



National Park Service HTLN Fire Ecology Annual Report Calendar Year 2023

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Members of the Fire Science Exchange network at the Tallgrass Prairie National Preserve during a field trip in April 2023.

The National Park Service (NPS) Division of Fire and Aviation Management relies on science and long-term monitoring to inform an adaptive management approach for assessing and improving fire management programs and activities at park units. Adaptive management, along with policies, standards, and responsibilities for monitoring are described in Chapter 8 of [Reference Manual 18](#). The NPS Fire Ecology Program is responsible for the collection, analysis, and interpretation of fire effects monitoring data for park managers to use for program evaluation and decision making. This annual report is intended to partially fulfill reporting requirements for the Fire Ecology Program and does not constitute a complete analysis of any NPS fire management program or activity. Additional interpretation and reporting can be found in previous annual reports at [NPS DataStore](#) or by contacting the author(s) of this report.

Table of Contents

A. Summary	3
B. Monitoring Results and Recommendations	4
C. Research, Planning, and Communication	9
D. Future Direction	10
E. References, Links, and Additional Reading	10
Appendix A. Staffing and Accomplishments	12
Appendix B. History of Fire Effects Monitoring Plots.....	14
Appendix C. Fire/Fuels Treatments and Associated Monitoring (OPTIONAL).....	14
Appendices D-X. Individual Park Annual Reports (OPTIONAL).....	16

A. Summary

The fire ecology program for the Tallgrass Prairie ecoregion in Regions 3, 4, and 5 is a collaborative effort with the Heartland Inventory and Monitoring Network (HTLN). There are seven park units within this Network in which fire occurrence and vegetation data are collected by HTLN: Wilson's Creek National Battlefield (WICR), Tallgrass Prairie National Preserve (TAPR), Homestead National Monument of America (HOME), Pipestone National Monument (PIPE), Effigy Mounds National Monument (EFMO), Herbert Hoover National Historic Site (HEHO), and George Washington Carver National Monument (GWCA).

Currently, there are no NPS fire-funded field staff focused on serving these parks. The Plant Ecologist's primary roles are on vegetation monitoring projects, but those projects also benefit from a fire ecology perspective. The current fire ecology data collection includes post-burn mapping at all 7 parks. Mapping is facilitated by the MTBS program. Although we have not been able to be part of prescribed fire operations in the last year, we have been engaged with fire management plan development for four parks in the network. As part of that effort, the Plant Ecologist developed ecological goals and objectives and wrote the fire ecology monitoring plan and climate change sections for four park's plans. We provided a previously developed template for public outreach and prescribed burn notices to EFMO as part of their planning effort. We also worked with the planning team revising the HEHO prairie management plan which included considerations for fire and alternatives to prescribed fire.

Two staff based at CUVA also participated in wildfire duty including as a Resource Advisor. The Plant Ecologist attended the NPS national fire ecology training at NCTC in February and that trip was funded by the Midwest regional fire program. Additional activities included consultations on a children's fire ecology book and fire ecology travel article on the tallgrass prairie national preserve. The Plant Ecologist also provided a presentation at the Association for Fire Ecology Fire Congress on the prairie-forest ecotone in the Midwest USA.

Monitoring reports that included discussion of fire ecology issues for EFMO and HOME were completed in addition to an informal report on Missouri bladderpod for WICR. A monitoring report on the grasslands for HOME, HEHO, and PIPE was recently published as well (Leis and Morrison 2024). A monitoring report for TAPR including the 2023 data is in development.

Updates to monitoring processes include numbered tree tags and use of contract botanists. In 2023 we completed tagging trees with numbered tags to facilitate accurate and efficient field operations. We also look forward to seeing how well tags were retained and weathered over since installation in 2019. We've also operationalized hiring contract botanists to aide NPS field crews for field sampling. This investment alleviates fluctuating botanical expertise in the network and improves field accuracy while expanding awareness of science in the parks.

Table 1. Fire Effects Plot Workload (2023)

Park ¹	Monitoring Unit	Plot Type (FMH Forest/Brush/Grass plot, photo point, Rapid Assessment, CBI, etc.)	Years Data Collected (start-end)	Annual Total (2023)	Total Plots
Wilson's Creek NB	Glades	Glade: 10 grids (2 monumented, 8 virtual) where each grid cell is a plot.	1997-2023	851	1337
Tallgrass Prairie NP	Tallgrass prairie	Remnant grassland: Number of sites are provided, but consist of 10 subplots each.	2002-2023	30	72
Total				881	1409

¹Sampling workload for parks sampled in other years of the rotation are listed in [Appendix B](#).

