Future Viable Plant Palettes for Metropolitan Areas

By David Hopman, PLA, ASLA

Abstract

Essays about plants usually focus on specific plants, specific approaches to combinations of plants, practical uses for plants, plants for specific habitats, etc. These essays are indicative of the broad and continually evolving way that landscape architects approach planting design. This series of short essays, originally published on the ASLA PPN website, takes a step back to address the issue of how and why landscape architects should use a clear set of principles to inform their palette of plants. By thinking first about the plant palette, new approaches to planting design will emerge that reflect the contemporary concerns of both the profession of landscape architecture and society at large.

The principles outlined in these essays were used to develop the native plant polycultures planted in the front of the CAPPA building at The University of Texas at Arlington. Questions should be addressed to: David Hopman, ASLA, PLA: dhopman@uta.edu

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Crystal Canyon entrance garden in Arlington, Texas. Grasses installed by landscape architecture students from The University of Texas at Arlington and wildflowers compost seeded in. Photo taken in June of 2013, one year after installation.
image: David Hopman

Part 1: Aesthetics, Environment, and Ecology in the Creation of Plant Palettes

Essays about plants usually focus on specific plants, specific approaches to combinations of plants, practical uses for plants, plants for specific habitats, etc. These essays are indicative of the broad and continually evolving way that landscape architects approach planting design. This post takes a step back to address the issue of how landscape architects should use a clear set of principles to inform their palette of plants. By thinking first about the plant palette, new approaches to planting design will emerge that reflect the contemporary concerns of both the profession of landscape architecture and society at large.

Many design firms have design priorities that can be summed up in a few words. The ideas are sometimes illustrated with Venn diagrams and referred to as a triple (or quadruple) bottom line. The three criteria that are the focus of this series of posts are aesthetics, environment, and ecology. Other important elements, such as community and economics, can be addressed with a plant palette that balances these three important criteria. However, if art or economics, for example, are the driving generators of a plant palette, it may not be possible to bring the plants into balance with environmental and ecological concerns. Ecology is the most difficult and complex parameter to bring into balance and is currently the leading edge of future viable planting design innovation for landscape architects.

A variety of approaches to the selection of plants will be tested against the criteria of aesthetics, environment, and ecology in future posts. These posts will begin with a critique of palettes that are the most out of balance and proceed to others that gradually bring the three elements into equilibrium. The end of the series will propose a methodology for creating a palette of aesthetically qualified e typical kinds of projects undertaken by landscape architects in metropolitan areas.

Aesthetics, Environment, and Ecology in the Creation of Plant Palettes

A brief description of the three areas of aesthetics, environment, and ecology will help clarify how they are used to analyze selection criteria for plant palettes as the series progresses. A broad definition of experiential aesthetics is utilized for this series, summarized by John Dewey as “The *enhancement* and *intensification* of everyday experience.” This broader definition encompasses all the criteria that effect human experience and does not focus more narrowly on formal principles and visual models. Planting design aesthetics are often understood through the lens of time-honored design principles that have been used by landscape designers for millennia and are codified in many planting design books. The formal principles of balance, texture, form, scale, color theory, line, and many others are addressed briefly but are not the focus of this series. The broader definition of *experience* can be summarized as environmental psychology, cultural influences, personal growth and creativity, and the complex human responses to nature and natural systems. Aesthetics are often the focus of plant palettes because they

are an easy sell for both landscape architects and for clients. The pure imageability and experience of aesthetics sells design services and frequently defines the perceived success for both the clients and for the end users of newly constructed landscapes.

The second category, environmental issues, has been elevated as a design criteria to an unprecedented extent in recent years. Phytoremediation of air and water, reducing potable water use, increasing carbon sequestration and reducing the carbon footprint of landscapes, reducing the use of synthetic fertilizer, pesticides, and fungicides, and many other criteria that affect the quality of air, water, and climate change are directly impacted by plant palette decisions. Saving water, saving energy, and air quality are easy to understand and have direct economic impacts that are facilitating the implementation of plant palettes that respond to these important imperatives. Even in geographical areas not generally recognized as environmentally progressive, well adapted plants that save resources are rapidly making their way into the horticulture industry. For example, in North Texas it is very easy to find *Salvia greggii* (Autumn Sage) in big box hardware stores. This very drought tolerant sub-shrub, native from the Texas Hill Country to the Big Bend area of West Texas, was only available in expensive specialty nurseries as recently as the 1990s.

Ecology is by far the least addressed and understood of the three elements under discussion and can be rightly labeled an *even more* inconvenient truth. A concise definition comes from the Cary Institute (http://www.caryinstitute.org/discover-ecology/definition-ecology): "The scientific study of the processes influencing the distribution and abundance of organisms, the interactions among organisms, and the interactions between organisms and the transformation and flux of energy and matter." The challenge for landscape architects is to bridge the divide between well-established ecological systems in undesigned areas and the imperatives of development in metropolitan areas that are the focus of most of the profession of landscape architecture. Another challenge is to learn from ecologists and other natural scientists so that we can combine their knowledge and commitment to ecology with our understanding of human systems and aesthetics.

A new focus on ecology will help metropolitan areas from becoming vast kill zones for the huge variety of flora and fauna that thrived before settlement. It will also help prevent the disruption of complex biotic relationships that we may be only dimly aware of. For example, there have been a number of studies in recent years that show that the Western Fence Lizard (*Sceloporus occidentalis*) is an incompatible host for Lyme disease and actually removes it from infected ticks. The multifarious interactions between ticks, Fence Lizards, and the environment that creates a healthy lizard population is a small subset of the potential for unintended consequences that can arise from the almost total destruction of ecological systems in metropolitan areas—an unfortunate and frequent outcome of landscape development.

Microflora are another ecological concern getting increasing attention from a variety of disciplines. Doctors are beginning to focus on the relationship between the human biome and health effects ranging

from childhood obesity to ear infections. Landscape architects are also studying and implementing practices that promote the benefits of healthy colonies of microflora in soil. Eliminating the use of synthetic fertilizer and pesticides, mitigating compaction caused by construction practices, reducing overwatering, and proper selection and maintenance of native species are just a few of the factors that can lead to a healthy and productive food chain in the soil. The microbiome that begins with bacteria and fungi and moves up through protozoa, nematodes, earthworms, arthropods, and finally to birds and mammals is increasingly being understood for its contribution to the resource efficiency and long term viability of landscapes. This deepens an awareness of ecology beyond the populist realm of birds, butterflies, and bees that are often the focus of information about fauna in horticulture information sources.

A greater emphasis has been placed on ecology in the brief description of the three areas under consideration because it is the area that is most frequently a very low priority in plant palette decisions. It is a tremendous challenge to reconceptualize a plant palette that brings the three areas into a better balance—a new plant palette that mandates a rethinking of the 'cultural rules' that continue to drive planting design in the profession of landscape architecture and also requires a carefully considered reconceptualization of 'urban nature.' As the series develops, I will explain in detail a proposed methodology that can be used to create this new palette, its benefits, and how it can be a way forward towards a better balance of the three areas.

Future Viable Plant Palettes for Metropolitan Areas

Part 2: Fine Gardening

Figure 1: Dallas Arboretum: Warning sign added here in Photoshop.

This month's post begins the discussion of plant palettes and planting design approaches with 'fine gardening', a methodology that is very out of balance with the goal of aesthetic, environmental and ecological concerns. 'Fine Gardening' is an approach where the artistic intentionality of the designer and the direct sensuous experience to the user are often the only, priority. This approach is used in many high end residential projects, botanical gardens, and other landscapes where cost is not a determining factor. For example, at the new Getty museum in Los Angeles, the gardeners take the heroic measure of hand-snipping every third leaf twice a month of every branch of the London Plane trees that line the path of the famous Robert Irwin garden, per Robert Irwin's precise instructions.[i] Fine gardening is promoted heavily in many newspapers and in magazines such as *Southern Living, Fine Gardening* and many others.

Figure 2: Relative balance of Fine Gardening

Another famous example of a large fine gardening landscape is Butchart Gardens on Victoria Island in British Columbia, Canada. The garden has become a travel destination for garden enthusiasts from

around the world and is instructive for the influence it exerts on garden design thinking far from its temperate location in zone 8b of British Columbia, Canada. The spectacular displays at Butchart Gardens are made possible by the annual planting of over 300,000 non-native bulbs—geared for a three week display in April and May.[ii] The display, following time tested rules for plant combinations, combines annual bulbs with rhododendrons, flowering trees and blooming perennials to create scenes like the one shown in figure 2.

Figure 3: Butchart Garden. May

While Butchart gardens can be appreciated for its aesthetic achievement, it is problematic in that it sets a standard for ornamental display gardens that reverberates throughout North America, and throughout the world. Figures 3 shows the display garden at the Dallas Arboretum and Botanical Garden in Dallas, Texas, designed to compete on the international stage with gardens such as Butchart but in an area with a much less temperate climate. So many bulbs and other plants have been planted and so many soil amendments added that the entire 66 acre arboretum no longer has any native soil and is "like one giant pot" according to the former director of horticulture. This garden, influenced in concept by other display gardens, is a big educational resource for many of the wealthy homeowners who live in the North Texas metropolitan area. Visitors receive a tacit education in an aesthetic that they often emulate in their home and business landscapes. This transfer of values is reinforced by the types of plants tested in its trial gardens and by volunteer opportunities that reinforce the intensive gardening practices. The economic elites that are influenced by the Dallas Arboretum produce home landscapes that are often featured in popular gardening magazines and pass on the resultant aesthetic priorities to a larger proportion of the population. Additionally, the wealthy patrons of the Dallas Arboretum are both influenced by and exert an influence on the direction of the organization in a self-reinforcing loop that is encouraged by the horticulture industry. A more sustainable approach would be to educate the

Figure 4: Dallas Arboretum: Spring display

public that the Dallas Arboretum is an 'art museum for plants', designed to be appreciated as a public place and not as a landscape model for North Texas (see figure 4).

The plant trials at the Dallas Arboretum are good indicators of the priorities used to develop their fine gardening plant palette. These priorities are skewed to focus entirely on aesthetics with little consideration of environmental concerns or ecology. The four criteria evaluated are display, uniformity, leaf color, and vigor[iii]. It is assumed that all horticultural considerations can be mitigated, with the possible exception of temperature. Several times a year the Dallas Arboretum sends out breathless e-mails and promotes results of its trials on its website. For example, in 2015 the Arboretum promoted *Lobelia erinus* 'Techno Heat' as a four week cool season annual in the temperate weather between winter annuals and the installation of summer annuals for the hot summers in North Texas. All of the financial and environmental resources required for growing, transporting, and installing the plant are designed for a 'life cycle' of less than two months geared towards a spring color display. The misleading label in their promotions of "Trial by Flower!!! If we can't kill it no one can" makes it appear that the plant is being tested for adaptability when, in reality, adaptability to the regional climate is not a consideration in the trials for this plant.[iv]

The ethos of seasonally replacing annuals as the climate changes throughout the year is reinforced by certain sectors of the horticulture industry. I attended a plant introduction symposium held at the Dallas Arboretum sponsored by a company called Plant Development Services Inc. About half of the attendees were landscape architects and the rest were from various sectors of the horticulture industry. Plant Development Services Inc. introduced The Southern Living Plant Collection and handed out a very well-produced binder with talking points for retail distributers and for designers to help with marketing the plants to their clients. The Collection was developed in a region of acid soil ranging from the Southern Living headquarters in Birmingham, Alabama, to experts at the University of Georgia in Athens, Georgia, and shows the fallacy of creating a national plant palette using experts and resources from one particular region. Most of the Southern Living Plant Collection is composed of exotic hybrid species that can only grow in acid soils and that require moist and well drained conditions. However, the North Texas region only has only alkaline and small areas of circumneutral soils and most of the soils in the area are heavy clay and drain very slowly.

Every page promoting a plant at the introduction had the statement "Athens Select™ have been tested by Dr. Allan Armitage at the University of Georgia, and selected for superior performance in extreme heat and humidity. Purchase of these plants helps support university research programs."[v] The introduced plants had the imprimatur of The Dallas Arboretum (having been introduced by their director of horticulture), the very popular Southern Living Magazine, and the research of the University of Georgia. As a result, the attendees of the introduction seemed to be sold on the palette even though most of the plants are very poorly adapted to North Texas and require vast resources to create the horticultural conditions that would make their survival possible. It is easy to understand how a lay person who is honestly seeking horticultural advice could be as convinced as the attendees seemed to be and would heed the advice to both buy the plants and to expend the monetary and environmental resources required for their success.

