed and validated by Nisbet et al. (2009). Other minor sections were included, incorporating wording around consent, verge garden questions, and providing an email address to unsubscribe from reminders to complete the questionnaire in the future. The first main section asked participants basic demographic questions, including age, gender, postal code, living arrangement, educational attainment. These questions provided a base to describe the participant pool and understand the current demographic of people who are interesting in gardening for pollinators. It also indicates the absent demographics, which may potentially be part of a wider target audience.

The second major section in the questionnaire related to the motivations of participants to be involved with Pollinator Link® and included questions on what resources people were providing for wildlife in their gardens. The resource questions included three questions relating to water, food and shelter resources for wildlife. This data provided a picture of

what this participant pool was providing as a group for wildlife in urban areas. Questions exploring the motivations of each participant provided an understanding of why people are interested in such activities and helped indicate the type of person who would be interested in these activities. This helps to identify the specific target audience who may be interested in gardening for pollinators.

The third major section related to the challenges that participants faced when providing habitat resources for wildlife. Participants were asked about the challenges they faced, what they thought could help them to overcome those challenges, and how much time they spent working in their gardens per week. Participants were asked about the challenge they faced simply to understand what environmental groups (Pollinator Link® in this case) can do to help their members overcome these challenges and have a greater effect on pollinator conservation in their gardens. The solutions were guided for a similar reason, to help environmental groups understand what their members want in order to succeed in gardening for pollinators. The amount of time participants spent working in their gardens was asked to reveal how much time this participant pool was spending gardening.

The last of the four main sections measured the extent to which participants are connected to nature, using the validated Nature Relatedness Scale (Nisbet et al., 2009). A Likert scale was used to obtain a score for each question, once complete all scores were averaged to an overall nature relatedness score ranging from 1-5 for each participant. Some questions score were required to be reversed in order to correctly interpret data. For example, the statement “Conservation is unnecessary because nature is strong enough to recover from any human impact” was reversed before averaging out overall scores (Nisbet et al., 2009). This component was included in the questionnaire to determine whether participants were more strongly connected to nature than the general population.

The questionnaire was administered online using Google Forms, with an email to the 276 subscribers of Pollinator Link® providing a participant information sheet, instructions and a link to the questionnaire. The questionnaire was sent out on 26th June 2020 with reminder emails sent on 20th July, 4th August, 11th August, 17th August, and 21st August to encourage/remind subscribers to participate in the study. A total of 104 legible responses

were submitted over the 2 month period. These responses were downloaded as a .csv data set and stored using the secure UQ Research Data Manager (RDM). The majority of tables and figures were generated using Microsoft Excel version 16.39. Postcode data was mapped using QGIS version 3.10.7-A Coruña (figure 1).

Results

The questionnaire in this study focused on four major topics: the demographic profile of participants, what wildlife habitat resources they are providing, their motivations to participate in conservation activities at home, and the challenges they face when performing these activities. Over the 2 months that the questionnaire was live, there were 104 responses (37.68% of the participant pool).

Demographic profile

The majority of participants were female, and 69% of the participants were older than 50, with the largest age range being 61-70 years old (Table 1). There were no responses from the 18-20 year old age bracket. The majority of participants owned their home, and 79.5% had a university education. The majority of the participant pool were strongly related to nature, with nearly 80% of participants scoring between four and five on the Nature Relatedness Scale, compared with an average of 3.47 for the Brisbane population as measured by Shanahan et al. (2017). These results suggest that females in older generations who own a home, have obtained a university education and relate highly with nature are a common demographic in gardening for pollinators.

Table 1: *Summarised demographic categories of 104 participants of questionnaire. Number of participants (n), proportions of participants (%).*

	n	**%**
Gender		
Male	28	26.9
Female	75	72.1
Prefer not to say	1	1
Age Range		
18-20	0	0
21-25	4	3.8
26-30	3	2.9
31-40	7	6.7
41-50	18	17.3

51-60	24	23.1
61-70	30	28.8
71+	18	17.3
Living situation		
Own your home	92	88.5
Rent, responsible for garden maintenance	3	2.9
Rent, landlord responsible for garden maintenance	3	2.9
Live with family	6	5.8
Educational Attainment		
Undergraduate Degree	38	37.3
Post-graduate Degree	43	42.2
Certificate 1,2,3,4	6	5.9
Trade Certificate	6	5.9
Finished year 12 or equivalent	4	3.9
Year 10	5	4.9
NR-Score		
0-3	1	1
3-4	20	19.2
4-5	83	79.8

Nine postal codes were excluded as they were from NSW, ACT or an error from a participant (Figure 1). The participants were widely distributed across Brisbane, although approximately 20% of the participants are from the postal code region of 4122, in which the Pollinator Link® project originated. The remaining participants are spread across greater Brisbane, indicating a broad geographic spread of participants.

