Title:
Mitigation, Adaptation, Uncertainty -- Managing Sense of Place in Transition: Coping with Climate Change

Journal Issue:
Places, 20(2)

Author:
Hunter, Mary Carol R.

Publication Date:
2008

Publication Info:
Places

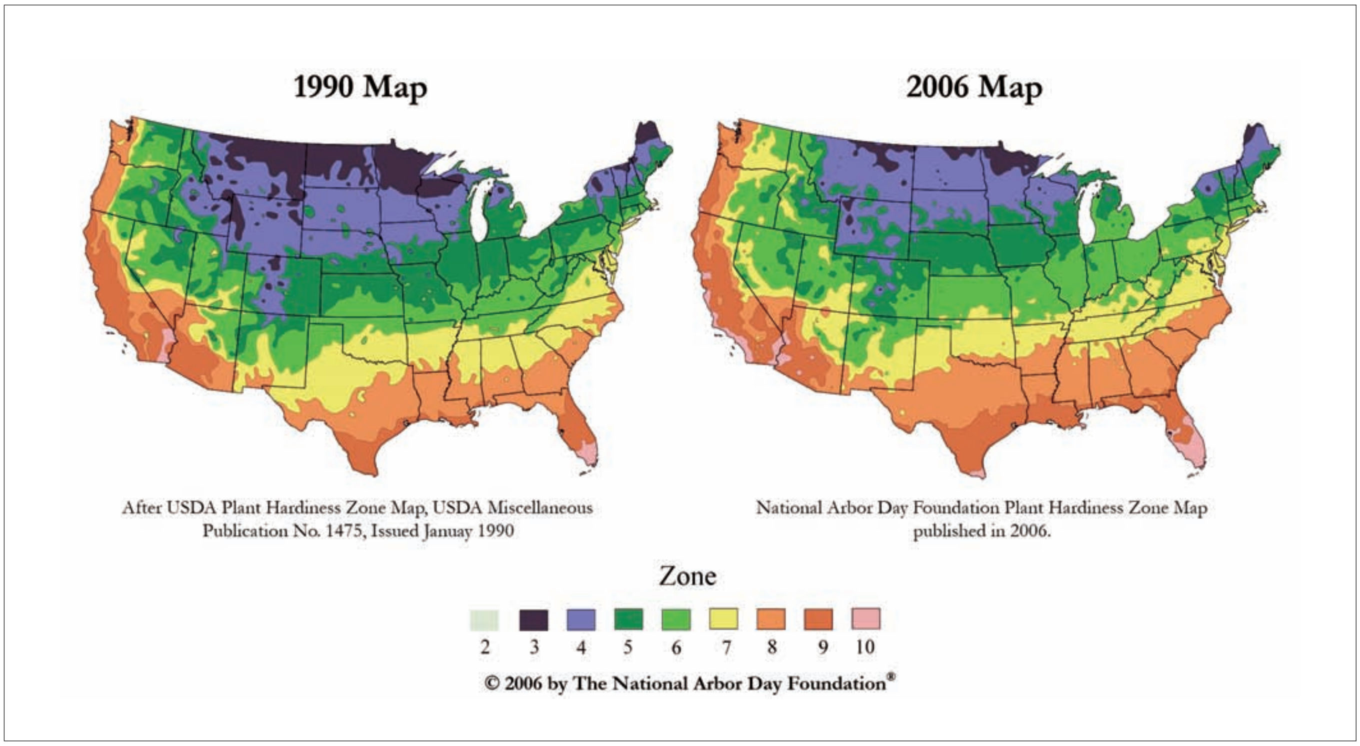
Permalink:
http://escholarship.org/uc/item/6143w59x

Acknowledgements:
This article was originally produced in Places Journal. To subscribe, visit www.places-journal.org. For reprint information, contact places@berkeley.edu.

Keywords:
places, placemaking, architecture, environment, landscape, urban design, public realm, planning, design, mitigation, adaptation, uncertainty, transition, coping, climate, change, mary carol, hunter

Managing Sense of Place in Transition: Coping with Climate Change

Mary Carol R. Hunter



For city people, sense of place owes much to familiarity with the organizational schemes and architectural themes of the urban-suburban milieu. But it also arises from hints and clues about the wildness the city once held. Place-making in every settlement, from high-pack ultra urban to forgotten semi-rural, owes much to the plants that frame and embrace the built environment.

