BIODIVERSITY OF PLANTS ON CONSERVATION LAND IN NORTH ALABAMA: LESSONS LEARNED FROM A STUDY OF *POALES* AT BLOUCHER FORD NATURE PRESERVE, MADISON COUNTY

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ABSTRACT

Alabama is a hotspot for diversity in the United States, but very little land is under public protection with many conservation areas under management of local land trusts. This study provides the results of the first floristic inventory (focused on the Order *Poales*) on a land trust property in North Alabama before and after a change in habitat management regime that identifies over 70 species of grasses, sedges, and rushes with 29 new and updated contributions to vascular flora records. The results outlined in this study demonstrate the high species richness possible to find within a small nature preserve, the need for changes in management that may be necessary to complete identification and inventory of species, and the necessity for more local vascular plant studies to reduce gaps in local conservation organization knowledge as well as state and regional plant records that could lead to flawed analyses for studies or models that rely on that data.

Keywords: *Poales*; herbarium database; vascular flora records; conservation management; floristic inventory

1. Introduction

1.1 Biodiversity in Alabama

The conservation of biodiversity plays an important role in preservation of ecosystem function and the intrinsic and anthropogenic values of the ecosystem services provided by those functions [1,2]. Alabama has long been known as a biodiversity hotspot in the United States [3] with a variety of studies over the last few decades lending evidence to the state's importance in the conservation of biodiversity of a wide range of organisms including lichens, amphibians, fish, and vascular plants [e.g., 4-7]. Despite this high biodiversity, very little land in Alabama (~4.9%) is owned or managed by public agencies for conservation purposes [8]. Instead, like many other areas of the United States, conservation of land for public recreation, or ecosystem preservation is taken up by community-based non-profit entities known as land trusts [9,10].

1.2 Land Trusts' Role in the Conservation of Biodiversity

Land trust organizations directly purchase lands or pay for the placement of conservation easements on private property to protect properties from development and provide for some form of conservation [10,11]. Land trusts provide an avenue for targeted community and charitable funding of biodiversity conservation particularly for property acquisition [12] and since they are private entities, land trust organizations have more flexibility than public agencies in how they can reach their land management goals [13]. As community-based organizations that operate across a range of landscapes and political/social climates, the strategies used for land protection, the community funding potential, social capital available for mobilizing local volunteers and the efficiency of their operations vary widely across regions [14]. As community-based organizations that operate across a range of landscapes and

political/social climates, the strategies used for land protection, the community funding potential, the social capital available for mobilizing local volunteers, and the efficiency of their operations vary widely across regions [10,14,15]. For example, in a survey of 626 land trusts across the United States, the Southeastern regions had the amount of lowest amount of land purchasing activity in the country relying on land easements instead, also had the most amount of urban land protected as well as the most likely to have urban areas within their service zone compared to other regions of the United States [10].

While land trusts are an important link in the preservation of biodiversity, there are also some shortcomings and gaps in the management of the conservation lands that are controlled by land trust organizations. These include gaps in the knowledge of land management, conservation biology, natural resource management, and biodiversity conservation [10,14,16]. There is also a lack of information and data on the effectiveness of land trusts in the conservation of biodiversity and the management decisions they make for their properties over time [14] including the presence of measurable goals that can define a level of ecological success over fundraising and land acquisition metrics [17]. There is also a reliance on volunteers for ecosystem evaluation and monitoring [18]; while this can increase community ownership and engagement in lant trust activities, there can be barriers to time and commitment. There are a wide variety of specific conservation objectives that would align with overall land trust aims and university research teams could assist in the creation, monitoring, and evaluation of these goals.

1.3 Herbariums, Inventories and Databases of Plant Records and their Importance

A vital part of the creation and monitoring of these conservation objectives would be an inventory of the population or subject of specific interest for each of the goals. Plant inventories, for example, provide the basis for estimating the local biodiversity and the lack of this information can reduce the accuracy of the mapping of plant communities needed for monitoring and evaluation [19]. These floristic studies are critical in understanding the threats to plant communities and the gaps in our understanding of the conservation status of certain plant populations [20,21], the relationships between plant populations and their environment [19], the changes in plant communities over time and due to differences in management or land use through monitoring [22], and introductions from invasive species [23]. Local inventories can span across a region or high spatial levels to illuminate larger scale trends and variations [24].

As floristic studies are completed, plant specimens are collected and stored in local and regional herbaria as a document of the plant's identity, morphology, and plant community as the species grew in specific climatic conditions in a particular time and place [25] with records validating each time that a plant species is found and identified with an area. These herbarium records offer a wealth of opportunities to explore how the phenology and biodiversity of a locality changes, and recent advances in DNA analysis and Big Data processing can unlock even more insights into the effects of events like climate change and the large-scale community shifts that can occur [26-28]. Digitizing and sharing local herbarium collections through state, regional, national and international databases offers a way to better understand spatial and temporal challenges to biotic communities that can lead to strategies to better conserve biodiversity [29-37]. Small local herbaria are especially important and are necessary to increase the total number of plant collections and inventories available to bridge temporal and spatial gaps found in larger collections [38,39].

A number of these biases can occur in the process of floristic inventories that can lead to gaps in plant records leading to the over- or under-sampling of plant communities or land-uses [39-42]. These biases can be geographic in nature with samples coming from areas easier to reach or land-uses that occur more frequently [41], sampling from plant communities that are more interesting or attractive [42], or difficulty in identification of species within a particular family or order (e.g., *Poales*) [43-45]. Bringing in collections from small herbaria that focus on local collections and have regional expertise can help alleviate these biases [39].

1.4 Purpose of this Study

This paper describes a research study conducted in collaboration with the Land Trust of North Alabama (LTNA), a 501(c)(3) conservation organization located in Huntsville, AL, established on June 24, 1987, as The Huntsville Land Trust, which was Alabama's first **l**and **t**rust. [46]. The overall objective of the study was to (1) document the diversity of vascular flora on LTNA properties and (2) provide LTNA management with the information necessary to make optimal decisions on the management of their plant community. For this paper, we will provide the results of the first floristic inventory (focused on the Order *Poales*) on a LTNA-owned property in North Alabama before and after a change in land management and then offer lessons learned about how the choice in vegetation management can affect the biodiversity of grasses, sedges, and rushes. We will also discuss new findings and updates to the records of vascular flora in the region including a selection of noteworthy flora found on the study site, and data gaps we have identified working with regional herbaria databases.

2. Materials and Methods

2.1 Study Area:

Bloucher Ford Nature Preserve is a 28.19-acre property managed by LTNA in New Market, AL (Madison County) in North Alabama in the Southeast Region of the United States (Figure 1).

2.1.1 Historic Land Use

The Bloucher Ford property is on the floodplain of the Flint River, an area whose anthropogenic use can be traced back to the Early Paleoindian, Late Archaic, and Middle Woodland periods [47] with Native American settlers occupying the land through the early 1800s. Modern settlers moved onto the property purchased from the United States government in 1809 and operated a grain mill from 1815 to 1959 marking the first settlement in what is now Madison County, AL [48]. In 1962, the property was effectively abandoned until the LTNA purchased the property in 2013 to develop the property as a recreational area and event venue.

2.1.2 Physical and Climatological Description

The study area is a floodplain consisting of wet meadows, riparian corridors, and bottomland hardwood forests at the confluence of Mountain Fork Creek with the Barren Fork of the Flint River which lies at the boundary of two physiographic regions: the Cumberland Plateau and the Tennessee Valley district of the Highland Rim. Most of the floodplain is covered in deep, well-drained soils of Humphreys silt loam (an Ultic Hapludalf). The lowest terraces along the stream are newer soils of the Lee-Lobellville complex soils that are poorly drained [47]. The soil along the waterways and in depressions on the floodplain are gravelly. Gravel bars and sand bars are abundant along the banks and in streambeds.

