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Restoration, reconciliation, and reconnecting with nature nearby

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ABSTRACT

Biotic homogenization is in many ways a function of spatial and temporal scale. Another aspect of this phenomenon that perhaps receives somewhat less attention is related to "the scale of human experience", particularly in the way that people view homogenization. Here, I examine the relationship between scale and efforts to reverse the loss of native species using two case studies in the Midwestern U.S. Both of these are focused on the restoration of prairie, one in a rapidly urbanizing area and one in a rural context. At a large reserve in a rural area, it is possible to restore prairie at a scale that is sufficient to accommodate populations of grassland obligate birds. This is an unrealistic goal, however, for small reserves in the midst of suburban development and rapidly escalating land prices. Small reserves in this context may be suitable for taxa with smaller habitat requirements, but also have a vital role in reversing biotic homogenization by enabling people to experience nature directly. Not only does this improve their quality of life, but may also foster support for efforts to maintain biodiversity in more remote locations. Thus, the goals of conservation and ecological restoration at various points on the land-use gradient are somewhat different but complementary and inter-related. Conservation scientists have an obvious role in the restoration and management of large reserves, but they also have an important part to play in restoring and maintaining elements of biodiversity in cities and suburbs.

1. Introduction

Biotic homogenization is in many ways a function of scale. As native habitats are replaced by agriculture or urban development, biodiversity is reduced regionally (and ultimately at global scales) as a relatively small number of species that thrive in human-dominated landscapes replace those that do not (McKinney and Lockwood, 1999). Spatial patterns of species replacement can be viewed as the product of a temporal sequence in which extirpation due to habitat loss is followed by range expansion due to habitat gain (McKinney and Lockwood, 2001), although these two phases often overlap. Locally, there may be a temporary increase in diversity as human-adapted species are added to the existing biota. Species loss may be forestalled depending on the pace of habitat conversion, colonization rates of human commensals, and the length of time that "sink" species can persist once their source habitats have disappeared (Pulliam, 1988; Tilman et al., 1994; Rosenzweig, 1995).

Temporal scale also affects public perception of biotic homogenization Kahn (2002) observed that environmental conditions encountered during childhood form the baseline

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against which people measure environmental degradation later in life and termed this phenomenon "environmental generational amnesia". Thus, the extent of biodiversity loss that is recognized and appreciated by the general public is lessened every few decades.

In this paper, I examine the relationship between scale and efforts to mitigate biotic homogenization resulting from human settlement. I consider spatial and temporal scale, the "scale of human experience" (Karasov, 1997), and two key strategies for reducing or reversing homogenization. The first is habitat restoration and the second is reconciliation (Rosenzweig, 2003), or the purposeful design of human land use to meet the needs of native species. To illustrate my points, I draw on two case studies in the Midwestern United States, one in a rapidly urbanizing area and, for purposes of comparison, the other in a more sparsely populated rural setting.

2. Case studies

The first wave of biotic homogenization in the upper Midwest was initiated in the mid-1800s with European settlement and the conversion of prairie to agriculture. One hundred years later, this was followed by a second wave during which rotation-based cropping systems were converted to row-crop monocultures (Jackson, 2002). The end result was the replacement of a diverse grassland mosaic by monotonous expanses of corn and soybeans. In Iowa, native prairie that once covered 85% of the state has been reduced to 0.1% and the native grasslands that once occupied 60% of Illinois have been reduced to 0.04% (Knopf, 1994; Robertson et al., 1997).

Although the prairie had nearly vanished by the dawn of the twentieth century, the form of agriculture that initially replaced it still maintained important processes and elements of the prairie ecosystem (Jackson, 2002). Extensive hayfields, for example, continued to provide habitat for many grassland birds. Circumstances have changed since the second plowdown and the shift to landscapes dominated solely by annual crops, and during the latter half of the twentieth century grassland birds have experienced greater declines than any other avian group in North America (Peterjohn and Sauer, 1993).

Both of the case studies discussed below involve attempts to restore prairie to landscapes that have been greatly transformed since settlement. My colleagues and I are conducting research at both locations to evaluate these efforts in terms of providing habitat for avian species that are grassland obligates.

