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UN DECADE ON ECOSYSTEM RESTORATION

Editor's Choice – From Practice

Restorative recreation: One landowner's experience restoring a cedar-infested native prairie remnant in Iowa's Loess Hills

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[Correction added on 29 June 2021, after first online publication: Conflict of Interest statement has been added.]

Abstract

1. Over 80% of pre-settlement Iowa was a prairie landscape, but conversion and neglect has reduced that to less than 0.1% of the original 30 million acres (12 million hectares). Much of the remaining remnant prairie lies within the Loess Hills landform in western Iowa.
2. Here I describe my experience as a landowner identifying and restoring a native Loess Hills prairie remnant overtaken by Eastern redcedar (*Juniperus virginiana*). Archived aerial photographs confirm its native remnant status and have been used to monitor restoration progress. Both shearing and hand clearing of cedars have been undertaken at this site, providing an opportunity to compare patterns of ecosystem recovery within one remnant prairie.
3. I find that cedar shearing, though effective at rapidly clearing a large swath of land, was associated with greater abundance of weedy and woody species compared to hand clearing that occurred more gradually over a longer period of time. However, consistent, targeted herbicide application to woody growth, as well as two prescribed fires, have led to good recovery and stabilization of the grassland with minimal annual recruitment of new brush.
4. Photographs of faunal associations with Pasque flowers (*Anemone patens*) provide an indicator of the biodiversity on this prairie and suggest Pasque flowers, due to their abundance at this site, function as a keystone species that drives early spring ecosystem productivity.
5. Based on my experience, I introduce a paradigm called *restorative recreation* to provide a framework for integrating ecosystem restoration activities with outdoor recreation to maximize benefits to personal health and well-being, while improving the landscape for other species that share our common home.

KEYWORDS
Loess Hills, outdoor recreation, Pasque flower, prairie restoration, reciprocity

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1 | INTRODUCTION

The Loess Hills extend roughly 200 miles (320 km) and encompass about 640,000 acres (266,000 hectares) across seven western Iowa counties (Iowa Department of Natural Resources, 2010). The Loess Hills landscape was formed from silt deposited along waterways as glaciers receded during the last Ice age and subsequently sculpted into dunes by prevailing winds (Prior, 2017). My association with the Loess Hills has its roots in formative experiences participating in and observing the results of prairie reconstruction and restoration activities during my youth and early adulthood, which fostered an interest in acquiring and restoring a prairie of my own. This dream culminated in the 2007 purchase of a ~60 acre (24 hectare) Loess Hills prairie remnant, about an hour's drive north of Omaha where I now live.

These experiences, and the circumstances that led me to purchase this property, are detailed in a book I recently published (Swanson, 2018), so I will not revisit them here, except to highlight three key factors that influenced my decision to acquire this parcel. First, on a visit to the property, I found hills overtaken by Eastern redcedar (*Juniperus virginiana*), but containing some traversable ridgelines where I identified native forbs and grasses, including Lead plant (*Amorpha canescens*) and Big bluestem (*Andropogon gerardii*), that led me to suspect it was a prairie remnant. Second, the proximity of the land to my home was amenable to my work- and home-life schedules. Third, the prairie had no buildings on it and was bordered by roads and crop ground, so I felt prescribed burning, which is an integral tool in prairie management, would be feasible. In the paragraphs that follow, I will describe evidence confirming my suspicion that the property is indeed a remnant prairie and discuss the approaches I took to begin restoring this ecosystem.

2 | ESTABLISHING REMNANT STATUS

The proximity of the property to nearby prairies within the Loess Hills State Forest gave me some confidence that the land might contain remnant prairie. From the ownership history, I knew the tract had been grazed, but I was not entirely sure of the extent of the original grassland. Soon after I purchased the parcel, I learned the Iowa Geographic Map Server had archival aerial photos dating to the 1930s for most of Iowa (Iowa State University Geographic Information Systems Support & Research Facility, 1999–2020). As shown in Figure 1, the earliest aerial photograph of this property reveals two roughly parallel ridges running north to south, largely free of trees. By the 1970s, scattered cedars can be seen dotting the lower flanks of the hillsides. By the 1990s the cedars had encroached on the ridgetops, and by 2006 the cedar coverage was nearly complete. The earliest photographs shows notches had been cut through each ridgeline, and a track had been bulldozed along the west ridge. A road also traversed the north-east corner of the property before being rerouted sometime after 1950. Other than these disturbances, the grassland appears intact through these historical reference photographs. Thus, I conclude the remaining prairie is a native remnant.

