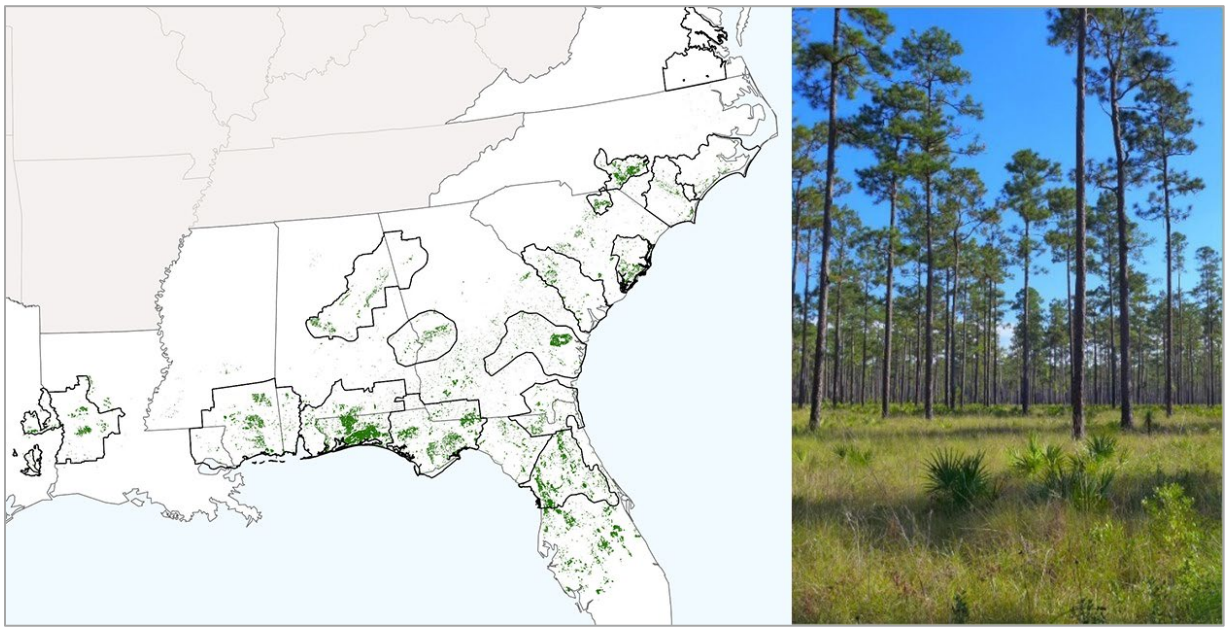
Southeast Longleaf Pine Ecosystem Occurrences Geodatabase

Phase 2 Final Report to the U.S. Endowment for Forestry and Communities, September 2023



Florida Natural Areas Inventory
Florida State University

With funding from USDA-NRCS through
the U. S. Endowment for Forestry and Communities

Florida Natural Areas Inventory

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Longleaf Ecosystem Occurrences

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EXECUTIVE SUMMARY

The Southeast Longleaf Ecosystem Occurrences Geodatabase (LEO GDB) is a project to develop a comprehensive GIS database of documented longleaf pine locations and ecological conditions across the range. The purpose for the database is to inform conservation and restoration planning, track longleaf acres and condition through time, and enable partners to view and analyze a map of longleaf pine occurrence and condition at multiple scales. With funding from USDA-NRCS through the U. S. Endowment for Forestry and Communities, Florida Natural Areas Inventory (FNAI) began work in April 2018 and The Longleaf Alliance (TLA) in June 2019. This report describes work completed for the LEO GDB v2.0 and represents the completion of LEO Phase 2 which focused on collecting new Rapid Assessment field data in strategic locations outside of the Local Implementation Team (LIT) areas and excluding Florida. This version also incorporates data from the Florida Longleaf Pine Ecosystem Geodatabase (LPEGDB) and several additional partner datasets.

The design and approach for building the LEO GDB is modeled after the Florida LPEGDB, and involves compiling existing longleaf datasets, conducting new field assessments to fill data gaps, then integrating all data into a single map, via a crosswalk system for placing attribute values into broad condition categories. FNAI worked with the America's Longleaf Restoration Initiative's (ALRI) Longleaf Partnership Council Mapping Committee to determine the geodatabase design, which included refining a set of condition attributes for canopy, midstory and ground layers that are consistent with Longleaf Pine Maintenance Condition Class Definitions (ALRI 2014).

FNAI gathered and integrated existing longleaf datasets from many sources across the range. We then identified data gaps for field surveys: Survey sites were developed within each of 14 LITs (Phase 1) as well as in strategic areas outside LITs (Phase 2) as a set of GIS polygons with high probability of containing longleaf pine. Sites were surveyed via Rapid Assessments conducted by surveyors under leadership of TLA using tools developed by FNAI, including Rapid Assessment training materials, a field protocol, and the LEO Collector app. The protocol was designed to assess vegetation structure and condition from a roadside view of stands. Field surveys began in spring 2019, with Phase I completed in October 2021 and Phase 2 completed in August 2023.

To integrate data from multiple sources FNAI developed a crosswalk system for displaying and summarizing condition data in broad categories, based on ALRI management category definitions for maintain, improve, and restore (ALRI 2009). Using this system, the Rapid Assessment results, along with existing data provided by many partners, were integrated into the LEO GDB.

The LEO GDB v2.0 contains 4.93 million acres of longleaf pine, with 75% identified as longleaf dominant or codominant. Most acres are from existing datasets, primarily federal and state lands. More than 1.58 million acres are from the Rapid Assessment field surveys on private lands, including sites from the Florida LPEGDB. The ability to map and report these acres should help ALRI partners in planning and measuring progress toward longleaf conservation and restoration goals.

The LEO database is envisioned as a central source for mapped longleaf on public and private lands that will enable partners to prioritize and monitor progress toward conservation and restoration goals. The success of this project depends on the ongoing and continued collaboration among many partners who contribute data and knowledge; review the database, tools, and policies for LEO; and who help ground truth the map.

ACKNOWLEDGMENTS

The LEO GDB project was funded by USDA-NRCS through the U.S. Endowment for Forestry and Communities, Inc. FNAI would like to thank the Longleaf Partnership Council (LPC), Bridgett Costanzo (USDA-NRCS), and Peter Stangel (U.S. Endowment for Forestry and Communities Inc.) for their vision and support of the LEO project. The LPC Mapping Committee provided input into project design. The LEO Executive Committee – Gary Burger (SC DNR), Ryan Bollinger (The Longleaf Alliance), Troy Ettel (formerly TNC), Colette DeGarady (TNC) and Alison McGee (formerly TNC) – provided review for major decisions and policies. Randy Browning (USFWS), Kevin McIntyre (Jones Ecological Center), and Mike Harris (USFWS) provided key input into database and field attribute design.

FNAI worked in close collaboration with TLA staff on many aspects of LEO. We thank Ryan Bollinger, Karen Zilliox Brown, Lucas Furman (formerly TLA), and Lisa Lord for their many contributions. The field survey contractors hired by TLA conducted professional, high quality field surveys across the Southeast.

The Nature Conservancy provided support of LEO at many levels, greatly enhancing the efficiency of our work. Colette DeGarady provided review and guidance; Cassidy Glassman, Analie Barnett, and the Resilience team generously shared knowledge, contacts and data. Within the LITs, LuAnn Creighton, Jeff Marcus, Ana Castillo, and Wendy Ledbetter championed LEO in its early stages.

We deeply appreciate the efforts of all LIT Coordinators and members who are facilitating and helping guide the work of LEO across the range. Members of the Desoto-Camp Shelby LIT played a key role in helping launch, test, and improve the Rapid Assessment Protocol, mobile app and training. We are especially grateful to Tamara Campbell (USFWS) for her enthusiastic support of LEO and for spearheading field surveys with her team. John Gruchy (MSDWFP), Melinda Lyman (TNC) and Tamara Campbell were instrumental in organizing and providing logistics for LEO training at Camp Shelby. Jeff Marcus and Dan Hannon embraced and ran with the LEO methodology, digitizing survey sites, training volunteers, conducting assessments, and developing a habitat quality index from LEO attributes. Charles Babb provided sage advice that informed the LEO privacy policy; Bret Beasley and Charles Babb provided acreage results from the SLPCP private land surveys.

We would like to express our deep gratitude to the many individuals, too numerous to name here, who generously took time to share knowledge and insights through phone calls, emails, and meetings. We greatly appreciate the efforts of those who shared data with the LEO project, especially the generosity of every state natural resource agency and natural heritage program we contacted, the US Forest Service and many U.S. Military Installations. Thank you. Partner participation is the foundation of the LEO GDB.

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INTRODUCTION

The Southeast Longleaf Pine Ecosystems Occurrences (LEO) database is a project to develop a GIS database of documented longleaf pine sites along with their ecological conditions across the range. Florida Natural Areas Inventory (FNAI) is building the LEO geodatabase (LEO GDB) with funding from USDA-NRCS via the U. S. Endowment for Forestry and Communities. We are working in close conjunction with the America's Longleaf Restoration Initiative (ALRI) including the Longleaf Partnership Council (LPC) mapping committee, The Longleaf Alliance, and other partners. This range-wide effort is modeled after the Florida Longleaf Pine Ecosystem Geodatabase (Florida LPEGDB) developed by the Florida Forest Service and FNAI from 2012-2018, which houses data for over 2 million acres of existing longleaf pine in Florida (https://www.fnai.org/species-communities/florida-longleaf).

The LEO project grew out of the need for comprehensive inventories and assessments to support ALRI's mission of conserving and improving existing longleaf stands and increasing the extent of longleaf pine forests across the range. The LEO GDB will serve as a central source for mapped longleaf on public and private lands and will enable partners to prioritize and monitor progress toward conservation and restoration goals.

Although mapping acres of existing longleaf is valuable, knowing the condition of those acres can further assist in tracking progress toward conservation goals. The ALRI Range-Wide Conservation Plan (2009, 2023) outlines three categories of management to use in classifying longleaf acres— maintain, improve, or restore.

Descriptions of management categories excerpted from the ALRI Plan:

- Maintain – "… forest conditions that reflect both the forest canopy and understory conditions that currently or will provide ecosystem functions, processes, and assemblages of representative species."

- Improve – "…longleaf trees present, but may be missing significant components of understory communities and fire regimes to support representative communities of the longleaf ecosystems."

- Restore – "Expanded efforts are needed to continue adding longleaf acreage from other land uses and forest types…"

The 2025-2040 ALRI Plan established a goal to increase longleaf acres from 5.2 to 8.0 million acres, with 3 million acres in the maintenance category. At a local scale, such condition classification of acres can assist land managers in planning and measuring progress toward ecological goals for stands and forests, and at larger scales assist agencies in planning and measuring progress toward regional conservation goals.

The LEO project employs the ALRI system of management categories to integrate longleaf data into a database with standard attributes to enable viewing and analysis of longleaf condition acres in a consistent manner at multiple scales.

The LEO Project objectives:

- Design and populate a spatial database to integrate existing and new longleaf pine occurrence and condition data from multiple sources, including new ground truthed data collected for the project.
- Solicit and integrate existing longleaf pine data from partners across the range.
- Identify data gaps and identify potential longleaf occurrence sites for field assessment within Local Implementation Team (LIT) areas (Phase 1) and between LITs (Phase 2).
- Develop a field data collection protocol, a mobile data collection app, and training guide for field staff.
- Develop a Web Map application for interactive query and display of data.

Lead Partner Roles

FNAI: FNAI's role in the LEO project is to provide the framework to house, collect, and maintain data for longleaf occurrence and condition via the objectives above. We rely on others to collect and provide the data that we integrate into the central LEO GDB.

Longleaf Alliance: The Longleaf Alliance is responsible for the LEO Rapid Assessment field survey effort, which involves scheduling, hiring, training, and managing contractors to conduct surveys within each LIT, as well as coordinating volunteers and other strategic planning for survey work. The Alliance also plays a key role in LEO project outreach, helping solicit data and educating partners about LEO. The Alliance is FNAI's primary liaison with the Local Implementation Teams and provides GIS support for developing field survey sites and assuring quality of field data.

Longleaf Partnership Council - Mapping Committee – LEO Executive Committee: The Executive Committee represents the Mapping Committee of the LPC and provides review and guidance on major decisions affecting outcomes of the project.

Local Implementation Teams: Interagency teams in 17 landscapes work collaboratively as part of the ALRI to develop and implement priorities for longleaf conservation and restoration. These teams provide critical support for the LEO field surveys. Throughout this report we use 'LITs' to refer to both the teams and the geographic areas where they work.

Florida Forest Service: The Florida Forest Service (FFS) partnered with FNAI for the original longleaf database project in Florida. The FFS encouraged inclusion of the Florida LPEGDB in the LEO GDB v.2.0. In 2013-2017, FFS county foresters conducted rapid assessments throughout the state for that project. A complete description of the Florida LPEGDB is available in a separate report (FNAI 2018).

The LEO database was developed through an extensive partnership of many agencies and organizations. Partners provide not only data, but also critical feedback to ensure the LEO GDB meets the needs of the longleaf conservation community. Other key partners, particularly data providers, are described in the Methods below.

LEO Schedule

LEO Phase 1

LEO Phase 1 was conducted from May 2018 – November 2021 and covers the eight states within the range of longleaf outside of Florida (listed from north to south): Virginia, North Carolina, South Carolina, Georgia, Alabama, Mississippi, Louisiana, and Texas. This phase focused on gathering partner data range wide and collecting new Rapid Assessment field data within 14 of 16 LIT areas outside of Florida.

A goal with the initial funding of LEO was to provide data that could be useful in gopher tortoise conservation planning; therefore, new field surveys were initially focused within 4 LITs within the range of gopher tortoise. These surveys were conducted June 2019 – November 2020 and results were included in LEO GDB v1.1. Surveys for the remaining 10 LITs were conducted August 2020 – October 2021 and included in LEO GDB v1.2, which represented the completion of LEO Phase 1.

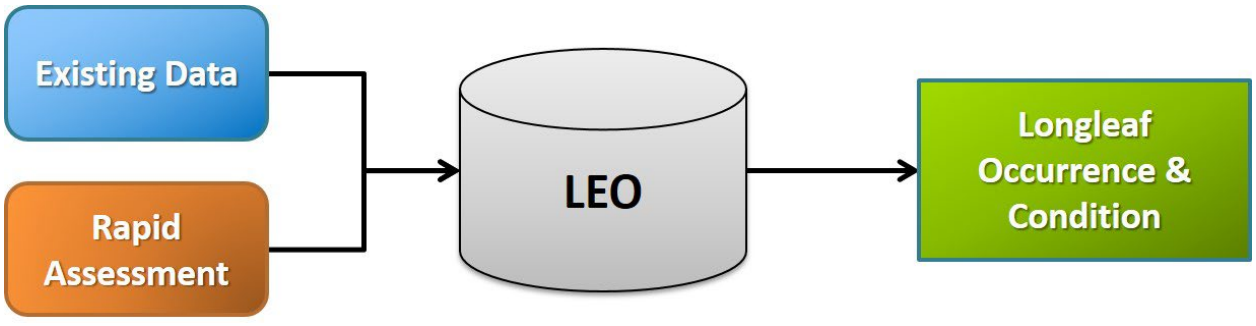
LEO Phase 2

Phase 2 of the project focused on collecting new field data in strategic locations outside of the original LIT focal areas, as well as continuing to fill remaining gaps in existing partner data. In addition, the Florida LPEGDB was integrated into the LEO GDB. This work occurred between August 2021 - September 2023 and is the focus of this report. Note that the methods for the Florida LPEGDB are described in a separate report (FNAI 2018).

METHODS

FNAI's work on the LEO project was divided into five major tasks, conducted from May 2018 through September 2023:

1. Design of the LEO geodatabase;
2. Compilation of existing longleaf pine occurrence data from partners across the range;
3. Development of potential longleaf occurrence sites for field assessment to help fill data gaps;
4. Development of a Rapid Assessment protocol, training, and mobile app to support field data collection;
5. Integration of existing and Rapid Assessment data into LEO GDB.



Geodatabase Design

The design of the LEO database is modeled on the Florida LPEGDB and envisioned to integrate existing partner datasets and new Rapid Assessment data into a single map via a crosswalk system for placing attribute values into broad condition categories. FNAI worked with the LPC Mapping Committee to adjust the Florida design to meet the needs of the LEO GDB project. This focused largely on review and revision of data attributes to align with the metrics of the Longleaf Pine Maintenance Condition Class Definitions (ALRI 2014) and NatureServe's Southern Open Pine Metrics v2.0 (Nordman and White 2018).

Technical aspects of the design involved selecting a standard coordinate system compatible with other southeast datasets, establishing rules for how overlapping source datasets are reconciled, and developing tools for data loading and quality control. We also considered partner needs for a shareable version of the database and designed the format, organization, and content to facilitate use by individuals with basic GIS knowledge.

Existing Longleaf Pine Occurrence Data

Existing partner spatial datasets are foundational to the LEO project and vital to building a range-wide understanding of where longleaf sites occur. FNAI, with assistance from The Longleaf Alliance (TLA), as well as LPC and LIT members, conducted outreach to collect longleaf data across the range, and many partner agencies and organizations throughout the Southeast contributed spatial data and expertise.

The stand-level datasets described in this section help establish a baseline of longleaf pine occurrence. Examples of stand-level data provided include forest stand inventories, ground truthed vegetation maps, and boundaries for conservation lands that are primarily longleaf pine habitats. In addition to longleaf presence, some datasets provided attributes related to vegetation structure and condition.

Stand-level data consist of polygons in shapefile or feature class format where each polygon typically represents a relatively uniform forest condition, and longleaf pine occurrence has been determined by some level of ground truthing. These data types include timber stands, natural communities, vegetation classes, and other ecological surveys that provide current documentation of the current extent and acreage of longleaf pine in the LEO GDB. Although Rapid Assessment field data collection for LEO Phase 2 was focused in strategic areas outside of LITs, the compilation of existing partner data occurred across the range of longleaf.

Data Processing

Sources differed in the amount and type of ecological condition data, requiring customized processing before loading into the GDB. Each dataset was reviewed, interpreted and processed into a standard GIS format; attributes that aligned with ALRI condition class metrics were transferred into the LEO GDB. To ensure accuracy, transparency, and repeatability, all processing steps were fully documented for each dataset.