Bloucher Ford Nature Preserve has very little change in topography with the elevation of the site ranges from 206 m at the north and south ends with very shallow incline to 209 m in the middle of the property [49]. From 1991-2020, the average annual rainfall for the area is 54.29 inches ranging between an average of 5.87 inches in the rainiest month of December and 3.49 inches in the driest month of September. Mean high temperatures reaching 91.5F in July and mean low temperatures reaching 33.1F in January with an average annual temperature of 73.8F [50].

Figure 1. Map of Bloucher Ford Nature Preserve (outlined in green), Madison County, Alabama, in the Southeastern United States [51].

2.2 Vascular Plant Inventory

A vascular plant inventory was conducted across the entire property starting in early September 2020 and continuing through early October 2022. The project began with a series of multi-day rapid assessment floristic surveys with local and regional expert botanists; these "expert bio-blitzes" [52] formed the base of the dataset as further data was collected for the next two years. This study focused on identifying and documenting occurrences of the grasses, sedges and rushes in the Order *Poales* due to the effect on those species by the current management regime on the property.

Past literature has shown that for sampling wetland areas such wet meadows and bottomland forests, the sampling method with the most detection power is the timed meander search procedure as outlined by Goff et al. [53]. The technique has been demonstrated to more efficiently and thoroughly document species with less energy and time expended [54], particularly when the understory cover is heterogenous [55]. Modifying the methodology to include extra quality measures such as allowing extra time for searching below dominant species [54] can alleviate some concerns about missing species hidden from walking view [55].

A modified meandering sample of species was collected weekly during the growing season with the full site sampled every two to three weeks. All major plant communities and physically accessible habitats were sampled. Loosely divided into eight collection regions, habitats sampled included active channels of the Flint River and Mountain Fork Creek, a man-made dam, a millrace, bluffs, ditches, floodplain terraces, gravel bars, levees, roadsides, sand bars, seasonally swampy areas, springs, wet meadows, and tree lines of the Flint River and Mountain Fork Creek at its confluence with Flint River.

Every habitat on the property is subject to seasonal flooding, usually during the winter months with flood events also known to occur during the fall and spring of each year.

Specimens were collected in flower or fruit non-destructively (when possible); cleaned of all possible debris, pressed using standard field presses, dried, and subjected to freezer conditions before being accessioned into the Forestry Herbarium (AAMU) at Alabama A&M University, Normal, Alabama. The flora is then digitized and vouchered to the Alabama Plant Atlas upon approval from the Land Trust of North Alabama.

2.3 Change in Conservation Management

As of July 2023, the site is not open for use to the public, so the only direct human influence on the management of site flora is from the LTNA. Prior to this study, the LTNA managed the property through intense, regular mowing of the grasslands and wet meadows to create a lawn-like appearance. Literature has shown that tolerance to mowing differs between species of grasses, sedges, and rushes [56,57] with mowing can have a variety of differing effects on the diversity of plant communities depending on the regime and intensity either increasing or preserving current biodiversity or species richness [57-60] or suppressing/reducing species and deteriorating plant communities [61,62]. In addition, the timing of mowing is an important factor with mowing during the reproductive period reducing diversity of grasslands [63]. For this study, beginning at the end of June 2021, LTNA management ceased mowing several areas of grassland and wet meadow to allow for grasses to grow, flower and fruit for identification and documentation of species suppressed by the mowing management.

2.4 Identification and Herbarium Records

Online sources of vascular plant collections and county records from Madison County, AL were searched during the study period from within the Alabama Plant Atlas [64], Consortium of Midwest Herbaria [65], SEINet Portal Network [66], and SERNEC Data Portal [67]. In particular, the Vascular Flora of Madison County, AL [68] was used to verify and append county records currently not recorded by the Alabama Plant Atlas [64]. In addition, personal correspondence with other organizations and herbaria such as the Botanic Research Institute of Texas [69] was used to confirm and correct entries for various species such as *Juncus acuminatus* Michx. [68]. Specimen identifications were determined using Aquatic and Wetland Plants of Southeastern United States: Monocotyledons [70]; Common Grasses, Legumes and Forbs of the Eastern United States Identification and Adaptation [71]; Flora of North America Cyperaceae Volume 23, Juncaceae Volume 22, Poales Volume 24, and Poales Volume 25 [72]; the Manual of the Vascular Flora of the Carolinas [73]; Weeds of the South [74]; and the online Flora of the Southeastern States: Alabama [75].

Scientific nomenclature and species circumscriptions follow PLANTS Database [76]. The online Alabama Natural Heritage Program list of Rare, Threatened, and Endangered Plants & Animals of Alabama [77] and NatureServe [78] provided the information needed to identify rare, threatened, or endangered species in Madison County, AL.

3. Results and Discussion

3.1 Vascular Plant Inventory

Our floristic survey over the course of two years located and collected a total of 71 species of grasses, sedges, and rushes in the Order *Poales* alone (Figure 2). Among these, there were 29 species in 5 genera in the family Cyperaceae, 5 species in 2 genera in the family Juncaceae, and 37 species in 29 genera in the family Poaceae (Table 1, Figure 3). *Carex* was the largest genus representing 18 species followed by

Cyperus, with 8 species and both genera in the family Cyperaceae. Poaceae was the family with the most recorded species overall. The full annotated checklist for all collected specimens is found in Appendix A.

Figure 2. Georeferenced locations of plant specimens with Order *Poales* located and collected at Bloucher Ford Nature Preserve in North Alabama [51]

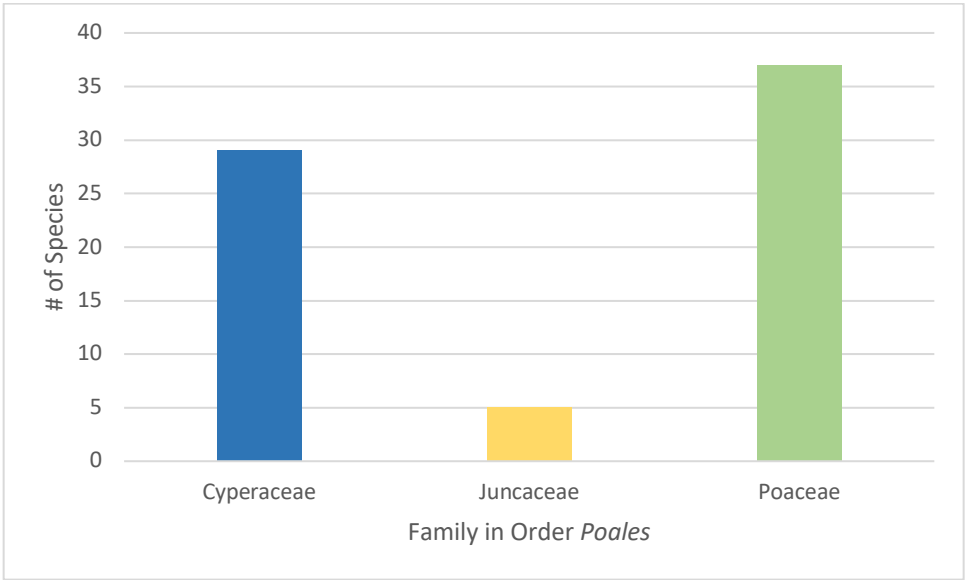

Figure 3. Number of species within each family in Order *Poales* identified at Bloucher Ford Nature Preserve in North Alabama

Table 1. Summary of *Poales* at Bloucher Ford Nature Preserve 2023.