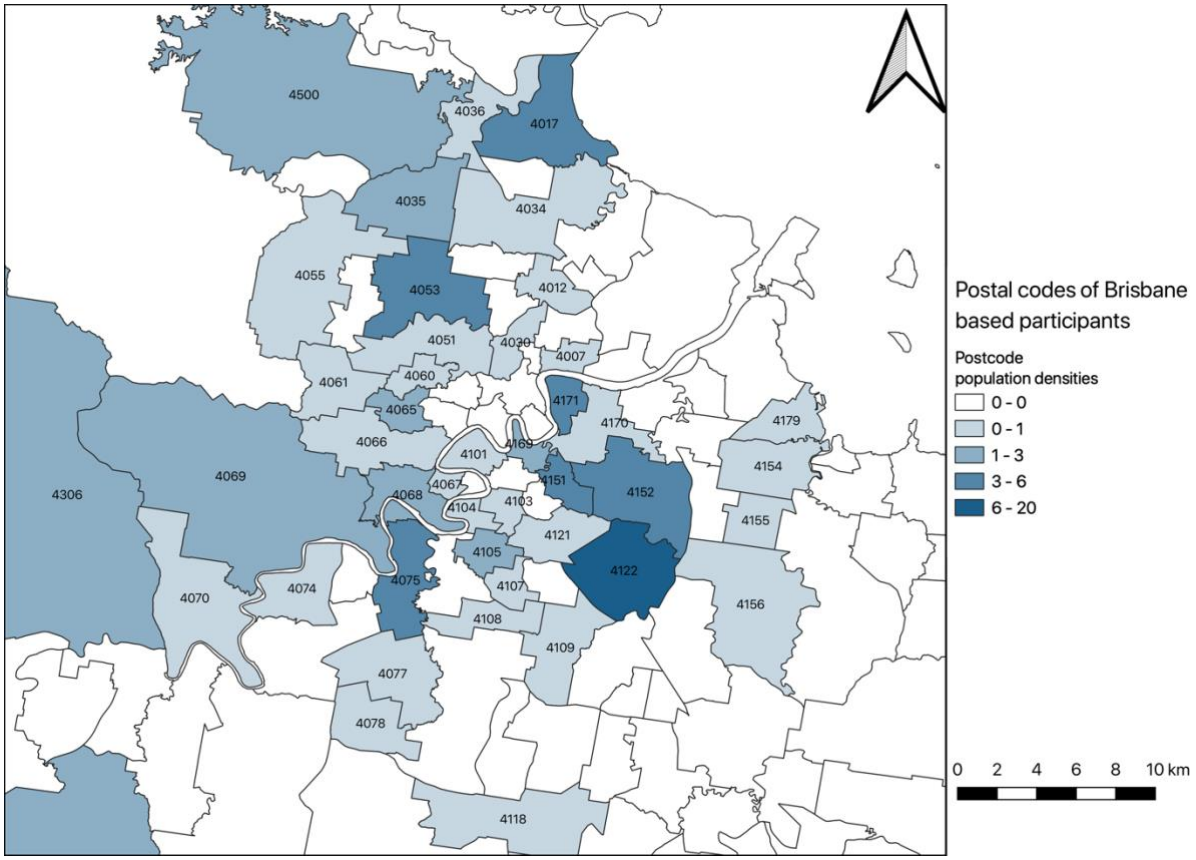

Figure 1: *Map representing the distribution of participants postal codes. Map represents the Greater Brisbane region of the participant pool.*

Resource provision for pollinators

Habitat resource elements provided by the participant pool were recorded for all individuals (Figure 2). This included different components of water, food and shelter relating to wildlife habitat resources that can be provided in urban gardens. Bird baths/shallow bowls were the most popular water component with nearly 50% of participants providing them. Food and shelter resources were much more evenly occurring in participants gardens. Nectar/pollen plants were most popular food resource with more than 25% of participants claiming these plants to be in their gardens. The most popular shelter resource was mature trees with just over 15% of participants claiming they are in their gardens, closely followed by dense shrubs and groundcover. This indicates that participants are providing a variety of habitat resources in their gardens for wildlife use.

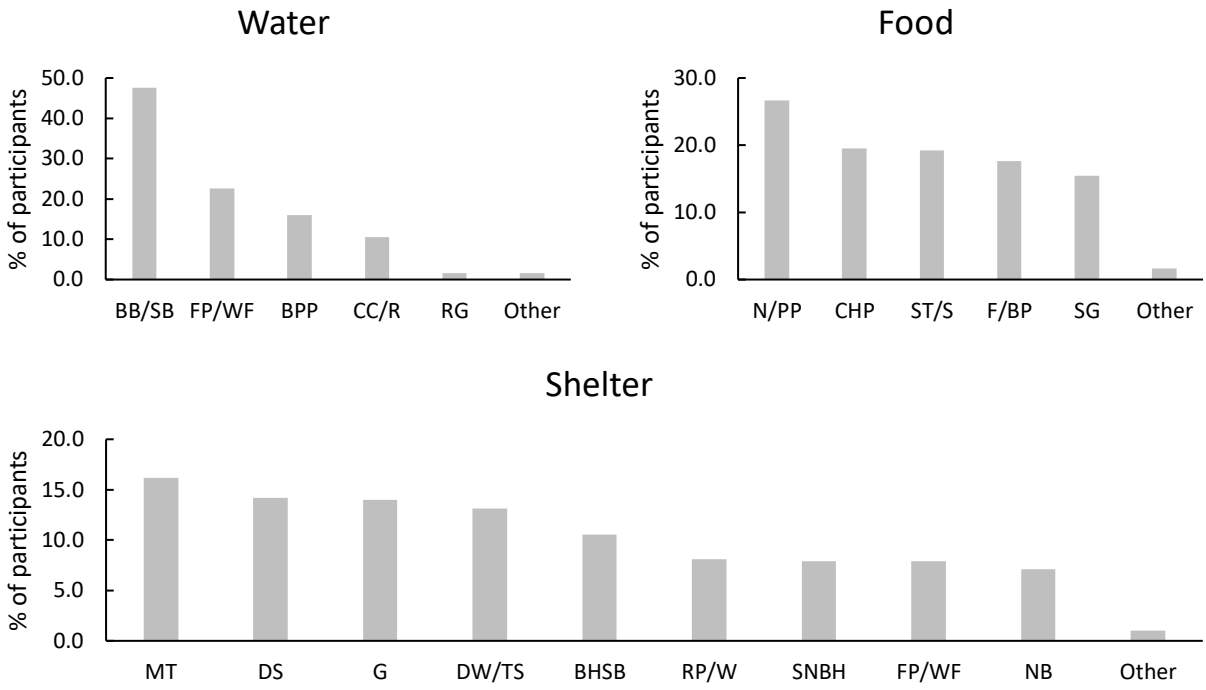

***Figure 2**: Wildlife habitat resources provided by participants in their gardens. **Abbreviations**: BB/SB = Birdbath/shallow bowl, FP/WF = Frog pond/water feature, BPP = Butterfly puddling place, CC/R = Close to creek/river, RG = Rain garden, N/PP = Nectar/ pollen plants, CHP = Caterpillar host plants e.g. citrus trees, ST/S = Seed trees/shrubs, F/BP = Fruits/ berry plants, SG = Seed grasses, MT = Mature trees, DS = Dense shrubs, G = Groundcover, DW/TS = Dead wood - log piles/ tree stumps, BHSB = Bee home for solitary bees, RP/W = Rock pile/ wall, SNBH = Stingless native bee hive, FP/WF = Frog pond/water feature, NB = Nest-box.*

Over 40% of participants worked in the garden for 1-2 days per week, with very few gardening less frequently (Figure 3). Notably, about a quarter of participants spent 5 or more days per week gardening, indicating a substantial time commitment by many participants in the Pollinator Link® programme. The overall average of time spent in the garden across all participants was 7.13 hours per week with a standard deviation of 6.83 hours. This helps us understand that participants are not primarily all avid gardeners and the participant pool is variable and not all the same.