3 | APPROACH TO RESTORATION

The size of the property and the scope of the cedar infestation made it obvious that I could not clear all the cedars by myself. I decided to enrol in a cost-share programme offered by the U.S. Fish and Wildlife Service to mechanically grind down the cedars on the west side of the property. Meanwhile, I focused on hand clearing the cedars on the east side. My deliberation was driven mostly by pragmatism; the west side was easier for heavy equipment to access than the east side, and the hills were less steep. This approach also offered an opportunity to compare results between the two methods of cedar removal.

The cedar-mulching project was completed in July 2007. While the views afforded by removing the trees were magnificent, seeing all the bare soil and piles of wood chips left behind by the forestry mulcher admittedly left me wondering whether I made a mistake in pursuing this option (Figure 2). Could the prairie recover? Furthermore, I found that not all the cedars in the project area were cleared. Those that were not safety reached by the equipment were left standing, so I had to remove those by hand.

Meanwhile, on the east side, progress was much slower and more deliberate. My approach was to use my chainsaw to cut paths through the tangle of cedar branches to reach the more open areas on the ridgetops. From there, I decided to cut down as many small cedars as possible and pull them off the hillside and then cut the limbs off the surrounding trees to let in more light. As the grassland recovered, I felled the trimmed trees and removed the tops and branches. These were then dragged off and stacked further downslope. The resulting slash piles were burned during the winter, or consumed in prescribed fires. Through iterations of this approach over many years, I have opened substantial portions of the eastern ridgeline.

While I considered the possibility of felling the cedars into windrows to dry out and eventually burn off in a prescribed fire, there were several reasons I decided against this option. First, the felled trees would obstruct free movement across the property. Second, the large fuel load resulting from this approach would create a significant risk of severe wildfire. Third, the shade and cover created by the downed timber would create conditions favourable for the establishment of woody growth, which can be more problematic than removing cedars. I witnessed this phenomenon on the west side of the property where some cedars too large to mulch were cut and moved into large piles, from which tree saplings soon emerged.

4 | ONGOING MANAGEMENT

As cedar removal has progressed, ongoing management has included periodic herbicide treatment of woody growth, sweeps for invasive plants and prescribed burning. For herbicide treatment, I constructed an applicator wand following a design developed by The Nature Conservancy and used their basal bark application technique (Winkel, 2012) to dab herbicide on invading deciduous shrubs and trees. In my case, sumac, dogwood, ash, mulberry, elm and, more recently, honeysuckle and tree-of-heaven, have been my most common targets.