Family	Genera	Species	Species of Concern – Rank *	Native Species	Non-native Species
Cyperaceae	5	29	1 - S1	27	2
	Carex	18	4-SNR/G4 1- S1/G4 1-*/G5 12-SNR/G5	18	0
	Cyperus	8	1-SNA/GNR Exotic 1-SNR/G5T5 6-SNR/G5	7	1
	Eleocharis	1	SNR/G5	1	0
	Kyllinga	1	SNA/GNR Exotic	0	1
	Scleria	1	SNR/G5	1	0
Juncaceae	2	5		5	0
	Luzula	1	1-SNR/G5	1	0
	Juncus	4	4-SNR/G5	4	0
Poaceae	29	37		23	14
	Andropogon	1	SNR/G5	1	0
	Arundinaria	1	SNR/G5	1	0
	Bromus	1	SNA/GNR Exotic	0	1
	Calamagrostis	1	SNR/G5	1	0
	Chasmanthium	1	SNR/G5	1	0
	Cinna	1	SNR/G5	1	0
	Cynodon	1	SNA/GNR	0	1
	Dactylis	1	SNA/GNR	0	1

			Exotic		
	Dichanthelium	1	SNR/G5	1	0
	Digitaria	1	SNR/G5	1	0
	Echinochloa	2	SNA/GNR Exotic SNR/G5T5	1	1
	Eleusine	1	SNA/GNR Exotic	0	1
	Elymus	2	1-*/GNR 1-SNR/G5	2	0
	Eragrostis	1	SNA/GNR Exotic	0	1
	Festuca	1	SNR/G5	1	0
	Hordeum	1	SNR/G5	1	0
	Leptochloa [Dinebra/ *Brachiaria*]	1	S1/G5	1	0
	Melica	1	SNR/G5	1	0
	Microstegium	1	SNA/GNR	0	1
	Muhlenbergia	1	SNR/G5	1	0
	Panicum	3	3-SNR/G5	3	0
	Paspalum	2	1-SNR/G5 1-SNA/GNR Exotic	1	1
	Poa	3	2-SNA/GNR Exotic 1-SNR/G5	1	2
	Schedonorus	1	SNA/GNR	0	1
	Setaria	2	2-SNA/GNR Exotic	0	2
	Sorghum	1	SNA/GNR Exotic	0	1

	Steinchisma	1	SNR/G5	1	0
	Tridens	1	SNR/G5	1	0
	Urochloa	1	S1**/G5	1	0
Total:	36	71		55	16

* Status ranks were acquired from NatureServe [78]; *C. corrugata* is not on the NatureServe map as being present in Alabama; *E. glabriflorus* is not yet rated or formally recognized by NatureServe and is not on the map as being present in Alabama. **The status of *Urochloa platyphylla* is conflicting between NatureServe [78] and Alabama Natural Heritage Program [77] tracking information.

The number of species found within just the *Poales* demonstrates the high species richness within the small nature preserve. Among the recorded 71 species, we would like to highlight a variety of noteworthy, endemic, and/or invasive/noxious species from the study (Table 2). Understanding species that are rare, in need of special management, or likely to create ecosystem problems is important for the preservation of the high diversity on the site. These species are listed in more detail with growth and habitat information in the following sections and a variety of these noteworthy species are documented in photographs in Appendix C.

3.1.1 Noteworthy, Rare, Threatened or Endangered Species (Table 2):

Carex socialis Mohlenbr. & Schwegm. Weninegar L.L.4427, 4450, 4460 was first recorded by Mollenbrock and Schwegman in 1969, currently in decline due to habitat loss [78], this species is endemic to the southeastern United States [75]. *C. socialis* is listed as S1 (critically imperiled) by Nature Serve [78], and S2 (imperiled) by the Alabama Natural Heritage Program [77].

The species was recorded in neighboring Jackson County, Alabama in 2019 [79]. Clear-cutting on floodplains and drainage of floodplains for agriculture, pastureland, or river channelization are likely the primary contributors to the species' decline and it has been suggested that floodplain protection is needed to prevent the further decline of the species and the invasion of its habitat by *Lonicera japonica* Thunb. (Japanese honeysuckle) and *Pueraria montana* (Lour.) Merr. (Kudzu). [78]

Small populations of *C. socialis* were observed in open, sunny, wet-mesic meadows of the Barren Fork region of the Flint River floodplain during this study. The area is subject to frequent flooding during the winter months, though flood conditions are not uncommon from late summer into early spring. Flowers appear in late April; fruit is fully mature in June of the year, at a time when mowing has traditionally occurred on the property. Though kudzu has not been documented on the property, Japanese honeysuckle is abundant on the floodplain. Prior to this study*, C.socialis* was known to exist in only 11 counties in Alabama [64].

No Federal or State of Alabama rare, threatened, or endangered grass or rush species were collected on the property [77]. Though NatureServe [78] lists *Urochloa platyphylla* (Munro ex C. Wright) R.D. Webster (broadleaf signalgrass), identified as *Brachiaria platyphylla* in the NatureServe database, as critically imperiled (S1) in Alabama, it currently is not tracked by the Alabama Natural Heritage Program [77]. Weakley [75] lists broadleaf signalgrass as an exotic species in the interior low plateau and an uncommon exotic in the Alabama mountains, while NatureServe lists it as a native species. An agricultural weed with very small seeds allows it to be easily transported with crop seeds to farm sites where the seeds germinate and become a pest species in corn, soybeans, and other economically

important crops, particularly in open sandy fields [80] potentially causing economic and environmental detriment to areas it exploits.

Eragrostis minor Host (little lovegrass*), Leptochloa panicea* (Retz.) Ohwi ssp. *brachiata* (Steud.) N. Snow (mucronate or red sprangletop), and *Melica mutica* Walter (twoflower melicgrass), are of minor importance on the Preserve; all three are vouchered in the Alabama Plant Atlas [64]. *E. minor* was vouchered during the initial bio-blitz surveys of October 2020 and is a county record from the Bloucher Ford Nature Preserve in New Market, AL. *E. minor* is an introduced grass from Europe [75]. The species has become naturalized across the United States [81].

Leptochloa. panicea ssp. *brachiata* is a native grass, first collected by R. David Whetstone 6977 with A.E. Radford on 15 October 1975 [64]. Its presence on Bloucher Ford Nature Preserve is the only other documented occurrence in Madison County, AL; also housed at UWAL was collected by J. Kevin England 11296, 04 October 2020 and vouchered as *Dinebra panacea (*Retz.) P.M. Peterson & N. Snow. Red sprangletop is often found in agricultural settings on disturbed, mesic soils. The U.S. Department of Agriculture considers it a noxious weed [82] but it is not on a more recent Federal Noxious Weed List [83]. The habitats of *E. minor* and *L. panicea* ssp. *brachiata* will be monitored to ascertain associated vegetation and the extent of their occurrence on the floodplain.

Two vouchered accounts of *Melica mutica* have been reported to the Alabama Plant Atlas [64] for Madison County, AL. Russell A. Meigs 349 collected it on 04 May 1980; two specimens were vouchered by Brian R. Keener 6956 on 27 March 2012. Twoflower melicgrass grows in well-drained soil under shade at Bloucher Ford Nature Preserve and is rare on the property. The species is a relatively small plant and can be easily overlooked amongst other more robust species in a study area.

3.1.2 Endemic Species Observed

Carex cherokeensis, *C. corrugata*, and *C. socialis* are endemic to the Southeastern United States. While *C. cherokeensis* and *C. corrugata* are well documented in the Southeast, in Alabama, *Carex conjuncta* and *C. normalis* occur very near their southernmost limit in the state [79] and are facultative wet (FACW) species; *C. socialis*, is currently not rated [84] but is found on moist to wet, well-drained floodplains, in calcareous soils. *Cyperus lancastriensis* is an endemic species [75] of frequent occurrence at Bloucher Ford Nature Preserve. It can be found in full sun near the edges of water and in open meadows.

3.1.3 Importance of Native Species at Bloucher Ford

Over 70% of the Poales species observed at Bloucher Ford Nature Preserve are native. Some of these plants have been historically important for food and cover for wildlife, floodplain stability, and for limiting the spread of non-native/exotic species. The preserve is currently being impacted by local recreation enthusiasts via kayaking and canoeing, fishing, swimming, and other outdoor activities (including unauthorized off-road vehicles). Urban land cover is also increasing in the region [85] and could impact the integrity of the floodplain as native trees, shrubs, and grasses are removed for development which can open gaps for non-native horticultural species of grasses, sedges, and rushes as well as ornamental cultivars of landscape plants not native to the area.

Table 2. Noteworthy species of Bloucher Ford Nature Preserve, Madison County, AL.