B. Monitoring Results and Recommendations

Monitoring results are included in published reports. See section C below for recent citations. A report for the 2022 data is in final stages of publication and will be available in the Integrated Resource Management Applications Portal ([IRMA](#)). Preliminary results for the 2023 monitoring event at the Tallgrass Prairie National Preserve are being developed. We highlight two preliminary trend results here (Figure 1, 2).

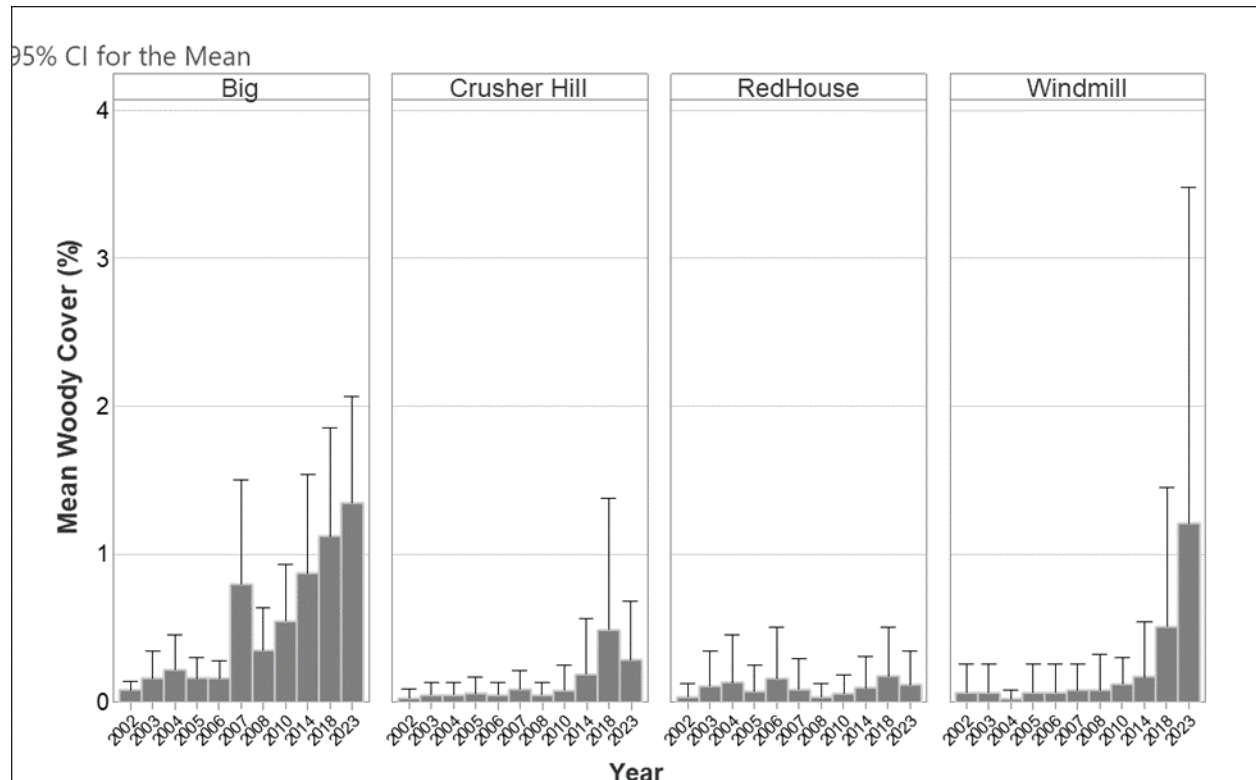


Figure 1. Mean woody cover (%) of native woody plants at the Tallgrass Prairie National Preserve in Kansas. The figure is paneled by pasture.

Mean woody cover is well below a 5% threshold for healthy prairie (Figure 1). However, we noted gradual increases in Big Pasture and more recent increase in Windmill Pasture. Windmill Pasture houses the bison, while Big Pasture is treated with patch-burn grazing. Because woody encroachment is common and problematic in the Great Plains, these results indicate the importance of vigilance through long-term monitoring.

