SEEDING CHANGE

PLANT NURSERIES + SPATIAL JUSTICE

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1.0 ABSTRACT

Plant nurseries are important partners for landscape architects, who design and help create vibrant and ecologically diverse landscapes. The operational goals of commercial nurseries affect our ability to create biodiverse, sustainable, and place-appropriate projects. Retail nurseries and garden centers are also sites of public interactions: plant availability and supportive programming influence which plants and ecologies feature in public imaginaries -- and which do not (Polefrone, 2020). In the United States, both nurseries and landscape design are complicit in patterns of inequality. During the 20th century, regulation of the emerging nursery industry disempowered communities of color by defining who could sell, raise, or care for plants in 'public' spaces (Bloch, 2019). Municipal nurseries and street-tree planting campaigns sowed the seeds for racial and socioeconomic disparities in urban canopies that persist today (Locke et al., 2021) In many cases, beautiful and healthy landscapes in more affluent neighborhoods were—and still are—created at the direct cost of others. Creating more just built environments requires contending with the past and present impacts of commercial(izing) plant production.

This report uses case study analysis to investigate how four contemporary nurseries cultivate plants alongside wider initiatives working towards social and spatial justice. It situates Monrovia Nursery Company, Oxbow Farm and Conservation Center, Citywide Horticulture, and Ploughshares Nursery within the 'modern' horticulture industries in the U.S. by using a material lifecycles lens to highlight each nursery as a space of material and human transformation. It synthesizes research findings through tabletop game design. A plant nursery-to-game design guide provides a framework for continued analysis of both nursery and nursery *relationships* through projective design. Sample games additionally illustrate how plant nursery games foster dialogue and, thus, coalition-building around shared goals in social and spatial justice.

Keywords:

Plant nurseries, material lifecycles, social justice, tabletop games, projective design.

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2. INTRODUCTION

"What if we looked at materials not simply as single-purpose products or commodities, but instead as continually changing matter that takes different forms, and is shaped by—but also shapes—others?"

(Hutton, 2020: 17)

Plant nurseries are important, though underappreciated, partners in the design and implementation of built environment projects. Landscape architects largely treat nurseries as passive suppliers of plants and their products as construction materials. Many of us rarely interact with nurseries directly, opting instead to follow 'standard' procedures of specifying landscape plants for contractors to procure and install. Once part and parcel of the same horticultural practice, plant nurseries and landscape design now occupy two sides of a growing chasm, with design(er)s frustrated by plant availability and growers shackled to shrinking profit margins (Pauly, 2007). Designing more 'just' landscapes is a futile endeavor without consideration—and reconfiguration—of these landscape *relations*.

Nursery plants, like all the materials otherwise "specified, acquired, and [re]assembled" in landscape construction, are anything but 'inert' or 'fixed' products (Hutton, 2020: 3-5). "Materials change shape as they travel from geological deposit or forest to factory and design project to landfill, passing through human hands and tools" (ibid.) Plants, too, are transformed by their environments as they grow from seed to saleable size and form, and again from stock plant to propagative material and/or compost. While Hutton (ibid) reminds us that all materials "perform beyond a project's fixed boundary," this is especially true to nursery plants. As living, breathing, and growing organisms, plants affect many of the ecosystem services that landscape designs use to measure their own performance. Plants absorb and filter water, they can phytoremediate contaminated soils, and support local flora and fauna. Maturing trees sequester carbon and cool urban heat islands. Plants also hold intrinsic cultural and spiritual values, many playing a critical role in local traditions and public perceptions of urban health. All plants are transformed by their environments and transform spaces around them. However, *nursery* plants in particular transform origin, destination, and transitional spaces, in many places affecting ecosystem services even during short stays in growing and/or retail spaces en route to final landscape 'destinations'. Seeing nursery plants as 'materials-in-motion,' reminds us of fundamental—though regrettably historic—ties between plant cultivation and landscape design.

Figure 1. Seed Packet (Source: Theodore Payne Foundation Archives)

2.1 A MODERN HISTORY OF U.S. HORTICULTURE

At the turn of the 19th Century, a nascent 'American' horticulture was still heavily influenced by European traditions and transplants. Though the term, 'horticulture', is today associated with hobby gardening, it originates in early 19th Century England as an enterprise dedicated to plant collection, breeding, and classification. The Horticultural Society of London was founded in 1804 and "promot[ed] meetings, nomenclatural projects, a lavish journal, a propagating garden, and a seed and plant exchange system" (Pauly, 2007:2). Horticultural technologies were simple though effective mechanisms to continue distribution of 'exotic' plants collected in Asia, Africa, and the Americas, such as the Wardian Case developed in 1833. American horticulture was, "from an institutional and material perspective…a scion of the European system" and closely connected to the colonial project (ibid.).

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(Pauly, 2007: 2)

Early, state-level organizations, such as the Massachusetts Horticultural Society (established in 1823) facilitated transfer of plants and plant material from their English corollaries (ibid.). National efforts further encouraged introduction of "'portmanteu biota' that had come to western Europe from Asia and Africa during millennia of agricultural activity and commercial intercourse…[and] replacement of New World plant species" (ibid). Thomas Jefferson touted that "the greatest service which can be rendered to any country is to add a useful plant to its culture" and this was freely cited by contemporary collectors, societies, and nurseries as justification for unrestricted introduction of new plant species and aesthetics (Thomas Jefferson in Pauly, 2007: 3).

Over time, growing awareness of the unique geographical conditions of the(ir) New World prompted additional interest in naturalization of introduced plants through careful selection, breeding, and – unbeknownst to many horticulturalists – evolutionary change. "Horticulturalists guided the forms and placement of organisms, but they controlled few, if any, completely" (ibid.). Plants (and stowaway insects and fungi) frequently hybridized with neighboring native and non-native varieties, seeding successfully "into and out of cultured settings." These 'reproductive and evolutionary strategies' altered local ecosystems. In California, for example, "eucalyptus plantations went wild, producing habitats that favored some birds and butterflies while distressing others and creating fire hazards for certain neighborhoods" (Farmer, 2017: xxx). Both amateur and professional horticulturalists – including nurserymen – participated in creating 'neo-European' landscapes and landscape aesthetics with little regard for or understanding of the ecological implications.

As migrant horticulturalists established multigenerational enterprises, many also shed 'Old World' associations in favor of a 'self-consciously 'American' naturalism that acknowledged the potential of 'New World' territories and plants. Though geographically broader than previous Euro-centric tastes, these newfound interests generally extended 'Settler' predilections for productivity and profit. Historian Pauly (2007: 3) writes that, "while settlers generally viewed American vegetation as timber to

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be cleared or weeds to be plowed, they intermittently hoped for the discovery of *usable* plants" (emphasis added). These attitudes pervaded horticultural institutions established in the mid- late 1800s, such as the United States Department of Agriculture, and both direct and affiliated outreach efforts such as Congressional Seed Distribution and state agricultural colleges (Pauly, 2007).

Establishment of land grant colleges following the Morrill Land Grant Act of 1862 formalized horticulture as scientific study and cultivation of plants. Newly created departments and professorships had decidedly agricultural interests, i.e., research and curricula emphasized commodity production at scale over, for example, conservation of species diversity (ibid.). Nurseries followed suit, frequently using resultant technologies to cultivate larger crops and, over time, hybridizing many to perform more and more reliably as monocultures. Landscape gardeners, on the other hand, moved towards formal design, effectively 'abandoning their identification with horticulture' (ibid.). With the rise of the architecture profession in the late 1800s, 'landscape gardeners,' including Andrew Jackson Downing and Frederick Law Olmsted, sought to align themselves with this field's comparative focus on design. Japanese nurserymen were important anomalies to this equation. Many, such as Frank Kubota and Makoto Hagiwara operated successful nursery and landscape design businesses into the 1940s, even enjoying high-profile commissions from municipal parks programs (Parmeter, 2010; Gorelick, 2020).

Figure 2. Worker tending trees at Rikers Island Nursery; street tree planting in Harlem, NY. (Source: Hutton, 2020)

The twentieth century marked an era of expansion and diversification of the nursery industry. Progressive reforms in the early 20th century catalyzed ambitious programs to beautify urban areas for the betterment of all. In many cities, including Seattle and Chicago, newly formed Parks Commissions undertook city-wide park development efforts, such as the 1903 and 1908 Olmsted Parks Plans for Seattle (*Friends of Olmsted Parks, 2004; 'History of Chicago's Parks*). New York and Pittsburgh, among others, launched street tree planting campaigns (Polefrone, 2020; Hutton, 2020). Conceived as a panacea to growing urban health crises in inner cities, street trees were "meant to rectify the environmental and economic degradation of industrialization, with broadly dispersed (if not exactly equitable) benefits for urban inhabitants" (Polefrone, 2020: 84). To be deployed at scale and with the uniformity desired of a coordinated planting campaign, street trees were grown in new, *municipal* nurseries and cared for by dedicated tree technicians and horticulturalists (ibid.).

Municipal nurseries offered horticultural and ideological advantages over commercial enterprises. Hutton (2020:151) writes of New York, "the street tree became a unique horticultural specimen. Unlike garden and park trees, street trees needed to be hard, straight, immune from insect attacks, shady, clean, and long-living." Cognizant of the comparatively extreme conditions urban environments posed on trees, cities sought to acquire those cultivated specifically to survive transplantation. At municipal nurseries, "city workers could trim taproots and encourage lateral root systems that would keep trees stable in shallow urban soil, trim the lower branches to allow for a taller canopy that could suspend over the traffic, and prune trees to give them strong central leaders".

Municipal nurseries evolved to supply large quantities of stock "grown to the correct specifications of a uniform planting system" and cheaper and more readily available than trees from commercial nurseries. In New York, this last characteristic came at a significant price: street trees were only below cost because they were grown at a municipally operated nursery on Rikers Island, an incarceration facility cited on a former landfill. Though this carceral nursery served dual purposes of supplying young trees for New York city and wholesome outdoor employment for incarcerated individuals, its financial feasibility hinged on under/un-compensated labor. Inmates described nursery detail as 'going to the country' compared to other rotations, however, most were at Rikers Island for less time than the average tree in their care (Hutton, 2020: 146-185).

In Pittsburgh, street trees wrest tree imaginaries from more affluent communities, promising trees for all where urban nature had historically been reserved for 'private elites.' Street trees promised to be a public good, distributed evenly and for the health and enjoyment of all (Polefrone, 2020: 85). Program implementation, however, fell grossly short of this goal. The Shade Tree Commission (STC) is a 'quasi-governmental entity' established in 1910 to "reclaim[] all ugly and unsanitary plots of land within the city, and transform[] them into spots of beauty and health" (Bigelow et. al in Polefrone, 2020). Their first act, however, was tree removal instead of planting. Trees "deemed unsuitable for the city's vision (or maintenance expectations)" were first removed, despite having grown and thrived in situ while the city industrialized around them (Polefrone, 2020: 85). Institutions such as the STC then exercised discretion over the siting of new trees, often "direct[ing] valuable trees to already well-provisioned neighborhoods" and neglecting to replace those removed from less affluent and/or minority neighborhoods (ibid.) In Harlem, NY, (by then a predominantly African-American neighborhood), fewer and smaller London Plane trees were planted where mature elms had been removed less than a century earlier to widen streets (Hutton, 2020: 153-9).

Figure 3. Rikers Island Nursery (Source: Hutton, 2020)

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(Polefrone, 2020: 85

From 1930-1960s, New Deal era programs affected similarly unequal results, this time at the federal scale. President Roosevelt established the Civilian Conservation Corps (CCC) in 1933 as a work relief program that offered young men nominal pay, room, and board, in exchange for work improving public lands, forests, and parks. They are most widely associated with reforestation. While U.S. Forest Service tree nurseries predate establishment of the CCC, corps battalions did much to expand the capacity and reach of this program. Corps members "climbed trees to pick seeds, skimmed them off the surface of forest streams and lakes where floating seeds collected," even raided squirrel caches to collect a whopping "875,000 bushels of cones and more than 13.5 million pounds of hardwood seeds" for cultivation (Maher, 2008: 53-4). By 1938, CCC contributions had helped establish an additional 22 federal and state nurseries, bringing the total number of these institutions to 100. With CCC assistance, USFS forest nurseries produced 370 million seedlings a year, a 100% increase from 1933 (ibid.).

Ghiggi (2010: 128), however, cautions against overly optimistic readings of these numbers, noting that the establishment of forest nurseries reflects overall forest decline as well as institutional investment. Forest nurseries only gain economic significance once existing forest resources have been degraded to the point where it is no longer viable to harvest and replant seedlings from extant areas. In many cases, CCC reforestation efforts also inflicted more harm than good, famously draining 'swamps' to control mosquito outbreaks and fighting soil erosion in Southern states by planting non-native kudzu vine as ground cover. Kudzu was known for its invasive growth habit but considered a suitable erosion control mechanism while it could be"controlled in fields by livestock, and on roads and other rights of way by convict or low-wage labor" (Pauly, 2007: 247). As both "free-ranging hogs and chain gangs became less prominent in the Southern landscape," kudzu grew rampantly to become, "the vine that ate the south" (ibid.; *Nature, Conservation and Recreation*).

Figure 4. Civilian Conservation Corps Crew Planting Trees (Source: USDA)

Though federal programs such as the CCC promised "no discrimination shall be made on account of race, color, and creed," again, implementation fell short of otherwise progressive aims (Nature, Conservation,

Figure 5. "Indian CCC Crew" (Source: Digital Public Library of America)

and Recreation). During the Great Depression, the CCC provided employment and education for three million men – as many as 57,000 corps members learned to read through camp-based education programs, in addition to pursuing vocational training available to all. For many, the CCC was their first job and helped meet their own needs and support families back home: $25 of their $30 paycheck was automatically sent home, effectively distributing the economic impact of this relief program across the country. Unfortunately, enrollees were disproportionately White. Though a limited number of African American men were enrolled in the program, they lived and worked in segregated camps. Native American recruits were similarly segregated in a dedicated 'Indian Division.' Overall, the program enrolled only 200,000 African Americans and 80,000 Native Americans, though unemployment rates were almost twice as high in these communities at the height of the Depression (ibid.). Discriminatory implementation of federal forest nursery and reforestation programs, thus, exacerbated racial inequalities.

Commercial nurseries proliferated with the post-war housing boom and following concerted adaption of many war-time technologies to civilian and agricultural applications. "Suburbia shaped habits of car dependency and community, patterns of spending and saving," and new visions of the American dream as suburban story of detached, single-family homes with well-tended gardens and lawns (Nicolaides and Wiese, 2017). Together, these led to the mid-century emergence of garden centers as dedicated retail nurseries often attached to home-improvement stores and promising the adventure of purchasing both plants and tools in a single shopping trip. Garden centers reflect further specialization of the nursery industry: with them, specific nurseries focused on selling plants to private, often residential consumers, while others dedicated efforts to wholesale production of plants (Ghiggi, 2010).

This was mirrored 'upstream' as nurseries adopted scientific management principles and specialized in pursuit of economies of scale: some, for example, focused on producing germination and plug production, while 'finishers' sourced and grew plugs into larger sizes for retail and/or trade customers. These developments distributed the nursery plant lifecycle across more and more players, systematically detaching consumers from producers and effectively fetishizing nursery plants as commodities by "conceal[ing] the source and labor conditions of [their] making" (Hutton, 2020: 6). Indeed, many secrets lurked beneath the bountiful plenty of plant varieties and colors increasingly available to suburban homeowners.

While commercial nurseries and garden centers did not exclude particular communities per se, accompanying federal policies certainly did. Post-war suburbanization is widely attributed to Federal Housing Administration (FHA) mortgage insurance programs and the Interstate Highway system. The former directly facilitated home ownership by setting national standards for lending risk assessment. It was accompanied by the 1944 'GI Bill' which made home ownership even more affordable for returning veterans – provided they were White. All three programs heightened racial disparities: minority neighborhoods were 'redlined' as 'hazardous' investments, White residents able to secure home financing in 'better' neighborhoods migrated out (often taking employment opportunities and political will with them), and African American, Latinx, and immigrant communities were left behind to face urban decline and/or removed to make way for highway-driven urban 'renewal'. Suburbanization – and with it the promise of big-box retail, garden centers, and home gardens – was, thus, a highly inequitable phenomenon (Nicolaides and Wiese, 2017).

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The rise of large commercial nurseries is also associated with the development of specific technologies. Though mass manufacture of plate glass made glasshouses more accessible in the early 1900s, mono-cultivated, temperature-dependent plant crops were highly susceptible to infestation– the humid and warm conditions critical to growing tropical plants in North America were equally enticing for insects and plant pathogens, such as powdery mildew and brown spot. Early attempts at pest management involved "inorganic poisons such as arsenic, lead, sulfur, and copper" (Pauly, 2007: 238-9). By the 1930s, scientists under fire for encouraging poison applications to food crops turned instead to organochemicals such as DDT, an insecticide originally developed by the military. These were cheaper, more effective, and less toxic that arsenicals and gained popularity tackling "suburban nuisances as the Japanese beetled and the gypsy moth" (ibid.). Organochemical herbicides offered the same, short-term miracles for 'weed' controls. Hormonal weedkillers, such as 2,4-D and 2,4,5-T, "were developed rapidly and secretly during World War II…acted selectively, decomposed rapidly" and claimed "minimal acute effects on animals" (ibid.). A mixture of the two later became known as 'Agent Orange,' an herbicide applied liberally as chemical warfare during the Vietnam War and, since 1969, known to cause both tumors and birth defects (ibid.).

Figure 6. Advertisement for DDT-based Insecticide
(Source: Lear, n.d.)

Synthetic fertilizer has an equally political history. Developed from the same Haber-Bosch technologies used to manufacture explosives during World War I, synthetic fertilizers affected radical change in agricultural production – and consumer expectations (Louchheim, 2014). Since the 1920s, Haber-Bosch derived nitrogen has been applied readily and extensively to overcome nutrient limitations in soils (Leigh, 2004). This has been the case overall in agriculture, but especially in container nurseries where plants depend on a limited, container-bound supply of soil and nutrients for their entire lifecycle. Prevailing fertilization protocols – often touted by land grant agriculture programs and funded by large chemical producers – promote frequent application with an emphasis on rate of coverage, with little care for literal and figurative downstream impacts on the environment (Monrovia Nursery Company – B, *Interview.* February 10, 2022). Nitrates are highly soluble and, therefore, mobile. Unabsorbed and/or excess amounts wash freely out of soils with irrigation runoff, often altering the chemical compositions of nearby water bodies to the point of contamination (Biello, 2022; Leigh, 2004). Non-discriminatory pesticides are also used extensively in large commercial nurseries and cause equal, if not greater damage, frequently wiping out whole communities of native beneficial pollinators and predator communities alongside targeted crop 'pests,' such as aphids or spider mites (Grozinger and Fleischer, 2016; Stokstad, 2021; Monrovia Nursery Company – B, *Interview.* February 10, 2022). Container-based cultivation techniques emerged in the 1960s and, to this day, depend heavily on fertilizers, herbicides, and pesticides to grow and sell plants entirely in containers (themselves a leading contributor to plastic waste).

Though post-war cultivation technologies accelerated nursery stock production and expanded the range of

Figure 7. Pioneers in container cultivation techniques
(Source: Monrovia Nursery Company)

plants available to consumers, their environmental impacts were considerable. Published in 1962, Rachel Carson's *Silent Spring* sparked widespread outcry over the documented – and through her book, publicized – environmental impacts of manufactured chemicals, such as DDT. Carson's book and Senate testimony led to national debate on the use of chemical pesticides, and ensuing legislation, such as the establishment of the Environmental Protection Agency (EPA) in 1970, a domestic DDT production ban in 1972, and the Clean Water Act in 1972 (Griswold, 2012). They also catalyzed a grassroots movement and public environmental consciousness about human activity impacts and responsibilities towards the environment (Lear, n.d). A renewed interest in native ecologies has since led to environmental restoration efforts and, to meet this new demand, a rise in dedicated native plant nurseries, "a hard and unforgiving business" that is, nevertheless, increasing in importance and prominence (Handel, 2017).

Since the 1980s, a burgeoning environmental justice movement has given rise to new types of plant nursery. Non-profit and social enterprise nurseries are emerging under the umbrella of 'mission-driven' nurseries. Diverse in form, size, and impact, nurseries such as the Theodore Payne Foundation, Oxbow Farm and Conservation Center, Planting Justice, and Trees Pittsburgh work hard to remedy some of the impacts of this modern history of plant nurseries. Though this work is vast and some constraints seemingly insurmountable, each of these nurseries add to our understanding of how plants can be grown for means other than profit. Isolated commercial examples, such as Monrovia Nursery Company, are adapting cultivation methods to explore what forms of sustainability are possible within this business model. The work of each is, like that of social justice more broadly, in progress. This research uses qualitative analysis and projective design to facilitate their efforts and collectively re-imagine plant nurseries as a vector for social and spatial justice.

Figure 8. In Store Plant-Finder Tool
(Source: Monrovia Nursery Company)

2.2 RESEARCH QUESTIONS + SCOPE

This background provides historical and theoretical context for understanding the role of contemporary plant nurseries in social and spatial justice. Our research begins this endeavor through in-depth case study analysis of four plant nurseries that vary in business model, scale, and mission: Monrovia Nursery Company, Oxbow Farm and Conservation Center, Citywide Horticulture, and Ploughshares Nursery. As Chapter 2 outlines, a case study methodology directed purposive sampling and in-depth analysis of each plant nursery in-context. An adaptive mixed method program of survey, semi-structured interview, and site observations yielded a wealth of qualitative, quantitative, and visual data, which we analyzed using thematic analysis and narrative analysis. A lifecycle lens served as a means for analysis and synthesis throughout this process: for each nursery, we followed a 'target plant' through each stage of cultivation. These plants were self-identified by nurseries or co-determined during interview conversations, and their transformation through the nursery site and organization provided insight into nursery operations, goals, and initiatives overall.