Family	Scientific Name	State Rank*	Global Rank*	Wetland Code**	Significance
Cyperaceae	*Carex abscondita* Mack.	SNR	G4	FAC	Though common in Alabama [75], it is a rare native species in the Preserve; possibly under-collected on floodplains due to its small size and hidden culms
	Carex albolutescens Schwein.	SNR	G5	FACW	Rare in the Preserve, wet meadows in acid soil along floodplain tree lines; this native species usually inhabits acidic, calcium-poor soils [79]; common in the interior low plateau and AL mountains [75]
	Carex amphibola Steud.	SNR	G5	FAC	Rare in the Preserve, native; a habitat generalist [78], often along riparian zones of streams, slopes above streams, and uplands [72]; it is often cultivated and sold in the nursery industry [86]
	Carex blanda Dewey	SNR	G5	FAC	Common in the Preserve, often weedy, along mesic well-drained banks of floodplain in partial shade near disturbed areas. A native that is common in the AL mountains and interior low plateau [75]

	Carex caroliniana Schwein.	SNR	G5	FACW	Rare in the Preserve, in part-sun to shady sites. A common native in the AL mountains and interior low plateau [75].
	Carex conjuncta Fernald	SNR	G4	FACW	Infrequent in the Preserve, A native; near the southern range for the species [79]; rare in the AL interior low plateau and mountains [75]
	Carex leavenworthii Dewey	SNR	G5	NR	Infrequent in the Preserve, in wet meadows along the east bank of Flint River. A native common to the interior low plateau and AL mountains [75]
	Carex longii Mack.	SNR	G5	OBL	Rare in the Preserve; a native and a Madison County, AL record; uncommon in AL mountains [75]
	Carex normalis Mack.	SNR	G5	FACW	Infrequent in the Preserve, a native; near the southern range for the species [79]; rare in AL mountains [75]
	Carex socialis Mohlenbr. & Schwegm.	S1	G4	NR	Infrequent in the Preserve. Rarity possibly due to frequent mowing within riparian zones/habitat during active growth/reproductive stage. SE endemic; rare to the interior

					plateau and AL mountains [75]
	Cyperus esculentus L.	SNR	G5	FACW	Grows with Cyperus strigosus and C. lancastriensis on the property. Native to interior low plateau and AL mountains [75]
	Cyperus iria L.	SNR/ Exotic	SNR	FACW	Common in the Preserve. Considered one of the world's worst weeds [64, 87]. Common in the AL mountains and interior low plateau [75]
	Cyperus lancastriensis Porter in A. Gray	SNR	G5	FAC	Common in full sun near water in the Preserve. Uncommon to lower interior plateau and AL mountains, endemic to Southeastern US [75]
	Kyllinga gracillima Miq. = *Cyperus brevifolioides* Thieret & Delahoussaye	SNR/ Exotic	SNR	FACU	Infrequent in the Preserve; Madison County, AL record; from eastern Asia; rare exotic in AL mountains. [75].
Poaceae	*Calamagrostis coarctata* Eaton	SNR	G5	OBL	A rare native species in Alabama [75] Madison County, AL Record; rare in the Preserve. It was known to only five counties in AL until this study [64].
	Cinna arundinacea L.	SNR	G5	FACW	An uncommon species in the Preserve. Madison County, AL Record

					[67]. A common native in AL mountains and interior low plateau [75]
	Cynodon dactylon (L.) Pers.	SNA/ Exotic	SNR	FACU	Madison County, AL Record [67]. A common exotic from Eurasia [75], noxious weed, first collected in 1897 along the Tennessee River in Madison County [67]; allelopathic [88]
	Dactylis glomerata L.	SNA/ Exotic	GNR	FACU	Madison County, AL Record [67]. Common in the Preserve. Grows in full sun in large wet meadows with various sedges, rushes, and other grasses. Exotic from Europe [75]
	Digitaria ciliaris (Retz.) Koeler	SNR	G5	FAC	Common weed in the Preserve; Madison County, AL Record. A common native to the interior low plateau and AL mountains [75].
	Microstegium vimineum (Trin.) A. Camus	SNR/ Exotic	SNR	FAC	Alabama - Class C noxious weed [83,84]; nonnative invasive; invaders forested floodplains [89]
	Muhlenbergia schreberi J.F. Gmel.	SNR	G5	FAC	Some success with use in the control of *Microstegium vimineum* [90]
	Setaria faberi Herrm.	SNA/ Exotic	SNR	UPL	Noxious weed [91]

	Sorghum halepense (L.) Pers.	SNR/ Exotic	SNR	FACU	Noxious weed introduced into the United States in the early 1800s [92] and is now naturalized; heavy presence in AL [93]
	Urochloa platyphylla (Munro ex C. Wright) R.D. Webster	S1	G5	FAC	A rare weedy species but is infrequent on the study site; its origin is also in question [75]. The last status review was in 1988 [78]

* Nature Serve [78] **Eastern Mountains and Piedmont, Plants.gov [84]

3.1.4 Selected Noxious Weed Species

Leptochloa panicea (Retz.) Ohwi ssp. *brachiata* (Steud.) N. Snow (red sprangletop) is an uncommon native in the lower interior plateau of Alabama [75]. It is a weedy species occupying moist to wet soils along the riparian zone, but not in abundance at Bloucher Ford Nature Preserve. United States Department of Agriculture has in the past labeled the species a noxious weed [82], but it is not on a more recent Federal Noxious Weed List [83].

Microstegium vimineum (Trin.) A. Camus (Nepalese browntop) is on the Alabama Noxious Weed List [94] as a Class C species capable of causing significant harm to agricultural industries. The state of Alabama considers the species a public nuisance. Since its introduction into the United States in 1919, it is now a frequent inhabitant of riparian zones of wooded floodplains, grows well in full sun, is extremely shade tolerant, and rapid vegetative reproduction is possible. The seeds are distributed via water, and animals [95]. This nonnative species is one of the most damaging in the United States to native ecosystems with seeds viable for up to five years. The grass is avoided by deer and livestock allowing it to grow without being browsed allowing its spread. The species is an early invader after prescribed burns and displaces native species, particularly if it is present in the burn area prior to the burn [96].

Setaria faberi Herrm. (Japanese bristlegrass) a native of SE Asia, is a troublesome weed in cultivated fields; the long awns of the mature fruit are injurious to grazing animals [97]. It was introduced in 1925 as a contaminant in grain and quickly became a major agricultural weed by the 1950s in corn and soybean crops [98]. The species is now common in the Northeastern Alabama counties [93] but is only now reported for Madison County, AL [64].

Most *Poales* species found at Bloucher Ford Nature Preserve are native (71%) (Figure 4); the remaining species (29%) are non-native introductions from Central and South America, Eurasia, Africa, the Pacific Islands, China, Japan, Korea, Taiwan, and the Middle East. Interestingly, all of the non-native invasive species were grasses in the Poaceae family.

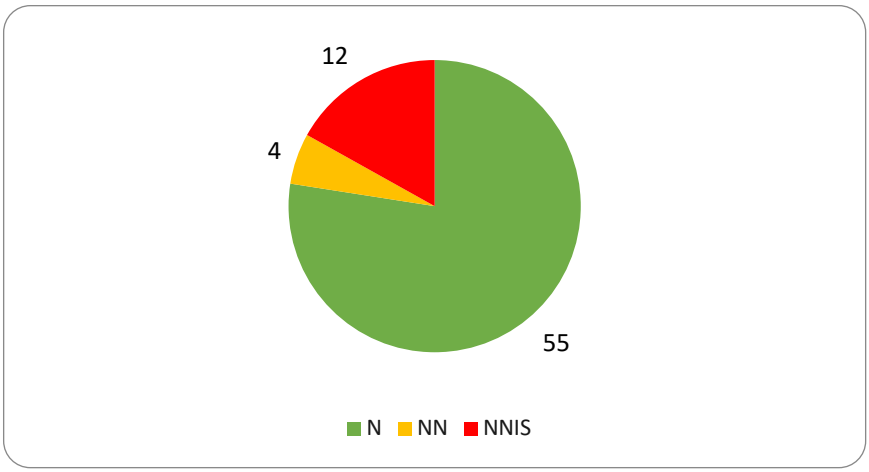

Figure 4. Number of native (N), non-native (NN) and non-native invasive species (NNIS) in Order *Poales* recorded at Bloucher Ford Nature Preserve, Madison County, Alabama

3.2 Change of Conservation Management

Floristic records documented after LTNA ceased mowing in late June 2021 show an increase in discovered species in the Fall of 2021 and the following Summer and Fall of 2022, particularly in additions to the Poaceae (grasses) family (Figure 5) that would have been most affected by activity. As with Kozub et al. [61], the diversity after mowing ended increased and while not every species discovery after Fall 2021 can be directly attributed to changes in mowing frequency and intensity, the change in management did have a dramatic effect on the ability to identify and collect species from the wet meadows and grasslands as well as better observe species density particularly for non-native invasive species.