Data Exclusions

Data identified as restricted by the data provider were excluded from the shareable LEO GDB. These data may be used in acreage summaries but will not be distributed or displayed on any maps, including the LEO web map. See the LEO Privacy Policy for information (Appendix A). Datasets were also excluded

if a submitted polygon represented an entire protected area (e.g., conservation land) boundary and longleaf is known to occur somewhere on the site, but more precise stand boundaries are not yet available. These areas remain opportunities for future spatial data refinement.

Omissions

The LEO project's collection of existing data depends on voluntary spatial data submission. Data outreach efforts to date focused on state and federal agencies and some non-governmental organizations. Data received to date is primarily for public and private conservation lands for which stand-level longleaf pine data existed and was readily contributed to the LEO project by the managing entities. Outreach to private and corporate timber landowners is still needed.

The LEO project is aware of many public and private conservation lands that are known to support longleaf pine, but for which spatial stand-level data for longleaf occurrence do not exist. Although some of these areas may be visited and mapped by the LEO RA teams, developing longleaf data within existing conservation lands is not the focus of the LEO project at this time. However, we encourage land managers to contact FNAI or the Longleaf Alliance to learn how they might collect LEO-compatible data on their properties.

The ALRI documented 1.7 million acres of new longleaf pine plantings from 2010-2022 (ALRI 2022) and it is likely that many of those acres are not reflected in the LEO GDB v2.0. Partner data submitted may include some of those plantings; the LEO Rapid Assessment field surveys focused primarily on extant natural longleaf. Many of those plantings are the result of state and federal cost share programs on private lands for which spatial data are not currently available to LEO.

Various authors have generated predictive vegetation maps within the range of longleaf pine using remote sensing, computer modeling, and other resources (e.g., Hogland et al. 2019; various LANDFIRE products). While these approaches are useful for identifying potential longleaf sites, data sources without some degree of ground-truthing or aerial photo review are not incorporated into the LEO geodatabase; LEO is designed to provide documentation, rather than prediction, of longleaf presence and condition.

Potential Longleaf Occurrence Sites for Field Assessment

The compilation of existing longleaf pine stand-level occurrences was the first step in identifying data gaps for field surveys. New field data collection focused on areas with high potential for natural longleaf pine occurrence but where longleaf occurrence and condition data were lacking. We delineated polygon datasets of potential longleaf occurrence sites for field assessment (aka field survey sites) based on review of digital aerial imagery along with GIS datasets that inform longleaf potential.

Longleaf Pine Species Distribution Model

For the Florida LPEGDB, we were able to use detailed land cover derived from aerial-photo interpretation as a starting point for developing polygons for field assessments. However, outside of Florida we found that limitations in the resolution and classification accuracy precluded our ability to use existing land cover datasets as a starting point for identifying potential longleaf occurrence. We therefore developed a species distribution model (SDM) for longleaf pine using MAXENT v3.4.1 software (Phillips et al. 2006) which creates a probability of longleaf occurrence based on the relationship of known longleaf pine occurrences and a suite of environmental variables.

Longleaf occurrence locations used to train the model were provided by Kyle Palmquist and Dr. Robert Peet from high accuracy longleaf plots on public lands in the Carolina Vegetation Survey (CVS) databases (Peet et al. 2012). We selected 17 environmental variables that were plausible to help predict the current extent of longleaf pine. Although the resulting model performed well, the pixelated raster output was impractical for developing discrete sites suitable for field surveys. Instead, the model was used to help guide the photo interpretation-based delineation of field survey sites in the focal LITs, as described below.

The model was revised in 2021 to include a subset of longleaf pine occurrences from the LEO GDB as training data, and a set of new or updated environmental variables. The selection of environmental variables was also refined based on biological relevance for longleaf and additional tests of collinearity. The revised model was run with Maxent in R statistical software to further fine-tune model settings for improved prediction accuracy. This revision helped guide site delineation in LEO Phase 2.

Delineation of Sites for Field Assessment

We digitized potential longleaf occurrence sites in ArcGIS based on aerial photo signatures from a combination of best available current and historical imagery, which varied among LITs. Older color infra-red imagery from 2006 and 1999 was especially useful for distinguishing wetlands and pine species signatures. In addition to imagery acquired and stored in-house, we also reviewed Google Earth imagery and street views as needed.

We used a suite of supplemental GIS data to help inform decisions about the potential for longleaf pine occurrence and polygon extent. These datasets varied among the LITs but typically included FNAI's longleaf pine SDM, the University of Georgia gopher tortoise habitat suitability model (Crawford et al. 2020), GAP/LANDFIRE National Terrestrial Ecosystems 2014, Southeast Fire Map v1.0 (starting in March 2021; Tall Timbers Research, Inc. 2021), LANDFIRE Elevation 2016 (for mountain longleaf areas), and to a lesser degree soil drainage class. We also reviewed Natural Heritage Program and other partner-provided occurrence data for species and communities associated with longleaf pine systems, although no species locations were directly used in the mapping. In the Chattahoochee Fall Line Conservation Partnership a dataset of Sandhill sites provided by Georgia Department of Natural Resources (GADNR) also helped guide polygon development (Elliott 2010). Point locations where state-issued burn permits indicated presence of longleaf pine were reviewed where available (Alabama, Georgia, and South Carolina). LIT members with local knowledge also assisted with polygon delineation, especially for the 3 LITs in North Carolina (Dan Hannon, Jeff Marcus, and Ana Castillo, TNC) and for Thomas County, GA in the ARSA LIT (Kim Sash, Tall Timbers Research, Inc.).

Each field survey site was intended to correspond to a relatively uniform stand signature on an aerial image. The decision to map a site was based on a combination of factors as described above, and not limited to whether longleaf pine was potentially a major component; sites could be included if longleaf was thought to be a minor component of the stand. Mapping field survey sites focused primarily on natural stands. Although large non-pine features were excluded, sites may contain small features such as small streams, ponds, or unpaved roads. Accessibility by road did not factor into mapping decisions. Mapping occurred largely on private lands where most data gaps remain; for public protected lands, we assumed that data might become available or collected through other means. We used multiple versions of the Protected Areas Database (PAD-US v2.0 [USGS 2018]; PAD-US v1.4 [USGS 2016]; PAD-US CBI edition v2.1 [CBI 2016]) to facilitate mapping outside of public lands. No ownership information was

used in the delineation of polygons; all boundaries were drawn based on aerial photo signatures of vegetation. Sites were typically 20 acres or larger and delineated at a scale of 1:8000 or lower. We delineated smaller sites in some cases; for example, when a site occurred in proximity to other stands and was potentially part of a larger longleaf landscape, or where burn permit or other data identified a small site that might lead surveyors to discover additional longleaf in the vicinity.

The nature of this approach means that errors of omission and commission in longleaf pine occurrence are expected. For example, it was not possible to discern newly cleared and planted longleaf stands from aerial photos; and field surveys revealed that many sites delineated were not longleaf. Nonetheless this method provides a reasonable set of initial field survey polygons that can be further refined and prioritized prior to field work by LIT members who are knowledgeable of ground conditions.

Rapid Assessment

The purpose of the LEO Rapid Assessment is to provide ground truth data on the presence and condition of longleaf pine ecosystems for the LEO mapping effort where no similar data exists from other sources. The LEO Rapid Assessment is conducted by field teams under leadership of The Longleaf Alliance, using tools developed by FNAI including training materials, a field protocol, and mobile data collection app. The methods and attributes are a modification of those used in the Florida LPEGDB, which uses a set of attributes for assessing canopy, midstory, and ground layer conditions that can be discerned either from within a site or from a roadside view of a site (FNAI 2018).

Development of Field Attributes and Protocol

FNAI worked with the LPC Mapping Committee to develop a set of field attributes for the LEO Rapid Assessment (Appendix B). We began with the Florida LPEGDB metrics and modified them to align with the America's Longleaf Maintenance Condition Class Metrics (ALRI 2014) and NatureServe's Southern Open Pine Metrics v2.0 (Nordman and White 2018). The set of attributes allows assessment of longleaf pine ecosystem condition consistent with the three management levels described in ALRI's Range-wide Conservation Plan for Longleaf Pine (ALRI 2009): maintain, improve and restore. The LEO attributes also reflect the interest of longleaf partners to understand the use of fire and occurrence of other pine grasslands in these landscapes. LEO attributes were refined further during the initial months of field data collection, in response to feedback from field surveyors.

The LEO field protocol was designed for persons skilled in plant ecology or forestry field data collection methods, familiar with the longleaf ecosystem flora of the area under survey, and who have received LEO Rapid Assessment training conducted by The Longleaf Alliance (TLA) or by FNAI. Ongoing technical support from TLA and FNAI are also provided to field surveyors. For each field attribute, the Rapid Assessment Protocol provides a definition, the rationale for inclusion, guidance for field interpretation and specifies attribute field values (Appendix C). The field protocol provides instruction for how to evaluate a site from a roadside view (private land) or from within a stand (public land or with documented landowner permission). For roadside assessments the surveyor plots a point offset from their location to just within the survey site boundary, to represent their vantage of the site. Points for within-site assessments are collected with GPS. In all cases surveyors are instructed to review the site to determine vegetation extent and variation, and then select an assessment point location that is representative of the entire stand, to the extent practical. Surveyors record the point type (plotted or GPS) as part of the assessment. GPS accuracy is recorded automatically through the mobile app.

Surveyors also make decisions and note needed edits to site boundaries. For example, a site may be split into two or more sites to reflect different ecological conditions or a site boundary may be edited (expanded, contracted, or refined) based on surveyor field observations.

Field Implementation: Mobile App, Training and Data Collection

FNAI used Esri Collector for ArcGIS (Esri Field Maps in 2021) to create a mobile data collection app for the LEO Rapid Assessment. Sites (polygons) for field assessment are deployed through the app to surveyors with smartphones or tablets. Surveyors collect point features and record assessment values through menu choices for each attribute. The app also allows photographs to be captured with point features but these are optional. Field data are automatically uploaded to a master dataset and reviewed for errors by TLA and FNAI.

FNAI developed training materials for the LEO Rapid Assessment including printable and presentation versions of the Rapid Assessment field protocol, Collector training, field data quality control procedures, and ArcGIS Online data submission. With the cooperation of Desoto-Camp Shelby LIT members, FNAI conducted the first training session March 21-22, 2019 with eight participants at Camp Shelby in Hattiesburg, MS. We conducted a second training at Camp Shelby on June 19-20, 2019 which included the Longleaf Alliance and the initial field contractor for the project. All subsequent training was conducted by TLA. FNAI has continued to work with TLA to provide training materials including training versions of the mobile app (see Appendix D for a list of training materials).

The Longleaf Alliance coordinated the LEO field surveys. Surveyors included a combination of TLA subcontractors, LIT partners and TLA staff (Appendix E). Within LITs (Phase 1), TLA worked with LIT leaders to develop a unique approach for each landscape. In some landscapes approaches such as consulting with steering committee members to prioritize survey sites, determining capacity of LIT partners to conduct field surveys, developing novel ways to maximize field efficiency, and gathering local knowledge were employed to enhance probability of longleaf encounters. Lessons learned from Phase 1 were applied to survey coordination in Phase 2.

The Rapid Assessment excluded 2 LITs: the Virginia Longleaf Pine Cooperators Group, which has little extant longleaf pine but has identified priority restoration sites for future potential assessment; and the Sandhills Longleaf Pine Conservation Partnership (SLPCP) in South Carolina which conducted its own comprehensive survey of private lands in 2017-2019.

Integration of Data into the LEO GDB

To integrate data from many disparate sources we developed a crosswalk system for displaying and summarizing ecological data in a format consistent with management categories defined by the America's Longleaf Restoration Initiative (ALRI 2009). In addition, for each LEO GDB polygon we provide information related to data quality and completeness: ‘Confidence Tiers’ and ‘Data Level’, respectively.

Crosswalk to Management Categories

The crosswalk allows detailed attribute values (cover classes, etc.) associated with longleaf sites to be assigned into ALRI management categories of Maintain, Improve, Restore (MIR) for viewing on a map and summarizing in reports. The LEO GDB version was modified from the crosswalk used in the Florida LPEGDB. In the LEO GDB, FNAI uses metric thresholds for maintenance condition from the LPC Longleaf

Pine Maintenance Condition Class Definitions (ALRI 2014) and from NatureServe's Southern Open Pine metrics v2.0 (Nordman and White 2018) to the extent feasible (Appendix F).

LEO Crosswalk Approach

- The LEO GDB crosswalk does not "roll up" metrics to a single condition class for a site; instead the LEO GDB reports condition class for each attribute, which allows users to view and summarize data based on their specific management needs.
- The LEO GDB applies one crosswalk (e.g., one set of criteria) across the range of longleaf pine. Although this approach is appropriate for general summaries and a range-wide snapshot of condition, users may want to adjust criteria (i.e., develop their own customized crosswalk) for use at finer scales. A crosswalk 'lookup' table is provided with the GDB so users can modify and update the crosswalk for their purposes.
- The LEO 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'. Sites that currently do not support longleaf pine, regardless of potential, are not within the LEO project scope and not included in the database.
- Although the standard attributes for LEO and the Florida LPEGDB were largely similar, there were some differences addressed in the crosswalk. Several attributes differed in their definitions but were crosswalked as roughly equivalent. For example, longleaf pine regeneration is defined as the grass stage to 2" dbh (diameter at breast height) in LEO but is defined as trees with a height of < 6 feet in the Florida data. For two attributes the measurements differed fundamentally: attributes for 'canopy hardwoods' and 'other pine' were measured as basal area (BA) in LEO and as percent cover classes in the Florida data. We included the cover classes within the respective LEO BA fields and noted them as such.

Attribute Quality and Completeness

Confidence Tiers are estimates of general data quality 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 reflects site conditions: 1) Forest Inventory; 2) Stand Forest Type; 3) Within-Stand Assessment; 4) Roadside Assessment; 5) Remote with Limited Ground truth; and 6) Site Boundary Only. See Appendix G for complete tier descriptions. These tiers do not convey accuracy of individual attributes.

Data Level characterizes the completeness of attribute information, in addition to occurrence status of longleaf pine, and conveys the need/opportunity for additional data. For sites with longleaf pine confirmed, levels A through D indicate which and how many condition attributes are complete; for example, level A sites are fully assessed, including data for midstory and/or ground layers, and level D sites have longleaf presence confirmed but no other information. For sites where longleaf pine occurrence is 'unknown' the levels indicate the likelihood of longleaf occurrence based on the data source. Data levels are described in Appendix G.

RESULTS

Geodatabase Design

The LEO GDB format and contents, including attribute definitions, are described in the LEO GDB data dictionary (Appendix H), metadata, and LEO GDB User Guide (Appendix I). The LEO GDB v2.0 contains existing partner data received from September 2018 through December 2022, existing data from the Florida LPEGDB, and Rapid Assessment field data collected in 2019 - 2023. These sources have been coalesced into two polygon datasets (feature classes):

> ***LLP_Occurrence_Status*** represents the extent of knowledge about longleaf pine presence, including confirmed longleaf pine sites, potential longleaf sites where occurrence status remains unknown, and stands that are indicated not to be longleaf sites.
>
> ***LLP_Mgmt_Categories*** contains only confirmed longleaf pine sites and includes ecological condition attributes that have been crosswalked into ALRI Management Categories described above.

These datasets also include attributes about the data source type, the quality and completeness of ecological data available for a site, geographic reference (e.g., county, LIT), and general owner type (public or private).

The LEO GDB is intended for use by ALRI partners for longleaf conservation purposes. The database is available to partners via a license agreement. No detailed ownership information is collected by FNAI or included in the LEO GDB. Restricted data (described in the LEO Privacy Policy) also are not included in the shareable database.

Existing Longleaf Pine Occurrence Data

To date the LEO GDB includes 79 partner stand-level datasets (Appendix J). We expect to continue receiving data from partners, and outreach to new partners will continue beyond Phase 2.

Partner datasets include approximately 3.08 million acres of confirmed longleaf pine, with 76% of longleaf occurring as dominant or codominant. An additional ca 50,000 acres of longleaf is estimated from datasets that are considered 'sensitive' (i.e., restricted), or that were provided as protected area boundaries within which longleaf is known to occur but precise stand locations are unavailable.

Sources often provided all stands managed by an agency, including stand types other than longleaf, or with unknown longleaf occurrence status. More than half of the sites housed in the LEO GDB are stands other than longleaf, due largely to full stand datasets for National Forests and military installations. These are included in the LEO GDB to represent the full extent of our knowledge about these lands. Summaries for partner provided data follow in the Integrated Data section below.

Potential Longleaf Occurrence Sites for Field Rapid Assessment

Just over 17,000 potential longleaf occurrence sites were delineated by FNAI or subcontractors and deployed to surveyors via the LEO Collector app – 15,107 within LITs (Phase 1) and 2,260 outside of LITs (Phase 2). Of these, 83% were targeted (i.e., field visit attempted) for field assessment. An additional

3,303 sites were added opportunistically during field surveys or prior to field surveys by LIT members with local knowledge. There were also 2,711 sites surveyed where the polygons were originally part of an existing partner dataset; these were often sites where longleaf occurrence status was unknown or additional condition data was needed. A total of 20,235 sites were targeted for surveys, with an average site size of 70 acres (Table 1). Sites that were not targeted for surveys are included in the LEO GDB and assigned as 'unknown' for Longleaf Occurrence Status.

Table 1. Number of survey site polygons delineated based on potential for longleaf occurrence, or included from existing partner data for LEO Phase 1 and 2 (excludes Florida).

Survey Site Polygon Origin	Targeted for surveys	Not targeted for surveys	Total
Sites delineated by FNAI or subcontractor	14,351	3,016	17,367
Sites added in field[a]	3,173	130	3,303
Sites from existing partner data	2,711		2,711
Total	**20,235**	**3,146**	**23,381**

[a]Almost half of the added sites were delineated prior to field surveys by TNC in North Carolina based on expert knowledge, ancillary data and aerial photo interpretation.

Rapid Assessment Field Surveys

This section reports the results of field surveys for all LEO Phase 1 and 2 Rapid Assessment (RA) sites. For a summary of only the LEO RA Phase 2 data, see Appendix K. RA surveys were completed for 20,235 sites covering 1.41 million acres outside of Florida. Of this total, 29% were inaccessible (e.g., not viewable from a public road) and assigned a survey status of 'no access'; these were counted as surveyed but longleaf occurrence status remains unknown. Of the remaining accessible sites, 75% contained longleaf pine (Table 2). This statistic includes some known longleaf from existing partner data as well as longleaf delineated opportunistically in the field; for sites that were delineated from aerial photos prior to surveys, 63% contained longleaf pine. The LEO Rapid Assessment confirmed about 775,000 acres of longleaf pine, mostly on private lands through roadside surveys; rapid assessments in Florida, conducted in 2013 and 2017 contribute an additional 1.07 million acres. Table 3 shows acreage of longleaf pine confirmed by rapid assessment within 16 LITs (including Florida). Figure 1 shows the location of field data, relative to existing partner data.