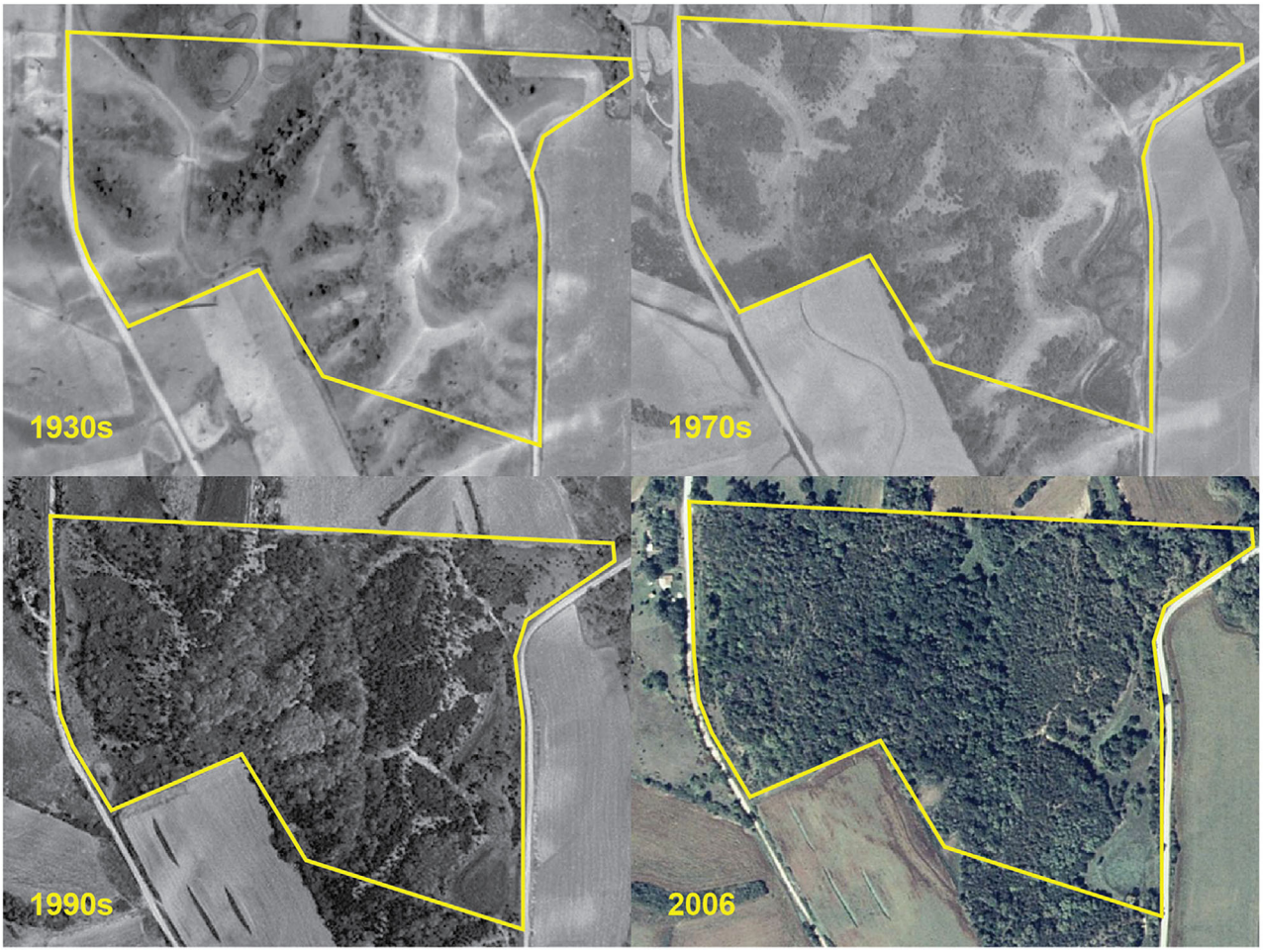


FIGURE 1 Progression of Eastern redcedar invasion. Archival aerial photographs of the property at selected time points were obtained from the Iowa Geographic Map Server (Iowa State University Geographic Information Systems Support & Research Facility, 1999 –2020). The approximate property boundary is outlined



FIGURE 2 Forestry mulcher clearing the western side of the property. Cedars were cleared using a Gyro Trac model GT13 forestry mulcher in July 2008 (left). Post-clearing photograph shows bare soil and mulching residue (right). (Photographs courtesy of Matt Dollison.)



FIGURE 3 Basal bark treatment outcome. Sumac and ash three weeks after basal bark herbicide application

I slightly modified the original design by replacing the plastic ball valve (which broke frequently in my hands) with a more durable brass valve, and by drilling a small hole near the end of the wand to tap a 1 inch (25.4 mm) wire brad nail through the applicator cloth to help keep it in place. I tend to do these applications during stretches of hot, dry weather from mid-summer to early fall, as woody growth seems particularly sensitive to the treatment under these conditions (e.g. see Figure 3).

So far, other than smooth brome, invasive plants have not become a serious issue on this remnant prairie. As I sweep the grassland looking for woodies to treat, I have located areas with some White sweet clover (*Melilotus albus*) and Leafy spurge (*Euphorbia sular*) that I monitor and attempt to control by hand pulling or at least removing the flower heads before they set seed. In the woodlands between the ridgelines, however, Garlic mustard (*Alliaria petiolata*) and Honeysuckle (*Lonicera japonica*) have become established over the last several years and have grown in abundance. I pull and treat what I can, but in my judgment, restoring the prairie takes precedence given my limited time.