Another environmentally destructive horticultural practice tied to fine gardening is actively promoted by Plant Development Services Inc. and their Encore Azaleas brand. The company still advocates the addition of Canadian sphagnum peat moss to North Texas soils in order to make the soils compatible with the needs of these very poorly adapted exotic plants.[vi] "Peatlands only cover about 3 percent of the Earth but they accumulate more carbon than tropical rainforests".[vii] These carbon sinks, that have been sequestering carbon for over 500 million years, are mined for the soil amendment that makes growing Azaleas possible in North Texas. Additionally, 80% of the Peat that is used in The United States is shipped from Canada which greatly increases the carbon footprint of the material. It is time for all landscape architects to remove from their specifications the destructive environmental practice of using plants that require peat moss and past time for Arboreta to still permit companies, such as Plant Development Services Inc., to actively promote the practice at symposia and plant promotions at their facilities.

The focus by the fine horticulture industry and enthusiasts on exotic poorly adapted hybrid plants and a 'no holds barred' acceptance of environmentally destructive practices such as soil amendments from distant locations is represented in figure 1. All plants provide some environmental and ecological services, however inadvertent, so this has been indicated. It is also possible to undertake fine horticulture using organic methods rather than chemicals. While highly preferable, this is still a very resource intensive undertaking as the organic soil amendments and pesticides required for success must be manufactured, transported, and installed with the resultant pollution and large carbon footprint an unavoidable consequence.

[i] see http://blogs.getty.edu/iris/pollarding-the-getty-knuckle-trees/#sthash.eANOM877.dpufIt Accessed 10-15

[ii] http://www.butchartgardens.com/gardens/plants. Accessed 1-2015

iiiLobelia erinus Techno Heat Dark Blue
http://www.dallasplanttrials.org/index.cfm?
fuseaction=plants.plantDetail&plant_id=7698&whichname=genus&ye ar=2013. Accessed 1-2015

iv For a list of summer annuals recommended by the Dallas Arboretum see
http://www.dallasplanttrials.org/index.cfm/fuseaction/home.showpage/pageID/38/index.htm

v Southern Living Plant Collection printed information on individual plant species, 2009

viSpecial Tips for North Central Texas. http://www.encoreazalea.com/garden-advice/article/special-tips-for-north-central-texas. Accessed 1-2015.

vii Bielo, David, 2009. Peat and Repeat: Can Major Carbon Sinks Be Restored by Rewetting the World's Drained Bogs? http://www.scientificamerican.com/article/peat-and-repeat-rewetting-carbon-sinks/. Accessed 1-2015

Future Viable Plant Palettes for Metropolitan Areas

Part 3: The National Green Industry 'Utility' Plant Palette

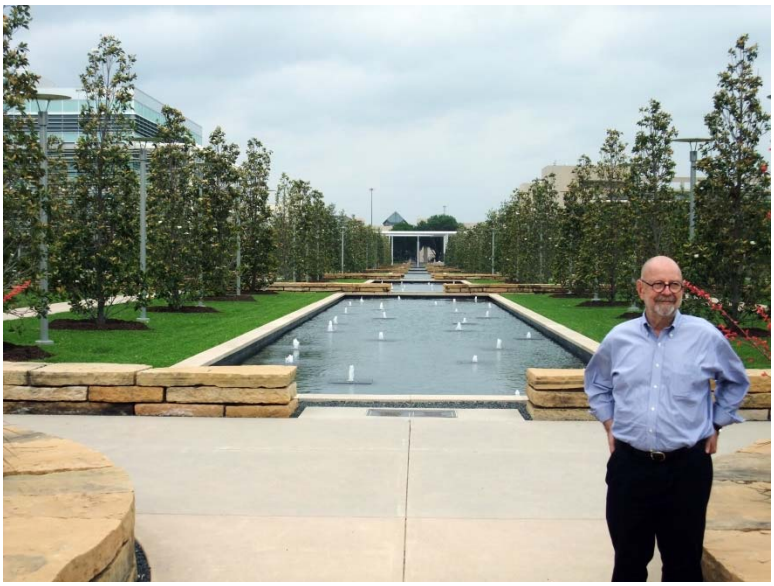

Figure 1: (2011) Peter Walker, FASLA stands in front of his redesign of the UT-Dallas Campus featuring exotic turf and tree species.

The next step forward in moving towards a better balance of aesthetics, environment, and ecology has flourished since the latter part of the 20th century with the introduction of better adapted plants by the national horticulture industry. These are the 'workhorses' used by landscape architects to cover large areas of ground in landscape development and to provide the structure and spatial definition desired for landscape designs. They are hybridized species of turf, groundcovers, annuals, perennials, shrubs and trees that are rarely indigenous to the areas where they are planted. The massive scale of the areas in the United States covered by these plants makes them the primary target for the aesthetically qualified native polycultures that are the subject of this series. Turfgrasses alone cover over 63,000 square miles—about the size of the State of Florida—and may be the largest irrigated crop in the United States[i].

As in part 2 of this series on fine gardening, the priorities of the companies and the plant palettes they produce are revealed by examining the search functions on their websites. These websites show what the companies want their customers to look for and, significantly, what is missing from the thinking that is reflected in the plant palettes produced.

One of the largest companies that grows plants for distribution on a national scale is Monrovia. The database they have created for plant searches features many useful criteria such as size, shape, habit, hardiness, water and light needs, flower and foliage color, landscape use criteria and garden styles, and special features such as Deer resistance and 'North America Native Selection'.[ii] However, using their search engine it is not possible to find plants that are native to a particular biome or region, any plant

soil preferences, plant heat tolerance for non-temperate areas, the preferred biome of plants, any associated plants that grow as a community, or even such basic information as whether the plant is an upland plant or a lowland plant. To test the Monrovia database, I searched for a very common horticultural condition in North Texas; a low water use groundcover for shade that is a 'North American native selection' hardy to Zone 8. Despite the thousands of species and varieties in their database, the search yielded no results. Changing the criteria to shrubs also produced no results. Taking away the 'North America Native' requirement only produced two results for groundcovers. This is an unfortunate result from this large grower that currently has almost 5,000 acres in production and sells plants to nurseries throughout the United States, including most nurseries and big box retailers in North Texas where I live.

Figure 2: *Ligustrum Quihoui* (Chinese Ligustrum) in Crystal Canyon Natural Area, Arlington, Texas being removed by students from the University of Texas at Arlington.

Figure 2: *Nandina domestica* encroaching into Crystal Canyon Natural Area, Arlington, Texas

Figure 4: Dallas Arboretum e-mail promoting exotic and invasive Winter Honeysuckle

Another serious problem with the mainstream corporate plant producers is the continued production and promotion of ecologically destructive and invasive exotic species. Some of the plants are capable of taking over a complete biome and supplanting entire categories of native species. The ability of these plants to thrive in undesigned areas varies greatly by region. However, there is little to no attempt to tailor regional plant palettes promoted to nurseries based on this important criteria. Figure 2 shows Waxy Leaf Privet (*Ligustrum Quihoui)* infesting large areas of woodland in North Texas. Hundreds of volunteers spend thousands of hours each year removing this plant that was very popular with home gardens and is still available for sale. The plant illustrates the fine line between a well-adapted exotic plant and a plant that will escape cultivation and wreak havoc with regional plant communities—a line that can change as a region gets wetter, dryer, warmer, or cooler with the increasing pace of climate change. Changing weather patterns can tip the balance in their favor and quickly destroy the complex plant and other ecological relationships between the indigenous flora and fauna

that have taken millennia to establish. The encroaching Nandina shown in figure 3 is currently a minor threat in North Texas. However, warmer temperatures and continued promotion and sale of varieties with viable berries could add this species to Waxy Leaf Privet as a threat to native understory trees, shrubs, and groundcovers in North Texas.

Figure 4 shows an e-mail sent from the Dallas Arboretum February 18, 2014 promoting a Honeysuckle that is listed on the Invasives of Texas Database as a serious threat.[iii] I was sold this species by accident last year at a specialty nursery. I was looking for the North Texas Native *Lonicera albiflora* (White Bush Honeysuckle) but was mistakenly sold this plant. As soon as I saw and smelled the blooms, I realized the mistake and removed it. The vast majority of people would have bought the plant and not realized the error, or most likely considered that it might be an issue. It is another example of the importance of changing the priorities of institutions that *should* be promoting local plants and ecology away from a narrow focus on aesthetics—a focus that is problematic when scaled up to millions of residents in a given area.

A third major problem with the mainstream horticulture industry is the continued promotion of monocultures rather than more diverse groups of plants. A recent consequence in North Texas has manifested in the hybrid Knockout Rose. Knockout has become so popular in recent years that it is often the only Rose variety specified for a large landscape design. Additionally, the traditional gardening practice of mixing roses with companion plants such as Society Garlic, or Artemisia 'Powis Castle' has been abandoned. These plants have traditionally been added to help deter garden pests and to help prevent the spread of viral diseases such as the Rose Rosette explained in figure 5.[iv]

Figure 5: Photograph of sign at Fort Worth Botanic Garden

the large monoculture communities promoted by the national green industry are also less resilient than more diverse communities of plants to changes in rainfall patterns, swings in temperature, ice and snow storms and all the other environmental and horticultural vagaries that challenge plants on a regular basis. A very clear example of this confronts every landscape designer who studies an installed planting design over a period of many years. After five or ten years, a significant percentage of the perennial species installed will have died out for various horticultural reasons (often overwatering) and because it is very hard for designers to find accurate information on the longevity of herbaceous perennials. It is not unusual for the entire landscape palette to be left with only three or four species—approaching monocultures and their problematic aspects. This phenomenon has also been documented in natural communities where severe drought can lead to species extinctions in prairies.[v] In both natural and the man-made planting designs, a wider and more diverse plant palette

will assure that even if a significant number of species are lost, there will still be enough variety to maintain a diverse and resilient plant community.

The relative balance of the corporate plant palette developed and promoted since the mid twentieth century is shown in figure 6. The diagram indicates that environmental factors are better in balance than with the fine gardening palette from post 2 of this series; due to the palette being somewhat better adapted. However, the continued reliance on large amounts of supplemental irrigation in dryer areas and the promotion of synthetic fertilizers and other chemicals keeps this palette from achieving an optimal environmental balance. The ecology portion remains the same as with a fine horticulture palette since native plants are frequently a very minor consideration and native plant communities, and their connection to the local ecosystem are not a feature of this plant palette.

Figure 6: relative balance of national green industry plant palette

[i] Bormann, F.H., Balmori, D., Geballe, G.T., 2001. Redesigning the American Lawn: A Search for Environmental Harmony. Yale University Press, New Haven.
http://scienceline.org/2011/07/lawns-vs-crops-in-the-continental-u-s/ Accessed 12-22-2016
[ii] Monrovia Plant Catalogue Database. http://www.monrovia.com/plant-catalog/. Accessed 1-2015.
[iii]Invasives Database. http://www.texasinvasives.org/plant_database/detail.php?symbol=LOFR. Accessed 1-2015
[iv] Druitt, Liz, 2004. *The Organic Rose Garden*. Dallas: Taylor Publishing Company
[v] Tilman, D., El Haddi, A., 1992. *Drought and biodiversity in grasslands*. Oecologia 89, 257–264.

Future Viable Plant Palettes for Metropolitan Areas

Part 4: Contemporary Native and Adapted Plant Palette

Figure 1: Subdivision entrance planting design using a native and adapted plant palette. Design and computer model by David Hopman, ASLA, PLA

The rise in research and the popularity of using native and adapted plant palettes can be traced to the work of the Colorado Water Board in the early 1980s.[i] They coined and copyrighted the term 'xeriscape™,"a combination of the word "landscape" and the Greek word "xeros," which means dry".[ii] Other terms have been created for similar approaches in other areas. In North Texas the term used by the North Central Texas Council of Governments is 'Texas Smartscape™'. According to their website, the program is designed to "Conserve water and save $Money$ on your water bills; beautify your home and local environment; attract native butterflies, hummingbirds and other wildlife; and prevent / help reduce storm water pollution!"[iii]

The native and adapted plant palette has made a large improvement to the environmental cost/benefits ratio of using plants for ornamental horticulture. The prime driver has been water savings, a subject that many people can relate to, including people who are not focused on other environmental issues or who may be primarily looking to save money and reduce maintenance. The gardening approach using this palette is flexible and can even approach fine gardening standards while using far less resources. The focus of designs using these plants is usually still discreet monocultures, or 'drifts', of single species of plants using, unity and contrast techniques derived from traditional principles. There has been a trend in

recent years towards more naturalistic intermingled plant combinations using this palette as well. It has been very well promoted by government, industry, the design community, and academia, thereby hastening the adoption of this important innovation. Plants that were very hard to find and very expensive a few years ago can now be found at very low prices in many big box retailers.

The native and adapted plant palette is currently the state of the art when it comes to a proven and commercially-viable environmentally friendly strategy for selecting plants. It is the one that the most forward thinking-landscape architects and garden designers use. Some of the tenets have even been written into landscape ordinances in drier parts of The United States. It is flexible, cost effective, and there is ample information easily available to train designers for success.

