Transitional Ecology: embedding ecological experiments into temporary urban public art

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Abstract
Understanding the environmental consequences of urbanization is a pressing objective, and more experimental ecology in urban areas would be useful in meeting this goal. Here we introduce the concept of Transitional Ecology, which involves incorporating ecological field research into temporary public art on vacant urban land. Ecological experiments can yield useful results about urban systems over short time periods. Incorporating such experiments into temporary public art allows the space to provide diverse community benefits. Although this fusion introduces challenges for both ecologists and artists, it can also create formal and informal science training activities while raising public awareness of environmental science. We illustrate these challenges and opportunities with the Urban Flower Field, a phytoremediation project in a temporary urban park.

Key words: gap filler, phytoremediation, urban ecology, urbanization, vacant urban spaces

Introduction
Urbanized areas produce most human-associated carbon emissions and residential water use, and urbanization is considered the most irreversible form of human-driven land use change (Seto et al. 2011; Elmqvist et al. 2019). Ecological research can help inform urban planning to reduce these impacts, and can strengthen the connection between city residents and natural ecosystems (Grimm et al. 2008; Rottle and Yocom 2010; Forman 2014; Tanner et al. 2014; Herrmann et al. 2016; McDonnell and MacGregor-Fors 2016; McPhearson et al. 2016; Jenerette 2018).

One way to promote urban ecology research is to incorporate it into the design of human-dominated systems (Childers et al. 2015). The Earth Stewardship initiative from the Ecological Society of America provides a framework for using ecology research to reduce impacts of planned development on ecosystem services while enhancing human well-being (Chapin et al. 2011). One approach for implementing this initiative is the concept of ‘designed experiments’, in which urban planners, architects and ecologists collaborate to incorporate ecology research into built projects such as subdivisions, road alignments and city parks (Felson and Pickett 2005; Ahern 2013; Felson et al. 2013a,b; Doroski et al. 2018).

We argue that the ‘designed experiment’ concept can be extended to make use of the significant amount of vacant land often present in industrialized cities, particularly in the USA. We suggest that integrating urban ecology experiments into temporary public art projects can revitalize vacant urban lands and help transition them into centers of community engagement. We call this integration Transitional Ecology (Fig. 1). We argue that Transitional Ecology can improve understanding of urban ecosystems while simultaneously engaging residents.

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The prevalence and challenges of urban vacant spaces

Traditional city planning has tended to develop conceptualizations that emphasize permanent outcomes (Jacobs 1961; Bishop and Williams 2012). However, increasingly scarce resources available for urban development coupled with rapidly changing economic conditions have led planners to focus more on the temporal aspects of development rather than simply the importance of structures and other ‘things’ (Patti and Polyak 2015; Dovey 2016).

One by-product of the dynamic nature of urban development is the prevalence of vacant lands, defined as ‘all land that is unused or abandoned for the longer term, including raw dirt, spontaneous vegetation and emergent ecologies, land with recently razed buildings, perimeter agricultural land fallen out of cultivation, brownfields and other contaminated sites, or land that supports long-term, abandoned derelict structures’ (Németh and Langhorst 2014, see Newman et al. 2016 for a similar definition). In a 2016 survey, Newman and colleagues found that on average ~16.7% of land was described as vacant by officials from 215 US cities with populations >100,000 residents. Officials cited disinvestment, suburbanization and deindustrialization as common contributors to increased vacancy. Vacant lots tend to be small or unconventionally shaped, which makes them difficult to redevelop. The percentage and kind of vacant land varies regionally, but has tended to remain fairly stable over time (Pagano and Bowman 2000; Newman et al. 2016). Our own 2014 survey in St. Paul, MN, shows that vacant land covers ~15% of the city, is made up of roughly the same amount of private and public land, and consists of various sized lots embedded throughout residential and commercial areas (Fig. 2).