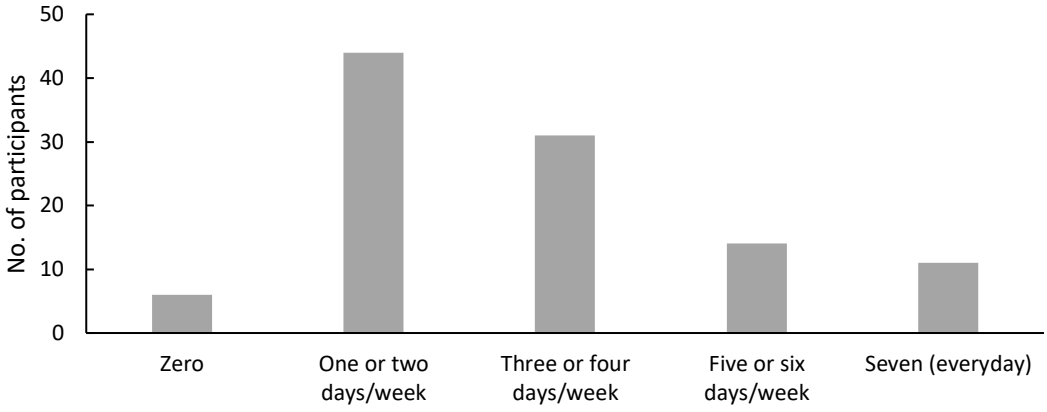

***Figure 3**: Days per week spent gardening by* participants.

Motivations

Participants were asked to share their motivations for being involved with Pollinator Link®. Table 2 below shows the eight motivation categories and their general descriptions of the motivations shared by participants and the counts of how many participants were in each category. These motivation categories were created by sorting the responses that participants made to the open-ended question "What motivated you to be involved with Pollinator Link?". There were 99 individual responses, although some responses indicated more than one motivation. Each response was individually sorted into one or more categories, with the largest category being "General environmental interest". This category encapsulated people who didn't specify a particular interest, instead stating their general interest or concern for nature and/or the environment. Example responses from this category include "a love of nature" and "care for the environment". Motivations of this type are more general and less topic specific compared to the next largest motivation category.

"Interest in flora/fauna" is a motivation category stating a more specific interest from participants, for example, "Knowing how important local native plants are to local insect species and other animals", "Wanting to encourage birds and native flora", etc. These responses generally gave more detail and were a longer answer in comparison to the "General environmental interest" motivation category.

Individuals that seemed to be motivated by something other than personal interest and more motivated from outside influences were included in the category "Inspired by others".

Answers from this motivation category typically stated an event or person who was the primary source of motivation for these responses. Example responses include “enthusiasm from our neighbour” and “engagement at a Brisbane fair”.

Some individuals perform conservation activities within their gardens on a regular basis. Whether these actions are providing basic water, food and shelter resources for wildlife or large scale regeneration of private land, these people have made these activities a habit or a way of life. The motivation category given to these participants is “Habitual”. People who work in a similar field have also been considered a part of this category. Example responses include “I have always gardened with wildlife in mind”, “It's a worthy cause that aligns with what I was already trying to achieve in my garden” and “I am a horticulturist”.

Some participants had a specific concern for wildlife in suburban areas. This motivation category was classified as “Suburban wildlife conservation”. These responses seemed to be more focused around solving a problem, in this case urban wildlife corridors. Examples include “the goal of creating corridors for wildlife in suburbia” and “saw importance of supporting pollinators in the suburbs where elimination of biodiversity is rife”. These responses show more of a concern rather than an interest and demonstrate a willingness to be part of a solution.

The attraction of pollinators to their garden was a primary motivator for some participants, hence the motivation category was classified as “Attraction of pollinators”. Some participants claimed they required beneficial insects for pollination of food crops such as vegetables and fruits, or other plants. However most of the participants who fell in this category simply wanted the presence of pollinators such as birds, butterflies and bees in their gardens to enjoy the sight. Answers included, “to keep our bees alive so that we can continue to grow food and enjoy our gardens” and “desire to bring birds back to my garden”, suggesting that participants wanted the enjoyment and/or the benefits that pollinators provide.

***Table 2**: Motivations for providing resources for pollinators among participants, classified into broad groups. Some participants listed more than one motivation.*

Motivation category	Description	Count
General environmental interest	This category includes people who are motivated by a general interest of the environment and nature, and/or concerned about environmental issues.	32
Interest in flora/fauna	This category includes people who are motivated by learning specifically about flora and/or fauna (invertebrates, pollinator, insects, etc.).	27
Inspired by others	This category includes people who are motivated/inspired by other people or events, such as friends/family, workshops or community events.	19
Habitual	This category includes people who are motivated by the decisions they make and actions they take in everyday life and has become more ingrained in their way of living. Participants either work/volunteer in similar fields or have performed these actions over long periods of time.	14
Suburban wildlife conservation	This category includes people who are motivated by making a difference for wildlife specifically in urban areas.	12
Attraction of pollinators	This category includes people who are motivated by the rewards of bringing pollinators to their garden, either for pollination of food crops or other plants or simply the enjoyment of seeing polllinators.	10
Community involvement	This category includes people who are motivated by being involved in a like-minded community and enjoy learning and sharing things within the community.	8
Interest in gardening	This category includes people who are motivated by their interest in gardening. Participants mentioned specifically that gardening was a key motivator.	3

The power of community engagement can be a motivating factor for some people. In this case, a number of participants listed motivations that fell into the “Community involvement” category. Examples of responses included, “to improve and share my knowledge of this” and “to be involved with a like-minded community with a passion for wildlife and conservation”. Participants who primarily wanted to engage and learn more from the community and give back to the community were listed within this category.