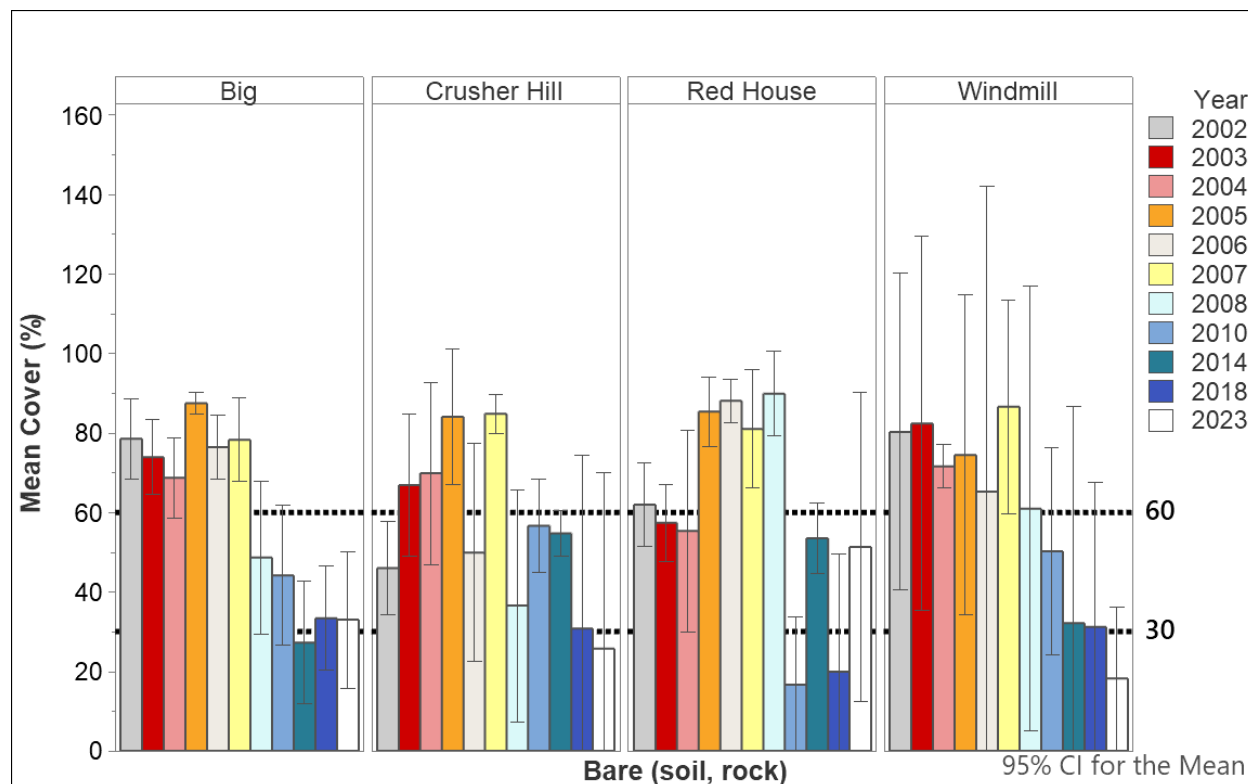


Figure 2. Mean cover of bare ground (including bare soil and rocks) for four pastures at the Tallgrass Prairie National Preserve in Kansas. Dashed horizontal lines indicate a desired range for bare ground with respect to Greater Prairie Chickens.

These results show that Big Pasture and Red House Pasture meet the desired condition at present, but Crusher Hill and Windmill pastures fall short of the minimum threshold (Figure 2).

Generally, there is less bare ground and more heterogeneity across the Preserve than in the early years of monitoring (e.g., 2002-2006). Decreases in prescribed fire and grazing likely facilitated the changes in bare ground (Leis 2022, Leis and Morrison 2022).

At many parks in the network, fire operations are less frequent than at the beginning of the century (Leis 2022). In fact, only one of the parks represented in the fire ecology focus parks was burned in 2023. Parks either missed their windows or were unable to burn as the result of needed planning efforts (FMP updates). We are closely watching woody encroachment in the grassland parks as a result. Four of the parks exhibited canopy cover that was measurable in a densiometer during the most recent sample event (Figure 3). Grasslands should be nearly absent of measurable canopy closure, so this result is notable and likely strongly associated with fire return intervals.

