Introduction

Cities are complex adaptive systems (Grove 2009), with ever-changing landscape forms, distribution, processes and functions (Turner and Gardner 2015). Rapid urbanization and climate change have exacerbated these dynamics in many cities, including Singapore. The city-state was originally forested, but by the 1870s, more than 90 percent of the forests had been cleared for agricultural purposes. In only a few decades following Singapore’s independence, the entire island was transformed into a totally urbanized city, with less than 0.5 percent of the original vegetation remaining (Corlett 1992; Yee et al. 2011). In the past 50 years, the population has almost quadrupled, jumping from 1.6 million to 5.6 million – and is predicted to reach 7 million by 2030 (MND 2013). Singapore, a largely low-lying island of only 740 square kilometers (286 square miles), stands to be greatly impacted by climate change. By the end of the 21st century, temperatures are projected to increase 1.4 degrees Celsius (2.5 degrees Fahrenheit) and the sea level will rise by 1 meter (3.3 feet) (NCCS 2020). Uncertain weather is anticipated to occur more frequently and alternating periods of intense rainfall and followed by drought will speed up the environmental changes. Singapore, with its rich tropical biodiversity, is likely to experience severe changes to the city’s landscapes and natural heritage.

The emerging reality of the socioecological impacts of urbanization and climate change suggests the need to rethink the roles of landscape planning and design. Conventional plans typically provide instant greening and focus on human dimensions, with minimal attention to ecological concerns (Forman 2008; Steiner 2012), but the new paradigm goes beyond such limited design considerations. Nassauer and Opdam (2008) define landscape design as an action to bridge knowledge and practices in urban ecology, ultimately contributing to landscape changes with the purpose of sustainably providing ecosystem services. Translating ecological knowledge from science into design action in professional practice has become a powerful approach in its own right; one that synergizes research, policy and implementation integrating the fields of ecology, landscape architecture and urbanism (Lister 2017).

Given the immediate need to protect and restore ecosystems globally on an unprecedented scale, the essential task of research in landscape planning and management is to understand landscape complexity and (un)predictable landscapes. Via the lens of urban ecology, landscape

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research can guide design and planning strategies to mitigate, adapt and, where possible, reverse
the curve of biological, biophysical and socioeconomic impacts. A range of tools (e.g., assess-
ment systems and frameworks) and associated theoretical concepts (e.g., landscape urbanism,
biophilic design, resilience planning, regenerative design) have been developed in recent decades
(Heymans et al. 2019). The various tools and concepts highlight that physical and technical
approaches may be critical, but changes in attitudes and values are equally vital. Design and plan-
ning strategies must cultivate an attitude of resilience, adaptation and transformative capacity to
achieve long-term sustainability, notably in the fast-growing tropical city context.

In Singapore, this new trajectory of landscape research supports the evolution of the city-
state’s greening policies, starting with the ‘Garden City’ initiative, evolving into the idea of a
‘City in a Garden,’ and most recently progressing into a ‘City in Nature’ (NParks 2020). This
last policy emphasizes urban landscapes as living ecosystems. The targets of the Singapore Green
Plan 2030 under the City in Nature initiative include doubling the annual rate of tree plant-
ing, increasing the land area of nature parks by over 50 percent, and adding 1,000 hectares
(2,741 acres) of green space (NParks 2020). The idea is to green the city by restoring nature in
the urban landscape and strengthening the ecological connectivity between urban green spaces
(NParks 2020). More importantly, the initiative highlights the attributes of urban green spaces
that conserve biodiversity, address climate change impacts and improve the physical and mental
health of city dwellers. The success of initiatives in delivering these outcomes hinges not just on
the amount of additional green space set aside to meet the target but also on the quality of the
green space, with respect to the benefits it offers.

In line with this greening policy, we explore the opportunities for landscape architectural
research to contribute to planning and design for a rapidly changing Singapore by looking
at two types of landscape: First, unmanaged landscapes slated to be cleared in the near future
and replaced by intensive land-use; second, managed human-made landscapes allowing natural
growth and succession after construction is complete. The discussion of each type of landscape
includes two sets of research questions based on urban ecological principles and proactive plan-
ning and design considerations that are feasible and applicable for moving Singapore toward
greater resilience to the predicted impacts of climate change and biodiversity loss.