I remember the cathedral sense of my old Detroit neighborhood when the American elm reigned. Here winter's end was signaled by robins poking at front lawns, and blue cornflowers and Queen Anne's lace littered summer roadsides and empty lots. Now, these bits of urban nature are gone or are threatened. The elms fell victim to a fungus-carrying beetle; the robins today bug-grub in drought-stricken lawns growing on contaminated soils; and the wildflowers have been outlawed for their heritage as exotic, invasive species.

Above: Comparison of plant cold-hardiness zones in 1990 (USDA) and 2006 (National Arborday Foundation) indicate a warming climate.

Opposite: This hypothetical comparison showing roadside vegetation with and without a native red-flowering species (beebalm, *Monarda didyma*) illustrates how visual cues provided by a single species can establish and support sense of place. Images by author

These losses derive from changes in culture and technology. They will pale in comparison to the impacts of climate change.

Climate Change and Plant Communities

As climate change adjusts weather patterns worldwide, plant-growth zones have already begun to shift.[1] In southeast Michigan, for example, minimum winter lows have risen by ten degrees Fahrenheit in less than a generation, from an average of minus twenty to minus ten in 1990, to minus ten to zero in 2006. The rise in winter temperatures suggests that the assemblage of local plants will also eventually change; and, indeed, this is beginning to happen.[2]

Equally critical aspects of climate change are increasing fluctuations in temperature, rainfall, and regional weather patterns. At a local level, this amplified variation in microclimate will be translated directly into changes in the vigor of individual plant species. Species will also be indirectly affected by changes in exposure to pollinators and disease agents. A sustained disruption of business as usual within urban ecological communities may result in places that will not look or feel the same.

Let's consider how this form of ecological instability might influence sense of place. Personal associations with place arise from typically encountered scenes. Imagine the following scenario invoked by a climate-induced change in phenology.[3] An atypically warm winter causes a common species to bloom earlier than usual—at a time when the plant's chief pollinator is absent because it relies on photoperiod rather than temperature to gauge time of season. When the pollinator does arrive, the flowers are nearly gone. Some seed is set that year, but by early summer the next year, the asynchrony between plant and pollinator has resulted in the near absence of a previously ubiquitous color and texture. Some of us will notice and consciously miss the old friend. Some will not know why it doesn't feel right. Others won't notice until a multitude of comparable changes have occurred.

As plant zones continue to shift northward—particularly if this occurs at the same pace as between 1990 and 2006—it is important that we develop a plan to protect our sense of place. The adaptation strategy described here offers an approach to the maintenance of aesthetic continuity, local biodiversity, and ecosystem health.

Ecological Considerations for Adaptive Design

If we hope to sustain a sense of place in the face of climate change, we should keep several ecological realities in focus.

First, the success of plant species undergoing a change in geographical range will depend on the availability of suitable habitat in an already fragmented landscape.[4] This need for habitat means it is essential to conserve existing natural areas and create new open space and linkage corridors within and around metropolitan areas.

Second, climate change will affect the timing and magnitude of interactions among community members.[5] Within a local plant community, climate change can shift encounter rates with beneficial species such as pollinators, mycorrhizae (symbiotic, nutrient-gathering fungi that live on or next to plant roots), and seed-dispersal agents such as birds and mammals. Climate change can also alter the presence and activity of detrimental species such as competitors, predators, parasites (a.k.a. herbivores), and agents of disease. All these effects can change the aesthetically familiar composition of a local plant community.

Third, climate change may disrupt the ability of familiar species to grow and reproduce. Each species occupies a niche within a web of local ecosystem processes, and each contributes to overall ecosystem maintenance by doing jobs like pollinating, providing food and shelter, mediating moisture conditions, and recycling nutrients. When a perturbation like climate change adjusts the availability of plants to their associates, each species suffers unless alternative partnerships are available. If more than one species can provide the required partnership, it is more likely the job will get done. An efficient way to achieve such "ecological redundancy" is to provide a diverse palette of plants whose functions overlap.[6]

To understand redundancy, one must recognize that functional roles are defined by many criteria. The most common are based on structure and temporal features (e.g., annuals, herbaceous perennials, woody shrubs, and trees). But functional groups can also be based in physiological traits, such as the drought tolerance among C_4 grasses and CAM (crassulacean acid metabolism) plants or the nitrogen-fixing ability of legumes.[7] When the goal is to stabilize a disturbed ecosystem, success is most likely when biodiversity is partitioned among many functional groups. When both functional diversity and redundancy are present, the urban ecosystem will be more productive, efficient, and better able to withstand disturbance.

