Eat Your Weeds:
Edible and Wild Plants in Urban Environmental Education and Outreach[1]

Abstract

Edible weedy plants are ubiquitous in human-dominated areas and provide opportunities to combat plant blindness and improve citizens' local ecological knowledge in formal and informal urban environmental educatio (UEE) programs. Weeds exemplify intriguing ecological, cultural, and ethnobotanical concepts, making them ideal resources for hands-on, socially relevant, and personally meaningful educational activities. Cosmopolitan, spontaneous, weedy plant species are often freely accessible for use in the curricula of many grade levels in varied educational venues as well as in extra-curricular activities for all learners, given that proper safety and legal precautions are taken. We developed and hosted a UEE outreach activity based on edible weedy plants at Rutgers University as part of an annual, university-wide event attended by over 80,000 people in the spring of 2014. Incorporating edible weeds into such programs teaches plant identification skills and ecological appreciation in settings that are "close to home" for most people.

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Key Words

botanical education; ecological knowledge; food; informal education; K-99 education; place-based learning; plant blindness; species identification; urban environmental education; urban vegetation

Footnotes

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Introduction

Positive human-nature interactions are vital to counteract modern day environmental problems, yet urbanization and development continue to threaten our connection with and understanding of the biosphere (Miller, 2005; White et al., 2010; Liefländer et al., 2012). Current generations are becoming increasingly estranged from living organisms except other humans, supermarket food plants, and pets (Miller, 2005). As of 2014, 82% of the population of the United States lived in urban areas (United Nations, 2014); native species diversity and abundance have declined in cities (Gaston, 2010; Duncan et al., 2011); and the ease of accessibility to green space tends to diminish as city populations grow (Fuller and Gaston, 2009). Together, these phenomena may prevent much of the world's population from experiencing and observing nature in a positive light (Morrone and Meredith, 2003), ultimately leading to a widespread lack of environmental concern (Chawla, 1998). Therefore, developing effective materials and curricula for urban environmental education (UEE) that target a broad audience is necessary to create an ecologically and socially responsible society for the future (Tidball and Krasny, 2010; Ardoin et al., 2012).

Spontaneous urban plants (also known as "weeds") are ubiquitous in cities worldwide; they inhabit every crack and corner of the cityscape. The omnipresence of weeds in modern cities and their suburbs makes them some of the most universally accessible wild species available for study and observation. These weedy plants, whether native or non-native, have traits that make them well suited to highly disturbed human-dominated environments such as suburban lawns or pavement cracks (e.g. Cheptou et al., 2008; Del Tredici, 2010). The sheer prevalence of weeds makes them convenient and effective tools for combatting plant blindness, defined as "the inability to see or notice the plants in one's own environment, leading to the inability to recognize the importance of plants in the biosphere and in human affairs" (Wandersee and Schussler, 1999; Smith, 2014). Learning about weeds has the potential to encourage people to notice the abundance of plant life that surrounds them on a daily basis (Allen, 2003), even within cities. Studying weeds is also a way to encourage learners of all ages and backgrounds to appreciate, respect, and inquire about nature in all of its diverse forms (e.g., useful versus not useful plants, or attractive versus "ugly" species).

Weedy plant foraging and city herbalism have experienced a resurgence in popular culture in the West in recent years (e.g. Wong and Leroux, 2012; Lerner, 2013; Vorass-Herrera, 2013; Blair, 2014). However, the fact that most urban, weedy plant species have ancient ethnobotanical histories and cultural relevance for diverse human groups is not well known today (Zimdahl, 2013). Chickweed, for