From Urban Woodlands to Multifunctional Urban Green Spaces

Urban woodlands generally yield multiple socioecological benefits, including the support of
biodiversity, the mitigation of heat and air pollution, a capacity for nitrogen fixing, the provi-
sion of a unique cultural heritage and the promotion of human well-being (Endreny 2018;
Nowak and Dwyer 2007). Yet regrowth forests in Singapore, where the original forests were
cleared for cultivation of crops and the land self-regenerated into forests within a few short
decades following abandonment, are often viewed as temporary and transitory landscapes await-
ing development (Figure 16.1). Under the Urban Redevelopment Authority (URA) Master
Plan 2030, most of the existing secondary forests, covering about 4,700 hectares (18,000 acres),
could be converted into new development land uses, such as residential, commercial, institution
or reserve sites, within the next 10–15 years (Tan et al. 2016). As a result, the city stands to lose
substantial natural habitats, further fragmenting and limiting urban green spaces and challenging
the maintenance of ecosystem equilibrium. Yet if the developed areas were well planned with
natural and semi-natural green spaces as a synergistic matrix, their spatial and temporal cumula-
tive effects could have a positive impact on the city’s natural systems as an organic whole. To
meet this more optimistic vision, we hypothesize a number of long-term socioecological con-
sequences that may compensate for or minimize the secondary forest loss.
Question 1: Can we make better decisions about which forested lands should be kept for natural conservation purposes and which are allocated for urban development?

Analyzing spatial patterns of secondary forests using patch-corridor-matrix parameters would help identify ecologically valuable patches at the city level. A fundamental principle could be to preserve sizable forests, as size is generally correlated to species richness and functional diversity (Karadimou et al. 2016). Preventing the removal of these sizable forests is an essential action, as not many large forests are left in Singapore – only around 50 patches of the total 2,400 forest patches are more than 10 hectares (24 acres) (Y. Wu 2018). Their quality varies, depending on their historical land use and geological and biophysical conditions (Morgenroth and Östberg 2017). To make systemic decisions on which are potentially more valuable, we need a hypothetical analysis of the relationship between spatial characteristics and ecosystem functions (Coleman et al. 2019).

It is necessary to explore to what degree remaining forests will maintain the resilience of ecosystem services in the face of changing drivers, including the removal of adjacent patches. To develop realistic design and planning scenarios, it is imperative to map forests intended to be maintained in the long term or scheduled to be removed in the near future and quantify their ecosystem services. For example, clearing of the Tengah Forest, one of the largest forested areas in Singapore, began last year. Plans call for a 33-hectare (82-acre) Dover forest, a stepping stone for wildlife, to be developed within a decade (Figure 16.2). Sequential mappings of deforestation timelines based on the current and future land development plans would contribute to the creation of deliberate and timely design and planning scenarios. Essential following research would be the estimation of the ecological and biophysical impact of the loss of the forest over time. When over 700 hectares (1,730 acres) in Tengah Forest are eliminated, the ecosystem fluxes of the entire region will be drastically changed because of the alteration of hydrological flow,

![Figure 16.1 A patch of Pasir Ris woodland in the northeastern tip of Singapore cleared for residential and institutional development in 2013.](source: Photograph by Zhijie Hu.)
runoff retention capacity, proximity of seed sources and the nutrient and materials cycle in surrounding areas. The situation is more complex when particular forests are strategically restored; as they mature, their ecological functions improve. Preemptive design and planning strategies based on simulation of these multiple scenarios would guide planners to minimize the ecological disturbance from successive deforestation and maximize the benefits from ongoing afforestation/restoration projects nearby.

To supplement the few larger and connected forest remnants, conservation plans could include more active planning actions, such as enlarging existing forests, fusing or connecting small woodlots with habitat corridors and merging the forest remnants with adjacent natural areas (Jim 2017). Regardless of their size, it is important to avoid redevelopment of forest patches closer to key natural habitats, nature reserves or ecological corridors critical for seed dispersal and wildlife movement. The recent conversion of reserved state land close to the nature reserve into designated nature parks (NParks 2020) is an encouraging example of this type of prioritization. The need to be connected or the extent of recommended distance between patches and sources depends on target species, however, so a critical review of habitat requirements using empirical data on each species is needed to make a more practical/realistic determination before developing habitat connectivity frameworks.