Figure 1 shows a proposed design for a subdivision in North Texas that used this approach. The design plays off of the Butterfly logo of the subdivision, has plants designed to attract Butterflies, and is evocative of the shape of a Butterfly wing. The Blue plant, *Conoclinium coelestinum* (Blue Mist Flower) is the only plant in the design that is actually native to North Texas. It blooms in the fall when hungry Monarch Butterflies are slowly migrating South through the area. Other adapted plants used include Zexmenia (*Wedelia hispida*), Autumn Sage (*Salvia Greggii*), Dwarf Yaupon Holly (*Ilex vomitoria nana),* and Iris sp. I designed this garden in 2012 and have been using this approach in both professional work and teaching since 1995.

As the example above shows, Texas Smartscape™ and other similar plant palettes of adapted plants are not very useful, though, if native plants and local ecology are a consideration. Searching the Smartscape™ database for the same drought and shade tolerant palette as was done with the Monrovia search in Field post 3 of this series yielded only four native plants (versus none on the Monrovia site). One of them (Violets) was listed as *Viola sp.* which would almost certainly point a purchaser to an exotic hybrid such as *Viola odorata* since the native species, *Viola missouriensis,* is difficult to find for sale in North Texas.

In January of 2015 the overall Smartscape plant list had 115 species listed as native and 122 listed as exotic. Of the 115 native species listed, at least 30 are not native to the area that is the target of the Smartscape program—North Texas. This is a big improvement over the national corporate plant palette but still leaves a long way to go to get into balance from the standpoint of local ecology. Additionally, with 2/3 of the well adapted species not native to the region, there is a much greater chance of accidentally introducing invasive exotic species.

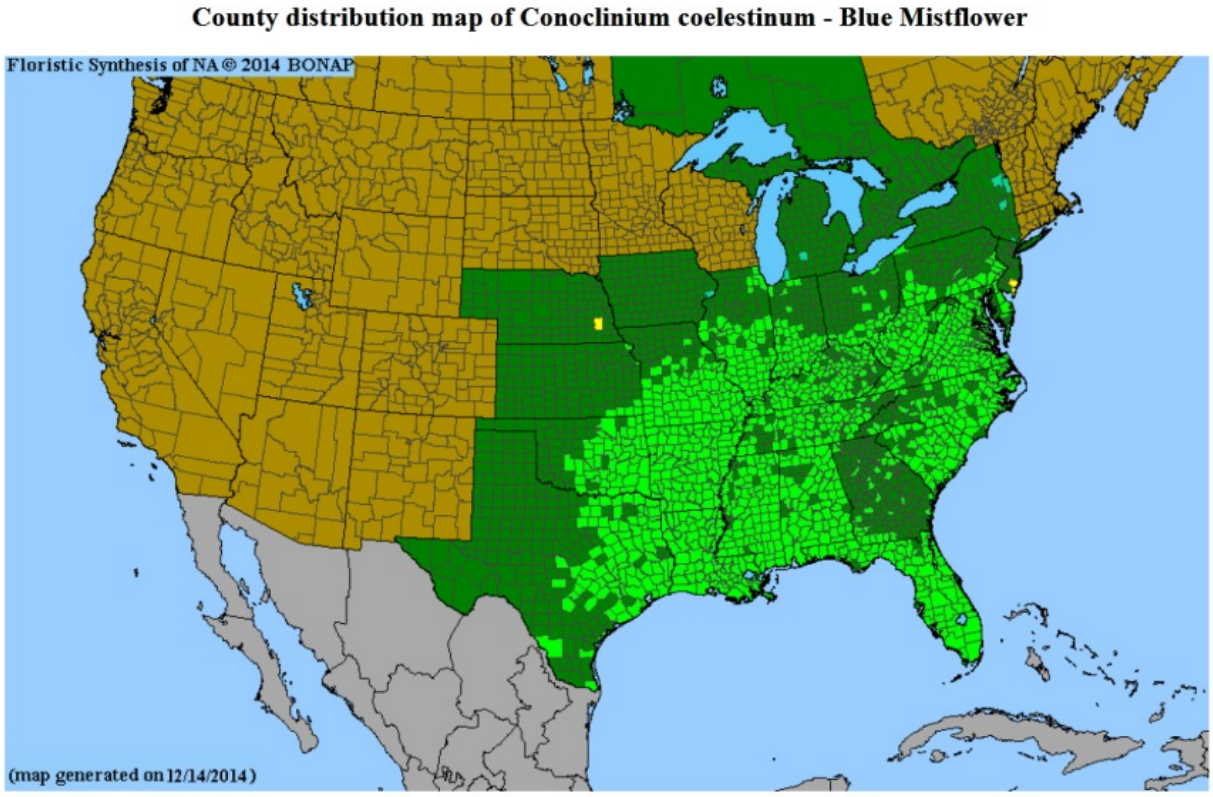

Figure 2: County distribution of Conoclinium coelestinum generated by BONAP

Readers of this post are encouraged to check their local sources of native and adapted plants for indigenous species by consulting BONAP-The Biota of North America Project – http://bonap.net/tdc. At Bonap, you can see an up-to-date nationwide county by county GIS of over 24,000 plant species growing in unmanaged areas that have been found and documented by reputable botanists. The plants are classified in maps produced by database queries as native, adventive, exotic and more. One of the most useful ways to use BONAP is to see where the location of your planting design is relative to the nationwide distribution of a plant. For example, in my area if a plant is native from North Texas East as in figure 2, it will probably be a lowland plant in North Texas because of a 1" increase in yearly rainfall for every 10 to 15 mile move to the east. If it is native from North Texas west, it is most likely more drought tolerant and will be more useful as an upland plant in North Texas. Similar correlations can be made with North/South distributions and cold hardiness. I am always pleased to find an attractive and useful plant that is endemic to one or two states in our part of the world. These plants offer unique opportunities to contribute to the regional character of a design and to impact the local ecology with a plant that is probably not typically grown by the national horticulture industry and may even be endangered.

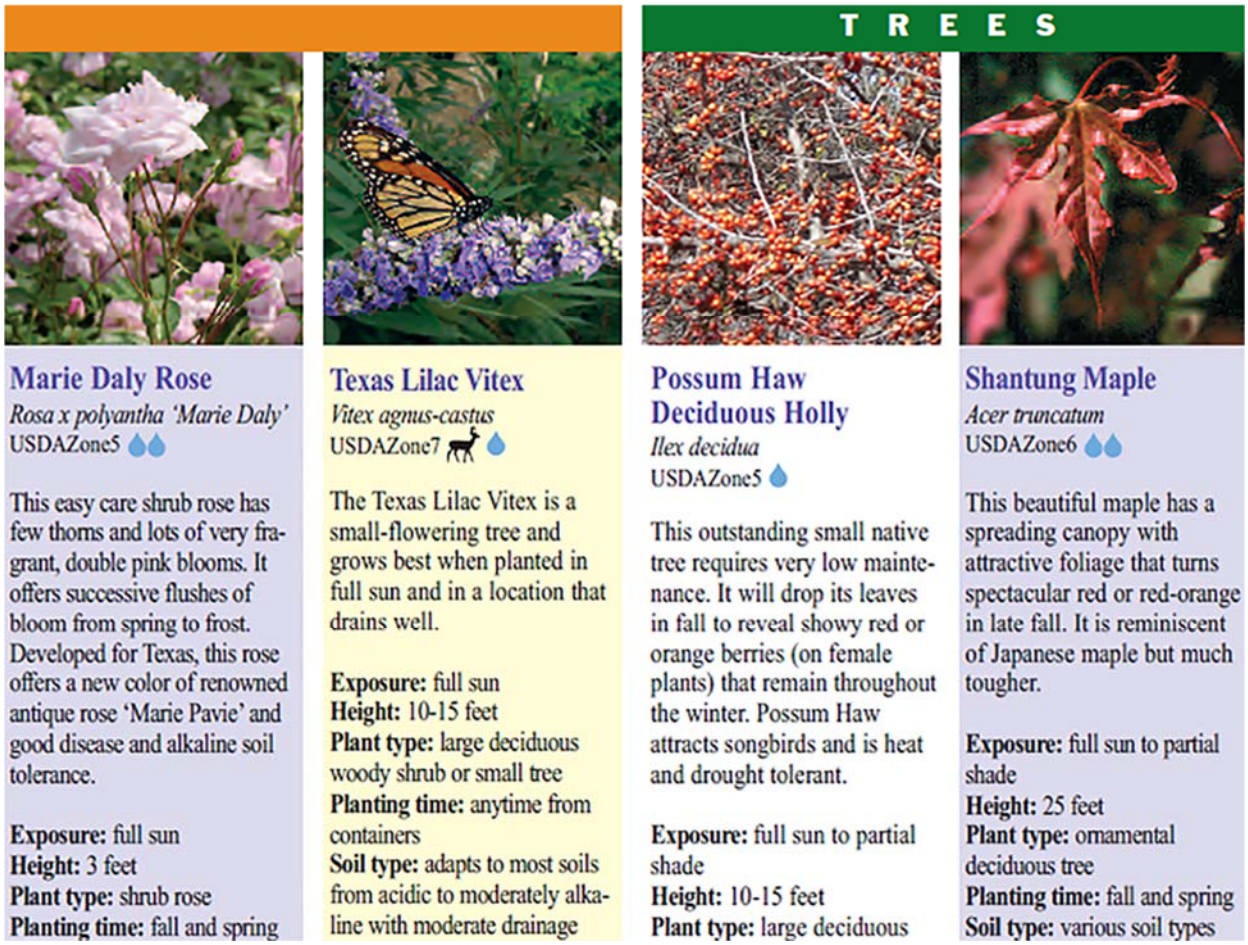

Figure 3: 'Texas Superstar' plants from Texas A&M

The most heavily promoted university based program in Texas that develops adapted plants for the horticulture industry is called the 'Texas Superstar' program, which has been developed and promoted in cooperation with Texas A&M University. The Texas Superstar brochure lists plants for the entire state with little regard for the nativity or regional ecological appropriateness of plants for specific biomes.[iv] Of the 41 plants that are promoted to both the horticulture industry and to designers and homeowners, only seven are native somewhere in the state of Texas. Interestingly and confusingly, one of the plants is called 'Texas Lilac Vitex' although the plant is in actuality a native of the Mediterranean region and Asia (*Vitex agnus-castus*). Figure 3 shows a sampling of plants from the 'Texas Superstar' list with three exotic and one Texas native (*Ilex decidua)*

The Smartscape, Texas Superstar, and other similar programs throughout the United States provide an expectation of aesthetics that is almost impossible to reproduce using a palette of native plants. It is a similar ornamental display ethos as the one featured at Butchart Gardens and the Dallas Arboretum from field post 2 of this series, but with plants that use fewer resources, especially water. The unique regional character of plants is not fully taken advantage of with a reconceptualization of the approach to planting design that better accounts for what native plants have to offer through the seasons. This character may not be as conspicuously or as consistently floriferous and controllable as using a palette of hybridized and exotic plants from around the world. Taking advantage of the seasonal attributes of

native flora is a prime benefit of using a diverse palette of aesthetically qualified native urban polycultures. The native plants bring a more subtle beauty to the landscape that is tied to the climate, soil, and biota as well as the unique aesthetics of the region.

Figure 5 illustrates the balance of the native and adapted plant palette as explained in post 1 of this series. It shows that it provides very good aesthetics, environmental considerations have improved, and ecology has also improved. However, the fundamental approach to planting design for most designers and the growing, but still limited, use of native plants keeps the ecological portion from moving into better equilibrium.

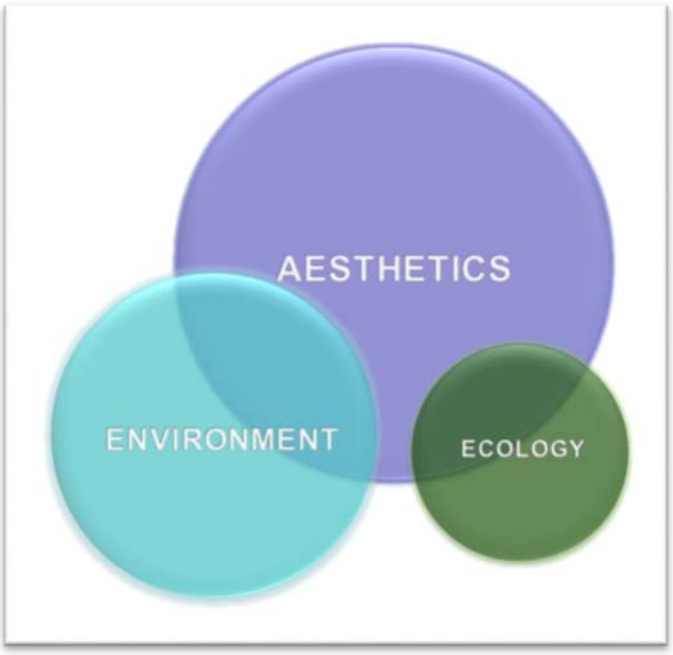

Figure 4: Aesthetic, environmental, and ecological balance in the contemporary native and adapted plant palette.

