Urban Forestry & Urban Greening 28 (2017) 97–102

Contents lists available at ScienceDirect

Urban Forestry & Urban Greening

journal homepage: www.elsevier.com/locate/ufug

Original article

Gathering Baltimore's bounty: Characterizing behaviors, motivations, and barriers of foragers in an urban ecosystem

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ARTICLE INFO

Keywords:
Alternative food systems
Land use
Urban foraging

ABSTRACT

As a component of urban food systems, foraging—the collection of plant or fungal materials, such as berries and nuts, not deliberately cultivated for human use—may promote positive cultural, ecological, economic, and health outcomes. Foraging behaviors, motivations, and barriers in the urban context remain under-characterized despite emerging literature on the subject.

We surveyed 105 self-identified foragers in Baltimore, Maryland about species, quantity, seasonality, and preparation of collected materials; frequency and locations of foraging activities; foraging experience; motivations for and barriers to foraging; and contributions of foraged materials to diets. Respondents collected from a diverse array of species (170 taxa) which, in some cases, constituted an important fraction of the overall diet.

This study contributes to the quantitative foundation needed for future work exploring relationships among foraging, public health, and urban ecosystems. This work could inform policy regarding the use and management of urban landscapes.

1. Introduction

Novel and hybrid ecologies common in urban environments provide ecosystem services for humans, including food provisioning (Hobbs et al., 2014; Hurley and Emery, 2017), which may contribute to social and ecological resilience (Lovell and Taylor 2013). Urban agriculture is recognized as a component of local food systems in many cities, uncertainties about potential exposures to soil contaminants and other environmental hazards notwithstanding (Kim et al., 2014; Wortman and Lovell 2013). Foraging in urban environments is also a source of food for some city residents, and research suggests that it supports physical and emotional wellbeing (McLain et al., 2014). Defined here as the collection of plant or fungal materials, such as berries and mushrooms, not deliberately cultivated for use, foraging provides food, medicine, and utilitarian resources (Hurley et al., 2015; McLain et al., 2014; Schlesinger et al., 2015; Unnikrishnan and Nagendra, 2014; Wehi and Wehi, 2010). The practices of seeking, harvesting, preparing, and consuming forageables sustain the cultures and identities of diverse urban populations, including indigenous peoples, settler populations, and recent immigrants (Poe et al., 2013). At a time when over half the world's population lives in cities and the pace of urbanization is increasing, foraging creates connections to nature (Poe et al., 2014) and biodiversity (Palliwoda et al., 2017).

Foraging can be a no-cost source of fresh, micro-nutrient dense food (Phillips et al., 2014), which may be particularly beneficial for low-income and/or food insecure households. The importance of urban foraged foods has been demonstrated in times of collective crisis such as armed conflict or natural disasters (Redzić 2010). In contrast to urban agriculture, foraging entails virtually no entry costs beyond the knowledge and time required for harvest. Urban forests may harbor large stocks of species with resource benefits for city residents, albeit with some species of interest to foragers found in low abundances (Hurley and Emery, 2017). Yet foragers may engage in stewardship practices that minimize their harvests of certain species and reduce

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http://dx.doi.org/10.1016/j.ufug.2017.10.007
Received 10 June 2017; Received in revised form 2 October 2017; Accepted 8 October 2017
Available online 10 October 2017

their impacts on these systems (McLain et al., 2017). These characteristics suggest foraging could contribute to healthy, diverse, and resilient urban food systems.

There may also be health risks associated with urban foraging. In addition to the potential for misidentification of species, people who collect or consume materials foraged in urban settings may be exposed to chemical contaminants present in soils, on the surfaces of collected materials, and/or in consumed tissues. Earlier studies suggest that careful consideration of site pollution (including nearby traffic density) and thorough washing can confer contaminant exposure reductions for collectors of foraged materials and other plants cultivated in urban environments (Säumel et al., 2012; von Hoffen and Säumel, 2014). Nevertheless, given urban industrial legacies and present day practices, uncertainty remains regarding the potential for exposure to contaminants through foraging activities and best practices necessary for mitigating these exposures.