In related work, a group of ecologists in Singapore studied songbird movements across forested areas and identified species characteristics that are good predictors of whether those species might be able to move between forest fragments, as well as species characteristics likely to be

Figure 16.2  Forested areas in general are indicated in black. Highlighted areas (dotted circles) have future development plans with various timelines. The selected areas are A – Tengah Forest under clearance, B – Dover Forest under planning, C – Paya Lebar Airbase to be cleared in 2050, D – Clementi Woodland with no development plan yet but designated residential.

Source: Photograph by Yun Hye Hwang.
negatively impacted by fragmentation and isolation (Cros et al. 2020). In similar research efforts in regional planning, Rüdisser (2012) designed an indicator to assess the ‘ecological connectivity’ of patches by their degree of naturalness and distance to natural habitats. Such an approach could incorporate a more functional component by drawing on large-scale landscape pattern analysis, such as core area measures and least cost distances (Kupfer 2012), to strengthen wildlife interactions as a part of regional-scale ecological networks (J.J. Wu 2008) beyond the currently demarcated secondary forests.

A growing number of public opinion articles target the need to save secondary forests in Singapore. For example, drone footage of a secondary forest went viral last year, and many people came to learn of and appreciate its wild beauty. After learning the land had been earmarked for residential development in the future, many called for its preservation (Elangovan 2021). The tension between conservation and development is more complex, as it is interdependent with political and social forces. Urban nature is not an independent entity but overlaps with the identity and values of society. Therefore, to apply research findings to land use policy, further investigation should include the contemplation of trade-offs in the ranking or prioritizing of future land use through interdisciplinary engagement with a variety of stakeholder groups, including the general public.

Questions 2 and 3: If removing a forest is inevitable for socioeconomic or other reasons, what are the development alternatives? To what extent can urban green spaces maintain ecological balance in the face of development?

Common construction practices involve clearing and levelling the land for development. Instead of bulldozing an entire forest patch, however, the most ecologically valuable core of the forest could be retained, leaving the rest of forest to be densely developed. Retaining key landscape features of existing forests, such as natural landforms, critical habitats and rare species, would minimize the negative impacts of deforestation. Spatial pattern matters. For example, a 5-hectare (12-acre) patch might maintain a certain level of biodiversity, while a 1-hectare-sized plot (2.5 acres) might degrade and its biodiversity decline over time, making the retention of the former more important than the latter. In a similar vein, an existing wide waterway (100 meters; 328 feet) may be sufficient for urban-adapted aquatic animals’ movement but a narrow waterway (10 meters; 32.8 feet) may not be enough for the movement of targeted species. Local studies on correlations of area size, form of green space and species (Castelletta et al. 2005; Chang and Lee 2016; Jain et al. 2020) are helpful references for determining optimum spatial and distributional patterns for remnant forest patches.

The enhancement of the ecological quality of the remaining forest patches should be a key planning principle, as many secondary forests in Singapore are young, generated from abandoned cultivated land, degraded, less dense and dominated by a mix of scrublands and fast-growing exotic tree species. The improvement of remaining patches has the potential to cater to a variety of ecological functions if well-executed restoration programs facilitate forest succession. The ‘framework species method’ (Elliott et al. 2003) would be an applicable restoration strategy – introducing key components of primary forest plant communities to increase structural complexity, enhance nitrogen fixation, attract fauna, increase the abundance of the biomass and allow time for the maturation of vegetation and biodiversity.

A possible preemptive design action before clearance could be designing blue and green infrastructure in line with natural landforms, natural hydrology and regional wildlife movement. Such an infrastructure would enhance habitat connectivity, prevent fragmented remnant pockets from being enveloped by built-up areas and accommodate multifunctional ecosystem services
(Collins 2020), including heat mitigation, soil improvement, water treatment and social and recreational spaces. In this way, urban green spaces could become a principal medium, restoring natural flows and sociocultural functions before other types of land development take place.