There were 32 species documented after mowing ended with 15 being Poaceae including 1 county record and 14 Cyperaceae including 3 county records (Figure 5, 6) amounting to 45% of all species identified during the study. The lack of mowing did allow us to identify several species of non-native invasive species on the property that had been hidden or suppressed by the mowing with 2 non-native, non-invasive and 6 non-native, invasive species identified in the entirety of the following year (Figure 7). Of the 32 new species identified from Fall 2021 through Fall 2022, 75% were native, 6.25% were non-native but not invasive, and 18.75% were non-native, invasive species (Figure 7).

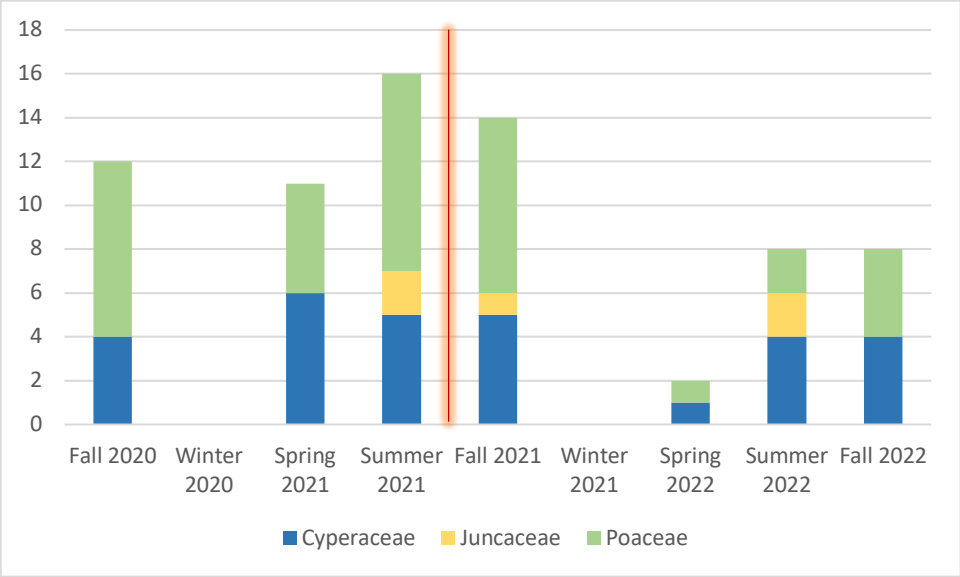

Figure 5. Number of species per family in Order *Poales* recorded by season and year in Bloucher Ford Nature Preserve, Madison County, Alabama. Red vertical line indicates the period of management change.

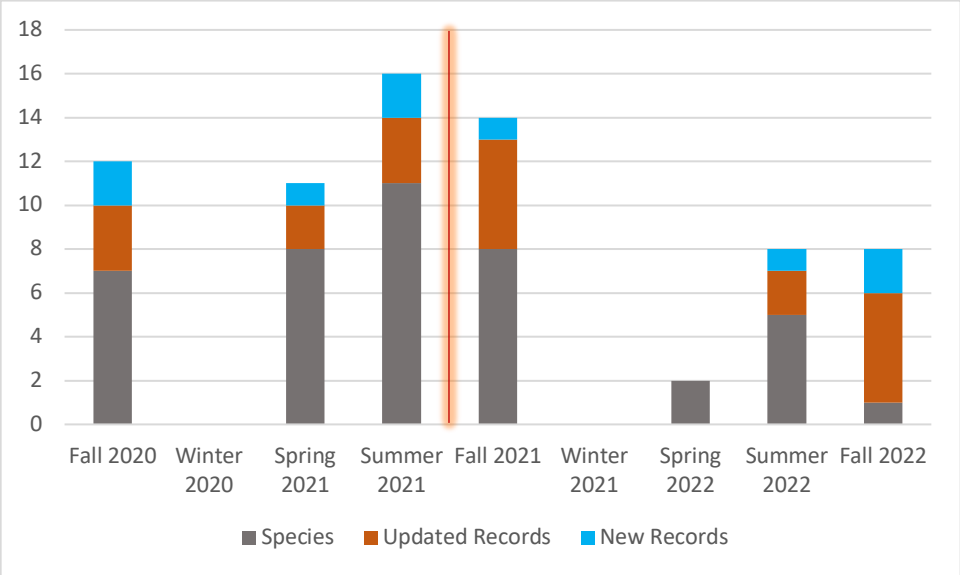

Figure 6. Number of identified species, updated county records and new county records recorded by season and year in Bloucher Ford Nature Preserve, Madison County, Alabama. Red vertical line indicates the period of management change.

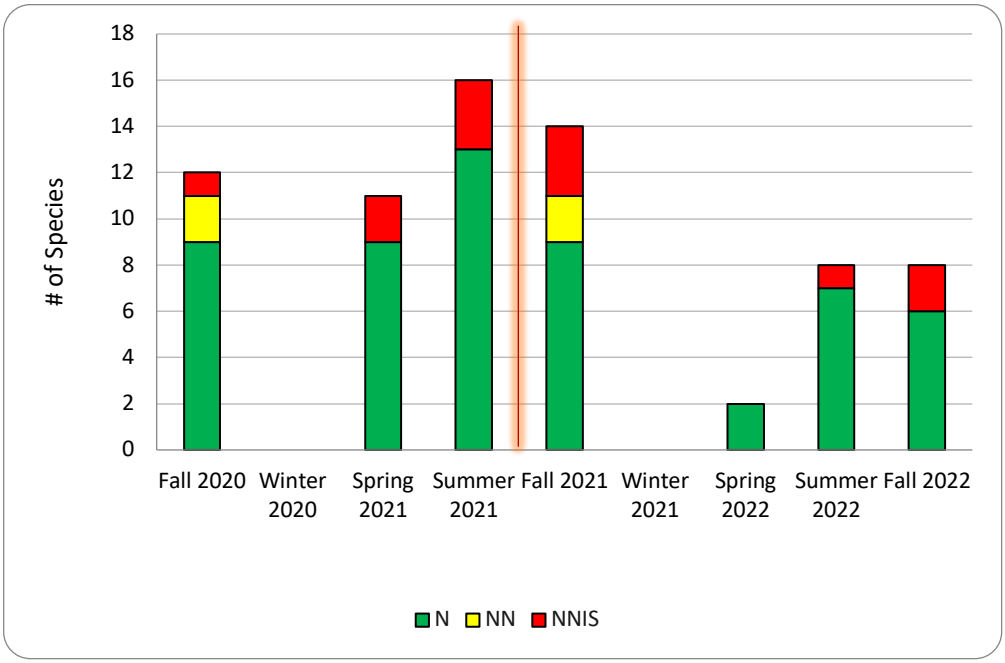

Figure 7. Number of total native (N), non-native (NN), and non-native invasive species (NNIS) recorded by season and year in Bloucher Ford Nature Preserve, Madison County, Alabama. Red vertical line indicates the period of management change.

3.3 Herbarium Records

This Bloucher Ford Nature Preserve floristic study and an extensive, time-consuming online data portal search revealed 29 new, missing, or incorrect first records for Madison County, Alabama within Order *Poales*, including species within the families: Cyperaceae (12), Juncaceae (1), and Poaceae (16). For a floristic study within such a small area, this study provides a strikingly large contribution to updating current local and regional botanical records. In comparison, a floristic study of *Carex* by Naczi et al. [79] of nearby Jackson County, Alabama, recorded an updated 23 species bringing the county-wide total to 90 vouchered species in the Alabama Plant Atlas [64].