The smallest motivation category was “Interested in gardening”. This category was created for the participants partially motivated by the gardening aspect of the activities involved with Pollinator Link®. Often this motivation category would overlap with other categories making it a partial motivation. The only three responses from the questionnaire were, “I am a keen gardener and am aware of the need for efficient pollination particularly as it relates to fruit and vegetable growing”, “…I am also a happy home gardener growing some veges

and plants of various kinds…" and "I am interested in things in my garden and surrounding environment".

In certain responses there were multiple motivation categories listed. An example of this is, "concern about climate change and habitat loss. Planting for wildlife is something I can do myself right where I live to support wildlife" (listed in "General environmental interest" & "Interest in flora/fauna"), and "grow native plants and encourage native birds, bees, butterflies and other native insects into garden to create a natural area within suburbia" (listed in "Interest in flora/fauna", "Suburban wildlife conservation" & "Attraction of pollinators").

Challenges

Listed below in Table 3 are the challenges of providing habitat resources for wildlife that were stated by the participant pool, with examples of each challenge category to make sorting easier. A total of four challenge categories were made in order to sort the responses logically. The counts on the side represent the number of participants in each challenge category with multiple participants listing more than one challenge. Participants who left this question blank were excluded from Table 3.

The majority of participants were listed under the "Logistics" challenge category, examples of this challenge can be seen in Table 3. This category covers a wide range of logistical issues related to the challenges of providing habitat resources for wildlife. A typical answer from participants in this challenge category was similar to this, "would like to make a verge garden but apparently not allowed on rural residential, found it hard to get accurate answer from Brisbane council on this matter. Also cost and time available. Also neighbours illegal land use". This answer covered multiple logistical challenges and was longer than most responses in this category.

Specific answers that related to plants included some of the examples in table 3. This challenge category was called "Plant related" and had similar characteristics to the "Animal related" challenge category which focus on the challenges faced from animals

(wild/pest/domestic). A good example of both was, “lack of knowledge of host plants for insects. Unaware of fauna nesting requirements”. This example shows the challenges faced when providing habitat resources related to both plants and animals.

“Other” was used for left over challenges that were uncommon and not repeated often. Examples from this challenge category can be seen in table 3.

Table 3*: Challenges of providing resources for pollinators among participants, classified into broad groups. Some participants listed more than one challenge each.*

Challenge category	Examples of challenges	Count
Logistics	Cost/money; Space; Council regulation/communication; Community involvement; Maintenance; Nest box installation; Neighbours; Landscape planning; Time; Water; Hard to find help/resources; Climate; Handyman work/labour	53
Plant related	Soil health; Controlling weeds; Pesticides; Plant choice; Establishing new plants; Social norms (garden tidiness); Access to native plants; Pets	29
Animal related	Pest animals; Fauna nesting requirements; Frog pond; Native Beekeeping	23
Other	Laziness; Nothing (Its easy); Age	8

Participants were then asked to suggest solutions to the challenges they faced when providing habitat resources for wildlife. There was a total of five solution categories created in order to logically group each response. Table 4 lists the solution categories in the same style as table 3 with general examples of solutions and the number of participants who stated a solution in that particular category.

The majority of participants made suggestions to have better resources online and at workshops to improve their knowledge of providing wildlife habitat resources. This solution category was called “Better educational resources/training”, and listed examples of solutions are found in table 4. Some participants suggested solutions that were more indirectly asking for help/advice, such as “simple easy ideas and trying to give us enthusiasm to carry them out”. The more direct responses that aimed at the provision of more information were examples such as “information/workshops on how to improve soil health and controlling weeds”. Participants who required general labouring help were also put into this category.

The typical “Plant related” and “Animal related” solution categories included both practical and impractical solutions for providing habitat for wildlife. An example of practical solutions was, “list of plants” or “time dedicated to gardening: reshaping garden: selecting and caring for plants, creating garden features for habitat”. Some impractical or unrealistic solutions were, “responsible cat owners! legislation on pesticide labelling (or just ban the stuff)” or “more rain”. It may be possible that these impractical solutions are just the results of ongoing frustrations of participants who have complex issues with neighbours, council, or pests.

***Table 4**: Suggested solutions for challenges of providing resources for pollinators among participants, classified into broad groups. Some participants listed more than one challenge each.*

Solution category	Examples of solutions	Count
Better educational resources/training	Workshops; Accessible information online; Time management skills; Simpler and easier ideas; Accessible website with online shop; More council resources/regulation; Power tool skills; Help from landscape/ gardening advisor/ arborists etc.; Help from volunteers for ideas	33
Plant related	More access to water for plants; Plant identification; More local plant nurseries; Planting in nearby parks	21
Societal dilemmas	Rates discounts from council for performing backyard conservation; Balance of what looks good versus pollinator friendly; More enthusiasm; Societal change; More space; Legislation on pesticide; Like-minded neighbours	15
Animal related	Local native bee hive suppliers; Pest removal; No pets	12
Other	Keep trying; Utilise what I have got; Change in priorities	3

The category, “Societal dilemmas”, was used as a solutions category because of the amount of participants who seemed to have challenges or barriers with neighbours or social norms in the community. Examples of such solutions were, “Better informed/coordinated local government!”, “Slower vehicles”, or “Neighbours sharing the same vision”. Sometimes these solutions were similar to some of the other impractical or unrealistic solutions in other categories.

Similar to the challenge categories there were solutions that were uncommon and not repeated often. Therefore they were placed in the “Other” section. Examples of these are seen in table 4.

Discussion

Demographic profile

The demographic attributes of these participants have provided an in depth understanding of who these individuals are and the types of people who are most likely to interact with environmental groups such as Pollinator Link®. This allows us to understand what types of people are showing interest in urban conservation activities and which demographic of people are most likely to join with environmental groups in performing urban conservation initiatives. A typical profile of a participant is a female over 50 years of age, who is university educated, owns their home and is strongly nature related. This provides a basis for environmental groups to understand their target audience and design effective marketing strategies which primarily appeal to this particular demographic. Individuals outside of this demographic should still be a focus for environmental groups when marketing, however specific strategies for engaging these demographics may differ and could show less uptake due to barriers to action (time, lack of knowledge, etc.) of these demographics. These barriers to action may not be represented in this data, meaning this may be an opportunity for future research.