Finally, at a time of climate change, it is important to understand that some plant species can go with the flow, adjusting to short-term environmental change with little trouble. This ability, called phenotypic plasticity, involves adaptation through physiology or morphology rather than by means of natural selection or the intervention

of alternative community partners. For example, black chokecherry is able to fare well during both extended drought and extended wet periods. As such, it is very plastic compared to its structural and aesthetic equivalent, silky dogwood, which occurs only along stream edges in the wild, and which has much greater water needs when planted in a garden.

Greater plasticity is often associated with a broader niche, a broader geographic range, and greater capacity to succeed with less cultivation (irrigating, weeding, fertilizing). Phenotypic plasticity is an excellent trait for planting designs intended to accommodate the uncertain outcome of climate change.[8]

Above: A city-wide loss of street trees in Ann Arbor, Michigan, caused community distress, leading some people to adapt by installing street-side plantings.
Opposite: Shrubby cinquefoil, *Potentilla fruticosa*, demonstrates several adaptive design principles: it is a rich nectar source for pollinators (ecological and aesthetic match); it extends resources for pollinators (redundancy); and it is drought tolerant (greater phenotypic plasticity). Photos by author.

Cultural Considerations for Adaptive Design

Although we are a highly plastic species, we often become distressed when we lose our sense of place. Negative human responses to major perturbations such as a hurricanes, fires, or the destruction of a neighborhood for a freeway are well known. Negative human responses to more subtle perturbations—replacement of oak by maple in a nearby woodland after a gypsy moth outbreak, or loss of a bus route that serves too few people—are much less well understood.

My own research suggests that even subtle change at the ecosystem scale can have dramatic effects on individual experience, and can lead to shifts in behavior. For example, after a massive loss of street trees in Ann Arbor on account of the emerald ash borer, some residents adapted by installing small curbside gardens in the easement area where the trees once stood.

Unlike the overnight loss of street trees, climate change offers only subtle evidence of change. Consequently, there is no emerging imperative that fires up action to protect sense of place for the future. However, the accompanying guidelines offer a plan for protecting urban sense of place

under climate change in a way that is congruent with other ecological goals: support of urban biodiversity, protection of air and water quality, and reconstitution of corridors for species movement.

A Practical Approach for Protecting Sense of Place in Transition

Protecting sense of place in enduring human settlements requires that we manage the change of scene as other species move on, move in, or die off. Protecting urban ecosystem health further requires that we support and even facilitate the movement of species.[9] Both goals can be addressed with sensitive design and land management.

Conservation of natural areas around or through cities can provide a continuous habitat for the movement of species. For example, the city of Toronto put a plan in place several decades ago to conserve and restore the riparian corridors that line its branched river system.[10] The plan provides both linked habitat for wild species and restorative destinations for city dwellers, and it contributes to a sense of place by helping residents witness the natural interactions that contribute to the city's aesthetic identity. It is serendipitous that this plan will also serve the city well with respect to climate change.

In urban settings adaptation can also be approached through the active creation of habitats that support ecosystem processes which may falter under the duress of climate change. On a large scale, cities can allow the naturalization of public open spaces and manage them as safe havens for local native species and species in transition.[11] But private gardens of all sizes, repeated across the metropolis, can also be designed or retrofitted with a plant palette that supports biodiversity and targets species with phenotypic plasticity and aesthetic characteristics reminiscent of existing but more fragile plant communities.

The accompanying planting design guidelines may be used to support the development of this plant palette. They offer a proactive, experimental path for adapting to circumstances we understand only in generalities. They can be applied in most settings as long as ecological context and sense of place are honestly accommodated.

We are a long way from being able to predict local climatic response to a changing global climate. However, predictive models can guide us to generalities that indicate ways to adapt the built environment for a favorable outcome in the face of uncertainty.

Subscribing to all the design criteria presented here is a daunting task even for the committed and botanically literate. But they offer a place to start. Information on meeting aesthetic and ecological goals can then be integrated by scientific and community efforts. Participation programs, data exchange on websites, and expert advice by professionals can lead to planting recommendations for specific locations and design goals that can be adopted by anyone.