An emerging body of literature has begun to examine foraging in cities around the globe including Bangalore, Berlin, Kampala, and New York. Studies documenting foraged taxa catalog dozens to hundreds of species harvested from temperate to tropical urban environments in the Southern and Northern hemispheres (see, for example, McLain et al., 2014; Mollee et al., 2017). Within cities, foraging occurs on public and private lands (Hurley et al., 2012; Mollee et al., 2017; Poe et al., 2013a,b; Shackleton et al., 2015; Wehi and Wehi, 2010), as well as common lands (Cocks et al., 2016; Unnikrishnan and Nagendra, 2015). Land use types are diverse, ranging from formally managed parks (Palliwoda et al., 2017) to vacant lots and interstitial spaces (Hurley et al., 2015; Poe et al., 2013).

Data on rates of participation in urban foraging generally are unavailable. However, a 2004 survey of residents of four northeastern U.S. states, over half of whom were urban residents, found that 26.3 percent had foraged in the previous five years (Robbins et al., 2008). Other studies have noted that urban forager demographics are diverse across dimensions including age, gender, income, and ethnicity (McLain et al., 2014). Nevertheless, Mollee et al. (2017) note that foraging in Kampala appears to be most common among individuals under the age of 51 years and those in low-income households (although 23 percent of households with the highest wealth status forage), while 78 percent of foragers observed in two central Berlin parks were women (Palliwoda et al., 2017).

A number of common motivations for foraging are evident, despite differences in taxa and environments in cities studied. Noteworthy among these are perceived nutritional and other health benefits of foraged plants and fungi, as well as enhanced dietary variety and access to culturally salient foods (McLain et al., 2014; Mollee et al., 2017; Palliwoda et al., 2017). Ability to engage in self-provisioning also is frequently cited, whether as a means of addressing immediate food insecurity or enhancing personal independence (McLain et al., 2014; Mollee et al., 2017; Palliwoda et al., 2017; Poe et al., 2013). Among other benefits of urban foraging and use of wild plants observed across multiple cities are support for cultures and identity (Ceuterick and Vandebroek 2017; Poe et al., 2013; Unnikrishnan and Nagendra, 2015) and connections with nature (Poe et al., 2014).

Scholars have identified a number of social and ecological barriers to urban foraging, despite its apparently widespread nature and benefits. In general, urban greenspaces are conceptualized as backdrops for recreation (Gobster 2007; Hurley et al., 2015; Unnikrishnan and Nagendra, 2015) and, until recently, provision of goods and human health and wellbeing have been regarded as outside the purview of urban greenspace management (Clark and Nicholas, 2013; McLain et al., 2012). Displacement of greenspaces by urbanization processes may further impede access to desired taxa. Potential exposure to contaminants from consuming urban foraged plants and fungi also may be a deterrent or source of concern for some foragers.

One of the earliest studies of urban foraging was conducted in Baltimore, Maryland, USA (Jahnige, 2002). Findings from this study, which took place in 1998 and 1999, presage much of what has subsequently been found in the research summarized above. Interviews with some 80 Baltimore foragers, land managers, and others identified values from collecting wild plants and fungi in the city including economic contributions primarily through self-provisioning, as well as nutritional, recreational, educational, and cultural benefits. The study also identified health risks as a potential, if avoidable, concern.

Urban foraging practices are under-characterized, despite the emerging literature discussed above. In order to better understand the potential benefits and risks, we characterized the behaviors and motivations of, and barriers faced by urban foragers in Baltimore, fifteen years after Jahnige's pioneering study. By quantifying foraging practices in Baltimore, particularly assessing the quantities of materials harvested and consumed, we reveal the importance of urban ecosystems for city residents who seek to derive material benefits from them. By considering which land use types and vegetated land covers feature more or less prominently in the practices of foragers, we provide additional insights into the nature of urban greenspaces that support the efforts of city residents to find these material benefits.

