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Punching above their weight: the ecological and social benefits of pop-up parks

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Running heads:

L Mata *et al*.

Socioecological benefits of pop-up parks

Current global enthusiasm for urban greening and bringing nature back into cities is unprecedented. Evidence of the socioecological benefits of large, permanent greenspaces is mounting, but the collective potential for pop-up parks (PUPs) – small, temporary greenspaces – to augment urban ecosystem services is unknown. To showcase the potential of PUPs, we first highlight a case study demonstrating how PUPs may enhance biodiversity in a densely urbanized area; we then review evidence linking the design of small greenspaces with positive social outcomes, including benefits to human well-being. Finally, we emphasize how PUPs can function as socioecological laboratories to help inform urban design, and then propose a research agenda to better understand how PUPs may be optimally designed to provide benefits to humans and other species.

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In a nutshell:

- Pop-up parks (PUPs) have swiftly evolved into a worldwide phenomenon, driven by the recognition of the value of greenspaces for humans and other species
- Resources provided by PUPs can boost and sustain functionally and taxonomically diverse arthropod communities
- PUPs may help people rekindle their connections with nature, socialize, spend time outdoors, and experience positive short-term body and mind states
- Such parks offer not only insight into how small, temporary greenspaces can complement permanent greenspaces in incorporating nature into cities but also provide a platform for addressing targeted research questions related to greenspace design

Urban ecosystems are increasingly valued for their environmental and social outcomes (Hartig and Kahn 2016), with increasing attention being paid to the design and management of urban greenspaces (Aronson *et al.* 2017). The socioecological benefits of greenspaces are substantial. Urban nature can have positive effects on physiological and psychological health (Shanahan *et al.* 2016), and both physical and mental well-being have been shown to correlate with the amount of and proximity and access to greenspaces (Hartig *et al.* 2014). Furthermore, greenspaces in urban environments provide vital resources for biodiversity (Beninde *et al.* 2015; Lepczyk *et al*. 2017; Threlfall *et al.* 2017), including threatened species (Ives *et al.* 2016). For these reasons, there is worldwide enthusiasm for urban greening (Hartig and Kahn 2016), with particular interest expressed by planning, landscape, and health practitioners seeking to bring nature back into cities. Although we acknowledge the central role of large, permanent greenspaces, here we draw attention to the emerging opportunity presented by small-scale, short-lived greenspaces such as pop-up parks (PUPs) to synergistically enrich urban nature for the benefit of biodiversity and people.

In the simplest terms, PUPs are small, temporary greenspaces, although they can vary considerably in size and duration (Figure 1, a–c); some may occupy just a few square meters (eg a planter box), whereas others extend over much larger areas (eg the 3000-m^2 A'Beckett Square in Melbourne, Australia; Figure 1b). PUPs may also be extremely short-lived; for instance, the first Park(ing) Day – which later became the Park(ing) Day project, an ongoing annual worldwide initiative in which metered parking spaces are temporarily converted to PUPs – in 2005 lasted merely for the parking meter's 2-hour time limit. Ultimately, a PUP's duration will depend on the factors that determined its creation. For example, a PUP may be used as a test-run for a permanent greenspace, to reassign the use of location to reflect the changing seasons, or to serve as an "in the meantime" use of a site that has been scheduled for redevelopment (Kelly 2012).

From their inconspicuous inception in the late 20th century (Lydon and Garcia 2015), PUPs have swiftly evolved into a global phenomenon. For instance, the Park(ing) Day project has grown into a global movement, with over 1500 PUPs created worldwide on PARK(ing) Day 2013 (Corey 2014; Figure 2). This and other community-led PUP initiatives have now morphed into more formal institutionalized programs; one notable example is the San Francisco, California, Planning Department's "Pavement to Parks" program, an initiative that transformed underutilized street space into public plazas and parks that existed for days or even years (Loukaitou-Sideris *et al.* 2012). As of 2014, at least 21 cities in North America were officially supporting or piloting PUP-oriented programs (Corey 2014). Other municipalities around the world have also embraced PUPs as a strategic component of urban planning; for instance, the City of Greater Dandenong, Australia, purposely incorporated PUPs into their "Revitalising Central Dandenong" renewal project, and in London, UK, the Boroughs of Lambeth and Southwark have taken up the Design Council's "Knee High Challenge", a program that specifically aims to use PUPs to increase the area of available outside-play-space for children and their parents.