This research is exploratory in intent and foundational application. With topics as complex as 'justice' and a timeline as short as nine months, we do not attempt comprehensive or conclusive overview of plant nurseries and social justice. Rather, we document our inquiry as evidence that social justice can manifest in the process and outcomes of research and so that this investigation may facilitate continued conversations between plant nurseries and landscape designers. An adaptive mixed- method program of surveys, semi-structured interviews, and site observations helped refine a preliminary evaluative criteria into three research questions:

1. How do plant nurseries operate?
2. What influences how plant nurseries operate?
3. How do plant nurseries influence social and spatial justice?

We analyzed resultant qualitative, quantitative, and visual data using thematic analysis and narrative analysis. A lifecycle lens served as a means for analysis and synthesis throughout this process: for each nursery, we followed a 'target plant' through each stage of cultivation. These plants were self-identified by nurseries or co-determined during interview conversations, and their transformation provided insight into nursery operations, goals, and initiatives overall.

Game Design emerged as a potential research and communication tool during case study sampling. As outlined in Chapter 2, a playing card exercise intended to facilitate case study sampling inspired us to synthesize research findings as a plant nursery game. Chapter 3 explains how games facilitate projective and interactive design. Games are a form of simulation or modeling. They allow designers to test relationships between phenomena, such as climate change and plant production, by manipulating identified variables in a controlled environment. Games also foster empathy and dialogue by asking players to make decisions as characters in a scenario: by defining mechanisms for interaction, games allow players to experience different types of environments and relationships. Chapter 3 summarizes findings from case study analysis of six tabletop games: *Monopoly, The Game of Life, Carcassonne, Wingspan, Century: Spice Road, and Space Cats Fight Fascism*. These analyses helped us identify the components of tabletop games and explore how different component combinations

Figure 9. Janelle Patterson unwraps a recent order of bare root plants at her nursery, Wildflowers NW

structure player interactions in each game.

Chapter 4 advances both nursery and game case study analysis through synthesis. Combined and collaborative analysis of plant nurseries as games led to development of a plant nursery-to-game design guide. This guide articulates the component typology developed through game analysis and provides a broader framework for adapting different aspects of plant nursery case studies into games. Designer intent and perspective are critical variables in this adaptation process: they will influence, for example, if nursery employees are interpreted as actors, with agency and power to shape processes, or resources, that still facilitate production but exercise little control over their application or outcome. Games, thus, both reflect and affect collective thought, formalizing designer values and goals in how scenarios and games are set up and fostering value enactment in how they are played.

Figure 10. A Monrovia Nursery Company craftswoman prepares juniper cuttings for planting.

We tested this dialectic in action by hosting a collaborative design session at GGN towards the end of our research project, and present plant nursery games designed during and after this session. As concluded in Chapter 5, game design guide and examples are, together, an invitation to charrette, to speculate how plant nurseries and landscape design might work together to advance social and spatial justice.

3. PLANT NURSERY CASE STUDIES

3.1 INTRODUCTION

"One of the underlying themes related to social justice inquiry is that the world is capable of being changed; that change can come from any direction, and especially from the bottom up…Such a paradigm means that we are all capable of—and therefore responsible for—changing the world."

(Johnson and Parry, 2015: 2)

Johnson and Parry (ibid.) remind us that social justice is both a shared responsibility and one that can—and must—manifest in both the process and outcomes of inquiry. This spirit drove early and frequent considerations of methodology and methods in our research. This section articulates how we centered social justice throughout our research *process*, from the development of deductive criteria based on precedent study review, to iterative research question refinement and qualitative data analysis. After reviewing research processes, we look in-depth at four nursery case studies, articulating how we applied research methods and reviewed resultant findings about plant lifecycles, operational influences, and social and spatial justice initiatives at each nursery.

3.2 CASE STUDY: METHODOLOGY + METHOD

Case studies are a widely misunderstood and overused tool. In some respect, most qualitative inquiries qualify as case studies because they are in-depth studies framed by a defined unit of analysis, be it an individual, a social group, or an event (Lashua, 2015: 141). As Lashua (ibid.) points out, however, "topics only become case studies when considered within wider analytical frames that address… how or why something happens." Our research employed case study as a research strategy for in-depth analysis of plant lifecycles in context. This methodology allowed us to treat each plant nursery in our study as a discrete unit, valued for what it can tell us about itself and for possible logical inferences about the world of commercial plant production, rather than sample representativeness or statistical inferences (Blaikie, 2010; Lashua, 2015; Yin, 1989).

Case studies are "multi-faceted investigations" (Deming and Swaffield, 2011: 80). As such, they are well suited to the analysis of both landscape – itself an aggregate of people, social and biophysical relationships, and physical features—and social justice inquiry (ibid., Lashua, 2015). Social justice inquiry's epistemological interests in "emotions, personal relationships, an ethic of care, political praxis, and multivocality to purposefully reveal inequities in all facets of society" find ample expression in case study research's thick descriptions, multimodal investigation, and approach to theory generation (Johnson and Parry, 2015: 13). Case study research makes no attempt to reduce the complexity of context and few claims to generalizability. As summarized by Stake (1995: xi), "specifics, particulars, and minutiae matter."

A case study research strategy enabled us to focus on thick descriptions of context: how and why do nurseries grow plants the way that they do? Where do or could these processes overlap with efforts around social and spatial justice? Focusing on detail in-context helped us understand the role of plant nurseries within industry and local environments heavily influenced by social, economic, and political factors (Stake, 2005: 444 in Lashua, 2015). It also emphasized plant nursery employees' experiential knowledge of these dynamics (ibid). Prioritizing specifics, however, also has implications for theory development. If every plant nursery is considered unique and inextricable from context, what can it tell us about other nurseries, or the broader nursery and greenhouse industry?

…our goal was to build a more comprehensive understanding of the relationship between plant nurseries and social justice and to use this knowledge to inform praxis.

How case study research approaches theory generation "reflects interwoven concerns of 'interpretation, generalizability, and transferability'" (Lashua, 2015: 154). Some proponents argue that generalizability is possible while others contend that theory generation is at odds with in-depth qualitative study because it inherently reduces details into patterns. Our research resolved these tensions by returning to our exploratory objective: our goal was to build a more comprehensive understanding of the relationship between plant nurseries and social justice and to use this knowledge to inform praxis. In this light, it was more important to understand the diversity of relationships at work in contemporary plant production than to define which was most important or significant.

3.2.1 EVALUATIVE CRITERIA

In keeping with an exploratory case study methodology, we developed and refined research questions throughout our investigation. We began with precedent study of 16 plant nurseries sampled broadly through review of material lifecycles literature, nursery industry reports, and historical studies of the horticulture industry in the United States. These included, for example: the U.S. Forest Services' Nursery in Coeur D'Alene, Idaho; the Memorial Tree Nursery established specifically to grow trees for the 9/11 Memorial; Everde Growers, a large-scale, multi-state commercial grower; and the Theodore Payne Foundation, a non-profit nursery and leader in the California native plants movement. Precedent studies elucidated dimensions of justice in the context of plant cultivation. These include, environmental impact, plant knowledges, public imaginaries, and labor practices, among others.

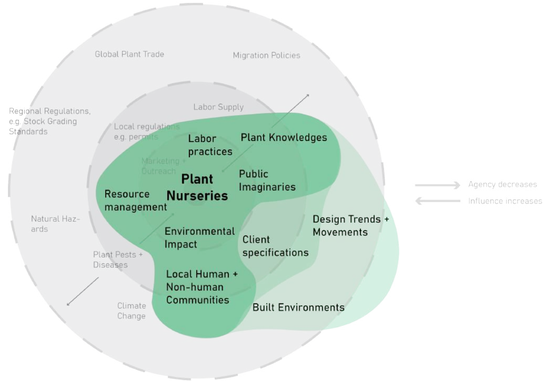

Figure 11. Evaluative Criteria developed by overlaying nursery agency with dimensions of justice

Precedent studies revealed many ways to categorize plant nurseries for further study: business model, physical size, production volumes, industry influence, plant type, and client or project type. Whole research projects could be dedicated to definitively categorizing plant nurseries to develop a nursery typology, a rough aggregate of physical size, production volume, and influence within the industry).

To select nurseries for further study, we created playing cards inspired by Jane Wolff's The Delta Primer (2003). As shown in Figure 12, this format made it much easier to visualize the diversity of our precedent study sample. We used these playing cards to purposefully sub-sample five plant nurseries for further, in-depth study, selecting for diversity in business model and size, and cross-referencing for geographic proximity to reduce costs of travel. This sample evolved during study recruitment and subsequent data collection and analysis phases. This evolution was also a purposeful application of case study methodology to the research process.

Figure 12. Plant nursery precedents adapted into playing cards for case study selection

3.2.2 RESEARCH QUESTIONS + DATA COLLECTION

A case study research strategy operationalizes its emphasis on context by adjusting research method to the particularities of each case: cases should be studied with whichever methods are deemed appropriate based on their characteristics and the "issues that circumscribe [them]" (Lashua, 2015: 148). Lashua (2015: 152) advises that "data collection… generate evidence that allows a researcher to 'paint' as complete as possible a picture to illustrate how and why the case operates or happens." Overall, we conducted plant nursery case studies using a mixed-method program of:

1. Structured interview (later, **survey**) focused on quantifiable and comparable information about nursery operations and programs, e.g. area under cultivation, number of plant species, years in business;

2. **Site visit** led by a nursery employee and during which we documented site observations and a 'target' plant's lifecycle using photography, site mapping, and field notes; and

3. **Semi-structured interview(s)** focusing on nursery evolution over time and programs or initiatives specific to each case.

We began each site visit by reiterating the scope and objectives of our research and obtaining free, prior, and informed consent from participants (See Appendix X). We invited participants to self-direct our site tour and to specify which of the above methods they were comfortable with and had capacity to participate in. Resultant data collection methods and/or analysis, thus, reflected nursery participant preference and researcher interpretation of which methods would best 'illustrate' each nursery and its contextual influences.

We analyzed preliminary findings from plant nursery site visits and used it to refine our evaluative criteria (Figure 11). We further elaborated this criteria into three research questions to guide analysis of spatial, quantitative, and qualitative data:

HOW DO PLANT NURSERIES OPERATE?

WHAT INFLUENCES HOW PLANT NURSERIES OPERATE?

HOW DO PLANT NURSERIES INFLUENCE SOCIAL AND SPATIAL JUSTICE?

HOW CAN THESE FINDINGS INFLUENCE LANDSCAPE ARCHITECTURE PRACTICE?

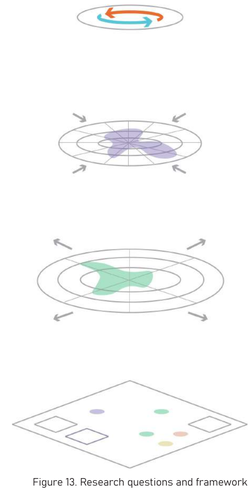

Figure 13. Research questions and framework

As shown in Figure 13, these questions vary in scope and in where they position each plant nursery in relation to its context.

3.2.3 DATA ANALYSIS

These questions were analyzed using:

1. **Lifecycle diagramming** to elucidate material flows, processes, spatial correlations, and social relationships at work in the lifecycle of a 'target plant' co-identified as representative of a plant nursery;

2. Open and axial **thematic coding** to categorize and compare participant reflections on nursery operations based on code instances (See Figures 14-15); and

3. Open and axial **narrative coding** to facilitate translation of plant nursery characteristics, dynamics, and stories into tabletop game components (See Section 5.2).

We adjusted these analysis methods to reflect the nuances of each case study. Some comparisons, for example, yielded little new information about plant lifecycles or how cultivation practices could advance social or spatial justice. We cataloged these for future and/or alternative studies, and focused our in-depth analysis on lessons, dynamics, and insights that expanded our understanding of how plant nurseries grow plants.

The remainder of this section presents four nursery case studies illustrating how different plant nurseries operate, what influences plant nursery operations, and how each nursery advances social and spatial justice. Each section articulates how our case study methodology was applied to each case by adapting data collection and analysis methods in response to plant nursery preferences and characteristics.

We then outlined the unique conditions, forces, and relationships at play in each plant nursery. Understanding plant cultivation practices in-context sheds light on plant nurseries as spaces of material and human transformations, as agents in a competitive industry, and as potential co-conspirators in the pursuit of justice.

Figure 14. Influences on nursery operations: code descriptions and examples

Figure 15. Nursery influences on social and spatial justice: code descriptions and examples

INFLUENCES ON NURSERIES

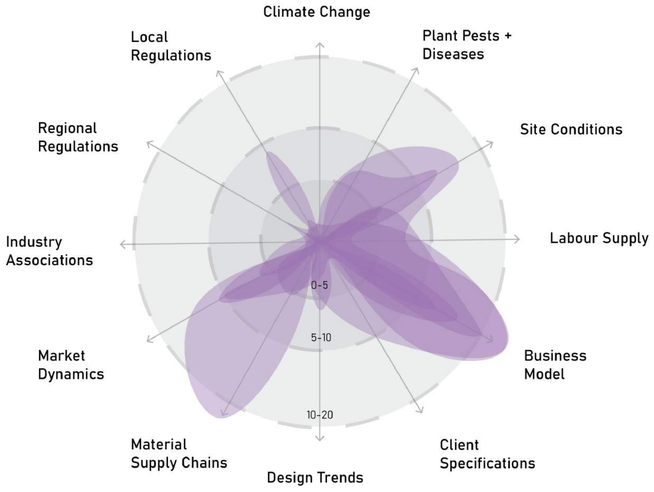

Figure 16. Influences on nursery operations: summary of results

Figure 17. Influences on nursery operations: results by nursery

Figure 18. Nursery influences on social and spatial justice: summary of results

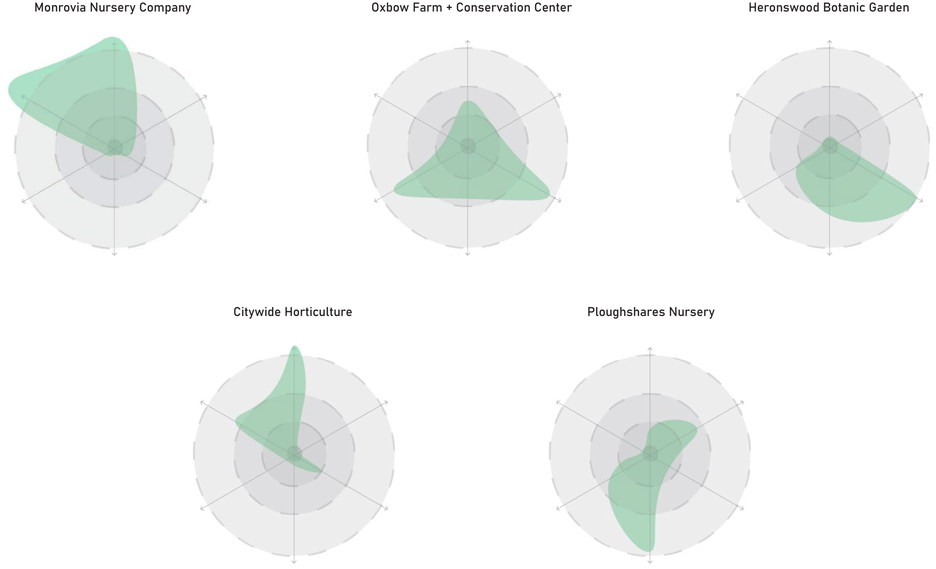

Figure 19. Nursery influences on social and spatial justice: results by nursery

3.3.1 MONROVIA NURSERY COMPANY

Background

The Monrovia Nursery Company (MNC) is a large-scale ornamental plant grower whose high-quality plants, detailed plant labels, and trademark green containers feature in retail nurseries across the United States. It was established in 1926 by Danish immigrant, Henry E. Rosedale Jr., in Azusa, CA. In 1941, MNC was one of the first U.S. growers to trademark a plant, and in the 1950s established an in-house R&D program to develop custom soil mixes for plants in cultivation. It became an early pioneer in container culture techniques in the 1960s and has, since then, become a role model for container nurseries across North America and Europe (Ghiggi, 2010: 132). MNC maintains a strong tradition of research and innovation today, continuing to develop new plant cultivars as well as more sustainable growing techniques. They have four major growing locations: Visalia, CA; Dayton, OR; Cairo, GA; and Granby, CT. Monrovia 'craftsmen' cultivate 4000 different plant species, including a Dan Hinckley collection of plants from around the world and, most recently, a 'High Impact Houseplant' Collection *(Monrovia – Legacy; Monrovia introduces high-impact houseplant collection*).

Methods

Monrovia Nursery Company (MNC) is the largest nursery included within our study sample – the physical size, production volume, diversity of plant species, and number of employees at their Dayton, OR, location alone dwarfs other nurseries within our sample (See Appendix X). They are also a purely commercial grower, though they do make efforts to improve how sustainably they grow and sell plants. We selected them to understand more about how contemporary large-scale growers operate and to provide comparison to the missions and business models of other nurseries in our sample. Of their four locations, we invited Dayton, OR, to participate in our study, both for their geographic proximity to Seattle and because this location maintains an established program of site tours for 'horticultural guests.'

MNC-Dayton was the first nursery visited and interviewed in our study. I conducted a full-day tour of their 550-acre facility, during which I interviewed a Regional Sales Coach, documented extensive site observations through photography and fieldnotes, met craftsmen and coaches working in multiple propagation areas, and interviewed a Plant Protection Manager. At this stage, my strategy was to conduct a structured interview during the site tour, and to dedicate semi-structured interview questions and conversations to where and when we were able to sit down in a quiet and dedicated space with a nursery employee. In practice, conducting a structured interview while also making site observations and participating in a tour proved unwieldy—even though audio recordings made it easier to record and later transcribe participant responses, my attention was consistently divided. I adjusted data collection strategy in subsequent site visits.

Cultures and Conifers: The Advantages of Scale

The Monrovia Nursery Company established their Dayton, OR, facility in 1984. Located on former agricultural land in the Willamette Valley, this location includes a 3-acre demonstration garden, extensive landscape plantings along perimeters, and multiple irrigation-runoff retention ponds. The facility is dedicated to "conifers, maples, broadleaf shrubs, and other cold-hardy plants" and is the company hub for tissue-culture – MNC is one of few growers in the U.S. who have established their own tissue culture labs and produces tissue cultured material for 75-100 species at this location (ibid.).

Tissue culture is a specialized propagation method that involves growing plant tissue in sterile conditions. It is a significant cost investment, but facilitates production of plants that are otherwise difficult to cultivate at scale, e.g. plants with variegations, plants who would otherwise reproduce too slowly in the Pacific Northwest, or plants who hybridize too easily when pollinated naturally, such as hellebores. Tissue culture emerged as a propagation technique in the 1980s and gained considerable popularity among commercial growers due to its reliability and speed compared to traditional methods (Heronswood Botanic Garden-A, *Interview.* Mar 3, 2022). Most commercial growers source tissue cultured material or plugs grown from this material from third-party tissue culture labs who specialize in 2-3 plant species (Monrovia Nursery Company – A, *Interview.* February 10, 2022). Establishing their own facilities allows MNC to grow its current diversity, volume, and consistency of specimen plants, but at the cost of genetic diversity: horticultural applications of tissue culture produce hundreds of genetically identical clones from a single plant sample. Seed or other reproductively grown plants are genetically unique from their parents and thus more varied in physiology—and function.

Though significant in volume and plant species, tissue culture is not the propagation method that this MNC – Dayton or MNC overall are known for. Participants felt that grafted conifers were more representative of MNC's expertise and production abilities. During the site tour, we were able to follow and document Colorado Spruce 'Iseli Fastigiate' plants through their lifecycle at MNC. As shown in the lifecycle diagram in Figure 20.

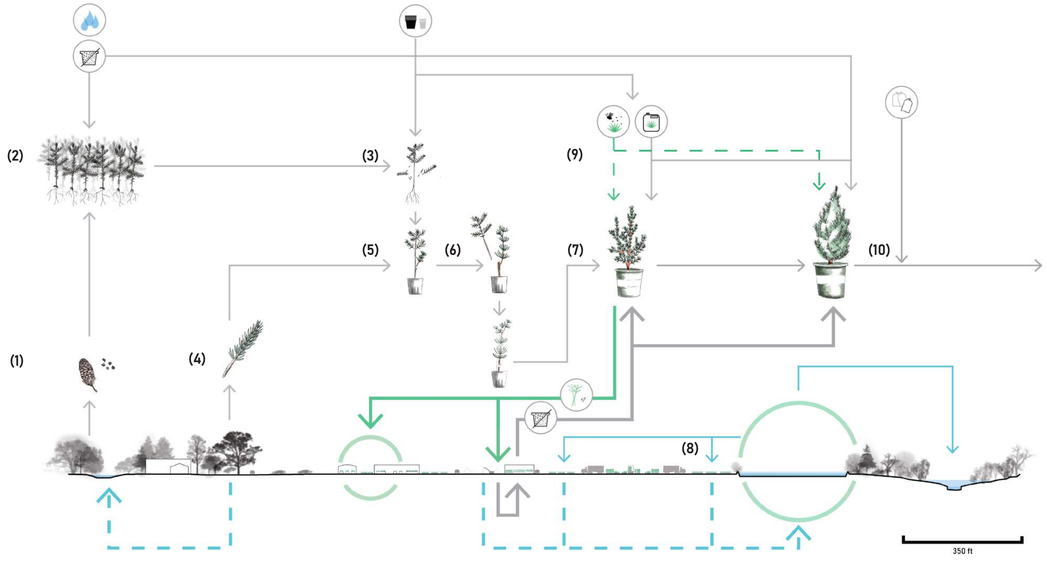

Figure 20: Grafted Conifer lifecycle at Monrovia Nursery Company

(1) Craftsmen on the Landscape Maintenance team collect Norway Spruce cones from trees in MNC-Dayton's botanic garden.

