Florida Longleaf Pine Ecosystem Occurrences Geodatabase v.5: Public Lands Update

Final Report to the Florida Forest Service

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ABSTRACT

From 2012-2018 Florida Forest Service (FFS) and Florida Natural Areas Inventory (FNAI) partnered to develop the Longleaf Pine Ecosystem Geodatabase (LPEGDB), a project to design and populate a spatial database that serves as the central repository for data on the distribution and condition of Longleaf Pine Ecosystems (LPE) in Florida. As of 2018, 2.36 million acres of longleaf were documented in the Florida LPEGDB v.4.

The current project, LPEGDB v.5, addresses several important updates to the LPEGDB, which support needs identified in the 2020 Florida Forest Action Plan: 1) inclusion of new and updated data from partners, including recent ecological assessment data collected by FNAI for various agencies; 2) modification of attributes to facilitate compatibility with the Southeast Longleaf Ecosystem Occurrences Geodatabase (SE LEO GDB); and 3) enhancements to identify old-growth stands, restoration demonstration projects, and ecological reference sites, and development of a groundcover condition analysis and attribute within the LPEGDB.

The LPEGDB v.5, completed in March 2024, contains approximately 2.4 million acres of confirmed longleaf pine in Florida, an increase of 40,000 acres from v.4. We received new or updated data from >20 partners, which accounts for 1.16 million acres of longleaf in the database. We created a preliminary dataset for old-growth stands but there is additional need for scientific agreement on criteria and methods for identifying and mapping old-growth longleaf forests. We were able assess more than 6,300 sites for groundcover condition, primarily on state and federal lands. This analysis highlighted gaps in data availability and consequences of differing data collection methods. Additional review and next steps are needed for all new components.

The LPEGDB v.5, now integrated with SE LEO GDB, will serve to inform longleaf restoration planning within Florida and across the southeast, including the next iteration of the Longleaf Pine Sustainability Analysis, a planning tool for America's Longleaf. This version represents progress toward fulfilling inventory and assessment objectives of Florida's Forest Action Plan and the America's Longleaf 2024 Range-wide Conservation Plan for Longleaf Pine.

ACKNOWLEDGEMENTS

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INTRODUCTION

The Florida Longleaf Pine Ecosystem Geodatabase (LPEGDB) is a partnership between The Florida Forest Service (FFS) and Florida Natural Areas Inventory (FNAI) to develop a central source for information on the distribution and ecological condition of longleaf pine ecosystems (LPE) in Florida. Previous work on this project (2012-2018) was successful in significantly increasing and consolidating data on longleaf location and condition, for both public and private lands. As of 2018, 2.36 million acres of longleaf were documented in the Florida LPEGDB v.4 (FNAI 2018).

The Florida database was the model for the Southeast Longleaf Pine Ecosystem Occurrences Geodatabase (SE LEO GDB) project, which began in 2018 and originally focused on consolidating longleaf spatial data outside of Florida, across the range of the species. To date 2.63 million acres of longleaf are documented in the SE LEO GDB, outside of Florida. In 2023 the LPEGDB v.4 was integrated into the LEO GDB v.2 (FNAI 2023) and now comprises 47% of the longleaf acreage documented in the SE LEO GDB.

The 2020 Florida Forest Action Plan (FAP; FFS 2020) recognized the need for continued inventories and assessment of longleaf pine ecosystems as a high priority, and for use of these data to support near and long-term goals for conservation and restoration. The current project addresses several important updates to the LPEGDB:

1. Inclusion of new and updated data from partners, primarily on public lands.

   Data sources for the LPEGDB include rapid assessment field surveys (mainly private lands) and existing partner data (mainly public lands), with the latter comprising more than half of the longleaf acreage in the previous version of the LPEGDB (v.4, published 2018). Since 2018, sources of important updates include forest stand inventories on federal and state lands, and ecological mapping and monitoring data collected by FNAI for many land managing agencies. We also include new data from partners that fill gaps in the database.

   This task directly supports the 2020 Florida Forest Action Plan (FAP) Goal 1 of continuing to assemble data from inventories and assessments of Longleaf Pine Ecosystems (LPEs) on public and private land and compile in accessible databases.

2. Modification or addition of several condition attributes to facilitate compatibility with the SE LEO GDB.

   Although the SE LEO GDB was modeled on the LPEGDB, there are some attribute differences that prevented full integration with LEO. For new and updated data sources we include all LEO attributes to the extent feasible. This task supports the integration of Florida data into range-wide and regional planning efforts for longleaf pine conservation and restoration, including future iterations of the Longleaf Pine Sustainability Analysis (FNAI and UF-CLCP 2023).

3. Enhancements to support additional goals and objectives of the 2020 Florida Forest Action Plan.

   a) Identification of old growth longleaf sites. The FAP Longleaf Pine Issue, Goal 3 – Reforestation of Longleaf Pine – includes a strategy (3.1.8) to identify old-growth longleaf

legacy forests and develop long-term management plans for them. We provide a spatial layer for old-growth sites to assist with this strategy.

b) Identification of ecological reference sites and restoration demonstration projects. Goal 1, Objective 1.1 of the FAP specifies updating the LPEGDB to identify sites where land managers and landowners can observe restoration projects at various stages. We provide spatial layers of reference and restoration sites to help fulfill this objective and related strategies.

c) Enhancement of groundcover condition data for public lands. We develop a groundcover condition analysis for the LPEGDB, to identify high quality groundcover sites for both longleaf pine and open pine grassland sites currently without longleaf pine. This task supports the FAP Longleaf Pine Issue, Goal 4 - Functional and native, diverse herbaceous groundcover exists or is being restored in stands that can be maintained with prescribed fire.

This report describes the updates that are now included the LPEGDB v.5. For detailed information on initial database development and subsequent iterations through version 4, readers should refer to earlier reports available on the Florida Longleaf Pine Database website: https://www.fnai.org/species-communities/florida-longleaf.

METHODS

The project was divided into three major tasks conducted from April 2023 through March 2024:

1. Solicitation and mining of existing longleaf pine data from agencies, organizations, and FNAI survey data.
2. Integration of new and updated data sources into the LPEGDB, including populating LEO attributes and crosswalking of ecological condition attributes into LEO management classes.
3. Development of new database components for old-growth, restoration demonstration sites, reference sites, and groundcover condition.

Mining Existing Data Sources

We conducted outreach to public land managing agencies for updates to longleaf pine occurrence and condition data, including new planting data. Many of these datasets were in the form of forest stand inventories, either updated since LPEGDB v4 or a new inventory for an agency. We also solicited data from counties and land trusts where longleaf occurred within LPEGDB v4 on properties they managed. Finally, we mined and summarized ecological data collected for many types of FNAI projects, including natural community mapping and monitoring, Florida Forever assessments, and rare species element occurrence records. For all sources, we requested or mined data for longleaf pine sites as well as open pine grassland sites where longleaf is currently absent. Descriptions of all datasets contributing to the update are described in Table 1.

Table 1. Open pine data sources contributing to updates in the LPEGDB v.5

Source Name	Dataset Description
NWFWMD v5	Northwest Florida Water Management District Forestry stands.
Florida Forest Service v5	Florida Forest Service Forestry stands.
Eglin Air Force Base v5	Eglin Air Force Base Forestry stands.
Nokuse Plantation v5	Longleaf pine plantings at Nokuse Plantation.
Tall Timbers NGC v5	Polygons for areas of native groundcover surveyed by Tall Timbers Research Station & Land Conservancy with associated attributes. *Excluded from web map.*
Tall Timbers CE v5	Polygons for Special Natural Areas within Tall Timbers Research Station & Land Conservancy Conservation Easements, with associated attributes. *Excluded from web map.*
Alachua Conservation Trust v5	Longleaf pine stands on Alachua Conservation Trust properties.
Florida State Parks v5	Florida State Parks Forestry Stands.
Putnam Land Conservancy v5	Polygons of Conservation Easements managed by Putnam Land Conservancy that contain longleaf, used to confirm longleaf pine stands from LPEGDB v4.
Volusia County v5	Volusia County Forestry Stands.
Green Horizon Land Trust v5	iNaturalist points of longleaf pine located on Barbara Pedersen Wildlife Preserve,
Archbold Biological Station v5	Location map of longleaf pine on Archbold Biological Station (ABS); polygons delineated by FNAI as indicated by ABS on aerial image.
SJRWMD v5	St. John's River Water Management District Forestry stands,
SRWMD v5	Suwannee River Water Management District Forestry stands,
Cooperative Land Cover v5	Detailed land cover map for Florida with boundaries primarily delineated from aerial photos. Polygon sources from CLC v3.6,
Bok Tower Gardens v5	Longleaf pine plantings at Bok Tower Gardens,
Conservation Foundation of the Gulf Coast v5	Longleaf pine stands on Pine Island, delineated from aerial imagery,
U. S. Forest Service v5	National Forest stands,
Avon Park Air Force Range v5	Avon Park Air Force Range Forestry stands,
FWC Plantings v5	Longleaf pine plantings on FL Fish and Wildlife Conservation Commission (FWC) lands,
St. Sebastian SP RCW dataset v5	RCW cavity tree records from St. Sebastian State Park,
Avon Park RCW dataset v5	RCW cavity tree records from Avon Park Air Force Range,
FNAI NC polygons v5	Natural Community polygons delineated by FNAI for natural community mapping projects on a variety of public lands and informed by ground-truthing.
FNAI NC points v5	Natural Community assessment points for vegetation structure and composition collected by Florida Natural Areas Inventory (FNAI) on a variety of managed lands.
FNAI OBVM v5	Objective-Based Vegetation Management (OBVM) monitoring plots collected by FNAI on FWC-managed lands with detailed data on plant species composition and structure.
FNAI EOs v5	Florida Natural Areas Inventory's Element Occurrence (EO) data, which identifies occurrences of rare plants and animals and exemplary natural communities,
FNAI Florida Forever v5	Point data collected by FNAI for natural communities and rare species during field assessments for proposed Florida Forever land acquisition projects.
FNAI FWC Reference Sites v5	Ecological reference sites for longleaf pine delineated and assessed by FNAI through an FWC-funded project.
FNAI DEP Reference Sites v5	Ecological reference sites for longleaf and other open pine delineated and assessed by FNAI through a DEP/EPA-funded project.