Prescribed burns have been the most challenging form of management to complete. This is a common refrain among landowners. I have been fortunate to have had two prescribed burns conducted on my property: the first in 2013 (February 27), and the second in 2018 (May 7). Both involved collaborative efforts between multiple agencies. The main objective of the first prescribed fire was to set back woody growth and cedars that emerged in areas mechanically cleared of cedars. This objective was largely achieved. The goal of the second prescribed fire was the same as the first, but I hoped that the later date might suppress Kentucky bluegrass (*Poa pratensis*) and Smooth brome (*Bromus inermis*) that was present in some areas. As it turned out, the weather post-burn was abnormally hot and dry for several weeks. Over the summer, I noticed fewer resprouts among the woody growth than I saw with the previous burn and the bluegrass seemed particularly well suppressed, especially on the east side of the property. Interestingly, the following year (2019), I noticed more Junegrass (*Koeleria macrantha*) than in previous years, which I speculate might have benefitted from having the Kentucky bluegrass set back.

As the grassland recovers and expands, a future goal is to introduce grazing regimes to periodically reduce the vigour of the warm season grasses to ensure opportunities for less competitive annuals and short-lived perennial forbs to increase their abundance and availability to pollinators and other foragers, and perhaps to assist in brush control.

5 | RESPONSE OF THE LANDSCAPE TO RESTORATION

The overall response to the management efforts conducted on my property has been very satisfying to observe. Aerial photographs taken shortly after the cedar-mulching project and up to the present show expansion of the grassland footprint on both the west and east sides of the property over time (Figures 4a–c). I have also taken pictures for qualitative point sampling (Clark and Hardegree, 2005) over the years, an example of which is shown in Figure 4d–f. Despite my initial reservations, the mechanically razed west side of the property has shown remarkable recovery and stabilization after an initial weedy phase (see Figure 5). By contrast, while occurring at a considerably slower pace, the hand-cleared eastern side has rebounded with much less weediness and woody recruitment than its western counterpart. In terms of plant biodiversity, many of the species found on nearby prairies in the Loess Hills State Forest units (Iowa Department of Natural Resources, 2010) are also found on my property. A fairly complete, but by no means exhaustive, prairie plant list (adapted from University of Iowa Press & The University of Iowa Libraries, 2020) is provided in Table 1. Several plants notably absent from this site are also included.

Among the most noteworthy plants present on this prairie remnant is the Pasque flower (*Anemone patens*), which is locally abundant. The Pasque flower is a well-known and photogenic early spring bloomer. Beyond their beauty, what captivates me about these flowers is the impressive array of life that is attracted to them. This has led me to attempt photo-documenting the many species I have witnessed using the plant to illustrate the diversity of life that inhabits this prairie. A sampling of the visitors is shown in Figure 6 and includes ants, bees, bugs, butterflies, flies, spiders and caterpillars. Observing the Pasque flowers and their associated fauna over many years has shown me that these plants support diverse inter-species interactions and likely influence the types and abundance of these species. This leads me to propose that the Pasque flower functions as a keystone species on this prairie remnant. I further suggest that photo-sampling pollinators and foragers using native plants is an enjoyable, informative and inspiring approach for those engaged in ecological restoration to better understand local biodiversity.

6 | RESTORATIVE RECREATION: A PARADIGM OF RESTORING SELF WHILE RESTORING THE LAND

In reflecting on my many years of work on this property, I realized that my efforts restoring the ecosystem has had a profound effect on my overall sense of well-being. Far from being 'work', I have come to see