2. Methods

2.1. Recruitment and forager surveys

We conducted in-person surveys in 2014–2015 with 105 persons who were 18+ years old and had foraged for food or medicine in Baltimore City or County at least once in the previous 12 months. We used purposive and snowball sampling techniques, with initial respondents recruited through events and locations known to be frequented by foragers (e.g., farm-to-table restaurants, natural food stores, social groups and media, and other avenues). To reach population subgroups for whom foraging may be an important means of acquiring culturally-significant materials, we translated the survey into Spanish and recruited at locations important to these communities; these efforts did not, however, yield any additional responses. The Johns Hopkins Bloomberg School of Public Health Institutional Review Board approved the human subjects research involved in this study.

The survey (SI Appendix A) included questions regarding the collection timing, frequency, quantity, preparation, and distribution for up to five of the respondent's most frequently foraged materials (henceforth "frequent forageables") in a typical year. Visual aids for the quantity of harvests (e.g., measuring cups) were provided to help respondents estimate harvest quantities. Beyond the detailed information provided for those five items, respondents provided a list of additional forageables. The survey also included questions about demographics, foraging experience, sources of foraging information, motivations for, and barriers to foraging, and contributions of forageables to their diets. Using Environmental Systems Research Institute (ESRI) Collector for ArcGIS, respondents also provided the geographic coordinates of up to five foraging locations and the forageables collected at each.

2.2. Material identification

Identification of foraged plant and fungal materials was based on common names provided by respondents. Using this information, a field botanist with extensive knowledge of Baltimore City and County flora assigned taxa. In cases where common names could represent multiple taxa, we used contextual information (i.e., season-of-harvest, preparation, parts consumed) to narrow down to the most specific level of classification possible (i.e., species, genus, family). Taxa counts included all distinct species, genera, and families. Some common names were associated with species whose natural range does not include the study area and are not known to be cultivated in the region. These species were likely misidentified and were excluded from our tally of unique taxa.

2.3. Foraging behaviors

We tallied the number of unique taxa collected by each respondent across their frequent forageables, their list of additional materials, and other forageables mentioned in reference to specific foraging locations. We estimated the number of outings per year for each respondent, O, as follows:

$$O = \sum_{i=1}^{n} (M_i \times F_i)$$

where i = a frequent forageable, n = number of frequent forageables (up to five), M = the number of months the respondent collected i, and F = the number of times per month i was collected.

For each respondent, we calculated the total annual volume of their frequent forageables, V, as follows:

$$V = \sum_{i=1}^{n} (M_i \times F_i \times C_i)$$

where C = the volume collected of forageable i per outing. In cases where respondents reported collection quantities as a mass or count, we converted to volume using nutrition and botanical information (e.g., US Department of Agriculture, 2016a,b). When forageable-specific information was unavailable, we used a proxy (e.g., the mass-to-volume conversion ratio was unavailable for chickweed, so we used the ratio for alfalfa sprouts). We used Stata 14 to conduct Pearson's test to assess correlations among selected demographic and behavioral variables.

2.4. Spatial analyses

To assess spatial patterns of foraging behavior, we converted the 28 land use codes designated by the Maryland Department of Planning (2010) into a land use classification scheme consisting of agricultural, commercial, green space, industrial, and residential categories (Table 1). Using that scheme, we assigned each geocoded foraging location a land use category. In addition, for each respondent, we estimated the typical distance traveled to foraging locations by averaging Euclidean distances from the centroid of the respondent home zip code to each of the geocoded foraging locations.

Table 1
Land use associated with the study area and foraging locations. Each grouped land use category spans multiple land use codes as designated by the Maryland Department of Planning (2010).