Of the 29 contributions to records added or updated, 9 of them are newly reported species in Madison County, Alabama including 4 in Cyperaceae (*Carex (2)*, *Cyperus Kyllinga*), 0 in Juncaceae, and 5 in Poaceae: (*Calamagrostis, Echinochloa, Elymus, Eragrostis, Urochloa)*.

The remaining are 20 updated or missing reports of Madison County vouchered records that are already housed in various herbaria across the country with 6 species already collected by Steven J. Threlkeld for his thesis, Vascular Flora of Madison County, AL [68] that are stored in the JSU Herbarium in Jacksonville, AL (Table **3**). Many of these records are from decades past with many from the 1970s through 1980s with the oldest from 1897. This highlights the necessity of small-scale studies and additions to local herbaria collections, such as demonstrated in this paper, in reducing data deficiencies and removing gaps in state-wide and regional herbarium databases. Without these updates, floristic studies or models relying on regional and state databases to track data such as plant migration, climate change or phenological changes in plants over time would be using outdated and incorrect information.

Table 3. Madison County, AL records documented October 2020 - October 2022.

Family	Scientific Name*	Collector/ Specimen Number	Collection Date	Alabama Plant Atlas Specimens	Herbarium**
Cyperaceae	*Carex abscondita* Mack.	Charles T. Bryson 554	02 May 1974	5	MISSA
	Carex albolutescens Schwein.	Charles T. Bryson 3541, 25885	23 May 1983, 05 May 2021	1, 1	GA; UWAL/APA
	Carex laevivaginata (Kük.) Mack.	Loretta L. Weninegar 4472, & 5032 w/Charles T. Bryson	23 Apr 2021, 25 Aug 2022	0	AAMU
	Carex longii Mack.	Loretta L. Weninegar 4986	01 Jun 2022	0	AAMU
	Carex normalis Mack.	Steven J. Threlkeld 273	05 May 1996	0	JSU
	Cyperus croceus Vahl	Loretta L. Weninegar 5023, Charles T. Bryson 27817	25 Aug 2022	0	AAMU (Weninegar) MMNS (Bryson)
	Cyperus echinatus (L.) Alph. Wood	Charles T. Bryson 13972	14 Jul 1994	0	VSC
	Cyperus esculentus L. var. *leptostachyus* Boeckeler	Charles T. Bryson 4947	26 Aug 1986	0	VSC
	Cyperus iria L.	R. Kral 74169	12 Aug 1987	1	VDB/BRIT

	Cyperus lancastriensis Porter ex A. Gray	Charles T. Bryson 3107	08 Aug 1980	0	IBE
	Kyllinga gracillima Miq. =*Cyperus brevifolioides* Thieret & Delahoussaye	Loretta L. Weninegar 4732 w/G.S. Bushey	28 Aug 2021	0	AAMU
	Scleria oligantha Michx.	R. Kral 70195	17 Jun 1983	2	VDB/BRIT
Juncaceae	*Juncus effusus* L.	Harold D. Green 081	20 Sep 1995	0	VDB/ BRIT
Poaceae	*Andropogon virginicus* L.	D. Giannasi, et al. 147	30 Sep 2001	1	GA
	Arundinaria gigantea (Walter) Muhlenberg	Ross C. Clark 18344	17 Aug 1967	2	NCU
	Bromus catharticus Vahl	Steven J. Threlkeld 285	05 May 1996	0	JSU
	Calamagrostis coarctata Eaton	Loretta L. Weninegar 5030 w/ C.T.Bryson	25 Aug 2022	0	AAMU
	Cinna arundinacea L.	Loretta L. Weninegar 4812 w/Anna M. Bright	17 Sep 2021	0	AAMU
	Cynodon dactylon (L.) Pers.	Heinrich K.D. Eggert s.n.	02 Jul 1897	1	MO
	Dactylis glomerata L.	Glen N. Montz 6117	12 Apr 1993	0	SELU

	Digitaria ciliaris (Retz.) Koeler	Steven J. Threlkeld 1092	04 Aug 1997	1	JSU
	Echinochloa colona (L.) Link	England, J. Kevin 11351	04 Oct 2020	2	UWAL
	Eleusine indica (L.) Gaertn.	Steven J. Threlkeld 1067	04 Aug 1997	2	**JSU**/UWAL
	Elymus glabriflorus (Vasey ex L.H. Dewey) Scribn. & C.R. Bell	Loretta L. Weninegar 4549 w/James E. Jackson, Jr.	08 Jun 2021	0	AAMU
	Eragrostis minor Host	J. Kevin England 11412	17 Oct 2020	1	UWAL
	Setaria faberi Herrm.	Charles T. Bryson 13948	11 Jul 1994	0	VSC
	Setaria pumila (Poir.) Roem. & Schult.	Stephen J. Threlkeld 462	05 May 1996	1	JSU/UWAL
	Sorghum halepense (L.) Pers.	Stephen J. Threlkeld 1 093	04 Aug 1997	1	JSU/UWAL
	Urochloa platyphylla (Munro ex C. Wright) R.D. Webster	Loretta L. Weninegar 4656 w/ Benjamin J. & Tiberius R. Hoksbergen; 4879 w/Jerry D. Green	23 Jul 2021, 24 Oct 2021	0	AAMU

* Species names follow USDA Plants online database [76]. **Thiers, B. M. Index Herbariorum [99], updated continuously (Table 4).

Table 4. Herbaria codes of the herbaria searched in the study [99]

AAMU	Alabama A&M Forestry Herbarium. U.S.A. Alabama. Normal.
BRIT	Botanical Research Institute of Texas. U.S.A. Texas. Fort Worth.
GA	University of Georgia. U.S.A. Georgia. Athens.
IBE	Institute of Botanical Exploration. U.S.A. Mississippi. University.
JSU	Jacksonville State University Herbarium. U.S.A. Alabama. Jacksonville.
MO	Missouri Botanical Garden Herbarium. U.S.A. Missouri. Saint Louis.
MISSA	Mississippi State University. U.S.A. Mississippi. Mississippi.
NCU	University of North Carolina at Chapel Hill Herbarium. U.S.A. North Carolina. Chapel Hill.
SELU	Southeastern Louisiana University. U.S.A. Louisiana. Hammond.
UWAL	University of West Alabama Herbarium. U.S.A. Alabama. Livingston.
VDB	Vanderbilt University Herbarium (now at BRIT). U.S.A. Texas. Fort Worth.
VSC	Valdosta State, U.S.A. Georgia. Valdosta.

4. Conclusions and Lessons Learned

This study reports on a vascular plant study conducted in North Alabama in collaboration with the Land Trust of North Alabama and added 29 new and updated contributions to regional *Poales* species records despite the small study area highlighting the high species richness of the order on the property and demonstrating the need for management that considers the effects of management activities on grasses, sedges, and rushes if that biodiversity is to be conserved.

4.1 Changes in Conservation Management

The reduction in mowing after June 2021 was an important change that allowed us to catalog additional species including several new county records throughout the second year. Even the discovery of new invasive species that were being suppressed by the mowing is important as it provides more detailed information to allow for better targeting of chemical or physical treatments for managing specific species. The willingness of LTNA management to change scheduled management activities and pause organizational goals for the property to gather more and better data is a valuable trait that demonstrates a desire to move toward ecological goals that are property specific and measurable such as those mentioned by Alexander and Hess [17]. Providing a clear time-bound pathway to collect this data and a commitment to finish the data collection were important to the LTNA for acceptance of our request to change their management regime.

Giving the preponderance of the literature on the effects of mowing on species richness and abundance in grasslands and meadows and the maintenance required to limit the invasion of undesired species (e.g., invasive, or woody species) [57-60], there will most likely need to be a return in the future of a less intense and better-timed mowing regime. Armed with the data from this study, we can assess and monitor how the changes in mowing affect the appearance (or disappearance) of species within the grasslands and wet meadows on the property.