example, is one of the most common vascular plants, found in over 100 city floras worldwide (Aronson et al., 2014). Chickweed has a well-documented ethnobotanical record in traditional South American, European, and Asian cultures: the young shoots and leaves are used as ophthalmic and anti-inflammatory medicines in Patagonia; used as fodder to increase egg-laying in poultry in central Italy; and cooked along with cabbage for human nourishment in southwest China (e.g. Guarrera et al., 2005; Weckerle et al., 2006; Molares and Ladio, 2009). Yet, most wellknown and beloved plants in today's Western cultures are showy horticultural ornamentals and garden crops—not the wild, weedy plants historically used for medicinal or food purposes. Exposing people to the edible, medicinal, and other cultural or historical uses of weeds can stimulate people's interest and curiosity in wild organisms. Furthermore, using edible urban weeds as study organisms roots UEE in the socio-ecological nature of the city by connecting students and the public to the natural world via cultural, culinary, biological, ecological, and historical references and provides a truly interdisciplinary framework for formal and informal education (Tidball and Krasny, 2010; Blanchet-Cohen and Reilly, 2013).

Using edible weedy plants in environmental educational initiatives also supports the development and maintenance of plant identification skills. Being able to identify a species and giving it a unique name is not only important for educational efforts in combatting plant blindness, but it is also a crucial pre-requisite to foraging for wild foods. Along with the ease and accessibility of incorporating edible weedy plants into UEE, a strong emphasis must be placed on safety precautions. A strong foundation of botanical identification skills and morphological knowledge is necessary for the success and safety of any edible wild plant program. Many plants are edible, but many others are toxic. Foragers, instructors, and learners must be aware of toxic "lookalikes" and should not consume any plant product until the identity of the collected species is certain. New foragers may choose to begin with a mentor or guide to learn the basics of plant identification. Thorough, reliable field guides and repeated field identification practice are essential for cautious foraging and can help remind even the most experienced field botanists of subtle yet potentially important morphological differences between specimens. In urban settings, in particular, educators must also ensure that foragers are careful to avoid potentially toxic urban sites that have been contaminated by pesticides, fertilizers, automotive fuel, heavy metals, or animal waste, among other pollutants. The possibility of individual reactions to allergens in common plants should be discussed prior to foraging. In addition to safety precautions, foragers should always acquire permission from landowners to access and remove plant materials from a given site.

We recognized the potential of using spontaneous weedy plants as an exciting and relevant way to engage the public, so we organized an outreach table featuring edible weedy plants for our local community. We held our outreach event at the annual Rutgers Day—a university-wide open house for Rutgers University in New Brunswick, New Jersey—that engages and informs the extended local community through activities provided by university students, clubs, and departments. The local and state-wide impact of this celebration is significant: in 2013, this event was attended by nearly 80,000 people. For Rutgers Day 2014, our environmental education table was entitled "Eat Your Weeds:

How to Safely Savor Wild Edible Plants." Our overarching teaching goal was to encourage community members to make meaningful connections not only with living wild plants, but also with ecological processes and associated biodiversity in urban and suburban areas through eating weeds (Table 1).

Activity Description

Plant species selection

Six edible urban weeds that are locally abundant were chosen to be showcased at our outreach table during Rutgers Day 2014 (Table 2): *Taraxacum officinale* (common dandelion), *Allium vineale* (field garlic, wild onion), *Alliaria petiolata* (garlic mustard), *Stellaria media* (common chickweed), *Cardamine hirsuta* (hairy cress), and *Rumex acetosella* (sheep sorrel). Although not as common in suburban and urban areas, and not always strictly weedy in our part of the world, we also included *Rosa canina* (wild rose) and *Sambucus nigra* (elderberry) as highlighted species due to the commercial availability of food products using these plants (see Table 2). We also served two prepared food products: Elderflower Lemonade from a syrup concentrate ("Flädersaft," IKEA Foods, Sweden) and Rose Hip Soup (cold) from a smoothie mix ("Nyponsoppa," Ekströms, Eslöv, Sweden).

Fact sheet preparation

Consuming and foraging for wild foods involves certain risks, such as injury while foraging, plants growing in polluted soils, and poisoning due to eating misidentified plants. To address these potential risks, we incorporated safety information into our activity plan in the following ways: (1) the back of each recipe card listed foraging tips and species-specific advice for plant identification; (2) we supplied a general handout to provide information on how to safely collect and consume edible, weedy plants; and (3) we chose to highlight plants that grow commonly in the lawns, gardens, and along the sidewalk edges of homes, where legal and informed foraging is most likely to occur (with information about pesticides, soil quality, and other risk factors). Preparation of recipe cards and handouts on safe foraging required approximately 8 person hours.