Grouped land use category	% of study area[a]	Foraging locations	%	MDP land use designation[b]	Foraging locations	%
Green space	30.4%	200	61.9%	Deciduous forest	146	45.2%
				Open urban land	38	11.8%
				Evergreen forest	9	2.8%
				Mixed forest	5	1.5%
				Brush	2	0.6%
Residential	36.3%	77	23.8%	High-density residential	50	15.5%
				Medium-density residential	19	5.9%
				Low-density residential	6	1.9%
				Large lot subdivision	2	0.6%
Commercial	6.6%	34	10.5%	Institutional	27	8.4%
				Commercial	7	2.2%
Industrial	5.5%	7	2.2%	Industrial	6	1.9%
				Transportation	1	0.3%
Agriculture	19.1%	5	1.5%	Cropland	4	1.2%
				Pasture	1	0.3%

[a] Baltimore City and County, excluding bodies of water over 100,000,000 square feet.
[b] Only includes codes in which foraging occurred.

2.5. Foraging motivations and barriers

We took a modified conventional content analysis approach (Hsieh and Shannon 2005) to identify the major themes in responses regarding motives for, and barriers to, foraging. This included the development of a codebook organized with axial codes and sub-codes derived from the themes. One researcher coded all qualitative responses and flagged those with ambiguous code assignments. Flagged responses were verified through an inter-rater process involving two other researchers individually coding the responses. Three researchers subsequently met to resolve disputed responses. When a response met the criteria for multiple codes, it was assigned all relevant codes.

3. Results

3.1. Forager demographics

We surveyed 105 respondents living within 24 zip codes in the Baltimore study area. Most were white (91%), female (59%), non-students (80%), with at least a bachelor's degree (78%). The median age was 34 (range: 20–66). Half had five years or fewer of foraging experience. See Fig. 1 for additional demographic information.

3.2. Collected materials

We documented the collection of 170 unique taxa (SI Appendix B), with respondents reporting collecting a median of 10 unique taxa in a typical year. When the number of taxa collected was put into quartiles, we found a significant negative correlation with income ($r = -0.27$, $p = < 0.01$), though the correlation lost significance ($r = -0.14$, $p = 0.16$) when number of taxa were examined as a continuous variable. The median number of taxa collected by income bracket was characterized by a reverse J-shaped distribution (SI Fig. 2). Low- and high-income foragers collected a greater variety of taxa than middle-income foragers, with low-income foragers collecting the largest number of taxa.

By frequency of mention, vascular species accounted for 85% of forageables, with propagules (fruits/nuts/berries) (41%) and leaves (21%) the most frequently reported plant materials. The volume of leaves surpassed that of propagules by 10%. Fungi accounted for 75% of forageables by volume (SI Appendix B). The difference among the most frequently and abundantly collected materials may be a result of differences in popular awareness, ease of identification, local abundance, or typically foraged volumes, and is a topic for further research. The median combined volume of respondents' frequent forageables was 19.6 L yr^{-1}. The volume of frequent forageables was significantly correlated with the number of taxa ($r = 0.22$, $p = < 0.05$), suggesting that those who collected more by volume were more likely to collect a more diverse range of taxa. Taxa-specific volume data are presented in SI Appendix B.

3.3. Foraging frequency and temporality

The median number of reported foraging outings per year was 29 (IQR: 14–62). Consistent with the seasonal availability of most forageables, foraging activity predominantly took place between April and October, though 48% of respondents also foraged from November through March. The months of May and January had the highest (79%) and lowest (6%) number of respondents reporting foraging, respectively (SI Fig. 1).