Such vacant lands often have negative and persistent impacts on urban communities, creating blight, disinvestment and safety hazards (Goldstein, Jensen, and Reiskin 2001). Redevelopment of vacant lots often takes considerable time because of extended slumps in property markets, changes in market demands such as those associated with deindustrialization, or costs of removing remnant infrastructure or remediating contaminated soil (Temel 2006). These constraints become particularly acute as municipal resources for redevelopment...
Vacant spaces and urban ecology

Several researchers have highlighted the value of incorporating ecology into vacant spaces (McPherson, Kremer, and Hamstead 2013; Pearsall and Lucas 2014; Kim 2016). Vacant lots can provide multiple ecological benefits including biodiversity habitat, stormwater absorption, temperature regulation and air purification (Bolund and Hunhammar 1999). They can also be used for community gardens and urban farms, resulting in local food production, pollinator habitat and green gathering spaces. Enhancing ecological value in vacant spaces can also help prevent blighting and ease the transition of vacant spaces to productive long-term use (Benham, Rastorfer, and Spilka 2002).

Ecological experiments in vacant spaces could in principle provide some of the same ecosystem services and community benefits of greenspace projects while at the same time creating opportunities for hypothesis testing and experiential learning. The temporary nature of urban ecology experiments may be especially appealing to a broad array of community interests. Although rarely emphasized in the ecological literature, urban greenspace will often not bring as much long-term economic benefit to neighborhoods as commercial or residential development, especially if projects are scaled for long periods over large areas in urban cores. Moreover, permanent projects may require city investments and land tenure agreements that are difficult to obtain (Németh and Langhorst 2014). This tension between socio-environmental benefits and economic interests underlies some of the policies that limit the tenure of community gardens on vacant lands (Schmelzkopf 2002; Drake and Lawson 2014). Tenure limits can challenge projects such as community gardens that often benefit from investments in soil, irrigation, or other structures. In contrast, because of the discrete time periods of most ecology experiments, urban ecology research may be well-suited as a transformative tool that can add environmental and social value to vacant spaces without interfering with the potential development of commercial, residential or public uses. Short-term, transformative projects are likely to be particular useful as contemporary urban ecology increasingly focuses on the temporal dynamics and spatial complexity that are hallmarks of urban development (Ramalho and Hobbs 2012).

Vacant spaces and public art

Our call for urban ecologists to help transform vacant space is similar to current developments in urban design and public art. Tactical Urbanism, the use of short-term, low-cost, open and iterative interventions in neighborhood building, is a growing design response to the often intractable cost and regulatory barriers to development (Lydon and Garcia 2015). Tactical Urbanism projects are often bottom-up, citizen-led artistic projects to reclaim or redesign vacant public space in a way that often falls outside of traditional planning processes. These projects are diverse and widespread, and include pop-up stores, ‘parklets’ (small, temporary parks in parking spaces or other public areas), guerilla gardens and shipping container markets. Such projects can provide important ecological and social benefits (Mata et al. 2019), and have been essential for initiating rapid social change and facilitating transition to more permanent development. For example, the ‘Pallet Pavilion’, ‘Re: Start (shipping container) Mall’ and other ‘Gap Filler’ projects helped revitalize Christchurch, New Zealand after earthquakes in 2010 and 2011 (http://www.gapfiller.org.nz/, accessed 26 Oct 2019).

Public art is a key component of Tactical Urbanism. The work of public artists can help facilitate the often iterative city design process, encourage and incorporate community participation, and ensure that the construction and implementation of projects contribute to the public space.

Urban ecology and public art

We argue that ecologists can collaborate with Tactical Urbanism artists to create projects that produce scientific results, engage communities and develop urban assets. Past collaborations between ecologists and artists have helped to engage the imagination of communities and stimulate people to transform society to environmental sustainability (Hawkes 2003; Kagan and Kirchberg 2008; Thorne 2008; Whiteley 2011; Curtis, Reid, and Ballard 2012; Weintraub 2012; Guy, Henshaw, and Heidrich 2015). Some well-known examples of ‘Eco-Art’ include ‘Wheatfields: A Confrontation’, a project by Agnes Denes set on a brownfield in lower Manhattan (Denes 1990), Mel Chin’s ‘Revival Field’, a phytoremediation project created in a brownfield site in Minnesota (Matilsky 1992) and Wolfgang Weidler’s ‘Stilt House’ project in Singapore that raises awareness of plastic recycling (Weintraub 2012; Guy, Henshaw, and Heidrich 2015). Such projects have articulated concerns about ecological challenges and social justice while providing enduring images that inspire action (Reichold and Graf 2003; Curtis, Reid, and Ballard 2012; Weintraub 2012).