Remnant forest patches and newly developed blue and green infrastructure could be converted into nature parks with alternative forms of recreational activities, bringing nature closer to people's everyday lives and contributing to the creation of a biophilic neighborhood. A good example is a Singaporean public housing development project, where 10 hectares (25 acres) of existing woodland have been converted into a park at the heart of the residential estate (Lin 2019), thus allowing the community to increase its affinity for nature and wildlife. Such demand for green spaces may reflect an intrinsic need to connect with nature, especially during the COVID–19 pandemic, as Singapore's green spaces received an unprecedented influx of users, many of whom had not visited nature areas in Singapore before. Problematically, however, there are increasing reports of human–wildlife conflict, such as wild boar attacks on pedestrians in a woodland fringe, and mounting wariness of a future zoonotic disease carried by wild animals (Lu et al. 2021). How to incorporate a greater range of innovative sustainable management practices and community engagement programs to overcome fear and enhance the positive relationship between humans and wildlife near a woodland fringe is a possible line of research.

Instead of immediate land clearance, the development of alternative timelines could accommodate the steady evolution of land use changes and allow the sustainable use of natural resources. Existing landscape planning guidelines (e.g., Neighbourhood Landscape Design Guidelines (NLDG) and Sustainable Site Initiative (SITES)) introduce design actions in phased construction processes before the removal of forests. Examples in the guidelines include the following: minimizing earthwork and conserving natural topography, diverting construction and demolition materials from disposal (e.g., soil from undulated land clearance) and securing and reusing natural resources (e.g., healthy soil, leaf litter, timber and rocks). Simulating multiple predictive models of new urban green spaces highlighting quantifiable socioecological benefits and economic losses would also be useful research. A good example is the work done by Alberti for the Snohomish Basin 2060 Scenarios (Alberti 2013).

Planning and Design Considerations When Saving Urban Woodlands

The underlying premise is that urban woodlands can be better sustained when natural ecological processes integrate with the accumulated human knowledge and ingenuity to survive. We offer four planning and design considerations stemming from the preceding questions. First, beyond the local scale, there is an urgent need to evaluate the conservation value of every undesignated forested patch at the city scale. We should carefully assess and revalue the patches using multiple urban planning parameters to measure spatial structure, socioecological functions and sociopolitical forces. Such an assessment could be a precursor to the design of deforestation management policies and applicable to other fast-growing cities, especially given the recent drive of many cities to increase the quantity of urban green space.

Second, deforestation management offers unique design opportunities to create spatial heterogeneity to mitigate forest loss. Designers could leverage opportunities to integrate a diversity of characteristics of natural and semi-natural open spaces with newly developed green spaces that could fulfill a socioecological role in highly dense neighborhoods, as multifunctional everyday landscapes. Success could be evaluated via long-term monitoring, the use of existing planning frameworks and comparative analysis of pre- and post-land development (Tan et al. 2021).

Third, systematic and selective clearing of a forest using a phased plan would be essential to minimize the impact of deforestation. Furthermore, planning frameworks should include the
consideration of evolving land-use and ecological values over time. In other words, designers should not just be engaged in understanding the current condition or initial succession on fast time scales; they should also predict the potential of the forest to provide high levels of ecological functions—a 100-year timeline of the slow recovery of a secondary forest toward a pristine forest (Chua et al. 2013) with human-assisted enhancement to a diverse, structurally complex state, for example.

Fourth, to minimize undesirable impacts on ecological planning, we should consider social dimensions, such as mitigation of human–wildlife conflict (Hwang and Jain 2021) and functional trade-offs in design that encompass both ecological functions and demands for living and recreational spaces. We suggest active engagement with citizen groups, relevant communities and professionals in knowledge collection and decision-making processes. The time to act is now, while there is still an opportunity to protect a semblance of existing forests, showcase the regenerative power of nature, and shift mindsets toward a holistic view of greening cities.

From Manicured Landscapes Into Resilient Ecosystems

There is growing recognition that human-made urban green spaces can deliver ecological benefits and environmental qualities and contribute to the enhancement of landscape diversity and biodiversity in cities (Pickett et al. 2016; Tan and Jim 2017). Allowing the spontaneous growth of vegetation in an urban setting can permit ecological succession that supports wildlife (Fahrig et al. 2011), dependent food webs, nutrient cycles and biophysical composition (Beck 2013). Given their steady and humid climate conditions, tropical cities such as Singapore can accommodate the dynamism of a variety of flora and fauna, if given the opportunity. Such green spaces could reduce resource consumption and waste generation as they resist environmental stress and disturbance in the face of climate change.