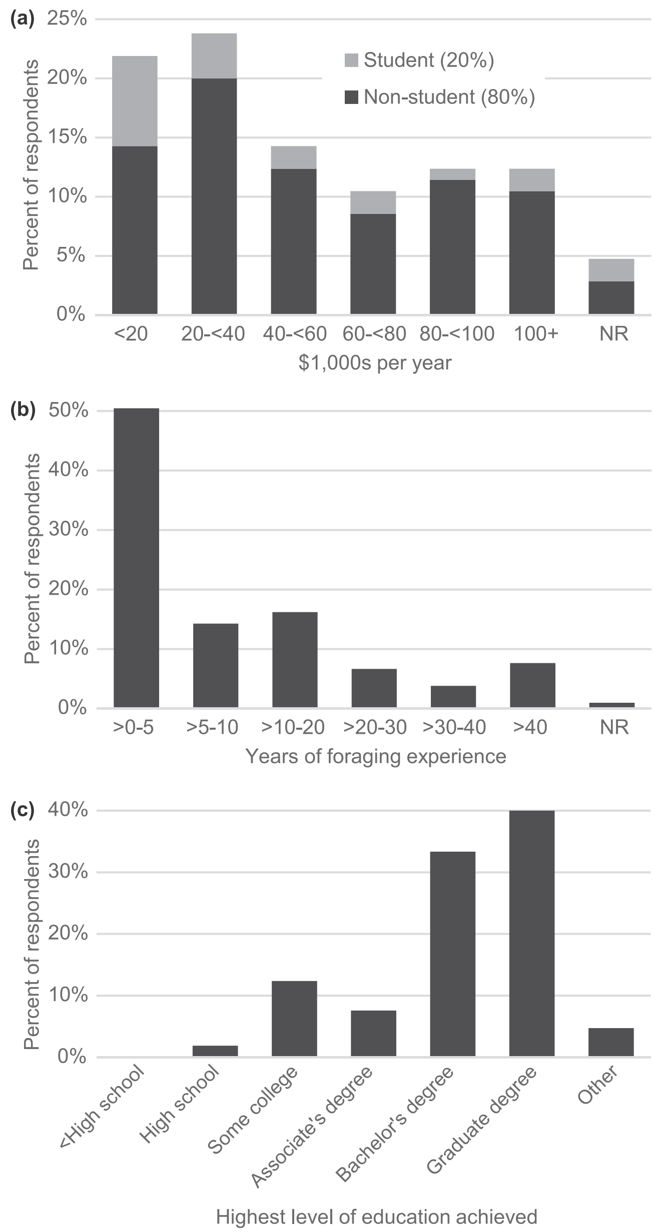

Fig. 1. Respondent demographic information. (a) Household income, by student status. (b) Years of foraging experience. (c) Highest level of education achieved. NR = not reporting.

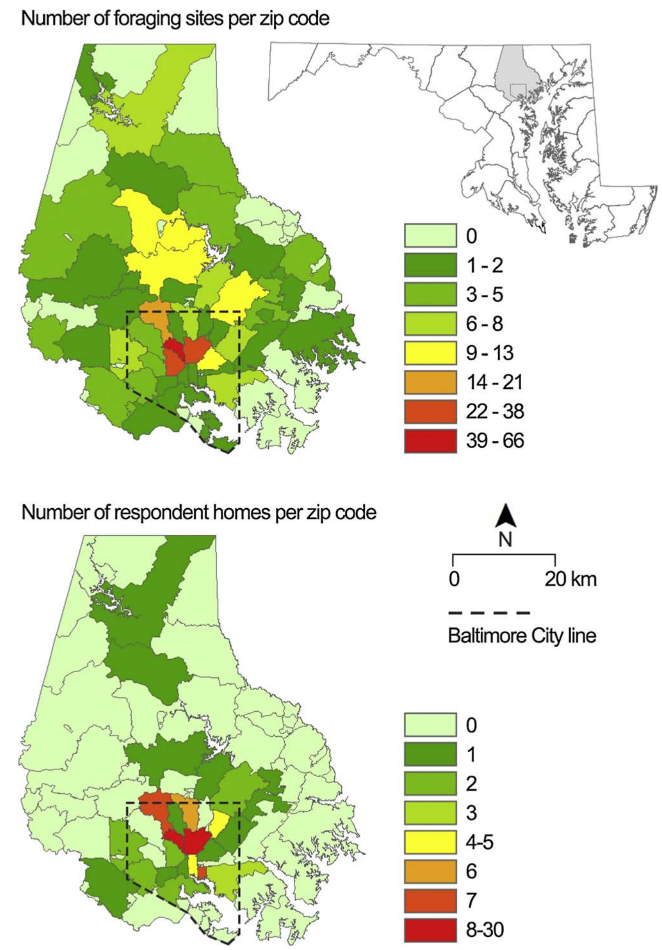

Fig. 2. Respondent foraging locations and homes, in Baltimore City and County, by zip code.