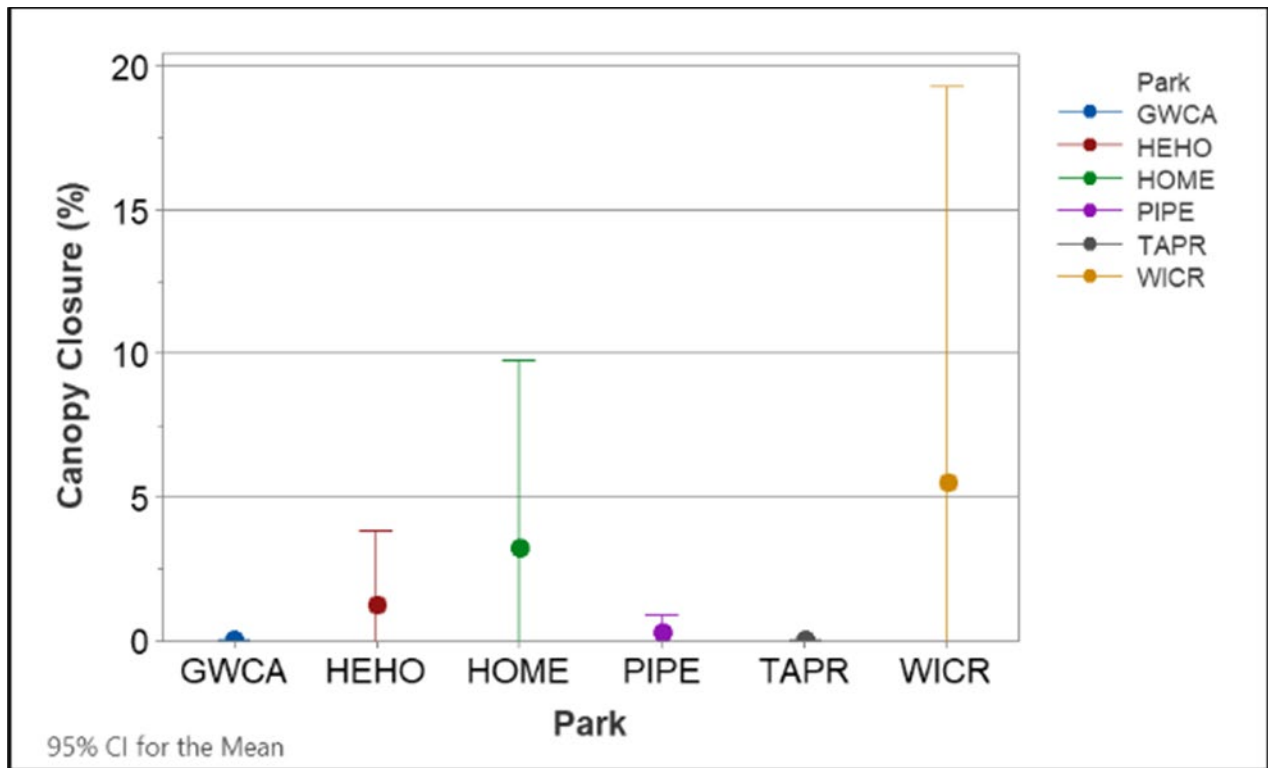


Figure 3. Mean canopy closure (%) for six parks with grassland reference frames. GWCA: (George Washington Carver National Memorial sampled in 2020, HEHO: Herbert Hoover National Historic Site sampled in 2022, HOME: Homestead National Historical Park sampled in 2022, PIPE: Pipestone National Monument, TAPR: Tallgrass Prairie National Preserve sampled in 2023, WICR: Wilson’s Creek National Battlefield sampled in 2020).