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PUPs illustrate the concept of "tactical" and "biophilic" urbanism, global approaches to urban planning and design that focus on short-term, low-cost greening initiatives to add vitality to vacant or underutilized spaces (Newman 2014; Lydon and Garcia 2015). PUPs are also part of the "do-it-yourself" urbanism movement (Finn 2014), in which residents assume responsibility for planning and executing place-making initiatives to improve unaddressed issues in the public space realm. Public health scholars, practitioners, and policy makers advocating for innovative approaches to enhance urban livability have included PUPs as community experiments in public health law and policy; for instance, PUPs were an important component of a series of public health actions implemented by the City of Minneapolis, Minnesota, as part of a citywide effort to foster violence-free social environments that were instrumental in catalyzing a 60% reduction in juvenile violent crime (McGowan *et al.* 2015). Because they can accommodate people for short time periods, PUPs have been cited as examples of emerging community amenities (Larson and Guenther 2012), attracting valuable social and economic activity around the places in which they are temporally located. PUPs may also be seen as constituting an applied example of "urban acupuncture", an environmentalist philosophy and theory that uses acupuncture as a metaphor for applying small-scale actions to address large-scale urban sustainability issues (Lerner 2014).

Despite the growing evidence for the socioecological benefits of large, permanent greenspaces (Sadler *et al.* 2010), to the best of our knowledge no previous studies – save for one notable exception (discussed below) – have investigated the corresponding benefits of PUPs. Here, we highlight the potential of PUPs to enhance biodiversity, and present empirical evidence of their capacity to deliver positive biodiversity outcomes using a case study conducted in Melbourne, Australia. We then review the direct or implied evidence from the literature regarding the possible social benefits of PUPs. Finally, we argue for the creation of a structured research agenda to explore PUP-related benefits, and discuss the best designs for achieving those benefits. Our focus on PUPs recognizes the decreasing opportunities available for decision makers and urban planners to create new, large, permanent greenspaces, and our objective is to help inform managers and policymakers how small-scale, short-lived greenspaces such as PUPs may be designed to maximize the delivery of socioecological benefits.

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The biodiversity benefits of PUPs

An increasing body of evidence highlights the contribution of large, permanent greenspaces for sustaining biodiversity within urban environments. A recent meta-analysis of the factors influencing intra-urban biodiversity variation demonstrated the positive effect of patch area on the species richness of numerous insect and vertebrate taxa, and indicated that sites must be at least 50 ha in size to sustain area-sensitive, urban-avoider species (Beninde *et al.* 2015). In addition, and arguably more importantly, Beninde *et al.*'s (2015) meta-analysis identified the critical contribution of biotic factors, such as vegetation structure and plant diversity, that operate in the urban matrix at much smaller scales, and that have the potential to be targeted for management actions. Similarly, a study examining how a functionally diverse insect community responded to management-induced vegetation changes in a range of greenspaces found that while large greenspaces (eg golf courses) sustained more species on average than smaller greenspaces (eg residential gardens), the key driver of insect diversity was a synergistic combination of vegetation structure and plant diversity (Mata *et al.* 2017). Working within the same experimental context, Threlfall *et al.* (2017) showed that plot-level factors, such as the volume of understory vegetation, were more influential drivers of bat, bird, bee, beetle, and bug diversity than tree density in the landscape. The results of these studies suggest that localized biotic factors can be more substantial drivers of the functional and taxonomic diversity within greenspaces than factors operating at large landscape scales. In the context of greenspace design, these biotic factors are key site attributes that, if properly managed, could contribute to the provision of food and habitat resources for a wide range of taxa in small-scale greenspaces. While we do not presume that all findings from these studies can be extrapolated directly to PUPs, we believe they highlight the untapped potential of small-scale greenspaces to deliver positive biodiversity outcomes, assuming that they are properly designed.