2.1. *Broken Kettle Grasslands Preserve*

The largest contiguous prairie in the state of Iowa is located in Plymouth County at the northern terminus of the Loess Hills (Fig. 1). Broken Kettle Grasslands Preserve comprises >1200 ha in the northwest part of the state and is owned and managed by The Nature Conservancy. Broken Kettle is bordered by the 340 ha Five Ridge Prairie Park, originally purchased by The Nature Conservancy in the early 1980s and later ceded to Plymouth County. An additional 650 ha of private

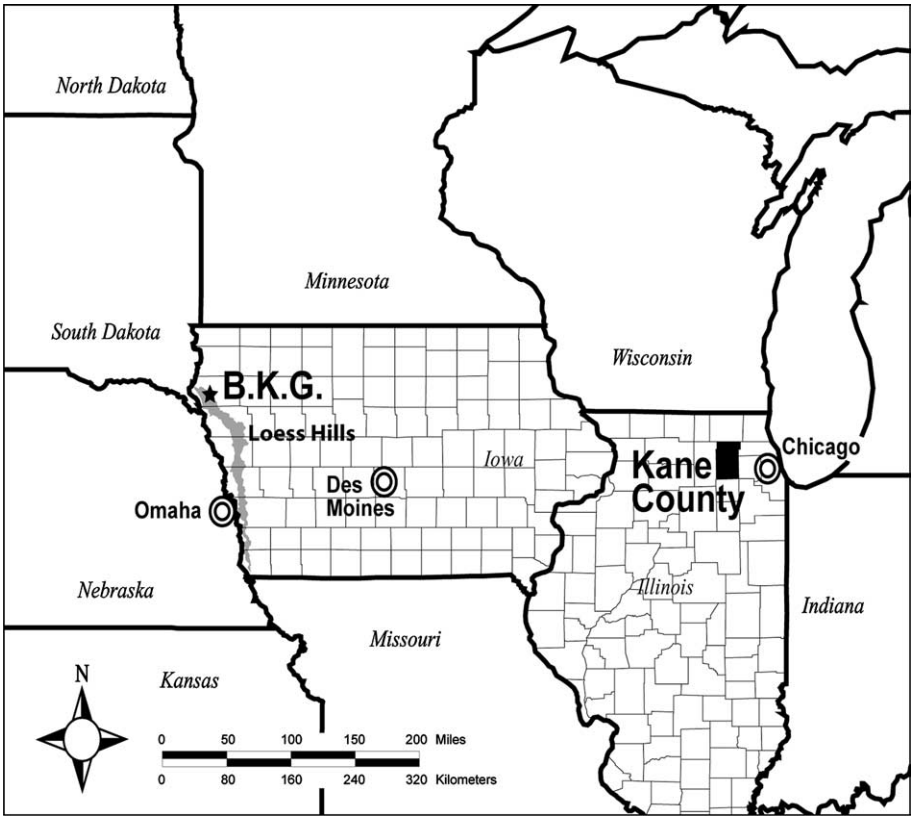

Fig. 1 – Locations of Broken Kettle Grasslands Preserve in the Loess Hills, Iowa, and Kane County, Illinois.

land surrounding the preserve is now under a permanent conservation easement.

It is no accident that the largest prairie in a state that was once 85% native grassland occurs in the Loess Hills. This internationally unique landform was created over 12,000 years ago from wind-blown loess deposits and sculpted by the erosive force of water. Prior to settlement, the hills were dominated by prairie in the uplands and woodland plant communities in valleys and ravines (Mutel, 1989). Much of the prairie has since been converted to agricultural uses, but the intricately dissected topography and highly erodable soils prevented the wholesale conversion to row crops so prevalent in the rest of the Midwest. Such conditions had two important consequences: grasslands in the Loess Hills were more often replaced by pastures and hay meadows, and a relatively large percentage (3–5%) of native prairie remained (Mutel, 1989).

Remnant grasslands throughout the Hills have been degraded by the encroachment of woody vegetation as a consequence of fire suppression (Mutel, 1989), but this impact has been less pronounced in the northernmost part of the landform. Here, the Loess Hills are characterized by rolling terrain, quite distinct from the steeper slopes and near vertical bluffs found to the south, and this enabled more widespread clearing of trees and shrubs to facilitate the grazing of livestock (S. Hickey, The Nature Conservancy's Loess Hills Project Director, personal communication). The combination of relatively open, rolling landscape and lower land prices than elsewhere in the region led to The Nature Conservancy's focus on the Broken Kettle area. The cost of land around the preserve remains low, compared to properties further south, at $2750–3750 (U.S.)/ha and this has allowed The Nature Conservancy to continue enlarging the preserve. Although the population of Plymouth County declined by 0.5% between 2000 and 2003 (U.S. Bureau of the Census, 2003), exurban development has begun to appear in the vicinity of the preserve. It is too early to ascertain the extent to which developers will compete for properties with conservation organizations or how much land prices will escalate as a result.