Table 2. 2023 Management Objectives and Monitoring Results

Monitoring Unit	Management Objective	Monitoring Results (w/level of certainty)	Progress Towards Meeting Objectives
EFMO	Open the forest canopy (mean <30% canopy)	2014: 87.54 (± 71.4 , 103.7 95%CI)	No treatments since 2009, monitoring suspended in 2014.
	Reduce woody plant encroachment in goat prairies.	Tree canopy 94% (± 92.3 , 96.5 95%CI) in 2022. Other woody plants could not be evaluated.	Objective written in 2023.
GWCA	Maintain at least 75 native species	2020: 99 native species	At standard in 2020.
	Maintain tree seedlings at less than 2000 stems/ha on average in prairie restorations.	2020: mean seedlings:2128.6 (± 2073.4 sd)	Metric was at the maximum value in 2020.
	reduce woody plant cover from 2020 levels to about 10% cover on average	2020: 16.1% (± 11.5 sd)	Await next monitoring event
	reduce canopy cover of the woodlands to achieve an open woodland/savannah structure (30-80% canopy cover)	2020: average woodland canopy cover 85-94% (Peitz and Reibold 2021)	Below standard at last monitoring event.
HEHO	Maintain native woody plants (non-tree species) at about 5% of the plant community	2022: mean 9.2% (2.4, 16.0 95% CI)	Currently greater than target level. Treatments ongoing.
	Maintain mean native species richness of plant community monitoring sites at greater than 40 and gamma diversity >80	2022: native S 38 (± 6.96 sd) native gamma diversity 83 species	Mean S is close to the goal, but less than desired. Gamma diversity is greater than the goal.
HOME	Maintain woodland (successional and bur oak) native plant species richness (gamma diversity) at ≥ 20	Last evaluated in 2017: species richness was 22 (± 7.1 SD) for 2 of the three sites. Gamma diversity not evaluated.	Species richness above goal. Reevaluate at next monitoring event.
	Remove undesired hackberries and other fire intolerant tree species in the subcanopy by >20% (+/- 1 SD)	Invasive plant data: Maclura pomifera and Morus alba declined by 18% and 12% of search units from 2017 to 2022, respectively. Hackberry not evaluated for proportion of canopy, but it is a dominant species in much of the woods..	Hackberry not evaluated. Other nonnative trees above threshold as a group. Consider revising goal for clarity..
	Over 15-20 years, reduce woodland canopy cover to 40-50% (+/-1 SD)	2022: Bur oak 94.4% (N = 1), Successional 95.0% (0.4 $\pm$ sd, N = 3	Treatments not yet implemented, goal not met.

	Prairie cool season exotics should be <10 % of prairie area (as measured by HTLN invasive project)	2022: all nonnative species 3.4% (1.59, 8.3 95% CI) plant community	Nonnative species have declined by 35,419.3 m2 since 2006. They are 8.8% of the prairie. Goal achieved.
	Maintain shrubs and vines in the prairie at or near the minimum value recorded by the bird habitat data.	2022: 7.59+ 14.86, however, the least recorded vegetation was mean 0.61% + 0.93.	Woody plants are expanding rather than contracting.
PIPE	Kentucky bluegrass: Within six years (two burn rotations), reduce the abundance of class 4 plots by half. Reduction should result in abundance shifting to lower classes (1-3) (Young 2020)	The number of class 4 cells declined, but classes 5 and 6 increased by 47 and 12 plots. Overall abundance of the plant also increased between 2017 and 2022.	Two rotations of fire not yet completed, however Kentucky bluegrass has expanded and not contracted.
	Maintain native plant diversity (H') in the remnant and Sioux quartzite prairie and increase native plant diversity in the restored prairie based on 2017 abundance levels (Leis and Morrison 2020)	2022 H' was 2.5 (2.23, 2.84 95% CI), similar to 2017.	Achieved.
TAPR	Maintain cover of the woody plant guild below 5% cover	2023: 0.95% (± 1.4 sd)	Achieved.
	Keep Kentucky bluegrass (<i>Poa pratensis</i>) abundance < 5% cover	2023: <i>Poa pratensis</i> cover totaled 4.5% (± 0.23 sd) in plant community sites.	Achieved
WICR	In upland woodland monitoring sites, reduce Eastern redcedar below five stems/ha (2020 levels)	2020: <i>Juniperus virginiana</i> 5 stems/ha (± 9.8 95% CI)	Will evaluate after 2025 sampling.
	Maintain average number native grassland species at >35 native species	2020: mean native species richness 43.2 species	Achieved. Remeasure in 2025.
	Reduce cover of nonnative species such as sericea lespedeza (<i>Lespedeza cuneata</i>). Sericea lespedeza ranged from a maximum of 47.7% in 2008 to a low of 8% in 2020 (Leis 2022).	2020: nonnative total cover 4.27% (± 12.02 sd). Similar to 2016 3.43% (± 6.89 sd).	Total non native similar to prior years. Reduction goal for the guild not achieved although some species may have declined while others increased.
	Missouri bladderpod (<i>Physaria filiformis</i>). Maintain populations within monitored range (2007-2023) or greater for each population	Populations remain within the range of variation for the species at this park as of 2023.	Achieved. Remeasure annually.