Beyond large greenspaces, many greenspace types in the size range of PUPs (eg flower meadows, pocket parks, residential gardens, greenroofs) already play critical roles in supporting biodiversity in cities (Aronson *et al*. 2017; Lepczyk *et al*. 2017). In this section, we focus on greenroofs because of the recent evidence linking greenroof design with positive biodiversity outcomes. For instance, in a study involving 40 greenroofs, Braaker *et al.* (2017) demonstrated positive relationships between greenroof design features (eg plant diversity, flower abundance) and functionally and taxonomically diverse arthropod communities. Like PUPs, greenroofs are situated at the forefront of applied urban ecological research and practice (Oberndorfer *et al*. 2007), and face many of the same design challenges and considerations to achieve their full potential as providers of food and habitat resources. The short lifespan of PUPs adds an extra element of complexity not shared with greenroofs. How the brief lifespan of PUPs influences the number of species that successfully establish populations within them, what would be the ecological implications of PUP removal for these populations, and how improperly designed PUPs could act as ecological traps are appealing and topical avenues of future research.

There is a need for experimental evidence that links key features of greenspace design with specific biodiversity outcomes. Guidelines have been developed for practitioners wishing to incorporate ecological knowledge into urban planning, design, and development, including design guidelines that expressly target maintaining and introducing habitat (Garrard *et al.* 2018) and identifying species' critical life-cycle requirements (Weisser and Hauck 2017). Yet presently, the capacity for greenspaces to successfully deliver meaningful long-term biodiversity benefits is largely unknown. Evidence-based urban design that carefully considers the causal pathways linking design to biodiversity benefits will be key to the success of PUPs and other types of small-scale greenspaces for delivering positive biodiversity

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outcomes. Many questions remain, including (1) can PUPs, notwithstanding their small size and short lifespan, be colonized by and provide resources for species in densely urbanized areas, and (2) can PUPs contribute to the functional and taxonomic diversity, albeit temporarily, of the broader greenspace in which they might be embedded? To help answer these questions, we present a case study of a small, temporary greenspace that embodies an investigation of the biodiversity benefits of PUPs.

"Grasslands" case study

"Grasslands" was an art–science collaboration that temporarily greened the State Library of Victoria in Melbourne, Australia (Panel 1). We examined whether the short duration of this PUP would provide adequate time for an insect and spider community to become established and, if so, whether this would lead to an increase in the site's overall insect and spider diversity or simply mirror the diversity of the site's permanent vegetation. We hypothesized that the site's overall diversity would increase as a result of the unique insect and spider species living in the PUP vegetation, and tested this across five functional and six taxonomic groups. Detailed descriptions of our experimental design, data collection methodology, and data analysis framework are provided in Panel 1 and WebPanel 1.

Over the PUP's lifespan, we detected 90 insect and spider species at the site, 20 of which were unique to the permanent vegetation, 41 of which were unique to the PUP vegetation, and 29 of which occurred in both vegetation types (WebTable 2). For each functional and taxonomic group, and for all groups combined, we estimated the contribution of the PUP to the site's overall diversity, expressed as a percent change in species richness when compared to the insect and spider species detected in the permanent vegetation only (WebTable 3). Our results revealed that the PUP provided habitat for a diverse insect and spider community, and substantially increased the species richness of all functional (Figure 5) and taxonomic (WebFigure 1) groups. For example, as compared to the species observed in the vegetation excluding the PUP, there were on average approximately two-and-a-half times as many pollinator species, over three times as many parasitoid species, three-and-a-half times as many beetle species, and one-and-a-half times as many hemipteran bug species detected in the vegetation including the PUP (WebTable 3). Altogether, our findings highlight the potential of PUPs to boost and sustain functionally and taxonomically diverse arthropod communities. In this case, such increases were likely a consequence of the supplementary food and habitat resources provided by the plant species in the PUP, as well as increased vegetation complexity and a higher proportion of native species.