[i]Denver Water Board. Xeriscape Resources. http://www.denverwater.org/Conservation/Xeriscape/XeriscapeResources/. Accessed 1-2016
[ii] Denver Water Board. Xeriscape. http://www.denverwater.org/Conservation/Xeriscape/. Accessed 1-2016
[iii]North Central Texas Smartscape. http://www.txsmartscape.com/ Accessed 1-2016
[iv]Texas Department of Agriculture. Texas Superstar. http://texassuperstar.com/press/Superstar_13_rev2.pdf Accessed 1-2016

Future Viable Plant Palettes for Metropolitan Areas

Part 5: Lessons from the Bush Presidential Center: Local Consultants and Urban Prairies

Figure 1: Bush Center south Terrace on opening day in 2013-photo by David Hopman

The G. W. Bush Presidential Center landscape is a good point of departure for a discussion of a variety of strategies for future viable plant palettes. There were three relevant strategies employed for selecting plant species.

1. Using local consultants to check species for regional appropriateness,

2. Recreating a local prairie ecosystem in an urban context using ecological restoration consultants, and
3. Using an aesthetically qualified native polyculture

The Bush Center is a 23 acre campus near downtown Dallas that features four distinctly different plant palettes. Almost the entire campus, designed by Michael Van Valkenburgh and Associates, Inc., is designed with sophisticated sustainable strategies. A small internal Rose garden, however, uses a more traditional green industry plant palette and demonstrates a good balance of a small area of resource intensive exotic species within a large, biologically diverse, resource efficient landscape—with many species of native plants.

Strategy 1: Using local consultants to check species for regional appropriateness

The South Terrace of the Bush Center (figure 1) is a transition zone from the cultural landscape of primarily lawn on the north side of the campus to the prairie re-creation on the south side (see the plan at http://www.mvvainc.com/project.php?id=14). As part of their design process, the landscape architects were referred to three local plant experts by the Dallas chapter of the Native Plant Society of Texas. They were Carol Feldman, PLA, David Hopman, PLA, ASLA, and Dr. Peter Schaar.

Texas, as in many parts of the country, has a very complex and diverse matrix of biomes that reflect the rapid drop in rainfall as one moves west, and the frequent changes in soil conditions that mirror the interlaced fingers of the underlying geology. It is a difficult area to understand ecologically without the benefit of considerable study and experience. Large landscape architecture firms with a broad national practice frequently design projects here since it is one of the most rapidly developing areas of the United States. These firms often make questionable plant palette decisions so I was very pleased when the three of us were invited to participate in a portion of the design process.

At the beginning of the process, it was evident that the lead designers were focusing on a plant palette more appropriate for the much drier climate west of the DFW area. With a relatively small amount of effort, we were able to steer them towards more regionally appropriate species for the native and adapted plant palette on the South Terrace (figure 1) without impinging on the control of the planting design by the prime consultants. This effort showed that for a very nominal expenditure of time and money, it is possible to use local consultants to fine tune a regional plant palette in a location distant from the home base of a designer. The barriers to adoption of this important practice are not financial. They are ideological (i.e. is it important enough to make the effort to find the best consultant for the project?) and, perhaps competitive. Either way, to make a native and adapted plant palette more future viable, we must find a way around the obstacles and find qualified forward thinking regional consultants. Perhaps we need a new category of consultants that understand landscape architecture and development, but are not inclined to poach clients or biased to promote their existing plant inventory or other green industry business. A brief survey of North Texas firms and my personal office experience indicates that local consultants are frequently used. This raises a number of important questions;

1. Who are the most appropriate local professionals to consult who understand and can balance the horticultural requirements of development conditions and the poetics of the local native plants and natural systems?
2. Are currently used local consultants moving the plant palette in a more future viable direction or are they a force that is maintaining the status quo?

Responses to these questions and other experiences with regional plant consultants are welcome below. I will summarize the comments in a future post.

Strategy 2: Recreating a local prairie ecosystem in an urban context using ecological restoration consultants

The Bush center features 8.6 acres of restored prairie plants consisting of Prairie and Savannah, a Wildflower Meadow, a Wet Prairie, and Bioswales[i]. The entire system of plants was aided in the design process by the Ecosystem Design Group at The Ladybird Johnson Wildflower Center at The University of Texas at Austin as well as regional native plant growers. The Design Group provided an initial site assessment, reviewed soil specifications, recommended plants, and developed a 5-year maintenance and operation plan to control invasive species. The prairie restoration has been successful from a plant establishment standpoint. It does, however, raise a number of important issues related to the *idea* of utilizing a high use area in a densely populated city as a restoration opportunity.

The Problem with Prairies in Metropolitan Areas

Using a complete prairie plant palette to accomplish a prairie restoration in metropolitan areas can be highly problematic. Prairies are hazardous to traverse on foot because of insects, and also inhospitable to most forms of human activities that are a feature of urbanizing areas. For example, there is a microscopic insect in prairies called a chigger that appears in the summer months. The chigger larvae (about 1/100 inch in diameter) are parasitic. Once a larva finds a host, it typically feeds for 3 days before dropping off to digest its meal and molt into its next life stage.[ii] Unprotected people can suffer with hundreds of bites if a particularly dense infestation is encountered. Unfortunately, there is no way to tell if you have been infected until two to four hours after exposure when the itching and swelling on the skin begins. Chiggers can be controlled using an insect repellent with DEET or by using sulfur as a repellent, but this requires forethought and constant vigilance, and may represent a larger human health problem than the chiggers themselves. Chiggers are not life threatening, but they are very uncomfortable and one of the elements that add to the general perception of prairies as places that are best avoided. Preference studies using photo elicitation have shown that the grasslands that were once the predominant biome of the Great Plains region of the Unites States area are one of the least popular types of natural landscapes, compared with the favorability ratings for mountains, rivers, forests, and large water bodies[iii] Figure 2 was photographed during opening day at The Bush Center when tens of thousands of people were passing through the new Presidential Center. On the same day and with perfect weather, the prairie park was almost completely deserted and I had to wait over 15 minutes to capture the scene in figure 2 with people in it.

Figure 2: Bush Presidential Center prairie restoration on opening day, May 4, 2013. Photo by David Hopman

Another problem with prairies is their general incompatibility with most human activities. One cannot throw a Frisbee, play a ball game, or walk a dog on a prairie. The prairie is, in effect, a large ecologically constituted view garden. There is not a way to inhabit a prairie with its mix of grasses and forbs without trampling them. Additionally, many prairie plants need full sun; not the ideal condition for human comfort in hot Midwestern areas with increasingly warm urban heat islands. Treeless prairies are also not compatible with the imperative to cover hard metropolitan paving surfaces with biomass (trees and vines) for shade, thereby helping to mitigate the urban heat island, air pollution, and urban hardscape stormwater runoff.

The duration of prairie plants is another significant impediment to prairie restoration in metropolitan areas. Many of the more than 200 species of plants typically found in a mature prairie are annuals that survive the extreme disturbances in the Great Plains as seed. These seeds have strategies for widespread disbursement by ingestion, wind, attachment to fauna, etc. These strategies are very effective for large areas of prairie where there is room for these dispersal mechanisms to be effective. However, metropolitan planting areas tend to be in small patches that are mostly edge conditions, and the edges are where aggressively reseeding exotic invasive species are most likely to take hold. The combination of exotic invasive species pushing in from the edges and the problematic dispersal systems of many of the native annuals makes a historic mix of native prairie plants only suitable for areas of sufficient size. For smaller patches, the aggressive exotic annuals often outcompete the native prairie annuals, which will quickly disappear. Encroaching native annuals can also be an issue as the planting designer loses control

of such basic urban imperatives as the height of the planting and the erosion control of small planting areas. The creative aesthetic components of the design will also be impossible to maintain with a plant palette that changes dramatically from year to year, especially with the relatively unsophisticated maintenance work force used in most landscapes.

Finally, the economics of restoring prairies in urban areas create a missed opportunity to make a more significant impact on regional ecology. For the exorbitant cost of a single problematic acre of restored prairie in an urban area it may be possible to restore 500, or even 1,000 acres in a rural area—patches that are of sufficient size to support the diverse biology required for a true prairie ecosystem (see figure 3).

Midwestern prairies are beautiful, fascinating, and critically important biomes for environmental services and ecological diversity. The Bush library is providing a service to the people of Texas and visitors from throughout the world by serving as a museum for this important and endangered feature of the native Texas landscape. The contention here, however, is that this prairie restoration should not be a model for more widespread use throughout the DFW area in the same way that the large ornamental display gardens from post 2 of this series should not be a model for widespread adoption.

Figure 3: 13.5 square mile Konza Prairie in Kansas—late March during a spring burn. Pictured is Kansas State professor Chip Winslow. by David Hopman

Figure 4 documents the relative balance of a prairie restoration plant palette in an urban area showing very good environmental and ecological performance but a lower emphasis on human use and enjoyment.

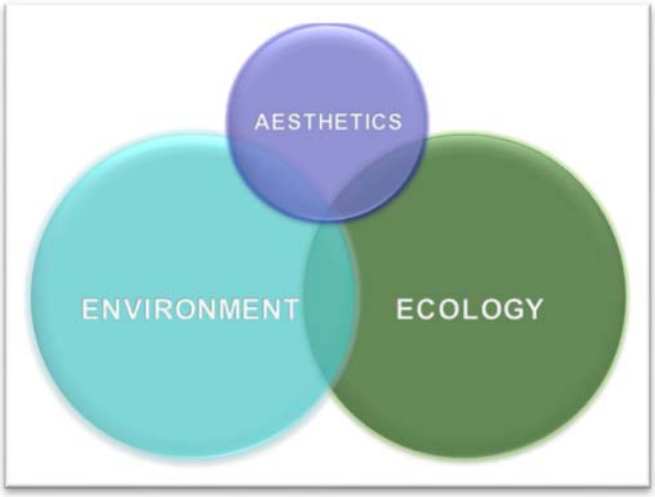

Figure 4: Aesthetic, environmental, and ecological balance in a prairie plant palette

[i] See http://www.bushcenter.org/sites/default/files/GWBPC%20Prairie%20Plant%20List_20130508.pdf for a complete listing of plant species. Accessed 1-3-2016

[ii] Moore, Glen C. and M.E. Merchant. *Chiggers*. https://web.archive.org/web/20140811110743/https://insects.tamu.edu/extension/publications/epubs/e-365.cfm. Accessed 12-2015

[iii] See Bourassa, Steven C. *The Aesthetics of Landscape*. London: Belhaven Press, 1991, 121-132 for a discussion on landscape preferences.

Future Viable Plant Palettes for Metropolitan Areas

Part 6: Native Plant Turf Polycultures

Figure 1: Unmowed HABITURF® at the Bush Presidential Center in Dallas, Texas

Post 5 of this series introduced three relevant strategies at the new Bush Presidential Center that were employed to select future viable species of plants. The first two, using local plant consultants and recreating a local prairie ecosystem, are addressed in post 5. This month's post will focus on the third strategy, using an aesthetically qualified native polyculture for large areas of turf at The Bush Center.

The idea of using a palette of indigenous (actual native) plants is currently largely the purview of a small relatively sophisticated cadre of native plant specialists and enthusiasts. Reconciling two points of view—the desire to restore complete ecological ecosystems with their environmental and ecological benefits, and using native and other adapted plants with a more traditional design approach, requires a reconceptualization of natural plant communities within a cultural context. This difficult problem must first be addressed at the macro scale by finding the most appropriate native ecosystems, within the overall biomes, that are most practical and useful for the extraction of species for a new environment, the 'new nature' created by development conditions in metropolitan areas. It must then be addressed at the micro scale by constituting the details of this new synthetic environment, the particular plant palette, so that it meets biological, cultural, personal, and environmental goals and achieves a better balance of the three areas of aesthetics, environment, and ecology. The native turf polyculture used at the Bush Presidential Center was created using both of these strategies.

What's in a name?

When I first began seriously studying the idea of carefully selected groups of native plant species growing and intermingling together I referred to the result as 'recombinant urban corollaries for regional ecological communities'. Later, I decided that this was not really descriptive because the main goal of the process is not to create complex new plant communities, but rather to balance ecology with environmental performance and, importantly, aesthetics and human use. I then thought of calling them 'guilds' but the term is overly tied to permaculture and sustainable farm practices—the kinds of practices taught to the earliest pilgrim immigrants to America by the native Indians such as growing corn, squash, and beans together. The Ladybird Johnson Wildflower Center prefers to call native groups of plants 'assemblages'. This works, but is not really descriptive as any group of plants growing either intermingled or in discreet monocultures can be called an assemblage. I settled on polycultures to distinguish the practice from single species of monocultures. 'Polyculture' also has a strong history in agriculture but is redefined here within an ornamental horticulture context.