Teaching Goals	Learning Outcomes
To inspire enthusiasm in a wide range of participants To enable people to enjoy, risk- and cost-free edible weedy plants	For participants across age ranges to express excitement and enthusiasm in trying new culinary dishes featuring weeds
To disseminate information regarding the safe identification, procurement, and preparation of weedy plants	For participants to collect resources enabling effective plant identification, collection, and preparation with the intent to use them in the future
To broaden perspectives and attitudes about-weedy plants	For participants to entertain wider viewpoints regarding the usefulness of spontaneous vegetation

Table 1. "Eat Your Weeds" educational outreach goals and outcomes.

Plant species name	Recipe(s) created	Role(s) in activity
Alliaria petiolata Garlic mustard (Brassicaceae)	Garlic Mustard Hummus	Sample tasting, recipe handout, and live plant display
Allium vineale Wild garlic or onion (Amaryllidaceae)	Cream Cheese Spread with Wild Garlic Shoots	Sample tasting, recipe handout, and live plant display
Cardamine hirsuta Hairy cress (Brassicaceae)	Hairy Cress Salad with Goat Cheese, Walnuts, and Honey-Dijon Vinaigrette	Recipe handout and live plant display
Rosa canina Wild rose (Rosaceae)	Rose Hip Soup*	Sample tasting and live plant display
Rumex acetosella Sheep sorrel (Polygonaceae)	Fresh Fruit Salad with Sheep Sorrel and Sweet Whipped Cream	Recipe handout
Sambucus nigra Elderberry (Adoxaceae)	Elderflower Lemonade*	Sample tasting
Stellaria media Chickweed (Caryophyllaceae)	Sautéed Chickweed with Ginger, Garlic, and Soy Sauce	Recipe handout and live plant display
Taraxacum officinale Dandelion (Asteraceae)	Dandelion Flower Lemonade†; Deep-Fried Dandelion Flowers; Orecchiette Pasta with Italian Sausage, Dandelion Greens, and Lemon Zest	Sample tasting, recipe handouts, and live plant display

Table 2. Food and drink featured plant contents and role.

Notes:
**Rose Hip Soup and Elderflower Lemonade are not original recipes; these beverages are available commercially. †Dandelion Flower Lemonade was used as the sample tasting dish for* T. officinale.

Recipe preparation

Over several weeks we developed eight original recipes based on six of our highlighted weedy plant species. We selected three of the eight original recipes to feature in our free tastings, using three species of the most easily accessible and identifiable weeds: *Alliaria petiolata, Allium vineale*, and *Taraxacum officinale.* For ingredients we spent approximately 3 hours foraging for plant material locally in areas where pesticides and herbicides had not been applied. We prepared Cream Cheese Spread with Wild Garlic Shoots (Fig. 1), Garlic Mustard Hummus, Elderflower Lemonade, Rose Hip Soup, and Dandelion Flower Lemonade in bulk to offer as samples on crackers and in small tasting cups at our table (see Table 2). Food preparation prior to the event required approximately 6 hours to prepare the necessary quantities (i.e. two gallons of Rose Hip Soup, two gallons of Dandelion Flower Lemonade, two gallons of Elderflower Lemonade, and 64 ounces each of Garlic Mustard Hummus and Cream Cheese Spread with Wild Garlic Shoots).