(2) Propagation teams process the cones for seed and sow them in open air pumice beds – pumice is sourced from local quarries and used as a growing media throughout a plant's lifecycle, but especially at this stage.

(3) Once the seedlings are sufficiently mature, propagation craftsmen will bare-root the plants and trim off side branches and needles to prepare it for grafting. Norway Spruce is used as root stock for 14 different grafted conifer species at MNC.

(4) MNC craftsmen harvest 'Iseli Fastigiate' cuttings from mature trees in their botanic garden and landscape plantings.

(5) Trained grafters will turn cuttings into scions and insert them into a grove cut into the base of the root stock. The graft will be bound with special tape, and the grafted conifer protected in a dedicated growing area for the next 6-7 months.

(6) In May/June, once the grafted conifer is showing signs of fresh growth, the grafting team will cut back the root stock to the graft point and train the scion upright. The tree will continue growing in quart-sized containers for 6-12 months.

(7) Craftsmen in the 'canning station' pot up straight and dense 'Iseli Fastigiate' trees into gallon containers using a custom soil mix containing mulch and compost from on-site programs mixed with pumice, nutrients, and other growing media. These will be arranged 'can-tight' in the gravel bed 'fields' and maintained mechanically until they fill out.

(8) MNC sells 'Iseli Fastigiate' trees in 5- and 10-gallon sizes. Craftsmen assigned to the conifer area space-out maturing trees by hand. This allows space for regular plant scouting, irrigation and air-flow, and individual pruning (again by machine, but customized to desired plant form and shape.

(9) Plant protection teams will apply beneficial insects and herbicides as needed during 5-10 year lifecycle of 5- and 10-gallon 'Iseli Fastigiate' trees. They only apply pesticides as a rescue, but are more likely to use chemical controls on '*de venta*,' or 'saleable,' plants in order to prevent pest or pathogen spread off-site.

(10) MNC plant labels detail plant needs and characteristics—and indicate possible trademarks. Shipping teams attach labels to plants before they are shipped to retail partners.

(Monrovia Nursery Company – A, *Interview,* February 10, 2022; Monrovia Nursery Company – B, *Interview,* February 10, 2022; *Field Notes and Photographs,* February 10, 2022)

550 Acres of Site Conditions, Decades of Market Experience

As the complexity of flow arrows in Figure 20 shows, MNC has excelled at building efficiencies into material flows throughout the plant production process. These flows are directly related to the physical site of the nursery and associated features or qualities: Blue arrows indicate irrigation and stormwater runoff draining into ornamental water features or dedicated water retention basins before being re-used for irrigation. Trimmings left over from regular pruning activities are collected in pruning machines. Craftsmen process viable material into cuttings for propagation and direct unviable material to onsite mulch and compost programs. Figure 21 supports the spatial correlation that we see here: MNC reported site conditions have a greater influence on nursery operations compared to other nurseries in our case study sample. Context is both a facilitator and an 'interrupter': the temperate Pacific Northwest Climate enabled MNC to become a significant conifer and broadleaf shrub grower. Local agricultural context has, however, also limited cultivation of specific plants: one of their immediate neighbors is a large hazelnut orchard. Blight on these trees often spread to MNC's Cordyalis and Hamamelis species. Eventually, container growing these plants 'clean' (i.e. without extensive chemical use and without pest or pathogen infestations) became so difficult that MNC ceased growing them altogether (Monrovia Nursery Company – A, *Interview.* February 10, 2022).

As shown in Figure Y, MNC also reported 'market dynamics' as a larger influence on nursery operations than at other nurseries (See Figure 19). This reflects their comparative size and market experience as well as strategic decisions. Namely, unlike other nurseries in our sample, MNC no longer grows plants based on speculation. Since the 2008 recession (and resultant crop and human downsizing), MNC determines plant species and growing targets based on market research, feedback from sales representatives, and growing capacity assessments from production teams (ibid.). This has improved their ability to respond to market trends. Retail nurseries and garden centers are MNC's primary channel. They have made some efforts to reach landscape and contractor customers through re-wholesale, but this is a smaller and less predictable revenue stream than longstanding retail distribution partnerships. As reported by one participant,

"a lot of our sales reps have their customers tell them, 'you tell me what I should be charging for this'...that's opening the door not just to my inventory, but also to, 'Do I survive? Can I employ more people? Can I pay my people? These people that I like but are seasonal, can I find a way to keep them year-round?'"

(Monrovia Nursery Company – A, *Interview.* February 10, 2022)

With almost 100 years of experience as a wholesale grower, MNC understands their reputation as a more sustainable ornamental grower allows them to set higher price points: "that's a choice between a green pot with our name on it and a black pot. If it's the same Winter Gem Boxwood, you start thinking, 'what went into this? Why am I going to buy this? What sort of controls went into this?'" (Ibid.). Higher price points allow MNC to exercise more agency over how they produce plants. This is a strategic decision that, as described below, has both positive and negative impacts on their role in advancing social and spatial justice.

Is resource management enough?

As shown in Figure X, 'mitigating environmental impact' and 'sustainable resource management' feature disproportionately in Monrovia Nursery Company's (MNC) reflections on impact. These codes are closely related so, for the purposes of our study, we differentiated them based on area of focus. We coded internally-focused measures as 'sustainable resource management,' such as MNC's investment in pot sterilization chambers to facilitate plastic container re-use on-site. We coded externally focused measures as 'mitigating environmental

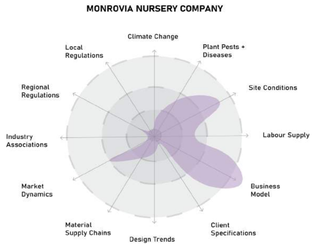

Figure 21. Monrovia Nursery Company: Influences on Operations

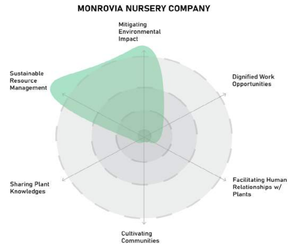

Figure 22. Monrovia Nursery Company: Influences on Justice

ANALYSIS SUMMARY: MONROVIA NURSERY COMPANY	
TARGET PLANT GRAFTED COLORADO SPRUCE 'ISELI FASTIGIATE'	
MAJOR INFLUENCES ON OPERATIONS BUSINESS MODEL SITE CONDITIONS MARKET DYNAMICS	S + SJ INITIATIVES MITIGATING ENVIRONMENTAL IMPACT SUSTAINABLE RESOURCE MANAGEMENT

Figure 23. Monrovia Nursery Company: Analysis Summary

impact.' MNC, for example, also uses higher-grade plastic for the branded containers used to ship and sell plants. These pots are less likely to break down in transit or with exposure to the elements at a customer nursery and can be recycled in municipal programs. These measures are intended to reduce plastic waste beyond the nursery site (ibid.).

Plant Protection is another area where MNC has improved environmental impact and resource management. In addition to recycling 95% of irrigation water, MNC has been steadily shifting to biological pest management since piloting a predatory mite program in the 2000s. This strategy required 'a paradigm shift' in how the nursery approached pest infestations: plants are scouted regularly by a dedicated team, but pest and predator sightings now inform management of 'population dynamics'. Chemical control programs emphasize frequency of application and coverage, often applying more pesticide to a crop than necessary and killing insects indiscriminately. As an interview participant explained,

"We used to scout for the aphid and spray and then it got worse. So we started paying attention and realized that there's a parasitoid. The aphid is not that fast of a reproducer anyway, the only time it ever got out of control was if we sprayed it. So we stopped spraying and started paying attention to the parasitoids, and as long as the parasitoids were there we leave it alone and see what happens. That one controls itself. We don't release anything, we don't spray, we just leave it alone. It will take care of itself."

(Monrovia Nursery Company –B, *Interview.* February 10, 2022)

Shifting to biological pest controls has direct and indirect benefits: MNC has been able to phase out most restricted-use pesticides and significantly reduce overall pesticide applications. This has reduced the amount of chemicals in irrigation runoff and local water bodies – a local EPA water-quality monitoring site has had zero complaints in years of testing (Monrovia Nursery Company – A, *Interview.* February 10, 2022). Agricultural neighbors also benefit: the beneficials program monitors native predator populations. They also inoculate plants early and regularly, allowing predators to find the prey; predator balance that they need and excess to predators to migrate away to surrounding areas. MNC – Dayton's success with this program is encouraging other facilities to adopt similar initiatives. A beneficial insects program is an overall gain for local ecologies, but MNC warns that entry-costs are high and that not all beneficial insects sources are created equal. Most smaller or dedicated insectaries rely on brokers to manage sales, but some have been acquired by chemical companies as part of vertical integration strategies. These companies then recommend to 'spray our chemicals and then apply beneficials,' which "just doesn't make sense" (Monrovia Nursery Company – B, *Interview.* February 10, 2022).

MNC's initiatives to improve environmental sustainability are considerable. Some of these have indirect positive impacts on other dimensions of social and spatial justice. For example, reducing restricted-use pesticide application also reduces craftsman exposure to harmful chemicals. This could be considered part of creating a more 'Dignified Workplace.' Overall, however, MNC's initiatives skew towards environmental impacts at the cost of addressing economic, political, social, and cultural dimensions of justice. Their demonstration garden and education/outreach efforts focus on horticultural trades and less on sharing plants or plant knowledges in ways that are accessible for the public. Tissue culture and plant cultivar development programs also detract from otherwise positive contributions to environmental impact or plant knowledge sharing. Plant trademarks heavily restrict distribution of plant material and knowledge: if trademark plants have been clearly labeled, individuals can be held liable for even unintentional plant reproduction, e.g. if a composted plant or cane roots and multiplies. Nurseries can also charge royalties for trademarked plants, so these become more expensive and cannot be obtained outside of sale or commercial transactions (Fulcher et. al, n.d).

The Monrovia Nursery Company's case study reminds us of the advantages of scale and the costs and benefits of producing plants as commodities: strategies that yield the greatest return on revenue often restrict accessibility or further distribution, yet higher and more consistent revenues also support investments in better growing practices. It is worth investigating both employee experiences and opportunities as craftsmen and to what extent the Monrovia Nursery Company–Dayton influences plant cultivation practice at other facilities and across the industry. Are MNC's initiatives in environmental sustainability enough to offset reductions in plant genetic diversity through tissue culture, and resultant homogenization of nursery plants—and landscapes?

3.3.2 OXBOW FARM + CONSERVATION CENTER

Background

Oxbow Farm and Conservation Center (OFCC) is a non-profit organization located on 240 acres of Coast Salish land in the Snoqualmie Valley (*About Oxbow Farm and Conservation Center*). It gets its name from an adjacent oxbow lake and was founded in 2008 by the Alberg family, who owned the property and are prominent venture capitalists and philanthropists in the Greater Seattle Area. The organization's portfolio of programs reflects its threefold mission: promote sustainable food systems, build resilient, biodiverse ecosystems, and educate and inspire people to care about "food, farming, and the environment" (ibid.). The Alberg family started a Native Plant Nursery at OFCC to support their son's interest in plant cultivation and on the recommendation of a faculty member at the University of Idaho who specialized in native plant nurseries (Oxbow Farm and Conservation Center – A, *Interview.* March 25, 2022). The Native Plant Nursery started operations in 2013 and quickly secured a contract to grow 70,000 plants for the Burke Museum project. Since the culmination of this project in 2020, they continue to work closely with GGN and are expanding their client base and distribution mechanisms to include small retail nurseries, restoration projects in the Snoqualmie Valley, and local farmers markets (Ibid). OFCC has worked with the Snoqualmie Tribe in the past and are eager to explore continued partnership opportunities.

Methods

Oxbow Farm and Conservation Center (OFCC) was an immediate candidate for case study analysis. GGN works closely with the organization and in multiple capacities: they source native plants for landscape projects and provide consultation for OFCC projects. Shannon Nichol, a founding partner at GGN, is a longtime supporter of the Native Plant Nursery's (NPN) work and serves on OFCC's Board of Directors.

These connections lent nuance to conversations with OFCC staff and discussions about the relationships between landscape architecture firms and plant nurseries.

OFCC was one of the last nurseries visited and interviewed for this research. By this stage, I had adjusted data collection methods in notable ways. In place of a structured interview, I offered OFCC

Figure 24. *Field Notes + Site Observations.* March 25, 2022)

the opportunity to complete a pre-site visit survey. This helped situate on-site data collection and provided easily and immediately documented points of comparison across nurseries, e.g. acres under cover. On the day of the site visit, I conducted a semi-structured interview with a nursery manager and a programs director. The conversation included considerable discussion about the organizations' history and evolving mission. The nursery manager then guided a short tour of the NPN. During this time, we were able to discuss plant lifecycles in more depth. Following the interview and tour, I continued observing and documenting the nursery spaces independently using photography and field notes. I completed data collection by annotating an aerial image of OFCC with findings and reflections from the visit (See Figure 24).

Huckleberries: Evergreen Demand for Native Plant Plugs

Oxbow Farm and Conservation Center (OFCC) identified Huckleberries as representative of their nursery and mission. It is one of their most popular plants across customer types. They grow four different varieties, including red and evergreen huckleberries, both of which are consistently in demand by restoration practitioners, local retail nurseries, landscape architects, and home gardeners. The OFCC participant explained that huckleberry demand is a function of interest and growing time: a 1-gallon huckleberry plant takes three years to produce. An evergreen huckleberry's lifecycle at NPN is as follows,

(1) NPN staff collect ripe huckleberries from stock plants at the nursery, restored riparian forest areas at OFCC, or during seed collection hikes in the surrounding areas. They process berries to remove pulp-y material and leave them to dry.

(2) Staff and manager sow prepared seeds in deep, growing flats and cover them with a muslin to protect from birds and maintain a humid environment around germinating seeds. Germinated seedlings will grow, uncovered, in nursery flats for up to one year.

(3) Staff prick out separate and transplant into individual cone-tainers by hand. Cone-tainers are deep root training devices commonly used to grow tree saplings in forestry.

(4) After 1 year of growth, staff will pull huckleberry plants from their cone-tainers and saran-wrap them in groups of ten. Most huckleberry plants are sold as plugs. Cone-tainers are then cleaned and re-used.

(5) Staff will pot up a smaller portion of the huckleberry crop into 1-gallon containers. These require an additional year to reach maturity, but are a more popular size among landscape trades and retail customers. These plants will either fulfill a landscape contract or be sold at OFCC's farmstand.

(Oxbow Farm and Conservation Center, *Interview.* March 25, 2022; *Field Observations and Photographs.* March 25, 2022).

Managerial Turnover and Contract Conundra

As shown in Figure 25, Oxbow Farm and Conservation Center (OFCC) reported business model, labor supply, and client specifications as major influences on nursery operations. Their Business Model is consistent with other nurseries in our sample, while labor supply and client specifications are more unique to OFCC. The 'Labor Supply' code categorizes responses related to permanent, seasonal, and volunteer labor. Unlike other non-profit nurseries in our sample and other programs at the organization, OFCC's Native Plant Nursery (NPN) does not have an active volunteer program. Nevertheless, both organization and nursery program experienced significant turnover during the COVID-19 pandemic. The Assistant Nursery Manager stepped into an Interim Manager position, but their own position is yet to be backfilled. Without this capacity, the program has been unable to continue or upgrade their inventory system, develop internship or long-term volunteer opportunities, or continue running their educational workshop series. Both organization and nursery have also experienced challenges with recruitment: applications for seasonal, entry-level, and managerial level positions have declined steeply since the COVID-19 pandemic. Participants guessed that this reflected the rising costs of living in the Greater Seattle Area and shared that the organization is working to establish recruitment channels with local colleges and institutions to mitigate low application numbers (ibid.).

As shown in Figure 25, client specifications were a greater determinant of nursery operations at OFCC than at other nurseries in our sample. This is unsurprising given that 95% of their plants are grown on contract. However, qualitative analysis of these codes shed light on important considerations for mission-driven production nurseries. Namely, not all contracts are created equal. A nursery's experience of a grow contract depends heavily on the client experience and expectations. "Some contracts are super easy...Others need more 'hand-holding' or just aren't aware of the timing of native plant production or when they need to be contacting you in relation to when they will need the plants" (ibid.). Depending on the contract specifications and timeline, NPN may source plugs or liners from other wholesale growers and 'grow them on [to a bigger size]' instead of growing plants from seeds, spores, or tubers – for specific and slow-growing plants, such as ferns, NPN cannot afford to give up nursery space for as long as

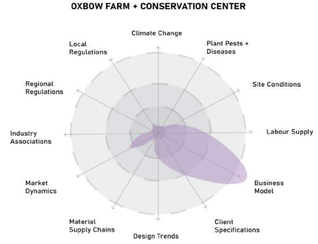

Figure 25. Oxbow Farm and Conservation Center: Influences on Operations

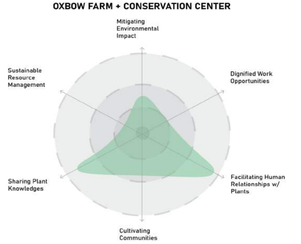

Figure 26. Oxbow Farm and Conservation Center: Influences on Justice

ANALYSIS SUMMARY: OXBOW FARM + CONSERVATION CENTER	
TARGET PLANT SEED-GROWN EVERGREEN HUCKLEBERRY PLUG	
MAJOR INFLUENCES ON OPERATIONS BUSINESS MODEL CLIENT SPECIFICATIONS LABOR SUPPLY	S + SJ INITIATIVES MITIGATING ENVIRONMENTAL IMPACT FACILITATING HUMAN RELATIONSHIPS W/ PLANTS SHARING PLANT KNWOLEDGES

Figure 27. Oxbow Farm and Conservation Center: Analysis Summary

capacity to grow 70,000 plants a year – this is both a significant capacity in the context of a small, non-profit nursery, and a trivial amount compared to the average production nursery volumes. Typical landscape and restoration contracts specify plant quantities in the hundreds and thousands. Native plants are much slower to reach saleable sizes, and so NPN experiences a strong need to balance contracts against the time it will take to fulfill them. As a non-profit nursery, they are less dependent on revenue generated from plant sales and so can also ask important questions about whether contracts align with their mission or values.

Reconciling Influence with Initiative

As shown in Figure 26, Oxbow Farm and Conservation Center's (OFCC) has three areas of impact: Mitigating Impact on Environment, Facilitating Human Relationships with Plants, and Sharing Plant Knowledges. Each of these areas correspond directly with a program (Conservation, Education, and Native Plant Nursery) and are addressed through different aspects of how the Native Plant Nursery works. As explained by an interview participant,

"A lot of it is so subtle...without even putting it into our processes, we're optimizing for plant health and wellbeing, and environmental health and well-being in everything that we do. There's more opportunity to do that, but I suspect that that is driving a whole bunch of different relationships than we're even conscious of."

(Oxbow Farm and Conservation Center, *Interview.* March 25, 2022)

it will take to grow them (ibid.). Nevertheless, leadership changes have prompted the organization to review priorities and how they put them into action: they are currently working on a five-year strategy document and putting careful consideration into how these commitments are operationalized across OFCC (Oxbow Farm and Conservation Center, *Interview.* March 25, 2022).

Nursery capacity and customer base, for example, are prompting important conversations about how plant production can align with OFCC's broader mission of inspiring a native plant movement. Restoration practitioners are an ideal market for native plants, but, for the most part, already inspired. GGN has encouraged landscape contracts as an avenue for engaging more "people who are ripe to be converted to the native plant movement and healthy food systems", but this has had its own challenges:

> ***"If we grow 10,000 plants for a landscape project, then that's 1/7 of our capacity that's taken up by plants destined for a private residential customer where they'll be seen by few people."***
>
> (Oxbow Farm and Conservation Center, *Interview.* March 25, 2022).

More landscape contracts of this type, for example, could take up nursery capacity for years but do less to promote the organization's mission of inspiring and educating. OFCC is testing who they can reach through retail channels: NPN sold roughly 5000 plants last year at OFCC's newly opened farmstand and will soon start growing plants to be sold at a local retail nursery. Both landscape contracts and retail expand OFCC's market reach beyond restoration practitioners and have the potential to also support the mission of building public awareness about native plants and environments. The devil will be in details and implementation (ibid.).

OFCC's conversations about contract types and outreach strategies, however, also reflect an important piece of context: they can afford to choose which contracts they accept because, as part of a larger and well-funded non-profit organization, the Native Plant Nursery (NPN) program is not as dependent on plant sales for revenue (ibid.). Supported by the elusive combination of non-profit status and healthy finances, OFCC can afford to have conversations when compared to smaller, less connected, and less resourced non-profit organizations. The NPN has been incredibly influential in promoting a native plant movement in the Greater Seattle Area. This has overall benefits in terms of reviving an ecological consciousness about native ecologies but, taken in-context, also raises questions about who native plants are grown by and for. Who does OFCC use their privilege and influence to reach, engage, and/or elevate?

OFCC's partnership(s) with the Snoqualmie Tribe is an important—and evolving—dimension of their work. The partnership was initiated by former NPN manager, Bridget McNassar, but largely operationalized through OFCC's conservation and restoration work in the Snoqualmie Valley (ibid). Chief Andres 'Andy' Juan de los Angeles, then Chairman of the Snoqualmie Tribe, blessed the plants destined for the Burke Museum, but NPN acknowledges there has been little tribal involvement or consultation with their program beyond this (ibid.). The Tribe experienced significant transitions during the COVID-19 pandemic: Chief Andy passed away in January 2021 and many public and tribal gatherings were suspended due to social-distancing requirements (*Remembering Chief Andres 'Andy' Juan de los Angeles).* OFCC continues to engage and elevate the Snoqualmie Tribe in short term opportunities, such as an upcoming school lecture on fire ecology, but is also keen to centralize outreach efforts to mitigate possible burdens on the Tribe (Oxbow Farm and Conservation Center, *Interview.* March 25, 2022). This is an area worth exploring for future partnerships, practice, and research, but one that must importantly be undertaken with tribal leadership at the helm.