4.2 State Plant Records and Data Availability

Vascular plant studies are not particularly rare state-wide in Alabama with spatial scales reaching from park to county-size and objectives ranging from building plant inventories to updating state and county checklists [100-104]. Most of these studies, however, have been conducted across the central and southern regions of the state leading to a blind spot in available botanical records for an area, such as North Alabama, that is rapidly urbanizing. Between 2010 and 2020, Huntsville grew at a population growth rate of over 19% while Madison County's growth rate topped 32% [105]. With urban growth model predictions [85] estimating a rapid 1% growth rate in urban land cover for Madison and Limestone Counties, it becomes even more imperative that conservation land management decisions be made with the best available data to make the best choices regarding biodiversity conservation as habitat is replaced by urban infrastructure. Land conservation organizations such as LTNA, cannot act to conserve or manage habitat for species they do not know exist on the properties under their management. Likewise, up-to-date county plant records can provide data for estimating what plants are likely to occur on a property assisting conservation organizations in deciding what sites to invest money in protecting.

Without local studies, such as this one, and the subsequent time-consuming efforts in searching, examining, adding, and updating state and regional botanical databases and herbaria records, gaps in spatial and temporal information can be formed [39] that can lead to flawed analyses for studies that use the data to assess changes in population, phenology, and community structure over time. Difficulty in finding plant record data is increased when searching for local records held in out-of-state or regional herbaria which can contain, as this study shows, important contributions to records kept in databases that then need to be manually updated (Table 3). With digitalization and sharing through regional databases, the difficulty of gathering data can be reduced. However, even with online resources, there are vast areas of the United States that lack in floristic herbaria records [106]. This lack of data hinders our ability to make the best decisions for the conservation of biodiversity and will only be solved by the completion, documentation, and publication of vascular flora studies from those regions.

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Data Availability Statement: Data from this project is found in the appendices below.

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Conflicts of Interest: The authors declare no conflicts of interest.

APPENDIX A

Annotated Checklist of Vascular Flora of Bloucher Ford Nature Preserve

All species are within the division Magnoliophyta and the order Poales. Species are further divided into the families Cyperaceae, Juncaceae, and Poaceae. Family names are arranged alphabetically and within each family, the species are alphabetized. A few symbols are used in the list of species in Appendix 1. A star (★) denotes a species not considered to be native to Madison County, Alabama. A triangle (▲) denotes a non-native invasive species. A dagger (†) after the species name indicates a species photographed by the author but not collected due to oversight; a specimen will be collected and vouchered as soon as feasible. Species the author collected are followed by the author's collection number(s) in *italics*. Madison County, Alabama records collected by the author are denoted by a closed circle (●) A few vouchers collected by Dr. Charles T. Bryson while on the property with the author are listed with the last name of the collector, collector's specimen number, and herbarium code where they are deposited in bold and italics. A plus (+) identifies the species as one having an earlier Madison County, AL record that was located through a data portal but not currently documented by the Alabama Plant Atlas. Loretta Lynne R. Weninegar collected and compiled this flora from late September 2020 through early October 2022. Many field assistants and volunteers participated in field collections; the last name of anyone present when the specimen was collected will follow the author's collection number. The few specimens not vouchered by the author are housed in the herbarium at the University of West Alabama (UWAL) in Livingston, AL.; a diamond ( ) follows the scientific name, the last name of the collector, collector's specimen number, and herbarium code in bold and italics. All specimens collected by the author are housed at Alabama A&M University, Normal, AL, and will be accessioned into the Alabama A&M Forestry Herbarium (AAMU). Specimens highlighted in green have pictures included as figures in this publication in Appendix C.

Cyperaceae
Carex
Carex abscondita Mack. + *5024* w/Bryson
Carex albolutescens Schwein + *4968* w/ Mousel
Carex amphibola Steudel *4425* w/Bright
Carex blanda Dewey *4435* w/Bright, *4959b* w/Mousel
Carex caroliniana Schwein.*4998*
Carex cherokeensis Schwein.*4416* w/Bowman, *4613* w/Jackson
Carex conjuncta Boott *4513* w/Young, *4532* w/Hoksbergen
Carex corrugata Fernald *4945* w/Czech, *4959a* w/Mousel, *4973* w/Czech & Troby, *4980* w/Czech & Troby, *4992, 5001*
Carex frankii Kunth *4556* w/Jackson, *4576* w/Jackson & Lacy, *4972* w/Czech & Troby
Carex grayi Carey *4409* w/Bowman, *4419* w/ Bright, *4502* w/Young, *4557* w/Jackson *Bryson 27818 MMNS w/Weninegar*
Carex laevivaginata (Kük.) Mack. ● *4472*, *5032* w/Bryson
Carex leavenworthii Dewey *4424* w/Bright, *4479* w/Young
Carex longii Mack. ● *4986*
Carex lupulina Muhl. ex Willd. *4171* w/Bowman, Czech, & England, *4555* w/Jackson, 4583 w/Jackson & Lacy, *5029* w/Bryson
Carex normalis Mack. *4547* w/Jackson
Carex socialis Mohlenbr. & Schwegm. *4427* w/Bright, *4450, 4460*, *4991*
Carex tribuloides Wahlenb. *4977* w/Czech & Troby
Carex vulpinoidea Michx. *4571* w/Jackson & Lacy

Cyperus
Cyperus croceus Vahl● *5023* w/*Bryson 27817 MMNS*
Cyperus echinatus (L.) Alph. Wood *5005, 5019* w/Bryson
Cyperus erythrorhizos Muhl. *4210* w/Bowman, Czech, & Finzel
Cyperus esculentus L. ▲ 5026 w/Bryson
Cyperus iria L.★ + *4686*
Cyperus lancastriensis Porter ex A. Gray *4218* w/Bowman, Czech, & Finzel, *4602* w/Jackson & Lacy, *4691*, *4731* w/Bushey, *5021* w/Bryson *27816 MMNS*, *5028* w/Bryson
Cyperus odoratus L. *4186* w/Bowman, Czech, & England
Cyperus strigosus L. *4682; 4764* & *4765* w/Bushey, *5020* w/Bryson
Eleocharis
Eleocharis obtusa Willd. *4688*
Kyllinga
Kyllinga gracillima Miq. ★●
(*Cyperus brevifolioides* Thieret & Delahouss.) *4732* w/Bushey, *5022* w/Bryson
Scleria
Scleria cf oligantha Michx. + *4876* w/Green

Juncaceae
Juncus
Juncus acuminatus Michx. *4975 & 4981* w/Czech & Troby, *5000*
Juncus dichotomus Elliott *4575* w/Jackson & Lacy
Juncus effusus L. *4577* w/Jackson & Lacy, *4976* w/Czech & Troby
Juncus tenuis Willd. *4480*, *4683*, *4897* w/Green
Luzula
Luzula bulbosa (Alph. Wood) Smyth & Smyth 4957 w/Mousel

Poaceae
Andropogon
Andropogon virginicus L. + *4180, 4181*
Arundinaria
Arundinaria gigantea (Walter) Muhlenberg + *4437* w/Bright, *4623* w/Jackson
Bromus
Bromus catharticus Vahl ★▲ *4459, 4589* w/Jackson & Lacy, *4756* w/Bushey
Calamagrostis
Calamagrostis coarctata Eaton ●*5030* w/Bryson
Chasmanthium
Chasmanthium latifolium (Michx.) Yates 4620 & 4719 w/Jackson
Cinna
Cinna arundinacea L.● *4812* w/Bright
Cynodon
Cynodon dactylon (L.) Pers.★▲ + *4676, 5017*
Dactylis
Dactylis glomerata L.★▲ *4995*
Dichanthelium
Dichanthelium commutatum (Schult.) Gould *4640* w/Jackson & Lacy, *4795*
Digitaria