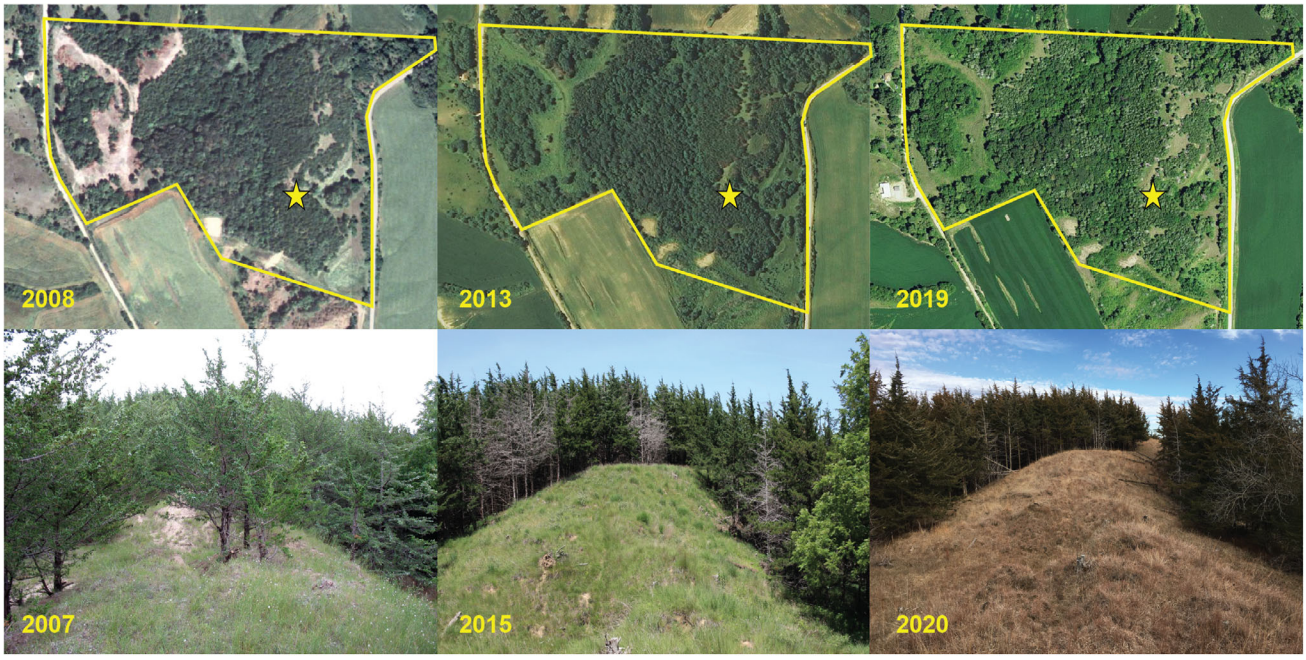


FIGURE 4 Serial aerial and ground photographs depicting restoration progress. Aerial photographs of the property obtained from the Iowa Geographic Map Server (Iowa State University Geographic Information Systems Support & Research Facility, 1999 –2020) at various times following initiation of restoration activities (top row). Point sampling photographs taken at the location identified by the star in the upper panels show progressive manual removal of cedars and recovery of prairie species (bottom row)



FIGURE 5 Recovery of prairie following mechanical cedar mulching. Two areas subjected to mechanical cedar clearing in 2008 photographed shortly after project completion (top row, right photograph courtesy of Matt Dollison) and again 10–11 years later from approximately the same location (bottom row)