Integration of Data Sources into the LPEGDB

We integrated all updated and new data sources into the LPEGDB, for both spatial configuration and attributes. We tracked the sources for all sites within an internal version of the database. We added and populated several new attributes that are part of the SE LEO GDB and developed other attributes specifically for LPEGDB v.5. For some sites, ecological condition attributes were populated from more than one data source. For example, a site could have forestry attributes like basal area from recent a recent timber inventory, and groundcover condition from an FNAI natural community survey. Attribute changes for LPEGDB v.5 are described below.

Attributes from SE LEO added to LPEGDB v.5

We added 3 condition attributes − Longleaf Pine Stand Age, Other Pine Basal Area (BA), and Canopy Hardwood BA − from the SE LEO GDB to the LPEGDB v.5 and populated them where feasible from v.5 sources. The previous LPEGDB v.4 recorded the other pine and canopy hardwood attributes as cover classes which we retained for non-updated records, but report in v.5 within the BA fields. We also added Year of Origin, to enable population of Stand Age. We originally planned to add a fire history attribute but decided to wait until the release of SE Fire Map v.2, expected in summer or fall 2024, which is expected to be a substantial improvement of the SE Fire Map v.1 (SE Fire Map 2021). We included Currentness, Data Level and Confidence Tier attributes from the SE LEO GDB that help characterize the completeness and accuracy of the data; we expanded the data level values (i.e., categories that describe data completeness) for sites without longleaf to more comprehensively describe other open pine sites (Appendix A). Finally, we included attributes for Owner Type and Source Type (existing partner data vs. LEO field surveys). Note that no personally identifiable information (PII) is collected or stored in the LPEGDB or LEO GDB. All LPEGDB v.5 condition attributes are described in Appendix B.

Other Attributes added to the LPEGDB v.5

To facilitate analyses of ecological condition, we added attributes for natural community/land cover type, hydrology class and open pine status. We assigned a land cover type for each site based on the majority overlap with the SITE_NAME in the Cooperative Land Cover Map v3.7 (FWC and FNAI 2023). We then assigned hydrology class as xeric, sub-mesic, mesic, or hydric based on the land cover type (Table 2). For pine plantations and other land cover types for which hydrology is ambiguous, we assigned mesic as the default hydrology type. We determined open pine status based on the majority overlap of open pine land cover types within a site (Table 2).

LPE Ecological Conditions Crosswalk

The main challenge with integrating datasets from multiple sources is the crosswalk of ecological condition attributes which vary among data sources. Condition data in both the LPEGDB v.4 and SE LEO GDB v.2 were crosswalked into three management levels (Maintain, Improve, Restore) as described in the Range-wide Conservation Plan for Longleaf Pine (America's Longleaf 2024); however, the crosswalk systems of the two databases differ. To enhance compatibility, we applied the SE LEO GDB v.2 crosswalk to the LPEGDB v.5 (Appendix C).

Table 2. Hydrology classes assigned to open pine natural communities in the LPEGDB v.5. The natural community types listed below may correspond to more that one class in the Cooperative Land Cover Map. For example, wet flatwoods is also typed as hydric pine flatwoods in CLC.

Open Pine Type	xeric	sub-mesic	mesic	hydric
Mesic Flatwoods			X	
Sandhill	X			
Scrubby Flatwoods	X			
Upland Mixed Woodland		X		
Upland Pine		X		
Wet Flatwoods				X

New LPEGDB Components

Old-growth

To help FFS identify old-growth longleaf sites we used Year of Origin to find older stands of longleaf pine. We chose an age threshold of stands >150 years, following Varner and Kush (2004), and excluded small stands of remnant trees within disturbed settings. We also mined published reports and consulted with researchers for locations that have been previously recognized as old-growth longleaf sites. We created a point data file of the known and previously recognized old-growth longleaf sites for inclusion in the LPEGDB v.5; where the precise location of a stand was unknown, we added a point in the center of the managed area polygon.

We recognize that stand age does not capture many of the features that define old-growth longleaf forests (Landers and Boyer 1999, Harms 1996, Varner and Kush 2004, Johnson et al. 2018, Zampieri and Pau 2022). Old-growth longleaf features include many stand characteristics (e.g., multiple age classes, presence of trees with fungal and age-related damage, flat-top canopy morphology) and site characteristics (e.g., diverse, native pyrogenic groundcover, lack of widespread soil disturbance, a presence of snags, stumps, downed woody debris), but currently, data for these additional features are either not included in the LPEGDB or are of very limited availability in the database.

It is also important to note for a large percentage of records in the LPEGDB v.5, the attribute Year of Origin is not populated. There are certainly many additional public and private lands in Florida that support old-growth longleaf pine stands, but spatial stand-level data either do not currently exist or remain unknown to us. The limitations and research needs for identifying and mapping old-growth longleaf forests are discussed later in this report.

Restoration Demonstration Sites

We solicited information about potential restoration demonstration sites from the leads of the 4 longleaf Local Implementation Teams (LITs) in Florida. We requested examples of restoration projects where managers and landowners can visit to see different types of restoration at various stages of progress. Examples could be for groundcover, midstory, or longleaf (or combination) and include planting, seeding, hardwood removal, post-hurricane recovery, etc. with various starting conditions such

as old field, pine plantation, natural degraded site, etc. We also contacted FFS for a list restoration projects they would like to see included for state forests. From the responses we developed a point feature class, located in the center of the managed area, with an attribute describing the restoration type.

Ecological Reference Sites

We compiled a set of ecological reference sites for open pine communities from reference site projects conducted by FNAI from 2009-2023 (Table 1). Plot-level data collected for these sites was summarized and integrated into the LPEGDB v.5.

Groundcover Condition

We developed a groundcover condition attribute and populated it for existing longleaf pine and other open pine grassland sites. As part of this task we solicited groundcover data from managing agencies along with the request for longleaf pine data.

We derived the criteria and ranking scheme for groundcover condition from a habitat quality index for assessing longleaf pine habitat condition that was developed by The Nature Conservancy (TNC) in North Carolina in cooperation with FNAI and The Longleaf Alliance (Hannon and Marcus 2022). The TNC scheme employs habitat suitability curves to score and weight individual metrics within categories for canopy, midstory, and understory. The TNC system includes 5 metrics for understory: short shrub cover, native herbaceous cover, pyrogenic graminoid cover, invasive plant cover, and longleaf pine regeneration cover. For the LPEGDB v.5 groundcover condition we used the TNC understory scoring method, but modified it to exclude longleaf pine regeneration. Although an important component of overall site condition, regeneration does not directly inform groundcover condition. We also adjusted the scoring method to allow scoring for 'presence only' data, e.g., source indicated presence but no cover data for a particular metric. In those cases, we assigned a moderate value in the cover score for that metric. Scoring within the TNC system varies based on soil hydrology. We assigned a hydrology class to all open pine sites as described above. The LPEGDB scoring method for groundcover is presented in Appendix D.

In addition to the TNC scoring method, we evaluated several other methods that estimate groundcover condition including the 2014 ALRI Longleaf Pine Maintenance Condition Class Definitions, NatureServe's Rapid Assessment Metrics for Wildlife and Biodiversity in Southern Open Pine Ecosystems ([SOP]; Nordman and White 2016), and the USFS Ecological Condition Model for longleaf habitats in the Apalachicola National Forest (Trager et. al. 2018). Although all methods had merit, the TNC method was directly aligned with LPEGDB/LEO attributes and employed a weighting system based on the ecological importance of the individual metrics.

RESULTS

LPEGDB Version 5

Statewide LPE Occurrence and Distribution

The LPEGDB v.5 contains confirmed locations of approximately 2.4 million acres of longleaf pine ecosystems in Florida. We also track the longleaf occurrence status of other pinelands where there is evidence that longleaf is likely absent (4.28 million acres) and where evidence indicates the potential for longleaf but occurrence remains unknown (2.17 million acres) (Fig. 1). Most longleaf (57%) occurs on lands managed by state and federal agencies (Table 3). In Florida, longleaf dominant or co-dominant sites make up 71% of total longleaf acreage (Fig. 2). We also assume that some portion of the 14% of sites where longleaf is confirmed but that lack additional information, will also be longleaf dominant or young planted pine that are not part of the canopy. LPEGDB v.5 increases the documented acreage of longleaf pine by 40,000 acres since LPEGDB v.4.