Recombinant Turf Polycultures

Aesthetically qualified recombinant native plant polycultures are not intended to entirely supplant a more traditional planting design approach that uses native and well adapted plants. They are rather intended to replace a portion of the millions of acres of monoculture groundcovers that are currently grown in metropolitan areas of the United States. Turfgrasses alone are the largest irrigated crop in the Unites States covering over forty million acres, of which 25 million acres is residential lawn that uses 30-60% of all the potable water in The United States.[i] A number of native turf polycultures have been developed and introduced into the horticulture industry, primarily planted by seed. Research has revealed a number of benefits of these turf mixes when measured against monocultures of native or non-native turf species. These benefits include:

1. More efficient use of resources,
2. greater plant community stability,
3. more resistance and resilience to seasonal climatic fluctuation and disturbance,
4. more resistance to weed invasion,
5. reduced herbicide applications,
6. reduced pesticide applications, and
7. more resistance to pathogens.[ii]

A detailed discussion of the benefits of polycultures will be the subject of a future post.

Native turf mixes are appropriate for the regions they were designed for and become less ecologically appropriate farther away from the source of production. For example, S&S Seeds makes a variety of native lawn mixes that are only designed for and appropriate to the state of California. It should be noted that these seed mixes are not the same thing as 'no mow' blends which can be either native or exotic introduced species, or even invasive plants. Prairie Nursery, High Country Gardens, and Wildflower Farm manufacture and market non-native low mow turf mixes more in keeping with the

ethos of saving water and other resources than with ecological considerations. Creating seed mixes with regionally native plants and only marketing them to the regions where they are produced is the only way that native turf polycultures will make their way into appropriate regions where the plants are actually indigenous.

Figure 2: detail of unmown HABITURF® at the Bush Center

A good example of a mix that uses native species, called HABITURF®, was developed at the Ladybird Johnson Wildflower Center at The University of Texas at Austin. HABITURF® is a blend of *Bouteloua dactyloides* (Buffalo Grass), *Bouteloua gracilis* (Blue Grama), *Hilaria belangeri* (Curly-Mesquite), and others. This turf blend is designed to 'read' as a fine bladed monoculture despite the diversity of species. The grass species selected for the turf mix at the Bush library have been aesthetically qualified to blend together by selecting for height, color, and texture, as well as for horticultural considerations and their turf-like growth patterns. The diversity of species helps mitigate the problems associated with each individual species such as poor density, susceptibility to invasion by weeds, and a tendency toward dormancy when under stress (Buffalograss), and slow spreading and color issues (Blue Grama). HABITURF® can be left un-mown in which case it will have a succession of seed heads that may or may not be desirable, or can be mown every two to four weeks for a more traditional and formal lawn appearance. The height to maintain the HABITURF® at The Bush Center is a big topic of discussion between people who like a more traditional lawn look and people who enjoy a short grass polyculture with plants expressing their form as they would in the wild.

Figure 3: HABITURF® winter character at the Bush Center

At the present time, the online brochure that describes HABITURF® shows a map of all of Texas, Oklahoma, New Mexico, and Arizona as the appropriate region for the mix.[iii] However, two of the three main grasses in HABITURF® are not native to East Texas (Curly Mesquite and Blue Grama) and even the popular Buffalograss is only rarely found in Arizona and is sometimes considered an invasive

Figure 4: HABITURF® spring character at the Bush Center

species that is changing the native ecosystems there. Landscape architects should consult BONAP (see post 4) to test the regional appropriateness of any seed mix specified.

Figure 4 represents the balance achieved with the HABITURF® polyculture at the Bush Center. Human use and aesthetics have been balanced with a more diverse palette of plants that enhances both the ecological services and the biological diversity of the planting design. Native turf polycultures require less water, fertilizer, and maintenance than many monoculture turf species and provide a much better balance of aesthetics, environment, and ecology.

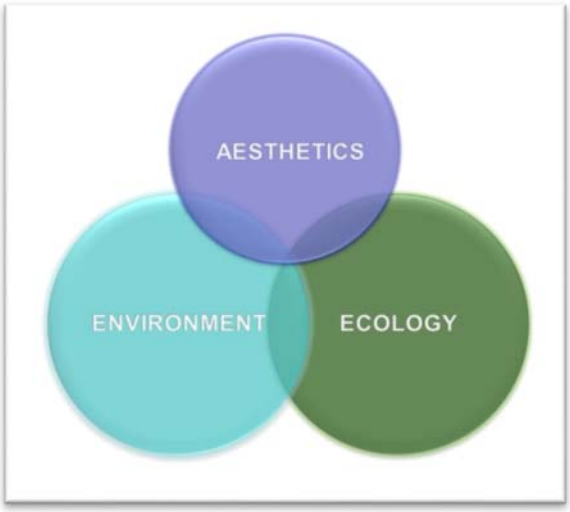

Figure 5: balance of native turf polyculture

Native grass mixes are an important beginning for the range of polycultures that must be constituted for the myriad horticultural niches and varying aesthetic requirements typically needed for planting design in metropolitan developments. Landscape architects can take an incremental approach to adoption of this important innovation. Next month's post will discuss strategies I am using to gradually develop a palette of workable aesthetically qualified native polycultures from the native plants I already know and use.

[i] Mark Simmons, Michelle Bertelsena, Steve Windhager, Holly Zafianb, *The performance of native and non-native turfgrass monocultures and native turfgrass polycultures: An ecological approach to sustainable lawns*, Ecological Engineering Volume 37, Issue 8, August 2011, Pages 1095–1103

[ii] Simmons, Mark et al.

[iii] The Ladybird Johnson Wildflower Center. Habiturf, the Ecological Lawn. http://www.wildflower.org/habiturf/Habiturf%20Brochure%202013.pdf. Accessed 1-2016
Also see https://www.wildflower.org/consulting_apply_portfolio/ for a picture of mowed Habiturf on the UT – Austin campus

Future Viable Plant Palettes for Metropolitan Areas

Part 7: Beginning the Transition to Native Polycultures

Developing a Plant Palette that Balances Aesthetic Control, Environment, and Ecology

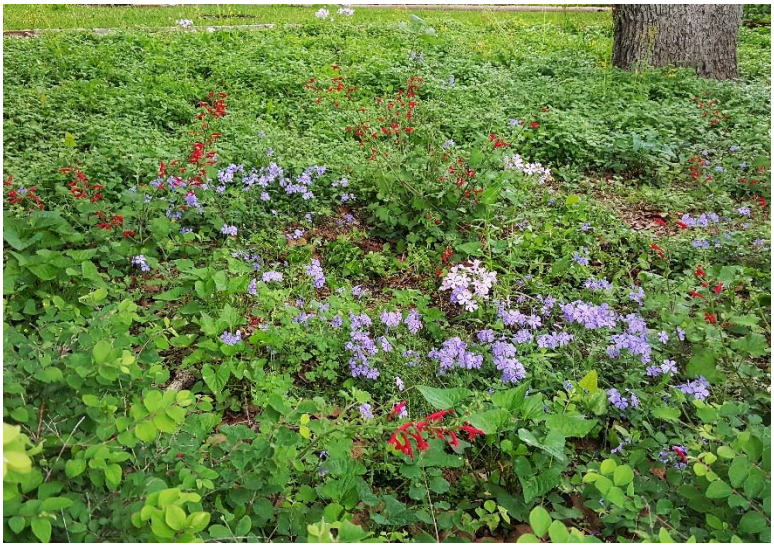

Figure 1: Simple low woodland polyculture in spring (April 12) at Hopman residence in Arlington, Texas. Woodland Phlox (*Phlox divaricata*), Wood Violets (*Viola missouriensis*), Cedar Sage (*Salvia roemeriana*), Horseherb (*Calyptocarpus vialis*), and Golden Groundsel (*Packera ovata*).

Developing a plant palette for metropolitan areas that moves beyond the native and adapted plant palette is a very challenging and necessarily a very long term proposition. The vast corporate, design, regulatory, and research infrastructure that has evolved to the current state of the art will change very slowly as it has in the past. As with any innovation, it will first be seen as radical and even eccentric and there will be many stakeholders that will push back hard against the tide of change. There are a number of possible scenarios for moving forward towards a more resilient and ecologically and environmentally supportive landscape palette.

One likely scenario for the transition to a more balanced palette is an incremental approach that gradually introduces native species and native varieties and cultivars into the infrastructure of the green industry. This would be an evolution of the 'native and adapted' palette that has been emerging since the 1980s, perhaps accelerated by climate change and the 'new normal' of warmer conditions with wide swings in rainfall patterns, coupled with increasing water needs from a rapidly growing population. This evolving palette will represent the same basic approach currently used by many designers for the selection of

plants. Designers will search for aesthetically pleasing groupings, or drifts, of discreet monocultures that meet the practical, aesthetic, and financial criteria desired, albeit in a more environmentally and ecologically sustainable way.

Reconceptualizing a Plant Palette using Native Polycultures

Reconceptualizing nature in an urban context is no trivial matter. It is one thing to address the visual aesthetic forms of nature and quite another to bring ecological functioning into the design process, particularly in urban or urbanizing areas. This will be a disruptive break with traditional practice that will require the entire green industry to adapt if it is going to be scaled up and have a meaningful impact on regional ecological and environmental imperatives.

Working planting designers must first understand the aesthetics and methodologies for designing with complex intermingled planting designs before they can begin to consider potential candidate plants for the process. Fortunately, Piet Oudolf and Noel Kingsbury have written a seminal book that outlines the concepts and provides many inspirational examples of successful polycultures from throughout the world. Their 2013 book *Planting: A New Perspective*[i] should be on any serious planting designers bookshelf. There you will learn the basic design vocabulary of designing with intermingled combinations. I like to think of polycultures as slow motion action painting (see figure 2) that utilize a palette of underlying matrix plants (think polyculture groundcovers), accent plants (like “boulders in a stream”), and the important emergent and transparent scatter plants that mover your eye through the design, help unify the polyculture and add structure, character and seasonal interest.

Figure 2: Number 7 by Jackson Pollock, 1952. Image by David Hopman

The principal difference between my approach and their approach is that they do not focus on regional ecology by placing a high priority on the use of native plants. Their methodology advocates the native and adapted plant palette as explained in post 4 of this series. Additionally, their highly evolved and artistic methodology may not be practical for many designers who do not have the knowledge or plant focus that they have. My approach celebrates and encourages this level of commitment but it is also very important to move these concepts into the everyday landscape of groundcovers and turf that are such a ubiquitous feature of the metropolitan landscapes of the United States.

Once a decision has been made that the polyculture approach is desirable and practical, the slow task begins of adapting a plant palette and a planting design process that moves in this direction. This does not need to be as daunting a task as it might first appear. Everyone interested in plants has seen many examples of plants encroaching into each other's territory. The main leap here is to carefully consider if this is a good thing or a bad thing before automatically separating them back into discreet monocultures.

If you begin with groundcovers and keep the rest of the planting design intact (particularly the structure planting), this will be much easier to implement. There are a few issues to consider.

Do the plants have some unifying and/or complimentary characteristics?

I look for plants that provide some sense of unity by looking for form, line, texture, height, and color. This can start very simple and evolve over time as more species are added. For example, just mixing *Liriope Muscari* with *Hemerocallis Stella d'oro* is a baby step in this direction. The two plants have similar height, texture, grass-like leaves, and blooms that are complimentary in color and season. Adding Tulbaghia violacea as a scatter plant increases interest and species diversity within a very carefully controlled overall unity. I mention this combination because it is one that is easy to use, and a safe small step in the direction of polycultures using non-native plants that are widely available.

As sensitivity is developed to successful combination of plants, more polycultures will reveal themselves both through research and through serendipity. In 1995 I planted two species of plants under some shade trees in my house in Dallas, Texas. Both plants are native to North Texas and very well adapted for the conditions of the site. The plants were *Chasmanthium latifolium* (Inland Sea Oats), and *Tradescantia gigantea* (Giant Spiderwort). The Sea Oats spread, as it always will, but I discovered that the two plants together were actually much more attractive than either by themselves. The Spiderwort forms a very irregular groundcover that is only really of interest in the spring and early summer. It can even die back to the ground in summer and early fall if not given enough water. The Sea Oats looks good for most of the year, especially in winter, but lacks presence and stature in the spring and is a little monotonous in large areas. Figure 3 shows the Sea Oats with the blooming Tradescantia in spring. The Sea Oats foliage hides the problematic foliage of the Tradescantia which, in turn, makes it appear that the Oats are blooming. This combination remained in place for over 15 years proving that it is very persistent—an important consideration for native polycultures in landscape development.