Table 2. The survey status of potential longleaf pine sites evaluated during the LEO Phase I and 2 Rapid Assessment.

Survey Status	Number of RA sites	% of all sites	% of accessible sites
Longleaf Pine Present – Assessed	9,995	*49*	*70*
Longleaf Pine Present – Not Assessed	709	*4*	*5*
Longleaf Absent	3,669	*18*	*25*
No Access	5,862	*29*	n/a
Total	20,235		

Table 3. Acreage of longleaf pine within Rapid Assessment sites for 16 LITs.*

LIT	Longleaf Pine Acreage
Altamaha/Ft. Stewart Longleaf Restoration Partnership	66,809
Apalachicola Regional Stewardship Alliance	311,024
Cape Fear Arch Conservation Collaboration	33,822
Chattahoochee Fall Line Conservation Partnership	66,023
Desoto-Camp Shelby LIT	91,550
Gulf Coastal Plain Ecosystem Partnership	248,692
North Carolina Sandhills Conservation Partnership	41,409
Ocala Longleaf Implementation Team	261,778
Okefenokee and Osceola LIT	30,325
Onslow Bight Conservation Forum	7,667
Sandhills Longleaf Pine Conservation Partnership	1,652
Sewee Longleaf Conservation Cooperative	22,746
SoLo-ACE Longleaf Partnership	59,709
Talladega-Mountain Longleaf Conservation Partnership	22,140
Texas Longleaf Implementation Team	9,255
West-Central Louisiana Ecosystem Project	14,158
Outside LITs	559,053
Total	**1,847,813**

*Includes field survey data from Florida LPEGDB; no field surveys were conducted within the Virginia Longleaf Pine Cooperator's Group.

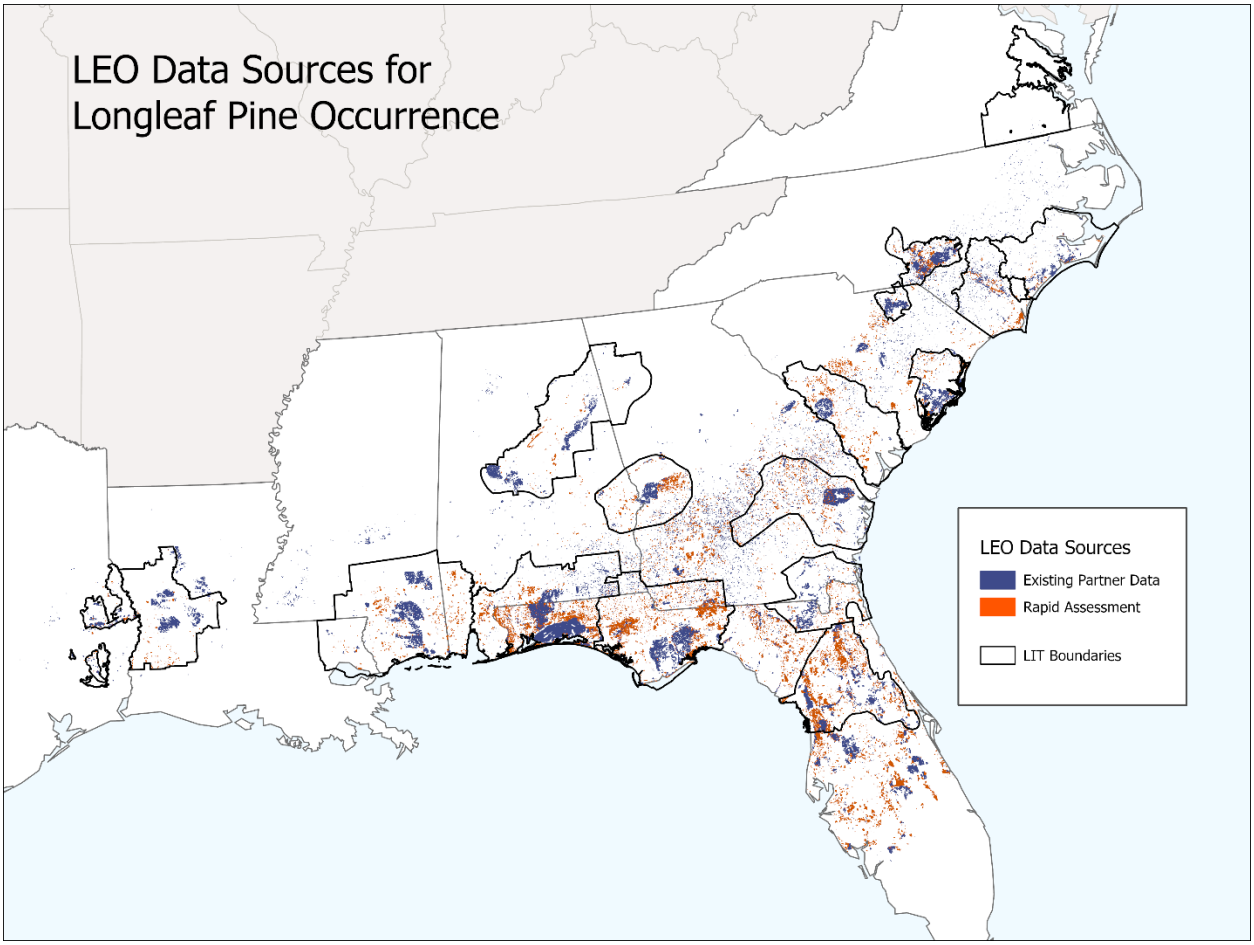


Figure 1. Documented longleaf pine occurrences from existing partner data and Rapid Assessments.

Rapid Assessment Attributes

Longleaf dominance

Where longleaf pine was observed it was mostly dominant (56%) or codominant (24%) (Table 4). The field surveys also documented more than 118,000 acres (15% of RA acreage) where longleaf was occasional to rare, indicating potentially restorable sites.

Table 4. Relative dominance of longleaf pine within RA sites for LEO Phase 1 and 2.

Longleaf Dominance	**Acres**	***%***
Dominant	435,175	*56*
Codominant	188,373	*24*
Occasional – Rare	118,027	*15*
Present - No condition data	34,066	*4*
Total	**775,641**	***100***

Natural vs. planted longleaf

Delineation of LEO RA survey sites focused on natural stands where potential longleaf could be interpreted from aerial photo signatures. Planted longleaf, especially young plantation, was difficult to discern and we relied on opportunistic observations by field surveyors to capture these stand types. Planted stands make up 24% of LEO RA longleaf sites. In the Florida LPEGDB planted pine made up a

smaller percentage (13%) of sites assessed as longleaf, even though all pinelands within the FL range of longleaf, including pine plantation, were targeted for surveys.

Fire evidence

Occurrence of fire was recorded in one of four categories based on visual evidence such as fire scars on trees, blackened tree trunks, standing blackened shrubs, woody understory density and height, and deep duff. Evidence of frequent or recent fire was recorded on 43% of LEO RA sites (by acreage); 38% of longleaf acres confirmed by RA had no visible evidence of fire (Table 5). Fire evidence was not recorded at sites in the Florida LPEGDB, and therefore not reported in Table 5.

Table 5. Fire evidence observed within LEO RA survey sites Phase 1 and 2 (longleaf pine present).

Fire Evidence Category	**Total Acres**	***%***
Frequent	306,158	*39*
Recent, Not Frequent	27,763	*4*
Infrequent	96,516	*12*
No Evidence	292,690	*38*
No Data	52,514	*7*
Total	**775,641**	***100***

Other LEO condition attributes

As described in the methods, 17 of the LEO Rapid Assessment condition attributes were crosswalked into categories for maintain or improve (see Appendix F for crosswalk) so that the RA data could be displayed and interpreted along with data from other sources in the LEO GDB. The proportion of RA acreage in maintain vs. improve status for each attribute is shown in Figure 3. Attributes for hardwood canopy basal area, fire tolerant midstory hardwood cover, and invasive plant cover met maintenance condition thresholds to a high degree (>75% of RA acreage). Although flat-top pines were observed on only 26% of RA acres, large longleaf, another indicator of old trees, were observed on 52% of acreage. For longleaf early regeneration, longleaf saplings, and pyrogenic grass cover, <40% of RA acreage was in maintenance condition (Fig. 3).

Other grassland ecosystems

For sites where longleaf pine was absent, surveyors had the option to record the occurrence of functioning grassland ecosystems. For example, “Other pine grassland” was used to indicate several conditions including other natural pine systems (e.g., shortleaf or pond pine dominated systems), or areas where longleaf had been extirpated and replaced with other species such as loblolly or slash pine, but that are maintained as open pine grasslands (e.g., lands managed with fire for wildlife such as quail). Similarly, they could also note other pyrogenic grassland natural communities; and sites where the vegetation was clearly that of a longleaf ecosystem although pines were not observed. Identification of these sites was not comprehensive but may be useful at a local scale. There were 406 sites (ca. 44,500 acres) in these categories.

LEO GDB v2.0 – Integrated Data

Longleaf Pine Occurrence and Condition

The LEO GDB v2.0 contains locations of approximately 4.9 million acres of longleaf pine (Fig. 2), with 42% on private lands and 58% on public lands (Table 6). Federal lands account for most of the longleaf acreage, followed by state lands. The private lands acreage largely corresponds to the LEO and Florida LPEGDB Rapid Assessment data, but also includes some private conservation land data provided by partners.

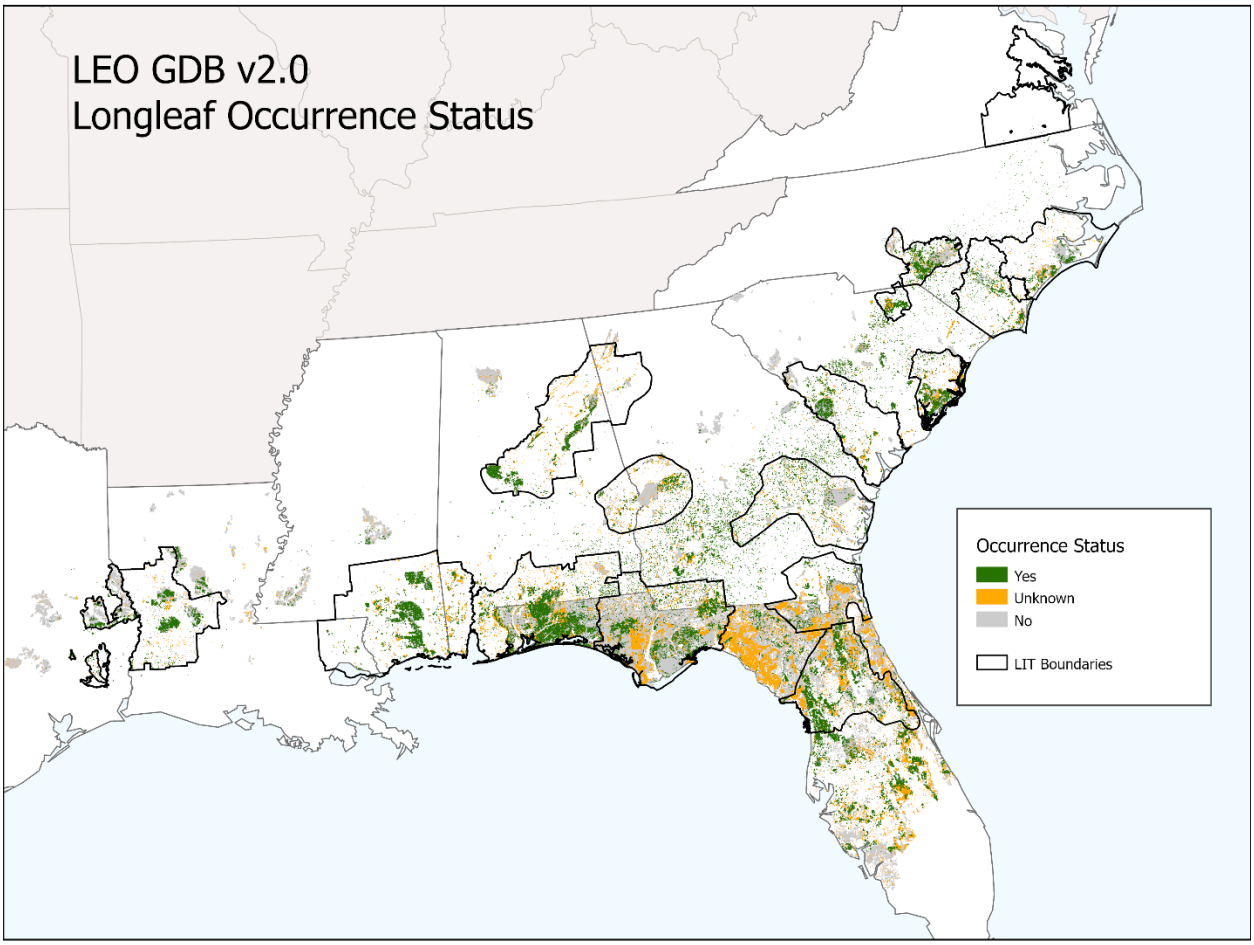


Figure 2. Longleaf pine occurrence status in the LEO GDB v2.0

Table 6. Acreage of longleaf pine in the LEO GDB by owner type.

Owner Type	**Acres**	***%***
Federal	1,814,003	*37*
State	1,022,390	*21*
Local	45,388	*<1*
Private Conservation Land	79,427	*2*
Private Conservation Easement	105,841	*2*
Private – Unprotected	1,860,511	*38*
Other	517	*<1*
Total	**4,928,076**	***100***

Most longleaf in the LEO GDB occurs as longleaf dominant or codominant sites (74%; Table 7). Although dominance information exists for 87% of all longleaf sites in the database, other LEO condition attributes were not available for many partner datasets (Table 8). Partner data are collected for many purposes and were not intended to address LEO attributes; therefore absence of data for most LEO attributes is expected. Figures 3 and 4 illustrate the disparity in completeness of LEO condition attributes between the Rapid Assessment and partner data.

Table 7. Acreage of longleaf pine in the LEO GDB by dominance status.

Longleaf Dominance	**Acres**	***%***
Dominant	2,927,626	*59*
Codominant	749,591	*15*
Occasional – Rare	611,091	*12*
Present - No condition data	638,657	*13*
Total	**4,928,076**	***100***

Table 8. Data level for sites with confirmed longleaf included in the LEO GDB v2.0

Data Level Description	**Acres**	***%***
Ecological data for canopy plus midstory and/or ground layers	1,925,940	*39*
Some forestry data but without midstory or ground layer data	1,283,974	*26*
Dominance status available, but no additional information	1,199,899	*24*
Longleaf presence confirmed, but no additional information	518,262	*11*
Total	**4,928,076**	***100***

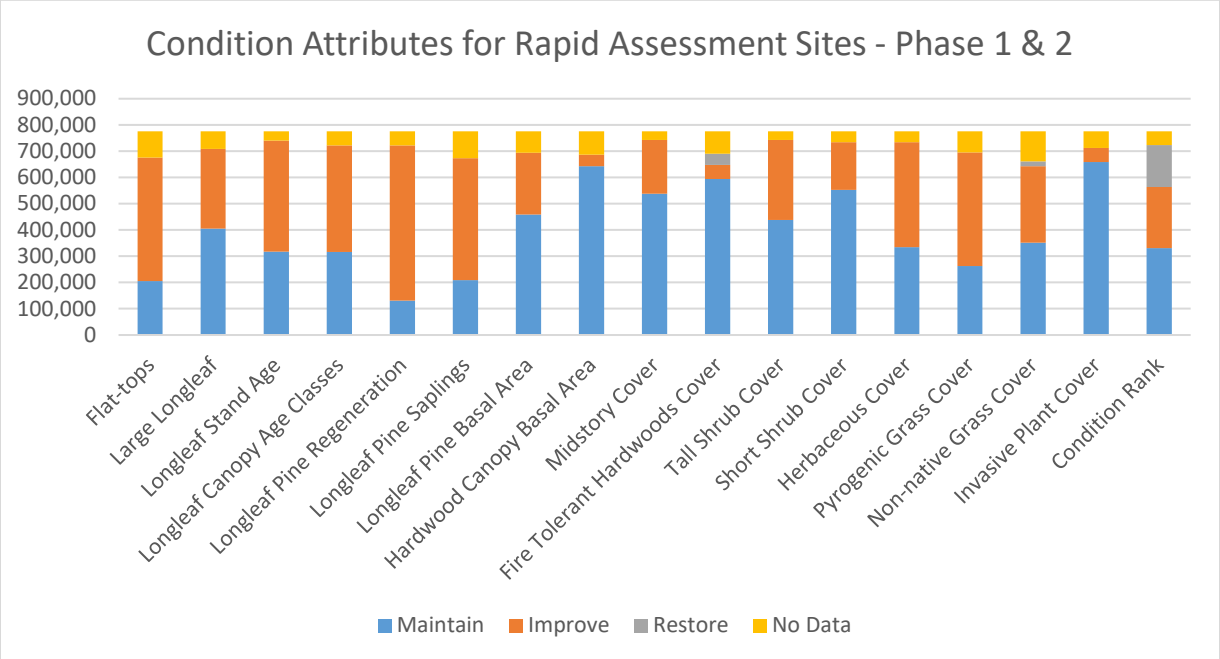


Figure 3. Longleaf pine acreage within management categories for each of 17 condition attributes derived from the LEO Rapid Assessment (RA) Phase 1 and 2. Florida LPEGDB RA is excluded because some attributes were not collected.