As a general demographic this group of people were considered highly related to nature due to their scores on the nature relatedness scale (Nisbet et al., 2009). This was expected due to their connection with pro-environmental groups such as Pollinator Link®. There was a larger proportion of females who responded to the questionnaire and they showed a higher nature relatedness than males. This aligns with a Brisbane based study by Dean et al. (2018) where females have a significantly higher nature relatedness than males. Moreover, the participant pool in the Shanahan et al. (2017) study had a lower average nature relatedness score (3.47) than the participants of this study (4.34), indicating that the subscribers of Pollinator Link® have an above average NR-score compared to the average Brisbane resident.

Resource provision for pollinators

Understanding what these people are doing for wildlife in their gardens can help us compare participant pools across studies with different demographical attributes or in different locations. A UK study by Gaston et al. (2007) showed that across the country there was a significant number of households participating in some form of wildlife gardening. In this case it was related to providing certain garden features that were beneficial for wildlife, such as bird feeders, bird baths, ponds, nest boxes etc. The sample population for that study was drawn from across the general population and did not necessarily have a specific connection with an environmental group such as Pollinator Link®. Due to our case study focusing on participants that are actively following an environmental group who advocates gardening for wildlife, there is a difference in participant pools across these studies and indicates that individuals who aren't associated with these groups can also be active in gardening for wildlife (Gaston et al., 2007). This suggests that environmental groups like Pollinator Link® potentially have a wide target audience who are actively participating in some form of wildlife gardening and may not know about community groups advocating wildlife gardening activities or are not interested in being directly involved with a group. Goddard et al. (2013) noted in a survey there was a mean of 5.1 ($\pm$2.7) wildlife-friendly garden features across 533 households in the city of Leeds in the UK. Comparable to this study there is a similarity in the diversity of garden features being provided by urban residents, which provides wildlife with varieties of water, food, and shelter resources.

Time spent working in the garden was asked in order to gauge the amount of time people are willing to spend performing urban conservation activities in their private gardens. This may potentially influence a recommendation for environmental groups creating citizen science projects that fit the requirements of time people are willing to spend in their garden. As seen with this participant pool the majority of participants are working in their gardens at least one or two days per week if not more. With participants who are spending five or more days in the garden it could be assumed these individuals are avid gardeners and rely on this being a routine to work in their garden because they enjoy it. Peeters et al. (2014) found that mid-age and older women enjoy mental and physical well-being benefits from garden work, however young women's well-being declines. This indicates that the

older generation of participants from this study may happily take a few minutes out of their daily routine to monitor a citizen science project in their own garden. The presence of pollinators in urban areas is a common occurrence, with Baldock et al. (2019) showing gardens and allotments having pollinator 'hotspots', and recommend city-scale urban planning strategies to enhance pollinator conservation. This can be achieved through multiple actions in urban gardens. These could be but are not limited to solitary bee hotels, butterfly puddling places, providing bare soil for ground nesting bees or planting a diversity of local native plants used by pollinators. If these activities were performed and monitored in urban gardens across Brisbane it could have a large impact on pollinator conservation and research. There is ample evidence that non-scientist citizens are capable of collecting scientific data in a setting that incorporates well organised instructions and direction from organisers (Graham et al., 2014). The introduction of a pollinator conservation citizen science project to this participant pool has potential to benefit conservation through an increase in the participants direct interest in pollinators and the potential for recovering urban pollinator populations (McKinley et al., 2017, Mason, 2018).

The variability in hours per week spent working in the garden suggests that the research participant pool is a mixed population who are not all focused primarily on gardening for their leisure activities. Pollinator Link® is focused on urban wildlife conservation, hence they may not be focused primarily on the activity of gardening but more on providing wildlife habitat resources in urban areas. Having a population who vary in their gardening interest will be more beneficial for comparing across different studies than a population who are all avid gardeners which may not be standard.

Motivations

Using the eight motivations created from the questionnaire responses, we have started to understand why people actively participate with environmental groups to conserve pollinators in urban areas. It can be seen in table 2 that "General environmental interest" was the most common motivator for participants. The average nature relatedness scores of each motivation category are all considered highly nature related with scores higher than 4.2 across all categories. This confirms the fact that this participant pool has an above

average nature relatedness score compared to the average Brisbane resident (Dean et al., 2018).

It can be noticed that the smallest motivation category (Table 2) was “Interest in gardening” with only three participants. This suggests that gardening is not a primary motivator for participants to provide pollinator resources in their gardens, however participants could still be avid gardeners due to the amount of time they spend working in the garden. This finding has important implications for communications and outreach, suggesting that focusing on the gardening aspect of the activity might not be the best way to attract people to participate in urban wildlife resource provision.

Using our knowledge of why people are motivated to be involved with environmental groups that advocate wildlife habitat resources in urban landscapes, we can establish an understanding of how environmental groups can better engage communities in urban conservation. The key motivators have been identified and described in table 2, so that they can be used as a guide for environmental groups to engage people who are interested in these topics. For example, marketing material can be focused toward interesting facts about flora and fauna and how these things can benefit nature in general. This will appeal to individuals who lie in the motivation categories of “General environmental interest” and “Interest in flora/fauna”, which are considered the most popular motivators for people already engaged in these groups and activities. Material presented on social media by environmental groups should be influenced by these motivations to better engage the community.