Figure 3: Chasmanthium latifolium/Tradescantia gigantea mix in spring

Discovering two or three reliable intermingled plant combinations begins the journey to a full-fledged polyculture. The Chasmanthium/Tradescantia combination above became the anchor for a polyculture recently planted at The University of Texas at Arlington, where I teach (see post 1 of this series). Since the two plants look good all year by themselves, the other plants used for an intermingled combination could be a little more experimental. It was then a matter of looking for seasonal interest—especially during the busy fall and spring semesters. Asclepias tuberosa with its leaves that mimic the Chasmanthium was added for summer color, winter interest, and to attract butterflies. Ruellia nudiflora, and Dicliptera brachteata were also added for later summer and fall bloom when the Asclepias blooms only sporadically. *Elymus Canadensis* was placed as a tall scatter plants for late spring into early summer interest.

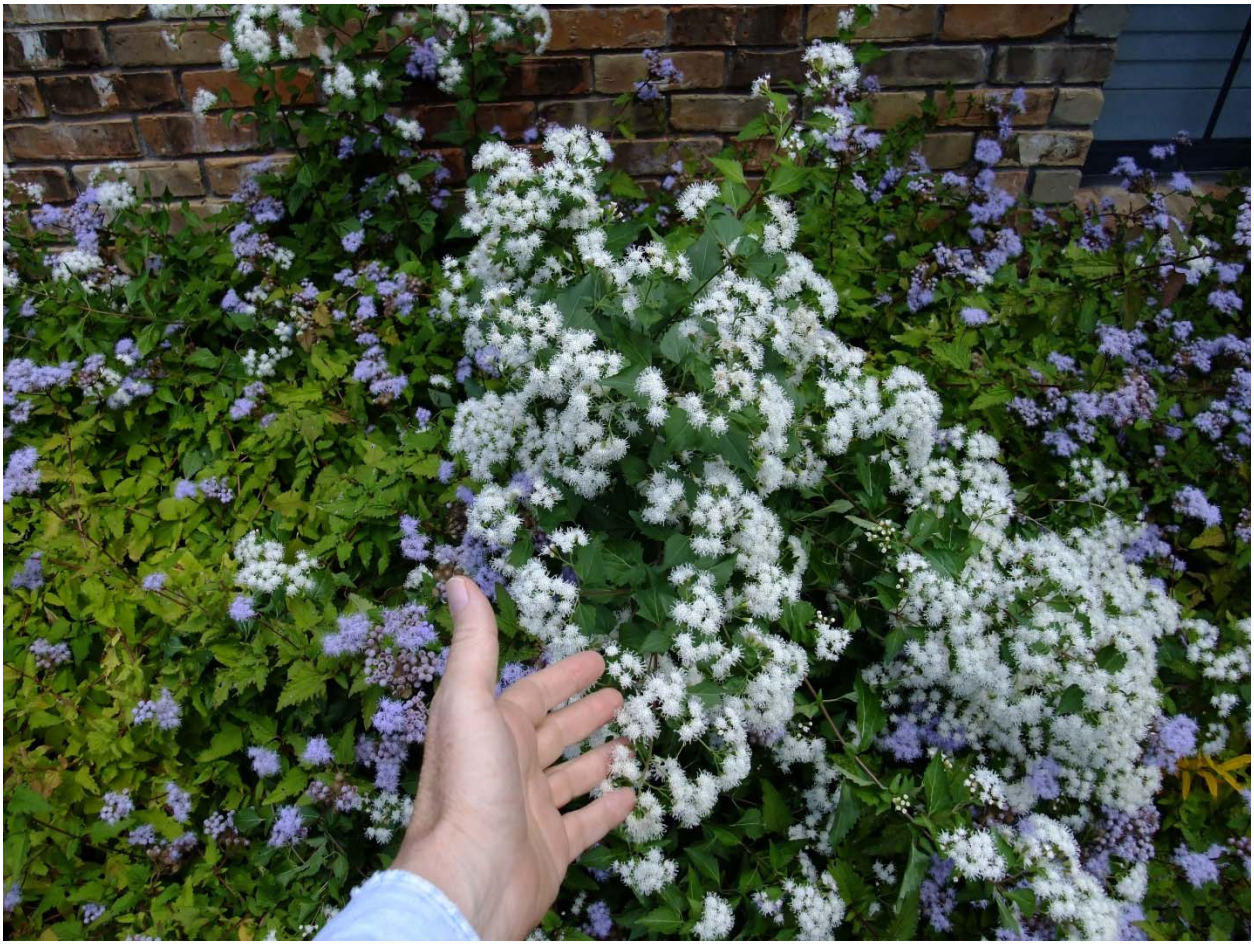

Figure 4: Ageratina havanensis shown blooming in late fall mixed with Conoclinium coelestinum

Finally, the larger woody mass of Ageratina havanensis (unified by texture) was placed into the matrix as a taller accent—like 'boulders in a stream'. The Ageratina blooms for three or four weeks in late fall with very fragrant white flowers and is a welcome book-end to the many spring blooming trees, and shrubs that appear throughout our campus. The entire polyculture is enclosed with a low hedge of Symphoricarpos orbiculatus (Coralberry) to provide seasonal interest, a more architectonic edge for the wild mass of vegetation, and to keep pedestrians, bicycles, and utility vehicles off of the planting bed in this high use area. All of the plants in the polyculture are native to North Texas. The seasonal table in figure 5 outlines the seasonal plant characteristics of the UT-Arlington polyculture garden.

	Spring	Early summer	Mid-summer	Late summer	Early autumn	Late autumn	Winter
Structure plants							
Chasmanthium latifolium							
Symphoricarpus orbiculatus							
Ageratina havanensis							
Companion plants							
Tradescantia gigantea							
Ruellia nudiflora							
Asclepias tuberosa							
Elymus canadensis							
Ground-cover plants							
Dicliptera bracheata							

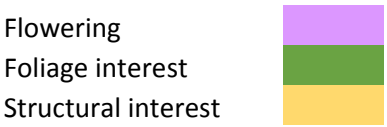

Figure 5: Seasonal reference table for native polyculture at UT-Arlington.[ii]

Any native groundcover that has been used successfully can be the basis for beginning the development of an aesthetically qualified native polyculture for your area. Their character can range from low and delicate to very large and exuberant. I am currently testing 13 polycultures in the North Texas area at UT-Arlington, The Botanical Research Institute of Texas, and at my home in Arlington, Texas. The matrix "anchors" that were the starting point for these polycultures include *Chasmanthium latifolium, Conoclinium coelestinum* (pictured in figure four above blooming blue)*, native Carex sp., native Juncus sp., Marsilea macropoda, Bouteloua curtipendula, Phyla nudiflora, Scutellaria ovata, Dicliptera Bracteata, Symphoricarpus orbiculatus, Calyptocarpus vialis,* and others. I encourage the readers of this post to develop native polycultures suitable for development conditions in your area and to report the results here and to other interested parties in your area.

[i] Oudolf, Piet, and Noel Kingsbury, 2013. Planting: A New Perspective. Portland: Timber Press, Inc.

[ii] See Ibid, page 211

Future Viable Plant Palettes for Metropolitan Areas

Part 8: Case study: Extracting native polycultures for bio-retention structures at The Botanical Research Institute of Texas (BRIT)

Figure 1: Design and Photoshop mockup of Sun-Juncus polyculture and low polyculture edge for bioretention structure at BRIT. Lower left shows existing plants being killed by solarization. Design and image by David Hopman

Reconceptualizing a Plant Palette using Native Polycultures

Post 7 of this series focused on small steps that can be taken by any planting designer that will gradually move their designs in the direction of aesthetically qualified native urban polycultures. This post begins the discussion of a more complex and rigorous approach that I used in North Texas. The complexity of The Dallas/Fort Worth/Arlington area of North Texas is confounding when considering the use of extracted native polycultures as design components. It is a sprawling and rapidly growing metropolitan area of more than seven million people that is larger than the state of Massachusetts. The problems and opportunities associated with reconceptualizing nature in this non-temperate area clarify an understanding of the issues in other areas where integrating nature may not be quite as complex and problematic. A detailed discussion is presented below that illustrates a research methodology used to develop 10 contrasting native polycultures for ecological retention structures on the campus of The Botanical Research Institute of Texas (BRIT) in Fort Worth, Texas.

Using Research to Define Aesthetically Qualified Native Urban Polycultures in North Texas

In North Texas, as in many other areas of the United States, the information needed to extract a wide range of native polycultures is simply not available. Academics and research institutes have a unique role to play in developing this information as the following description demonstrates. This research is directed at a palette of plants for ecological retention structures (large scale rain gardens), but can also serve as a model that can be adapted for the plant palettes required for many other types of planting design in metropolitan conditions in the Great Plains of The United States and other biomes throughout the world. The palettes of plants that are the product of the research were defined by myself with the help of several Graduate Research Assistants at The University of Texas at Arlington, notably Kerry Gray-Harrison. The impetus for the research was a landscape project at the Botanical Research Institute of Texas (BRIT) where some of them will be tested in large ecological detention islands between parking bays in the 242 car parking lot at the BRIT headquarters in Fort Worth. BRIT and the Fort Worth Botanic share the parking and were struggling to find a plant palette that was more ecologically constituted than the typical ornamental native and adapted palette, featured at the Fort Worth Arboretum, but with more aesthetic appeal for botanic garden visitors than the existing native plant palette on the site.

Figure 2: Existing parking lot plant character at the BRIT headquarters in 2015.

The research began with a few important assumptions. The first was that for aesthetic (regional character), environmental, and ecological reasons, only plants that are indigenous to North Texas will be used. The second assumption was that annuals will be avoided in order to make the plant combinations more resilient within an urban context as was previously explained in post 5 of this series. The third criterion for the first round of plant selections was that the plants need to be adaptable to both low water use and to regular inundation. Obligate upland and wetland plants were eliminated unless there was very persuasive personal or other evidence that the plants are appropriate and adaptable. The final, and most important, assumption was that aesthetically qualified combinations of plants will be extracted that are designed to grow together in compatible, but sometimes unpredictable ways, rather than arranging them as discreet monocultures and maintaining the arrangement over time as the planting matures. The polyculture plant palettes started with an overall carpeting matrix layer. Larger indigenous, aesthetically compatible, and less aggressive plants were added for additional interest as accents and “scatter plants” as explained in post 7 of this series. The polyculture groupings produced have a range of visual character from relatively subtle, low, and controlled to tall, dramatic, and exuberant.

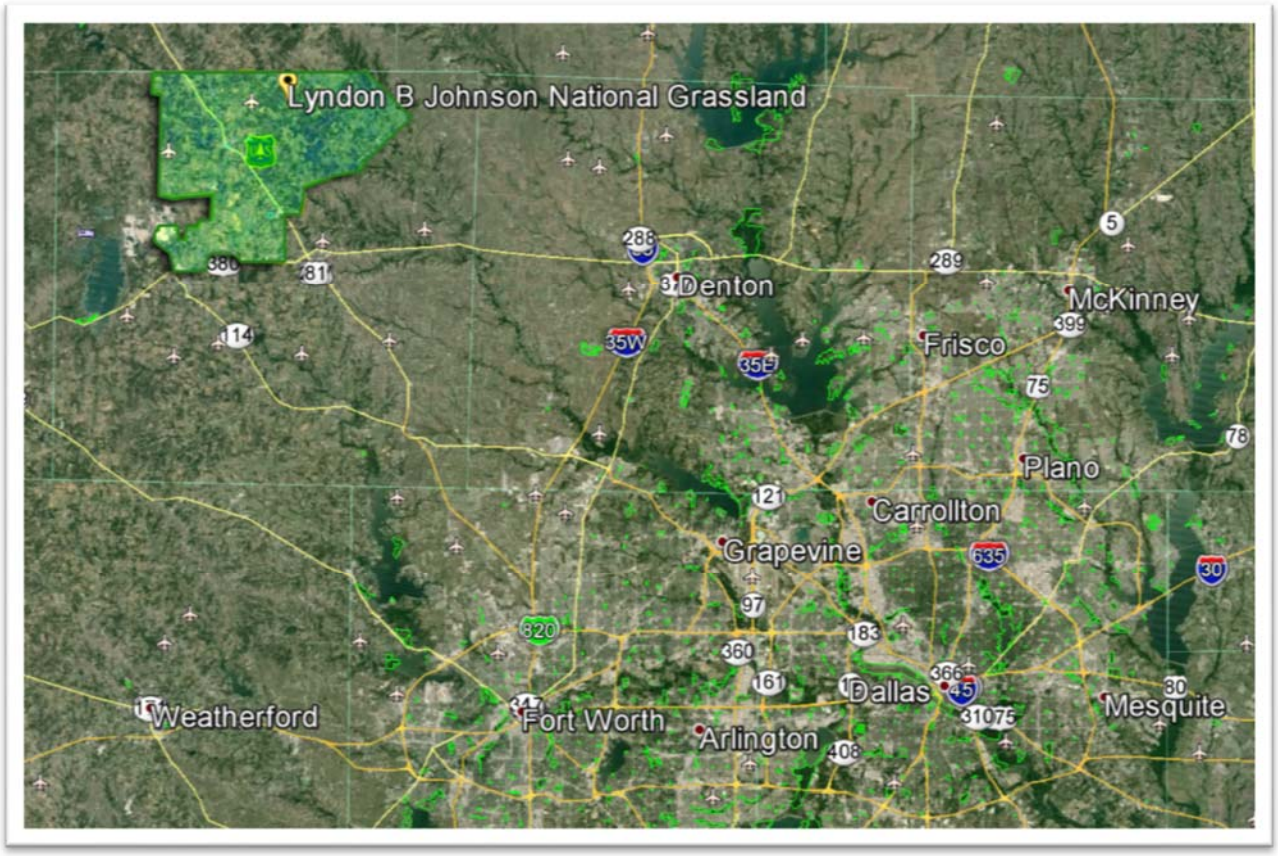

Figure 3: Location map for Caddo-LBJ National Grassland from Google Earth

Figure 4: Natural gilgae depressions in the Clymer meadow northeast of Dallas shortly after a spring burn. by David Hopman