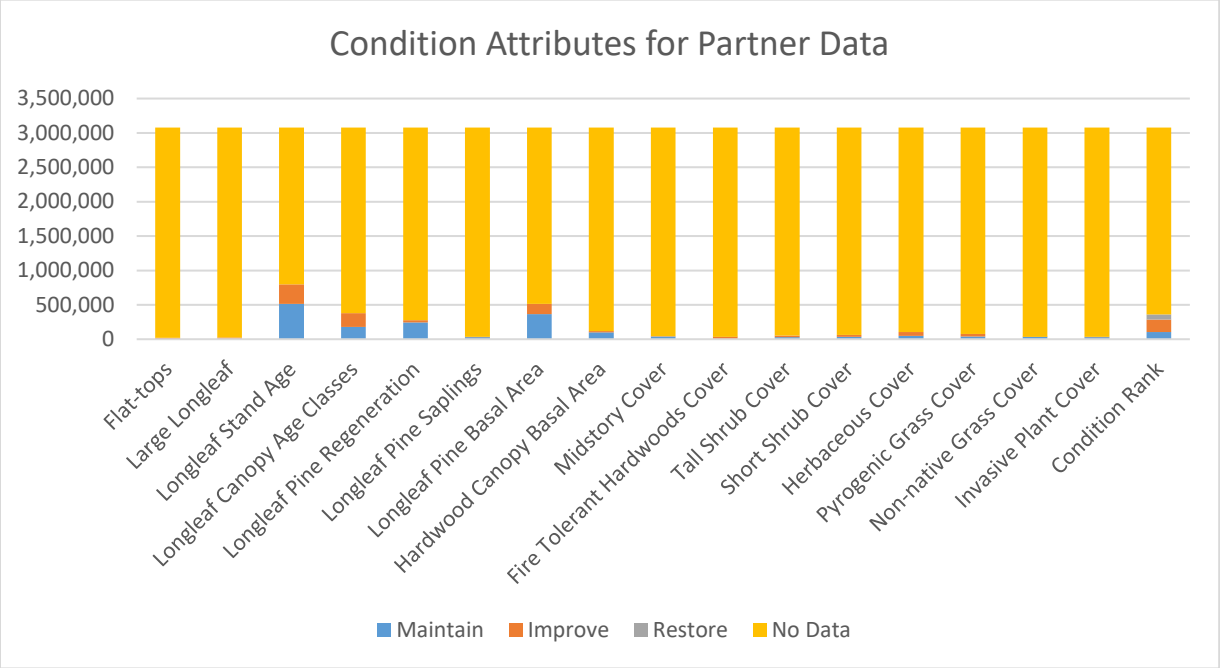


Figure 4. Longleaf pine acreage within management categories for each of 17 condition attributes derived from existing partner data sources. Partner data are collected for many purposes and were not intended to address LEO attributes; therefore absence of data for most LEO attributes is expected.

Longleaf Occurrence Status Absent or Unknown

In addition to confirmed longleaf pine occurrence, the LEO GDB v.2.0 contains sites where occurrence status is recorded as 'No' (absent) or 'Unknown' (Fig. 2; Table 9). These designations are not comprehensive, and their interpretation varies by data source. Longleaf absence was assigned for Rapid Assessment sites where surveyors did not observe longleaf and serves as a record for future monitoring. It was also assigned where existing stand data indicated a forest type other than longleaf pine, typically within site-wide stand datasets provided by state and federal agencies. In some of these cases longleaf may still occur as a stand component.

A longleaf occurrence status of unknown was assigned for Rapid Assessment sites that were not accessible, as determined by surveyors in the field, or that were not targeted for surveys. These 'unknowns' were originally delineated based on indicators of longleaf occurrence and still retain a fair probability of containing longleaf given the RA occurrence rate of 63% for accessible sites. Unknown status was also assigned if existing partner data indicated a stand forest type where longleaf was a possible component, but without confirmation of occurrence, e.g., mixed pine, yellow pine, or where ancillary data indicated potential for longleaf occurrence, e.g., red-cockaded woodpecker cavity trees.

Table 9. Longleaf occurrence status of sites in the LEO GDB. Note that acreages of sites with status Unknown or No are not comprehensive and interpretation depends on the data source type and confidence tier in the database.

Longleaf Pine Occurrence Status	Acres
Yes	4,928,076
Unknown	3,387,348
No	8,093,286

Limitations

To make best use of data in the LEO GDB users should be aware of the following limitations:

1. Recognition and protection of the remaining "great places" or "reference sites" for longleaf ecosystem groundcover diversity is critically important to longleaf pine ecosystem conservation. While LEO attributes include many details about ecological condition, the attributes do not provide the level of detail necessary to identify such significant groundcover biodiversity.
2. Existing data received to date is primarily for public and private conservation lands for which stand-level longleaf pine data existed and was readily contributed to the LEO project by the managing entities. Omissions include many public and private conservation lands that are known to support longleaf pine, but for which spatial stand-level data for longleaf occurrence do not exist. The LEO GDB likely is also missing many sites with new longleaf plantings. See 'Omissions' in Methods above.
3. LEO does not track management activity or intent (e.g., the USFS Million-Acre Challenge).
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. Steps were taken to assure data quality as described in the methods, but error within the database was not quantified. The large number of records in the database precludes a detailed review of every polygon. Errors associated with original source data are unknown.
6. The database contains information from many different sources collected for a variety of purposes. Methods used to assess ecological condition varied from the Rapid Assessment, to timber stand inventories, to detailed vegetation monitoring. The CONF_TIER and DATA_LEVEL fields in the LEO_GDB contain attribute confidence and completeness estimates for all data submitted (Appendix G).
7. The Rapid Assessment field surveys often represent a roadside view of stands and may not accurately capture conditions within all stands. The CONF_TIER field in the LEO_GDB can be used to filter data by Confidence Tier.
8. The 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. The SRC_DATE field in the LEO GDB indicates when data were provided to the LEO project. Known dates for data collection are shown in the SurveyDate field; for many datasets, however, that information was incomplete or not available.

9. In order to display condition data from multiple sources, we crosswalked detailed information into broad management categories proposed by ALRI. We believe the thresholds we applied represent a reasonable estimate given the variability in both data and types of longleaf pine ecosystems. However, this crosswalk should only be used to provide a general picture of condition. The LEO GDB provides tools for users to customize thresholds for their own analyses.
10. The location of longleaf pine on many private and corporate lands remains a data gap in the LEO GDB. We hope to include these in a future iteration of the database if information and funding become available.

SUMMARY AND NEXT STEPS

The LEO project to date has been successful in integrating longleaf data from across the southeast into a single map, and in implementing rapid field assessment methods to fill gaps in our knowledge about longleaf occurrence and condition. The LEO GDB v2.0 houses data for more than 4.93 million acres of longleaf. The ability to map and report these acres should help ALRI in measuring progress toward the goal of 8 million acres.

Tracking acres by ecological condition, however, is a bigger challenge. New field data collected via the LEO Rapid Assessment in Phases 1 and 2 is helping meet that challenge, with over 775,000 longleaf acres assessed in 16 LITs. But overall, ecological condition is currently not well-represented in the LEO GDB. This is because existing data contributed by Partners to LEO were collected for many different purposes and were not intended to address LEO ecological condition; this is expected. Four attributes most commonly submitted by Partners that do contribute ecological condition information include Longleaf Dominance, Longleaf Basal Area, Longleaf Stand Age, and Longleaf Regeneration.

Ecological condition data in addition to that collected for the LEO GDB v2.0 likely exists and could be incorporated in the future; for example, some National Forests may have Ecological Condition data overlays in addition to the forestry stand inventory data. Additional work is needed to incorporate these types of condition assessments where they exist. If desired, the LEO project can also provide information to assist Partners with incorporation of some or all of the LEO attributes in their ongoing routine field data collection efforts.

The success of the LEO project may be most apparent at the Local Implementation Team level. LIT members now have a map to help guide priorities for longleaf conservation and restoration, including cost-share planning. Continued data development for LEO depends on collaboration with LIT members who provide knowledge and data support, participate in training and data collection, and assist with project outreach.

In addition to continued outreach for public lands data, we plan to continue future effort on gathering data for private lands. We recognize the sensitivity of private lands data and are talking with partners who understand and work closely with private landowners. We have developed a Privacy Policy (Appendix A) and a LEO Data License to help address privacy concerns. We are hopeful that the LEO database can be used as an outreach tool to encourage continued data submission to the project.

With the completion of LEO GDB v2.0 we are now considering strategies for monitoring longleaf occurrence and condition in the future. We anticipate working closely with ALRI and its partners to develop a monitoring plan that takes advantage of the data, protocols and tools developed through the

LEO project, as well as existing systems, new technology and other relevant approaches that can contribute to tracking progress toward conservation and restoration goals for longleaf.

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Appendix A. LEO Privacy Policy

Southeast Longleaf Pine Ecosystem Occurrences (LEO) Geodatabase and Web Map Privacy Policy

The Southeast Longleaf Ecosystem Occurrences Geodatabase (LEO) Project is being conducted by the Florida Natural Areas Inventory (FNAI) and the Longleaf Alliance (TLA) in cooperation with the USDA Natural Resources Conservation Service. The primary goal of the LEO project is to develop a comprehensive map database of existing longleaf pine ecosystems in the U.S.

About the LEO Geodatabase and Web Map

The LEO geodatabase (LEO GDB) is a natural resource map database of longleaf pine ecosystems as documented by the Southeast LEO project. The LEO project does not solicit, collect, or store private landowner information of any kind, including landowner name(s), contact information, or other personal data. The LEO GDB includes only general information on landowner type (e.g., public or private) and information about data sources. The remaining information in the database pertains to longleaf ecosystem occurrence, acres, and vegetative condition.

The LEO GDB includes longleaf ecosystem boundaries submitted by data partners or identified by LEO Rapid Assessment; these may reflect land use history and thus coincide with ownership boundaries in some instances. The LEO GDB also includes publicly available data (e.g., conservation land stand boundaries) that may coincide with ownership boundaries.

The LEO GDB serves as a central repository for longleaf data and contains information from many partner landowners, agencies and organizations. The LEO GDB and associated products are not legal descriptions or documents and do not attempt to define jurisdiction or geographic extent of any federal, state, or local government program.

Original data files submitted to the LEO project are not shared with anyone else. We use the spatial features (boundaries and locations) and vegetation attributes of original data files to inform and build the LEO GDB. Sources of data are credited in the LEO GDB. The Southeast LEO project will utilize data in the LEO GDB to build an interactive web map.

Visit the LEO project website https://www.fnai.org/species-communities/southeast-longleaf to learn more about the project and database content.

Rationale for Privacy Policy

Some project partners have concerns that use of the LEO GDB in a public web map or other public display of detailed longleaf pine spatial data (polygons) overlaying private lands could be sensitive even when those data are collected in the “common domain” via aerial photo interpretation and roadside surveys. To address these concerns, the distribution and use of the LEO GDB and its web map will be available only to America’s Longleaf Restoration Initiative (ALRI) partners, university-affiliated researchers, and LEO data providers working in longleaf conservation under a data license agreement with FNAI in cooperation with USDA’s Natural Resources Conservation Service.

Data Privacy Levels and Data Sharing

In addition, a data provider may request further restrictions on the use and display of their longleaf data. Providers may choose the Privacy Level for how their data are shared through the LEO GDB and how their data are viewed via a web map, as described in the table below.

GDB PRIVACY LEVELS		
Level No.	Data Privacy Level	How data are shared
1	**Restricted from GDB**: Withheld from public and partners	Data provider shares with FNAI only for reporting purposes; spatial data is maintained only on the secure FNAI server. Spatial information (polygons, specific location) is withheld from public and partners. Only non-spatial longleaf data (acres and vegetation attributes) to be shared in tabular format at the county level.
2	**GDB Protected:** shared only with authorized partners*	Data provider agrees to share spatial data with authorized partners* through the LEO GDB. Examples: data for private lands participating in cost share or other conservation programs (eg, land trusts).
WEB MAP PRIVACY LEVELS		
1	**Withheld from any Web Map**	Data will not be visible on any web map, protected or public.
2	**Protected Web Map:** Visible only to authorized partners*	Data visible on the password protected LEO GDB web map available only to authorized partners*.
3	**Public Web Map at Limited Scale**	Data visible on a public web map but not visible when zoomed in closer than a 1:160,000 (standard 'Cities' map scale).
4	**Public Web Map No Restrictions**	No restrictions – data may be included on any LEO GDB web map at any scale. Example: data from many public lands. This option would apply if we develop a different web map for the public using only data that has no restrictions placed upon it.

*Authorized partners are limited to ALRI partners and LEO Data providers working in longleaf conservation under a data license agreement with FNAI in cooperation with USDA's Natural Resources Conservation Service. For a definition of ALRI partners see: https://americaslongleaf.org/who-s-involved/partners/

The LEO GDB does not include restricted data (GDB Level 1). Instead, a tabular file (MS Excel or text format) of non-spatial data for all records, including restricted, stripped of location and site information except state and county, is made available to ALRI partners so that data can be tallied at the state or county level.

Restricted spatial data may be utilized only by FNAI for reporting purposes (for example, longleaf acre tallies by state, county, watershed, or custom scale).

Storage of Data

FNAI maintains all data on the FNAI in-house server. Restricted data are flagged and processed into a master database using the appropriate Data Privacy Level attributes as listed above. We filter out restricted data from the LEO GDB and web maps according to the data restriction level as described in the above table.

For further information on the Southeast LEO project data privacy policy, please contact Amy Knight at aknight@fnai.fsu.edu, 850-339-2773; or Carly Voight at cvoight@fnai.fsu.edu.

Appendix B. Quick Reference Table of LEO Rapid Assessment Attributes

Quick Reference Table of LEO Rapid Assessment Attributes v.3

June 2020

Spatial scale	Field Name *= essential	Field Definition	Field Abbreviation	Field values
	Survey Date*	Date of the field assessment	SURVEYDATE	Mm/dd/yyyy
	Surveyor*	Surveyor name	SURVEYOR	Surveyor name or initials
	Point Type*	Indicates whether point was collected with GPS or plotted on-screen.	POINT_TYPE	GPS plotted – field on site plotted – field at boundary plotted - remote
Stand	Survey Status*	Indicates LLP is present, absent, or the site is inaccessible (not evaluated), and if a longleaf ecosystem assessment was done.	SURVEYSTAT	LLP present – assessed LLP present – not assessed LLP absent no access
Stand	Other Pine Present	Indicates if non-longleaf pine are present and if they appear to be of planted or natural origin.	OTH_PINEPR	none other pine - planted other pine - natural
Stand	Other Pine Species	Indicates predominant species of other pine present.	OTH_PINESP	loblolly slash shortleaf pond pitch sand unknown or other pine species none
Stand	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 (e.g. fire scars on trees, blackened tree trunks, standing blackened shrubs, woody understory density and height).	FIRE_EVID	no evidence of fire evidence of fire exists, but not recent or frequent evidence of frequent fire evidence of recent fire, but not frequent
Stand	Rare Species Observed	Rare animal or plant species observed.	RARE_SP	none Gopher tortoise –burrow Gopher tortoise Other – provide in comments

Spatial scale	Field Name *= essential	Field Definition	Field Abbreviation	Field values
Stand	Site Comment	Provides additional information about the site and the Survey Status chosen.	SITECOM	Revisit to assess (temporary placeholder) Data from secondary source only indicates LLP P/A Other pine grassland Natural treeless grassland/prairie Live longleaf pine not visible in any stratum (eg., clear cut, storm damage, wildfire) but vegetation clearly indicates presence of a longleaf ecosystem Other (specify in comments field below) None (no comments)
IF LONGLEAF NOT ASSESSED STOP HERE. IF LONGLEAF ASSESSED, CONTINUE DATA COLLECTION				
Stand	Longleaf Stand Type*	Indicates whether the longleaf appear to be of planted or natural origin.	LLP_TYPE	natural planted not applicable
Stand	Longleaf Dominance*	Indicates dominance of LLP in the stand relative to other tree species. Dominant: LLP occupies the highest percentage of area of the stand Codominant: LLP occupies approximately the same percentage as other stand tree species Occasional-rare: LLP present but a low percentage relative to other stand tree species, or if the only trees present are very sparse (<1% cover) longleaf regeneration or saplings. Live longleaf pine in any stratum not visible	LLP_DOM	dominant codominant occasional-rare live LLP not visible in any stratum
Stand	Flat-top Tree Presence	Indicates the presence and abundance of flat-topped trees observed within the stand.	FLAT_TOPS	none single tree 2-3 trees >3 trees
Stand	Large Longleaf Pine	Indicates the presence and abundance of Longleaf pines > 14” dbh observed within the stand.	LRG_LLP	none single tree 2-3 trees >3 trees

Spatial scale	Field Name *= essential	Field Definition	Field Abbreviation	Field values
Stand	Longleaf Stand Age*	Predominant LLP age class determined by visual estimate and judgement of field evaluator. Older mature: large longleaf (>12" dbh) are common and/or flat-top trees are present. If tree ages are known, the canopy longleaf trees should average 50+ years old. Younger Mature: the majority of trees in the stand have reached reproductive status, large (>12") or flat-top trees are rare or absent. If tree ages are known they should average 20-50 years. Pre-reproductive: majority of longleaf in the stand are small in stature and little or no reproduction is evident because the trees are too young. If tree ages are known they average < 20 years. Not applicable: no live longleaf visible in any stratum	LLP_ST_AGE	older mature younger mature pre-reproductive not applicable
Stand	Longleaf Regeneration	Estimated cover of LLP regeneration from grass stage to 2" dbh.	LLP_REGEN	not evident < 1% 1 - 5% 5 - 15% > 15%
Stand	Longleaf Saplings	Estimated cover of LLP saplings from > 2" to < 5" dbh in the stand.	LLP_SAPL	not evident < 1% 1 - 5% 5 - 15% > 15%
Stand	Longleaf Canopy Age Classes	Indicator of an even- or uneven-aged stand; 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.	LLCAN_AGCL	at least 3 age classes 2 age classes 1 age class mature trees absent
Basal area - if within the stand, estimate from GPS point; If outside the stand looking in, estimate for the stand.				

Spatial scale	Field Name *= essential	Field Definition	Field Abbreviation	Field values
From point if pt-type = GPS	Longleaf Total Basal Area	Estimated basal area of all longleaf pines ≥ 5" dbh for the entire stand rounded to the nearest ten.	LLP_TOT_BA	0, 10, 20, 30, 40, 50, 60, 70, 80, 90, 100, 110, 120, 130, 140, 150, 160, 170, 180, >180
From point if pt-type = GPS	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.	OTHPINE_BA	See LLP_TOT_BA.
From point if pt-type = GPS	Hardwood Canopy 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.	HW_CAN_BA	See LLP_TOT_BA.
All percent cover values (except invasive plants): if within the stand, estimate within 20 m radius circle around GPS point; If outside the stand looking in, estimate for the stand. See protocol for further guidance.				
In 20 m radius circle if pt-type GPS	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.	MIDST_COV	0 < 1% 1 - 5% 6 - 15% 16 - 25% 26 - 35% 36- 45% 46 - 55% 55 - 65% 66 - 75% 76 - 85% 86 - 95% 96 - 100%
In 20 m radius circle if pt-type GPS	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 a canopy [< 5" dbh]). Spaces between leaves and stems count as cover.	FIREHW_COV	See MIDST_COV.
In 20 m radius circle if pt-type GPS	Tall Shrub Cover*	Percentage of the ground within the stand covered by woody plants other than LLP that are 3 – 10 feet tall. Spaces between leaves and stems count as cover.	TSHRUB_COV	See MIDST_COV.