3.4. Foraging locations and distances traveled

Approximately 95% of respondents identified up to five specific foraging locations; the other 5% declined, citing concerns about over-harvesting, increased foot traffic, and degradation of site conditions. A total of 323 unique locations were reported, 64% of which were located in Baltimore City (as compared to 36% in Baltimore County). Most (62%) corresponded to the green space land use category, despite only 30% of the study area being classified as green space (Table 1). Of these, 73% were in deciduous forests and 19% were in areas designated as open urban land (e.g., parks, golf courses, and recreation areas).

Foraging was reported in 49 of 71 possible zip codes in Baltimore City and County (Fig. 2). For most respondents (57%), at least one reported foraging location was in their home zip code. Less than one-third of locations (29%), however, were within respondents' home zip codes, suggesting that foragers usually traveled outside their home zip codes. The median average distance traveled by respondents was 6.9 km (IQR: 2.9–12.2 km). The number of zip codes in which a respondent's sites were located correlated with the number of unique taxa collected ($r = 0.42$, $p = < 0.001$) and volume of frequent forageables ($r = 0.36$, $p = < 0.001$). These associations could be explained by the well-traveled forager encountering a greater variety and total volume of edible materials. Conversely, foragers seeking a diverse and substantial quantity of material may traverse a broader landscape. The number of zip codes also correlated with the number of outings ($r = 0.20$, $p = < 0.05$).

3.5. Contributions to diet

Respondents reported that forageables accounted for < 1–47% of their diets, with a mean contribution of 7%. Most respondents (67%) said foraged materials comprised ≤5% of their diet, though one-fifth of respondents reported that foraged materials accounted for ≥ 10% of their diets (SI Fig. 3). Dietary contributions were negatively correlated with income ($r = -0.20$, $p = < 0.05$). The average dietary contribution among respondents earning between $20k and $40k, for example, was over three times higher than that of respondents earning over $100k. Taken together with the association between income and number of taxa collected, these findings may be indicative of either a greater reliance on foraged materials (e.g., for sustenance and/or cost-savings) among lower-income participants. We also found correlations between dietary contributions and number of unique taxa ($r = 0.48$, $p = < 0.01$), number of outings ($r = 0.55$, $p = < 0.01$), number of foraging location zip codes ($r = 0.28$, $p = < 0.01$), average distance traveled to foraging locations ($r = 0.24$, $p = < 0.02$), and volume of frequent forageables (r = 0.33, p = < 0.01).

3.6. Use of forageables

An average of 67% of respondents' frequent forageables was consumed by the respondent. All respondents consumed at least some of each taxon foraged, with 76% and 8% sharing or selling a portion, respectively. Each of 72 unique taxa was shared by at least one respondent (SI Appendix B). All sellers (8) distributed at least one taxon directly to restaurants while two also sold through a personal contact or their own business.

3.7. Preparation of forageables

Washing and cooking may play a role in the risk of exposure to contaminants from consuming forageables. On average, respondents reported washing 52% (by volume) of their frequent forageables. Fungal and plant materials were washed 52% and 61% of the time, respectively. Some respondents indicated they did a brush cleaning of mushrooms without water.

Plant materials were consumed raw in 65% of cases; no respondents consumed raw mushrooms. We identified 30 plant materials (7%) as peelable and growing close enough to the ground such that peeling could reduce potential exposures to soil contaminants; of these, respondents peeled less than half (47%).

3.8. Information sources

Key foraging information sources consulted by respondents were books (69%), the internet (62%), other foragers (58%), and friends (53%) (SI Table 1). The number of consulted sources (μ = 3.6) correlated with the number of taxa collected (r = 0.33, p = < 0.001).