The ecological detention plant research began with a list of 734 taxa, identified over a 30-year period by scientists at BRIT, growing around the more than 1,200 ponds at the Caddo-LBJ National Grasslands, just Northwest of Fort Worth, Texas. I am very fortunate and grateful to have received access, with the help of Robert O'Kennon, to the database of BRIT for this purpose. The Caddo-LBJ National Grasslands comprises 20,250 acres and is the largest publically accessible undeveloped open space near the Dallas/Fort Worth/Arlington area (figure 1).[i]

The plants were first qualified for native status using BONAP (explained in post 4), The Flora of North Central Texas[ii], the plant database at The Ladybird Johnson Wildflower Center, and other reputable and rigorous sources. Only plants native to North Texas that are reliably perennial were selected. It should be noted that availability was rarely considered and it was assumed that the botanists at BRIT could find wild populations of hard to find plants and the Fort Worth botanic garden could help with propagation. Wetland status was then determined using the previous sources as well as the Army Corps of Engineers National Wetland Plant List[iii]. Since we were looking for plants for ecological detention structures (rain gardens), the plants that were especially interesting were facultative and facultative wetland. These are plants that tend to grow in Palustrine aquatic system—non-tidal wetlands, seeps, springs, vernal pools, seasonal wetlands, and other low lying areas such as the depressions in natural gilgai prairie structures shown in figure 3. Finally, duration (annual or perennial) was determined for North Texas using primarily The Wildflower Center database and the Flora of North Central Texas. Any plants that are not reliably perennial were eliminated in order to make the palette more reliably persistent.

It was very high priority for the native plants selected to have an aesthetic presence that can be subtle, but needs to make a significant aesthetic contribution to the new plant groupings. This is where the judgement of an experienced planting designer, preferably a trained landscape architect, is key. We had to be able to assess the aesthetic attributes and document them so that they can be paired and contrasted with other plants to form an aesthetically qualified native polyculture—as was done with the turf polyculture in post 6 of this series. We needed to see good photographs of a species in various stages of development and colonization in order to get a good idea of its potential for the polycultures. The final consideration is critical to the ultimate success of the polycultures after installation. There must be enough horticultural information available to make meaningful decisions about the potential for success in the artificial environment of an ecological retention structure. Many of the plants found by botanists and volunteers at BRIT growing without human intervention have never been produced for sale and horticultural information on them is too sparse to be useful for this effort.

The 109 native plants selected from the original list of 734 based on the criteria above were then carefully analyzed horticulturally and aesthetically by using about 55 database fields. This enabled them to be useful for selecting the plant palette for the new polycultures (figure 5). At this stage, many books on native Texas Plants were used as well as web based resources that included university, state, and federal databases, botanical gardens and arboreta web sites, and even plant social media sites. These fields will need to be adjusted for other regions. For example, we did not looks at salt tolerance since we are not near a salty waterbody and we rarely have ice and snow events in North Texas that result in the streets being salted.

Figure 5: Database fields for the final 109 plants selected for bioretention polycultures

The process of studying the large database of taxa from the Caddo-LBJ National Grasslands was very interesting and revealed compelling plant species that were new to me, even though I have used native plants for planting design since the early 1990s and have been teaching native plants in the UT-Arlington MLA program since 2004. It was a great way to dig into some exciting possibilities that are beyond what is currently offered in the native plant industry.

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[i] USDA. Caddo-LBJ National Grasslands. http://www.fs.usda.gov/detail/texas/about-forest/districts/?cid=fswdev3_008440. Accessed 6-2016

[ii] http://www.brit.org/brit-press/nctexasflora/online Accessed 6-2016

[iii] http://rsgisias.crrel.usace.army.mil/nwpl_static/viewer.html Accessed 6-2016

Future Viable Plant Palettes for Metropolitan Areas

Part 9: Assembling polycultures from a qualified palette

Figure 1: Knee high grass polyculture in full sun designed for BRIT ecological detention structure. See below for explanation and plant names keyed to the numbers. Design and image by David Hopman.

Post 8 of this series detailed the rationale and methodology for extracting qualified native plant species for use in creating polycultures. This month will feature a discussion of how to successfully combine the species into a low maintenance native polyculture that can take the place of a monoculture groundcover.

The 109 species selected for use in part 8 were sorted to find groupings unified by height, texture, line, color, or form. Two categories of plants were created for each of the main polycultures. The first is very aggressive groupings of lower plants that serve as the primary intermingled groundcover. The second group of plants for each polyculture are accent plants that are unified with the lower grouping by texture, line, color, or form, but also have a strong contrasting element that will show them to best

advantage. These are either more transparent scatter plants or more opaque shrubby plants used more like rocks or small hill shapes.

This sorting of plants for the final polycultures is both a qualitative and quantitative exercise. The qualitative, or creative, part involves imagining the character of the overall polyculture based on the character of two or three of the core plants in the underlying matrix. Ideally, these are plants that you have some experience with that can serve as the "anchors" that will help assure the success of the polyculture. When assembling the ten polycultures for BRIT, I looked for a wide range of core plant characters by putting good pictures of the plants into a large folder for study. The polycultures where then built around the visual characteristics of those plants. This is where the quantitative data is very helpful. Once a decision is made on plant height, form, or texture, for example, the database can be used to suggest more species that will fit those criteria. The species can then be tested by using the database for horticultural compatibility, bloom season, and all the other variables described in post 8. Once a final palette emerges from this process for each polyculture, a mock up is made using Photoshop (see figure 1 for this post and for post 8) to get as honest a vision as possible of what the polyculture might look like. If the results are positive, the Photoshop mockup can be also be used to obtain buy-in from the client as these types of planting designs are very difficult for most people to visualize.

The edge condition is also carefully considered. Putting a more formal edge on a loose grouping of plants is a time tested way to make them more appealing and less threatening to people who are afraid of nature and may believe that snakes or rats are going to breed in the groundcover. When designing with a high priority on ecology, we need to always be aware of nature/culture alternatives just as we are aware of prospect/refuge and sun/shade alternatives. Some people enjoy an immersive experience in native plants. Others enjoy being next to them with a more controlled edge. And still others only want to see them pictorially from a distance. The successful perception of polycultures by a wide diversity of people in a metropolitan environment depends on addressing all three preferences.

Figure 2: Close-up photos taken in July 2016 (3 months after installation) of edge condition shown in figure 1. Mimosa strigillosa (Sensitive Plant) and Phyla nodiflora (Texas Frogfruit).

All of the polycultures developed have a crisp edge that is a very low polyculture groundcover (usually with a stone or gravel band to separate it from the main polyculture), a low hedge, or a low wall. These

edges allow more aesthetic freedom in the center plantings while still exhibiting design control and intentionality to a wide variety of tastes. One of the polycultures is even two mowable turf species that would be at home in any suburban setting.

Ten plant communities, extracted from the qualified plant list, were initially proposed for testing. Six edge communities that can help frame the larger groupings and transition to walkways and other paved surfaces were also proposed. Plant palettes for sun, part sun, and dappled shade conditions are included. The proposed combinations range from highly ornamental and floriferous to more carefully controlled and unified.

Summary of Research Methodology for Finding Aesthetically Qualified Native Urban Polycultures for Ecological Detention Structures

1. Obtain the most comprehensive list of plants available that grow in your area in regularly inundated conditions without human intervention; around ponds, lakes, streams, seeps, draws, and other watercourses and low-lying areas.
    a. North Texas research used a comprehensive list of 734 species identified around ponds and streams in the LBJ National Grasslands by BRIT.
2. Qualify useful plants for planting design in ecological retention structures using the following criteria:
    a. native (indigenous to EPA level 3 ecological zone),
    b. reliably perennial and persistent (if known),
    c. facultative as to water requirements,
    d. aesthetic “presence”,
    e. Enough information available for an informed decision.
        i. a range of photos available to get a good sense of the plant’s texture, line, form, color, and seasonal attributes,
        ii. Horticultural information from both trusted published sources and web based resources as they can be more up to date and comprehensive.
3. Assign key attributes to all plants selected
    a. A variety of representative photos of each plant
        i. Closer for texture, color, and line,
        ii. More distant for form
        iii. Overall visual effect and massing.
        iv. Seasonal variation and dormant form
    b. Database fields useful for searching when making plant grouping decisions: See post 8 for complete list of database fields
4. Filter database fields to select unifying attribute(s) for selected plant polycultures.
    a. Form,
    b. texture,

c. line,
d. height,
e. color,
f. and seasonal interest.
g. Try to make sure that two or three species are well proven, reliable, persistent, and available. These plants will be the 'anchors' that will cover the practical requirements of the planting design as a ground cover.

5. Place photos of plants selected for each polyculture into separate folders for visual study as a group,
    a. After final selections are made, use Photoshop to mock up the combinations and test the visual appeal.
6. Check key horticultural attributes of each polyculture's plants to make sure there is some overlap and that they are compatible.
    a. Light requirements
    b. Soil tolerance/preference
    c. Aggressiveness
    d. Water use and drought tolerance
    e. Other site specific requirements such as Deer resistant plants.
7. Assign as many plants as possible to each polyculture that meet the aesthetic goals of the combinations. A further narrowing can be done later for site specific design and horticultural considerations. For example selecting for deeper shade or wetter soil conditions.

The polyculture example that follows describes the lead caption above intended for the campus of BRIT (figure 1).

Knee high grass polyculture in full sun (KHGS)

This polyculture is intended for part to full sun and periodically inundated conditions as would be found in ecological retention structures in North Texas. The grasses are moderately to very aggressive and are in a mid-range from around 2 to 3 feet. The texture is fine to medium fine with an ascending to upright diagonal line. There is a base of carpeting grasses and several plants are added as accents. The look is relatively controlled since there is a very tight similarity of texture and color. Many of these plants are not found in the nursery industry and will need to be collected in the wild and propagated either in in-situ or in the Botanic Garden greenhouses. All the plants listed are verified native to the DFW area and perennial.

Base carpeting grasses: (see spreadsheet for detailed information) mixed and placed 12 to 18 Inches on center: 1-*Paspalum distichum* (Knotgrass), 2-*Agrostis hyemalis* (Ticklegrass), 3-*Muhlenbergia reverchonii* (Seep Muhly), 4-*Panicum obtusum* (Vine Mesquite Grass), 5-*Pascopyrum smithii* (Western Wheatgrass) **Accents**: 6-*Helenium autumnale* (Fall Sneezeweed), 7-*Hypericum hypericoides* (St. Andrew's Cross), 8-*Lythrum alatum var. lanceolatum* (Winged Lythrum), 9-*Muhlenbergia lindheimeri* (Lindheimer's Muhly),

10-*Zizia aurea* Golden Zizia), 11-*Tridens strictus (*Longspike Tridens), 12-*Dodecatheon meadia* (Shooting Star),
Trees/shrubs: 13-*Amorpha fruticosa* (False Indigo)
Edge polyculture: 14-Mimosa strigillosa (Sensitive Plant), 15-Phyla nodiflora (Texas Frogfruit)

By extracting plants from similar biomes (the LBJ Grassland Ponds), and by using them in relatively large combinations, plant communities were created that provide some, but certainly not all, of the environmental and ecological services that a community created by a restoration process provides. Biodiversity is further enhanced by using a range of polycultures on a given site that in aggregate will cover many of the ecological bases that are eliminated from most landscape designs. Designers are also able to address cultural rules and personal creativity by tailoring the communities to the practical and aesthetic goals set for each project. The expression of region and other attributes of planting design are under the designers control without losing the key element of local ecology.