Update Sources

Partners other than FNAI contributed 1.16 million acres of longleaf occurrence data and 695,000 acres of other open pine grassland or planted pine not currently in longleaf. In addition to attributes associated with partner sources, ecological condition was informed by more than 10,000 FNAI plot data locations for various projects, covering ca. 156,000 acres.
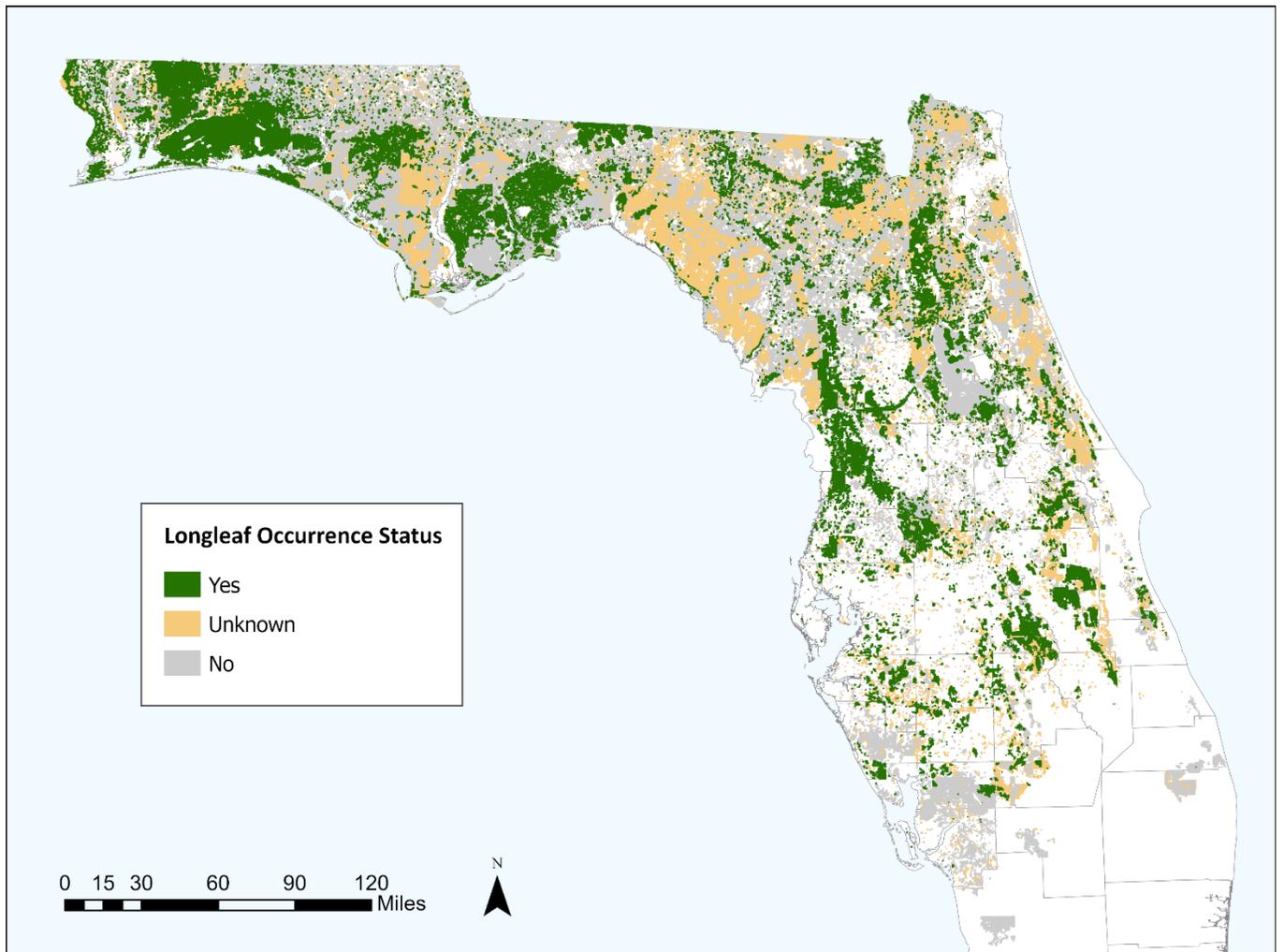
Figure 1. Occurrence status of longleaf pine sites in the LPEGDB v.5. Yes indicates longleaf pine presence is confirmed; Unknown indicates there is potential evidence forlongleaf pine presencebut without confirmation; No indicates evidence that longleaf is likely absent.

New LPEGDB Components

Old-growth sites

Based on the stand age criteria used for this project, we identified 30 old-growth stands >150 years of age within 5 Florida managed areas, all on federal USFS or DOD lands except one site on state lands. Year of origin, which allowed calculation of stand age, was available for 17,717 sites, or 39% of all longleaf sites in the LPEGDB. We added an additional 10 locations for old-growth sites documented in published reports and identified via communication with researchers (Davis 2003, Varner and Kush 2004, Huffman and Platt 2014, Zampieri and Pau 2022, Zampieri 2024, pers. comm., Cox 2024, pers. comm.).

Table 3. Acres of confirmed longleaf pine ecosystems by manager type.

Manager Type	Agency Acres	Agency Group Acres
Federal Conservation Lands		**689,442**
US Dept. of Defense	367,687	
US Fish and Wildlife Service	20,798	
US Forest Service	300,085	
Federal Conservation Lands- Other	872	
State Conservation Lands		**688,651**
FL DEP, Florida Coastal Office	1,157	
FL Fish and Wildlife Conservation Commission	74,880	
Florida Forest Service	381,698	
Florida Park Service	57,557	
Northwest Florida Water Management District	28,504	
South Florida Water Management District	1,451	
Southwest Florida Water Management District	58,484	
St. Johns River Water Management District	22,422	
Suwannee River Water Management District	21,666	
Florida Dept. of Military Affairs	29,798	
State Conservation Lands- Other	11,034	
Local Conservation Lands		**43,452**
Private Conservation Lands		**18,492**
Conservation Easements & Mitigation Banks		**88,767**
Other Private Lands		**875,600**
Total		**2,404,404**
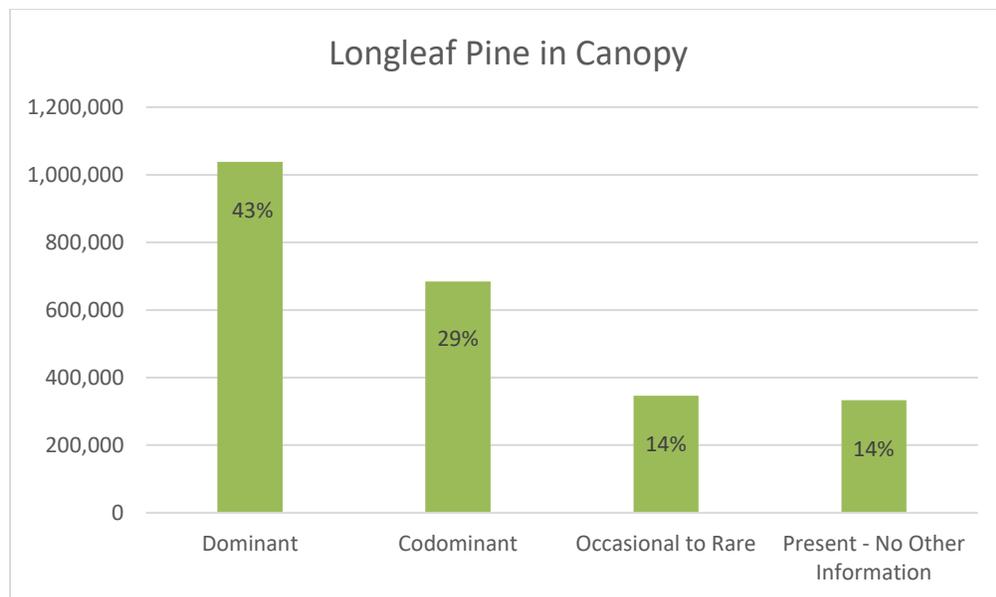
Figure 2. Acreage (vertical axis) of longleaf assessed by dominance in the canopy in LPEGDB v.5

Restoration Demonstration Sites

We compiled information for 26 restoration projects on a variety of local, state and federally managed lands (Fig. 3). Eleven sites were contributed by Florida Forest Service. Longleaf planting was the primary restoration activity, but many projects featured activities such as groundcover restoration, hardwood removal, invasive species control and prescribed fire.