3.3.3 CITYWIDE HORTICULTURE

Background

Citywide Horticulture is a municipal nursery owned and operated by the City of Seattle's Parks and Recreation Department (SPR). The in-house horticulture program has evolved considerably in space and scope over time as the department's organization and responsibilities have shifted. The Horticulture program was established around the Olmsted Bros. 1903-9 Park Plans for Seattle (*Horticulture – Parks; Friends of Seattle's Olmsted Parks*). The plan laid out an extensive system of municipally-owned and operated public park facilities. Implementation of the plan was swift though erratic, and likely included or at least catalyzed provisions for a municipal horticulture program to facilitate procurement of plants in park-scale quantities and to specifications – a recurring pattern across the U.S. at the time (See Section 2.1). At its heyday, the SPR horticulture program maintained nurseries and holding sites across the City of Seattle (Citywide Horticulture – A, *Interview.* March 15, 2022; Green Seattle Partnership – A, *Interview*, March 17, 2022). Overtime and with the pressures of recession and rising labor and material costs, sites such as Woodland Park Zoo, Volunteer Park Conservatory, and Atlantic City Nursery were phased out of parks management. Production activities centralized to Jefferson Park and—once acquired—Kubota Gardens (ibid). Citywide Horticulture (CH) is a production facility operating out of Jefferson Park. They grow "100,000-120,000 annuals and perennials, plus an additional 75,000 woody natives and ornamentals every year" for city parks, citywide landscaping, and Green Seattle Partnership – a public-private partnership that restores and manages urban forests (*Horticulture – Parks).*

Methods

This history of municipal and federal nurseries in the United States most closely reflects the co-evolution of modern plant nurseries and the planning profession. Both types of nurseries grew rapidly in response to Progressive era-city improvement schemes and New Deal era. Both also experienced decline, closure, or reorganization in the mid-late 20th Century as political sentiments shifted away from public funded open-space improvements and towards efficient management of shrinking resources. We included a nursery of this type in our sample deliberately to understand how those that have survived continue to grow plants for public use and projects. Nurseries considered for study included Citywide Horticulture, the U.S. Forest Service Nursery in Coeur D'Alene, Idaho, and the Department of Natural Resources' Webster Forest Nursery in

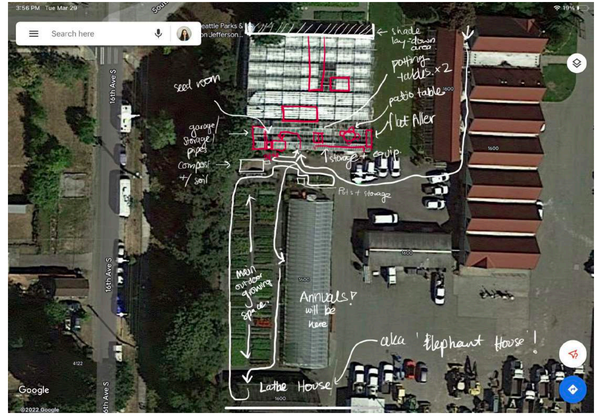

Figure 28. *Field Notes + Site Observations.* March 15, 2022)

Thurston County, WA. We selected Citywide Horticulture anticipating that insights from this case study might inform how landscape architecture firms engage with both municipal nurseries and urban park projects.

Citywide Horticulture (CH) was one of the later case studies conducted for this study. I conducted a semi-structured interview and site tour with a head gardener before independently documenting the site using photographs and field observations annotated on an aerial image (See Figure 28). They were unable to complete the pre-site visit survey due to capacity constraints but offered responses to many of its questions during our semi-structured interview. I also interviewed a Plant Ecologist working for the Seattle Parks and Recreation Department and Green Seattle Partnership (GSP). They are an important 'client' for CH and, unlike standard SPR park programs, create opportunities for Seattle residents to get involved in restoration and maintenance of forested areas, such as Discovery Park, Seward Park, and the Cheasty Boulevard and Greenspace. This interview shed light on how some of the plants grown at CH are used and how they are distributed around the City.

Liner to 1-gallon 'finishers'

Citywide Horticulture and Green Seattle Partnership (GSP) are part of a connected, though not exclusive, plant lifecycle. Both identified the Western Sword Fern as a plant that represented their work and mission: Western Sword Ferns are native to the Pacific Northwest and popular among Seattle Parks' department (SPR) gardeners and restoration practitioners for their adaptability. How CH grows Western Sword Ferns reflects their enduring utility and strengths as a program. I was able to document the lifecycle of sword ferns through CH and GSP during site visits. Though CH historically grew sword ferns from spores, this method was too slow for the volume of plants requested. Plants are now grown as follows:

(1) GSP works with professional maintenance teams and volunteer forest stewards to compile a list of plants required for ongoing restoration activities. This list always includes a large quantity of Western Sword Ferns. Plant requests are sent to CH, who use them to determine sourcing requirements and growing targets for the year.

(2) CH sources required Western Sword Ferns 'liners' from native plant nurseries in WA and OR. 'Liners' is the horticultural term for perennial plant plugs.

(3) CH receives liners and pots them up into 4" or band pots using 'Heronswood Mix' soil – a proprietary soil mix developed by Heronswood Nursery and Botanic Garden and sold only by Specialty Soils.

(4) This size of Sword Ferns grows in CH greenhouses for up to 6 months (depending on time of year) before gardeners shift it outdoors to be hardened off in the 'field'.

(5) CH will send some sword ferns to GSP more quickly and at a smaller size. They will pot up the majority of ferns into 1-gallon containers and grow them for an additional year. GSP uses both 4" and 1-gal sword ferns in urban restoration and forest stewardship projects across Seattle.

(Citywide Horticulture – A, *Interview,* March 15, 2022; Green Seattle Partnership – A, *Interview,* March 17, 2022)

Spores and Supply Chains

Citywide Horticulture's (CH) reflections on nursery operations and growing practices show the widest range of influences out of all the nurseries in this study. As shown in Figure 29, their responses indicated their practices are influenced by material supply chains, local regulations, business model, market dynamics, site conditions, and plant pests and diseases. Business model appears less of an influence for CH than other case study nurseries and local regulations more, but, in CH's case, these two influences may be understood as two sides of the same coin. In other nurseries, the local regulations code reflected the impact of municipal regulations. Business model and municipal regulations are one and the same for CH.

Material supply chains and market dynamics are dominant influences at CH. This is closely connected to an overall lower influence of the business model and reflects how much pressure public programs experience to remain 'profitable.' Though the City of Seattle's budget is healthier than most major U.S. cities, individual programs still face regular (and, depending on the administration, unforgiving) scrutiny. Citywide Horticulture is no different and has experienced significant and recent reductions in scope. Ornamental and annual plants used to be grown at the Volunteer Park Conservatory before this space was given over the Friends of the Conservatory group (Citywide Horticulture – A, *Interview.* March 15, 2022). CH used to start native plant seedlings before moving them south to Atlantic City Nursery to reach maturity alongside ornamental tree and shrub stock (ibid.). Atlantic City Nursery was closed in 2010, and the space was renamed Rainier Beach Urban Farm and Wetlands and leased out to Seattle Tilth (Zimmerley, et. al. 2010; Rainier Beach Action Coalition). The City outsourced ornamental

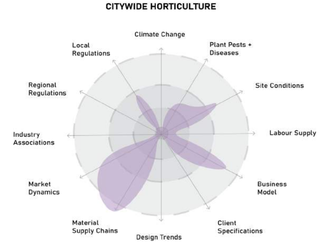

Figure 29: Citywide Horticulture: Influences on Operations

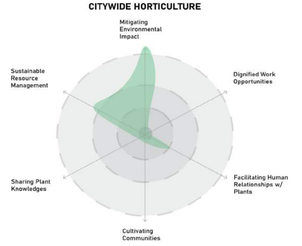

Figure 30: Citywide Horticulture: Influences on Justice

ANALYSIS SUMMARY: CITYWIDE HORTICULTURE	
TARGET PLANT WESTERN SWORD FERN GROWN FROM LINER	
MAJOR INFLUENCES ON OPERATIONS MATERIAL SUPPLY CHAINS MARKET DYNAMICS LOCAL REGULATIONS	S + SJ INITIATIVES MITIGATING ENVIRONMENTAL IMPACT SUSTAINABLE RESOURCE MANAGEMENT FACILITATING HUMAN RELATIONSHIPS W/ PLANTS

Figure 31: Citywide Horticulture: Analysis Summary

tree and shrub production entirely, and moved the remaining native plant program to CH at Jefferson Park (Citywide Horticulture – A, *Interview.* March 15, 2022). Similar closures and centralization took place across the nursery and greenhouse industry in the wake of the 2008 recessions. In the context of CH, an interview participant reflected candidly that the City's decision is hard to argue with: ornamental trees and shrubs took 3-10 years to produce for city-use. Their growing spaces ended up functioning more like 'holding facilities' for plants, and ultimately, the plants "just don't pay for themselves" in an urban context (ibid.). With real estate and housing costs continuing to increase faster than minimum wage, the City is under increasing pressure to cut back on any such program.

The CH - Jefferson Park facility came under similar review but they were able to demonstrate that they grow enough plants under cost to justify continuing operations. Their model is simple: CH either sows plants from seed or sources them as plugs or liners from local wholesale growers. CH then has the infrastructure, space, and expertise needed to grow these plants until they reach the sizes requested by SPR gardeners and ecologists. Using this model, CH can produce a 4" marigold plant for $0.25-$0.35. The same plant would cost $1.50-$1.75 at a retail nursery, and these margins add up quickly when multiplied by the volume of plants required for annual parks and public areas maintenance. CH might lose money producing a 2-year old Spruce Tree from bare-root, but these losses balance out when considered alongside considerable savings on perennial and annual production and in the context of urban biodiversity (ibid.).

Indeed, CH gardeners caution against a reliance on numbers: "Physical numbers don't mean anything" (ibid.). CH considers their 'bottom line,' but they also

grow smaller crops and are willing to trial more growing methods than commercial growers. This is especially true for native plants, which are much less predictable and more difficult to grow in production settings: a sundew plant, for example, has found its' calling in CH's greenhouse and helps control shorefly outbreaks from germinating wapato seeds (*Field Observations and Photographs*. March 15, 2022). CH is also collaborating with Green Seattle Partnership (GSP) to investigate and mitigate Sword Fern die-off in Seward Park. A GSP volunteer collected spores from remaining healthy ferns and brought them to CH, where CH gardeners have propagated and grown them from spores to 1-gallon plants. This was a very slow and labor-intensive process, but after years of careful cultivation, CH and GSP are now returning the first 1-gallon 'Lazarus' ferns to Seward Park (*Planting out the Lazarus Fern Babies)*. The programs' hope these ferns inherited those genetic traits that allowed parent ferns to resist the die-off, and will help the overall fern population recover (Citywide Horticulture – A, *Interview.* March 15, 2022.). CH is, thus, both a cost-effective program and an increasingly essential one as Seattle's parks and forested areas experience increasing pressure from urbanization and climate change (ibid.).

Plants for the Public Good

As indicated in interview responses and demonstrated in Figure 30, Citywide Horticulture (CH) takes its role as a public program seriously. Their responses skew as strongly towards mitigating environmental impact and sustainable resource management as Monrovia Nursery Company, but also indicate additional efforts to facilitate human relationships with plants.

CH produces close to 200,000 plants for Seattle's Parks and Recreation (SPR) department every year. SPR also sources plants directly from wholesale growers, but for certain types of plants, Citywide Horticulture has the resources and expertise to grow them below cost. This allows SPR and the Green Seattle Partnership (GSP) to create and maintain more biodiverse public landscapes that they would have been able to if they depended on commercial growers alone. Many of the annual and perennial plants grown at CH are 'low-hanging fruit,' i.e., easy to grow or grow on at scale and under budget in existing greenhouses and growing spaces. Savings here allow CH – and through them, SPR—to grow what they can't otherwise source from local wholesale nurseries. In many cases, these are native plants and/or plants at specifications not available on the market. SPR gardeners have been increasingly requesting 2-year old Western Red Cedar trees because these survive better during almost-annual heat waves. CH has been able to source these as bare-root plants and grow them to required age and sizes (ibid.).

CH supplies plants to each of the Park regions free-of-cost (but within budget) and to GSP at-cost. In practice, park and GSP's plant requests are analogous to plant contracts: they specify quantities and varieties of plants for CH to grow and/or source for them. However, since these contracts recur annually and within SPR, CH is able to close material loops: SPR and GSP staff collect and return all plastic pots to CH for re-use, diverting this waste stream from municipal recycling facilities/landfills. This both significantly reduces the amount of pots that must be purchased each year and reduces the amount of plastic waste generated by this program overall (ibid.).

CH is a largely internal-facing program. Plants grown here are largely transferred to other Park staff or programs to plant in public spaces. CH, however, does maintain some opportunities to directly connect local communities with plants: gardeners at the adjacent Beacon Hill Food Forest, for example, are allotted greenhouse space where they can sow vegetable starts ahead of the Spring growing season or through the Winter. This year, gardeners have space, but CH is unable to offer growing containers because of an industry-wide shortage. Modest public tour and volunteer programs were also put on hold during the COVID-19 pandemic and are waiting to resume (ibid.).

Overall, CH's case reminds us of the need to protect municipal horticulture programs against inevitable pressure to cut costs. If production facilities are retained, municipal nurseries can grow plants more efficiently and responsibly than commercial growers, and they can grow plants that just need to be grown. Cost-savings from annual and perennial plant programs allow CH to trial and conserve plant communities and spaces that are already under pressure from urbanization and climate change. The 'Lazarus ferns' are incontrovertible proof of the need to retain municipal nurseries as both a public resource and as an important partner in the restoration of urban biodiversity.

3.3.4 PLOUGHSHARES NURSERY

Background

The Alameda Point Collaborative (APC) is a supportive housing community located in the former Naval Air Station in Alameda, CA. In 1994, a group of local non-profit organizations and public agencies jointly petitioned for this land to be made available for individuals experiencing homelessness. In 1999, they were awarded a 59-year lease to manage 34 acres of land including housing units, program buildings, warehouses, and open space. Alameda Point Collaborative "co-exists with two partner agencies" to provide over 500 residents stable housing, job and life skills training, and mental health counseling. They are the only supportive housing community in the United States that does not have a maximum length of stay. Since 2008, APC has been working steadily to implement more sustainable strategies across their programs, including, for example, improving housing stock, much of which had not been updated since Base closure (*About Us; FAQs; Annual Report*; Ploughshares Nursery – B, *Interview.* March 30, 2022).

APC operates three social enterprises: an urban farm and CSA program, a commercial kitchen, and a plant nursery. Each provides on-the-job training opportunities for APC residents and revenue for APC, in addition to other benefits and services. Ploughshares Nursery is "a staple in the Alameda community" (Ploughshares Nursery – A, *Interview.* February 17, 2022). Their volunteer programs are attended by corporate, school, and community groups from the Bay Area. Before the COVID-19 pandemic they hosted regular educational workshops and boasted a steady and loyal customer base among home gardeners on the Island. Both educational and volunteer programs were put on hold during the COVID-19 pandemic, though the nursery was able to maintain retail operations. A new nursery manager joined the Ploughshares team earlier this year and is leading efforts to re-vitalize both nursery spaces and programs (ibid.).

Methods

Social Enterprise is one of the most intriguing business models for a nursery. We were eager to include one such nursery in our study because of how different this production and business models are from the 'typical' commercial nursery. Some social enterprise nurseries have retail operations, but not all. Some have permanent titles for their land, others operate on multi-year leases. All of those reviewed in this study include job training programs and recognize that horticultural employment can help trainees practice life skills and benefit from therapeutic benefits of working with plants (See Figure 15 for additional examples). Social enterprise nurseries must balance "the social and the enterprise," i.e. grow plants for sale in exacting and competitive markets and provide safe learning and healing environments for program participants (Ploughshares Nursery – B, *Interview.* March 30, 2022). We selected Ploughshares Nursery (PN) for further case study based on its geographic proximity to both Seattle and its program participants; of the nurseries reviewed in our study, PN is the only one located on the same site as the community it supports and employs.

Ploughshares Nursery was one of the earlier site visits conducted in our study. I conducted a semi-structured interview with a nursery manager while touring the nursery spaces and observing customers browsing and shopping for plants. This interview was long as we had combined structured and semi-structured interview questions into a single guide to simplify site tour and documentation procedures. After some time, both the nursery manager and I noticed shared interview fatigue. We decided to shorten our conversation to leave time to document site observations. We addressed remaining questions over email and in a second interview with a senior manager at the Alameda Point Collaborative (APC). This second interview shed light on APC's origins and how PN has evolved over time.

Plant Relations

Ploughshares Nursery's (PN) priorities are 'sharing knowledge about plants and encouraging people to grow plants in an environmentally responsible way' (Ploughshares Nursery - A, *Interview.* February, 17, 2022). Their plant availability, programs, and spaces reflect this: as shown in Figure X, a large area of the nursery is dedicated to community gathering space. After discussing how and where this focus on community and knowledge-sharing influences plant production, the nursery manager and I collectively determined that a passionfruit vine grown from a cutting gifted by a community member would best represent the nursery's mission and work. Community and local nurseries often gift plants, seeds, or growing materials. Plants at various and new stages of this lifecycle were visible around the nursery, even though plant production activity had slowed overall during the manager transition and resultant shifts in programs.

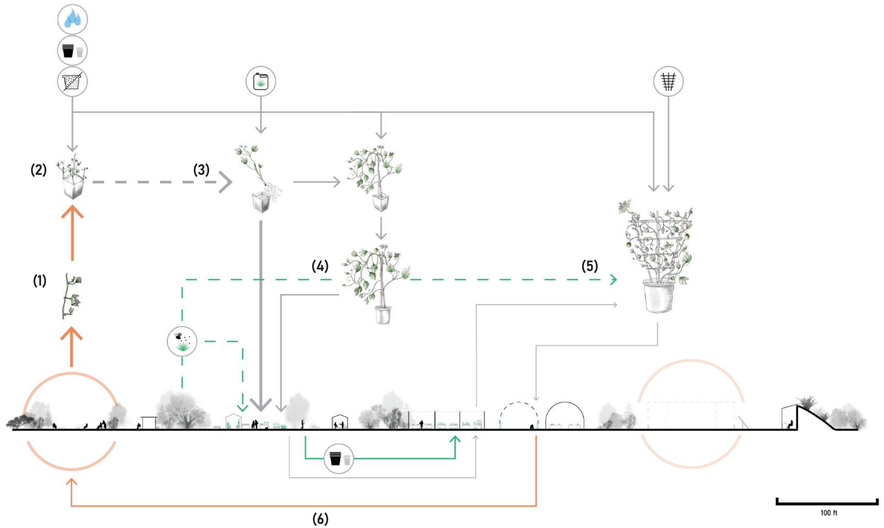

Figure 32. Gifted Passionflower cutting lifecycle at Ploughshares Nursery

The lifecycle shown in Figure 32 is as follows,

(1) Community members who frequent nursery events and/or workshops donate passionflower cuttings from their home.

(2) PN staff plant the cuttings into quart containers filled with pumice. Staff and on-the-job training (OJT) participants care for these cuttings in the growing space, making sure they are adequately watered and drained to promote root development. Cuttings will root and develop fresh growth depending on the time of year.

(3) OJT trainees and nursery staff transplant successful cuttings into individual 4" containers. Plants will remain in the growing area until they have rooted into these containers.

(4) Most passionfruit vines are sold in 4" containers. Any that do not sell and/or outgrow their pots will be transferred back to the growing area and transplanted into 1-gallon. containers and sold at a higher (though still lower than market) price in the retail area.

(5) Plants continue to mature in the retail areas. Extra mature and healthy individuals will be grown on as stock plants and living shade for other growing plants.

(6) Community members, volunteers, OJT trainees, and staff can harvest passion fruit from mature vines. Harvests are shared with neighboring organizations and APC residents – and have been tested for possible PFC contaminants from past naval base activities.

(Ploughshares Nursery – A, *Interview.* February 17, 2022; Ploughshares Nursery – B, *Interview.* March 30, 2022; *Field Observations and Photographs*, February 17, 2022)

'The Social and the Enterprise'

Ploughshares Nursery's (PN) responses indicated that business model, labor supply, and site conditions strongly influence nursery operations, as shown in Figure 33. Though these also strongly influence Monrovia Nursery Company (MNC) and Oxbow Farm and Conservation Center (OFCC), qualitative comparison of each nursery's responses reveals stark differences in context. Business Model, for instance, is both a facilitator and a limitation for PN: like OFCC, PN experiences less pressure to survive based on plant sales alone. Federal job-training grants are one of PN's most significant funding streams and serve a dual function of closing budget gaps at the nursery and supporting the Alameda Point Collaborative (APC) more broadly. Most of this funding is 'restricted', i.e. disbursed with specific requirements for how, where, and when it can be spent. By maintaining an active job-training program at PN, APC converts these restricted funds into unrestricted funds that then can support a wider array of programs, many of which have fewer funding options, such as stable housing with on-site counselors and no maximum length of stay (Ploughshares Nursery – B, *Interview.* March 30, 2022).

Business model becomes a limiting influence in terms of labor: PN only has capacity to employ three staff members. As a result, they rely heavily on volunteers to help implement larger projects, such as constructing equipment and clearing overgrown areas for community use. On-the-job trainees (OJT) were a small component of PN's overall team, but a large part of their identity. Both volunteer and OJT programs ground to a halt during the COVID-19 pandemic, impacting PN's ability to keep up with larger maintenance and expansion efforts (Ploughshares Nursery – A, *Interview.* February 17, 2022). A planned, permitted, and financed built structure intended to house indoor retail and workshop spaces stands half-completed, neither freeing up space for alternate uses nor serving its promised functions as "the 'greenest' building in the Bay Area" (*About Us; Field Observations and Photographs.* February 17, 2022). Though volunteers are a flexible type of labor and can help implement many different tasks, their attendance and participation is also variable. As a result, PN must schedule larger work around when volunteer groups are available, rather than when the nursery needs it done (Ploughshares Nursery – A, *Interview.* February 17, 2022).