Challenges

Most participants were challenged by logistical elements of providing wildlife habitat resources in their gardens. These include (but are not limited to, see table 3) lack of time, money, physical labour or agreements with neighbours/councils. These answers may be correlated with the older demographic of this participant pool and the physical exertion needed to perform some garden maintenance tasks. However, individual challenges may come down to the individual participant and other life factors that play a role in restricting

people to perform these tasks. For example, a parent who works full time and needs to get their children to school or sports each day may find time to be an issue and that is not due to their lack of ability to perform any strenuous tasks in the garden. Hence, other life factors and responsibilities could play a large role in the challenges stated by most participants. Societal norms played a small role in some participants responses, and according to Goddard et al. (2013), “social norms are a considerable barrier to uptake of wildlife-friendly activities” in a UK city, suggesting there may be differences in societal norms across countries. Challenge categories such as “Animal related” and “Plant related” may be more specific challenges that are not affected by other life factors or responsibilities. For example, the difficulty a participant finds in choosing flora species for their garden is related to a lack of knowledge and is not influenced by other life factors or responsibilities. This type of challenge may be easier to address from the environmental group standpoint. The ability for environmental groups to provide solutions regarding urban conservation is more sensible than giving time management advice or solving neighbour disputes.

The majority of suggested solutions provided by participants fell in the “Better educational resources/training” solution category (table 4). Answers of each solution category are shown in table 4, where results provide useful answers that environmental groups can potentially use to further engage with the community. These solutions may be seen as actionable for environmental groups whereby they can take on board suggestions from their subscription/member base to address and help solve the challenges or barriers they are facing in urban conservation.

It is possible that many individuals have not subscribed or participated in activities with Pollinator Link® due to barriers they are facing. This may be evident in the demographic of renters that have a low representation in Table 1. This could be an opportunity for Pollinator Link® to expand its target audience to renters by addressing the barriers that renters face when gardening for pollinators. This may be an opportunity for further research into why renters specifically are not represented in this participant pool and what challenges/barriers they face in gardening for pollinators.

Some of these solutions may be addressed by environmental groups through the use of citizen science projects. The aim of citizen science is to enable a broad range of volunteer participants in collecting data which can be quantitative or qualitative which allows the project access to larger and more geographically wider data sets (Dickinson et al., 2010, Dickinson et al., 2012). If the right type of citizen science project is used, this not only allows participants to learn more about urban conservation through better educational resources and training but allows the environmental group to perform important research in the relevant fields. These projects must be of interest to participants to ensure their interest and engagement in the activities (McKinley et al., 2017, Mason, 2018). A well designed citizen science project that sufficiently trains and informs participants will go a long way in having a community that is engaged and actively learning. This allows the organising environmental group the chance to address some of these challenges and solutions.

Engaging communities is extremely important when trying to improve urban conservation outcomes. Urbanisation has resulted in widespread depletion of pollinator resources, and this can be addressed through engaging people to supply wildlife resources in urban landscapes. Such projects can supply pollinators with corridors of habitat resources in urban landscapes which would otherwise be unsuitable habitat. Having a diversity of pollinators in urban landscapes will increase productivity of an important ecosystem service, pollination. Understanding the demographics, motivations and challenges listed by people participating in urban conservation activities can help environmental groups to tailor their marketing and community engagement strategies. In turn this may increase the participation of urban residents in these activities, resulting in a stronger effort to conserve pollinators in urban landscapes.

Reference list

ADAIR, R. J. 1995. The threat of environmental weeds to biodiversity in Australia: a search for solutions. 184-201.

BALDOCK, K. C., GODDARD, M. A., HICKS, D. M., KUNIN, W. E., MITSCHUNAS, N., MORSE, H., OSGATHORPE, L. M., POTTS, S. G., ROBERTSON, K. M. & SCOTT, A. V. 2019. A systems approach reveals urban pollinator hotspots and conservation opportunities. *Nature ecology & evolution,* 3**,** 363-373.

BATLEY, M. & HOGENDOORN, K. 2009. Diversity and conservation status of native Australian bees. *Apidologie,* 40**,** 347-354.

BERNARDINI, C. & IRVINE, K. 2007. The 'nature'of urban sustainability: private or public greenspaces? *WIT Transactions on Ecology and the Environment,* 102.

CAMPBELL, B., KHACHATRYAN, H. & RIHN, A. 2017. Pollinator-friendly plants: reasons for and barriers to purchase. *HortTechnology,* 27**,** 831-839.

CARTWRIGHT, K. 2016. Exploring the Human Dimension of Conservation Gardening. *In:* MITTEN, D., CHALQUIST, C., SHORB, T. & TALLAMY, D. (eds.). ProQuest Dissertations Publishing.

DEAN, J. H., SHANAHAN, D. F., BUSH, R., GASTON, K. J., LIN, B. B., BARBER, E., FRANCO, L. & FULLER, R. A. 2018. Is nature relatedness associated with better mental and physical health? *International journal of environmental research and public health,* 15**,** 1371.

DICKINSON, J. L., SHIRK, J., BONTER, D., BONNEY, R., CRAIN, R. L., MARTIN, J., PHILLIPS, T. & PURCELL, K. 2012. The current state of citizen science as a tool for ecological research and public engagement. *Frontiers in Ecology and the Environment,* 10**,** 291-297.

DICKINSON, J. L., ZUCKERBERG, B. & BONTER, D. N. 2010. Citizen science as an ecological research tool: challenges and benefits. *Annual review of ecology, evolution, and systematics,* 41**,** 149-172.

GASTON, K. J., FULLER, R. A., LORAM, A., MACDONALD, C., POWER, S. & DEMPSEY, N. 2007. Urban domestic gardens (XI): variation in urban wildlife gardening in the United Kingdom. *Biodiversity and conservation,* 16**,** 3227-3238.

GIFFORD, R. & NILSSON, A. 2014. Personal and social factors that influence pro-environmental concern and behaviour: A review. *International Journal of Psychology,* 49**,** 141-157.

GODDARD, M. A., DOUGILL, A. J. & BENTON, T. G. 2010. Scaling up from gardens: biodiversity conservation in urban environments. *Trends in Ecology & Evolution,* 25**,** 90-98.

GODDARD, M. A., DOUGILL, A. J. & BENTON, T. G. 2013. Why garden for wildlife? Social and ecological drivers, motivations and barriers for biodiversity management in residential landscapes. *Ecological economics,* 86**,** 258-273.

GRAHAM, J. 2014. Monitoring tunnel nesting, solitary bees and wasps in North Central Florida using artificial nesting habitats. *In:* ELLIS, J. (ed.). ProQuest Dissertations Publishing.