Reference Sites

We include 70 reference sites in the LPEGDB – 50 with longleaf pine present and 20 without longleaf, but within mesic or wet flatwoods communities (Fig. 3). These sites were compiled from 2 FNAI projects with different data collection methods: an FWC-funded natural community reference site project (33 sites, all longleaf), and a FDEP/EPA-funded wetland reference site project, with 17 and 20 sites with and without longleaf, respectively. A site was typically a small area (average 23 acres) delineated within a larger natural community of the same type. These sites are a subset of those described in online story maps for these 2 projects: https://geodata.fnai.org/
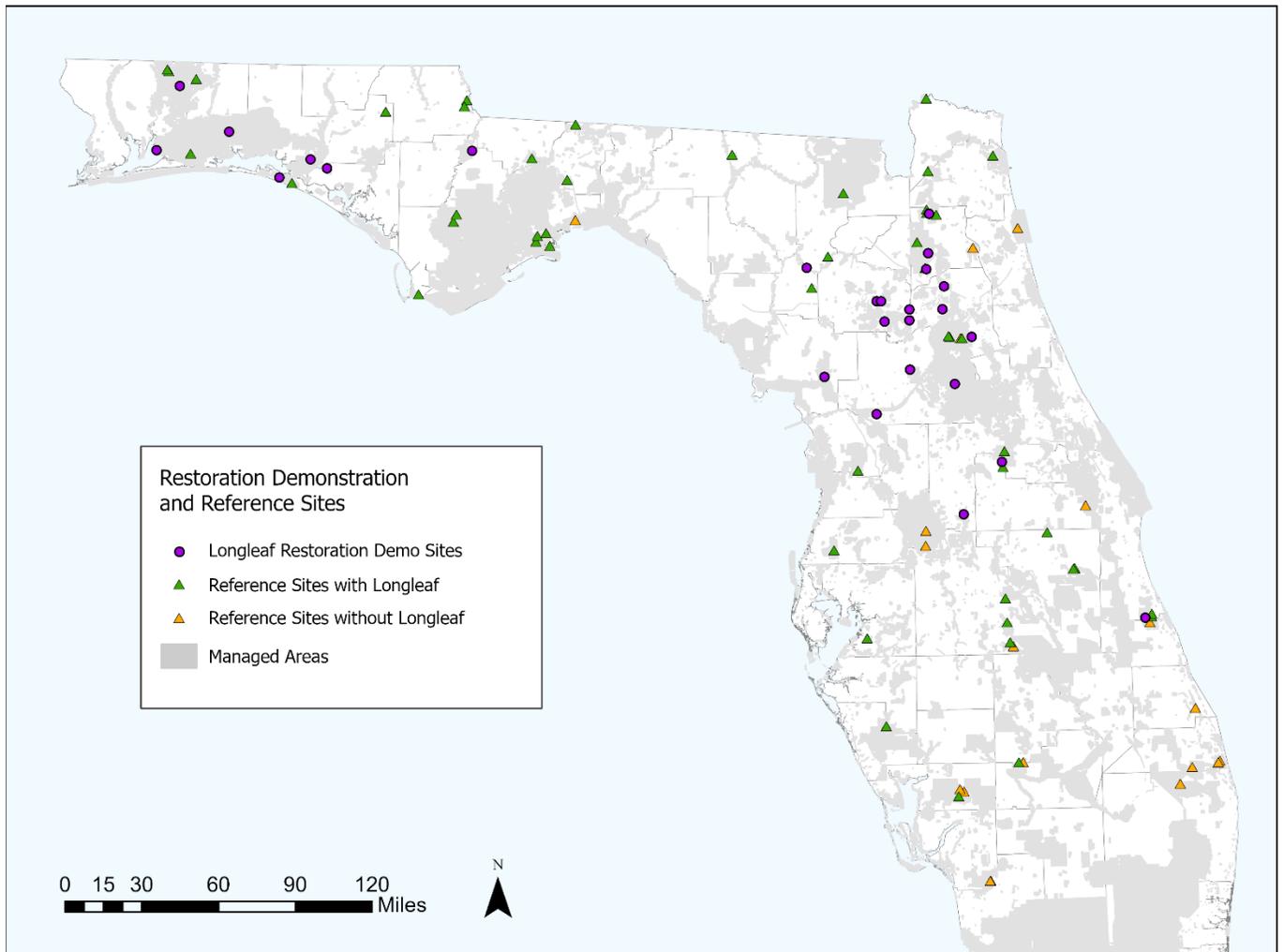

Figure 3. Locations of ecological reference sites and proposed restoration demonstration sites and in the LPEGDB v.5

Groundcover Condition

Groundcover condition was assessed for 8,737 open pine sites − 19% of longleaf pine sites and 4% of all sites in the database. Of the assessed sites, 75% had 'complete' data, i.e., cover classes were recorded for all 4 metrics included in the assessment; the remaining 25% had at least one metric that was recorded as presence only, and therefore assigned a default score for that metric.

Most sites (53%) assessed for groundcover condition were informed by natural community assessment points collected as part of FNAI natural community mapping projects for multiple agencies. Another 26% of sites were informed by Objective-Based Vegetation Management (OBVM) plots that FNAI collected for the Florida Fish and Wildlife Conservation Commission (FWC).

OBVM uses a quadrat sampling method to assess cover classes in which surveyors record cover from a top-down vantage point. This approach results in cover values that are generally lower than those recorded from visual assessments used by FNAI natural community mapping and the LPEGDB rapid assessment protocol. In addition, the groundcover scoring method we used is on a scale consistent with mapping and rapid assessment protocols. We decided to exclude OBVM data from the summary of groundcover condition in an effort to present results that are based on consistent data collection methods.

Of the 6,375 remaining sites assessed, 31% were longleaf sites and 69% were other open pine sites. Groundcover was excellent or good for 41% of sites assessed, with 21% and 38% in the fair and low categories, respectively (Fig. 4). The pattern varied, however, by site type with relatively lower proportions in the excellent and good categories for longleaf vs. other open pine sites. Ninety-two percent of assessed sites were on state-managed lands.
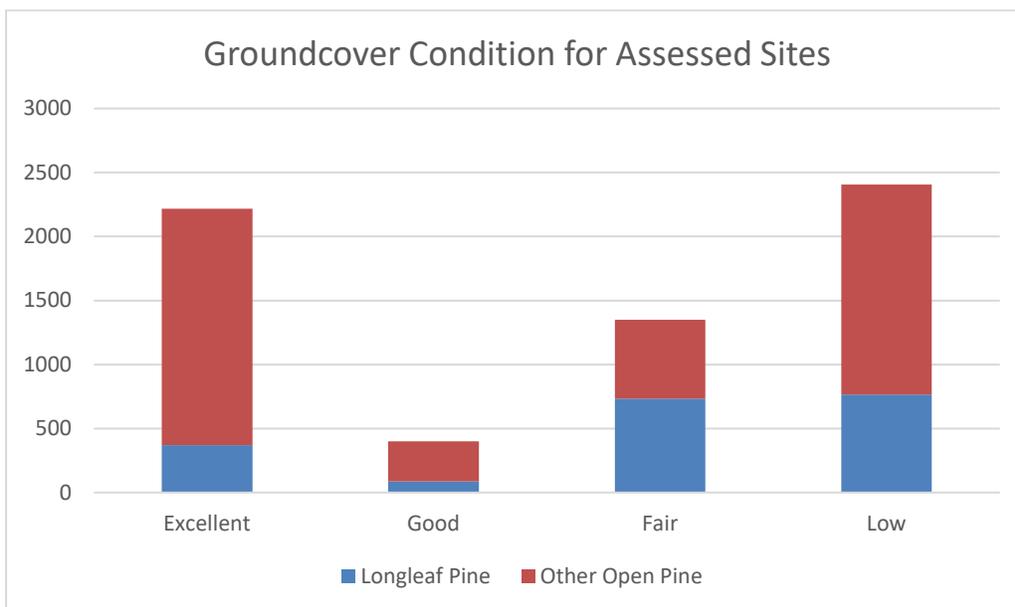
Figure 4. Groundcover condition classes for 6,375 sites assessed within the LPEGDB v.5.

DISCUSSION

The LPEGDB v.5 currently houses 2.4 million acres of longleaf pine, an increase of about 40,000 acres from version 4. This update does not necessarily reflect on-the-ground change, but rather provides a more accurate and complete snapshot of what we currently know about longleaf occurrence and condition in Florida. Updated datasets from partners included changes in stand spatial configuration, inventory methods, and other factors that can result in acreage differences. The amount of ecological condition data, especially on public lands, increased with the addition of recent FNAI natural community surveys and OBVM data, but data currentness still varies considerably across sites.

New Database Components

The new database components for old-growth, restoration demonstration sites, reference sites, and groundcover condition should be considered preliminary. Each has its own set of challenges, limitations, and potential next steps.

Old-growth
The set of 40 old-growth sites compiled for the LPEGDB v.5 should be considered preliminary. There are certainly many public and private lands in Florida that support old-growth longleaf pine, but spatial stand-level data do not currently exist. Even where stand-level year of origin data exist, the criteria, accuracy and meaning as it relates to old-growth may be unclear.

There is a need for scientific agreement on criteria and methods for identifying and mapping old-growth longleaf forests. While many definitions for old-growth longleaf forests exist, we found no consensus on a specific method for identifying them (Harms 1996, Gaines et al. 1997, Landers and Boyer 1999, Davis 2003, Varner and Kush 2004, Mitchell et al. 2009, Johnson et al. 2018, USDA 2023). For example, minimum tree/stand age thresholds varied from 80 to >200 years. Some studies identified old-growth as "primary" forests, i.e., areas that remain relatively undisturbed/unlogged since before European settlement (Davis 2003), while others identified old-growth longleaf forest in locations that may have been selectively logged or otherwise subjected to past human disturbances but have recovered sufficiently to meet selected criteria (Mitchell et al. 2009, Johnson et al. 2018, USDA 2023).

Descriptions of old-growth longleaf forests also include a complex suite of stand and ecosystem characteristics. The oldest trees have gnarled, "flat-top" canopy morphology, multiple longleaf age classes are present in the canopy and subcanopy, patchy cohort distributions at varying scales, and occasional canopy gaps (Platt et al. 1988; Varner et al. 2003, Pederson 2010); there are trees that have incurred fungal or other age-related damage, snags, stumps, and down woody debris (Landers and Boyer 1999, Mitchell et al. 2009, Johnson et al. 2018, Ulyshen et al. 2018). Site features include undisturbed soils and a species-rich groundcover of native grasses, forbs and shrubs adapted to frequent fires (Landers and Boyers 1999, Walker 1999). The presence of animals associated with old-growth longleaf such as red-cockaded woodpeckers may also be an indicator of old-growth characteristics at a site (Walters 1991, Walker 1999). The cultural and historical aspects of old-growth sites have also been suggested as important considerations; this year the Mature and Old-growth

initiative, with the U.S. Forest Service, is in the process of redefining the concept of old-growth using an approach that integrates western science with indigenous knowledge (Eisenberg et al. 2024).

Restoration Sites

Restoration demonstration sites provide a starting point for land managers and landowners to interact with practitioners to develop realistic expectations for restoration efforts and site potential. We were able to compile sites for a variety of restoration activities and in diverse regions of the state, but additional steps are needed to improve the utility of these data. A next version could include consulting project managers for more precise project boundaries, more detailed descriptions of restoration activities, and contact information. We also think a user-friendly online tool, such as a story map that highlights select projects and activities, would facilitate use of the information.