Material supply chains are a lesser though immediate influence on PN's operations. In comparison to MNC, PN responds more nimbly to supply chain issues: these more often raise the short-term costs of materials than disrupt plant production entirely. When recent industry-wide shortages made it difficult to source nursery pots from nursery suppliers, PN purchased alternatives from a local garden center. Though retail price was much more expensive than wholesale, it made sense to pay it to have vegetable starts ready in time for Spring (Ibid.). Alternative containers might have just as easily halted production at a large commercial grower, such as MNC, where automation technologies often require specific sizes and/or types of materials. Similarly, when PN was unable to source lettuce starts, a nursery employee took a seed packet off the retail shelf and sowed them (Ibid.). Compared to more mechanized or streamlined growing operations, PN, thus, enjoys greater flexibility as a small grower who frequently uses available resources creatively to meet needs.

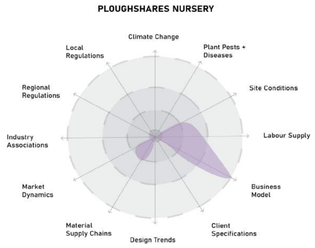

Figure 33. Ploughshares Nursery: Influences on Operations

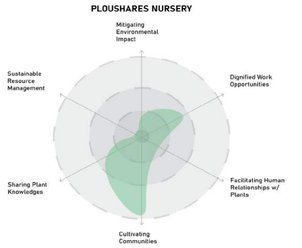

Figure 34. Ploughshares Nursery: Influences on Justice

ANALYSIS SUMMARY: PLOUGHSHARES NURSERY	
TARGET PLANT PASSION FRUIT VINE GROWN FROM GIFTED CUTTING	
MAJOR INFLUENCES ON OPERATIONS	S + SJ INITIATIVES
BUSINESS MODEL LABOR SUPPLY SITE CONDITIONS	CULTIVATING COMMUNITY DIGNIFIED WORK OPPORTUNITIES SHARING PLANT KNOWLEDGES

Figure 35. Ploughshares Nursery: Analysis Summary

Transformations in Transition

Of all the nurseries sampled, Ploughshares Nursery's (PN) spider diagram for social and spatial justice initiatives is most distinct. As shown in Figure X, PN's responses scored highly in 'Cultivating Community', 'Dignified Work Opportunities', and 'Sharing Plant Knowledges'. Their largest area of impact, 'Cultivating Communities', is visible in the spatial arrangement of the nursery and resultant relationships: as mentioned earlier, PN maintains a large area dedicated to community gathering. This is located close to the entrance of the nursery and adjacent to their retail area, providing a clear balance in how visitors can engage with site programs. Gathering and retail areas are shared with a local bird rescue and the neighboring APC Farm2Market: the latter maintains beehives at the nursery, whose residents actively pollinate nursery crops, dense native plant borders, and fruit trees planted throughout the nursery (*Field Observations and Photographs.* February 17, 2022). Though the APC farm is a younger program, PN holds that "this is where the magic happens" (ibid.). The farm operates a popular CSA program every summer, shares produce with APC residents and the APC commercial kitchen, and consistently hosts on-the-job trainees. They also share resources and strategies with PN regularly. Together, the two make serious headway in APC's mission to "change the narrative around formerly homeless individuals to one of self-sufficiency and resilience" (Ploughshares Nursery - B, *Interview.* March 30, 2022).

'Cultivating Community' is also one of the main goals driving PN's re-organization and 're-brand'. Their new manager is eager to create

"a cooperative space where all of the community hands that support the nursery can also have space to enjoy, relax, and feel welcomed in nursery space"

(Ploughshares Nursery – A, *Interview.* February 17, 2022).

Connecting volunteers and plant cultivation is part of this vision: in recent years, PN had reduced plant production in favor of sourcing and growing on and/or re-selling plants grown by wholesalers. PN staff are keen to reverse this: they'd like to grow more of their own plants from seed again and they think this could be a great strategy to revitalize both volunteer and OJT programs at Ploughshares.

Volunteers are slowly returning to PN and already contribute 150 hours a month. However, they're most frequently assigned to tasks like weeding or maintenance. Reflecting on a regular group of 14-15 students from a nearby Oakland High School, a participant noted, "they're capable of so much more" (ibid.) Involving volunteers more in plant cultivation is a synergy that could underscore efforts to build community and create more dignified work opportunities. PN staff believe creating such opportunities for youth – from both neighboring communities and APC's youth OJT cohort - will inspire them to think differently about their environments and could even catalyze careers. When asked to reflect on industry wide shortages in skilled labor, a participant responded that this is where APC sees opportunity instead of constraint: this trend underscores the need to improve the accessibility of greens jobs training and this is an area where PN aspires to help both aspiring horticulturalists and local organizations who could benefit from learning about PN's model and strategies for success.

Compared to other nurseries in our sample, PN's responses skew strongly towards the social and cultural dimensions of justice. Figure 34 shows relatively few responses related to 'Mitigating Impact on Environment' or 'Sustainable Resource Management, but this distribution merits further study of PN's growing practices. They may not have runoff retention ponds like Monrovia Nursery Company, but most of their plants are CA native and/or drought tolerant species so overall water use is likely lower than an ornamental grower of the same size. PN's seed-grown native plants might also support local ecologies more than cultivars or tissue cultures. As PN resumes volunteer and OJT programs in the coming year, there is additional opportunity to investigate both participant experiences and program 'success' rates: Does involving volunteers in seed-grown plant cultivation increase hourly contributions? How can workshops run by and for community facilitate sharing of plants and plant knowledges? Critically, can PN foster plant stewards as well as plants?

3.4 CONCLUSION

Overall, this case study of plant nurseries reveals a diversity of plant lifecycles, influences and social and spatial justice initiatives across the business models sampled in our study. We used case study as a methodology throughout the research process, focusing on thick descriptions of nursery operations in-context. This strategy highlighted unique dynamics at work within each plant nursery and allowed us to build a relatively comprehensive picture of a plant nursery's mission, programs, spaces, and practices within a relatively short time frame. These case studies contribute to an overall understanding of contemporary plant production practices and models, as shown in Figures 16 and 18. Next, we applied the same case study research strategy to tabletop games. The following section situates our work within a larger body of game design and research and presents tabletop game analyses conducted to develop our game design glossary.

4. (GAME) DESIGN AS RESEARCH

4.1 INTRODUCTION

"The construction of knowledge in a risk society demands better tools for deliberation—tools with which we imagine and debate the consequences, collective alliances, and, ultimately, the ethics…"

(Kim, 2019)

"to design deliberately, at a microscale, and to systematically analyze the possibilities and relationships thus created, is a complementary research strategy to the large-scale exploration of structural landscape possibilities and relationships."

(Deming and Swaffield, 2011: 216)

As applied research, our study involved early and frequent consideration of research outcomes. How would the results of our research be used? What types of design would this inform, and by and for who? Historical and case study research confirmed a persistent and deep divide between landscape architecture firms and plant nurseries. Practices on either side of this divide were and are implicated in spatial justice. Without understanding what it takes to cultivate thousands of plants to exacting specifications, landscape designers frequently make sourcing decisions based on immediate availability and price differences – this privileges large wholesale growers over smaller, often more subsistence-oriented nurseries. Equally, without understanding the constraints and knowledge gaps in landscape design practice, plant nurseries have little incentive to grow plants on contract when retail markets beckon. Without empathy for each other's constraints, the two industries continue to work apart. We were eager for this research study to facilitate conversations – and ideally spur partnerships – across this divide.

A case study sampling activity eventually led to adoption of game design as a research lens and communication tool for this study. As mentioned in Section 2.2, Wolff's (2003) Delta Primer inspired adaptation of nursery precedent studies into playing cards for visualization and comparison. Wolff's (ibid) cards invite readers "to combine or separate characteristics as one would assemble and reassemble playing cards in various combinations seeking a winning hand." This strategy proved very effective: by forcing ourselves to choose a five nursery 'hand' out of 16 possible options, we had to make trade-offs about which nursery types to include in our sample and which nursery would represent each type. Discussions ensued, where we debated and deliberated, for example, why one nursery would provide better insights into non-profit nursery management than another, or why it made sense to choose a municipal nursery over a federal example. By setting up an activity with mechanisms and rules, we were able to bring "seemingly incommensurate values…into a space of meaningful comparison" (Kim, 2019). In doing so, we realized important similarities in the decision-making process. Plant nurseries are powerful agents: they use strategy and expertise to navigate shifting markets and environmental conditions. They, too, make trade-offs every day, such as when to sow plants, which to 'buy-in', or whether and how many seasonal employees to hire. A game offered three-fold benefits of synthesizing the findings of our research, communicating in a manner that emphasized nurseries as agents within their contexts, and facilitating empathy, discussion, and coalition-building

A game offered three-fold benefits of synthesizing the findings of our research, communicating in a manner that emphasized nurseries as agents within their contexts, and facilitating empathy, discussion, and coalition-building.

Methods literature supported game design as research. In the context of social justice inquiry, game design provides opportunity to both describe and analyze nurseries as phenomena in-context. Like experiments or modeling, games use a simulated 'universe' to test the impacts of manipulating some variables while holding others constant. Elizabeth Hargrave's *Wingspan*, for example, invites players to test different strategies for attracting birds to habitats on their boards: outcomes are different whether players prioritize collecting food tokens, laying eggs, or collecting bonus cards (see Section 4.2.4). While experiments isolate phenomena to quantify relationships between defined variables, games model relationships between phenomena and "interactions among players, objectives, and resources" (Kim, 2019). Like case studies, they facilitate thick descriptions of phenomena, context, and relationships.

As engagement tools, games "prompt debate, acknowledge differences, and navigate their negotiation" (Kim, 2019). Games are interactive and build empathy by letting players "experience a social life under controlled conditions" (Blaikie, 2010: 194). *Monopoly*, for example, actively pits players against one another through individual player actions and a competitive scoring system (see Section 4.2.1). In contrast, *Pandemic* players must work cooperatively to mitigate the spread of disease. Game mechanisms and rules influence how players interact with each other within the universe of the game: territory-control games ask players to initiate conflict, while an emerging sub-group of games, such as *Pandemic*, *Spirit Island*, and *Co-opoly*, encourage cooperation. Either often also prompts the reverse, as evident in the proliferation of 'house rules' or alliances in competitive games and revealed through implicit biases in collaborative games. The act of playing – and designing – a game facilitates dialogue by involving players in recreation and manipulation of controlled scenarios.

Games are also projective design tools: players not only make decisions, they also play-out their consequences. In *The Game of Life*, for example, players must decide whether to attend college or night-school and then proceed through life with accordant career and income options – and liabilities such as college loans (see Section 4.2.2). In doing so, games accomplish a critical task for social justice inquiry: they acknowledge risk. In place of optimistic 'win-win' solutions games acknowledge that "there are inevitably, deliberately, and regrettably, lowers—and have always been losers" (Kim, 2019). Social and spatial justice demand recognition that vulnerable communities – and places - often bear the risks of 'innovations,' such as the Interstate Highway System or municipal street tree planting campaigns (Hutton, 2020; *Segregation by Design*). Radical change demands re-affixing risk in the public imagination and recognizing that even systemic change will affect losses: our task is to recognize this inevitability and ensure that risks and benefits are distributed in ways that remedy past injustices.

Radical change demands re-affixing risk in the public imagination and recognizing that even systemic change will affect losses: our task is to recognize this inevitability and ensure that risks and benefits are distributed in ways that remedy past injustices.

Each of the plant nursery case studies presented in Section 3.2 end with consideration of social and spatial justice initiatives in practice at each nursery and questions for further study. These are both recommendations for future research and propositions for future work. Plant nursery game(s) are an interactive and projective tool for the social and spatial justice implications of each of these propositions. To support this application, this section outlines six game case studies undertaken to create the game design glossary later presented in this study. Each case study documents game background, scenario, mechanisms, and rules, as well as providing brief reflections on game type and mechanisms adaptations to plant nurseries. We conclude by summarizing lessons learned through this game design research and re-iterating this format's potential as a research and communication tool.

4.2.1 MONOPOLY

DESIGNER/S: CHARLES DARROW

THEME: REAL ESTATE MARKETS

GAME TYPE: ROLL + MOVE

PLAYERS: 2-8

PLAYER INTERACTION: COMPETITIVE

Background

Monopoly is a real estate speculation game. This version was developed in 1933 based on an earlier game created by Elizabeth J. Magie. *The Landlord's Game* was a critique of capitalism and demonstrated how a system of rent consolidated power with one player at the cost of all others. Players could choose to play this version or an alternate which introduced a 'Single Tax' – a progressive tax charged only on land-based wealth and which proponents such as Magie believed would lead to a fairer society (*Monopoly*).

Core Game Play

Players compete to acquire and develop properties. Players roll dice and move the indicated number of spaces around a circuit on the board. They must take different actions (e.g. draw cards, buy property, or pay rent) depending on where they land on the board.

Mechanisms + Rules

(1) All players start at 'GO' and move clockwise around the board. Players collect income each time they pass go.

(2) One player volunteers as 'banker'. They are responsible for paying out incomes, collecting fees/fines/taxes, and managing property deed and building transactions.

(3) Acquiring Property: if a player lands on a unowned property, they may purchase it for the cost listed. If they do not purchase the property, it is put up for auction and any player may bid to purchase it. Bidding starts at $1.

(4) Collecting/Paying Rent: If a player lands on a property that is already owned by another player, they must pay the property owner the amount listed on the property deed.

(5) Developing Property: Once a player owns all properties in a color set, they can build houses and hotels on these spaces. Color sets and buildings both increase the amount of rent property owners are able to charge players who land on these spaces.

(6) Chance or Community Chest spaces require players draw a card from the respective piles and complete the actions indicated. These range from collecting small rewards, to paying fines or going to jail.

Game End

Players unable to keep up with rising rents must sell their properties and eventually go bankrupt. The last player remaining wins the game.

Application

Monopoly seems like an odd lens through which to protectively design more just systems of plant cultivation, but it is one of the most widely played and, therefore, legible board games available. An unflinchingly capitalist game could critique these modes of production and the social, economic, and political relations that support them. The 'modern' plant nursery (and most large-scale commercial growers) treats plants as commodities to be traded: they are only as valuable as the revenue they yield. Too often, this logic extends to how all resources are managed: people, space, water, air, soil, and knowledge. A monopolistic plant nursery game could draw attention to the risks of growing plants based on speculation. It could also help players understand the impact of plant patents, a mechanism for controlling distribution and reproduction of plants for patent-holders gain.

Monopoly offers opportunities to demonstrate inequalities inherent in extractive modes of production. Monopoly also draws attention to the role of currency: this game interprets currency literally, but designers might consider what else holds – or should hold – equivalent importance. What acts as currency in a game and how is it traded and/or exchanged?

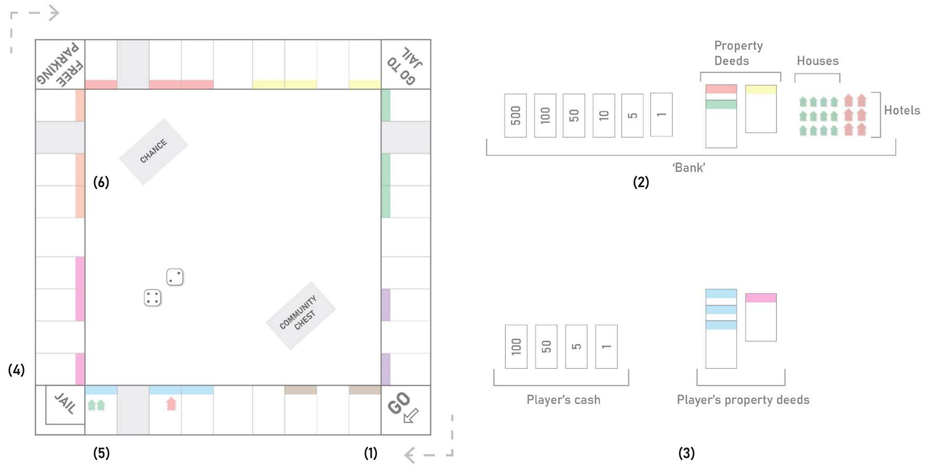

Figure 33. *Monopoly:* Mechanisms and Rules

4.2.2 THE GAME OF LIFE

DESIGNER/S: MILTON BRADLEY

THEME: LIFE STAGES

GAME TYPE: ROLL + MOVE / CAMPAIGN

PLAYERS: 2-6

PLAYER INTERACTION: COMPETITIVE

Background

Milton Bradley created the original *Checkered Game of Life* in 1860 as a moralistic parlor game. Players earned rewards by making virtuous choices throughout life. Those who pursued vices suffered consequences such as 'bankruptcy' and 'suicide.' The version commonly played today has exchanged moral lessons with more modern definitions of success, such as careers and investments.

Core Game Play

Players compete to collect the most assets as they move through 'life.' Game path follows general life stages: players must decide careers, lifestyles, and investments to pursue. Decisions made at each of these junctions impact available options throughout the rest of the game.

Mechanisms + Rules

(1) Players start the game by deciding whether to attend college. Attending college opens up more career options, but also requires taking on student loans. Players take turns using the spinner to determine how many spaces they will move along their chosen path.

(2) A volunteer 'banker' is responsible for distributing player incomes on payday, collecting investments, and administering loans.

(3) Path spaces are color-coded and associated with decks of cards. Players change careers, invest in properties or take actions depending on where they land.

(4) Stop: Players must stop on these spaces regardless of the number spun on their turn. These spaces force players to choose between possible paths and slow down fast-moving players so that everyone in the game is pursuing similar (or at least adjacent) life stages at the same time.

(5) Investments: Players use an investment card to indicate type and amount of investments made throughout the game, e.g. $30 K in a Sports Team.

(6) Loans: Players unable to pay debts or buy assets can take out bank loans in $50 K increments. These can be paid back at any time by returning the loan certificate and $60 K in cash to the bank.

Game End

Game ends when all players reach the end of 'life': retirement. Everyone calculates final asset values by adding up cash, investments, and asset values, and subtracting outstanding liabilities. The player with the most assets wins.

Application

Both original and modern iterations of *The Game of Life* are highly prescriptive. This is a useful format to play out the impacts of a defined set of options but is inflexible to user adaptation or changing contexts. Action cards and spinner maintain some level of randomness or chance within the game. In some versions of the game, players use the spinner to determine the extent of a particular action, e.g. they earn money if they spin an even number and must pay money if they spin an odd number. Stop spaces force players to choose between possible paths and slow down fast-moving players so that everyone in the game is pursuing similar (or at least adjacent) life stages at the same time. This helps equalize the effects of very high or very low number spins.

Players track progress on the board using cars: each player has a car and adds family members when they get married and if they have childre (7). Family members have few implications on game play beyond increasing expenses, but these cars are an interesting representation of capacity that could be adapted to different elements of growing plants in a nursery, e.g. collecting plants in a cart to represent species in cultivation.

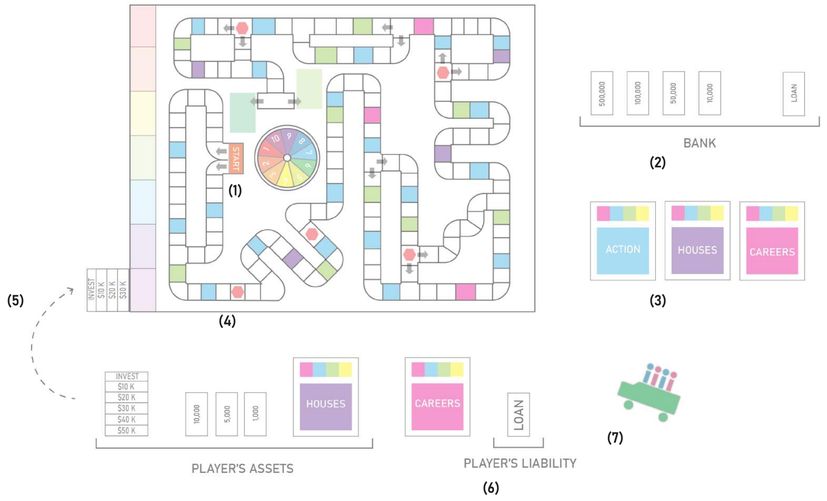

Figure 34. *The Game of Life:* Mechanisms and Rules

4.2.3 CARCASSONNE

DESIGNER/S: KLAUS-JÜRGEN WREDE

THEME: TERRITORY CONTROL

GAME TYPE: TILE PLACEMENT

PLAYERS: 2-5

PLAYER INTERACTION: COMPETITIVE

Scenario

Carcassonne is a tile placement game named after a Medieval town in Southern France. Players build out a fictitious landscape based on arrangements of roads, towns, and monasteries and must strategize where to place a limited supply of meeples on this landscape. Player opportunities develop as the map expands. Expansion packs add additional features and mechanics to the game, including additional landscape features, characters, and functions.

Core Game Play

Players take turns drawing and placing tiles to build out a landscape of roads, fields, and monasteries. Players use a limited supply of 'meeples' to claim territory and earn points for completed geographical features.

Mechanisms + Rules

(1) Tiles are set up in four piles. Players can draw from any of these piles, but must place drawn tiles around the starting tile so that landscape features are continuous, e.g. fields cannot cut off roads or towns.

(2) Turn Sequence:

a. Place tile
b. Use meeple to claim feature on placed tile.
c. Earn points for completed features.

(3) Each player has 8 meeples: 1 is used to track points on the scoreboard and 7 are used to claim features.