TABLE 1 Prairie plant list

Species identified on restored prairie remnant		
Agoseris cuspidata (Pursh) (Prairie dandelion)	*Amorpha canescens* Pursh (Lead plant)	*Andropogon gerardii* Vitman (Big bluestem)
Anemone cylindrica Gray (Thimbleweed)	*Anemone patens* L. (Pasque flower)	*Antennaria neglecta* Greene (Pussytoes)
Asclepias verticillata L. (Whorled milkweed)	*Asclepias viridiflora* Raf. (Green milkweed)	*Aster ericoides* L. (Heath aster)
Aster laevis L. (Smooth blue aster)	*Aster lanceolatus* Willd. (Panicled aster)	*Aster sericeus* Vent. (Silky aster)
Astragalus canadensis L. (Milk vetch)	*Astragalus crassicarpus* Nutt. (Ground plum)	*Bouteloua curtipendula* (Michx.) Torrey (Side-oats grama)
Brickellia eupatorioides (L.) Shinners (False boneset)	*Cacalia tuberosa* Nutt. (Prairie Indian plantain)	*Castilleja sessiliflora* Pursh (Downy painted cup)
Ceanothus herbaceus Raf. (Redroot)	*Cirsium altissimum* (L.) Sprengel (Tall thistle)	*Comandra umbellata* (L.) Nutt. (Bastard toadflax)
Dalea candida Willd. (White prairie clover)	*Dalea purpurea* Vent. (Purple prairie clover)	*Desmodium canadense* (L.) DC. (Showy tick trefoil)
Echinacea pallida Nutt. (Pale coneflower)	*Elymus canadensis* L. (Canada wild rye)	*Equisetum arvense* L. (Common horsetail)
Erigeron strigosus Muhl. ex Willd. (Daisy fleabane)	*Euphorbia corollata* L. (Flowering spurge)	*Euphorbia marginata* Pursh (Snow-on-the-mountain)
Helianthus rigidus (Cass.) Desf. (Prairie sunflower)	*Koeleria macrantha* (Ledeb.) Schultes (June grass)	*Lactuca tatarica* (L.) C. A. Meyer (Blue lettuce)
Liatris aspera Michx. (Rough blazing star)	*Liatris punctata* Hooker (Dotted blazing star)	*Linum rigidum* Pursh (Stiff flax)
Linum sulcatum Riddell (Yellow flax)	*Lithospermum canescens* (Michx.) Lehm. (Hoary puccoon)	*Lithospermum incisum* Lehm. (Fringed puccoon)
Lygodesmia juncea (Pursh) D. Don (Skeleton weed)	*Machaeranthera spinulosa* Greene (Cut-leaved goldenrod)	*Muhlenbergia cuspidata* (Torrey) Rydb. (Plains muhly)
Nothocalais cuspidata (Pursh) Greene (Prairie dandelion)	*Oenothera biennis* L. var. *canescens* T. & G. (Gray evening primrose)	*Oenothera serrulata* Nutt. (Toothed evening primrose)
Onosmodium molle Michx. (False gromwell)	*Oxytropis lambertii* Pursh (Locoweed)	*Panicum scribnerianum* Nash (Scribner's panic grass)
Panicum virgatum L. (Switchgrass)	*Pediomelum esculentum* (Pursh) Rydb. (Prairie turnip)	*Penstemon grandiflorus* Nutt. (Large-flowered beardtongue)
Physalis heterophylla Nees (Ground cherry)	*Potentilla arguta* Pursh (Tall cinquefoil)	*Rosa arkansana* Porter (Prairie rose)
Senecio plattensis Nutt. (Prairie ragwort)	*Silphium laciniatum* L. (Compass plant)	*Sisyrinchium campestre* Bickn. (Blue-eyed grass)
Solidago altissima L. (Tall goldenrod)	*Solidago missouriensis* Nutt. (Missouri goldenrod)	*Solidago nemoralis* Aiton (Gray goldenrod)
Solidago rigida L. (Stiff goldenrod)	*Solidago speciosa* Nutt. (Showy goldenrod)	*Sorghastrum nutans* (L.) Nash (Indian grass)
Stipa spartea Trin. (Porcupine grass)	*Verbena stricta* Vent. (Hoary vervain)	*Vernonia baldwinii* Torrey (Baldwin's ironweed)
Viola papilionacea Pursh (Common blue violet)	*Viola pedatifida* G. Don (Prairie violet)	
Some species notably absent on prairie remnant		
Asclepias tuberosa L. (Butterfly weed)	Dalea enneandra Nutt. (Nine-anther dalea)	Gaura coccinea Pursh (Scarlet gaura)
Lespedeza capitata Michx. (Round-headed bush clover)	Pediomelum argophyllum (Pursh) Grimes (Silverleaf scurf-pea)	Ratibida pinnata (Vent.) Barnh. (Gray-headed coneflower)
Salix humilis Marsh. (Prairie willow)	Silphium integrifolium Michx. (Rosinweed)	Spiranthes cernua (L.) L. C. Rich. (Nodding ladies'-tresses)
Yucca glauca Nutt. ex Fraser (Yucca)		



FIGURE 6 Faunal biodiversity associated with Pasque flowers. Selection of photographs showing various species of insects, Lepidoptera larvae and arachnids visiting Pasque flowers, with possible classification using the online BugGuide.Net resource (https://bugguide.net/) (a) European honeybee (*Apis mellifera*); (b) *Andrena spp.* (subgenus *Trachandrena*)? (c) *Nomada spp.* (ruficornis species group)? (d) *Nomada spp.* (heminomada species group)? (e) *Nomada spp.* (ruficornis species group)? (f) *Agapostemon spp.?* (g) *Halictus spp.?* (h) *Helophilus spp.?* (i) family Muscoidea? (j) family Formicidae? (k) order Heteroptera; (l) family Philodromidae (running crab spider)? (m) *Misumena spp.* (flower crab spider) with prey (n) Eastern comma (*Polygonia comma*) (o) Common checkered skipper (*Pyrgus communis*) (p) nymph of family Acrididae (Short-horned Grasshoppers), possibly subfamily Oedipodinae (Band-winged Grasshoppers) (q) order Lepidoptera larva (r) order Lepidoptera larva (possibly family Geometridae)? (s) family Salticidae (jumping spider) with prey