Eco-Art projects have not been fully incorporated into the Tactical Urbanism movement. However, collaborations should readily emerge because features of Tactical Urbanism projects—low-cost, short-term, iterative—are similar to those of many ecology research programs.

Transitional Ecology—integrating ecology research and public art in vacant urban land

This history of adapting to similar constraints and opportunities should help experimental ecologists and public artists work together to help transition abandon spaces to more productive uses (Fig. 1). We call this integration Transitional Ecology. Below we describe an example of Transitional Ecology, and highlight the opportunities and challenges of the model.

An example of Transitional Ecology: Urban Flower Field

The Urban Flower Field (UFF) in St. Paul, MN was established in 2014 to help transition a vacant downtown lot. UFF is on a quarter block in an urban commercial/residential section. The land was donated to the city under the stipulation that it be converted into a park. In the interim, city officials commissioned one of us (Lovelee) to transform the site from an abandoned, blighted lot to an attractive community gathering space. Lovelee recruited ecology researchers to design a
project that could yield useful results while contributing esthetically to the space.

The ecology experiment is testing whether increased plant biodiversity enhances phytoremediation. The site is suited for this type of research because the soil contained heavy metal concentrations typical of urban areas (concentrations were measurable but well below EPA exposure standards). The study uses annual and perennial wildflowers that were chosen in part because of their esthetic value. Flowers are planted in 96 circular plots that contain 1, 2, 4 or 8 species. A forthcoming manuscript will describe treatments effects on plant biomass production and soil contaminant remediation.

The experiment is seamlessly embedded into public art (Fig. 3). The 96 plots are arranged in eight spirals that extend out from a circular central patio. Field stones, decorated by community members, line each of the spirals. The ground design is reflected in a vast mural painted on a brick wall bordering the site.

The project is co-created with the community. The site is a public space, and residents, professionals and visitors often gather there informally. Portable chairs provide places for visitors to sit. Artistic signs and paintings explain the artistic vision, the science experiment and the biology of the experimental wildflowers. Public events at the site, including film showings and art–science discussions, have facilitated community engagement. An informal survey revealed that the visitors think the project has transformed the space from ‘unhappy’ to a ‘lovely place that serves as a green community gathering space’.

The esthetics and conceptual aspect of the site led to a 2014 ‘Great Places Award’ presented by the Sensible Land Use Coalition, a regional organization aimed at promoting urban development.
The project was designed as a temporary installation. It has no major infrastructure and thus can be easily converted to other uses. As a result, it can serve as a field site for urban ecology research and as an inspirational public space without complicating future development.

**Transitional Ecology: benefits and challenges**

Transitional Ecology has the potential to facilitate field experimentation in urban ecology while simultaneously creating community assets.

Table 1: Some benefits and challenges associated with Transitional Ecology

| Benefits                                                                 | Challenges                                                                 |
|-------------------------------------------------------------------------|----------------------------------------------------------------------------|
| Creates field sites to further urban ecology research                   | Exposes research to potential disturbance                                   |
| Preserves or develops urban green space                                  | Requires consideration of esthetics in site planning and maintenance        |
| Facilitate diverse collaborations                                         | Increases demands for public communication                                  |
| Increases opportunities for public engagement with ecological science    |                                                                           |
| Help communities connect to and value spaces                             |                                                                           |
| Transitions blighted land to community assets with minimal investment    |                                                                           |
| Increase property values in surrounding areas and inspire environmental stewardship |                                                                           |

Another set of challenges stems from potential trade-offs between experimental design and the esthetic needs of site planning and maintenance. Experimental features such as bare-ground control plots, yield reducing treatments or the use of weedy species with a lot of dead aboveground biomass may lead to public dissatisfaction with the project. We chose wildflower species for the UFF experiment based on trait mixtures appropriate for a biodiversity–phytoremediation experiment, but we also considered how their appearance would be perceived by the general public. In addition, sites need to be maintained for public presentation, creating additional time demands on project managers. We believe these esthetic challenges can be overcome, particularly with the help of public artists with experience operating under such constraints.