(4) Players encounter opportunities for active competition as they build out the town: if claimed features are later connected, the player with the most meeples in the feature will win the points.

(5) Completed features are worth the following points,

Roads = 1 pt per tile
Towns = 2 pts per tile + 2pts for any coat of arms in the town
Monastery = 9 pts – considered complete when completely surrounded by fields.

(6) Players retrieve their meeple once a feature is completed and scored.

Game End

The game ends when all tiles have been placed. Players calculate points for incomplete features and add these to their total score. The player with the highest score wins.

Application

Carcassonne diverges significantly from 'traditional' board games by eliminating both dice and board. Player outcomes are much less based on chance and much more on strategy. For example, players must balance when to place meeples and when to conserve this limited resource for use elsewhere. Though players cannot choose which tiles they draw, they can place them to their advantage—and an opponent's disadvantage. *Carcassonne* players compete actively to claim features and passively to accumulate the most points.

Tile placement is a simple though effective mechanism: it allows for infinite variability and introduces the added element of adjacencies. Space and resource management are important element of nursery operations and site design. Tile placement could be adapted to represent progressive development of a nursery or activation of growing beds for seasonal crops. Rules governing tile placement and a limited supply of meeples constrain possible game play options and force players to make trade-offs between different courses of action. This encourages strategic game play and reflects real-world challenges of finite resources.

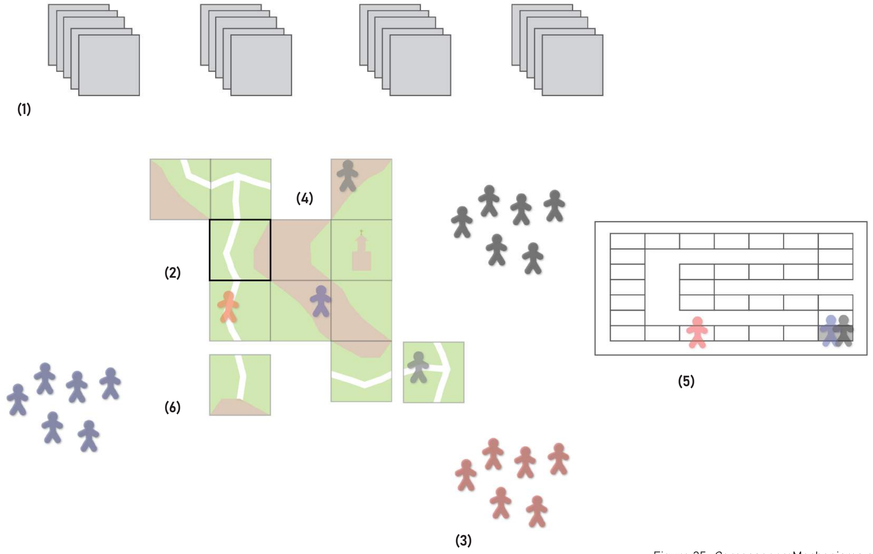

Figure 35. *Carcassonne:* Mechanisms and Rules

4.2.4 WINGSPAN

DESIGNER/S: ELIZABETH HARGRAVE

THEME:BIRDING

GAME TYPE: ENGINE-BUILDER

PLAYERS: 1-5

PLAYER INTERACTION: PASSIVE COMPETITION

Scenario

Players are bird enthusiasts whose objective is to attract the most diverse and beautiful birds to their habitats. Designer Elizabeth Hargrave was inspired by charts that she made to track bird observations at Lake Artemesia, MD. The game has received widespread acclaim for its accurate representations of bird ecologies.

Core Game Play

Each turn, players may choose between 4 actions:

a. playing a bird
b. collecting food tokens
c. laying eggs
d. drawing bird cards for future play.

Mechanisms + Rules

(1) Game is played in four progressively shorter rounds. Rounds provide intermediate 'goals', e.g. # of birds in forest habitat.

(2) Players use set of eight cubes to track actions, end-of-round results, and how many turns are left in a round.

(3) A 'first play' token is passed to a different player each round. This helps equalize potential dis/advantages of being the first player to take actions.

(4) Player boards are divided into 3 habitats: forest, prairie, and wetland. Each habitat is associated with a different action, e.g. laying eggs.

(5) Bird cards list,

a. Common and scientific names
b. Habitat requirements
c. Food token cost to play
d. Nest type + egg capacity
e. Bird powers

Bird powers are unique abilities that multiple through rounds of play and/or in combination with other birds.

(6) Bonus cards enable players to accumulate additional points at the end of the game. They are based on different bird-related jobs, e.g. biologist or photographer

Game End

Points are calculated and compared at the end of rounds. Players earn points for birds played, bonus cards, eggs, end of round goals, and card-related functions, e.g. birds of prey 'hunt' smaller birds by tucking cards behind themselves.

Application

Birds function as 'engines' in *Wingspan* – they require resources to play and have spatial limitations (i.e., habitat preferences), but also multiply starting resources (food tokens or eggs) into more valuable points. Bird cards also function as resource capacity: players must play birds to be able to collect and store eggs as points and for future play. Together, these mechanisms encourage players to aim for complexity, an important dimension for any representation of ecology.

Food token dice and large bird and bonus card decks function as elements of chance. Players must choose each from a limited number of available options. These constraints encourage strategic game play, e.g. players must choose from three face up bird cards or draw a new card from the deck. Intermediate, end-of-round goals help track game progression and create variations in game progression. Players randomly select and assign goal tiles to an end-of-round point tracker, ensuring that additional and different incentives are built into each instance of game play.

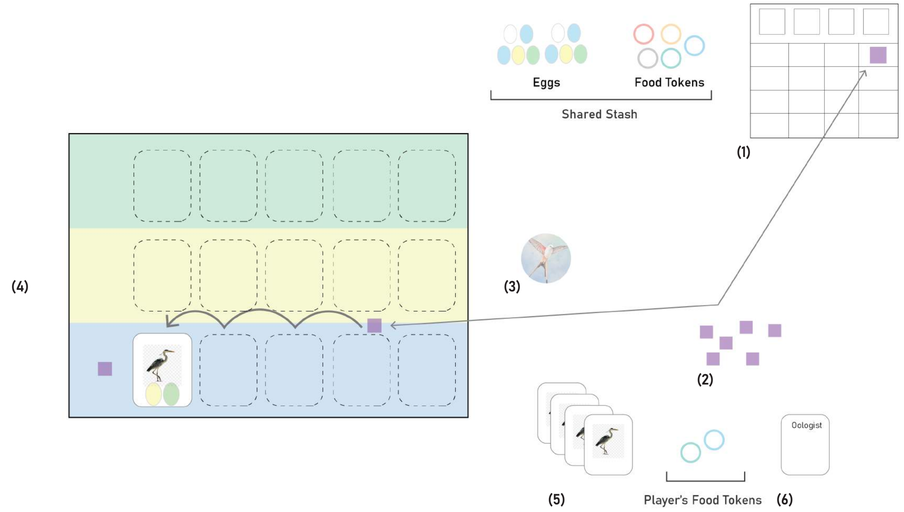

Figure 36. *Wingspan*: Mechanisms and Rules

4.2.5 CENTURY : SPICE ROAD

DESIGNER/S: EMERSON MATSUUCHI

THEME: SPICE TRADING

GAME TYPE: DECK IMPROVEMENT

PLAYERS: 2-5

PLAYER INTERACTION: COMPETITIVE

Scenario

Players are caravan leaders who are competing to grow and trade spices along the Spice Road.

Core Game Play

Each turn, players take one of the following actions:

a. Acquiring a trader card
b. Trading or harvesting spices by playing a card from their hand
c. Earning a Victory Card
d. Rest, and recover played cards into their hand

Mechanisms + Rules

(1) Each player has a caravan card which can transport up to ten spice cubes at a time.

(2) Spices are physically represented in colored cubes and increase in value from turmeric, saffron, cardamon, to cinnamon. Spices can be converted from one type to the type immediately higher or lower in value, or using Trader Cards.

(3) Card Decks: Trader and Victory cards are arranged in the center of the play space. Six trader and five victory cards are placed face up next to their respective decks. Players choose from these available options and must pay token prices indicated to earn them. Trader and victory cards are replenished from their decks as needed.

(4) Trader Cards allow players to collect, convert, or exchange spices. Players can acquire the left most card for free. All others require paying one spice token for each card to the left of their choice, e.g. to draw the second card from the left, a player must pay one spice token. Spice tokens are played onto the respective cards and are earned by whichever player later acquires them.

(5) Victory Cards cost spice tokens to acquire and earn their owner points. The left most cards also earn players gold or silver coins.

Game End

The Game ends when a player scores their fifth victory card. Players calculate total points based on earned victory cards and the point value of spices in their caravan. The player with the most points wins.

Application

Century: Spice Road focuses on resource trading without a shared, central board. It's spice representation and conversion system draw attention to the relative value of different materials and what this means for overall production. This is comparable to the nursery industry: annual plants are easier and faster to grow, but command lower profit margins than perennial plants, shrubs, or trees. Without fixed, central board, *Spice Road* is as variable in game outcomes as a tile placement game, such as *Carcassonne* (See section 4.2.3): players encounter different sequences of trader and victory card options each time they shuffle the respective card decks.

Though 'spice' resource supplies are infinite, individual player boards affect capacity constraints: there are only ten spaces for players to store earned spice resources, and this function forces them to make decisions about which resources to store and trade. This is very applicable to spatial constraints at plant nurseries. Nurseries must always balance crop quantities and sizes against whether they are these most efficient or profitable uses for a growing space.

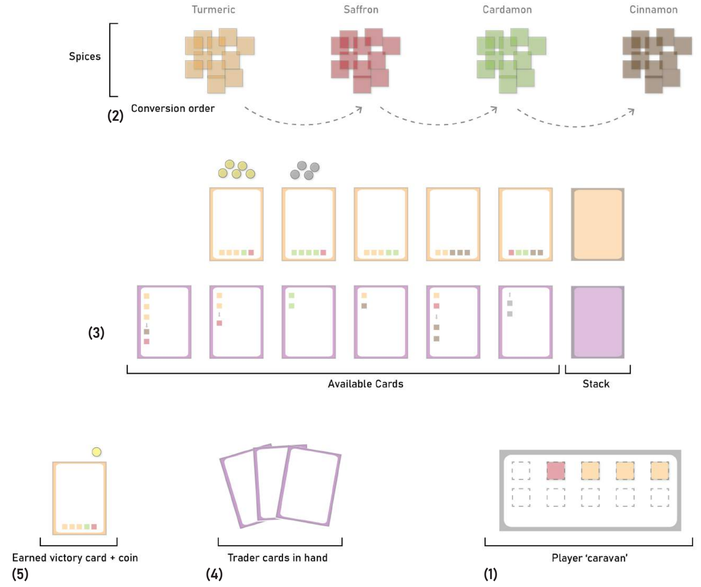

Figure 37. *Century Spice Road*. Mechanisms and Rules

4.2.6 SPACE CATS FIGHT FASCISM

DESIGNER/S: BRIAN VAN SLYKE

THEME: SCIENCE FICTION / POLITICAL SATIRE

GAME TYPE: AREA INFLUENCE

PLAYERS: 2-4

PLAYER INTERACTION: COOPERATIVE

Scenario

Players are rebel cats who work together to liberate a fictional galaxy of planets from fascist rat rule.

Core Game Play

Players take individual turns. Each turn, a player make take up to 3 of the following actions:

a. Move to an adjacent planet
b. Remove a fascist token from current planet
c. Draw Resist cards until full hand of four
d. Play Resist card(s)

Players may do the same action multiple times and can complete actions in any order. Players end turn by rolling the fascism dice.

Mechanisms + Rules

((1) Galaxy is set up by shuffling and arranging 12 planet cards in three rows of four. Each planet card has an associated number.

(2) Players determine level of difficulty using Fascism scale – easier games will start with two dice and a lower score, and more difficult games with three dice and a higher starting score. Events throughout the game will either increase or decrease the fascism scale.

(3) Cats: Each player chooses a character to play. Each cat has a 'home planet' and unique abilities that multiple the impact of specific cards or moves. Cats get 'scratched' each time fascists are added to their current planet or because of particular events.

(4) Tokens: Occupation and Liberation are represented in Blue (Fascist) or Orange (Rebel) tokens. At the start of the game, one fascist token is placed on each player's home planet and on each even numbered planet. Additional fascist tokens are placed on the board based on the numbers rolled on the fascism dice. Player actions remove fascist tokens and add liberation tokens.

There can only be one color of token on a planet at a time. There is on maximum limit for number of tokens on a planet.

(5) Flags: Planets with at least four tokens are considered 'Occupied' or 'Liberated' and market with the relevant flag. Flags are removed if the number of tokens drops below four.

(6) Resist Cards: Players may hold up to four resist cards at a time. Each card has one of four effects,

a. + 1 Liberation
b. -1 or -2 Fascists
c. Heal 1 or Heal 2 (removes scratches from a cat)
d. Teleport (move to any planet)

Most resist cards apply to a cat's current planet. Some have space-limited abilities, indicated by symbols. These can only be played on matching planets.

(7) Dice: Players roll 1-3 dice at the end of their turn depending on collective fascism scale score and whether they have removed fascist tokens from the board during their turn. E.g if they remove 1 fascist, they roll one less die. Players must roll at least one die at the end of their turn.

(8) Planets 9-12 are 'Fascist Strongholds'. Each time a player rolls one of these numbers, they must draw a 'Galactic News' card. These cards impact the fascism scale and inflict scratches, even if that planet is already liberated or occupied.

Game End

Players win if they can get all four Liberated flags on the planets at the same time. Players lose if three different planets are Occupied, if the Fascism scale reaches 'Lose', or if all 20 Fascist tokens are on the planets.

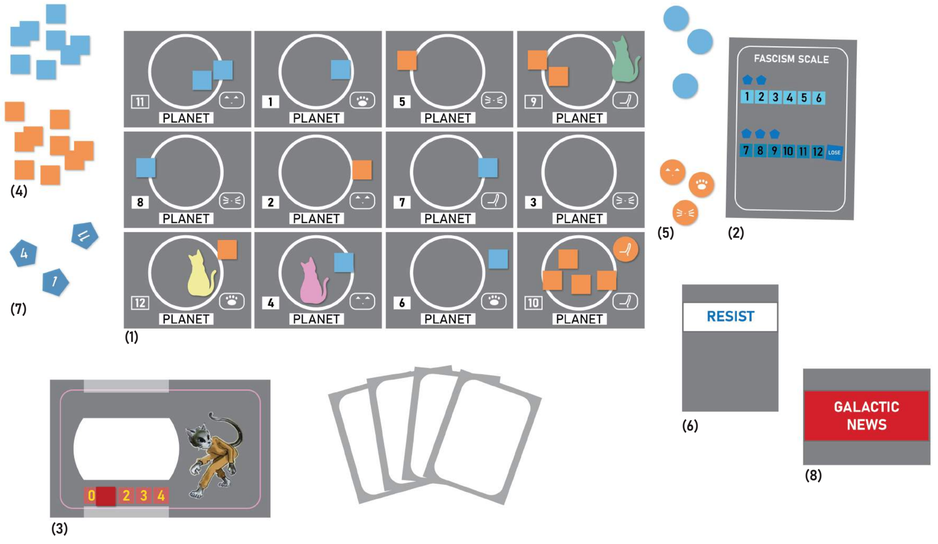

Figure 38. *Space Cats Fight Fascism*: Mechanisms and Rules

Application

Space Cats is a fast paced, area influence game. Replacing board with planet cards improves the variability of game play: the game area changes based on how players arrange planet cards and this, in turn, influences where players move and how fast they can respond to the spread of fascism. Dice rolls determine how fascist tokens distribute across the 'board' and player actions determine how they are removed and replaced by liberation tokens. This mechanism is often used to model a phenomena's spread across a space, such as diseases and pests – or ideas! Dice rolls also affect News cards. These are another representation of chance and, unlike token distribution, have multiple types of impacts, e.g. fascist scale change or scratches. This card deck allows the game to include additional variety in how an opposing force can influence players.

Though *Space Cats* players take individual actions, they are scored as one team. Additionally, some player abilities and resist cards can benefit other players, e.g. the 'Medic' character can heal an additional cat depending on when and where they use a heal Resist card. Both mechanisms encourage players to discuss and coordinate their actions.

4.3 CONCLUSION

Games are a rich analytical lens for projectively designig "alternate rules for power-sharing" and testing their implications for social and spatial justice (Kim, 2019). As the case studies presented in this section demonstrate, games facilitate both thick descriptions of context and manipulation of contextual variables within game parameters. Each game uses scenario to frame a context for play and rules to define how mechanisms, such as roll + move, tile placement, and area influence, operate within this context. Scenario, mechanisms, and rules combine to affect different player interactions: competitive, passively competitive, and cooperative. Analysis of these dynamics across six tabletop games underscores this medium's potential as both research and engagement tool. Next, we combine nursery and game case studies to develop a game glossary intended to support design and implementation of multiple plant nursery games.

5. GAME DESIGN AS SYNTHESIS

5.1 HOW TO USE THIS GUIDE

"Synthesis is a reciprocal procedure: to reconstitute components back into a coherent whole, but, in so doing, to transform it in significant ways."

(Deming and Swaffield, 2011: 210)

We facilitate application and (re)interpretation of our research findings by synthesizing plant nursery (Chapter 3) and tabletop game case studies (Chapter 4) in a 'Nursery-to-Game' Design Guide. As articulated by Deming and Swaffield (ibid) above, this guide begins by distilling tabletop games into their component parts: board, players, components, and mechanisms. We present each component individually with sample translations to plant nursery games, before sharing findings from a game design session conducted at GGN in April 2022. Both sample component translations and example games created during this design session 'reconstitute' game components into a coherent whole. Overall, this guide is deliberately open-ended, flexible, and intended to catalyze creative process rather than to prescribe (Wolff, 2003: 9). It is an invitation to charrette, to cooperatively and projectively transform plant nurseries and nursery relationships to advance social and spatial justice.

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5.2 GAME DESIGN: BASIC FORMULA

Design process, game play objectives, and scope influence how real-world phenomena translate into both games and their individual components. We developed a 'plant nursery-to-game' design framework using qualitative analysis. After abstracting game case studies into their component parts, we thematically coded plant nursery case studies again, this time categorizing responses based on narrative components: how was each nursery started, how did it develop? Which factors influenced the nursery internally, and which were experienced as external forces? What strategic decisions did each nursery take throughout its journey? Resultant axial codes were defined as follows:

Story: the origins and evolution of each plant nursery

Site: physical conditions of plant nursery site, e.g. sloping terrain or pre-existing structures; geographic considerations and determinants, such as proximity to other plant nurseries or related industries.

Actors: agents or personas within a nursery's story, e.g. founders, influential employees

Resources: elements required for plant production and wider nursery operations, e.g. labor, growing media, or plant material. These can be internal or external to plant nurseries, e.g. sourced from off-site but recycled within.

Place: an aggregate of environment, people/personas, resources, and resulting relationships.

Interrupters + Facilitators: forces or phenomena with disrupted or accelerated plant production or nursery development, but which notably are experienced and described as external to the nursery, e.g. COVID-19 pandemic and housing boom both influenced nursery

operations but originate and primarily operate outside of the nursery space and organization .

Next, we mapped each code onto a game component and tested their relationships to one another by designing sample plant nursery games. The collaborative design session conducted with GGN designers and staff helped refine a framework for translating plant nursery dynamics into tabletop game design. As shown in Figure 39, tabletop games consist of scenarios, players, mechanisms, and rules. The relationships between these elements play out on a board(s) using game pieces. Game outcomes are a function of game mechanisms and chance. Each of these components have sub-types or variations. These are outlined below with explanations of function, correlation to game case studies in Section 4.2, and illustrated through examples of application to plant nursery-games. It is important to reiterate, however, that translation of plant nursery context to game design is a highly subjective process: it depends on game objectives and scope of inquiry. Section 5.4 demonstrates this subjectivity by describing three games developed during collaborative design and framework-testing.

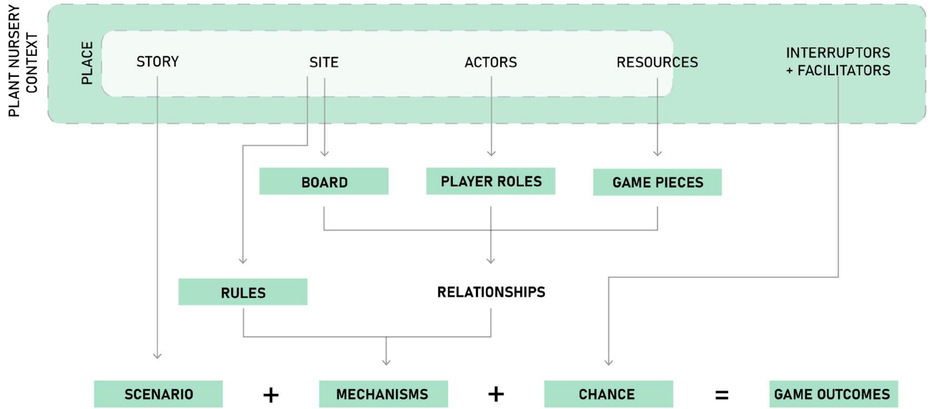


Figure 39: Plant Nursery -to-Game Translation Framework

5.3 GAME DESIGN COMPONENTS

5.3.1 BOARDS

Boards are two-dimensional play surfaces. They can be individual or shared among all players, and fixed or re-configurable. Boards typically represent space and/or capacity, but can also represent the passage of time. Boards often dictate which options players will encounter and choose between during the game.