Reference Sites

The 2020 FAP recognized the need for longleaf pine reference sites in appropriate, accessible habitat on public conservation land, specifically where stands are permitted to attain old-growth characteristics and fire is applied at a regular, appropriate interval. We integrated existing ecological reference sites that were identified and assessed by FNAI ecologists for two statewide projects. The selection of these sites considered canopy, midstory, and ground conditions, with large longleaf pine being a primary criterion of the FWC project (33 sites). The groundcover condition index created for LPEGDB v.5 could be combined with other canopy and midstory metrics to identify additional reference sites for longleaf. For example, there are 84 sites on federal and state lands with older mature stands of longleaf pine and groundcover in excellent or good condition. Data for these sites is largely based on a combination of sources, e.g., forestry attributes from agency stand data plus midstory and ground assessment from an FNAI field survey. A caveat of the FWC reference sites is that data collection used the OBVM protocol which results in cover values that are lower than expected (see details in Groundcover Condition section).

Groundcover Condition

Native, diverse groundcover is a defining characteristic of healthy longleaf pine ecosystems. Given its importance in promoting fire and its difficulty to restore, inventory and maintenance of sites with intact groundcover is a priority (FFS 2020). Although we were able to initially rank ca. 8,700 open pine sites for groundcover condition, this is a fraction of all longleaf/open pine sites in the LPEGDB. The rapid assessment field survey data includes information on three of the four groundcover components for an additional 6,490 sites that could not be ranked. Moreover, we had to rely on presence-only data for a portion of the data which diminished the rank reliability of those sites. We also found that the data collection method used for OBVM plot data on FWC-managed lands resulted in values that were not comparable to other groundcover data in the database. In the near term we may explore applying a scaling factor to increase compatibility of OBVM, rapid assessment, and other sources.

A statewide systematic protocol for groundcover data collection is needed. There are many existing approaches, from intense botanical inventory to remote sensing of structural data. A successful protocol will allow for consistent, objective, and cost-effective data collection at a resolution and extent that are meaningful for management and restoration planning.

Limitations

To make best use of these data users should be aware of the following limitations:

1. The database contains information from many different sources. Methods used to assess ecological condition varied from the Rapid Assessment field surveys, to stand inventories, to detailed vegetation monitoring. It is also important to recognize that condition information derived from multiple sources spans a large time frame. The CURRENTNESS field provides a year or year range for observed occurrence and condition, as indicated by the data provider, or approximated from data fields. (Appendix B).
2. The Rapid Assessment field surveys conducted by FFS County Foresters in 2013 and 2017, largely represent a roadside view of stands and may not accurately capture conditions within all stands.
3. Omissions include lands that are known to support longleaf pine, but for which spatial stand-level data for longleaf occurrence do not exist. The LPEGDB is likely is also missing many sites with new longleaf plantings.
4. Polygons within the database vary in how they were delineated. In some cases, a polygon represents the extent of a natural community or land cover class which may contain a mosaic of habitat conditions. In other cases, polygons were derived from forest stands, which varied in interpretation among sources. Ideally, each polygon would represent a uniform set of conditions, but even this is subject to interpretation depending on the scale of analysis.
5. All longleaf pine sites in the database do not fit a standard definition of a longleaf pine ecosystem. We allowed this definition to be flexible to accommodate sites with restoration potential. For example, we included assessment of pine plantation which in some cases lacks the composition and structure adequate to be considered functioning LPEs. The same may be true of assessed sites that were dominated by hardwoods and without other apparent indicators of LPEs. The assessment data within the LPEGDB may be used to parse sites based on ecological condition.
6. In order to display condition data from multiple sources, we crosswalked detailed information into more general management classes proposed by ALRI. The thresholds applied here for Maintain, Improve, and Restore represent a reasonable estimate for Florida given the variability in both data and types of longleaf pine ecosystems. However, this crosswalk has not been widely vetted and should only be used to provide a general picture of condition.
7. Steps were taken to assure data quality, but error within the database was not quantified. The large number of records in the database precludes a detailed review of every polygon. Some error associated with assignment of point-based field data to polygons is expected. Errors also were found in some original source data and corrected where possible.

SUMMARY

The LPEGDB v.5 provides a snapshot of what we know about longleaf occurrence and condition. This version is now compatible with the SE LEO GDB and the acronym LPEGDB may be used interchangeably with FL LEO. The LPEGDB will continue to be available through FFS to users who sign a license

agreement. The old-growth and restoration components developed for this project will not be publicly available until further review by FFS and partners.

This report documents updates that were the primary objective of this project but does not describe many aspects of the original database development. For detailed methods and additional background users should refer to the LPEGDB v.4 report, available on the Florida Longleaf Pine Database webpages published by FNAI and FFS (https://www.fnai.org/species-communities/florida-longleaf; https://www.fdacs.gov/Forest-Wildfire/Our-Forests/The-Florida-Longleaf-Pine-Ecosystem-Geodatabase).

We encourage use of these data for mapping and summarizing longleaf pine information, with an understanding of the limitations described in this report. By integrating multiple sources into a single system for ecological condition data, the LPEGDB enables users to evaluate quality for different purposes and at multiple scales. The LPEGDB v.5 should serve as a tool help guide state, regional, and LIT priorities for longleaf conservation and restoration. Along with range-wide data in the SE LEO GDB, this update is expected to inform the next version of the Longleaf Sustainability Analysis (FNAI and UF-CLCP 2023), a conservation and restoration planning tool developed for America's Longleaf Restoration Initiative.

We welcome suggestions on ways to improve user experience, including additional reporting needs. Users are encouraged to submit new information, corrections, and other feedback to FNAI and FFS.

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Appendix A. LPEGDB v.5 Attribute Quality and Completeness

LPEGDB Attribute Quality and Completeness

Confidence Tiers

Confidence tiers are a measure of attribute representation accuracy for a site. Based upon the thoroughness with which the data were collected for each site, we classified the data record into one of six tiers, reflecting our presumed level of confidence with which the suite of attributes reflect site conditions: Forest Inventory; Stand Forest Type; Within-Stand Assessment; Roadside Assessment; Remote with Limited Ground truth; and Site Boundary Only. These tiers are estimates, intended to reflect general data quality for each site.

TIER 1-plot. Forest Inventory: timber cruise, vegetation assessment & monitoring, or other plot-type data collection where stand characteristics have been summarized by LEO from multiple points.

TIER 1-stand. Stand Forest Type: stands with forest type or tree species data but without other forestry stand statistics such as basal area (BA), trees per acre (TPA), etc. provided to LEO. This includes stands described by data providers as longleaf planting sites.

TIER 2. Within-Stand Assessment: a single ground truthed point that occurs within the stand and is representative of stand condition as determined by LEO field surveyor from within the stand; or an overall stand assessment by a knowledgeable observer; or longleaf presence in polygon is derived from ground truthed vegetation type. This applies to GPS Rapid Assessment data as well as sources such as a land manager evaluation.

TIER 3. Roadside Assessment: ground truthed observation made from the edge of a stand, as determine by LEO field surveyor from outside of the stand, looking in. Although confidence within this category can vary depending on visibility and uniformity of a stand, the LEO Rapid Assessment does not capture surveyor confidence in the ability to accurately assess a stand, but instead categorized all sites assessed from site exterior as Tier 3.

TIER 4. Remote with Limited Ground truth: Longleaf occurrence status and condition in a polygon is derived mostly from remote sensing (ie, aerial imagery interpretation) but with some ground truthing or general knowledge of longleaf occurrence. This includes data where the data provider confirmed longleaf presence or absence within a managed area boundary only, then LEO refined site boundaries using aerial imagery interpretation.

TIER 5. Site Boundary: Longleaf occurrence status is indicated within managed area boundary only; stand polygons within the managed area boundary are not available.

Data Level

Data Level characterizes the depth of attribute information, in addition to occurrence status of longleaf pine. The level conveys the need/opportunity for additional data.

Y-A. Longleaf presence is confirmed with ecological data for canopy plus midstory and/or ground layers.

Y-B. Longleaf pine presence is confirmed with some forestry data but not including midstory or ground layer ecological data.

Y-C. Longleaf pine presence is confirmed with dominance status, but no additional information.

Y-D. Longleaf pine presence is confirmed, but no additional information is available.

U-A. Longleaf pine presence is unknown but likely based on ancillary data source; for example, data indicate wiregrass presence but without tree species data; or presence is unknown but ecological data exists for midstory or ground layers.

U-B. Longleaf pine presence is unknown but potential based on remote interpretation or ground-truthed confirmation of an open pine natural community. This includes sites classified as longleaf ecosystems based on aerial imagery interpretation, any LEO or FNAI open pine natural community field polygons that remain unassessed, or other remotely sensed or modeled datasets that identify potential longleaf pine.

U-C. Longleaf pine presence is unknown but possible. This is a catch-all for any other sources where pine is identified (remotely or otherwise; eg mixed pines,) within the range of longleaf, but no species information is available. These would typically be a low priority for assessment.

N-A. Longleaf pine absence is indicated from source data, site is classified as open pine (including pine plantation), and ecological data exists for midstory or ground layers.

N-B. Longleaf pine absence is indicated from source data and site is classified as open pine (including pine plantation), but ecological data does not exist for midstory or ground layers.

N-C. Longleaf pine absence is assumed based on forest or ecosystem type with low or no potential for longleaf pine occurrence.