Future Viable Plant Palettes for Metropolitan Areas

Part 10: Polyculture Maintenance and Plant Palettes

Figure 1: BRIT bioswale 2 polyculture in July, 2016 after weeding and mulching have brought the planting back closer to the original design intent shown in lead image from post 7. The bioswale is now ready for hundreds of additional specified plants that will be installed in the fall once the weather cools down.

This post is about the maintenance decisions that can have a profound effect on the range of plants useful for an aesthetically qualified urban polyculture. Some of the issues are addressed in the spread sheet that was presented in part 8 of this series. For example, relative aggressiveness will help determine if plants play well together or if one plant is almost sure to dominate. However, the discussion that follows is on factors affecting plant palate decisions that go beyond the intrinsic characteristics of each plant that is considered.

Pruning:

Polycultures of herbaceous perennial plants and grasses are low maintenance but will frequently be more useful for aesthetically qualified native urban polycultures if they are pruned two or three times a year. Just because a plant is native, does not mean that it must be allowed to express only its non-maintained form. This is especially true when soil amendments and irrigation are used. Water, fertilizer, and soils that are richer than what the plant would normally grow in without human intervention tend to make the plants taller, fuller, and more aggressive than otherwise, and may even cause them to flop over, particularly when they are blooming. Selective pruning may actually bring their appearance and stature back closer to a "natural" state. Another big advantage to selective pruning is that it broadens the range of plants that can fit the aesthetic criteria of a particular polyculture. For example, one of the best native plants we have for shade conditions in North Texas is Inland Sea Oats (Chasmanthium latifolium). It is tolerant of both drought and seasonal inundation, stays attractive throughout the year, and establishes and spreads very easily. However, with irrigation it can easily get 3-4 feet tall which may not be a desirable trait in an urban polyculture where other lower plants could have a seasonal focus. By cutting Sea Oats in half early in the season, it can easily be maintained at 18". Some of the plants can also be left taller as "scatter plants" which is how we are maintaining the UT-Arlington polyculture featured in part 7 of this series. In North Texas, we have a large palette of native plants that function much better in metropolitan settings with a 4th of July mid-season pruning. Some examples include Maximillian Sunflower (*Helianthus maximiliani*), Mexican Bush Sage (*Salvia leucantha*), Blue Mist Flower (*Conoclinium coelestinum*), and Turk's Cap (*Malvaviscus arboreus var. drummondii*). This pruning can be done very carefully with a line trimmer if the operator REALLY knows what they are doing and does not cut back other plants by accident. The line trimmer will, of course, not leave as clean a cut as a hedge trimmer or the more time consuming but much better looking use of pruning shears. A good compromise is to use the pruning shears where viewers are closest and follow up with the line trimmer or hedge trimmer further away from walkways. This midseason pruning can help determine how the plants are used in the polyculture and which polycultures they are appropriate for.

Another important consideration with pruning is the seasonal character of many native plants, particularly in non-temperate areas. Even with some irrigation, there are plants that need "freshening up" after a long, hot summer. Plants such as Horseherb (*Calyptocarpus vialis*) and Dwarf Water Clover (*Marsilea macropoda*) will benefit from careful trimming with a line trimmer around the other plants in a polyculture. A complete mowing is possible, but the yearly growth cycle of the other plants in the polyculture must be carefully considered.

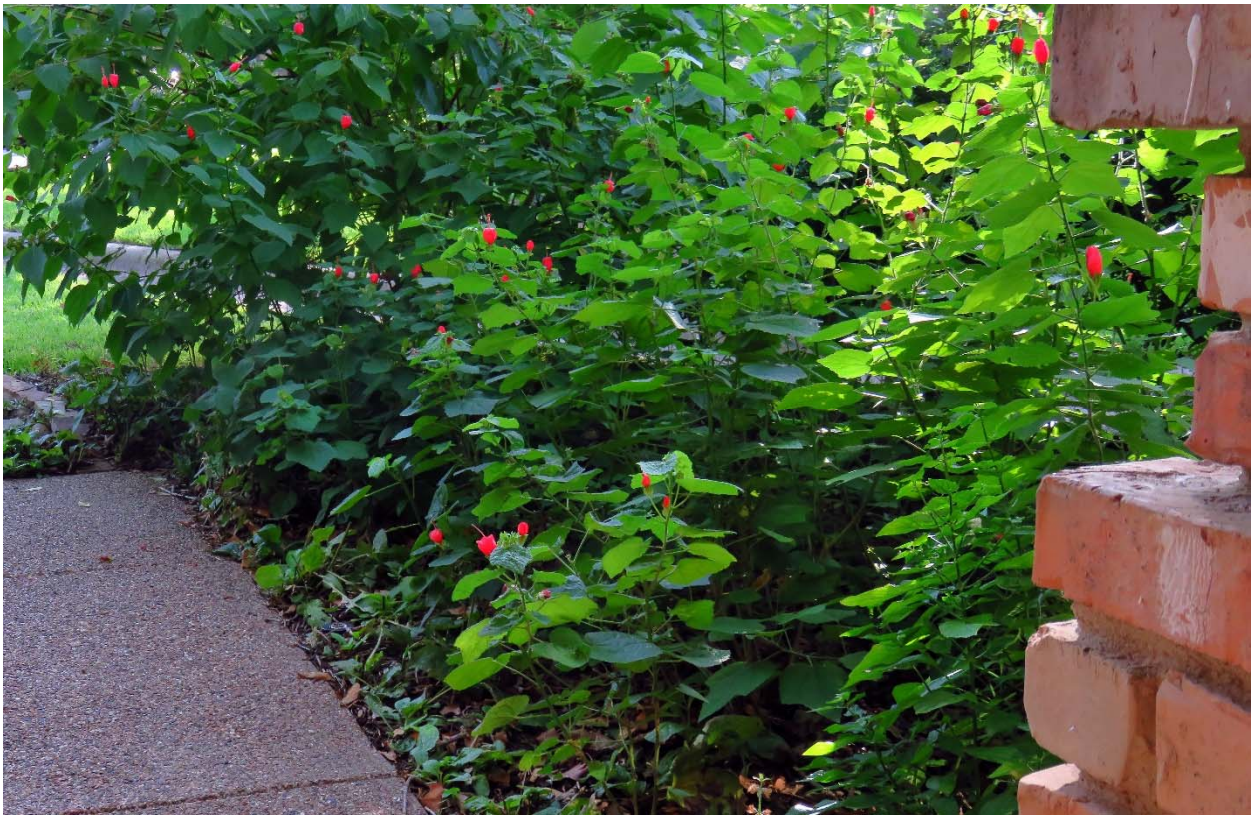

Figure 2: Course textured polyculture in early August when only the Turk's Cap is in bloom. The Branched Foldwing (*Dicliptera bracteata)* immediately adjacent to the bricks on the right and the American Beautyberry (*Callicarpa Americana*) in the back on the left will add their seasonal display in September. The Turk's Cap by the walk is maintained lower and is left taller in the background.

The edges of the polycultures must also be maintained in order for the design to exhibit intentionality to a wide audience. Figure 2 shows the edge of a course textured polyculture with Turk's Cap, Heart leaf Skullcap, Lyre Leaf Sage, Branched Foldwing, and White Avens. By mid-summer, the edge under the Turk's Cap is mostly the spring blooming Lyre Leaf Sage. The regularly trimmed edge keeps it from looking thin, stressed, and overgrown. The same issues apply to the Frogfruit/Sensitive plant combination featured in Post 9 if this series. Coralberry is another edge condition that would not be possible without pruning 2 or 3 times a year. The natural form of the Coralberry would be an irregular mass that spreads indefinitely. I was able to make use of this beautiful, drought tolerant, shrub as an edger only by including its pruning in the polyculture maintenance plan. Careful consideration of the height of plants through the season and the edge condition can make the difference between acceptance of a polyculture by the client or a mandated reversion to a more traditional monoculture groundcover. It opens up new avenues for more varied plant combinations and personal garden expressions.

Weeding

The discussion that follows is about removing undesirable plants, not changing the balance of species in what Oudolf refers to as "dynamic planting".[1] Key to keeping weeds under control is a dense enough spacing when they

[1] Oudolf, Piet, and Noel Kingsbury, 2013. Planting: A New Perspective. Portland: Timber Press, Inc. 36-40

are first planted and the use of mulch. These are the same issues that apply to any planting but they are more crucial here as it will be more difficult to separate the polyculture seedlings from the undesirables than it would be with a monoculture planting. If the weed seeds are kept from germinating until the other polyculture plants are established, the balance of propagules going forward will be in favor of the intended species.

My experience with weeding shows that it is better to remove all weeds from an area at the same time, rather than working species by species. Otherwise the bare ground that results from pulling a plant can be an invitation to the other weed species that surround it to drop their seeds and increase their numbers. Mulch can be placed on any bare ground created by pulling the weeds to prevent their reestablishment. It is critical to immediately place weeds into a container that will keep them from dropping seeds as you go. The weeds should then be either carefully composted or placed in the trash. Some weeds, such as the highly invasive Hairy Crabweed (*Fatoua villosa*), can produce seeds when they are only a few inches tall despite their mature height which can be several feet so they must be removed when very small. Don't worry about the biomass lost as the majority of the biomass is underground in the root zone.

Figure 3: BRIT bioswale 2 polyculture (see figure 1) after a spring and summer with minimal weeding. June 2016

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Figure 1 shows the bioswale planting at BRIT featured as the lead image in Post 7 of this series as a Photoshop mockup. The plants were spaced much too far apart due to delays in propagating the species, most of which are not generally available in the horticulture trade. There was also too little weeding and bare ground was allowed to persist where mulch had washed away. The original design of the polyculture is almost imperceptible. Figure 1 shows the bioswales after several days of weeding and spreading mulch on areas that were left bare after the

weeds were removed. The design intent is once more coming into focus and the swale is ready for a fall planting that will infill the bare areas with plants from the original plan, bringing the polyculture closer to the design intent. The plants can then fill in without competing with a mass of species that have not been through the qualification process described in parts 8 and 9 of this series.

The polycultures that I have been personally maintaining personally have proven to be very low maintenance as long as a careful eye is kept on them to keep things on track. Having carefully executed Photoshop mockups will certainly help clients understand where the design is headed. Having a maintenance book is also crucial. Every plant in the polyculture should have at least 2 pictures; one when it is a seedling and another when it is larger showing mature leaves and form. A seasonal table for maintenance should also be developed that shows each species and how it should be maintained throughout the year. The booklet is especially important when using native plants because many homeowners and landscape professionals will be unfamiliar with maintaining them. Additionally, books on native plants rarely describe the maintenance that will keep them looking their best throughout the year, much less in a polyculture planting

Watering

One other relevant issue that must be touched on in making plant palette decisions using native plants is watering. In many areas of the country, watering will not be a prime determinant of plant palettes, particularly if native plants are used in appropriate ways. In other areas, such as North Texas where I live, decisions about watering are one of the most important determinants for plant palette decisions. The imperative to save water has pushed many designers in our area to adopt non-native species from drier parts of the state and from other dry areas around the world. This trend is another manifestation of the ethos of favoring environment over ecology discussed in part 1 of this series.

In Texas, as in other non-temperate areas, rainfall amounts vary greatly by year and are expected to diverge even more as the climate changes. They range in the DFW area from a very dry low of about 18 inches a year to the record last year of 62.6 inches. We can have several months with no rainfall, either in summer or in winter, as well as months where it rains more than 16 inches as it did in May of 2015. Native plants tend to be adapted to these varied conditions but will not necessarily perform acceptably in metropolitan situations if left to the vagaries of natural rainfall or the quantity of water available from water harvesting strategies. Therefore, I advocate a regular program of irrigation for most planted areas (as opposed to “natural” areas). The watering will be very minimal in wetter years. By more carefully monitoring of soil conditions and rainfall, watering can be kept to a minimum in normal to dry years. The goal should be to artificially create a normal to wet year that will keep the plants thriving. Not overwatering will actually reduce maintenance by discouraging weed seedlings and lessening the need for trimming as described above.

A decision should be made at the start of the project on how often a site will be irrigated during droughts. A watering interval of one to two weeks after a rain provides flexibility in native plant palette decisions but will require careful consideration of lowland species to make sure they will not go dormant in the dry months. This is a significant reduction in water use from the regular twice a week watering that is the norm in North Texas. Watering once every week or two will assure that the plant patches provides as broad an array of both environmental and ecological services as possible, where and when they are needed most, in dense cultural environments surrounded by buildings and hardscape materials.[2]

[2] http://www.latimes.com/science/sciencenow/la-sci-sn-lawn-drought-plants-20160801-snap-story.html

This series on future viable plant palettes for Metropolitan areas has presented a rationale and a methodology for using complex intermingled native plant combinations to create a better balance of aesthetics, environmental services, and ecological services in planting designs by landscape architects and others. Next month's post will respond directly to objections to the use of native plants; objections that are currently a pervasive element of the culture and professional practice of landscape architecture in the United States.