An additional challenge is the demand for public communication. The need to field questions and discuss outcomes with community groups is an essential aspect of projects conducted in public spaces. This 'challenge' also provides opportunities. Visitation by community members to UFF allows our undergraduate researchers to serve as ambassadors for the project and the city. Such informal interactions can make environmental research more tangible and relevant to citizens, and can lead to a more authentic connection to the city planning process.

**Discussion**

Transitional Ecology, the intersection of urban ecology, public art and urban revitalization (Fig. 1), can be useful for advancing ecological knowledge while simultaneously creating social and environmental benefits from vacant urban spaces. In proposing this model, we do not seek to prescribe a single approach that will work in all circumstances. Community interests, city regulations, land ownership, general economic conditions and site features (size, isolation, presence of structures, vegetation, soil contamination and safety) will all influence the suitability of vacant spaces for Transitional Ecology projects. However, the scope of urban ecology (Forman 2014) and the abundance, wide spatial distribution and diversity of urban vacant spaces (Fig 2) suggest that Transitional Ecology can be used to address a wide variety of questions. Moreover, projects could be tailored to specific characteristics of vacant spaces. For example, small, odd-shaped or isolated lots may be ideal for experimental work addressing questions about spatial patchiness or dispersal.
limitations, while sites with degraded soils could support projects related to stress tolerance, remediation or related issues.

It is worth asking, given Transitional Ecology’s potential costs (Table 1), whether a public art collaboration will in the end help ecologists advance knowledge in their field. In practice, urban ecology experiments could be done with an exclusive focus on science and implemented in vacant spaces that are isolated from the public (e.g. with fencing). Although such an approach would reduce disruption and potential damage, including public art as a core component of projects can provide at least three research-related advantages for urban ecology. First, public art could help ensure the community support that may be necessary for project implementation. The fate of vacant spaces is often of considerable concern to community members because of the impact of such spaces on neighborhood esthetics, property values and economic opportunities. An ecology experiment that excludes the surrounding community may be blocked in the planning phase or shut down prematurely because of neighbor or business complaints. For the UFF project, project leaders and city officials engaged with community members before and during project implementation to ensure they were included in much of the process. Second, collaborating with public artists can help urban ecologists and other scientists gain insights about urban environments and the creative process that emerge from outside of traditional disciplinary boundaries (Sheehy 2016). While designing UFF, the artist (Lovelle) and scientists (Kay, Scherber, Gaitan) challenged each other’s assumptions about what were essential elements of both the artistic and scientific process. The success of the compromise helped inspire us to develop the Transitional Ecology concept, with the aim of broadly expanding opportunities for ecology experimentation in urban spaces. Finally, a public art collaboration can help encourage community participation in the scientific process. The rise of citizen science has helped extend the scale and resolution of research projects around the world by enlistng citizens as data collectors (Bonney 2014). Citizen participation can also help focus research on questions that are most pressing to communities. Transitional Ecology experiments designed to encourage regular interactions with community members provide new opportunities for scientific inspiration and insights for researchers.

A critical next step is to encourage and support long-term collaborations between public artists and ecologists. One step can be to support symposia and other gatherings in which artists and ecologists come together to explore and challenge disciplinary boundaries. One example is the City Art Collaboratory project in St. Paul, MN, which supported artists and scientists to innovate together around environmental challenges (Matsson 2016). The Transitional Ecology concept gives ecologists and public artists a way to turn such relationship building activities into tangible products with scientific and social benefit.

Conclusion

Rapid global urbanization creates a pressing need for more research in urban ecology. More ecological research in vacant lots, a common feature in many cities, can help to address this need. Integrating such experiments with public art can help engage communities in both the urban planning and the scientific process while creating green oases on previously neglected land. We are optimistic that the combination of creativity, ingenuity and low-budget, DIY mindsets that are hallmarks of both ecologists and public artists will help collaborators transform abandoned space into exciting and informative destinations.

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