Event day set-up

With set-up teams consisting of two people and two handcarts, we set up three tables along one of the major pedestrian paths on Cook Campus, Rutgers University during Rutgers Day. Our outreach area was equipped with a large, custom-designed overhead sign reading "WEEDS" made from clear plastic tubing filled with a variety of dried weedy plant parts (Fig. 2). A newly developed, original logo that read "EAT YOUR WEEDS" appeared on all outreach materials (Fig. 3). Outreach materials included recipe cards with a picture of its featured edible weed and specific foraging tips; new, illustrated field identification guides

Figure 1. *Cream Cheese Spread with Wild Garlic Shoots and hairy cress garnish (center) and Garlic Mustard Hummus (either side) on crackers. These recipes were prepared in bulk to distribute sample tastings at our "Eat Your Weeds" table at Rutgers Day 2014. Photo: cc // Lena Struwe, 2014.*

to 34 local weeds; and handouts on safe foraging practices. We dug up and potted over 20 living examples of weedy species featured in our field guide and displayed these on one of the tables (see Fig. 2). We also incentivized food sampling by handing out stickers about weeds to all tasters with fun and informative messages such as "I eat weeds," "Weeds are also made of stardust," "I drink weeds," "Weeds are superevolutionary," and "Without humans, no weeds." All of our materials (recipe cards, field guide, and foraging safety handout) are freely available as PDF files on our website and blog (Struwe, 2014; http://4weeds.blogspot.com). We staffed our table with two to four rotating volunteers throughout the day.column.}

Results

At the 8-hour-long Rutgers Day event on 26 April 2014, we distributed over 2000 free samples of weedy food and beverage items

Figure 2. *A memorable sign, reading "WEEDS" and made out of dried plant material in tubes, sits above potted weedy plant example specimens at our "Eat Your Weeds" table at Rutgers Day 2014. Pictured from left to right are Lauren J. Frazee, volunteer Zachary Bunda, and Dr. Lena Struwe. Photo: cc // Jennifer Blake-Mahmud, 2014.*

at our outreach table. We estimate that we communicated directly or indirectly (though visuals, handout materials, or "sticker interactions") with 2000 to 3000 visitors about the public misconceptions and overlooked virtues of weeds in today's society, including but not limited to edibility. We also handed out over 400 recipe cards and about 500 field guide pamphlets. Almost 84,000 people attended Rutgers Day 2014 overall (Szteinbaum et al., 2014).

Although Rutgers Day attracts community members of diverse backgrounds, there were common themes in responses from the public. While we conducted no formal assessment of visitors to our table to evaluate our learning goals and outcomes, volunteers jotted down notes of interesting stories and interactions during the event. Five to six table volunteers then discussed these anecdotes during our reflection and debriefing process, and here we present and interpret that information. Table visitors included faculty members, students, friends, and parents as well as local families with elderly relatives and toddlers in tow. Most people were very interested in the sample tastings, and some returned to the table twice or more that day. The most popular recipe cards were for Deep-Fried Dandelion Flowers and Cream Cheese Spread with Wild Garlic Shoots. Many visitors quickly recognized our example specimens and sample ingredients (see Table 2; Fig. 2) as plants that are common in their own yards or neighborhoods. The most common question for plant identification was about *Lamium purpureum* (deadnettle), a common weed in many front yards at that time of the year (i.e., early-mid spring), and many people wanted to know how to rid their yards of it.

Children as well as adults added the stickers to their clothing and wore them around campus for the remainder of the day, potentially providing (and provoking) interactions on weedy plant topics with additional visitors that not yet had visited (or could not visit) our

Figure 3. *An original logo created for our "Eat Your Weeds" table at Rutgers Day 2014 appeared on all outreach materials. Image: cc // Lena Struwe, 2014*

table. Many adults reminisced with us about what they or their older relatives used to eat earlier in their lives and told us (and children, if present) about foraging for wild plants as children, drinking older relatives' dandelion wine, and where the best spots were for finding certain species. A disabled veteran told us about foraging for stinging nettle in New Jersey and that he appreciated our effort to educate the public about edible plants.

Discussion

Using edible weeds in UEE is an effective way to stimulate curiosity in plants, to broaden perspectives on spontaneous weedy vegetation, and to encourage plant identification skills. This activity combats plant blindness by encouraging participants to observe and experience weedy plants, which are often overlooked and underappreciated. The intended take-home message for festival-goers and visitors to our table was: "Notice these plants, all plants, and all life, for that matter; experience them; enjoy them; and find out what they do and represent" (see Table 1). This type of activity strengthens connections between the people of the New Jersey–New York metropolitan area and their local, urban flora.