Yet it is common to see urban vegetation used as the tool of a green makeover and accompanied by a high level of maintenance. An example is state land covered by manicured lawns that require biweekly grass cutting to maintain a neat and tidy appearance, even though public access to them is limited. This may be changing, however, as there is a movement to make better use of Singapore’s many green spaces to enrich biodiversity in the urban environment, rejuvenate urban parks, and improve resource efficiency (NParks 2020). The City in Nature initiative advances the city’s greening through two green policies: ‘Nature ways,’ mimicking a forest-like vegetation structure along roads, and ‘Rewilding plans,’ applying more naturalistic landscapes. The recent halting of regular grass cutting during the COVID-19 pandemic also represented a unique opportunity to promote the natural growth of urban vegetation and was received favorably by citizens (Tan 2020). Rethinking ‘green carpets’ (Ignatieva and Hedblom 2018) and re-examining conventional management practice with ‘rewilding initiatives’ (Hwang et al. 2020) might be timely research topics in the face of the twin crises of climate change and biodiversity collapse.

Questions 4 and 5: How does planted and unplanted urban vegetation grow? How can human interventions enhance urban biodiversity and ecosystem services over time?

Although biologists have substantial knowledge of the ecological succession of intact tropical forests (Ashton 2014; Lohbeck et al. 2012), their application of the knowledge to the novel ecosystems in the city where anthropogenic influences have reshaped and reorganized biotic systems...
remains relatively unexplored. The growth of urban vegetation is complex, heterogeneous and highly dependent on three factors: available plant species, stresses of site conditions and intensity of human disturbance (Figure 16.3). The most influential factor in the natural growth of urban vegetation in managed greenery is intentional human intervention. A study on vegetation changes in Bishan Park (Figure 16.4) found the changes could be explained by management requirements (e.g., ease of maintenance, hydrological needs, pest control) and sociocultural goals (e.g., aesthetics, comfort, safety) (Hwang et al. 2021). From this, we can infer that the intentional manipulation of spontaneous growth of unplanted and planted vegetation is a key driver of increases or decreases in urban biodiversity. To that end, we formulate the following questions. What will urban green spaces look like after 100 years of maintaining the current management regime or after introducing a new type of maintenance and appropriate regeneration strategies? What are the long-term implications of anticipated trajectories of urban landscape change for the resilience or vulnerability of ecosystem services? Vegetation models visualizing plant growth

**Figure 16.3** Factors affecting urban vegetation dynamics.
Figure 16.4  Vegetation changes in Bishan-Ang Mo Kio Park between 2012 (top) and 2019 (bottom).
Source: Photographs by Yit Chuan Tan (top) and Mayura Patil (bottom).
and cumulative functional performance (Oldfield et al. 2013) by intensity and types of management practices would be helpful to envision and hypothesize these situations.

Thousands of plant species are found in tropical rainforests but only a few hundred, at most, have been used in Singapore’s urban green spaces. Cultivated plants may not exhibit the full range of internal genetic and external biotic interactions of tropical plants, such as pollination, seed dispersal and soil improvement. Moreover, the competition between native and exotic horticultural plants is unpredictable. A practical way to promote robust vegetation dynamics is to identify native forest species that could tolerate urban conditions. These key species would ideally thrive in urban conditions and gradually enrich the planting scheme over the years to create a functional mimicry of mixed dipterocarp rainforests. Spontaneous vegetation that adapts to climate change might be a good addition to planting palettes, as some nonnative, spontaneously occurring species may support the growth of other native flora (Davis et al. 2011), and not all nonnative species displace native species (Lum and Min 2021). Such approaches allow room for novelty, yield diversity and promote resilience in plants given high levels of uncertainty due to climate change. Besides species’ level of abundance, understanding their degree/capacity of colonization, patterns of growth/decay and long-term survival would be key components of knowledge contributing to habitat diversity in the long run. To implement this approach as a landscape policy, we need more research on the correlations between lush and naturally grown, planted and unplanted vegetation and how these species support or generate associated ecosystem services.