TYPE	FUNCTION	EXAMPLE	APPLICATION
SINGLE, CENTRAL, BOARD	All players follow the same path or circuit. Individual outcomes or pace of movement along path/circuit typically determined by chance mechanism(s) (See Section 5.3.5)	*Monopoly, Game of Life*	Game play involves navigating nursery establishment and growth. A central board and path asks all players to make decisions at critical junctures, e.g. whether or not to invest in additional propagation facilities at Year 5.
TILES WITH INDIVIDUAL SCORING	Tiles typically represent spatial features; feature distribution depends on tile arrangement and changes each session. Players may compete actively for feature ownership and/or points	*Carcassonne*	Game play involves expanding influence across a given space, e.g. nurseries competing for contracts spread across the city, or plants/pests competing for dominance over an area.
TILES WITH COLLECTIVE SCORING	Tiles represent spatial features and could be arranged during game set up or play. Players strategize movements and actions and earn points together.	*Space Cats Fight Fascism*	Plant nursery workers work together to manage the spread of plant pests and diseases in a large commercial nursery.
INDIVIDUAL BOARDS	Boards represent impacts of individual player resources and actions only. Players compete passively to earn points throughout game.	*Wingspan, Century: Spice Road*	Players represent different plant nurseries who cultivate plants and run programs during the course of the game.

DESIGN CONSIDERATIONS:

- How much would you like game options to vary between play sessions? Tiles are more flexible than fixed boards.
- What is a bigger determinant of progress within the cultivation context in question, space or time?
- What are you more interested in exploring, spatial relationships and/or progression over time?

5.3.2 PLAYER ROLES

Player Roles are personas or characters that each player takes on and takes actions on behalf of during the game. Games vary in the extent to which they differentiate player roles, skills, and actions.

TYPE	FUNCTION	EXAMPLE	APPLICATION
IDENTICAL ROLES	All players play the same role and have the same range of actions available to them.	*Monopoly, Carcassonne*	Players are nursery managers
VARIED SKILLS / ACTIONS	All players play the same or similar role. Players acquire different skills or actions throughout course of game	*Game of Life Century: Spice Road*	Players are nursery workers who develop more specialized skills through course of game, e.g. irrigation, propagation, plant protection
ROLE DEPENDENT SKILLS / ACTIONS	Player roles are highly defined. Skills and possible actions are tied to specific characters.	*Space Cats Fight Fascism*	Players determine specific nursery roles or business models to play, e.g. players are commercial, non-profit, or social enterprise nurseries and have associated abilities and actions

DESIGN CONSIDERATIONS:

- Who is/are the agents in your game scenario?
- What are the power dynamics like between agents? Who influences who?
- What type of relationship(s) would you like players to experience and practice?

5.3.3 GAME PIECES

Game pieces represent resources, points, abilities, and/or actions that are earned and traded through the course of the game. These usually have relative values to each other. Game mechanisms and rules may also specify how to convert or trade one type of game piece for another, e.g. currency might be used to buy and sell tokens or cards. Players typically start the game with a specified number and/or combination of these pieces.

TYPE	FUNCTION	EXAMPLE	APPLICATION
PRESENCE TOKENS	Physical representations of player presence	*Space Cats Fight Fascism, Monopoly*	Players are plant species competing for influence across a space.
RESOURCE TOKENS	Physical representations of a defined group of resources	*Wingspan, Century: Spice Road*	Players must earn and trade plants to earn points throughout game
CARDS	Descriptive representations of a large group of resources, actions, or skills. Card 'value' is a function of exchangeability and probability of drawing from deck.	*Monopoly, The Game of Life, Wingspan, Century: Spice Road, Space Cats Fight Fascism*	Players collect plants throughout the game. Plant characteristics, e.g. seasonality, propagation method, grow time, and demand, influence additional resource, skill, or point acquisition.
CURRENCY	Can be interpreted literally, e.g. 'mock' money, or functionally, depending on piece exchangeability and mechanisms.	*Literal : Monopoly, The Game of Life* *Functional : Wingspan, Century: Spice Road*	Players cooperatively manage nursery assets and liabilities through a general organizational lifecycle of establishment, growth, and maturity. Assets include investments in different types of facilities, e.g. tissue culture lab.

DESIGN CONSIDERATIONS:

- How much would you like game options to vary between play sessions? Tiles are more flexible than fixed boards.
- What is a bigger determinant of progress within the cultivation context in question, space or time?
- What are you more interested in exploring, spatial relationships and/or progression over time?

5.3.4 MECHANISMS + RULES

Mechanisms (or mechanics) are how a game works, or how and why players take actions. They add constraints to the game. Rules regulate how mechanisms are implemented. Mechanisms and rules together influence player interactions, i.e., if players compete actively or passively, or collaborate. For example, a game that uses a 'roll + move' mechanism might involve players rolling a dice and moving spaces accordingly along a path on the board. Without rules, this mechanism could be implemented completely differently by each player: one might move spaces backwards, another forwards, another might consider moving optional. This would make the game too easy and/or too chaotic to win. Rules defining when players roll + move and how would help structure player actions and make progress along the path in question more challenging, e.g. if players roll once per turn, must move the number of spaces indicated on the dice forward, and take actions depending only on the space they land on (not those they cross).

Most games include more than one mechanism. Some mechanisms have associated boards, player roles, and/or pieces, while others can be applied to many different component types. This section describes common mechanisms that are applicable to plant nursery game design. This list is broader than other component types presented in this guide so, accordingly, also provides tabletop game examples from outside of the case study in Section 4.0. Rules are game objective and context dependent. Each mechanism could be governed by infinite or any combination of rules. As a result, we do not attempt a typology of game rules.

MECHANISM	GAME PLAY	EXAMPLE
AREA CONTROL / INFLUENCE	Players compete to dominate or defence a map or board	*Risk, Catan,* ***Carcassonne,*** ***Space Cats Fight Fascism***
CAMPAIGN / LEGACY	Individual plays follow series of connected scenarios; outcome of one scenario affects the next	***Game of Life***
DECK BUILDER	Initial deck of cards influences play throughout game	*Magic: The Gathering, Pokemon*
DECK IMPROVEMENT	Players create and customize deck throughout game	*Dominion,* ***Space Cats Fight Fascism***
DECK MANAGEMENT	Players balance when to play and discard actions from a character-specific deck of options	*Spirit Island*
ENGINE - BUILDER	'Engine' converts initial resources to more, eventually translating into points	*Res Arcana,* ***Century: Spice Road, Wingspan***
'EURO'	Strategy focus; passive competition; limited randomness	*Agricola*
'ROLL + MOVE'	Spaces on track or path unlock or dictate player actions	***Monopoly,*** *Snakes and Ladders*
DEDUCTION	Players collaborate to solve mystery or determine secrete identity.	*Cluedo, Mafia, Ultimate Werewolf*
STORYTELLING	Narrative focused game; directed by players	*The King's Dilemma*
WORKER PLACEMENT	Choose actions from spaces on board by assigning a pool of (thematic) workers to them	*Agricola, Caverna,* ***Carcassonne***
TILE PLACEMENT	Players build out 'board' by placing tiles. Adjacencies often trigger or restrict ability to move, place additional tiles, and/or score points	***Carcassonne,*** *Cascadia, Azul*

5.3.5 CHANCE

All games incorporate some element of chance – without chance, game progression and outcome would be entirely pre-determined and there would be few opportunities for player strategy. Game mechanisms must strike a balance between total and no randomness, both of which are frustrating experiences for players. This section outlines two game pieces that physically represent chance and are calibrated to the intended probability of different outcomes.

TYPE	FUNCTION	EXAMPLE	APPLICATION
DICE / SPINNER	Rolling or spinning determine how players move, which resources they can acquire, or which event impacts their progression. Probability of different outcomes follows normal distribution for range of values, i.e. 1 and 6 are least common rolled values for traditional 6-sided die.	*Monopoly,* *The Game of Life,* *Wingspan,* *Space Cats Fight Fascism*	Players roll a dice to determine the quantity of a particular resource they acquire, e.g. '6' units of fertilizer
CARD / TILE DECK	Card order is a function of chance. Rules defining when cards are shuffled and how they are drawn combine with card occurrence to determine how this chance mechanism influences game play.	*All*	Players who land on an 'event' space must draw from a pile of possible event cards and take actions accordingly, e.g. deck contains equal numbers of different climate events, such as drought, heat wave, or flood.

DESIGN CONSIDERATIONS:

- How much agency do your players have over game outcome?
- How much randomness is there in your game?
- Which dynamics or relationships would you like to emphasize as functions of agency versus chance?

5.4 GAME DESIGN IN ACTION

In April 2022, our research team hosted a virtual 'Gaming Charrette' with designers at GGN. We presented designers brief comparisons of plant nurseries surveyed in our research before shifting 'locations' to a dedicated virtual whiteboard space. We pre-populated this with sample game 'scenarios' and a resource bank. Scenarios offered fictional – and sometimes fantastical – adaptation of nursery case studies for teams to integrate into their designs. All drew inspiration from the stories shared with us during nursery site visits and mimicked the rhetorical style of game instruction booklets. For example,

> *"Hummingbird Haven was once a popular botanic garden known for its exotic plant collections and engaging public programs. It went bankrupt during the 2008 recession and the land has been 'vacant' since. But all is not as it seems. Beneath the blackberries and ivy lie a community of plants that are ready and waiting to bring this space back to life. Fend off pesky critters and speculative real estate agents while harnessing your ecological benefits to rehabilitate this space as a specialist plant nursery. Which plants will become leaders and who will be recruited? Can you attract the right humans back to the landscape?"*

This shares similarities with Heronswood Botanic Garden's evolution from independent nursery to corporate ownership and now tribal management (Heronswood Botanic Garden – A, Interview. March 3, 2022). However, this scenario also contains noticeable adaptations: Hummingbird Haven is a botanic garden turned nursery, rather than the other way round; plants are also the central agents in this restoration story, rather than people. Such obvious and liberal adaptation of nursery stories invited design teams to be similarly creative in how they translated the world of plant nurseries into games.

Our game resource bank also paired nursery case study references with an open-ended format. As shown in Figure 40, this contained icons representing all manner of physical, environmental, plant, and human resources. These reflect interview responses coded as 'Resources' and then categorized into functional or thematic groups. Categories included, Growing Spaces, Site Features, Resources, People, Plants, and Interrupters. We developed graphic icons to represent each type of resource or feature and arranged them so that teams could easily drag or 'copy and paste' icons onto blank cards or shapes in their workspaces. This resource bank was deliberately open-ended. For example, we intentionally described nursery roles as 'people' instead of 'characters'. We hoped this would avoid leading design teams towards human player roles, and that this openness would in turn increase the diversity of games created during this session.

Participants self-selected into teams of 5 and were randomly assigned a game mechanism. Each team had a dedicated workspace containing a game case study diagram, prompts for consideration, and blank game pieces and templates (See sample workspace in Figure Y). We gave teams 40 minutes to design and play-test a plant nursery game. We recommended teams start by choosing or writing a scenario, but also invited designers to interpret mechanism assignments and design recommendations at will. We were curious to observe how different teams interpreted a common set of components based on a game mechanism assignment. This was, in effect, narrative analysis in reverse. Did designers gravitate towards human characters for player roles? Which events or interrupters featured heavily in landscape designers' translation of plant nurseries to game? Did some scenarios align better with specific mechanisms?

Teams created vastly different games. Many defaulted to competitive games, though three teams tried to build more cooperative mechanisms and/or rules into these games. We present three examples here, providing screenshots of team games and a brief description of game scenarios and objectives. Each is summarized using the game design framework outlined in Section 5.2. Overall, however, it is important to note that we developed this framework based on findings from the charrette. Notably, designers reflected that it was challenging to design a game 'from scratch' and without clearer guidelines of how or what to translate from a nursery case study. The charrette, thus, catalyzed development of the game design guideline presented here. The session also confirmed that game design can facilitate meaningful conversations about precedents, possibilities, and partnerships.

GROWING SPACES

- GROWING BEDS / LAY-DOWN SPACE
- HOOPHOUSE
- GREENHOUSE
- PUMICE BED
- TISSUE CULTURE LAB

SITE FEATURES

- DEMONSTRATION GARDEN
- LANDSCAPE PLANTING
- SHIPPING DOCK
- SOIL + COMPOST
- RETAIL AREA
- RETENTION POND
- COMMUNITY SPACE

RESOURCES

- WATER
- PLANTING MEDIA
- CONTAINERS
- PLANT LABELS
- FERTILIZERS
- PESTICIDES
- BENEFICIALS
- PLANT MATERIAL

PEOPLE

- GENERAL
- MARKETING + SALES
- R + D
- PRODUCTION WORKERS
- SEASONAL WORKERS
- PLANT PROTECTION
- MANAGERS

PLANTS

- PLUGS
- BARE ROOT
- BEDDING / EDIBLE STARTS
- ANNUALS
- SHRUBS
- TREES
- NATIVE PLANTS
- PERENNIALS
- HOUSEPLANTS

INTERRUPTORS

ENVIRONMENTAL:
storms, drought, floods, frost, earthquake, tsunami, hurricane, wildfire, landslide, water contamination, soil contamination

PLANT-SPECIFIC:
invasive plant species, plant diseases (e.g. powdery mildew, root rot, blight, rust), plant pests (deer, racoons, cats, spider mites, aphids, whitefly, murder hornets, blackbirds, caterpillars).

ECONOMIC:
inflation, supply chain disruptions, speculation, plant patents, patent infringement lawsuits, competition, buy-outs, bankruptcy, mergers, tax write-offs, tariffs, layoffs, housing boom;

SOCIAL /POLITICAL:
collective action (work to rule, strike), protest, immigration ban; licensing requirements; poaching; acceptable plant regulations (e.g. 'noxious plant lists'); industry certifications; trade associations; resignations; retirement; pesticide regulation; plant trends;

OTHER:
Pandemic; climate change

Figure 40. Game Design Charrette Resource Bank

5.4.1 PLANTING PROWESS

Planting Prowess is a collaborative 'roll + move' game. Each player is a plant nursery owner who must grow their nursery from start up to survivor by sharing resources and working with other players to build a nursery network across regions and seasons. Game play follows a seasonal cycle: players have a set number of turns before each growing season ends. Players need to amass enough resources as a team for each nursery to stay in business for the next year.

BOARD: SHARED CENTRAL, W/ INDIVIDUAL NURSERY SPACES

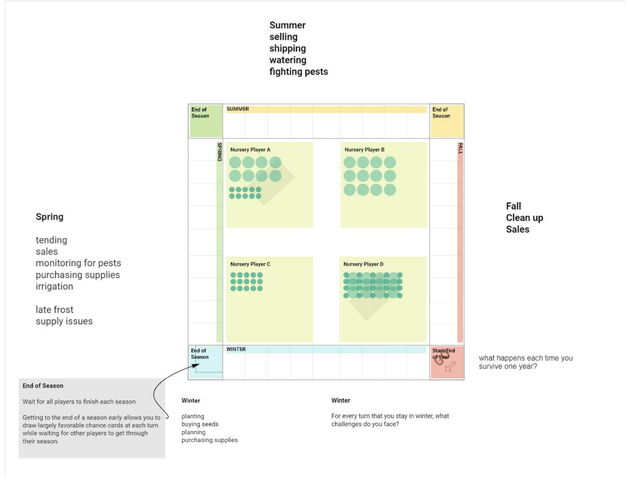
PLAYER ROLE: ROLE-DEPENDENT SKILLS/ ACTIONS

PLAYER INTERACTION: COOPERATIVE

GAME PIECES:
- CHARACTER CARDS
- CHANCE CARDS
- TOKENS REPRESENTING DIFFERENT PLANT TYPES, E.G. SHRUB, TREE, ANNUALS

MECHANISMS: ROLL + MOVE; DECK-BUILDER

CHANCE: CARD DECK



5.4.2 PLANTING MILLIONS

Planting Millions is a competitive campaign game. Players are nursery owners and compete to amass plant stock. Players roll dice and move the indicated number of spaces around a circuit of growing seasons. Board spaces represent different types of events: individual events impact only the player who landed on the space, while world events impact all the players in a game. Card spaces additionally require players to draw from a card deck containing both positive and negative events. Once a player has collected enough plant stock, they move towards the 'End of the Season' and attempt to roll exactly the number needed to 'Sell their Plant Stock' and 'Retire with Millions'. The first player to successfully retire wins.

BOARD: SHARED CENTRAL

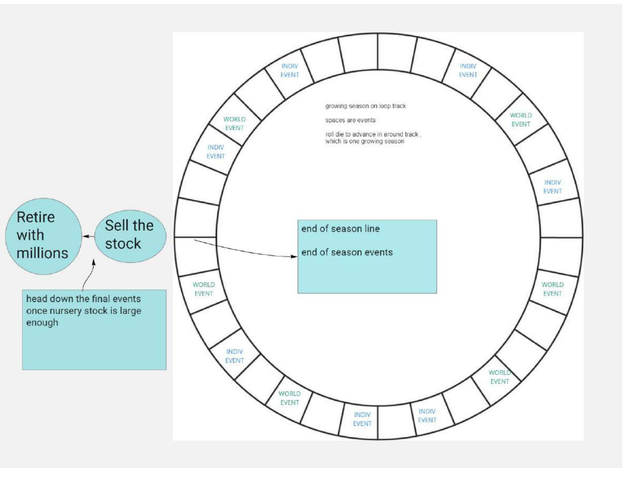
PLAYER ROLE: IDENTICAL ROLES

PLAYER INTERACTION: COMPETITIVE

GAME PIECES:
- PLANT TOKENS REPRESENTING PLANT TYPES, E.G. SHRUBS OR TREES
- 'CHANCE' CARDS
- PLAYER TOKENS TO TRACK PROGRESS AROUND CIRCUIT

MECHANISMS: ROLL + MOVE; CAMPAIGN

CHANCE: DICE; CARD DECK



5.4.3 NURSERY DEAL

Nursery Deal is a deck builder and 'roll + move' game. Players are plant nurseries competing to bring plants to market. At the start of the game, players are dealt value cards. These are kept private (to induce competition) and influence how different possible events impact you as a nursery. Some cards are common to all. Trading of value cards and cooperation between players is encouraged. Players move around a circuit on a shared board and must spin a phenomena spinner each time they land on associated spaces. This affects different types of natural hazard or climate events on the player and their nursery. Value cards will influence how much certain phenomena impact you. Other board spaces require players to draw action cards. Players' goals are to acquire and trade resources: plants with specified climate requirements and vulnerabilities. Players collectively win if there are multiple successful nurseries in the game.

BOARD: SHARED CENTRAL BOARD

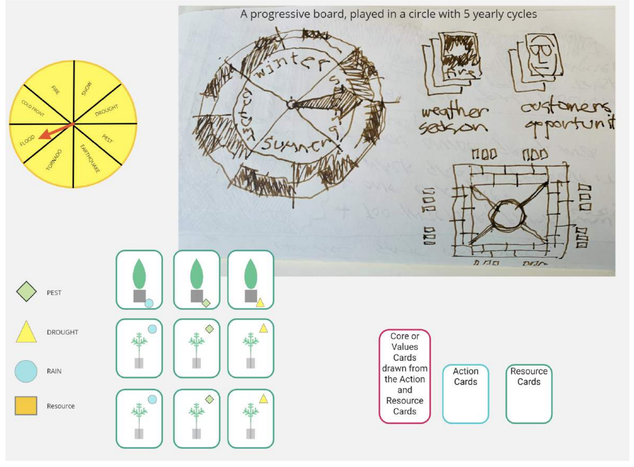
PLAYER ROLE: VARIED SKILLS/ACTIONS

PLAYER INTERACTION: COOPERATIVE

GAME PIECES:
- VALUE CARDS
- ACTION CARDS
- PLANT CARDS DETAILING RESOURCE REQUIREMENTS

MECHANISMS: ROLL + MOVE; DECK-BUILDER

CHANCE: SPINNER; CARD DECK



5.4.4 SUCCESSION

Succession is a tile-based, area-control game. Players take on the role of habitats who use resources to grow their plant army and 'green' a city. 'City' tiles are randomly arranged at the start of the game. Each tile requires a certain number of plants to 'take over'. Players start with the same resources and must acquire and trade resources for plants for their habitat type. A deck of 'modifier' cards either advances or hinders a habitat's progress, e.g. villains such as drought, pandemic, or pests deplete player resources. Allied relationships with animals or natural elements increase the amount of resources a player has, and thus the number of plants they can grow and mobilize to 'green' the city. The habitat with the most claimed tiles wins the game..

BOARD: TILES WITH INDIVIDUAL SCORING

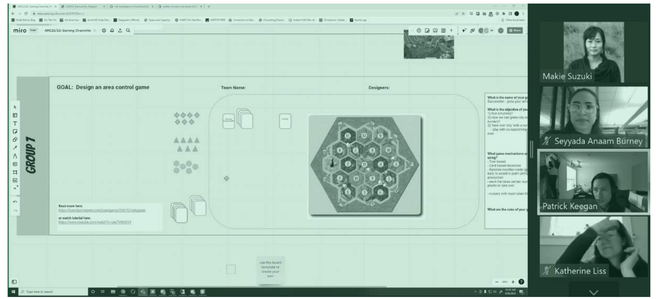
PLAYER ROLE: ROLE-DEPENDENT SKILLS/ ACTIONS

PLAYER INTERACTION: COMPETITIVE

GAME PIECES:
- 'MODIFIER CARDS THAT IMPACT ON PLAYER RESOURCES OR PROGRESS
- TOKENS REPRESENTING RESOURCES REQUIRED TO GROW PLANTS
- COLOR TOKENS REPRESENTING PLAYER PRESENCE

MECHANISMS: AREA INFLUENCE; DECK-BUILDER

CHANCE: CARD DECK



At the end of the design session, teams returned to the main group to share their games and reflect on the design process. Designers reported enjoying the activity and that collaborative game design had facilitated conversations about their relationships with plant nurseries. Some shared that they felt hesitant to design a game based on a 'world' they knew only a little about. Others reported difficulty 'getting started' with game design because they were less familiar with game design terms or the (predominantly Western) games presented as mechanism examples. Their games and feedback encouraged us to develop the design framework and guide presented in this section. We implemented this design framework in a synthetic game design of our own. The game instructions and components presented in the next section reflect cumulative analysis of plant nurseries and tabletop games and incorporate elements from each of the games designed during this session. They are a nascent vision for a plant nursery game that can build awareness about plant cultivation practices and catalyze coalition-building around social and spatial justice.