Appendix B. Geodatabase Data Dictionary for the LPEGDB v5.gdb

Geodatabase Data Dictionary for the LPEGDB_v5.gdb

GDB Feature Classes and Tables

LPE_Occurrence_Status_v5 - Feature Class
LPE_Mgmt_Categories_v5 - Feature Class
tbl_LPE_to_Mgmt_Category_Lookup - Table

LPE_Occurrence_Status_v5 - FeatureClass

Name	LPE_Occurrence_Status_v5
ShapeType	Polygon
FeatureType	Simple
AliasName	LPE_Occurrence_Status_v5
Description	The LPE_Occurrence_Status_v5 is a polygon feature class of confirmed longleaf pine ecosystems, potential longleaf sites where occurrence status remains unknown, and pinelands or other stands that are known not to be longleaf sites. These data were developed as part of the Florida Longleaf Pine Ecosystem Occurrences Geodatabase (LPEGDB), also known as FL LEO GDB. The purpose of the LPEGDB is to provide data on the distribution and condition of longleaf pine ecosystems in the Florida.

Field	DataType	Length	AliasName	Description
LEO_ID	String	20	LEO_ID	Unique identification number assigned to each polygon in the database.
LLP_Occ_Status	String	50	LLP Occurrence Status	Occurrence status of longleaf pine within the polygon: yes, no, or unknown
POLY_ACRES	Single	4	Poly_Acres	Acres calculated in GIS
STATE	String	5	State	Name of state containing majority of the polygon. Determined by spatial intersection of LEO polygon with state boundaries from National Atlas of the United States of America
COUNTY	String	50	County	Name of county containing majority of the polygon. Determined by spatial intersection of LEO polygon with county boundaries from National Atlas of the United States of America

Field	DataType	Length	AliasName	Description
OWNER_TYPE	String	30	Owner Type	LEO displays the OWNER_TYPE for the protected area that contains the majority of the polygon. Determined by spatial intersection with Protected Areas Database - CBI version 2.1 (2016) as amended by FNAI to add missing protected areas from other sources including PAD (USGS) v.2. Own_type definition from CBI: General land owner description (e.g. Federal Land, State Land, Local Land, Private Conservation Land) standardized for the nation.
LIT	String	60	LIT	Local Longleaf Implementation Team name for the LIT that contains the majority of the polygon
CONF_TIER	String	10	Confidence Tier	Confidence Tiers (Attribute Representation Accuracy) characterize how well attribute data apply to the stand as a whole, to facilitate usefulness of data in analyses. These tiers are estimates, intended to reflect general data quality. FNAI classified the data record into one of five tiers, based upon the thoroughness with which the data were collected for each site, and reflecting the presumed level of accuracy with which the suite of attributes reflect site conditions, See corresponding CONF_TIER_DESC field.
CONF_TIER_DESC	String	150	Confidence Tier Description	Description of Confidence Tiers assigned in the CONF_TIER field.
DATA_LEVEL	String	10	Data Level	Data Level characterizes the depth of attribute information, in addition to occurrence status of longleaf pine. The level conveys the need/opportunity for additional data. See DATA_LEVEL_DESC field.
DATA_LEVEL_DESC	String	150	Data Level Description	Description of the data level assigned in the DATA_LEVEL field.
SOURCETYPE	String	50	Source Type	Indicates whether attribute information was from one of three categories: • Existing Partner Data (i.e., state agency, federal agency, NGO, etc) • Existing Partner Data* - asterisk indicates that LLP occurrence status is from existing partner data, but other condition data is a combination of partner data and LEO Field Assessments. • LEO Field Assessment (i.e., rapid assessment data collected as part of the LEO or FL longleaf projects). • LEO Remote Sensing (polygons delineated as potential longleaf occurrence sites but not targeted for surveys)

Field	DataType	Length	AliasName	Description
CURRENTNESS	String	100	Source Currentness	Year or year range for observed occurrence and condition, as indicated by the data provider, or approximated from data fields. Approximated date(s) is indicated by 'ca.'
SURVEYDATE	Date	8	Survey Date	Date of the field assessment
SURVEYSTAT	String	30	Survey Status	Longleaf pine assessment status for the LEO Rapid Assessment. Indicates whether longleaf is present, absent, or the site is inaccessible (not evaluated), and whether or not longleaf assessment was done.
OTH_PINEPR	String	20	Other Pine Present	Indicates if non- longleaf pine are present and if they are of planted or natural origin.
OTH_PINESP	String	20	Other Pine Species	Indicates predominant species of other pine present.
FIRE_EVID	String	20	Fire Evidence	Describes whether or not there is evidence that fire has occurred at the site and the general fire frequency, as determined by visual evidence
SITECOM	String	50	Site Comment	Provides additional information about the site and the Survey Status chosen.
LLP_TYPE	String	10	Longleaf Stand Type	Indicates whether the longleaf are of planted or natural origin.
LLP_DOM	String	30	LLP Dominance	Indicates dominance of longleaf pine in the stand relative to other tree species.
FLAT_TOPS	String	15	Flat-top Tree Presence	Indicates the presence and abundance of flat- topped trees observed within the stand.
LRG_LLP	String	20	Large Longleaf Pine Basal Area	Indicates the presence and abundance of large trees observed within the stand.
LLP_ST_AGE	String	20	Longleaf Stand Age	Predominant longleaf age class for the stand.
LLCAN_AGCL	String	25	Longleaf Canopy Age	Indicates the number of age classes of mature LLP present in the canopy and sub- canopy. Excludes LLP_REGEN, and LLP_SAPL which are captured separately.
LLP_TOT_BA	String	20	Total Longleaf Basal Area	Estimated basal area of all longleaf pines > 5" dbh for the entire stand rounded to the nearest ten.
LLP_REGEN	String	15	Longleaf Regeneration	Estimated cover of longleaf pine regeneration from grass stage to 2" dbh.
LLP_SAPL	String	20	Longleaf Saplings	Estimated cover of longleaf pine saplings from > 2" to < 5" dbh in the stand.
OTHPINE_BA	String	20	Other Pine Basal Area	Estimated basal area in square feet per acre of other pines (not LLP) with dbh > 5" for the entire stand rounded to the nearest ten. This field also includes Other Pine cover classes that were collected instead of BA for the Florida Longleaf Pine database.

Field	DataType	Length	AliasName	Description
				All values were assigned to BA categories of <=20, 30-50, or >=60, but not assigned as Maintain/Improve/Restore.
HW_CAN_BA	String	20	Canopy Hardwood Basal Area	Estimated basal area in square feet per acre of canopy hardwoods with dbh > 5" for the entire stand rounded to the nearest ten. This field also includes canopy hardwood cover classes that were collected instead of BA for the Florida Longleaf Pine database. All values were assigned to Maintain or Improve in the HW_CAN_BA_mc field.
MIDST_COV	String	50	Midstory Cover	Percentage of the ground within the stand covered by all woody plants other than LLP that are greater than 10 feet tall and that were not counted in the canopy (< 5" dbh). Spaces between leaves and stems count as cover.
FIREHW_COV	String	50	Midstory Fire Tolerant Hardwood Cover	Percentage of the ground within the stand covered by fire tolerant hardwoods such as turkey oak, sand post oak, bluejack oak, blackjack oak, black oak, post oak, southern red oak, black hickory and flowering dogwood within the midstory (stems greater than 10 feet tall that were not counted as canopy).
TSHRUB_COV	String	50	Tall Shrub Cover	Percentage of the ground within the stand covered by woody plants other than LLP that are 3– 10 feet tall.
SSHRUB_COV	String	50	Short Shrub Cover	Percentage of the ground within the stand covered by woody plants other than LLP that are <3 feet tall.
HERB_COV	String	50	Native Herbaceous Cover	Percent cover of all native non-woody, soft-tissued plants regardless of height, including non-woody vines, legumes, and graminoids (grasses, sedges, rushes); does not include non-native pasture grasses.
PYROGR_COV	String	50	Native Pyrogenic Graminoid Cover	Percent cover of native perennial graminoids that are maintained by periodic fire.
NONNAT_COV	String	50	Non-native Herbaceous Cover	Percent cover of non-native herbaceous species, often grasses, are indicators of fallow agriculture or planted pastures.
INVPL_COV	String	15	Invasive Plant Cover	Percent cover of invasive exotic plants (woody and herbaceous) within the stand. Refer to "A Field Guide for the Identification of Invasive Plants in Southern Forests" by James Miller 2010
SURV_RANK	String	10	Surveyor Rank	The field surveyor's impression of the ecological condition of the vegetation relative to an undisturbed, well- maintained natural system.

Field	DataType	Length	AliasName	Description
COND_RANK_SRC	String	50	Condition Rank from Source	Condition rank or score of longleaf stands provided by the data source (eg, longleaf condition class model from Francis Marion NF or ecological condition class model from other USFS)
SOIL_HYDRO	String	10	Soil Hydrology	Soil Hydrology describes how fast water drains through the soil and was assigned by the surveyor. See Hydro_Class field for classes assigned by land cover type.
COMMENTS	String	300	Comments	Comments provides additional, optional information about the site (polygon)
YEAR_OF_ORIGIN	String	20	YEAR_OF_ORIGIN	Year of origin for the stand. Crosswalked from various fields across original source datasests, eg EST_YEAR, DATE_PLTD, ESTABLISHE, ESTDATE
Land_Cover_Class	String	50	Land Cover Class	Land cover assigned to site based on the majority class in the Cooperative Land Cover SITE_NAME field.
Open Pine Status	String	20	Open Pine Status	Indicates whether site is an open pine type (Yes), a type that is ambiguous, e.g., pine plantation (Unk), or not an open pine type (No). Note that land cover class and open pine status may conflict if there are many land cover types within a site.
Hydrology_Class	String	20	Hydrology Class	Hydrology class assigned to open pine types as xeric, sub-mesic, mesic, or hydric.
LLP_RefSite	String	25	Reference Site	Indicates if polygon is an FNAI ecological reference site.