Another challenge is that vegetation dynamics in the urban context involve contextual interdependencies at nested scales. To give an example, the management of three university campus lawns in Singapore was halted for two years. Despite the closeness of the three plots, researchers found marked differences in the species growing in each lawn, the dominating vegetation types and the rates at which each type grew (Hwang et al. 2017). Similar patterns were found in a study of the Beijing Olympic Forest Park where spontaneous vegetation grew better in certain conditions; for example, unplanned plots under trees and near waterways contained the most diverse micro habitats (Li et al. 2019). Such studies suggest the immediate surroundings and micro-scale conditions (e.g., microclimate, soil and water, grading) have an impact on the spontaneous growth of vegetation within similar surrounding contexts. Researchers should also probe the correlations of the growth of spontaneous vegetation, geographical contexts and connectivity with sources at a regional scale. Plant functional connectivity, defined as the effective dispersal of organisms across green spaces, should be studied at the individual species level. External factors at multiple landscape scales, such as seed dispersal or pollen flow, matter as well, as species establishment usually extends beyond a project’s boundaries (Auffret et al. 2017). Mechanistic dispersal modeling and ecological network analysis could help us understand how and where plants move across green spaces.

**Questions 6–8:** What are the popular perceptions of dynamic nature? How can we shape public preferences for wilder green spaces? Do economic parameters promote dynamic vegetation growth?

Despite scholars’ attention to the socioecological benefits of fostering the natural ecological processes of urban green spaces, management practice tends to preclude them, as the general public commonly equates natural ecological practices with poor maintenance regimes (Ignatieva and Hedblom 2018). Thus, social perspectives on wilder vegetation cannot be ignored. Beyond
A social study found Singaporeans tended to prefer manicured landscape over natural vegetation for aesthetic reasons (Khew et al. 2014). And another study highlighted that wealthier Singaporean residents have a tendency to live closer to more managed vegetation than natural vegetation (Nghiem et al. 2021). At the same time, the public has expressed concerns about untidiness, safety issues caused by overgrown bushes that might block views of traffic or harbor mosquitoes (Hwang 2020). Yet Singaporeans are increasingly conscious of the value of conserving urban forests (Hwang and Roscoe 2017) and are not opposed to less-manicured urban greenery (Hwang et al. 2019). A shift in public perception was amplified during the recent COVID-19 ‘Circuit Breaker’ period, as vegetation left ‘wild’ when nonessential maintenance operations were eliminated resulted in added biodiversity, including wildflowers that were greatly appreciated by the public (Tan 2020).

Nassauer’s concept of a ‘cue to care’ refers to the actions people take that demonstrate a yard or landscape is maintained in a way that meets public preferences or expectations. Nassauer’s research found there was a widespread dislike of dynamic natural ecosystems related to the view that they were untidy and not well maintained (Nassauer 1995). A direct intervention to challenge this attitude would be to design landscape elements of naturally growing green spaces to present an alternative aesthetic result. Ecological aesthetics induced by environmental ethics and environmental education could increase positive perceptions of what are otherwise seen as untidy or messy ecosystems (Steiner 2019). Public preferences could also change if naturalized green spaces are related to human health and utilitarian functions. Suggested studies linking health to densely grown nature include examining whether intensive use of gasoline-powered mowers and leaf blowers to maintain manicured landscapes affects human health or if the risk of dengue and other vector-borne diseases negatively correlates with biodiverse landscapes and mosquito breeding conditions. Plant preferences may be also associated with a sense of connectedness and familiarity with nonhuman living organisms. Good examples of such attempts include a program sending complimentary mail to trees that survived during a 10-year drought in Melbourne, Australia (Milman 2015), and ‘One Million Trees Movement’ in Singapore involving the community in tree-planting activities to facilitate collective ownership of greenery and to create a stronger sense of place.

A high level of energy input and carbon cost associated with maintenance is common for urban green spaces that accommodate land uses such as recreation. In many instances, urban green spaces are not accessible for recreation but still have regular pruning that restricts growth of vegetation, so their ecological functions are low. Economic dimensions of vegetation succession in terms of resource efficiency (e.g., reduction of maintenance inputs, such as water, fertilizer, compost and labor hours) could be reflected in decision making to retrofit such spaces. If current intensive management trends continue, what is the lifecycle cost? What could an alternative regime be and what is an achievable future when applying the reduced, or no maintenance approach? We could use quantification and dynamic models to project future outcomes of nature-dependent management. Choice experiments may be another useful method to explore attainable choices, accounting for both direct outputs and indirect environmental values (Terris-Prestholt et al. 2019). Trade-off processes, social and ecological choices and consequences could be articulated, visualized and prioritized. A possible choice experiment study would be a residential survey to determine attitudes regarding the potential benefits of less manicured landscapes highlighting maintenance costs, required resources, attainable biodiversity, potential disservices and initial capital costs incurred for construction.
Planning and Design Considerations When Rewilding Manicured Landscapes