"Grasslands" is an example of a PUP that supports fundamental advances in understanding the potential of small-scale, temporary urban greenspaces to provide biodiversity benefits. However, our results have raised additional questions in need of further investigation. Most importantly, we lack the evidence to ascertain if the insect species documented in the PUP (1) actively colonized and established populations in the temporary vegetation after having dispersed from the surrounding (permanent) greenspace patches; (2) were simply attracted from surrounding patches to the

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resources in the PUP, where the insects temporarily aggregated; or (3) were passively transferred with the soil and plants used to assemble the PUP. Our research will serve as a foundation for future investigations seeking to disentangle the mechanisms that enable PUPs to attract biodiversity to urban environments. Furthermore, we were unable to assess whether any insect species that may have been initially attracted to the PUP eventually colonized the permanent vegetation, and therefore remained on-site after the temporary vegetation was removed; we are currently designing a follow-up field experiment to address this knowledge gap. Despite these limitations, the findings from the "Grasslands" case study suggest that PUPs can contribute to our understanding of how to optimally design greenspaces to attract/bring biodiversity back into urban areas.

Potential social benefits of PUPs

Multiple threads of evidence from epidemiological, experimental, and survey studies have repeatedly substantiated the link between large, permanent greenspaces and a wide range of social benefits, including improvements in physical health and mental well-being; increased social contact and cohesion; improved child cognitive development; reduction of aggression, violence, and crime; opportunities for education; and fostering and re-forging connections with nature (Dadvand *et al.* 2015; ; Davern *et al.* 2017; Hand *et al*. 2017). Indeed, the provision of greenspaces for positive social outcomes has underpinned the creation of large, permanent parks in the densest areas of cities since the 19th century (Hartig and Kahn 2016), an especially early example being the Alameda de Hércules in Seville, Spain, which dates back to the 1500s. This reasoning now sits at the core of several global sustainability initiatives, such as the UN's Sustainable Development Goals (Griggs *et al.* 2013) and New Urban Agenda (UN 2017), and is guiding local government policy around the world (eg City of Melbourne 2017; ICLEI 2017).

An intriguing question is whether PUPs can provide the same social benefits as those provided by large, permanent greenspaces. PUPs might be less likely, for example, to provide health benefits derived from physical activities, such as walking and running, or those associated with long-term exposure to phytoncides (volatile organic compounds released by plants) and reduced air pollution. However, we suggest that PUPs may help people connect with and spend time in urban nature, engage in positive social interactions, , and activate beneficial short-term body and mind states, including mental restoration and concentration. With an emphasis on the social interaction and mental restoration potential of PUPs, our attention is directed to evidence provided by small-scale, permanent greenspaces like pocket parks. For instance, Peschardt *et al.* (2012) investigated the use of nine pocket parks located in a densely populated urban setting and found that the primary reasons people visited the parks were for socializing and mental invigoration restitution. Related studies on the design of pocket parks highlighted the key role of particular design elements in stimulating social interactions and mental restoration, from varying the amount and arrangement of both natural (eg vegetation [including flowers], water) and human-made (eg seating arrangements) elements (Nordh and Ostby 2013; Peschardt *et al.*

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2016). Moreover, by examining patterns of PUP use through robust direct observation, Salvo *et al*. (2017) showed that PUPs triggered beneficial changes in time-allocation patterns among users, including a reduction in screen time and an increase in overall time spent outdoors; we believe that this is the first, and thus far only, published work to provide empirical evidence of the social benefits of PUPs.

The most effective manner to study the social benefits of PUPs has yet to be determined. People's instantaneous and short-term responses to PUPs may require new methodological tools to complement or go beyond the physiological and psychological methods traditionally used to assess responses to greenspace design (Chang *et al.* 2016; Wolf *et al*. 2017). An exciting alternative – one that is currently being used to study the emotional states of urban residents in environmental psychology projects (eg WeSense, Mappiness) – would be to couple the experience-sampling method (Csikszentmihalyi and Larson 2014) with mobile technologies and social media information systems capable of collecting real-time, spatially explicit data. Although financial and time limitations precluded us from employing this methodology in the "Grasslands" case study, we believe this novel approach has great potential.