C. Research, Planning, and Communication

- Monitoring plan status for park(s) and location/links to completed monitoring plans: The [protocol for plant community monitoring](#), including the fire mapping standard operating procedure was revised in 2022. The [project history](#) is also up-to-date thru 2022. The [Missouri bladderpod monitoring protocol](#) will begin a revision process in 2024. The long-term monitoring protocols were cited and described In the monitoring plan sections of fire management plans being drafted for WICR, HEHO, EFMO, TAPR, PIPE, HOME, GWCA.
- NPS Reserve Fund Research – no requests made
- Publications produced using NPS fire effects monitoring data:
 - [Leis SA. 2023. Vegetation Monitoring Summary: Overstory in the goat prairie sites at Effigy Mounds National Monument. National Park Service. Republic, MO.](#)
 - [Leis SA. 2023. Overstory Summary: Homestead National Historical Park. National Park Service. Republic, MO.](#)
 - Leis, S. A., and M. S. Short. 2023. Vegetation community monitoring at Pea Ridge National Military Park, Arkansas: 2007–2021. Natural Resource Report NPS/HTLN/NRR—2023/2526. National Park Service, Fort Collins, Colorado. <https://doi.org/10.36967/2299454>
 - Morrison, L.W., S. A. Leis, M.D. DeBacker. 2023. Observer error in grassland vegetation surveys: effects on species diversity metrics and species–abundance relationships, *Journal of Plant Ecology* 16: rtad002, <https://doi.org/10.1093/jpe/rtad002>
- Planning efforts: We contributed to the HEHO prairie management plan revision and fire management plans for HEHO, WICR, GWCA, and EFMO over the last year. We also contributed to climate planning efforts for TAPR and HEHO. The Plant Ecologist also participated in the program review of the OZAR fire zone.
- Key research questions are documented in recent revisions to the fire management plans.
- The Plant Ecologist gave a presentation on collaboration with I&M to the National NPS Fire Ecologists meeting in 2023. The Plant Ecologist also gave a presentation to the Association for Fire Ecology Fire Congress on the prairie forest ecotone. That presentation highlighted the role of fire history in progressing woody encroachment leading to the loss of grassland.
- The Plant Ecologist was approached by a member of the public writing a children’s book on prescribed fire and fire ecology. The ecologist reviewed the content for the author providing scientific expertise.
- The Plant Ecologist is an advisor to the Great Plains Fire Science Exchange. In that role, she provides insights about fire ecology, communicates agency information and research needs to the Exchange as well as shares the Exchange’s products to NPS.

D. Future Direction

- As the result in shifting botanical expertise in the network, we have been including contract botanists in our field sampling. This provides local expertise within our large geographic range and supports our efforts to reduce errors in field observations.
- In 2023, we completed tagging trees with numbered tags and look forward to observing how well tags weathered and improve observations. We'll be revisiting the first set of tagged trees in 2024.
- We aim to keep our reporting current. In 2024 we also plan to begin a revision to the Missouri bladderpod monitoring protocol.
- Staffing is anticipated to return to normal levels in 2024. A botanist will begin work in January and a student worker also supports the plant ecology project. An intern will be hired to help with protocol revision in the spring as well as other project needs.

E. References, Links, and Additional Reading

Provide sources for information in the report and key documents associated with the fire ecology program:

- Additional literature cited in this report
 - Leis SA. 2022. Network scale fire atlas supports land management in national parks. Natural Resource Report. NPS/HTLN/NRR—2022/2480. National Park Service. Fort Collins, Colorado. <https://doi.org/10.36967/2295133>
 - Leis SA and Morrison LW. 2022. Plant community trends at Tallgrass Prairie National Preserve: 1998–2018. Natural Resource Report. NPS/HTLN/NRR—2022/2463. National Park Service. Fort Collins, Colorado. <https://doi.org/10.36967/2294512>
 - Leis, S. A., and L. W. Morrison. 2024. Long-term trends in prairie vegetation at three national parks: 1998–2022. Natural Resource Report NPS/HTLN/NRR—2024/2623. National Park Service, Fort Collins, Colorado. <https://doi.org/10.36967/2302359>
 - [Heartland Inventory and Monitoring Network. 2023. Plant Community Monitoring Project History. Heartland Inventory and Monitoring Network. Wilson's Creek National Battlefield, Republic, Missouri.](#)
- Location/link to monitoring methods: see hyperlinks in text.
 - New publications based on monitoring data
 - [Leis SA. 2023. Vegetation Monitoring Summary: Overstory in the goat prairie sites at Effigy Mounds National Monument. National Park Service. Republic, MO.](#)
 - [Leis SA. 2023. Overstory Summary: Homestead National Historical Park. National Park Service. Republic, MO.](#)
 - Leis, S. A., and M. S. Short. 2023. Vegetation community monitoring at Pea Ridge National Military Park, Arkansas: 2007–2021. Natural Resource Report

NPS/HTLN/NRR—2023/2526. National Park Service, Fort Collins, Colorado.
<https://doi.org/10.36967/2299454>

- Morrison, L.W., S. A. Leis, M.D. DeBacker. 2023. Observer error in grassland vegetation surveys: effects on species diversity metrics and species–abundance relationships, *Journal of Plant Ecology* 16: rtad002, <https://doi.org/10.1093/jpe/rtad002>
- Links to most recent IRMA Data Store record(s) for FFI database(s). 2023 Databases not yet posted.

PERI: [DataStore - HTLN Pea Ridge National Battlefield FFI Fire Effects Monitoring Data \(nps.gov\)](#)

GWCA: [DataStore - George Washington Carver National Memorial FFI Fire Effects Monitoring Data \(nps.gov\)](#)

WICR: [DataStore - NPS Heartland I&M Network - FFI Fire Effects Monitoring Data WICR](#)

HOME: [DataStore - Homestead National Monument of America FFI Fire Effects Monitoring Data \(nps.gov\)](#)

EFMO: [DataStore - Effigy Mounds National Monument FFI Fire Effects Monitoring Data \(nps.gov\)](#)

HEHO: [DataStore - Herbert Hoover National Historic Site FFI Fire Effects Monitoring Data \(nps.gov\)](#)

PIPE: [DataStore - Pipestone National Monument FFI Fire Effects Monitoring Data \(nps.gov\)](#)

HLTN vegetation community data package: [DataStore - Vegetation Community Monitoring Dataset for the Heartland Inventory and Monitoring Network \(nps.gov\)](#)

Appendices

Appendix A (Staffing and Accomplishments) and Appendix B (History of Fire Effects Plots) are required. If all existing plots (not just those visited in the current year) are included in [Table 1](#) in the Summary section, then Appendix B is not required.

Appendix C (Fire/Fuels Treatments and Associated Monitoring) and Appendix D (Individual Park Annual Reports) are optional. Add other Appendices for any additional information to include in the annual report as needed.

Appendix A. Staffing and Accomplishments

We do not have any fire funded positions. The Plant Ecologist does collateral duty as an expert in fire ecology (Table A-1). The Plant Ecologist completed the annual fire refresher and pack test.

Table A-1. Fire Ecology Staffing 2023

Ecologist and Monitors	Position	Appointment Length	Training and Development
None			

Provide information about the fire ecologist's role and function in Table A-2. Within each category, we estimated the percent of time the plant ecologist spent on these focus areas. "Percent time" is the percentage of total time worked (excluding leave and holidays).