5.5 GAME DESIGN IN PROGRESS: GROWTOPIA

Grow-topia is a collaborative game for 2-4 players. Players are horticulturalists who collaborate to transform an abandoned plant nursery into a center of community power. Players collect and use energy tokens to restore infrastructure, propagate and care for plants, and manage a portfolio of programs. Players take actions individually, but the team wins or loses together.

BOARD: TILES W/ COLLECTIVE SCORING

PLAYER ROLE: ROLE-DEPENDENT SKILLS/ ACTIONS

PLAYER INTERACTION: COOPERATIVE

GAME PIECES:
- ENERGY TOKENS
- CHARACTER CARDS + ACTION DECKS
- CHARACTER TOKENS
- GREEN 'TEAM' TOKENS TO TRACK PRESENCE ACROSS BOARD
- GREY 'GAME' TOKENS TO TRACK SPREAD OF PESTS, DISEASE, OR CORPORATE INFLUENCE
- RESILIENCE POINT BOARD
- EVENT CARDS

MECHANISMS: DECK MANAGEMENT
AREA INFLUENCE

CHANCE: DICE; CARD DECK

Scenario

In the year 2050, an intersection of crises has left many North American cities facing devastation and ruin: recurrent heatwaves have decimated urban canopies and parks, biodiversity loss has triggered global famine, and the decline of fossil fuels has led to industry closures and global recession.

Tropic Treasure was once a thriving exotic plants nursery located on a remnant 2-acre agricultural parcel in an otherwise industrialized neighborhood. They employed 100+ people, many of whom lived and built communities in the area. The nursery was well known for their exotic ornamental and house plants, and often sold 20-50,000 plants a year. Recession struck this nursery hard: plant sales and profit margins fell rapidly as fossil fuel prices rose. Unemployment led to a decline in plant purchases, and heat waves caused crop losses and health code violations as greenhouses overheated. The owners declared bankruptcy and left the area abruptly, leaving behind defunct infrastructure but taking many stock plants and immigrant dreams with them.

Community members are undeterred by these challenges. They see potential in this site and dream of creating a new type of nursery: one where plants and community are cultivated side-by-side, and where operational decisions prioritize justice over profit. Do you have what it takes to transform an abandoned exotic plants nursery into a sanctuary?

Game Setup

Arrange nursery tiles face down so that each tile is immediately adjacent to at least two others (See Figure 41). This area is referred to as the board. Each player chooses a character and collects associated token, card, and action deck. Players are dealt 3 energy tokens and may place their character token on any tile to start. The player who visited a plant nursery most recently takes the first turn.

Players take actions individually but earn resilience points collectively. Coordinating individual actions improves a team's ability to run a successful and just nursery.

How to Play

1. Rounds + Turns:
Players take up to four actions each turn:

1. MOVE to an adjacent tile
2. GAIN energy tokens
3. ACT by playing and discarding an action card, or REST and recover played action cards
4. GROW your nursery by flipping a nursery tile

Players may do any combination of these actions and may take actions in any order. Moving four times, or gaining energy twice and then moving twice are both legal plays.

When all players have taken their turns, the team must roll the dice to complete the round.

2. Energy Tokens:
Leaf-shaped energy tokens power player actions. Players must collect and play tokens to play action cards. Energy tokens are also required for flipping a nursery tile. Players cannot share tokens.

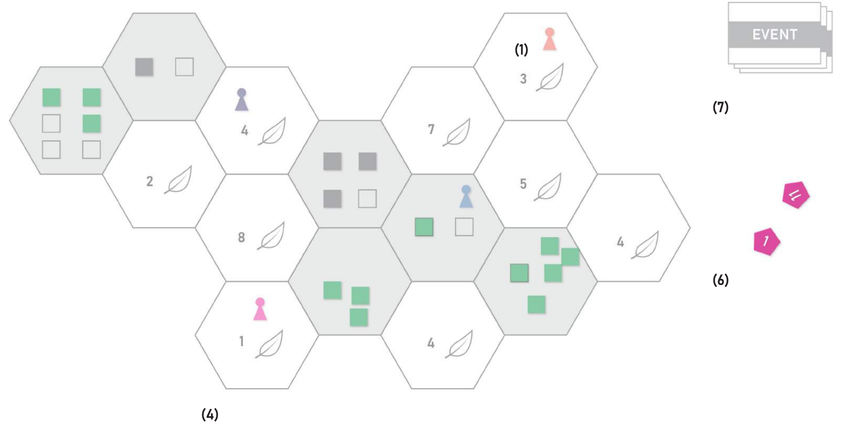


Figure 41. *Grow-topia*: Mechanisms and Rules

3. Character Cards:
Character cards describe each nursery worker's responsibilities and skills. Skills are innate and inexhaustible. These are actions that a player can take regardless of action cards in their hand or available energy tokens. Each character card is associated with a character token.

Character Token:
Each player has a character token. This represents a player's presence on the board and helps track their movement around the nursery space.

Action Cards:
Each character has an associated deck of action cards. These are exhaustible and cost energy tokens. To play an action, players must pay the required energy 'price'. Action cards must be turned over or discarded once they have been played. They cannot be reclaimed until a player decides to use one of their turn actions to REST and recover all played cards. Each player has at least one action card that they can lend to another player, but they must still pay the required energy price to do so.

4. Nursery Tiles:
Each nursery tile indicates the amount of energy required to flip or transform it. Flipping tiles is how players expand nursery operations and earn resilience points, though there is always a risk. The more tiles that are flipped, the more spaces where game presence tokens can accrue.

Players flip a tile by moving to it and paying the required energy cost (or combined energy and action cost) to transform this space. Players can only flip the tile where they are currently located. Some flipped tiles earn immediate resilience points while others require additional team presence.

5. Team Presence Tokens:
Green cubes represent the player team's stewardship of their nursery. These are added to flipped nursery tiles through player actions or Facilitator event cards, e.g. 'Warm Spring' adds one team presence token to all propagation-related tiles

Game Presence Tokens:
Grey cubes represent the game's efforts to undermine player progress. These are added to the board through dice rolls (see above) and Interrupter event cards, such as 'Aphid Infestation' or 'Patent Infringement.'

There can only be one type of presence on a tile at a time: grey or green. If one game presence is added to a tile with pre-existing team presence tokens, this reduces the number of team presence tokens on the tile by one. If there is no team presence on a tile, additions of one game presence will result in a grey presence token being added to the tile.

Presence is, thus, not permanent. There is also no upper limit to how many presence tokens can be on a tile, i.e. players should add more than required to earn resilience points in order to protect the tile space for game presence.

6. Dice Rolls:
12-sided game dice influence how negative 'game' presence is added back to the board. Add a grey token to the tiles associated with the numbers rolled. If players roll numbers 9-12, they must also draw an event card follow the instructions on this card.

7. Event Cards:
Event cards interrupt or facilitate your nursery's mission. Players must draw an event card if they roll 9, 10, 11, or 12. If they roll two of these numbers, they must draw two cards.

8. Resilience Points:
There are three categories of resilience points: environmental, social, and political-economic. The team earns resilience points by fulfilling a flipped nursery tile's presence requirement. Players lose resilience points if team presence drops below the resilience point requirement of a tile. Track resilience points using the dedicated board and spare game or team presence tokens.

Game End

Game play continues until one of the following:
The nursery team wins if they successfully transform 10 nursery tiles or earn 20 resilience points.

The team loses if all 20 grey tokens end up on the board.

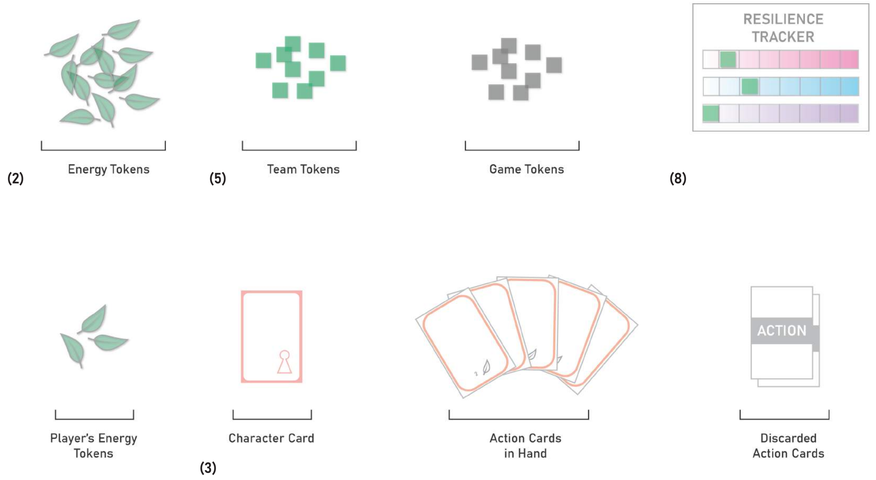
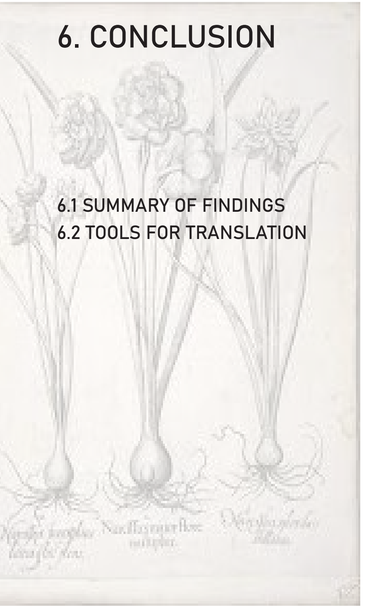


Figure 42. *Grow-topia*: Mechanisms and Rules continued

6. CONCLUSION



As this research study demonstrates, plant nurseries play an important role in social and spatial justice. Landscape architects depend on nurseries to produce plants for built projects, but as an industry and practice, we are deeply disconnected from them. We specify plants with little attention to what local nurseries are growing, and even less to the opportunities and constraints that they experience. A material lifecycles lens draws attention to plant nurseries as a space of material and human transformation: growing practices transform living plant beings and knowledges into commodities for consumption, but equally also support livelihoods and, in notable cases, wider initiatives to improve access to horticultural education and jobs. Treating plants as inert materials that appear on site risks neglecting these relationships. Nurseries are active navigators of environmental, social, and political-economic contexts. Elevating their agency or the diversity of their missions, programs, and growing practices advances our shared efforts to create more just built environments.

We started this research project with a broad goal of exploring the relationship between contemporary plant nurseries and social and spatial justice and retroductively defined three questions for qualitative analysis:

1. How do plant nurseries operate?
2. What influences how plant nurseries operate?
3. How do plant nurseries influence social and spatial justice?

We explored these questions through site visits, surveys, and semi-structured interviews with seven plant nurseries. A case study methodology helped adjust data collection and analysis methods to each nursery. Based on nursery characteristics and capacity, we, for instance, opted for a longer interview over both interview and survey. Equally, we might document one nursery's site characteristics and stories extensively, but consciously avoid doing so for another where an emphasis on documentation risked breaking trust with research participants.

Elevating their agency or the diversity of their missions, programs, and growing practices advances our shared efforts to create more just built environments.

These adjustments helped center justice in our research product and process. By practicing flexibility in research methods, we communicated a desire to build relationships with plant nurseries and respect for their interests and preferences. Doing so also de-centered our role as researchers and opened up more space for co-creation of knowledge about how plant nurseries in our study were established, weathered change, and continue to pursue broader missions than commercial plant production.

6.1 SUMMARY OF FINDINGS

This report presents in-depth analysis of four plant nurseries as case studies of cultivation – some more focused on plant production for sale, but all engaged in wider initiatives to improve livelihoods, foster equity, and steward environments. Thematic and narrative analysis situated Monrovia Nursery Company, Oxbow Farm and Conservation Center, Citywide Horticulture, and Ploughshares Nursery's operational decisions and growing practices in-context. Citywide Horticulture, for example, functions as a contract-grower for Seattle Parks and Recreation (SPR) and, by virtue of municipal funding, can trial more novel cultivation techniques and grow smaller crops than a wholesale grower. They operate at just the right scale to be both nimble within and critical to an otherwise bureaucratic system.

Comparisons across nursery case studies (See Section 3.3) shed light on relative influences on nursery operations. Nurseries in our study consistently referenced business models, site conditions, and material supply chains when describing plant lifecycles and operational decisions, such as growing targets or plant selection. Within this, individual nursery responses varied considerably. Oxbow Farm and Conservation Center's, for example, skewed strongly towards business model and labor supply, while Citywide Horticulture's were distributed across more areas: material supply chains and market dynamics, local regulations, site conditions, and business model. These findings are simple though telling. As a municipal nursery, the latter experiences many more influences on how it grows plants, which programs it runs, and what types of relationships it fosters. As a well-funded non-profit, the former experiences less. Interpreted together, case study nursery responses offer preliminary insight into industry dynamics, such as the extent to which regulations, market forces, or built environment trends influence nursery plant production.

Case study nurseries reported equally varied social and spatial justice initiatives, though each recognized that they consider justice a part their work overall. Monrovia Nursery Company, Citywide Horticulture, and Heronswood Botanic Garden skewed strongly towards a single dimension, either environmental impact and resource management or human-plant relationships. In contrast, Ploughshares Nursery's efforts were strongly divided between cultivating community and improving work opportunities. Oxbow Farm and Conservation Center differed again, this time engaging in three areas of justice: human-plant relationships, plant knowledges, and environmental impact. This diversity in initiatives underscores our belief that plant nurseries affect social and spatial justice in a multitude of ways.

'Un-seeing' nursery plants as commodities – and seeing them instead as *"a process of ongoing relationships"* – reminds us of deep, even innate connections severed in the pursuit of profit: between nurseries and designers, plants and pollinators, and plants and people.

Hutton (2020: 7–9)

Overall, mixed-method case study of plant nurseries allows us to "witness the continuity" between plants as living, agentic beings and plants as landscape materials (Hutton, 2020: 7–9). 'Un-seeing' nursery plants as commodities – and seeing them instead as "a process of ongoing relationships" – reminds us of deep, even innate connections severed in the pursuit of profit: between nurseries and designers, plants and pollinators, and plants and people. These are critical first steps for creating more just built environments. Without application, however, these ideas remain mere propositions. To this, we add games as powerful research and design tools to help us practice re-building connections.

6.2 TOOLS FOR TRANSLATIONS

Game design served as an additional projective design tool for our study. Like experiments and predictive models, games simulate environments to test relationships between phenomena. These can be observed relationships, in which case, gameplay is an opportunity to prove or disprove findings from research. They can also be hypothetical or proposed relationships, in which case games serve as a speculative tool, allowing designers and players opportunity to play out the impacts of different decisions or variables. The latter is most promising in the context of social justice inquiry for it facilitates explorations of new relationships and ways of working oriented around shared goals.

Figure 43. Design students play *Carcassonne* after class.

Game design and play are also highly interactive, unlike other simulation-based research methods. Both invite participants to communicate with each other, to articulate interests or biases, and to

interpret and navigate a scenario together. By setting up specific player interactions, games foster engagement and dialogue. We observed and tested this medium in action during a collaborative design session with GGN designers. Their games and reflections on design processes encouraged later articulation of a plant-nursery-to-game framework. Described in Chapter 5, this documents how we brought nursery and game case studies together, using each to inform the other. This design guide is also 'an invitation to charrette'. We offer it as a creative tool for using games to collectively "determine which characteristics and values are compatible with each other and which elements are incompatible, inconsistent, or intractable and hence must be traded off or left behind" (Wolff, 2003: 9).

We conclude by sharing an emerging plant nursery game that synthesizes the nursery and game research conducted in this study. This game is one of many iterations, partial in its framing of plant nurseries and imperfect in its predictions for how to cultivate justice alongside plants. Both partialness and imperfection are intentional. They reflect our honest belief that the work of social and spatial justice is continuous and that the rules of this most fundamental game will continue to evolve as our understandings deepen. Like the nursery plants that inspired our work, this game, too, is a material in-motion: "anything but fixed in time, space, or form" and designed by us to be re-designed by each of you.

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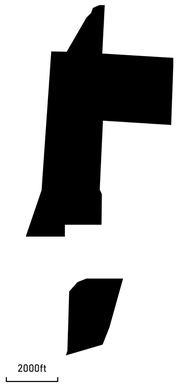
7.1 RESEARCH TRANSCRIPTS AND DATA

NURSERY	METHOD	DATE
Monrovia Nursery Company - A	Interview	02/10/22
Monrovia Nursery Company - B	Interview	02/10/22
	Field Notes + Photographs	02/10/22
Ploughshares Nursery - A	Interview	02/17/22
Ploughshares Nursery - B	Interview	03/30/22
	Field Notes + Photographs	03/03/22
Heronswood Botanic Garden - A	Interview	02/17/22
Heronswood Botanic Garden	Survey	03/04/22
	Field Notes	03/03/22
Citywide Horticulture - A	Interview	03/15/22
	Field Notes + Photographs	03/15/22
Green Seattle Partnernship - A	Interview	03/17/22
	Field Notes + Photographs	03/17/22
Oxbow Farm and Conservation Center - A	Interview	03/25/22
Oxbow Farm and Conservation Center - B	Survey	03/24/22
	Field Notes + Photographs	03/25/22
Wildflowers NW- A	Interview	03/26/22
	Survey	03/25/22
	Field Notes + Photographs	03/26/22

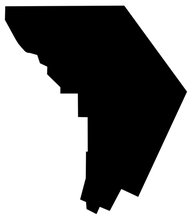
8. APPENDICES

APPENDIX A. NURSERY SCALE STUDY

Monrovia Nursery company - OR



Everde Growers



USFS - Coeur D'Alene

Oxbow Farm + Conservation Center

Banksavers Tribal Nursery

Prairie Conservation Nursery @ WA Womens Correctional Facility

Theodore Payne Foundation

Citywide Horticulture

Growing Grounds

Trees Pittsburgh Heritage Nursery

Ploughshares Nursery

APPENDIX B. INFORMED CONSENT FORM

UNIVERSITY of WASHINGTON GGN

Informed Consent Form

Research Title: Seeding Change: The Role of Plant Nurseries in Spatial Justice
Investigator: Seyyada A. Burney
Faculty Advisor: Catherine De Almeida, ASLA
Project Summary: This research investigates plant material lifecycles to understand the factors influencing nursery operations and to map network-actor relationships within the nursery industry. The goal of this research is to foster conversation between landscape architecture firms and plant nurseries and explore how they might work together to promote more just built environments.

This study is for purely educational purposes and has been approved by the University of Washington's Institutional Review Board.

The University of Washington requires the following informed consent for all participants in human subjects research:

A. Your participation is voluntary. You may withdraw consent at any time and should only answer questions that you feel comfortable responding to.
B. You may direct questions to the investigator at any time.
C. Interviews conducted in-person or over the phone will be recorded using an audio recording device. Site visits will be photographed. You may decline the use of either device at any time.
D. Information from this study will be treated as strictly confidential. Names, email addresses, phone numbers, and voice recordings will be stored separately from your responses and discarded at the end of a required retention period, per UW Records Retention Policy and state law.
E. You may waive your right to confidentiality later if you want your name published in the findings.
F. The results of this study will be used in a research report published on the UW ARC Program website and may be used in future publications, presentations or professional conferences.
G. There is no monetary compensation provided for your participation.

If you understand the above, and consent to participate in the project, please sign here:

_____ (Sign here)

_____ (Print name here) _____ (Date)

If you have any questions about your rights as a research subject, please contact the **University of Washington's Human Subjects Division at (206) 543-0098**. If you have any questions about this research study, contact Seyyada Burney (the investigator) at sburne@uw.edu or Catherine De Almeida (the faculty advisor) at cdealmei@uw.edu.

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APPENDIX C. SURVEY QUESTIONS

What is your job title?

How many acres is your nursery?
How many acres are actively used for plant production?
How many acres of production space are under cover?
What influences how many acres are cultivated?

How many plants do you produce each year?
How many plant species do you cultivate?
Have these numbers increased or decreased in the past ten years? Why?

How do you decide which plant species to grow?
How long are different plant types under your care? (e.g. annuals, perennials, shrubs...)
What are your most profitable plants?
Who are your main customers?
What are major inputs during a plant's lifecycle? (e.g. soil, fertilizer, plant material...)
Who are your main suppliers for these inputs?
What are major outputs during a plant's lifecycle? (irrigation runoff, pruning material, soil)
What happens to these outputs? Where do they go?

Do you have any questions for the researchers?

APPENDIX D. INTERVIEW GUIDE - GENERAL

How long have you been working at this nursery? How did you find this job? How have your responsibilities changed over time?
What are your priorities as a grower?
How do these influence your production methods and programs?
Who are your major suppliers and customers? (ref. network diagram)
Are you part of any professional associations? Why or why not?
Do you grow plants on contract or for custom/special orders?
What has the experience of contract growing been like for you?

Nurseries generally reported a lack of skilled labor as a constraint to growth. Have you experienced this?
How many employees do you have (permanent, seasonal, full or part-time, corporate, production, volunteers)?
How many employees or volunteers did you start with?
How many employees or volunteers would you like to grow to?
What are the different employee and/or volunteer roles at your nursery?
Which are essential?
How do most employees find out about opportunities at your nursery?
What strategies have you adopted to improve employee training and retention?
What percentage of employees take advantage of these opportunities? Why or why not?

Who is your nursery's community (other nurseries, local schools, industry partners, local neighborhood)? How do you engage with them?
Who would you like to be engaging with and how?

What is trending in the plant nursery industry right now?
Who or what influences these trends?
What is your opinion on the native plant movement?