PUPs as socioecological laboratories

PUPs potentially offer a controlled environment for studying many urban design questions that have to date seemed intractable. PUPs can be considered as socioecological laboratories: that is, unique testing grounds to conduct designed experiments capable of informing urban design (Felson *et al.* 2013). As illustrated by the "Grasslands" case study, adding food and habitat resources can lead to quantifiable biodiversity outcomes, which may be used to inform evidence-based conservation actions in urban greenspaces. Experimentally controlling design features and the duration and spatial configuration of PUPs will be particularly valuable for elucidating evidence of causal pathways and interactions between greenspace design and socioecological benefits.

Ecologists, social scientists, and urban design and planning professionals are now presented with an exciting opportunity to collaborate and identify an interdisciplinary research agenda for exploring the socioecological benefits of PUPs. As a starting point, these groups can seek to understand how PUPs may be used to build the evidence base for biodiversity and social benefits derived directly from contact with nature in cities, to address the degree by which these benefits potentially differ from those in permanent greenspaces, and to explore particular design features of PUPs that are most important for promoting benefits to humans and other species. Moreover, given that they are currently being considered as alternative urban greening solutions in many cities around the world, PUPs present a unique opportunity to test potential differences arising from dissimilar biogeographical and cultural contexts. Importantly, the synergies and trade-offs of designing for multiple, and sometimes contrasting, objectives and the impermanency of POPs could be deliberately assessed. By providing an experimental socioecological framework,

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PUPs offer a platform for addressing targeted research questions and resolving key knowledge gaps in urban greenspace design.

Conclusions

PUPs are swiftly evolving into a global phenomenon, but their capacity to benefit biodiversity and people in cities remains unharnessed. However, PUPs should not be considered as substitutes for existing large, permanent greenspaces. Instead, we advocate for the synergistic role that small, temporary greenspaces can play in urban environments by proposing PUPs as an additional and complementary means of bringing nature back into cities. Given the rapid rate of urbanization, PUPs and other small-scale greenspaces provide important opportunities for people living in dense urban areas to engage with nature. To help meet this challenge, urban planners must explore how best to design future PUPs.

Acknowledgements

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Supporting Information

Additional, web-only material may be found in the online version of this article at

Figures and figure captions

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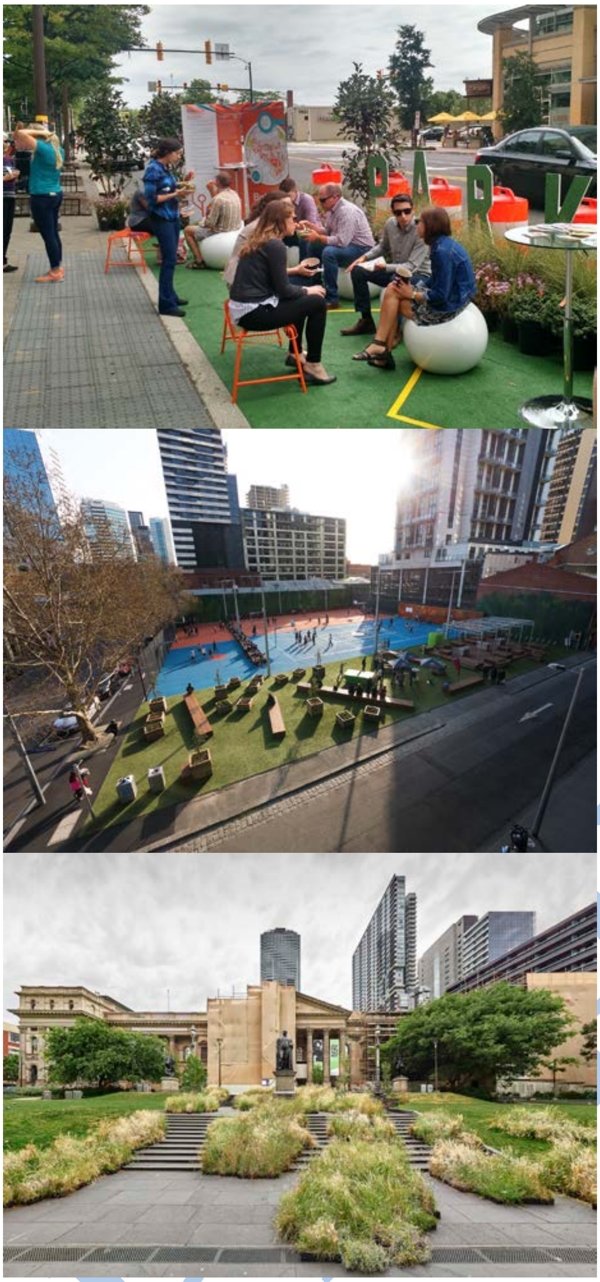