In 2003, the Iowa Department of Natural Resources underscored the importance of Broken Kettle in preserving avian diversity by designating it as the focal point of the state's third Bird Conservation Area. The Bird Conservation Area model was first developed in Wisconsin (Sample and Mossman, 1997) and has since been applied to grassland areas of the United States. Intended to maintain viable populations at the landscape scale, the model specifies that a protected core area of $\geqslant$800 ha should be embedded in a 4000 ha matrix that includes $\geqslant$1000 ha of grassland habitat. Field surveys suggest that several grassland obligate species, most notably the Grasshopper Sparrow (*Ammodramus savannarum*) and Dickcissel (*Spiza americana*), occur in substantial numbers at Broken Kettle and on surrounding properties; moreover, monitoring of Grasshopper Sparrow nests indicate that the preserve is a source habitat for this species (Walker, 2005).

2.2. *Kane County*

Approximately 700 km to the east of Broken Kettle Grasslands, Kane County, Illinois, is located in the central forest/grassland transition zone (Ricketts et al., 1999). Grasslands covered just over 60% of the 1325 km^2 county at the time of settlement and the remainder was forested (Kilburn, 1959), reflecting the overall composition of Illinois during this period. Although the first wave of biotic homogenization in this area was similar to that experienced in the Loess Hills, the subsequent conversion to row-crop agriculture was much more pronounced and now accounts for >50% of Kane County's land cover (Illinois Department of Agriculture, 2001). The county's forests, virtually all of which are second-growth, have been reduced by 76%. Grasslands still cover nearly 24,000 ha, but these are mainly pastures and hayfields, remnants of a dairy industry that once was much larger relative to that of other counties in northeastern Illinois (Greenberg, 2002). The fate of original prairie in the county mirrors its decline in the state as a whole, where this habitat has been reduced by >99.9% (Robertson et al., 1997).

The second wave of biotic homogenization following conversion to row-crop agriculture put Kane County on a different trajectory from Plymouth County, Iowa, in terms of potential for conserving grassland bird habitat. The difference has been made more profound as a result of the third wave of homogenization. Whereas Plymouth County has witnessed a slight decline in population and modest increase in exurban development in recent years, Kane County has experienced the full brunt of sprawl emanating from Chicago. As in many metropolitan areas in the U.S., the amount of area consumed by sprawl has been disproportionate to the increase in population; Chicago expanded by 40% between 1990 and 1996, while its population increased by only 9% (Sierra Club, 1998).

The rapid spread of the metropolitan area meant that it reached Kane County, 95 km from the city of Chicago, in a relatively short period of time. Growth rates in the county have sky-rocketed over the last 15 years, with the population expanding 27.3% from 1990 to 2000 and another 13.1% from 2000 to 2003 (U.S. Bureau of the Census, 2003). Indeed, growth now appears to be exponential, with rates projected to increase to >13% for 2004 (D. Ullberg, Kane County Forest Preserve District, personal communication). This would mean that with >500,000 people, Kane County's population would be 20 times greater than that of Plymouth County, but in 60% of the area. By 2030, this population is projected to exceed 800,000.

The rapid pace of urbanization has imposed real limits on the ability of the Kane County Forest Preserve District to acquire property. The Forest Preserve District was established in 1925 and, like its counterparts in other Illinois counties, initially focused on acquiring and managing lands that contained "natural" forests (Greenberg, 2002). Since that time, they have been given greater latitude in the lands they can purchase and their mission has broadened to include habitat restoration. In Kane County, the District currently manages 58 properties totaling nearly 5500 ha and continues to augment these holdings, adding 690 ha in 2003 (Kane County Forest Preserve District, 2004), but finds it increasingly difficult to compete with developers. Land prices in the more heavily developed eastern third of the county currently exceed $74,000/ha (25× values in the vicinity of Broken Kettle) and

continue to rise (D. Ullberg, personal communication). Moreover, land acquisition by the District is not solely driven by ecological value, but rather by a variety of considerations that reflect different aspects of its mission, such as providing recreational opportunities and preserving cultural and historic resources.