Spatial scale	Field Name *= essential	Field Definition	Field Abbreviation	Field values
In 20 m radius circle if pt-type GPS	Short Shrub Cover*	Percentage of the ground within the stand covered by woody plants other than LLP that are ≤3 feet tall. Spaces between leaves and stems count as cover. <1% includes zero and "not visible" is only used when outside a stand looking in, and the stratum is not visible because of a visual barrier. This might due to topography (berms, roadcuts) or structures (fencing, walls).	SSHRUB_COV	0 < 1% 1 - 5% 6 - 15% 16 - 25% 26 - 35% 36- 45% 46 - 55% 55 - 65% 66 - 75% 76 - 85% 86 - 95% 96 - 100% not visible
In 20 m radius circle if pt-type GPS	Native Herbaceous Cover*	Percent cover of all native non-woody, soft-tissue plants regardless of height, including non-woody vines, legumes, and graminoids (grasses, sedges, rushes). Spaces between leaves and stems count as cover.	HERB_COV	See SSHRUB_COV.
In 20 m radius circle if pt-type GPS	Native Pyrogenic Graminoid Cover	Percent cover of native perennial pyrogenic graminoids (grasses and grass-like species) that are maintained by periodic fire; includes, but not limited to wiregrass (*Aristida stricta*, *A. beyrichiana*), dropseed grasses (*Sporobolus* spp.), cutover muhly (Muhlenbergia capillaris var. trichopodes), toothache grass (*Ctenium aromaticum*), little bluestem (*Schizachyrum scoparium*), splitbeard bluestem (Andropogon ternarius), Elliott's bluestem (*A.gyrans* var. *gyrans*), big bluestem (*A. gerardii*), Indiangrasses (*Sorghastrum* spp.), slender bluestem (*Schizachyrum tenerum*), Chapman's beaksedge (*Rhynchospora chapmanii*). Excluded from this group are species that commonly proliferate after soil disturbance (ie, weedy species) such as: switchgrass (*Panicum virgatum*) and old field broomsedge (*A. virginicus*).	PYROGR_COV	See SSHRUB_COV.
In 20 m radius circle if pt-type GPS	Non-native Herbaceous Cover	Percent cover of non-native herbaceous species, often grasses, that are indicators of fallow agriculture or planted pastures. Typically includes pasture grasses such as bahiagrass, centipede grass, carpet grass, digitgrass, bermudagrass, and limpograss.	NONNAT_COV	See SSHRUB_COV.
Invasive plant cover and remaining attributes: estimate for stand				

Spatial scale	Field Name *= essential	Field Definition	Field Abbreviation	Field values
Stand	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: https://www.srs.fs.fed.us/pubs/gtr/gtr_srs119.pdf.	INVPL_COV	not evident < 1% 1 - 3% 4 - 10% > 10%
Stand	Surveyor Ecological Rank	Surveyor's impression of the ecological condition of the vegetation relative to an undisturbed, well-maintained natural system. excellent: plant species composition, abundance and structure are characteristic of conditions prevalent under historic fire regime. good: plant species composition, abundance and structure are only partially characteristic of conditions previously prevalent under historic fire regime. fair: vegetation retains some components and/or structure characteristic under historic fire regime. Components of original pyrogenic groundcover are present, but sparse. low: vegetation retains little of the original community species components and/or structural characteristics. Components of original pyrogenic groundcover are not evident.	SURV_RANK	excellent good fair low

Spatial scale	Field Name *= essential	Field Definition	Field Abbreviation	Field values
Stand	Soil Hydrology	xeric: deep, well drained to excessively drained sands or gravelly sands; typical of sandhills or well drained soils on the rocky substrates of montane longleaf. sub-mesic: moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture; typical of upland pine (clay hills) and lower slopes of some montane areas. mesic: somewhat poorly drained soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture; typical of mesic flatwoods. hydric: poorly drained soils that have a high water table, soils that have a clay layer or other impervious material at or near the surface; typical of wet flatwoods.	SOIL_HYDRO	xeric sub-mesic mesic hydric
	Comments	Additional optional information	COMMENTS	

Note: the SE LEO RA relies on the USDA NRCS Plants Database (USDA, NRCS 2018) for classification of growth habit for vascular plants. The USDA recognizes the following growth habits: forb/herb, graminoid, shrub, subshrub, tree, vine. The SE LEO RA definition of shrub is all woody vegetation < 10 ft tall and defines woody to be USDA classes: shrubs, subshrubs, trees and vines. The USDA classification does not distinguish woody from herbaceous vines; for the SE LEO RA we anticipate that most vines observed and appreciably contributing to cover will be woody (*Vitis* spp., *Smilax* spp., *Gelsiminum* spp. for example). *Rubus* spp. are considered by USDS as subshrubs and thus in the LEO RA are counted as woody.

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Appendix C. LEO Rapid Assessment Protocol

LEO Rapid Assessment Protocol v.3

November 2020

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Introduction

The purpose of the LEO rapid assessment is to fill gaps in our knowledge of the distribution and ecological condition of longleaf pine ecosystems. The rapid assessment provides ground truth data for the LEO mapping effort. It is a highly standardized, thorough, and repeatable format by which a field surveyor describes what he/she observes. The data collection design is not intended for, nor does it adhere to, any experimental or statistical design.

How accurately the data describe a site and how precise the data are (i.e., how repeatable among sites and observers) will depend on the skill level, training, and consistency of the observers. This protocol is intended to be used by a team of people who are skilled in plant ecology or forestry methods, are familiar with the flora of the area under survey, and who have received training in the LEO rapid assessment purpose and data collection methods.

We welcome feedback from the teams regarding refinement of the field survey protocol. The LEO rapid assessment attributes and protocol are modeled after those used in the Florida Longleaf Ecosystem Occurrence Geodatabase, with modifications. The attributes are consistent with NatureServe Southern Open Pine Metrics V 1.9 and designed to support ecosystem condition classes as outlined in the America's Longleaf Maintenance Condition Metrics.

Answers to a few important questions

What constitutes a longleaf site? In the LEO project, a documented longleaf polygon contains longleaf pine in any stratum, whether it is rare or abundant, and when it is within vegetation indicative of a longleaf ecosystem, even if highly disturbed. A dense loblolly plantation with a few relic "boundary line" longleaf or an improved pasture/agricultural field with a few relic longleaf "shade trees" are not longleaf sites.

Other scenarios that constitute a "longleaf site":

- A longleaf pine plantation.
- A "seed tree" or "shelterwood" cut where sparse non-longleaf trees may occur in an overstory, but the site is clearly being converted to longleaf, as evidenced by an underplanting of longleaf.
- In rare cases, all visible living longleaf pine have been removed from the site (clear cut, storm damage, wildfire, other disturbance) but remaining vegetation clearly indicates the presence of a longleaf ecosystem (eg, site with native pyrogenic grass, shrub and tree species characteristic of a longleaf ecosystem).
- A mixed stand of loblolly or other tree species with longleaf within the stand, and with understory vegetation consistent with a natural longleaf ecosystem, even if overgrown or otherwise highly disturbed, should be counted as a longleaf site, even though the existing longleaf might be a rare or occasional component.

Field surveyors will find additional information in the sections "At the LEO Survey Polygon" (pg 6) -and "Rapid Assessment Attribute Values – Definitions & Field Guidance" (pgs 9 – 18).

Why are some data points GPS and others are plotted on screen in Collector? In the LEO rapid assessment there are two different levels of confidence inherent in the two different field types of field points associated with polygons: GPS or field-plotted. GPS points are taken when the surveyor has access to a site, can walk within it and gain a good understanding of the vegetation, and can collect data for percent cover and basal area at the GPS location within the polygon. These data are "tied" to the GPS point and represent a high level of confidence in the accuracy of observations taken at that point. Field-plotted points are taken when the surveyor does not access the area inside a polygon but makes observations from outside its boundary. Data associated with field-plotted

points are inherently of a lower confidence level than data from a GPS location, although still highly valuable ground truth information.

Why are LEO attribute classes for percent cover so narrow? We recognize the difficulty for the field surveyor to make accurate and precise measurements of percent cover within the narrow 10% classes provided; however these narrow categories maintain flexibility in future condition class assignment thresholds. Attribute value ranges (i.e. cut-off thresholds) for assigning ecological condition to a longleaf site differ among different agency programs and may change in the future. The narrow ranges allow flexible use of the database by different agencies with different longleaf conservation and management purposes. The narrow ranges also allow the LEO database to more readily incorporate a variety of data formats from field programs that utilize different cover scales.

LEO Rapid Assessment Daily "Nutshell" checklist

In this protocol we provide checklists to help you organize your day, your field preparation, and data quality control. The following short checklist provides a brief overview of the "day in the life of" a LEO rapid assessment field surveyor. The following pages of this protocol describe these tasks in more detail.

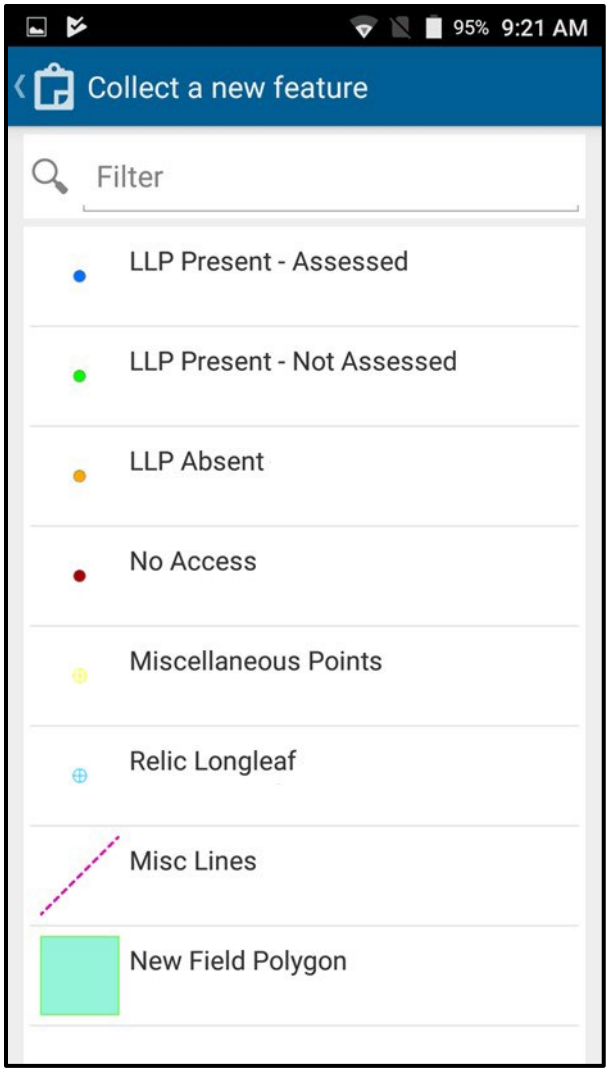
1. Plan your survey route.
2. Be safe at all times.
3. Look for and document longleaf stands outside of LEO survey polygons.
4. Collect a Survey Point for every polygon in your survey area.
5. Where you see a longleaf site, conduct an assessment – there are two different protocols:
    a. Within the site (GPS point, basal areas from center, percent covers within 20 m radius)
    b. Outside the site, looking inside (plotted point, estimate attribute values)
6. Check your work as you go.
    a. are your point, line and polygon placements correct?
    b. are associated data complete and clear?
7. Back in the office with a strong Wi-Fi connection, sync your data to ArcGIS Online (LEO_Group → LEO Collector map and feature service); and email your driving route data (KMZ file) to yourself and to Karen Zilliox Brown at karen@longleafalliance.org.

LEO Data Features to Collect–a Quick Preview

The information you will collect in the field is represented in this Android Collector App screenshot. You will collect

1. Survey Points that provide ground truth data for LEO survey polygons (solid colored dots).
2. Miscellaneous Points and Lines for polygon editing notes.
3. Relic Longleaf points for recording location of relic trees that you believe are important to record.
4. New field polygons for documenting longleaf stands you discover.

More details on each of these features is provided later in this document and in the **LEO Collector Interface** documents for Android or Ipad.



LEO Field Survey Checklist

Day before survey

1. Collector app is on your mobile device – and that both are working properly.
    a. In the Collector app, create an offline base map of satellite imagery & transparent LLP survey polygons of your survey area (see **Android or Iphone Collector Protocol for LEO Field Surveys**).
2. Your device has a GPS Logger app that will record daily routes driven. We use the "GPS Logger" app by Mendhak.
3. Review your survey area and make a rough plan of your day's driving route. Consider:
    a. Driving time and site survey time. Anticipate a few opportunistic/ unplanned LLP sightings.
    b. Daylight hours
    c. Public accessibility of roads
    d. Traffic patterns –times of day for heavy or light traffic, one-way routes or divided highways that may need to be driven in both directions, etc.
4. Additional Map for navigation. Consider you may not always have satellite service for downloading fresh maps or aerials for navigating to your survey area. For reference, you might:
    a. List or mark your planned route on paper (mark the route in a Gazetteer, print-out pertinent sections of county road maps),
    b. Upload comparable pdfs to your device, or
    c. Have a navigation app with road maps downloaded on your device (eg. Avenza, Google My Maps).
5. Make sure mobile devices are fully charged.
6. Check weather forecast for survey area.

Day of Survey

7. Sync your Collector map to ensure all features (points, polygons) are current. After you sync you can close Collector until you get to a survey site.
8. Prior to leaving the parking lot for field surveys, turn on a GPS track app and that will record your driving route. The GPS tracking app remains on throughout the day. When you finish driving for the day, save the GPX (or KMZ) file and email it to yourself.

Field Equipment

1. Mobile device fully charged with current apps and basemaps, GPS function working.
2. Device charging cables, plugs, and vehicle charging unit (eg., inverter) if needed.
3. Backup power sources for mobile units.
4. Backup map or navigation app.
5. Paper copies/pdfs of **LEO Field Protocol** and **Collector Protocol** documents for reference.
6. Binoculars.
7. 10 factor BA prism, dbh tape, 20 m tape (if you plan to be working within a site).
8. High Visibility vest.
9. Vehicle in excellent working order, and in particular, ensure DAILY that running lights, brake lights, emergency flashers, head lights and signal lights are working properly.
10. Plant identification references, as needed.

Other Materials

11. Driver's license, proof of insurance.
12. Business cards and information fliers about the project.

On the Road

Safety and Courtesy First

1. Pay attention to safety of yourself and others.
2. We recommend a team of two in a vehicle, one person to concentrate on driving while the other navigates and observes the landscape, scouting for longleaf.
3. Drive at a moderate speed, always within speed limits, and avoid unexpected actions such as sudden stops or turns. Be predictable.
4. Drive both on major and minor public roadways. County road maps are an excellent resource for public roads.
5. Never drive or walk on private property or roads without documented owner permission.
6. Be aware of the situation you're in; if you feel unsafe for any reason, leave the site.
7. Carry identification and information about the project.
8. In all interactions, be courteous and professional. You are an ambassador for the SE LEO Project!

Opportunistic Sightings of Longleaf

1. Driving to LEO survey polygons, look for longleaf stands along the way. If you see a longleaf stand that is not within the LEO survey polygons or the existing longleaf polygons, this is an opportunity to map a new LEO Survey polygon. Two options:
    a. Stop and assess the stand (preferred)
        i. Using Collector, draw a new polygon that represents the stand, and
        ii. Collect a Longleaf Present - Assessed Survey Point for the polygon. See the "At the LEO survey polygon" section for further instruction.
    b. Stop and collect data to flag the location for a later assessment visit:
        i. Collect a Longleaf Present – Not Assessed Survey Point
        ii. In Site Comments choose "Revisit to assess" from drop down menu.
2. You may see relic longleaf trees in yards or roadway edges.
    a. It is not required that you document relic trees in anthropogenic settings.
    b. The definition of relic longleaf: trees in urban/anthropogenic setting such as in residential yards, urban or developed landscaping, on a boundary line, in cemeteries or road right-of-ways.
    c. If you wish to document these trees, stop and collect a Relic Longleaf point.
    d. Reasons you may wish to document these relic longleaf pines:
        i. If no other longleaf are in the area, these trees provide evidence of historic distribution.
        ii. These trees may be useful for future research or for tree stock development.
        iii. They are the most incredible trees you've ever seen and you LOVE them and want to document their existence.
    e. Reasons to NOT document these "relic" longleaf pines:
        i. You know that longleaf stands are documented in the vicinity, so the relic tree locations would not contribute to understanding of historic distribution.
        ii. Time is limited; documenting opportune sightings of relic trees is not the focus of the LEO survey. Documenting longleaf stands and their condition takes priority over documenting the opportunistic sightings of relic trees.
3. Arriving at a LEO survey polygon, make sure to drive safely at all times, and see the "At the LEO Survey Polygon" section for further instruction.

At the LEO Survey Polygon

Survey Data to Collect for a Polygon

Once at your survey location, take a moment to just look at the vegetation you will describe. *Look carefully for longleaf pine within the polygon*. Note, on the site and on your Collector aerial photography, whether there are indicators of land management history such as past fire, soil disturbance, tree planting, etc.

You will collect one Survey Point to represent the polygon. Carefully review Definitions and Guidance for Survey Status (page 10), prior to choosing one of the four options below.

1. LLP Present-Assessed point when longleaf pine and/or longleaf ecosystem is present. See page 10 for guidance.

   See later sections "LLP-Assessed Survey Data Collection Steps - within Stand (or) - from Outside Stand Boundary" for further instruction.

2. LLP Present - Not Assessed point when:
   a. You can only identify longleaf presence from a distance (for example with binoculars), and can discern no other information about the site; or
   b. Information you provide about that polygon is from a secondary source that indicates longleaf presence only, with no additional information; these are typically plotted prior to fieldwork for polygons that are not accessible. Provide source information in the Comments field.
   c. You wish to flag the location for a later assessment visit.

3. LLP Absent point when longleaf and/or longleaf ecosystem is not present in the stand. Plot the point within the polygon. See page 10 for guidance.

   Note: if the site is a pine stand that is not a longleaf ecosystem, is not in a natural condition, and contains no longleaf within it (e.g., it is a dense loblolly plantation) but one or two relic longleaf are on the boundary, you can collect a Relic Longleaf point to document these.