Figure 1. Three examples of pop-up parks (PUPs). (a) A PARK(ing) Day PUP in Arlington, Virginia; (b) the A'Beckett Urban Square PUP on the City Campus of RMIT University in Melbourne, Australia; and (c) the "Grasslands" PUP in the forecourt greenspace of the State Library of Victoria in Melbourne, Australia.

Photo credits:

(a) County Environmental Services
(b) J Gollings
(c) M Stanton

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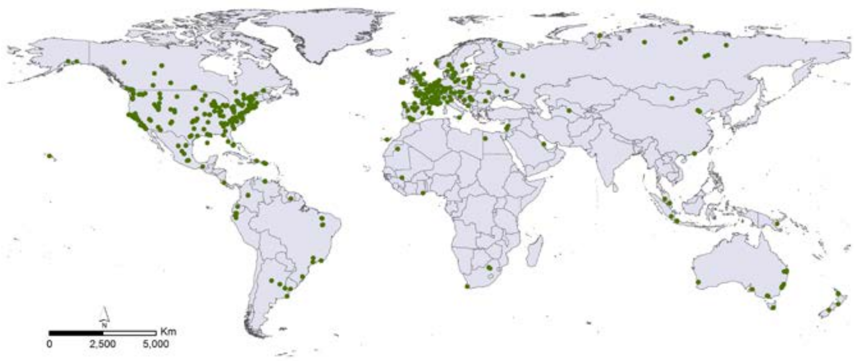

Figure 2. Location of PUPs occurring as part of Park(ing) Day 2013. Each green circle represents a PUP (data source: http://parkingday.org).

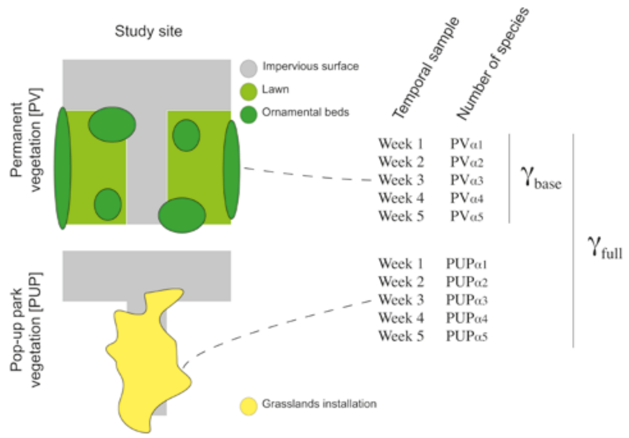

Figure 3. Schematic representation of the "Grasslands" case study experimental design. Samples were collected from both the permanent and PUP vegetation over a period of 5 consecutive weeks (Week 1 [ie week of]: 23 Oct 2014; Week 2: 30 Oct 2014; Week 3: 7 Nov 2014; Week 4: 12 Nov 2014; Week 5: 23 Nov 2014). This yielded 10 samples, five each from the permanent (PVα1…PVα5) and PUP (PUPα1…PUPα5) vegetation, which were then used to build the base (γ_{base}) and full (γ_{full}) datasets, as described in the main text.