Regardless of the action (or nonaction) we choose, community adaptation to climate change will be enhanced by education programs that help us understand the nature in our midst and its impact on our sense of place. With real knowledge and professional guidance we may accept the change or, where desirable, make informed adjustments.

Notes

1. National Arbor Day Foundation (2006) www.arborday.org/media/zones.cfm. The Arbor Day Foundation has recently completed an extensive updating of U.S. hardiness zones based upon data from five thousand National Climatic Data Center cooperative stations across the continental United States.
2. There is mounting evidence of latitudinal and altitudinal range shifts for a variety of organisms, including plants and pollinators, in response to temperature rise. A meta-analysis of 44 studies shows that more than 400 species of plants and animals have shifted their ranges or changed behaviors such as the timing of egg-laying. C. Parmesan and G. Yohe, "A Globally Coherent Fingerprint of Climate Change Impacts across Natural Systems," *Nature*, 421 (6918) (2003), pp. 37-42.
3. Phenology is the study of periodic plant and animal life-cycle events that are influenced by environmental changes.
4. G. T. McInerny and C. Dytham, "Range Shifting on a Fragmented Landscape," *Ecological Informatics*, Vol. 2, No. 1 (2007), pp. 1-8.
5. M. E. Visser and C. Both, "Shifts in Phenology Due to Global Climate Change: The Need for a Yardstick," *Proceedings of the Royal Society B*, 272 (2005), pp. 2561-69.
6. D. Tilman, J. Knops, D. Wedin, P. Reich, M. Ritchie, and E. Siemann, "Influence

Design Guidelines for Selecting Plant Species

The following guidelines can be used to help preserve sense of place and support urban ecosystem function in the face of unpredictable weather. The guidelines do not, of course, address other critical design criteria, such as spatial form. The examples offered are specific to the southeastern Michigan, which is part of the central hardwood region of the U.S.[12]

1. Identify plants that are "of place." To begin, amass a list of commercially available plant species in the target area. Confine the list to native species or noninvasive naturalized species that are already part of the local ecosystem. For each species, note ecological and aesthetic characteristics on a spreadsheet. Beyond descriptors of form, color, texture, and requirements for soil, moisture, and light, include spring emergence time, flowering period, natural community affiliation, wildlife value, drought and pollution tolerance, and restorative value for ecosystems and human well-being.
2. Identify the aesthetic and sensory characteristics most constituative of sense of place.[13] While individual designers are usually at liberty to make this call, a community survey may also help people become aware of what is at stake and engage their support for future efforts. Information on sense of place can also be captured in sketches or photographs depicting signature plant species —the combination of plants that is particularly memorable and identifies a particular place.[14]
3. Identify ecological design goals for plant selection. These may include creation of habitat for specific pollinators or wildlife species, stormwater-quality, erosion control, carbon storage, or air-quality improvements.
4. In light of the design goals, use the following criteria to select plant species from the spreadsheet database. Wherever possible, choose plants that accommodate ecological and aesthetic goals simultaneously.

A: Select plants with the greatest chance of withstanding weather fluctuations (extreme drought, rainfall, or temperature change). Begin by considering plants with plasticity. For example, select species with broader hardiness-zone ranges (e.g., zone 2-9, American mountain ash, *Sorbus americana*), or species known to withstand both drought and flooding (e.g., white swamp oak, *Quercus bicolor*).

B: Plasticity is not a universal salve. For greater community stability in the face of uncertainty, support niche diversification by including plant species with different stress tolerances. For example, select shrub species that