4. LLP-No Access point when the polygon is inaccessible. Plot the point within the polygon.

Data for Polygon edits - splits and boundary changes

1. Split: if you determine that the polygon should be split into two or more polygons, each representing different vegetation conditions, then
   a. Collect one Survey Point for each of those polygons (plot or GPS each point within each corresponding polygon boundary).
   b. Draw a Miscellaneous line that represents the split; make sure each end of the line is outside of the boundary (i.e, the line's "foot and head are off the bed").
   c. Collect additional editing notes, if needed, with Miscellaneous Points.

2. Boundary change: if you determine that the polygon boundary should be edited (but not split), collect notes for editing using Miscellaneous lines and points as needed.

3. New polygon: if you have discovered a longleaf stand that is not within an existing survey polygon, draw a new polygon that depicts the stand described in your Survey Point.

LLP-Assessed Survey Data Collection Steps (within a stand)

1. Choose your data collection point location after you have walked through the area to the extent that you have gained an understanding of the variation in vegetation composition and structure, and the types of disturbance/land use history in the area to be mapped.

2. Do not rush. Take a moment to just look at the vegetation you will describe - a preview. Take mental note of tree species, vegetation structure, whether you can see herbs or grasses, and whether there are indicators of land management history such as past fire, soil disturbance, tree planting, etc. Do you see wildlife or sign? Anticipate your assignment of RA values - for basal areas, percent cover for midstory, tall and short shrub, and herbaceous layers.

3. The data collection point should be in a place that is representative of the polygon. You will collect data at three scales:
    a. from this point,
    b. from within a 20 m radius circle around the point, and
    c. for the entire stand, as viewed from this point.

4. Look at your location in the Collector map.

    a. Use the GPS locater button to VERIFY YOUR STANDING LOCATION. You will need to re-verify this anytime that you zoom in or out. Make sure the point location indicated in the Collector map looks correct.
    b. Ensure that Collector GPS setting are: 20 ft accuracy, GPS averaging on, minimum of 20 readings per point. If this GPS accuracy or better is achieved, choose Point Type "GPS"
    c. Select & open the LLP-assessed field form. Ensure that Collector has registered the GPS location for the point.

    d. If no GPS signal is available or accuracy within 20 ft cannot be attained, then plot the point location and choose Point Type "plotted - field on site."

5. Measure and temporarily mark the 20 m from the point in 3-4 locations to help you envision the circle perimeter.

6. Collect LLP-Assessed data. See the "Rapid Assessment Attribute Values – Definitions & Field Guidance" section for detailed instructions for each attribute.
    a. From the point –measure all basal area measurements with a 10x prism.
    b. From within 20 m radius around the point – estimate all vegetation percent covers
    c. For the stand (inside and outside of the 20 m radius) – estimate all other attributes.

7. Before closing the survey form, REVIEW YOUR DATA to make sure it correctly represents your observation for each attribute – check for mistakenly chosen values, typos, omissions, logic, etc. Take the time to QC your data and make sure it looks right, while you are on site. Refer to the "LEO Field QC Checklist" in this document.

8. Save your data point to your mobile device. Do not connect to ArcGIS online in the field. At the end of the day when a good Wi-Fi connection is made, "push" the data to ArcGIS online.

9. Before and after data collection, look in all directions, inside and outside of the polygon. Use comments field to note important observations about the polygon or vicinity not captured in the attributes. If necessary, collect Miscellaneous Points or Lines for use in later polygon edits, using the guidance given in the "At the LEO Survey Polygon" section above.

LLP-Assessed Survey Data Collection Steps (looking into a stand from outside the boundary)

1. Before choosing a Survey Point location, view the polygon from several different locations around its perimeter if possible.
2. Do not rush. Take time preview the vegetation you will describe. Take mental note of tree species, vegetation structure, whether you can see herbs or grasses, and whether there are indicators of land management history such as past fire, soil disturbance, tree planting, etc, on the ground or aerial photo. Do you see wildlife or sign? Anticipate your assignment of RA values - for basal areas, percent cover for midstory, tall and short shrub, and herbaceous layers.
3. Choose a survey location that is representative of the polygon vegetation condition, as best you can determine.
4. Check that your standing location, outside the boundary, looks correct on Collector map.
5. Zoom in to the maximum closeness possible, and then plot the point near your standing position, but just inside the polygon boundary to represent where you are looking.
6. In the field form, and choose Point Type "plotted – field at boundary."
7. Collect LLP-Assessed data, based on what you can see within the polygon from your standing position.
8. Make your best estimates, imagining that you are standing at your plotted point. See the "Rapid Assessment Attribute Values – Definitions & Field Guidance" for detailed instructions for each attribute.
    a. From the Survey Point location - estimate basal areas
    b. From within 20 m radius around the point – estimate vegetation percent covers
    c. For the stand (inside and outside of the 20 m radius) – estimate all other attributes.
9. Before closing the survey form, REVIEW YOUR DATA to make sure it correctly represents your observation for each attribute - check for mistakenly chosen values, typos, omissions, logic, etc. Take the time to QC your data and make sure it looks right, while you are on site. Refer to the "LEO Field QC Checklist" later in this document.
10. Select "done" to save your data to your mobile device. Remember, do not connect to ArcGIS online in the field. At the end of the day when a good Wi-Fi connection is made, "push" your data to ArcGIS online.
11. Before and after data collection, look in all directions, inside and outside of the polygon. Use comments field to note important observations about the polygon or vicinity not captured in the attributes. If necessary, collect Miscellaneous Points and Lines for use in later polygon edits, using the guidance given in the "At the LEO Survey Polygon" section.

LEO Field QC Checklist

Attributes

1. Make sure typed comments are understandable, i.e. expand abbreviations, fix typos.
2. If Longleaf was assessed, review data to make sure it correctly represents your observations.
3. Check for logic in assessment values. The following must be true:

Midstory Fire Tolerant Hardwood Cover ≤ Midstory Cover; Native Pyrogenic Graminoid Cover ≤ Native Herbaceous Cover; Invasive Plant Cover ≤ Non-native Herbaceous Cover

If Short Shrubs = 'not visible' then Native Pyrogenic Graminoid Cover, Native Herbaceous Cover and Non-Native Herbaceous Cover must be also 'not visible.' See Short Shrub definition and guidance for details.

If Site Comment = 'Other (specify in comments field below)', then Comments cannot be NULL

If Longleaf Stand Age = 'mature' or 'older mature' OR Flat-top Tree Presence or Large Longleaf Pine ≠ 'none', then Mature Longleaf Age Classes cannot = 'mature trees absent'

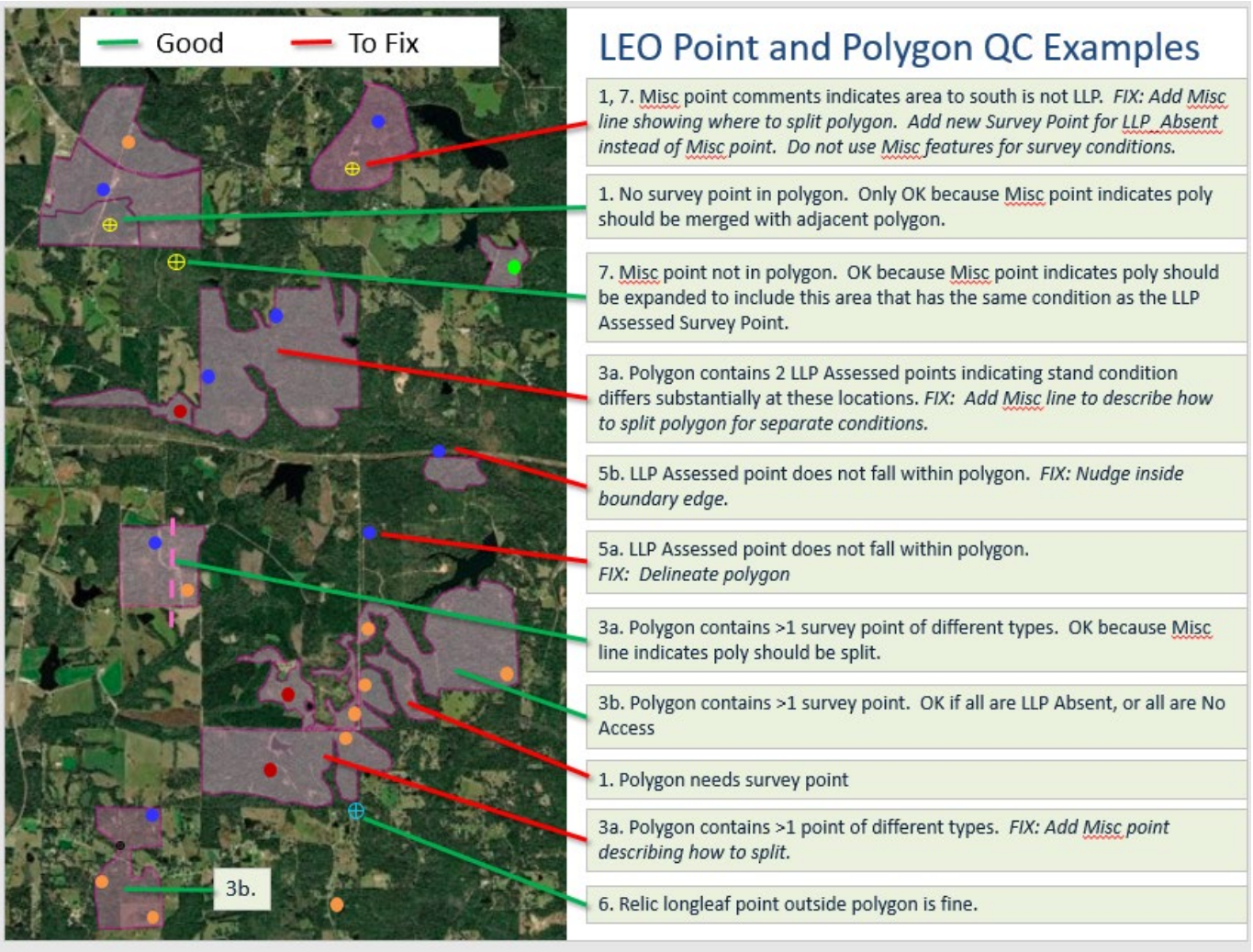
If Other Pine Present ≠ 'none' then Other Pine Species cannot = 'none' (and vice versa)

If Other Pine Basal Area > 0, then Other Pine Present cannot = 'none' AND Other Pine Species cannot = 'none'

Relationship of Survey Points to Polygons

1. All polygons must contain a Survey Point indicating LLP Present, Absent, or No Access.
   The ONLY exception is for adjacent polygons with the same condition. In this case one of the polygons should contain a LLP_Present – Assessed point and the other may contain a Miscellaneous Point indicating that these polygons should be merged into a single feature.
2. A Relic Longleaf point cannot be the only point in a polygon. Relic Longleaf points are not considered Survey Points and cannot represent the condition of a polygon.
3. Polygons should not contain multiple Survey Points.
   a. EXCEPTION: conditions vary enough to warrant splitting the polygon. In this case multiple Survey Points are required, one for each new polygon, and the surveyor MUST draw a Miscellaneous line indicating how to the split polygon. NOTE: Miscellaneous Points and Lines indicate where or how to edit polygons; Survey Points are used to collect survey data for each polygon.
   b. EXCEPTION: all the points in a polygon are LLP-Absent, or all are No Access. The polygon will not be split. The preference is still for a single point in these cases.
4. When adding new polygons, avoid overlaps with adjacent polygons if possible.
5. 'LLP Present' points (both 'Assessed' and 'Not Assessed') must occur within a polygon.
   a. If no polygon exists on the map, you must delineate one.
   b. If you are standing on the edge of an existing polygon, nudge your point so that it is just within the boundary. Do not snap the point to the edge.
6. Points outside of polygons are allowed for Relic Longleaf and Miscellaneous Points.
7. Editing polygons: Use Miscellaneous lines and points indicate how/where an existing polygon should be expanded, split, or merged. These may occur within or outside of polygons, depending on their intent. Do not use Miscellaneous features record varying ecological conditions within a polygon; see #3 above.

The figure below depicts several relationships of Survey Points to polygon scenarios; “good” = meets QC, “to fix” = do not meet QC. Other scenarios and question may arise as you conduct surveys, you Field Coordinator is available to answer questions. Remember – Survey Points convey ecological condition information about a survey polygon, and this information will be included as attributes for that polygon in the LEO geodatabase. Miscellaneous Points and Lines are used only to provide polygon editing instruction to LEO data managers.



Rapid Assessment Attribute Values – Definitions & Field Guidance

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Field Name: Survey Date

Field Abbreviation: SURVEYDATE

Definition: date of the field assessment

Field values: yyyy/mm/dd

Rationale: enables tracking of data age.

Field Name: Surveyor Name

Field Abbreviation: SURVEYOR

Definition: survey name or initials

Rationale: records surveyor identification.

Field Name: Point Type

Field Abbreviation: POINT_TYPE

Definition: indicates whether point was collected with GPS or plotted on-screen.

Field values:

- GPS
- plotted – field on site
- plotted – field at boundary
- plotted - remote

Rationale: provides information about the level of accuracy of the point location.

Guidance: the surveyor depends on GPS to verify their standing location. If assessing longleaf within a site/polygon, the point should always be at the GPS location, unless there is no GPS signal or accuracy is > 20 ft.

- GPS: the point is at the GPS location and GPS accuracy is within 20 ft.

- Plotted – field on site: use standing within a stand/polygon. GPS accuracy within 20 ft is not attainable or no GPS is available. Plot the point as accurately as you can.

- Plotted – field at boundary: use standing adjacent to a stand/polygon. Use the mobile device map to zoom in to the maximum closeness possible and reconfirm your GPS location, or if no GPS is available (this should be rare), then manually confirm your standing location. Plot the point just inside the stand/polygon boundary to represent the location being observed. The Plotted – field point location should always represent the location being observed, to the best of surveyor and equipment ability.

- Plotted- remote: surveyor is not at the stand/polygon location. Surveyor is either at a remote location in the field or has knowledge of the stand condition (either personal knowledge or from secondary sources) and plots the point in Collector or on a desktop computer screen.

Field Name: Survey Status

Field Abbreviation: SURVEYSTAT

Definition: indicates whether LLP is present, absent, or the site is inaccessible (not evaluated), and if a longleaf ecosystem assessment was done.

A site may be assessed as LLP-Present for

- A longleaf pine plantation / planted longleaf site;
- A "seed tree" or "shelterwood" cut where sparse non-longleaf trees may occur in an overstory, but the site is clearly being converted to longleaf, as evidenced by an underplanting of longleaf;
- A mixed stand of loblolly or other tree species with longleaf within the stand, and with understory vegetation consistent with a natural longleaf ecosystem, even if overgrown or otherwise highly disturbed, and even though the existing longleaf might be rare or occasional component; or
- In rare cases, all visible living longleaf pine have been removed from the site (clear cut, storm damage, wildfire, other disturbance) but remaining vegetation clearly indicates a longleaf ecosystem (eg, site with native pyrogenic grass, shrub and tree species characteristic of a longleaf ecosystem).

A site may not be assessed if:

- no longleaf pine are observed at the site, and vegetation of longleaf ecosystem is lacking;
- longleaf occurs only in an urban/anthropogenic setting;
- information about the site is from a secondary source that indicates longleaf presence only, with no additional information
- the surveyor flags a longleaf site for later assessment or
- the site is inaccessible and not visible to the surveyor.

Inaccessible is defined by: no road access (i.e., "can't get there") or the existence of a physical barrier that prohibits visual assessment.

Field values:

- LLP Present – Assessed
- LLP Present – Not Assessed *(site comment required)*
- LLP Absent *(site comment required if site is an other pine grassland or prairie*)
- No Access

Rationale: allows reporting on longleaf presence and survey status for sites visited.

Guidance: in the Collector app SURVEYSTAT is identical to the Survey Point name and is automatically filled out depending on the Survey Point form option you select. When longleaf pine occurs within a polygon in any stratum, whether it is rare (<1% of the stand) or abundant, and when it is within vegetation indicative of a longleaf ecosystem, even if highly disturbed; or if the site is a longleaf pine plantation, choose LLP present and assess the site. When the surveyor can only identify longleaf presence from a distance (for example with binoculars), and can discern no other information about the site, or the site is an opportunistic sighting that cannot be assessed immediately but should be assessed at a later time, then choose LLP present – Not Assessed. When longleaf is not present in the stand, choose LLP-absent. In rare instances, the site is a pine stand that is not longleaf, is clearly not in a natural condition, and contains no longleaf within it (e.g., a dense loblolly plantation),

but there are one or two relic longleaf at the boundary. In these situations, choose LLP-absent to characterize the polygon, and collect a Relic Longleaf point to document the boundary trees.

Field Name: Other Pine Present

Field Abbreviation: OTH_PINEPR

Definition: indicates if non-longleaf pine are present and if they appear to be of planted or natural origin.

Field values:

- none
- other pine – planted
- other pine - natural

Rationale: enables identification of sites with presence of other pine for a more complete description of pine composition, and can help distinguish planted pine (primarily plantations) from pine areas that appear natural in origin.

Guidance: when it is difficult to determine if pines are natural or planted, the surveyor must use best judgement based on the appearance of the stand, on ground or on aerial photography. Choose "planted" when the majority of the trees exhibit signs of being planted, e.g., trees are in rows, or arranged upon silvicultural soil topographic features such as raised beds or furrows, or if surveyor knows the trees were artificially seeded. Choose "natural" when there are no indicators that the trees were planted (no trees in rows, trees not bedded terrain). This category includes a wide variety of site conditions. If unknown based on the field visit, choose "natural".

Example 1: mature open stands of loblolly that appear natural, and although these could possibly be thinned planted pines, if the surveyor is unsure of the origin, and the appearance of the stand is natural, with no indicators of past planting observed (trees in rows, soil bedding, etc.), then the origin is "natural."

Example 2: clearing that has seeded in from surrounding pines. The surveyor may consider these to be "off-site" or "weedy," but if the trees do not appear to be intentionally planted, then the origin is "natural."

Field Name: Other Pine Species

Field Abbreviation: OTH_PINESP

Definition: indicates predominant species of other pine present.

Field values:

- loblolly
- slash
- shortleaf
- pond
- pitch
- sand
- unknown or other pine species
- none

Rationale: allows identification of other pine species on site. These data can indicate the potential occurrence of other southern open pine systems, such as shortleaf and pond pine systems.

Field Name: Fire Evidence

Field Abbreviation: FIRE_EVID

Definition: describes whether or not there is evidence that fire has occurred at the site and the general fire frequency, as determined by visual evidence (e.g., fire scars on trees, blackened tree trunks, standing blackened shrubs, woody understory density and height, presence and depth of leaf litter and duff).