LPE_Mgmt_Categories_v5 – Feature Class

Name LPE_Mgmt_Categories_v5
ShapeType Polygon
FeatureType Simple
Description The LPE_Mgmt_Categories_v5 is a polygon feature class of confirmed longleaf pine locations, with attributes for ecological condition. These data were developed as part of the Florida Longleaf Pine Ecosystem Occurrences Geodatabase (LPEGDB), also known as FL LEO GDB. The purpose of the LPEGDB to provide data on the distribution and condition of longleaf pine ecosystems in the Florida.

Field	DataType	Length	AliasName	Description
LEO_ID	String	20	LEO_ID	Unique identification number assigned to each polygon in the database.
LLP_Occ_Status	String	50	LLP Occurrence Status	Occurrence status of longleaf pine within the polygon: yes, no, or unknown. All sites are confirmed longleaf pine (i.e., assigned 'yes') in the LPE Mgmt Categories feature class.
POLY_ACRES	Single	4	Poly_Acres	Acres calculated in GIS
STATE	String	5	State	Name of state containing majority of the polygon. Determined by spatial intersection of LEO polygon with state boundaries from National Atlas of the United States of America
COUNTY	String	50	County	Name of county containing majority of the polygon. Determined by spatial intersection of LEO polygon with county boundaries from National Atlas of the United States of America
OWNER_TYPE	String	30	Owner Type	LEO displays the OWNER_TYPE for the protected area that contains the majority of the polygon. Determined by spatial intersection with Protected Areas Database - CBI version 2.1 (2016) as amended by FNAI to add missing protected areas from other sources including PAD (USGS) v.2. Own_type definition from CBI: General land owner description (e.g. Federal Land, State Land, Local Land, Private Conservation Land) standardized for the nation.
LIT	String	60	LIT	Local Longleaf Implementation Team name for the LIT that contains the majority of the polygon

Field	DataType	Length	AliasName	Description
CONF_TIER	String	10	Confidence Tier	Confidence Tiers (Attribute Representation Accuracy) characterize how well attribute data apply to the stand as a whole, to facilitate usefulness of data in analyses. These tiers are estimates, intended to reflect general data quality. FNAI classified the data record into one of five tiers, based upon the thoroughness with which the data were collected for each site, and reflecting the presumed level of accuracy with which the suite of attributes reflect site conditions, See corresonding CONF_TIER_DESC field.
CONF_TIER_DESC	String	150	Confidence Tier Description	Description of Confidence Tiers assigned in the CONF_TIER field.
DATA_LEVEL	String	10	Data Level	Data Level characterizes the depth of attribute information, in addition to occurrence status of longleaf pine. The level conveys the need/opportunity for additional data. See DATA_LEVEL_DESC field.
DATA_LEVEL_DESC	String	150	Data Level Description	Description of the data level assigned in the DATA_LEVEL field.
SOURCETYPE	String	50	Source Type	Indicates whether attribute information was from one of three categories: • Existing Partner Data (i.e., state agency, federal agency, NGO, etc) • Existing Partner Data* - asterisk indicates that LLP occurrence status is from existing partner data, but other condition data is a combination of partner data and LEO Field Assessments. • LEO Field Assessment (i.e., rapid assessment data collected as part of the LEO or FL longleaf projects). • LEO Remote Sensing (polygons delineated as potential longleaf occurrence sites but not targeted for surveys)
CURRENTNESS	String	100	Source Currentness	Year or year range for observed occurrence and condition, as indicated by the data provider, or approximated from data fields. Approximated date(s) is indicated by 'ca.'
SURVEYDATE	Date	8	Survey Date	Date of the field assessment
SURVEYSTAT	String	30	Survey Status	Longleaf pine assessment status for the LEO Rapid Assessment. Indicates whether longleaf is present, absent, or the site is inaccessible (not evaluated), and whether or not longleaf assessment was done.

Field	DataType	Length	AliasName	Description
OTH_PINEPR	String	20	Other Pine Present	Indicates if non- longleaf pine are present and if they are of planted or natural origin.
OTH_PINESP	String	20	Other Pine Species	Indicates predominant species of other pine present.
FIRE_EVID	String	20	Fire Evidence	Describes whether or not there is evidence that fire has occurred at the site and the general fire frequency, as determined by visual evidence
SITECOM	String	50	Site Comment	Provides additional information about the site and the Survey Status chosen.
LLP_TYPE	String	10	Longleaf Stand Type	Indicates whether the longleaf are of planted or natural origin.
LLP_DOM	String	30	LLP Dominance	Indicates dominance of longleaf pine in the stand relative to other tree species.
FLAT_TOPS	String	15	Flat-top Tree Presence	Indicates the presence and abundance of flat- topped trees observed within the stand.
LRG_LLP	String	20	Large Longleaf Pine Presence	Indicates the presence and abundance of large trees observed within the stand.
LLP_ST_AGE	String	20	Longleaf Stand Age	Predominant longleaf age class for the stand.
LLCAN_AGCL	String	25	Longleaf Canopy Age Classes	Indicates the number of age classes of mature LLP present in the canopy and sub- canopy. Excludes LLP_REGEN, and LLP_SAPL which are captured separately.
LLP_TOT_BA	String	20	Total Longleaf Basal Area	Estimated basal area of all longleaf pines > 5" dbh for the entire stand rounded to the nearest ten.
LLP_REGEN	String	15	Longleaf Regeneration	Estimated cover of longleaf pine regeneration from grass stage to 2" dbh.
LLP_SAPL	String	20	Longleaf Saplings	Estimated cover of longleaf pine saplings from > 2" to < 5" dbh in the stand.
OTHPINE_BA	String	20	Other Pine Basal Area	Estimated basal area in square feet per acre of other pines (not LLP) with dbh > 5" for the entire stand rounded to the nearest ten. This field also includes Other Pine cover classes that were collected instead of BA for the Florida Longleaf Pine database. All values were assigned to BA categories of <=20, 30-50, or >=60, but not assigned as Maintain/Improve/Restore.
HW_CAN_BA	String	20	Canopy Hardwood Basal Area	Estimated basal area in square feet per acre of canopy hardwoods with dbh > 5" for the entire stand rounded to the nearest ten. This field also includes canopy hardwood cover classes that were collected instead of BA for the Florida Longleaf Pine database. All values were assigned to Maintain or Improve in the HW_CAN_BA_mc field.

Field	DataType	Length	AliasName	Description
MIDST_COV	String	50	Midstory Cover	Percentage of the ground within the stand covered by all woody plants other than LLP that are greater than 10 feet tall and that were not counted in the canopy (< 5" dbh). Spaces between leaves and stems count as cover.
FIREHW_COV	String	50	Midstory Fire Tolerant Hardwood Cover	Percentage of the ground within the stand covered by fire tolerant hardwoods such as turkey oak, sand post oak, bluejack oak, blackjack oak, black oak, post oak, southern red oak, black hickory and flowering dogwood within the midstory (stems greater than 10 feet tall that were not counted as canopy).
TSHRUB_COV	String	50	Tall Shrub Cover	Percentage of the ground within the stand covered by woody plants other than LLP that are 3 – 10 feet tall.
SSHRUB_COV	String	50	Short Shrub Cover	Percentage of the ground within the stand covered by woody plants other than LLP that are <3 feet tall.
HERB_COV	String	50	Native Herbaceous Cover	Percent cover of all native non-woody, soft-tissued plants regardless of height, including non-woody vines, legumes, and graminoids (grasses, sedges, rushes); does not include non-native pasture grasses.
PYROGR_COV	String	50	Native Pyrogenic Graminoid Cover	Percent cover of native perennial graminoids that are maintained by periodic fire.
NONNAT_COV	String	50	Non-native Herbaceous Cover	Percent cover of non-native herbaceous species, often grasses, are indicators of fallow agriculture or planted pastures.
INVPL_COV	String	15	Invasive Plant Cover	Percent cover of invasive exotic plants (woody and herbaceous) within the stand. Refer to "A Field Guide for the Identification of Invasive Plants in Southern Forests" by James Miller 2010
SURV_RANK	String	10	Surveyor Rank	The field surveyor's impression of the ecological condition of the vegetation relative to an undisturbed, well- maintained natural system.
COND_RANK_SRC	String	50	Condition Rank from Source	Condition rank or score of longleaf stands provided by the data source (eg, longleaf condition class model from Francis Marion NF or ecological condition class model from other USFS)
SOIL_HYDRO	String	10	Soil Hydrology	Soil Hydrology describes how fast water drains through the soil. See Hydro_Class field for classes assigned by land cover type.
COMMENTS	String	300	Comments	Comments provides additional, optional information about the site (polygon)