To conclude our discussion, in this section, we offer six takeaways for potentially converting from manicured landscapes into viable and ecologically resilient alternatives for urban greening through rewilding:

1. Active human interventions could act as an impetus to facilitate a high level of urban biodiversity when accompanied by well-executed planning and management strategies. We need to use, synthesize and translate knowledge from plant ecology into landscape management and design.

2. Future planting selection for green space planning should not be limited to a dichotomous classification (planted vs unplanted, urban vs natural, native vs nonnative). Designers and planners should recognize the benefits of hybrid planting schemes, using naturally growing plants that tolerate urban conditions as essential landscape material and harnessing them to provide more robust ecosystem services.

3. Characterize landscape typologies based on site-specific conditions, such as streetscapes in the proximity of a primary native forest. In this case, the high seed dispersal capacity of the forest would boost fast ecological succession and plant diversity in rewilding.

4. Consider ever-changing surrounding conditions and climate shifts. This should be a key consideration in plant planning and design, as these would alter processes of decomposition, nutrient cycling, carbon update and the types of naturally dominant species that increase or decrease competition among native and exotic flora and fauna.

5. Action-oriented design research could help shift attitudes to the wilder landscapes required to mitigate climate change and biodiversity collapse. Noting that ‘cues to care’ vary across geographical and cultural contexts, and between disciplines (Li and Nassauer 2020), planning and design actions based on site-specific and interdisciplinary perception studies are essential. We suggest a number of potential studies: the accepted degree of wildness, a comfortable distance that separates people from wildlife, preferred facilities or recreational activities to support the enjoyment of wilder nature, landscape maintenance activities to increase positive attitudes to overgrown/tall grass patches.

6. Re-examining landscape maintenance practices and rescheduling would be useful. Applying the rewilding principle nationally might save thousands of labor-hours and reduce carbon emissions and use of associated resources for landscape maintenance, while enhancing urban biodiversity and adding biophilic value to urban green spaces. Survey processes must necessarily engage residents, collaborating with them on a learning journey based on continual adaptation of growing nature. Given the complexity of social and contextual variations, consensus is rarely possible, but a compromise may be reached if social and economic studies of design options actively engage stakeholder groups.

Conclusion: Dynamic Landscapes as a Research Opportunity

In an era of extremely rapid urbanization and accelerating climate change, the big challenge is to understand ecosystems and spatial patterns in the dimension of time. This calls for more research on complex and changing landscapes. The explicit recognition of transformation, resiliency and adaptation of the fundamental characteristics of urban nature could reconcile the ecological, social and economic imperatives for long-term sustainability. While common practices of landscape planning and design have typically paid less attention to the global biodiversity crisis and
changes post-construction, landscape research on such aspects could make a unique and valuable contribution to critical local and global environmental needs.

The uncertainty may be even more radical in Singapore. We have never experienced the entire lifecycle of existing landscape typologies, as most of the city’s urban fabric has been constructed within the last few decades. Remnant young secondary forests and strategically introduced urban greenery have an unpredictable future, but an exciting period of maturation for the next century. Accordingly, well-planned multifunctional forests and intentionally rewilded greenery with resilient ecosystems could become a powerful ecological backbone of the city.

Some of our proposed research and design considerations might provide immediate environmental improvement, while others may require a moderate time frame or a slow process of landscape change to unfold gradually. Our hope is that working with natural succession and habitat regeneration – even in cities with limited opportunities to integrate urban green spaces – will address the long-term viability of urban green spaces despite the complexity and inevitable uncertainty of dynamic urban environments. No prescribed research approach offers an optimum management of changing urban environments, and there are no guarantees that what works in one social-ecological setting will work in another. Yet research efforts stemming from the questions posed in this chapter may inspire research that can inform planning policies and suggest pathways to reach desired outcomes to be better prepared for a climate-uncertain future.

References


Dynamic Landscapes in a Rapidly Changing Tropical City