Formal grassland bird surveys have as yet not been conducted on District holdings in Kane County. Nonetheless, recreational birders have noted the presence of grassland obligate species on a number of properties that comprise hayfields or restored prairies. Recent analyses of nest data from five Midwestern states suggest that relatively small prairie fragments (<100 ha) may function as population sinks for grassland birds and that the protection and restoration of large (>1000 ha) areas should be the focus of conservation efforts for these species (Herkert et al., 2003). The largest contiguous grassland in Kane County is 142 ha. Given escalating land prices, it seems unlikely that the objective of acquiring and restoring "large" prairie tracts is attainable in Kane County without substantial increases in current funding levels.

3. Prairie restoration and reconciliation ecology

At Broken Kettle, prairie restoration is conducted over relatively broad spatial scales; hundreds of hectares may be burned in a given year. In fact the preserve is large enough that The Nature Conservancy is planning to establish a bison (*Bison bison*) herd in order to mimic more closely historic grazing patterns (Scott Moats, Director of Stewardship, Broken Kettle Grasslands Preserve, personal communication). Public access is limited, minimizing potential conflicts between recreation and conservation goals. In comparison, habitat restoration in Kane County occurs at finer scales, as exemplified by the District's strategy of managing prairie in 16-ha blocks. High levels of public access are expected, given the District's mission statement, and coupled with limited budgets may limit the extent to which conservation objectives can be met.

The relatively small size of nature reserves in Kane County are typical of the Midwestern U.S. (Schwartz and van Mantgem, 1997), a situation largely resulting from the combination of the high agricultural value of the land and a lack of appreciation at the time of settlement for the aesthetics of prairies as compared to, say, landscapes in the American West. There are exceptions to this rule, represented by scattered federal and state holdings, and a few properties in the portfolios of non-governmental organizations such as Broken Kettle. Although augmentation of existing reserves or the establishment of new ones tends to be most affordable in rural areas, there are still opportunities to acquire and restore habitats in urbanizing regions.

Despite the challenges posed to habitat acquisition and restoration in the Chicago region, it represents one of the world's great success stories in terms of mitigating biotic homogenization in an urbanizing context. The 13-county Chicago metropolitan area contains relatively more natural habitat than those parts of the Midwest that are dominated by agriculture, thanks in large part to the efforts of the forest preserve districts and establishment of state parks (Brawn and Stotz, 2001). Over 250,000 ha of prairies, savannas, wetlands, and woodlands have been protected; conservation and habitat restoration in this regional nature reserve are coordinated by a coalition of >175 public and private organizations (including the Kane County Forest Preserve District) known collectively as the "Chicago Wilderness" (<http://www.chicagowilderness.org>).

This group has done much to enhance prospects for biodiversity in the area by coordinating conservation activities among its members, instituting monitoring and inventory programs, developing educational and outreach activities, and training thousands of volunteers. Moreover, individuals associated with this organization have done much to advance the science of ecological restoration, particularly with regard to prairies and savannas (Packard and Mutel, 1997).

Chicago's regional reserve network and achievements in habitat restoration there are remarkable, but these tools alone may not be sufficient to sustain many elements of biodiversity over the long term. Rosenzweig (2003) observed that at global and continental scales, it is unlikely that much more than 5% of natural habitats will be protected in reserves, and that the amount of land added through ecological restoration is likely to be even less. This pattern appears to hold true at regional scales in some environments; protected areas included in the Chicago Wilderness cover approximately 5.7% of the city and its metropolitan region (Openlands Project, 1999). Rosenzweig goes on to suggest a third strategy to supplement reserves and restoration, and has termed it "reconciliation ecology", or the third 'R' of conservation biology. The goal of this approach is to reconcile human needs with those of native species by designing our surroundings in ways that will also meet their habitat requirements (Rosenzweig, 2003).

The notion of reconciliation ecology is appealing, but requires a much broader base of support than currently exists if it is to be effective. Still, there are encouraging examples that suggest the potential of this idea. For instance, an alternative to typical forms of suburban development is beginning to appear in many parts of the U.S. and is predicated on identifying and protecting environmentally sensitive areas on-site prior to laying out streets or lot lines. Conservation subdivisions (Arendt, 1996; Arendt, 2004) may preserve up to 70% of a site as open space while maintaining the same overall density as in a conventional development by clustering units on the remaining land. Such a framework may be a particularly effective conservation tool in places like Kane County, where funds for land acquisition are limited. With planning at regional scales, this form of development could be used to augment greenway networks and buffer existing reserves.