Field values:

- no evidence of fire
- evidence of fire exists, but not recent or frequent
- evidence of frequent fire
- evidence of recent fire, but not frequent

Rationale: provides general information about fire history at the site; this may be helpful in determining if application of fire is an ongoing part of site management.

Guidance: in the LEO project this is the surveyor's best judgement based on their experience with the fire responses of longleaf ecosystems in their area. Evidence of fire includes char on tree trunks, standing charred stems or fallen woody debris. When fire is excluded for long periods of time (ie, no evidence of fire, or fire not recent or frequent) shrubs and midstory vegetation typically grow tall and dense, and deep leaf/needle litter and duff accumulate. When fires are frequent, typically there is charring on tree trunks or on downed woody debris, there is little or no midstory (other than perhaps longleaf regeneration), shrubs are low in stature, grasses and forbs may be abundant, there is low accumulation of leaf / needle litter, and bare sand may be visible between groundcover vegetation. Longleaf regeneration may be present. In rare cases, the surveyor might observe a long-unburned site that recently burned; duff may be still be apparent although surficial layers burned away, and/or there is a high percentage of standing dead midstory stems. In the case of wildfires, overstory pines may have been heavily damaged, exhibiting needle scorch or defoliation. In these cases, the surveyor should choose "evidence of recent fire, but not frequent."

Field Name: Rare Species Observed

Field Abbreviation: RARE_SP

Definition: rare animal or plant species observed.

Field values:

- none
- Gopher tortoise –burrow
- Gopher tortoise
- other – provide in comments

Rationale: rare species' presence / absence may be one indicator of ecological condition or conservation value of the site. This attribute is provided to allow the surveyor to record incidental sightings. No rare species data (locational or descriptive) will be in the LEO geodatabase. Data collected may be used for tally of rare species sightings for landscape level reporting.

Guidance: LEO Rapid Assessment surveyor should not focus on or spend extra time looking for rare species at a site. This attribute is provided to allow the surveyor to record incidental sightings only.

Field Name: Site Comment

Field Abbreviation: SITECOM

Definition: provides additional information about the site and the Survey Status chosen.

- Revisit to assess
- Site information from a secondary source that only indicates longleaf presence/absence
- Other pine grassland
- Natural treeless grassland/prairie
- Live longleaf pine not visible in any stratum (eg., clear cut, storm damage, wildfire) but vegetation clearly indicates presence of a longleaf ecosystem
- Other (specify in Comment field below)
- None (no comment)

Rationale: allows field evaluator to capture additional standardized information on the ecological condition of the site if not fully assessed. Standardized language allows query and reporting on these observations.

Guidance: Your choices for SITECOM values will vary based on the Survey Status you chose. "Revisit to assess" is a temporary placeholder when the surveyor observes longleaf but cannot immediately conduct an assessment, but plans to return at a later time. "Site information from a secondary source.." is used when the surveyor does not visit a site but instead relies on a secondary source that indicates longleaf presence/absence with no ecological assessment data. The surveyor should cite the secondary source in Comments. "Other pine grassland" can be used to indicate several conditions. These include other natural pine systems (shortleaf or pond pine dominated systems, for example), or areas where longleaf have been extirpated and replaced with other species such as loblolly or slash pine, but that are maintained as open pine grasslands; for example, lands managed with fire for wildlife such as quail. "Natural treeless grassland/prairie" indicates a pyrogenic grassland natural community (e.g., wet prairie, seepage bog, dry prairie, etc.). "Live longleaf pine not visible" should be used in rare cases to indicate that, while you did not observe longleaf pine, you are conducting an assessment because the vegetation is clearly that of a longleaf ecosystem.

LONGLEAF ATTRIBUTES BELOW

Field Name: Longleaf Stand Type

Field Abbreviation: LLP_TYPE

Definition: indicates whether the longleaf appear to be of planted or natural origin.

Field values:

- natural
- planted
- not applicable

Rationale: allows identification of natural verses planted stands. It may be important for agency programs and partners to know how much longleaf pine has been planted and the extent of natural LLP systems.

Guidance: when it is difficult to determine if pines are natural or planted, the surveyor must use best judgement based on the appearance of the stand, on ground or on available aerial photography. Choose "planted" when the

majority of the trees exhibit signs of being planted, e.g., tree are in rows, or arranged upon silvicultural soil topographic features such as raised beds or furrows, or if surveyor knows the site was artificially seeded. Choose "natural" when there are no indicators that the trees were planted (no trees in rows, trees not bedded terrain). This category include a wide variety of site conditions. If unknown based on the field visit (i.e., there is no indication the site was planted) then record as natural. Choose "not applicable" in those rare cases where live longleaf pine are not visible in any stratum (eg., clear cut, storm damage, wildfire) but you are conducting an assessment because the site's vegetation clearly indicates presence of a longleaf ecosystem.

Field Name: LLP Dominance

Field Abbreviation: LLP_DOM

Definition: indicates dominance of LLP in the stand relative to other tree species.

Field values:	Value Definition:
• dominant	LLP occupies the highest percentage of area of the stand
• codominant	LLP occupies approximately the same percentage as other stand tree species
• occasional-rare	LLP present but in a low percentage relative to other stand tree species, or if LLP are the only trees present and LLP cover (all strata combined) is very sparse (<1% cover)
• live LLP not visible in any stratum	Live longleaf pine not visible in any stratum

Rationale: documentation of the presence and dominance of LLP in the stand helps to determine if that stand qualifies as a LLP site and if restoration may be appropriate for the stand.

Guidance: longleaf is dominant if it occupies 60-70% or greater of total tree species in the stand; codominance varies with the number of other species in the stand but can be as low as 20%; Occasional-rare roughly below 20% of tree species in the stand. Choose Occasional-rare also if longleaf is the only tree species present (100% of tree species in the stand) and longleaf aerial coverage is very sparse across all strata (<1 % cover of the stand). Choosing Occasional-Rare for this instance would more accurately reflect the stand conditions than deeming longleaf "dominant", even though there may not be other tree species present in the same stratum. Choose "live longleaf pine are not visible in any stratum" when longleaf have been removed (eg., clear cut, storm damage, wildfire) but you are conducting an assessment because the site's vegetation clearly indicates presence of a longleaf ecosystem.

Field Name: Flat-top Tree Presence

Field Abbreviation: FLAT_TOPS

Definition: indicates the presence and abundance of flat-topped trees observed within the stand.

Field values:

- none
- single tree
- 2-3 trees
- > 3 trees

Rationale: the presence and abundance of trees with older-mature morphology may be an indicator of structural diversity of the stand. This attribute can be used in assessing ecological condition and rarity of the site. Old, flat-top longleaf trees are rare, they are reservoirs of site environmental history, and their presence can be important for rare species such as red-cockaded woodpecker.

Field Name: Large Longleaf Pine

Field Abbreviation: LRG_LLP

Definition: Number of longleaf pines > 14" dbh.

Field values:

- none
- single tree
- 2-3 trees
- > 3 trees

Rationale: the presence and abundance of large, older longleaf pines can be an indicator of maturity and structural diversity of the stand. Consistent with America's Longleaf Maintenance Condition metrics.

Field Name: Longleaf Stand Age

Field Abbreviation: LLP_ST_AGE

Definition: predominant LLP age class determined by visual estimate and judgement of field evaluator.

Field values:	Value Definition:
• older mature	Longleaf (>12" dbh) are common and/or flat-top trees are present. If tree ages are known, the canopy longleaf trees should average 50+ years old
• younger mature	The majority of trees in the stand have reached reproductive status (ie, are of cone-bearing age), large (>12" dbh) or flat-top trees are rare or absent. If tree ages are known they should average 20-50 years
• pre-reproductive	Majority of longleaf in the stand are small in stature and little or no reproduction is evident because the trees are too young. If tree ages are known they average < 20 years
• not applicable	No live longleaf visible in any stratum

Rationale: this attribute enables the database user to distinguish general maturity among stands, which can be important for conservation planning. For example, older mature stands of longleaf as defined above may be of higher conservation value for specialist species (like red-cockaded woodpecker) than younger stands.

Guidance: in the LEO project this is the surveyor's best judgement of the reproductive maturity of the longleaf stand, based on their experience with longleaf ecosystems in their geographic region. Because the true ages of trees in the stand will likely not be known, surveyor judgement will rely on tree stature characteristics such as height, bole size, crown morphology. The value definitions above provide guidelines to help standardize judgement among field surveyors from a variety of academic or professional backgrounds in longleaf ecosystems. In "seed tree cuts" with abundant regeneration, the surveyor may choose "pre-reproductive" if this represents the majority of the trees in number and space occupied at the site, even if a scattering of older trees are present.

In this case, the presence of the "seed trees" should be captured in the LLP Overstory Canopy Age Classes attribute below. Choose "not applicable" when live longleaf pine are not visible in any stratum (eg. clear cut, storm damage, wildfire) but you are conducting an assessment because the site's vegetation clearly indicates presence of a longleaf ecosystem.

Field Name: Longleaf Regeneration

Field Abbreviation: LLP_REGEN

Definition: estimated cover of LLP regeneration from grass stage to 2" dbh in the stand.

Field values:

- not evident
- < 1%
- 1 - 5%
- 5 - 15%
- >15%

Rationale: regeneration is an indicator of the potential sustainability of the stand. It may also indicate the need for planting or active management of the stand such as burning and thinning to encourage seed germination. Presence of longleaf regeneration may eliminate or reduce the need for site-preparation for planting which can be detrimental to groundcover plants. Values in this field were chosen to be consistent with Americas Longleaf Maintenance Condition Metrics.

Field Name: Longleaf Saplings

Field Abbreviation: LLP_SAPL

Definition: estimated cover of LLP saplings from > 2" to < 5" dbh in the stand.

Field values:

- not evident
- < 1%
- 1 - 5%
- 5 - 15%
- >15%

Rationale: the presence of late regeneration saplings is an indicator of the potential sustainability of the stand, whether or not there is a need for active management to encourage regeneration and tree growth, and the stand's restoration potential. Sapling presence provides an indicator of vertical structure complexity. These trees also are "recruitment" waiting to replace canopy trees, should they be removed or damaged by storms, thus this attribute could possibly be one indicator of the overall resilience /persistence of the stand.

Guidance: for the entire stand, this is a rough estimate of the area within the stand that the LLP sapling/late regeneration occupies. Because regeneration can be patchy, and because this is a stand-wide attribute, it may be helpful to think of these percent cover classes as a combination of the number and size of patches observed, relative to the area of the entire stand. A single or a few saplings in a stand, or a single very small patch might be < 1% cover (i.e., presence discernable) for the stand; a few small patches, or a single large patch might be 1-5% cover of the stand. A few large patches or many small patches might be 5-15%, etc.

Field Name: Longleaf Canopy Age Classes

Field Abbreviation: LLCAN_AGCL

Definition: indicates an even or uneven overstory age structure; the number of age classes of longleaf in the overstory canopy and sub-canopy. These trees are mature (ie, of cone bearing age) and ≥ 5" dbh, and have reached or very nearly reached full height. Excludes LLP_REGEN and LLP_SAPL which are captured separately.

Field values:

- at least 3 age classes in overstory canopy
- 2 age classes in overstory canopy
- 1 age class in overstory canopy
- overstory canopy trees absent

Rationale: knowledge of the age structure of the stand can help indicate site history and future management needs. Natural stands tend to have multiple age classes in the canopy and subcanopy which contribute to structural diversity in the stand. Consistent with America's Longleaf Maintenance Condition metrics.

Guidance: this is the surveyor's best judgement of whether or not there are different age classes (or age cohorts) in the longleaf pine canopy and subcanopy. Because the true ages of the trees will likely not be known, the surveyor must rely on observable variation in canopy tree statures– uniformity of statures (height, dbh or crown morphology) typically indicates one age class; Variation or obvious differences in tree statures – for example, variation in crown morphologies (flat-top and younger) or obvious variation in dbh's among trees, typically indicate more than one age class is present.

Field Name: LLP Total Basal Area

Field Abbreviation: LLP_TOT_BA

Definition: estimated basal area (in sq. ft/ac) of all longleaf pines ≥ 5" dbh for the entire stand rounded to the nearest ten.

Field values: 0, 10, 20, 30, 40, 50, 60, 70, 80, 90, 100, 110, 120, 130, 140, 150, 160, 170, 180, >180

Rationale: consistent with America's Longleaf Maintenance Condition Metrics and NatureServe Southern Open Pine Metrics V 1.9. Basal area is repeatable using a 10 factor basal area prism or gauge. Basal area values are used in recommendations for various wildlife species habitat including red-cockaded woodpecker and northern bobwhite.

Guidance: within a stand, estimate basal area of canopy longleaf area using a 10 factor prism held over the GPS Survey Point. If you are outside the site boundary looking into the stand, you must estimate the BA for the stand. This requires that you have a good amount of experience with collecting BA data within stands of varying tree densities and sizes. Surveyors must be well practiced in this measurement. Also see "Guidance for Measuring Basal Area" at the end of this section.

NON-LONGLEAF ATTRIBUTES BELOW

Field Name: Other Pine Basal Area

Field Abbreviation: OTHPINE_BA

Definition: Estimated basal area (in sq. ft/ac) of other pines (not LLP) with dbh ≥ 5" for the entire stand rounded to the nearest ten.

Field values: see LLP Total Basal Area**.**

Rationale: indicator of abundance of other pines on site, for a more complete description of pine composition of the stand. Consistent with America's Longleaf Maintenance Condition Metrics and NatureServe Southern Open Pine Metrics V 1.9.

Guidance: see LLP Total Basal Area.

Field Name: Hardwood Canopy Basal Area

Field Abbreviation: HW_CAN_BA

Definition: estimated basal area (in sq. ft/ac) of canopy hardwoods with dbh ≥ 5" for the entire stand rounded to the nearest ten.

Field values: see LLP Total Basal Area.

Rationale: indicator of abundance of large hardwoods on the site. High levels of hardwoods in the canopy are generally detrimental to LLP systems because they shade groundcover. Reduced groundcover means less fuel to carry fire and less cover for wildlife species. Leaf litter from hardwood trees is less flammable than native groundcover further reducing the effectiveness of prescribed fires and potentially allowing continued invasion by hardwoods. Consistent with America's Longleaf Maintenance Condition Metrics and NatureServe Southern Open Pine Metrics V 1.9.

Guidance: see LLP Total Basal Area.

Field Name: Midstory Cover

Field Abbreviation: MIDST_COV

Definition: percentage of the ground within the stand covered by all woody plants other than LLP that are greater than 10 feet tall up to the bottom of the canopy and that were not counted in the canopy (< 5" dbh). Spaces between leaves and stems count as cover.

Field Values:

0 < 1%
1 - 5%
6 - 15%
16 - 25%
26 - 35%
36- 45%
46 - 55%
55 - 65%
66 - 75%
76 - 85%
86 - 95%
96 - 100%

Guidance for Estimating Percent Cover

Applies to all cover attributes

Within a stand, estimate percent covers within a 20 meter radius from the GPS Survey Point. Take time to walk around within the circle to observe vegetation before recording values. If you are outside a site boundary looking in, you must estimate for the stand. This requires that you first have a good amount of experience with these estimates within stands of varying vegetation heights and covers.

Percent cover is the percent of an area occupied by the vertical projection of vegetation cover onto that area. Spaces between leaves and stems also count as cover. Plants of different stratum will likely have overlapping covers.

Rationale: high levels of hardwood midstory are generally detrimental to LLP systems because they shade groundcover that is important for fuel to carry fire and cover for wildlife species. Leaf litter from hardwood trees is less flammable than native groundcover further reducing the effectiveness of prescribed fires. Cover of midstory woody species is an indicator of longleaf ecosystem condition. See Guidance box above for more detail.

Field Name: Midstory Fire-Tolerant Hardwood Cover

Field Abbreviation: FIREHW_COV

Definition: 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 a canopy [< 5" dbh]). Spaces between leaves and stems count as cover.

Field values: see Midstory Cover above

Rationale: high levels of hardwood midstory are generally detrimental to LLP systems because they shade groundcover that is important for fuel to carry fire and cover for wildlife species. Leaf litter from hardwood trees is less flammable than native groundcover further reducing the effectiveness of prescribed fires. However, certain hardwood species are somewhat fire tolerant and are naturally part of several of LLP systems. In order to determine the extent of hardwood species that invade these systems as a result of infrequent fire it is important to record the cover of the fire-tolerant hardwood species. Species listed are from NatureServe Southern Open Pine Metrics V 1.9.

Guidance: This measure is a subset of Midstory Cover. See the box "Guidance for Estimating Percent Cover" under Midstory Cover above.

Field Name: Tall Shrub Cover

Field Abbreviation: TSHRUB_COV

Definition: percentage of the ground within the stand covered by woody plants other than LLP that are 3 – 10 feet tall. Spaces between leaves and stems count as cover.

Field values: see Midstory Cover.

Rationale: shrub density and height can affect the suitability of the stand for many wildlife species. A dense tall shrub layer shades the ground, inhibiting longleaf pine regeneration and growth of pyrogenic grasses needed to carry fire.

Guidance: see box "Guidance for Estimating Percent Cover" under Midstory Cover.

Field Name: Short Shrub Cover

Field Abbreviation: SSHRUB_COV

Definition: percentage of the ground within the stand covered by woody plants other than LLP that are <3 feet tall. Spaces between leaves and stems count as cover. Note: <1% includes zero and "not visible" is only used when outside a stand looking in, and the stratum is not visible because of a visual barrier. This might due to topography (berms, roadcuts) or structures (fencing, walls).

Field Values:					
	0 < 1%	16 - 25%	46 - 55%	76 - 85%	not visible
	1 - 5%	26 - 35%	55 - 65%	86 - 95%	
	6 - 15%	36- 45%	66 - 75%	96 - 100%	

Rationale: shrub density is an indicator of ecosystem condition; very dense shrubs with a high percent cover can suppress grasses, forbs and longleaf pine regeneration. Consistent with America's Longleaf Maintenance Condition Metrics and NatureServe Southern Open Pine Metrics V 1.9.

Guidance: see box "Guidance for Estimating Percent Cover" under Midstory Cover. In rare instances when assessment is conducted from the exterior of a stand, area topography or structures such as fencing may not allow the surveyor to view low stratum of vegetation such as short shrubs and the herbs; in these instances, the "not visible" value indicates the surveyor was unable to see vegetation below 3 ft in height because of a physical barrier. If this is chosen, then HERB_COV, PYROGR_COV, and NONNAT_COV should also be "not visible." If the strata is viewable (i.e., no visual barrier) but no vegetation is seen in that strata, then choose <1% (i.e., a zero percent cover was observed).