3.9. Motivations and barriers

The most frequently reported motivations for foraging were enjoyment (55%), economic and health benefits (51% and 46%, respectively), and connection with nature (46%) (Table 2). Lack of time (59%), lack of knowledge (46%), and safety (37%) were the most frequently cited barriers (Table 3). Frequent mention of economic benefits may suggest forageables are used to replace some items that would otherwise need to be purchased. Income was not, however, associated with reporting an economic motivation for foraging.

4. Discussion

While recent studies have used quantitative and geospatial methods to examine foraging in African cities (Schlesinger et al., 2015), to our knowledge, ours is the first to do so in North America, reinforcing earlier qualitative findings. Our collection of data on precise locations of harvest, consumption volumes, preparation methods, and distribution across land use types within the city marks a novel step to understanding key spatial aspects of this practice. This study marks a first step toward assessing potential benefits and risks from consuming urban forageables. By identifying specific quantities of materials harvested in specific locations, these results will provide participant-oriented guidance on where and which types of land uses to examine when seeking to answer questions about risks associated with foraging.

Reliance on self-reported data and possible recall bias are limitations of the study. In particular, we were not able to collect voucher evidence (Culley 2013) and thus relied on respondent identification of forageables. We only collected detailed information for up to five forageables and five locations for each respondent; consequently our findings may not capture the full spectrum of foraging activities. Further, uncertainty exists in the estimation of the number of foraging outings; we assumed respondents made a separate trip for each item, which may overestimate the number of outings in the event that multiple items were collected on a single trip. Conversely, we could not account for outings to collect materials beyond the top five, potentially underestimating the number of outings.

By quantifying the contribution of harvested materials to study participants' diets, this work provides evidence for the potential role of forageables in satisfying the food needs of individuals, whereas previous research on foraging has sought largely to assess what materials are harvested and how they are used (McLain et al., 2014; Poe et al., 2013). Our quantitative approach opens the door for public health and food system researchers to empirically test hypotheses about contributions of forageables to food security (Clark and Nicholas, 2011) and to individual well-being (Poe et al., 2013).

Our study builds on work in Berlin (Palliwoda et al., 2017), which has pointed to the importance of parks for connecting foragers to specific species. Our study demonstrates that parks and other forms of open space are important land use types supporting foraging, but that other urban land use types support this practice as well. Here, the relatively high percentage of foraged materials located within high density housing or institutional lands provides support for observations about the ways developed areas and their landscaping, such as street trees, might contribute to forager practices (Hurley and Emery, 2017; Hurley et al., 2015). The coupling of species information with information about the quantities of material harvested also provides new insights to managers of open space about how they may engage with this practice (McLain et al., 2014).

5. Conclusions

Foraging practices continue to be more widespread than may be recognized and may be relatively longstanding in some locations. We documented an active urban foraging community in Baltimore, nearly 15 years after a previous study in the city characterized the presence of urban foragers in the U.S. for the first time. Our study describes a population engaged in the collection of a diverse array of plant and fungal materials which, in some cases, constituted an important fraction of an individual's overall diet. Despite this, foraging remains largely unrecognized in urban policy, planning, and design, except where prohibited by regulations governing public parks and other greenspaces.

Our study serves as a foundation for future investigations of the relationships among foraging, public health, and urban ecosystems. Foraging occurs at different levels on public and private lands characterized by different forest types. Moreover, our results point to variations in the quantities of materials that are harvested relative to both their use and the locations where they are harvested. A clearer understanding of the potential health benefits and risks associated with foraging could inform how these practices might explicitly be incorporated into urban food system policy.

Conflict of interest

The authors have no conflicts of interest to declare.

Acknowledgements

This research was supported by the United States Department of Agriculture, Forest Service (Northern Research Station) grant number 118751; National Center for Research Resources and the National Center for Advancing Translational Sciences of the National Institutes of Health grant number 1UL1TR001079; and the GRACE Communications Foundation. The funders had no role in study design; data collection, analysis, or interpretation; preparation of the manuscript; or decision to publish. The authors would like to thank Eric Kelly and Victoria Greba of Charm City Farms for their review of and feedback on the study survey tool.

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at http://dx.doi.org/10.1016/j.ufug.2017.10.007.

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