Figure 4. Representative species or taxa of each insect functional group documented and studied as part of the "Grasslands" PUP case study: (a) the pollinator hoverfly *Melangyna viridiceps*; (b) the herbivorous lygaeid heteropteran bug *Nysius vinitor*; (c) the predaceous formicine ant *Nylanderia rosae*; (d) a parasitoid pteromalid wasp; and

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(e) the detritivorous lawn fly *Hydrellia tritici*. All photos were taken in the "Grasslands" installation.

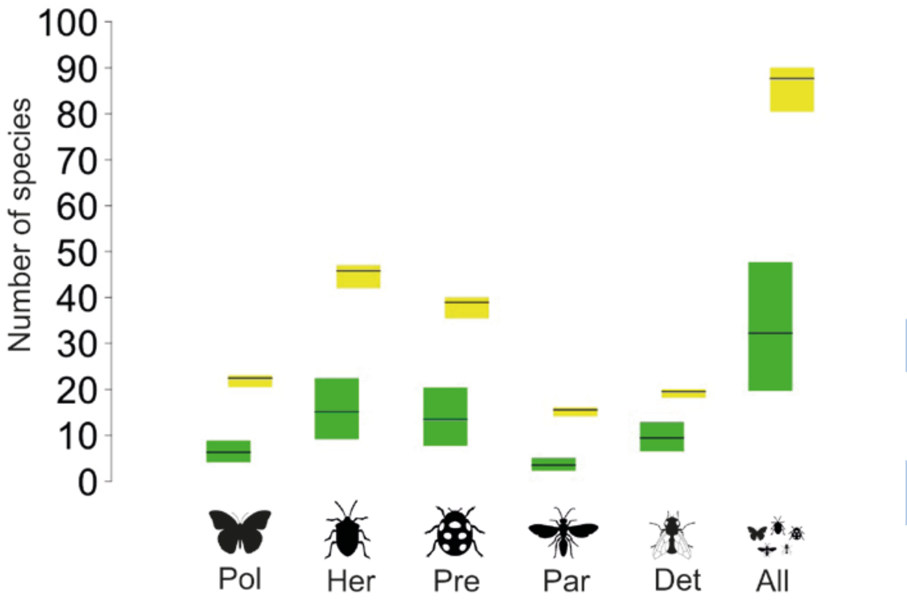

Figure 5. Estimated insect and spider species richness in the State Library of Victoria with (yellow rectangles) and without (green rectangles) the contribution of the "Grasslands" PUP for each arthropod functional group (Pol: pollinators; Her: herbivores; Pre: predators; Par: parasitoids; Det: detritivores) and for all groups combined. Black horizontal lines within each rectangle indicate the mean response; rectangles represent the 95% credible interval associated with each mean response.

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Panel 1. "Grasslands" case study experimental design

Our study site was the State Library of Victoria in Melbourne, Australia (Figure 3). At the time of our study, the site's permanent vegetation was structured with a series of ornamental bed islands, collectively spanning ~100-m^2 of vegetated cover and consisting mainly of non-native plants (WebTable 1; Figure 3). These were interspersed within a 1000-m^2 lawn (not included in the study). For 6 weeks during the Austral spring of 2014, the pop-up park (PUP) "Grasslands" was placed within the site's permanent vegetation, overlaid on top of the library's forecourt steps (Figures 1c and 3). "Grasslands" was conceived by artist Linda Tegg in recognition of the formerly widespread native grasslands in southeastern Australia. "Grasslands" was distinctly modular; consisting of 971 planter crates (52-cm × 26.5-cm × 12-cm) and 100 planter bags (0.125-m^3), for a total vegetated area of 130-m^2 (Figure 3). The 56 native plants used to assemble the PUP (WebTable 1) were grown in a greenhouse before being transferred to the site.