We attribute our success in implementing our outreach program on edible, urban weeds to three factors. First, utilizing local, urban weeds in UEE is a means of outdoor, place-based learning (Theobald, 1997; Kolb, 2014). In place-based learning, students make use of nearby resources to study both the natural world and the community; all such lessons come directly from the context of the local environment (Gruenewald and Smith, 2014). Place-based curricula have also been found to increase student motivations for scholastic achievement (Powers, 2004). Moreover, the opportunities (or "places" themselves) for studying weeds occur at every point in time and space along the urban-rural gradient. The cityscape itself is transformed into a living laboratory when weeds become study organisms. Students can uproot local weeds, bring them to their classroom, and interact with them directly. Getting students out and into their surroundings to experience wild organisms will help combat the ongoing trend of human disconnection from nature through direct contact with plants (Miller, 2005).

Second, the edible weeds that we presented at our activity have traditional significance for many ethnic and cultural groups and are highly recognizable. Simply put, humans both love and hate weeds. In general, weeds have been and continue to be associated with all human settlements in urban, suburban, and rural environments worldwide; weeds are a universal human phenomenon. All of the weedy plants featured in this activity are economically important as sources of flavoring agents, medicine, vegetables, fruits, and/or serve as ornamental species (see Table

2; Wiersema and León, 2013). In modern cities, weedy plants are considered important in the provisioning of ecosystem services such as habitat for wild species, microhabitat regulation, and air filtration (Robinson and Lundholm, 2012). The connections between metropolitan areas, people, and weeds are a result of the complex sociopolitical ecology of urban development (Gaston, 2010). In this way, we presented social as well as biological and cultural contexts for learning about each plant.

Third, our tasting opportunities, take-home recipes and guides, thought-provoking stickers, and weedy plant example specimens encouraged an active, multisensory, kinesthetic, and engaging experience (Stern et al., 2014). Eating, in itself, is a personal action that can translate into multi-sensory, experiential learning. Visitors to our outreach table could choose to partake in learning and exploration by any or all of the following methods: eating or drinking free samples; smelling plants, choosing favorite recipes for future use; perusing species guides and safety pamphlets; observing live plants labeled with species names; talking to us and asking questions; and even sharing their own experiences with fellow visitors.

In all, food is inherently motivating and, perhaps most importantly, eating weeds is a novelty in today's society. We tend to care about and remember the texture, tastes, and smells of certain foods, thereby encouraging connections with personal experiences. Using edible plants and food preparation methods in educational activities such as the Food, Math, and Science Teaching Enhancement Resource Initiative developed at East Carolina University (USA) has shown to increase students' abilities to retain information in the life sciences (Duffrin et al., 2010; Hovland et al., 2013). Moreover, both accompanying students in local foraging activities and encouraging members of the public to engage in independent wild plant foraging and then preparing wild plant foods promotes learning-by-doing, or experience-based learning. Outdoor, field-based experiences in general can be highly memorable and beneficial to learners (Dillon et al., 2006). Similarly, schoolyard vegetable gardening activities have been touted as a key method for improving children's environmental attitudes and aptitude in the sciences (Waliczek and Zajicek, 1999; Williams and Dixon, 2013).

Weeds are natural choices for use in urban environmental education due to their relative abundance in cities and suburbs, interesting ecological niches, and strong historical associations with a diversity of cultural practices. These are globally accessible resources with broad appeal for informal public outreach as well as formal nature education.