GRAHAM, J. R., TAN, Q., JONES, L. C. & ELLIS, J. D. 2014. Native Buzz: citizen scientists creating nesting habitat for solitary bees and wasps. *Florida Scientist***,** 204-218.

HENRÍQUEZ-PISKULICH, P., VERA, A., SANDOVAL, G. & VILLAGRA, C. 2018. Along urbanization sprawl, exotic plants distort native bee (Hymenoptera: Apoidea) assemblages in high elevation Andes ecosystem. *PeerJ,* 6**,** e5916.

KOLLMUSS, A. & AGYEMAN, J. 2002. Mind the gap: why do people act environmentally and what are the barriers to pro-environmental behavior? *Environmental education research,* 8**,** 239-260.

KOTHE, E. J., LING, M., NORTH, M., KLAS, A., MULLAN, B. A. & NOVORADOVSKAYA, L. 2019. Protection motivation theory and pro-environmental behaviour: A systematic mapping review. *Australian Journal of Psychology,* 71**,** 411-432.

LOWENSTEIN, D. M., MATTESON, K. C. & MINOR, E. S. 2015. Diversity of wild bees supports pollination services in an urbanized landscape. *Oecologia,* 179**,** 811-821.

MAKINSON, J. C., THRELFALL, C. G. & LATTY, T. 2017. Bee-friendly community gardens: Impact of environmental variables on the richness and abundance of exotic and native bees. *Urban Ecosystems,* 20**,** 463-476.

MASON, L. 2018. Native Bee Watch: Assessing the Efficacy of a Citizen Science Project Monitoring Native Bees in Fort Collins, Colorado. *In:* KONDRATIEFF, B., SESHADRI, A. & BRUYERE, B. (eds.). ProQuest Dissertations Publishing.

MCKINLEY, D. C., MILLER-RUSHING, A. J., BALLARD, H. L., BONNEY, R., BROWN, H., COOK-PATTON, S. C., EVANS, D. M., FRENCH, R. A., PARRISH, J. K. & PHILLIPS, T. B. 2017. Citizen science can improve conservation science, natural resource management, and environmental protection. *Biological Conservation,* 208**,** 15-28.

MUMAW, L. 2017. Transforming urban gardeners into land stewards. *Journal of Environmental Psychology,* 52**,** 92-103.

MUMAW, L. & BEKESSY, S. 2017. Wildlife gardening for collaborative public–private biodiversity conservation. *Australasian Journal of Environmental Management,* 24**,** 242-260.

NATIONS, U. 2014. *World urbanization prospects*.

NISBET, E. K., ZELENSKI, J. M. & MURPHY, S. A. 2009. The Nature Relatedness Scale:Linking Individuals' Connection With Nature to Environmental Concern and Behavior. *Environment and Behavior,* 41**,** 715-740.

OSBALDISTON, R. & SHELDON, K. M. 2003. Promoting internalized motivation for environmentally responsible behavior: A prospective study of environmental goals. *Journal of Environmental Psychology,* 23**,** 349-357.

PEETERS, G., VAN GELLECUM, Y. R., VAN UFFELEN, J. G., BURTON, N. W. & BROWN, W. J. 2014. Contribution of house and garden work to the association between physical activity and well-being in young, mid-aged and older women. *British Journal of Sports Medicine,* 48**,** 996-1001.

PRENDERGAST, K. 2018. Nesting biology of 'Megachile ignita' Smith, 1853 (Hymenoptera: Megachilidae) in artificial nesting blocks in urbanised southwestern Australia. *The Australian Entomologist,* 45**,** 139.

PRENDERGAST, K. 2019. Luxury bee-line to Western Australia: Staying in bee hotels. *Wildlife Australia,* 56**,** 8-11.

SAUNDERS, M. 2020. Why common names are essential for bee conservation. *Ecology is not a dirty word* [Online]. Available from: https://ecologyisnotadirtyword.com/2020/10/08/why-common-names-are-essential-for-bee-conservation/?blogsub=confirmed#blog_subscription-3 [Accessed 8/10/2020.

SHANAHAN, D. F., COX, D. T. C., FULLER, R. A., HANCOCK, S., LIN, B. B., ANDERSON, K., BUSH, R. & GASTON, K. J. 2017. Variation in experiences of nature across gradients of tree cover in compact and sprawling cities. *Landscape and Urban Planning,* 157**,** 231-238.

SHAW, A., MILLER, K. & WESCOTT, G. 2013. Wildlife Gardening and Connectedness to Nature: Engaging the Unengaged. *Environmental Values,* 22**,** 483-502.

SHAW, A. E. & MILLER, K. K. 2016. Preaching to the converted? Designing wildlife gardening programs to engage the unengaged. *Applied Environmental Education & Communication,* 15**,** 214-224.

SHWARTZ, A., TURBÉ, A., JULLIARD, R., SIMON, L. & PRÉVOT, A.-C. 2014. Outstanding challenges for urban conservation research and action. *Global Environmental Change,* 28**,** 39-49.

SIEGEL, L., CUTTER-MACKENZIE-KNOWLES, A. & BELLERT, A. 2018. Still 'Minding the Gap' Sixteen Years Later: (Re)Storying Pro-Environmental Behaviour. *Australian Journal of Environmental Education,* 34**,** 189-203.

SIMAIKA, J. P. & SAMWAYS, M. J. 2018. Insect conservation psychology. *Journal of Insect Conservation,* 22**,** 635-642.

STEG, L. & VLEK, C. 2009. Encouraging pro-environmental behaviour: An integrative review and research agenda. *Journal of Environmental Psychology,* 29**,** 309-317.

VAN DE VEN, D.-J., GONZÁLEZ-EGUINO, M. & ARTO, I. 2018. The potential of behavioural change for climate change mitigation: a case study for the European Union. *Mitigation and Adaptation Strategies for Global Change,* 23**,** 853-886.