We used an entomological net (50-cm diameter) to collected insects and spiders from the site's permanent and PUP vegetation over 5 consecutive weeks (Figure 3). We standardised the survey to 5 sweeps/m^3. of vegetation to guarantee a survey effort proportional to vegetated volume. - Sweep-netting was conducted by a single researcher [LM] to minimize bias. Samples were sorted into morphospecies (WebTable 2) and assigned into (1) functional groups, including pollinators, herbivores, predators, parasitoids, and detritivores (Figure 4); and (2) taxonomic groups, including spiders (Araneae); beetles (Coleoptera); flies (Diptera); true bugs (Hemiptera); ants, bees, and wasps (Hymenoptera); and butterflies and moths (Lepidoptera).

We used these data to build two datasets: one recording species site occupancy only at the site's permanent vegetation ("base"), and the other species site occupancy at both the permanent and pop-up vegetation ("full"). The weekly samples constituted the units of inference – that is, the temporal sample units used to draw inferences on species site occupancy (Figure 3) We analyzed these data using a variation of the hierarchical community model described by Mata *et al*. (2017). Findings are presented and discussed in the main text. Full descriptions of our analytical approach, statistical model and Bayesian inference implementation are provided in WebPanel 1; of the R scripts in WebPanel 2; and of the data used in the analysis in WebPanel 3.

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WebPanel 1. "Grasslands" case study: statistical model description and inference implementation

We analyzed our data with a multi-species site occupancy model. The hierarchical structure of our model was composed of three levels: a first level for the ecological process (ie species occupancy); a second level for the observation process (ie species detectability); and a third level to account for the sampling of each species from the metacommunity. Our model can therefore be understood as a metacommunity hypermodel, in which the occupancy and detection parameters for each species are treated as random effects governed by hyperparameters that describe the metacommunity (Kéry and Royle 2016). Specifically, we used a variation of the model developed by Mata *et al*. (2017). The occupancy level model was specified as:

$$z_{i,j} \sim \text{Bernoulli } \Psi_{i,j}$$

where $\Psi_{i,j}$ is the probability that species i occurs at sample j, and the detection level model as:

$$y_{i,j,k} \sim \text{Bernoulli } (\Phi_{i,j,k} \cdot z_{i,j})$$

where $\Phi_{i,j,k}$ is the detection probability of species i at sample j at vegetation type k.

The occupancy and detection level linear predictors were specified on the logit-probability scale as:

$$\text{logit } (\Psi_{i,j}) = \text{occ}_i$$
$$\text{logit } (\Phi_{i,j,k}) = \text{det}_i$$

where occ_i and det_i are the species-level random effects, which were specified as:

$$\text{occ}_i \sim \text{Normal (mu.occ, tau.occ)}$$
$$\text{det}_i \sim \text{Normal (mu.det, tau.det)}$$

where mu.occ and mu.det are governed by global occupancy hyperpriors specified as Uniform (0, 1), and tau.occ and tau.det are governed by global detection hyperpriors specified as Gamma (0.1, 0.1).

Finally, we estimated species richness using the following summation structure:

$$\sum_{i=1}^{S}\sum_{i=1}^{N} z_{ij}$$

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where S is the total number of samples, N is the total number of detected species, and $Z_{i,j}$ is the latent occurrence matrix. Because these calculations were conducted as derived quantities within our Markov Chain Monte Carlo (MCMC) modeling framework, we were able to report the species richness estimates with their full associated uncertainties.

We estimated model parameters using a Bayesian inference approach, and used MCMC simulations to draw samples from the parameters' posterior distributions, employing the MCMC algorithm implemented in JAGS (Plummer 2003) and accessed through the R package "jagsUI" (Kellner 2016). We used three chains of 30,000 iterations, discarding the first 3000 in each chain as burn-in, and thinning by three. We visually inspected the MCMC chains and the values of the Gelman-Rubin statistic (R-hat < 1.1) to verify that an acceptable convergence level had been reached (Gelman and Hill 2007).

WebReferences

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WebPanel 3. "Grasslands" case study: dataset

The full dataset to re-run our analyses is available as part of a public Open Science Framework project entitled "Punching above their weight: the ecological and social benefits of pop-up parks". The file (bugs.cvs) can be downloaded at https://osf.io/fp782.

WebPanel 4. Extended acknowledgements

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