Risk is an inherent part of foraging and consuming wild plant species, but the design of this activity helps to minimize those risks. We chose to highlight certain species for

sample tastings (i.e., dandelion, wild onion/wild garlic, and garlic mustard) that are easy to identify by characteristic leaf morphology and have no poisonous "look-alikes." Dandelion flower heads and their tufted, wind-blown fruits are well-recognized in modern culture, and their use as a decorative motif—in stationery, interior design, and even tattoos—has recently surged. Wild onion and garlic mustard leaves have distinct, pungent scents when broken. All of these species are usually found in high density and abundance where they are present and generally do not cause allergic reactions in humans. (However, people with food allergies should remain cautious.) In addition, these species look strikingly different from the most common poisonous plants in the mid-Atlantic and northeastern United States, such as jimsonweed, nightshade, and poison ivy, which can cause symptoms such as gastric irritation and painful rashes. We strongly discourage consuming or serving any foods made with wild plant species unless their species identities have been confirmed with 100% accuracy. All plant species used in this activity can be harvested up to two weeks before food preparation, refrigerated, and verified with a specialist ahead of time. Local botanical societies or institutions of higher education may be able to assist with verification. Learning to forage for edible plants, or simply knowing the toxic plants in your environment, necessitates a strong knowledge in botanical identification of species and their morphologies and provides an excellent argument for improved botanical education at the K-99 level.

Using urban edible plants in informal public education easily lends itself to formal lesson planning in the plant sciences and UEE as well as to other informal contexts in diverse venues and seasons. These activities could be prepared for small or large crowds anywhere there are wild edible plants, but the accessibility of edible weeds in city and suburban environments makes them especially meaningful for UEE. In the mid-Atlantic and northeastern urbanized United States, educators can typically forage during much of the growing season for plant materials or sample specimens of the species used here (after asking permission from property owners or land managers, where necessary). Wild onion grows prolifically in lawns in the early spring and late fall in this region, whereas dandelion and garlic mustard have leafy growth in lawns and suburban woods, respectively, from the early spring through the fall. Moreover, there are numerous other edible urban plant species available for harvest and study outside of temperate zones. Of the 17 most common urban plants in cities around the world (Aronson et al., 2014), all but four have well-described edible and/or medicinal uses (Wiersema and León, 2013).

We recommend that educators account for certain logistical factors when hosting large-scale outreach events based on foods and beverages made from urban weeds. The limiting factor in making this activity successful for large crowds (such as Rutgers Day) is simply the number of volunteer hours needed for bulk food preparation and "plating" or serving during the event. Crackers topped with Garlic Mustard Hummus and Cream Cheese Spread with Wild Garlic Shoots were taken up by visitors at a rate exceeding the speed at which we could prepare them. Various strategies could be implemented to relieve volunteers from this burden, such as using squeeze bottles to dispense toppings onto crackers, planning to serve less labor-intensive samples, or simply doing more preparatory work ahead of time. Furthermore, we suggest serving at least one drink and at least one solid food and choosing recipes that are palatable across a wide range of tastes

(e.g. sweet and savory) to diversify the menu. Tasters should have easy access to ingredient lists to avoid problems with food allergies and intolerances. Another important planning consideration is seasonality. For example, the herbaceous weedy species harvested for this event are not available in late fall and winter in temperate areas. However, we do see the potential for educators to develop seasonal edible weed activities that reflect the change in plant species composition throughout the year, especially in temperate climates.

Conclusions

Our "Eat Your Weeds" outreach table at Rutgers Day 2014 in New Brunswick, NJ, is an example of how to incorporate plant- and place-based learning, socioecological connections, and direct contact with wild organisms in urban environments in a practical and fun way. We have evaluated our outreach activity as highly successful in encouraging community members to become more familiar with local, wild plant biodiversity in an urban setting (see Table 1). We received overwhelmingly positive feedback and recognition from visitors, observers, and university media (Szteinbaum et al., 2014). Edible urban weeds are an easy and economical teaching tool for active, culturally relevant, place-based learning in UEE and in combatting plant blindness. Weeds are natural choices for use in UEE due to their relative abundance in cities and suburbs, interesting ecological niches, and strong historical associations with a diversity of cultural practices. These are globally accessible resources with broad appeal for informal public outreach as well as formal nature education.

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