WEBB, R., BAI, X., SMITH, M. S., COSTANZA, R., GRIGGS, D., MOGLIA, M., NEUMAN, M., NEWMAN, P., NEWTON, P., NORMAN, B., RYAN, C., SCHANDL, H., STEFFEN, W., TAPPER, N. & THOMSON, G. 2018. Sustainable urban systems: Co-design and framing for transformation. *Ambio,* 47**,** 57-77.

WHITTLES, C. 2018. *Guardian Scheme* [Online]. England. Available: https://www.masonbees.co.uk/bee-guardians [Accessed 17/03/2020].

WIGNALL, V. R., ALTON, K. & RATNIEKS, F. L. W. 2019. Garden centre customer attitudes to pollinators and pollinator-friendly planting. *PeerJ,* 7**,** e7088-e7088.

WRIGHT, D. R., UNDERHILL, L. G., KEENE, M. & KNIGHT, A. T. 2015. Understanding the Motivations and Satisfactions of Volunteers to Improve the Effectiveness of Citizen Science Programs. *Society & Natural Resources,* 28**,** 1013-1029.

ZOLLER, H. M., FUJISHIRO, K., MOBLEY, A. & LEHMAN, E. 2015. Perspectives on Communication and Participation in Research Notification Focus Groups. *Health Communication,* 30**,** 986-1000.

Appendix

Please help us build a picture of the Pollinator Link® community

- **Consent - Please refer to the Participant Information Sheet attached in email**
  - ☐ I am at least 18 years of age, and I have read and agree to the terms provided in the Participant Information Sheet

Pollinator Link® Questionnaire

1. **What is your age range?**
   - ☐ 18-20 years
   - ☐ 21-25 years
   - ☐ 26-30 years
   - ☐ 31-40 years
   - ☐ 41-50 years
   - ☐ 51-60 years
   - ☐ 61-70 years
   - ☐ 71+ years

2. **What is your gender?**
   - ☐ Male
   - ☐ Female
   - ☐ Prefer not to say

3. **What is the postcode of the town/suburb where you live?**

Please specify:

4. **Do you…?**
   - ☐ Own your home/apartment
   - ☐ Rent
     i. Responsible for garden maintenance
     ii. Landlord responsible for garden maintenance
   - ☐ Live with family
   - ☐ Other (Please specify)

5. **What is the highest qualification or schooling level you have completed?**
   - ☐ Finished Year 12 or equivalent
   - ☐ Certificate 1,2,3,4
   - ☐ Other (please specify)
   - ☐ Trade certificate
   - ☐ Undergraduate Degree
   - ☐ Post-graduate Degree

6. **What motivated you to be involved with Pollinator Link?**
   Please write your reason here:

Please tick the activities/resources that you are currently providing to wildlife on your property.

7. **How do you provide water for wildlife?**

Activity	Yes/No
Bird bath/ shallow bowl	
Butterfly Puddling place	
Rain Garden	
Frog Pond/ water feature	
Close to creek/ river	
Other (Please Specify)	

8. **How do you provide food for wildlife?**

Activity	Yes/No
Nectar/ pollen plants	
Fruits/ berry plants	
Seed trees/ shrubs	
Seed grasses	
Caterpillar host plants e.g. citrus trees	
Other (Please Specify)	

9. **How do you provide shelter and places to raise young for wildlife?**

Activity	Yes/No
Nest-box	
Bee Home for solitary bees	
Stingless native bee hive	

Frog Pond/water feature	
Mature trees	
Dense shrubs	
Groundcover	
Rock pile/ wall	
Dead wood – log piles or tree stumps	
Other (Please Specify)	

10. Have you planted a garden on the road verge in front of your property?

- ☐ Yes (Go to Q11.)
- ☐ No (Go to Q12.)

11. What is the main purpose of your verge garden?

- ☐ provide habitat for wildlife
- ☐ privacy or screening
- ☐ grow food
- ☐ landscape amenity (flowering plants etc)
- ☐ other (please specify)

12. What do you find challenging about providing habitat resources for wildlife?

Please write your answer here:

13. What would help you to overcome challenges?

Please write your answer here:

14. How many days per week do you work in the garden?

- ☐ One or two days/week
- ☐ Three or four days/week
- ☐ Five or six days/week
- ☐ Seven (everyday)

15. How many hours total do you spend working in the garden per week?

Please specify:

16. For each of the following, please rate the extent to which you agree with each statement, using the scale from 1 to 5 as shown below. Please respond as you really feel, rather than how you think "most people" feel.

	1 – Disagree Strongly	**2 – Disagree a little**	**3 – Neither agree or disagree**	**4 – Agree a little**	**5 – Strongly Agree**
My connection to nature and the environment is a part of my spirituality	☐	☐	☐	☐	☐
My relationship to nature is an important part of who I am	☐	☐	☐	☐	☐

I feel very connected to all living things and the earth	☐	☐	☐	☐	☐
I am not separate from nature, but a part of nature	☐	☐	☐	☐	☐
I always think about how my actions affect the environment	☐	☐	☐	☐	☐
I am very aware of environmental issues	☐	☐	☐	☐	☐
I think a lot about the suffering of animals	☐	☐	☐	☐	☐
Even in the middle of the city, I notice nature around me	☐	☐	☐	☐	☐
My feelings about nature do not affect how I live my life	☐	☐	☐	☐	☐
Humans have the right to use natural resources anyway we want	☐	☐	☐	☐	☐
Conservation is unnecessary because nature is strong enough to recover from any human impact	☐	☐	☐	☐	☐
Animals, birds and plants have fewer rights than humans	☐	☐	☐	☐	☐
Some species are just meant to die out or become extinct	☐	☐	☐	☐	☐
Nothing I do will change problems in other places on the planet	☐	☐	☐	☐	☐
The state of nonhuman species is an indicator of the future for humans	☐	☐	☐	☐	☐
The thought of being deep in the woods, away from civilization, is frightening	☐	☐	☐	☐	☐
My ideal vacation spot would be a remote, wilderness area enjoy being outdoors, even in unpleasant weather	☐	☐	☐	☐	☐
I don't often go out in nature	☐	☐	☐	☐	☐
I enjoy digging in the earth and getting dirt on my hands	☐	☐	☐	☐	☐
I take notice of wildlife wherever I am	☐	☐	☐	☐	☐