of Functional Diversity and Composition on Ecosystem Processes," *Science*, 277 (1997), pp. 1300-02.
7. C4 plant metabolism, found in about half of all grass species worldwide, allows efficient photosynthesis under conditions of high heat by avoiding photorespiration. Plants with CAM metabolism can also photosynthesize under conditions of severe drought by using a two-stage process that involves carbon dioxide uptake at night when water loss is at a minimum. Less than 10 percent of all flowering plants can do this. Legumes house microbial partners capable of taking nitrogen from the atmosphere and making it available to other community members.
8. The value of phenotypic plasticity in the face of climate change is taken up in S. L. Chown, S. Slabber, M. A. McGeoch, C. Janion and H.P. Leinaas, "Phenotypic Plasticity Mediates Climate Change Responses among Invasive and Indigenous Arthropods," *Proceedings of the Royal Society B*, 274 (2007), pp. 2531-37; and in A. Charmantier, R. H. McCleery, L. R. Cole, C. Perrins, L. E. B. Kruuk, and B. C. Sheldon, "Adaptive Phenotypic Plasticity in Response to Climate Change in a Wild Bird Population," *Science*, 320 (2008), pp. 800-03.
9. M. C. Hunter and M. D. Hunter, "Designing for Conservation of Insects in the Built Environment," *Insect Conservation and Diversity* (2008, in press), and online http://www3.interscience.wiley.com/journal/121355925/abstract.
10. J. Taylor, C. Paine and J. Fitzgibbon, "From Greenbelt to Greenways: Four Canadian Case-Studies," *Landscape and Urban Planning*, 33 (11-3) (1995), pp. 47-64.
11. J. Pöyry and H. Toivonen, "Climate Change Adaptation and Biological Diversity," FINADAPT Working Paper 3, Finnish Environment Institute Mimeographs, No. 333, Helsinki (2005), p. 46.
12. See J. Diekelmann and R. Schuster, *Natural Landscaping: Designing with Native Plant Communities* (Madison: University of Wisconsin Press, 2nd edition, 2002).
13. J. Woodward, "Signature-Based Landscape Design," in G. F. Thompson and F. R. Steiner, eds., *Ecological Design and Planning* (New York: John Wiley, 1997), pp. 210-15.
14. N. Robinson, "Place and Plant Design: Plant Signatures," *The Landscape*, 53 (1993), pp. 26-28.
15. C. J. Frost and M. D. Hunter, "Herbivore-Induced Shifts in Carbon and Nitrogen Allocation in Red Oak Seedlings," *New Phytologist*, Vol. 178, No. 4 (2008), pp. 835-45.
16. E. Marris, "A Garden for All Climates," *Nature*, Vol. 450, No. 13 (2007), pp. 937-39.

express a range of responses to water availability, from tolerance of drought (mapleleaf viburnum, *Viburnum acerifolium*), to flooding (redosier dogwood, *Cornus sericea*), to a capacity to handle either (shrubby cinquefoil, *Potentilla fruticosa*).
C: Include plants that match the aesthetic characteristics of the signature species in the area but which have a broader ecological range (e.g., choose white oak, *Quercus alba*, in lieu of American beech, *Fagus grandifolia*), or that prefer a slightly warmer climate. In lieu of American basswood, *Tilia americana*, and eastern hemlock, *Tsuga canadensis*, choose White Basswood, *T. heterophylla*, and Carolina hemlock, *T. caroliniana*, both of which naturally occur in warmer areas of central and eastern U.S. hardwood forests.
D: Maximize the number of functional groups to accomplish valuable ecological tasks. For example, create habitat structural diversity by modifying monocultural turf areas. Enlarge their borders to include deciduous trees, broad-leaf evergreen shrubs, and flowering groundcovers that better support birds through all seasons.
E: Establish ecological redundancy for important ecosystem functions. For example, select a set of flowering species that collectively ensure continuous blooms for pollinators under early springs (serviceberry, *Amelanchier arbore*) and extended falls (smooth aster, *Aster laevis*), and long-flowering species for a range of rainfall conditions from dry (e.g., sundrops, *Oenothera fruticosa*) to wet (e.g., cut-leaved coneflower, *Rudbeckia laciniata*, and Joe-Pye weed, *Eupatorium maculatum*).
F: Avoid highly opportunistic plant species that can easily outcompete and dominate under stressful conditions (e.g., for goldenrod, *Solidago spp*., substitute the naturalized *Achillea x Coronation Gold*, an aesthetic equivalent).
G: Manage ecosystem functions to better support the work of unseen community members with a critical role in nutrient recycling —the decomposers. Allow fallen plant bits to remain in place rather than tidying, and allow herbivory, because plant-eating animals facilitate nutrient recycling by offering soil microbes smaller packets.[15] For elevated nutrient production by soil microbes, select nitrogen-fixing species (e.g., speckled alder, *Alnus rugosa*).
5. Test. Sustainability requires a long-term commitment. Also let community participation inform adaptation efforts. Conservation programs worldwide are enlisting adults and schoolchildren to gather data on the timing of budburst and bloom periods to better protect pollinators. Engage local gardening organizations whose members can offer feedback on the success of planting designs for adaptation. The life of the gardener is one of continuous experimentation.[16]