Conservation subdivisions can further reconcile human needs with those of other species by implementing features of low-impact development, a site-level approach to creating hydrologically functional landscapes (Prince George's County, 1999). One of the major homogenizing effects of development is the degradation of streamside and aquatic habitats through increased surface runoff and decreased infiltration (Schueler, 1994). Replacing impervious surfaces

and conventional stormwater conveyance systems with low-impact development practices, which treat stormwater at the source, can greatly reduce such degradation. Designers in the Midwestern U.S. have expanded the low-impact development approach by constructing on-site wetlands and prairies in an attempt to mimic the ecological function of historic landscapes (Broughton and Apfelbaum, 1999). Pioneered in the Chicago area, these features in combination with low-impact development practices are projected to reduce annual runoff from a site by up to 70%, decrease peak discharge during storm events by 60%, and reduce waterborne contaminants by 70–100% (Broughton and Apfelbaum, 1999).

4. Reconnecting with nature

When measuring the effectiveness of efforts to reverse biotic homogenization in rural or urban settings, it is important to look beyond the direct benefits for biodiversity in a given place. If this is our only yardstick, nature reserves or conservation action in urban environments often pale in comparison to their rural counterparts. The contribution of Broken Kettle Grasslands to preserving grassland birds is far superior to that of Kane County, based on the area of contiguous prairie and habitat requirements of these species. A somewhat different assessment emerges if one also considers the accrual of social and educational assets (Box and Harrison, 1994).

Others have suggested that one of the root causes of biodiversity loss is the extinction of experience (Pyle, 1978; Pyle, 1993), or direct contact between people and nature, as our world becomes increasingly urbanized. Exacerbating this situation is a phenomenon termed environmental generational amnesia (Kahn, 2002), or the tendency for people to use the natural environment encountered during childhood as the baseline against which environmental degradation is measured later in life. In other words, not only are direct encounters with nature on the decline, but the encounters that do occur tend to be in environments of progressively lower quality. To paraphrase Gould (1991), how likely is it that people will save what they have not come to know and love?

There are essentially two ways to reverse this estrangement from the natural world: encourage people to move to more remote locations where ongoing contact with biologically rich environments is more likely, or enhance this possibility where people are already living (Turner et al., 2004). Until we become much more adept at reconciling human settlement with the needs of native species, the first option is unlikely to produce a favorable outcome for biodiversity. In fact, just the opposite is what's needed from the conservation perspective—to stem the tide of exurban and suburban growth in and around our remaining wildlands and biodiversity hotspots. This objective is not unrelated to our second option, enhance opportunities for meaningful interactions with nature in areas that are currently developed (or soon will be).

Improving the quality of life for city-dwellers may do much to reduce development pressures elsewhere (Shutkin, 2000; Merrill, 2004). Incorporating natural features in urban design has positive effects on human health and well-being that have been extensively documented at the scale of individual parcels, and can be reasonably extrapolated to the scale of neighborhoods and entire cities (Jackson et al., 2004). Furthermore, a growing number of studies support the hypothesis that ongoing contact with familiar natural environments greatly enhances children's emotional and intellectual development (Kellert, 2002).

Together, these observations suggest that the goals of conservation and ecological restoration at various points on the land-use gradient are somewhat different but interrelated, and also scale-dependent. At Broken Kettle, the target of restoration is the best approximation of a prairie ecosystem as it existed prior to settlement, with the goal of maintaining as many elements of biodiversity as possible, including viable populations of grassland obligate bird species. Although the scale of reserves in Kane County may not be conducive to sustaining populations of grassland birds, they may be adequate for other taxa such as prairie-obligate butterflies (D. Taron, Chicago Academy of Sciences, personal communication). The assets of these smaller set-asides should also be measured at the scale of human experience. By sheer virtue of their accessibility, these areas may do much to enhance the value of a prairie in the minds of those who live nearby. This in turn may translate into a more widespread recognition of the necessity of conserving more extensive grasslands elsewhere.

Just as conservation scientists have an obvious role in maintaining or restoring biodiversity in large reserves that are distant from major population centers, they also have an important part to play in reversing biotic homogenization in places like Kane County. Their voices need to be heard by policy-makers. Their active participation in research and management is needed if the full potential of small urban reserves and the promise of reconciliation ecology are to be realized. Achieving these goals will require new collaborations with social scientists, designers, and planners. It will also require a broader appreciation for the connections between biodiversity conservation and quality of life in the places where most of us live.

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