the labour I expend on this project as restorative to my body, mind and spirit in ways that other types of recreation do not seem to fully capture. For example, I enjoy trail hiking very much, but the feeling I have after a hike is tangibly different to me than how I feel after spending a day working on my prairie. Both activities provide fresh air and good exercise, so why does restoration work offer me a greater sense of fulfilment than a trail hike? I think the answer lies in the difference between being an *observer* and being a *participant*. When hiking, I observe the world around me, and while that is personally enjoyable, the landscape receives no real direct benefit from my presence; thus, the activity is essentially *consumptive*. By contrast, when working to restore the prairie, I participate directly in improving the biodiversity, biological holding capacity and resilience of the ecosystem; thus, the activity is much more *productive* than a hike from nature's standpoint.

The act of participating in a *nature producing* activity has several effects beyond the obvious health benefits of exercise. First, planning and executing restoration work diverts attention away from other competing (often personal or professional) concerns. Deciding management goals, strategizing about how to accomplish them, wielding a chainsaw, cutting and treating invasive species or even just gathering native seed all involve some level of imagination and concentration, which engages and calms the mind. Second, consistent effort to restore a site, applied through the seasons and over the years, builds a familiarity to place and its inhabitants that provides a deep sense of connectivity and belonging that is not easily achieved by most other forms of recreation. Third, by leaving time to observe how the landscape and its denizens respond to one's restoration work, one can receive the only gratitude that the inhabitants are able to give: an opportunity to witness their lives. The spiritual impact of this gift is difficult to describe but is profound for those open to pondering the awe and wonder of nature's beauty and interrelationships. The way I try to accomplish this is by limiting my restoration work to the first few hours of the day, followed by lunch (usually perched on a hillside), and then some active listening and wandering with my camera before I embark on my trip home. I have shared pictures and essays resulting from these forays on social and online media outlets including Facebook groups for the Iowa Prairie Network (Swanson, 2020c) and Iowa Wildflower Report (Swanson, 2020a), and the Bleeding Heartland blog (Swanson, 2019–2020).

My experience and reflections working on this prairie remnant have led me to formulate a paradigm that I have termed *restorative recreation*. Restorative recreation seeks to actively integrate ecosystem

restoration work and outdoor recreation to restore the land, while also restoring body, mind and spirit. While the idea that ecological restoration activities can have reciprocal healing effects on an individual and cultural level is not new (Kimmerer, 2011), what I hope the concept of restorative recreation and my application of it adds to this conversation is a framework and an example for how to incorporate ecological restoration into a contemporary lifestyle. To fully benefit from engaging in restorative recreation, I believe two important shifts in mindset are required. The first is a change from thinking of one's self as a volunteer to identifying one's self as a steward, a change that subtly elevates the relationship and responsibility of the individual to the ecosystem. The second is a change from being an intellectually uncommitted participant in restoration activities to becoming a more active life-long learner seeking to better recognize and understand the occupants of an ecosystem and their interactions and the effects of restoration activities on the ecosystem itself. Growing awareness of how one's restoration efforts affect the ecosystem is likely to be complemented by a growing awareness of how these activities affect one's own sense of self and wellness, as well as one's place and purpose within the ecosystem.

While I have focused on restoring a native prairie remnant, I emphasize that restorative recreation can be pursued wherever the landscape is degraded, from parks and nature reserves, to abandoned lots and marginal lands, to one's own back yard. Professional and volunteer land stewards can play key roles in offering the public opportunities to engage in restorative recreation activities, thereby helping to develop committed individuals who can sustain and improve natural ecosystems. While it might seem that I am asking readers to eschew normative forms of outdoor recreation, that is not my intent. I enjoy many outdoor activities that use nature as a backdrop (including biking, hiking, fishing, skiing and snowshoeing). Simply put, I suggest aspiring to dedicate a portion of the time and money spent on one's favourite outdoor activity to pursuing restorative recreation, ideally in the ecosystem that supports it. In this way, one achieves greater balance between consumptive and productive forms of recreation in nature to maximize the benefit to body, mind, spirit and the other species that share our common home.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

This manuscript has no accompanying data.

PEER REVIEW

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