Table A-2. Plant Ecologist 2023 Accomplishments/Focus Areas

Category	Percent Time	Accomplishments and/or areas of activities
Planning	10	FMP, EA, EIS, CE, section 7 consultation, monitoring plan, burn plan development and review, etc.
Presentations	10	Scientific meetings, park staff, public, etc.
Meetings/task groups	10	Park, regional or national – FFI, others; interagency work (LANDFIRE, FPA, FLN, etc.); park visits/meetings
Wildfire assignments	0	Identify types of assignments (FEMO, FFT1, GISS, PIO2, etc.); include REAF/READ (Resource Advisor) and BAER/BAR activities
Prescribed fire/fuels treatment projects	0	Estimated amount of time spent assisting with prescribed fire and non-fire fuels projects (mechanical fuel reduction using chainsaws or other, herbicide/mowing; include project preparation (e.g., digging line, mechanical fuel reduction/removal, etc.), and REAF/READ activities (note: planning activities for projects should be included in Planning category above)
Research	0	NPS Reserve Fund Research Request, JFSP, other
Field work/data collection	20	Estimated amount of time spent in the field collecting data; include time spent preparing for field work and travel time to plot locations
Data management	10	Estimated amount of time spent entering data from paper to FFI database, managing data in FFI, preparing and/or archiving data, and/or conducting quality control activities
Data analysis	10	Estimated amount of time spent performing analyses, including data summaries and statistical tests
Supervision/admin tasks	5	Hiring, supervision, payroll, travel authorization/vouchers, purchasing, etc.
Training	10	Estimated amount of time spent in training (include time for all training courses attended including in-park, NPS/interagency, and non-government); formats may be classroom, webinars, or self-guided training; include any physical training if applicable

Category	Percent Time	Accomplishments and/or areas of activities
Miscellaneous	8	Things that don't fit in other categories – assistance to other work groups/projects (e.g., natural resources), etc.

We don't have a fire effects crew, so have not completed this table.

Table A-3. Fire Effects Crew 2023 Accomplishments/Focus Areas

Category	Percent Time	Notes
Data collection		
Wildfire assignments		
Prescribed fire/fuels treatment projects		
Travel out-of-park for plot or project work		
Data entry/management		
Data analysis		
Administrative activities		
Training		
Miscellaneous		

Appendix B. History of Fire Effects Monitoring Plots

If [Table 1](#) in the summary section does not include all fire effects plots established, complete Table B-1. A complete history of vegetation monitoring sites was completed: [DataStore - Plant Community Monitoring Project History \(nps.gov\)](#)

Table B-1. All Fire Effects Plots Established

Park	Monitoring Unit	Plot Type (FMH Forest/Brush/Grass plot, photo point, Rapid Assessment, CBI, etc.)	Years Data Collected (start-end)	Total Plots
Effigy Mounds	Goat Prairie	I&M Prairie Plot ¹	1997-2022	8
Effigy Mounds	Deciduous Forest	I&M Forest Plot	2003 - 2014	18
George Washington Carver	Restored Prairie	I&M Prairie Plot	2004 - 2020	7
Herbert Hoover	Restored Prairie	I&M Prairie Plot	2004 - 2022	5
Homestead	Restored Prairie	I&M Prairie Plot ¹	1998 - 2022	7
Homestead	Riparian Forest	I&M Forest Plot ¹	2000 - 2022	3
Pipestone	Tallgrass Prairie	Plotless orchid search areas	1993 - 2023	3
Pipestone	Tallgrass Prairie	I&M Prairie Plot	1996 - 2022	4
Pipestone	Sioux Quartzite Prairie	I&M Prairie Plot ¹	1996 - 2022	3
Pipestone	Restored Prairie	I&M Prairie Plot ¹	1996 - 2022	9
Wilson's Creek	Restored tallgrass prairie and savanna	I&M Forest Plot ²	2001 - 2023	6
Wilson's Creek	Upland Oak Forest	I&M Forest Plot	1998 - 2020	4
Total				65

Appendix C. Fire/Fuels Treatments and Associated Monitoring (OPTIONAL)

Fires documented and mapped for calendar year 2023 for the seven focal parks in the network are listed in the table below (Table C-1).

Table C-1. Summary of 2023 Fire/Fuels Treatments and Associated Monitoring

Park	Fire/Treatment Name	Monitoring Conducted	Acres
TAPR	23 RP_1, RP_2, CH_1, CH_2 BIL	Long-term vegetation, fire mapping	1357
	23 ET1, ET2, ET3, TS3, TS4, RF18 BIL	Long-term vegetation, fire mapping	1508
	23 BP_3, BP_2, BP_1 BIL	Long-term vegetation, fire mapping	330
	23 BP_4, BP_5 BIL	Long-term vegetation, fire mapping	826
	RF_1-3, RF_7, RF_13, Cp_1, CP_2, draws in RF_11, Rf_12	Long-term vegetation, fire mapping	247

Appendices D-X. Individual Park Annual Reports (OPTIONAL)

Monitoring reports are linked in the various sections of this report and are available at [Portal - Welcome to IRMA \(nps.gov\)](https://irma.nps.gov/).