Digitaria ciliaris (Retz.) Koeler + *4834*, *4837*
Echinochloa
Echinochloa colona (L.) Link★*4191* w/Bowman, Czech, & England, *4690*, *4706* w/Jackson
Echinochloa muricata (P. Beauv.) Fernald *4658* w/Hoksbergen & Hoksbergen, *4774* w/Bushey
Eleusine
Eleusine indica (L.) Gaertn.★▲ + *4211* w/Bowman, Czech, & Finzel, *4839*
Elymus
Elymus glabriflorus (Vasey ex L.H. Dewey) Scribn. & C.R. Bell● 4549 w/Jackson
Elymus virginicus L. *4173* w/Bowman, Czech, & England
Eragrostis
Eragrostis minor Host ★ *E*ngland 11412 UWAL w/Bowman, Czech, & Weninegar
Festuca
Festuca subverticillata (Pers.) Alexeev *4431* w/Bright, *4956* & *4974* w/Czech & Troby
Hordeum
Hordeum pusillum Nutt.*4967* w/Mousel
Leptochloa
Leptochloa panicea (Retz.) Ohwi ssp. *Brachiate* (Steud.) N. Snow
Dinebra panicea (Retz.) P.M. Peterson & N. Snow ssp. *brachiata* (Steud.) P.M. Peterson & N. Snow *England 11296 UWAL*
Melica
Melica mutica Walter *4447*
Microstegium
Microstegium vimineum (Trin.) A. Camus ★▲ *4880* w/Green
Muhlenbergia
Muhlenbergia schreberi J.F. Gmel. *4175* w/Bowman, Czech, & England, *4816* w/Bright
Panicum
Panicum dichotomiflorum Michx.★ *England 11308 UWAL*
Panicum rigidulum Bosc ex Nees *4757* w/Bushey
Panicum virgatum L. *4818* & *4826* w/Bright
Paspalum
Paspalum dilatatum Poir. ★▲ *4680*
Paspalum pubiflorum Rupr. ex Fourn. *5031* w/Bryson
Poa
Poa annua L.★▲ *4432* w/Bright, *4907* w/Czech, Z.M. Green, & Knight
Poa compressa L.★▲ *4573* w/Jackson & Lacy
Poa sylvestris A. Gray 4952 & *4955* w/Czech
Schedonorus
Schedonorus arundinaceus (Schreb.) Dumort., nom. cons.★▲ *4550* w/Jackson, *4574* w/Jackson & Lacy, *4994*, *4999*
Setaria
Setaria faberi Herrm.★▲✝ *5027* w/Bryson
Setaria pumila (Poir.) Roem. & Schult. ★▲+ *4653* & *4662 w*/Hoksbergen & Hoksbergen, *4681, 4724* w/Jakson, *4744* w/Bushey, *4809* w/Bright
Sorghum
Sorghum halepense (L.) Pers.★ ▲✝ + England *11331 UWAL*
Steinchisma
Steinchisma hians (Elliott) Nash *4631* w/Jackson, *4685*
Tridens
Tridens flavus (L.) Hitchc. *4824* w/Bright

Urochloa
Urochloa platyphylla (Munro ex C. Wright) R.D. Webster ● *4656* w/Hoksbergen & Hoksbergen, *4879* w/Green

APPENDIX B

Madison County AL Plant County Record Status in Alabama Plant Atlas [64]

Madison County, AL records with vouchers collected earlier than Alabama Plant Atlas records [64] (11):

Cyperaceae (4)
Carex abscondita Mack. (Bryson 1974)
Carex albolutescens Schwein (Bryson 1983)
Cyperus iria L. (Kral 1987)
Scleria oligantha Michx. (Kral 1983)

Poaceae (7)
Andropogon virginicus L. (Giannasi et al. 2001) *
Arundinaria gigantea (Walter) Muhl. (Clark 1967)
Cynodon dactylon (L.) Pers. (Eggert 1897) *
Digitaria ciliaris (Retz.) Koeler (Threlkeld 1997) *
Eleusine indica (L.) Gaertn. (Threlkeld 1997) *
Setaria pumila (Poir.) Roem. & Schult. (Threlkeld 1996) *
Sorghum halepense (L.) Pers. (Threlkeld 1997)*

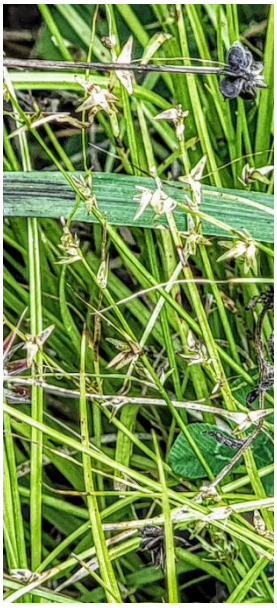
County Records not recorded in the Alabama Plant Atlas [64] prior to the Bloucher Ford Nature Preserve study (18):

Cyperaceae (8)
Carex laevivaginata (Kük.) Mack. (Weninegar 2021; Weninegar & Bryson 2022)
Carex longii Mack. (Weninegar 2022)
Carex normalis Mack. (Threlkeld 1996)
Cyperus croceus Vahl (Weninegar & Bryson 2022)
Cyperus echinatus (L.) Alph. Wood (Bryson 1994)
Cyperus esculentus L. var. *leptostachyus* Boeckeler (Bryson 1986)
Cyperus lancastriensis Porter ex A. Gray (Bryson 1980)
Kyllinga gracillima Miq. [*Cyperus brevifolioides* Thieret & Delahoussaye] (Weninegar & Bushey 2021)
Juncaceae (1)
Juncus effusus L. (Green 1995)
Poaceae (9)
Bromus catharticus Vahl (Threlkeld 1996)
Calamagrostis coarctata Eaton (Weninegar & Bryson 2022)
Cinna arundinacea L. (Weninegar & Bright 2021)
Dactylis glomerata L. (Montz 1993)
Echinochloa colona (L.) Link (England 2020)
Elymus glabriflorus (Vasey ex L.H. Dewey) Scribn. & C.R. Bell (Weninegar & Jackson, Jr. 2021)
Eragrostis minor Host (England 2020) *
Setaria faberi Herrm. (Bryson 1994) ✝
Urochloa platyphylla (Munro ex C. Wright) R.D. Webster (Weninegar, Hoksbergen & Hoksbergen 2021)

* The only voucher in Alabama Plant Atlas [64] for Madison County is a Bloucher Ford Nature Preserve specimen from this study.
✝ A photo voucher was taken 22 August 2022; at Bloucher Ford; a specimen was collected on 28 July 2023 by Weninegar.

APPENDIX C

Photographs of noteworthy Poales species identified at Bloucher Ford Nature Preserve in Madison County, Alabama with description and location data (Latitude and Longitude).


b.

c.


Figure 17. *Carex socialis* Mohlenbr. & Schwegm., 01 June 2022, (34.875293, -86.475966), a. culms, b. culms & leaves, c. mature fruit.

Figure 18. *Cyperus croceus* Vahl, 25 August 2022, (34.878986, -86.481269)

Figure 19. *Cyperus esculentus* var. l*eptostachyus* Boeckeler, 25 August 2022, (34.879817, -86.48128)

Figure 20. *Kyllinga gracillima* Miq., 25 August 2022, (34.878868, -86.481901)

Figure 21. *Calamagrostis coarctata* Eaton, 25 August 2022, (34.878254, -86.47965)

Figure 22. *Cinna arundinacea* L., 17 September 2021, (34.880277, -86.480364)

Figure 23. *Elymus glabriflorus* (Vasey ex L.H. Dewey) Scribn. & C.R. Bell
08 June 2021, (34.880177, -86.481831)

Figure 24. *Microstegium vimineum* (Trin.) A. Camus
11 September 2021, (34.875941, -86.474059)

Figure 25. *Muhlenbergia schreberi* J.F. Gmel., 11 September 2021,
(34.875955, -86.474077)

Figure 26. Schedonorus arundinaceus (Schreb.) Dumort., nom. Cons., 14 June 2021. (34.87549, -86.475561)

Figure 27. *Setaria faberi* Herrm. ✝️, 25 August 2022, (34.875871, -86.474831)

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