Field	DataType	Length	AliasName	Description
YEAR_OF_ORIGIN	String	20	YEAR_OF_ORIGIN	Year of origin for the stand. Crosswalked from various fields across original source datasests, eg EST_YEAR, DATE_PLTD, ESTABLISHE, ESTDATE
Land_Cover_Class	String	50	Land Cover Class	Land cover assigned to site based on the majority class in the Cooperative Land Cover SITE_NAME field.
Open Pine Status	String	20	Open Pine Status	Indicates whether site is an open pine type (Yes), a type that is ambiguous, e.g., pine plantation (Unk), or not an open pine type (No). Note that land cover class and open pine status may conflict if there are many land cover types within a site.
Hydrology_Class	String	20	Hydrology Class	Hydrology class assigned to open pine types as xeric, sub-mesic, mesic, or hydric.
LLP_RefSite	String	25	Reference Site	Indicates if polygon is an FNAI ecological reference site.
FLAT_TOPS_mc	String	25	FLAT_TOPS_mc	
LRG_LLP_mc	String	25	LRG_LLP_mc	
LLP_ST_AGE_mc	String	40	LLP_ST_AGE_mc	
LLCAN_AGCL_mc	String	40	LLCAN_AGCL_mc	
LLP_TOT_BA_mc	String	25	LLP_TOT_BA_mc	
LLP_REGEN_mc	String	25	LLP_REGEN_mc	
LLP_SAPL_mc	String	25	LLP_SAPL_mc	
OTHPINE_BA_mc	String	25	OTHPINE_BA_mc	Fields with the '_mc' suffix indicate that values from origin fields (ie, fields with the same name but without the _mc suffix, as defined above) have been crosswalked into management classes for Maintain, Improve or Restore. Refer to Appendix C of the LPEGDB v.5 Report for the crosswalk scheme.
HW_CAN_BA_mc	String	25	HW_CAN_BA_mc	
MIDST_COV_mc	String	10	MIDST_COV_mc	
FIREHW_COV_mc	String	10	FIREHW_COV_mc	
TSHRUB_COV_mc	String	10	TSHRUB_COV_mc	
SSHRUB_COV_mc	String	10	SSHRUB_COV_mc	
HERB_COV_mc	String	10	HERB_COV_mc	
PYROGR_COV_mc	String	10	PYROGR_COV_mc	
NONNAT_COV_mc	String	25	NONNAT_COV_mc	
INVPL_COV_mc	String	10	INVPL_COV_mc	
SURV_RANK_mc	String	25	SURV_RANK_mc	

Appendix C. Crosswalk of LEO and LPEGDB Attributes to ALRI Management Categories

Crosswalk of LEO Attributes to ALRI Management Categories for Maintain, Improve, Restore (MIR)

This crosswalk is intended as a tool for displaying and summarizing ecological data from multiple sources, in a format consistent with definitions from the America's Longleaf Restoration Initiative. The crosswalk allows detailed metric values (cover classes, etc) associated with longleaf sites, to be 'rolled up' into categories of Maintain, Improve, Restore for viewing on a map and summarizing in reports. The LEO draft was modified from the crosswalk used in the Florida Longleaf Pine Database. In the current version FNAI uses thresholds for maintenance condition from the LPC Longleaf Pine Maintenance Condition Class Definitions to the extent feasible. In addition we consulted the latest NatureServe Southern Open Pine metrics (v2.0).

Attribute	Maintain	Improve	Restore[c]	Source[a]
Longleaf Pine Dominance	-	-	-	LEO
Flat-tops	Yes	None		LPC, SOP- excellent
Large Longleaf	Yes	None		LPC
Longleaf Stand Age	Older Mature	Younger Mature or Pre-reproductive		LPC
Longleaf Canopy Age Classes	Multiple (2+) age classes	One age class or LLP absent from canopy		LPC
Longleaf Pine Regeneration (<2 inch dbh)	≥5%	<5%, or not evident		LPC, SOP
Longleaf Pine Sapling (Late Regeneration)	≥5%	<5%, or not evident		LEO (following LPC Regen)
Longleaf Pine Basal Area	20 - 90; 30 - 90[fl]	<20 or >90; <30 or >90[fl]		SOP- excellent, good
Hardwood Canopy Basal Area	≤20; <=35% cover[fl]	>20; >35% cover[fl]		SOP- excellent, good
Midstory Cover	≤20%	>20%		LPC
Fire Tolerant Hardwoods Cover	≤25%	>25%	>45%	FNAI-FL
Tall Shrub Cover	<15%	≥15%		SOP
Short Shrub Cover	≤30%	>30%		LPC
Herbaceous Cover	>35%	≤35%		LPC
Pyrogenic Grass Cover	>15%	≤15		SOP
Non-native Grass Cover	<1%	1 – 15%	>15%	FNAI-FL
Invasive Plant Cover	≤1%	>1%		LPC
Condition Rank	Excellent-Good	Fair	Low	LEO
Other Pine Basal Area[d]	-	-	-	LEO

[a]Crosswalk criteria source: LPC = Longleaf Partnership Council 2014 - General Longleaf Pine Maintenance Condition Class Metrics; SOP = Southern Open Pine, from Field Guide of Southern Open Pine Rapid Assessment Metrics (v2.0; NatureServe, 2018).

[b]LEO cover classes are based on 10% range intervals, e.g. 16-25%, 26-35%. This means that maintenance class threshold values of 20 and 25, (e.g., midstory cover and fire tolerant hardwood cover, respectively) are equivalent because both fall within the actual range value of 16-25% in the LEO system.

[c]The current crosswalk differs from the Florida version in that 'Restore' thresholds are not identified for most attributes; instead we interpret 'Restore' following ALRI as 'adding longleaf acreage from other land uses and forest types'. Non-Longleaf sites in need of conversion are not within the LEO project scope and not included in the database. A few values are included for Restore where these are derived from the FL database; additional review is expected.

[d]LPC metric is % cover of off-site pine, LEO does not address; metric is informational and will not convert to MIR. Instead this metric is displayed in informational categories of <20, 30-50, >60 BA; or for Florida data as <15% cover, 16-45% cover, >45% cover.

[fl]Indicates data crosswalk for Florida LPEGDB RA data where the metrics differed from the LEO protocol. Note that the FL Longleaf Pine Basal Area values differed from LEO only in the initial 2013 data collection and were consistent with LEO values subsequent to 2013.

Appendix D. Florida LPEGDB v.5 Groundcover Condition Scoring System

Florida Longleaf Pine Ecosystem Geodatabase (LPEGDB) Groundcover Scoring System

We developed and populated a groundcover condition attribute for the Florida LPEGDB, to identify high quality groundcover sites for both longleaf pine and open pine grassland sites currently without longleaf pine. We derived the criteria and ranking scheme for groundcover condition from a habitat quality index for assessing longleaf pine habitat condition that was developed by The Nature Conservancy (TNC) in North Carolina in cooperation with FNAI and The Longleaf Alliance (Hannon and Marcus 2022). The TNC system was developed for use with the Southeast Longleaf Pine Ecosystem Occurrences Geodatabase (SE LEO GDB) includes 5 metrics for understory: short shrub cover, native herbaceous cover, pyrogenic graminoid cover, invasive plant cover, and longleaf pine regeneration cover. For the LPEGDB groundcover condition we used the TNC understory scoring method, but modified it to exclude longleaf pine regeneration. The LPEGDB scoring method for groundcover is described below. All scoring was calculated in R.

Table D-1. Short shrub cover scoring matrix.

Short Shrub Cover: Scoring by Soil Hydrology					
	Soil Hydrology				
	Xeric	Sub-mesic	Mesic	Hydric	Weight factor
Cover (%)	Score	Score	Score	Score	0.75
0 - 5%	0.75	0.8	0.8	0.8	
6 - 15%	1	1	1	1	
16 -25%	1	1	1	1	
26 - 35%	0.625	0.75	0.8	0.8	
36-45%	0.375	0.625	0.75	0.75	
46 - 55%	0.2	0.5	0.625	0.625	
56 - 65%	0.1	0.25	0.5	0.5	
66 - 75%	0	0.1	0.25	0.25	
76 - 85%	0	0	0.1	0.1	
86 - 95%	0	0	0	0	
96 - 100%	0	0	0	0	

Table D-2. Native herbaceous cover scoring matrix.

	Herbaceous Cover: Scoring by Soil Hydrology				
	Soil Hydrology				
	Xeric	Sub-mesic	Mesic	Hydric	Weight factor
Cover (%)	Score	Score	Score	Score	1.75
0 - 5%	0	0	0	0	
6 - 15%	0.1	0.1	0.1	0.1	
16 -25%	0.35	0.3	0.275	0.275	
26 - 35%	0.75	0.75	0.6	0.5	
36-45%	1	1	1	1	
46 - 55%	1	1	1	1	
56 - 65%	1	1	1	1	
66 - 75%	1	1	1	1	
76 - 85%	1	1	1	1	
86 - 95%	1	1	1	1	
96 - 100%	0.8	0.8	0.8	0.8	

Table D-3. Pyrogenic graminoid cover scoring matrix.

	Pyrogenic Graminoid Cover: Scoring by Soil Hydrology				
	Soil Hydrology				
	Xeric	Sub-mesic	Mesic	Hydric	Weight factor
Cover (%)	Score	Score	Score	Score	3
0 - 5%	0	0	0	0	
6 - 15%	0.25	0.25	0.25	0.25	
16 -25%	0.6	0.5	0.5	0.5	
26 - 35%	1	1	1	1	
36-45%	1	1	1	1	
46 - 55%	1	1	1	1	
56 - 65%	1	1	1	1	
66 - 75%	1	1	1	1	
76 - 85%	1	1	1	1	
86 - 95%	0.8	0.9	0.9	0.9	
96 - 100%	0.7	0.7	0.7	0.7	

Table D-4. Invasive plant cover scoring matrix.

Invasive Plant Cover: Scoring		
	LEO - all soil types	Weight factor
Age Classes	Score	1
No evidence	0	
<1%	-0.25	
1 - 3%	-0.6	
4 - 10%	-0.8	
>10%	-1	

Table D-5. Maximum score for each groundcover metric.

Cover Class	Maximum Points	Weights	Max Score
Short Shrub Cover	1.00	0.75	0.75
Total Herbaceous Cover	1.00	1.75	1.75
Pyrogenic Graminoid Cover	1.00	3.00	3.00
Invasive Plant Cover	-1.00	1.00	0.00
Total			5.50

Table D-6. Condition class rankings for groundcover.

Condition	Score Range (sum[points * weight])	Score ([Score/Total Possible]*100)*
Excellent	5.2 – 5.5	80 - 100%
Good	3.9 – 5.2	60 - 80 %
Fair	1.95 – 3.9	30 - 60%
Low	0.0 – 1.95	0 - 30%