Field Name: Native Herbaceous Cover

Field Abbreviation: HERB_COV

Definition: percent cover of all native non-woody, soft-tissue plants regardless of height, including non-woody vines, legumes, and graminoids (grasses, sedges, rushes). Spaces between leaves and stems count as cover.

Field values: see Short Shrub Cover.

Rationale: herbaceous cover is a general indicator of the amount of light reaching the ground. Although not as important for fuel as the specific subset of pyrogenic grasses, herbaceous cover can indicate the ability of the site to carry a fire and is important for many wildlife species. Consistent NatureServe Southern Open Pine Metrics V 1.9.

Guidance: see Short Shrub Cover guidance. Percent over of herbaceous material Includes both living (green) and attached dead plant materials connected to a live plant.

Field Name: Native Pyrogenic Graminoid Cover

Field Abbreviation: PYROGR_COV

Definition: percent cover of native perennial pyrogenic graminoids (grasses and grass-like species) that are maintained by periodic fire; includes, but not limited to wiregrass (*Aristida stricta*, A. *beyrichiana*), dropseed grasses (*Sporobolus* spp.), cutover muhly (*Muhlenbergia capillaris* var. *trichopodes*), toothache grass (*Ctenium aromaticum*), little bluestem (*Schizachyrum scoparium*), splitbeard bluestem (*Andropogon ternarius*), Elliott's bluestem (*Andropogon gyrans* var. *gyrans*), big bluestem (*Andropogon gerardii*), Indiangrasses (*Sorghastrum* spp.), slender bluestem (*Schizachyrum tenerum*), Chapman's beaksedge (*Rhynchospora chapmanii*).

Excluded from this group are species that commonly proliferate after soil disturbance (i.e., weedy species) such as: switchgrass (*Panicum virgatum*) and old field broomsedge (*Andropogon virginicus*).

Field values: see Short Shrub Cover.

Rationale: native pyrogenic graminoid cover indicates ground cover condition in longleaf pine ecosystems. These plants also provide fine fuels for carrying fire. Consistent with America's Longleaf Maintenance Condition Metrics and NatureServe Southern Open Pine Metrics V 1.9.

Guidance: see Short Shrub Cover guidance. Percent over of herbaceous material Includes both living (green) and attached dead plant materials connected to a live plant.

Field Name: Non-native Herbaceous Cover

Field Abbreviation: NONNAT_COV

Definition: percent cover of non-native herbaceous species, often grasses, are indicators of fallow agriculture or planted pastures. Typically includes pasture grasses such as bahiagrass, centipede grass, carpet grass, digitgrass, bermudagrass, and limpograss.

Field values: see Short Shrub Cover.

Rationale: describes percentage of herbaceous groundcover that is non-native, which can be an indicator of ground cover condition. For example, non-native pasture grasses such as bahiagrass and torpedo grass outcompete native ground cover and can indicate poor ground cover condition. Presence of these grasses also increases the difficulty of native ground cover restoration.

Guidance: see Short Shrub Cover guidance. Percent over of herbaceous material Includes both living (green) and attached dead plant materials connected to a live plant.

Field Name: Invasive Plant Cover

Field Abbreviation: INVPL_COV

Definition: 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: https://www.srs.fs.fed.us/pubs/gtr/gtr_srs119.pdf. If the invasive exotic plants are herbaceous, this value is a subset of non-native herbaceous cover.

Field values:

- not evident
- < 1%
- 1 - 3%
- 4 - 10%
- > 10%

Rationale: invasive exotic plant species are a major threat to biological integrity of vegetative plant communities, including LLP systems. These species can out-compete the native species, thus altering ecological function and contributing to decline in ecological integrity.

Guidance: see Box "Guidance for Estimating Percent Cover" under Midstory Cover and also see Short Shrub Cover guidance. Include Includes both living (green) and attached dead plant materials connected to a live plant.

Field Name: Surveyor Ecological Rank

Field Abbreviation: SURV_RANK

Definition: the field surveyor's impression of the ecological condition of the vegetation relative to an undisturbed, well-maintained natural system.

Field Values:	Value Definition:
• excellent	Plant species composition, abundance and structure are characteristic of conditions prevalent under historic fire regime.
• good	Plant species composition, abundance and structure are only partially characteristic of conditions previously prevalent under historic fire regime.
• fair	Vegetation retains some components and/or structure characteristic under historic fire regime. Components of original pyrogenic groundcover are sparse or suppressed so as to be functionally irrelevant.
• low	Vegetation retains little of the original community species components and/or structural characteristics. Components of original pyrogenic groundcover are not evident.

Rationale: this attribute provides an additional tool for evaluating the ecological condition of the site that is not necessarily tied to the other variables in the rapid assessment. It allows the surveyor to convey their overall impression of ecological condition, based on their knowledge of the range of conditions described above. This field is particularly useful for identifying sites that are ecologically intact but are structurally deficient. This field was favored in the FNAI longleaf pine partners meeting of October 2014.

Guidance: this attribute is not a judgement of land management; stands that are very well-managed and of high value from a silvicultural or agricultural perspective may have a low ecological condition rank.

Field name: Soil Hydrology

Field Abbreviation: SOIL_HYDRO

Definition: soil hydrology describes how fast water drains through the soil:

Field Values:	Value Definition:
• xeric	Deep, well drained to excessively drained sands or gravelly sands; typical of sandhills or well drained soils on the rocky substrates of montane longleaf.
• sub-mesic	Moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture; typical of upland pine (clay hills) and lower slopes of some montane areas.
• mesic	Somewhat poorly drained soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture; typical of mesic flatwoods.
• hydric	poorly drained soils that have a high water table, soils that have a clay layer or other impervious material at or near the surface; typical of wet flatwoods.

Rationale: structure and composition of LLP systems is related to soil hydrology. Values for this field will help to classify the historic or current natural community, which may be useful for species habitat mapping and land use planning.

Field Name: Comments

Field Abbreviation: COMMENTS

Definition: additional information about the site and/or about rare species observed, if any.

Rationale: allows the field evaluator to provide any additional comments.

Note: the SE LEO RA vegetation attributes rely on the USDA NRCS Plants Database (USDA, NRCS 2018) for classification of growth habit for vascular plants. The USDA recognizes these growth habits include: forb/herb, graminoid, shrub, subshrub, tree, and vine. The SE LEO RA protocol definition of shrub is all woody vegetation below 10 ft in height, and includes as woody the USDA classes shrubs, subshrubs, trees and vines if under 10 ft. The USDA classification does not distinguish woody from herbaceous vines; for the SE LEO RA we anticipate that most vines observed and appreciably contributing to cover will be woody (*Vitis* spp., *Smilax* sp., *Gelsiminum* spp. for example. *Rubus* spp. are considered by USDS as subshrubs and thus in the LEO RA are counted as woody.

Guidance for Measuring Basal Area

Using the 10 factor prism, hold prism at eye level and at a comfortable distance from the eye with the bottom edge of the prism parallel to the ground. Sight a tree at approximately breast height (4.5 ft from ground). The prism offsets an image of the tree bole. Count "in" trees according to the position of this offset image in the prism, relative to the actual tree bole. If the offset image overlaps the tree, the tree is counted as "in." If there is no overlap at all, the tree is not counted. The first case of borderline trees (i.e. those trees whose offset image is not clearly overlapping or separated, but the edges align) is counted; thereafter every other borderline tree is counted. Conduct the count with the prism held over the sample station center point while you pivot around the center 360º. Do not stand in one place while moving the prism around your body. You move around the prism. Multiplied your count by 10 to determine basal area per acre. This is the final number to record.

References

NatureServe. 2018. Field Guide of Southern Open Pine Rapid Assessment Metrics (v1.9) (Aug 29). Durham, NC.

America's Longleaf Restoration Initiative. 2014. General Longleaf Pine Maintenance Condition Class Metrics.

Florida Natural Areas Inventory and Florida Forest Service. 2018. Longleaf Pine Ecosystem Geodatabase v.4 Final Report. Sept 2018.

USDA, NRCS. 2018. The PLANTS Database (http://plants.usda.gov, 21 December 2018). National Plant Data Team, Greensboro, NC 27401-4901 USA.

Miller, J., Chambliss, Loewenstein, N. 2010. A Field Guide for the Identification of Invasive Plants in Southern Forests. General Technical Report SRS–119. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 126 p. https://www.srs.fs.fed.us/pubs/gtr/gtr_srs119.pdf
https://www.fs.usda.gov/treesearch/pubs/35292

Appendix D. List of LEO Rapid Assessment Training Materials

List of LEO Rapid Assessment Training Materials

1_LEO_RA_Training_Intro_2020xxxx.pptx: Overview of LEO project with focus on field survey components.

2_LEO_Collector ipad Protoco_2020xxxx.pdf: Written description of Collector set-up, with reference to RA protocol and Collector Interface pdfs

3_LEO_RA_Training_ipadCollector_Interface2020xxxx.pdf: Slides with screenshots to demonstrate use of Collector for LEO project. We have versions for Collector Classic (Android) and Collector for iPad.

4_LEO_RA_Training_Attributes_2020xxxx.pptx: Slides describing each attribute with interpretation/collection guidance.

5a_LEO_Rapid_Assessment_Field_Protocol_2020xxxx.pdf: Written document with complete field survey protocol.

5b_LEO_RA_Attribute_Table_ 2020xxxx.pdf: Succinct tabular version of attributes, for quick reference.

6_LEO RA_Logistics_and_Field_QC_2020xxxx.pptx: Slides used for discussion of parsing survey area into zones and for field data QC. Reiterates QC rules from p.9 of RA protocol and provides image with examples.

Other docs that might be useful:

Flyer_for_FieldSurveyors_Mar2020.pdf: Brief ½ page synopsis of project, for giving to public encountered during field surveys.

Collector Quick Reference 2-pager for Android.pdf: Collector help sheet, for use in the field. Currently only for Android.

LEO_attribute_list_2020xxxx.: short list of attributes (1 page)

LEO_RA_Attribute_descriptions_2020xxxx: attribute descriptions only (excerpted from Protocol)

LEO_RA_Essential_Atr_for_a_LLP_site_2020xxxx: identified first for Tall Timbers for data collection in fire monitoring; what we consider the "bare essential" condition attributes. For use in ongoing monitoring programs that want to be consistent with LEO. This is a subset of the LEO RA required attributes.

Appendix E. Field Surveyors for the LEO Project, 2019-2023

Field Surveyors for the LEO Project, Phase 1, 2019-2021

LIT Landscape	Field Surveyor(s)
Altamaha/Ft. Stewart Longleaf Restoration Partnership	Flatwoods Ecosystem Services LLC; The Longleaf Alliance (TLA) staff; LIT partners
Apalachicola Regional Stewardship Alliance	Upland Ecological, LLC
Cape Fear Arch Conservation Collaboration	TNC-ORISE position; trained volunteers
Chattahoochee Fall Line Conservation Partnership	Georgia Forestry Commission; Regional Environmental Specialists, LLC
Desoto-Camp Shelby LIT	Holmes Forestry; USFWS staff
Gulf Coastal Plain Ecosystem Partnership	Regional Environmental Specialists, LLC
North Carolina Sandhills Conservation Partnership	TNC-ORISE position; trained volunteers
Okefenokee and Osceola LIT	TLA staff
Onslow Bight Conservation Forum	TNC-ORISE position; trained volunteers
Sewee Longleaf Conservation Cooperative	Sabine & Waters, Inc.; TLA staff
SoLo-ACE Longleaf Partnership	Sabine & Waters, Inc; TLA staff
Talladega-Mountain Longleaf Conservation Partnership	Regional Environmental Specialists, LLC
Texas Longleaf Implementation Team	Azimuth Forestry
West-Central Louisiana Ecosystem Project	Regional Environmental Specialists, LLC

Field Surveyors for the LEO Project, Phase 2, 2021-2023

State	Field Surveyor(s)
Texas	Azimuth Forestry Services
Louisiana	Jacob Ecological Services; TLA staff
Mississippi	TLA staff
Alabama	Upland Ecological
Georgia	Lanier Forestry & Environmental, Wildcat Land Investments, Flatwoods Ecosystem Services
South Carolina	Sabine & Waters, TLA staff
North Carolina	Ember Alliance, TNC partners, TLA staff

Appendix F. Crosswalk of LEO 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 G. LEO Attribute Quality and Completeness

LEO 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 highly likely based on ancillary data source; for example, data indicate wiregrass presence but without tree species data.

U-B. Longleaf pine presence is unknown but potential based on remote interpretation. This includes sites classified as longleaf ecosystems based on aerial imagery interpretation, any LEO field polygons that remain unassessed, or other remotely sensed or modeled datasets that identify potential longleaf pine. Note that any ground truthed areas within such maps would fall into a higher tier.

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

Appendix H. Geodatabase Data Dictionary for SE_LEO_v2.gdb (revised September 2023)

Geodatabase Data Dictionary for SE_LEO_v2.gdb

GDB Feature Classes and Tables

LLP_Occurrence_Status_v2 - Feature Class
LLP_Mgmt_Categories_v2 - Feature Class
tbl_LEO_to_Mgmt_Category_Lookup - Table

LLP_Occurrence_Status_v2 - FeatureClass

Name LLP_Occurrence_Status_v2
ShapeType Polygon
FeatureType Simple
AliasName LLP_Occurrence_Status_v2
Description The LLP_Occurrence_Status_v2 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 Southeast Longleaf Pine Ecosystem Occurrences (LEO) geodatabase. The purpose of the SE LEO GDB to provide data on the distribution and condition of longleaf pine ecosystems in the southeast.

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 two categories: Existing Partner Data (i.e., state agency, federal agency, NGO, etc) or LEO Field Assessment (i.e., rapid assessment data collected as part of the LEO or FL longleaf projects).
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

Field	DataType	Length	AliasName	Description
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.
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.

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
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

LLP_Mgmt_Categories_v2 – Feature Class

Name LLP_Mgmt_Categories_v2
ShapeType Polygon
FeatureType Simple
Description The LLP_Mgmt_Categories_v2 is a polygon feature class of confirmed longleaf pine locations, with attributes for ecological condition. These data were developed as part of the Southeast Longleaf Pine Ecosystem Occurrences (LEO) geodatabase. The purpose of the SE LEO GDB to provide data on the distribution and condition of longleaf pine ecosystems in the southeast.

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
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 two categories: Existing Partner Data (i.e., state agency, federal agency, NGO, etc) or LEO Field Assessment (i.e., rapid assessment data collected as part of the LEO or FL longleaf projects).
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.

Field	DataType	Length	AliasName	Description
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.
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.
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.

Field	DataType	Length	AliasName	Description
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
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
FLAT_TOPS_mc	String	25	FLAT_TOPS_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 the tbl_LEO_to_Mgmt_Category_Lookup within the LEO GDB, or Appendix E of the LEO GDB Final Report v.1 for the crosswalk scheme.
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	
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	

Field	DataType	Length	AliasName	Description
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	

tbl_LEO_to_Mgmt_Category_Lookup – Table

Name tbl_LEO_to_Mgmt_Category_Lookup

Description The LEO to Mgmt Category Lookup Table is a tool for crosswalking detailed LEO attribute values (cover classes, etc.) associated with longleaf sites, to be assigned into ALRI categories of Maintain, Improve, Restore (MIR) for viewing on a map and summarizing in reports. In the LEO GDB, FNAI uses thresholds for maintenance condition from the LPC Longleaf Pine Maintenance Condition Class Definitions (ALRI 2014) to the extent feasible.

The LEO project follows ALRI/LPC metrics in applying one set of criteria across all longleaf pine ecosystem types. Although this approach is appropriate for general summaries and a rangewide snapshot of condition, users may want to adjust criteria for use at finer scales. A crosswalk 'lookup' table is provided with the GDB so users can modify and update the crosswalk for their purposes.

Appendix I. LEO GDB v2 User Guide

Steps for Accessing Data

1. Fill out and return the LEO Data License Agreement to

   Amy Knight (aknight@fnai.fsu.edu); or Carly Voight (cvoight@fnai.fsu.edu)

   You will receive a link via email to download a zip file: LEO_GDB_v2_YearMo.zip

2. Extract the zip. Contents will extract into a folder named LEO_GDB_v2.

3. The folder contents are a File Geodatabase: SE_LEO_v2.gdb and related content, including documentation.

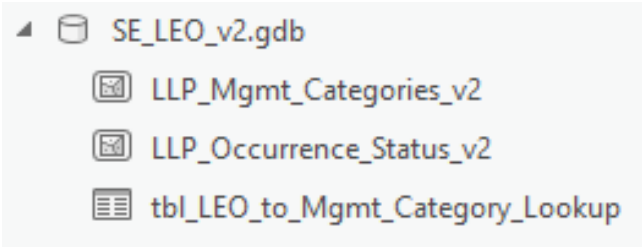
4. You may load the contents (feature classes & tables) of the SE_LEO_v2.gdb into your own GIS maps; or open a map document provided for ArcMap (mxd) or ArcPro (mapx) to display the LEO GDB layers.

Users are encouraged to refer to the metadata associated with each feature class and the LEO GDB v.2 report for details about attributes.

For technical data questions please contact Amy Knight (850-339-2773) or Carly Voight (850-224-8207)

SE_LEO_v2.gdb

CONTENTS



Feature Classes

LLP_Occurrence_Status_v2 polygons

Includes confirmed longleaf pine sites, potential longleaf sites where occurrence status remains unknown, and stands that are indicated not to be longleaf sites.

LLP_Mgmt_Categories_v2 polygons

Includes confirmed longleaf sites with ecological condition attributes from multiple sources that have been crosswalked into management classes for Maintain & Improve.

Tables

tbl_LEO_to_Mgmt_Category_Lookup: Contains LLP condition attribute values and corresponding management category values

SE_LEO_v2_Map.mxd for ArcMap Users

Default View for SE_LEO_v2_Map.mxd
(A mapx file is provided for ArcPro users)

Layers occur in Groups:

LONGLEAF PINE OCCURRENCE STATUS

Each layer within this group has a definition query on the LLP_Occurrence_Status field of the *LLP_Occurrence_Status_v2* feature class.

ECOLOGICAL CONDITIONS

Expand this group to view layers based on 19 different condition attributes. Only polygons with confirmed longleaf are included in this group. All layers in this group are based on the *LLP_Mgmt_Categories_v2* feature class.

OTHER VIEWS

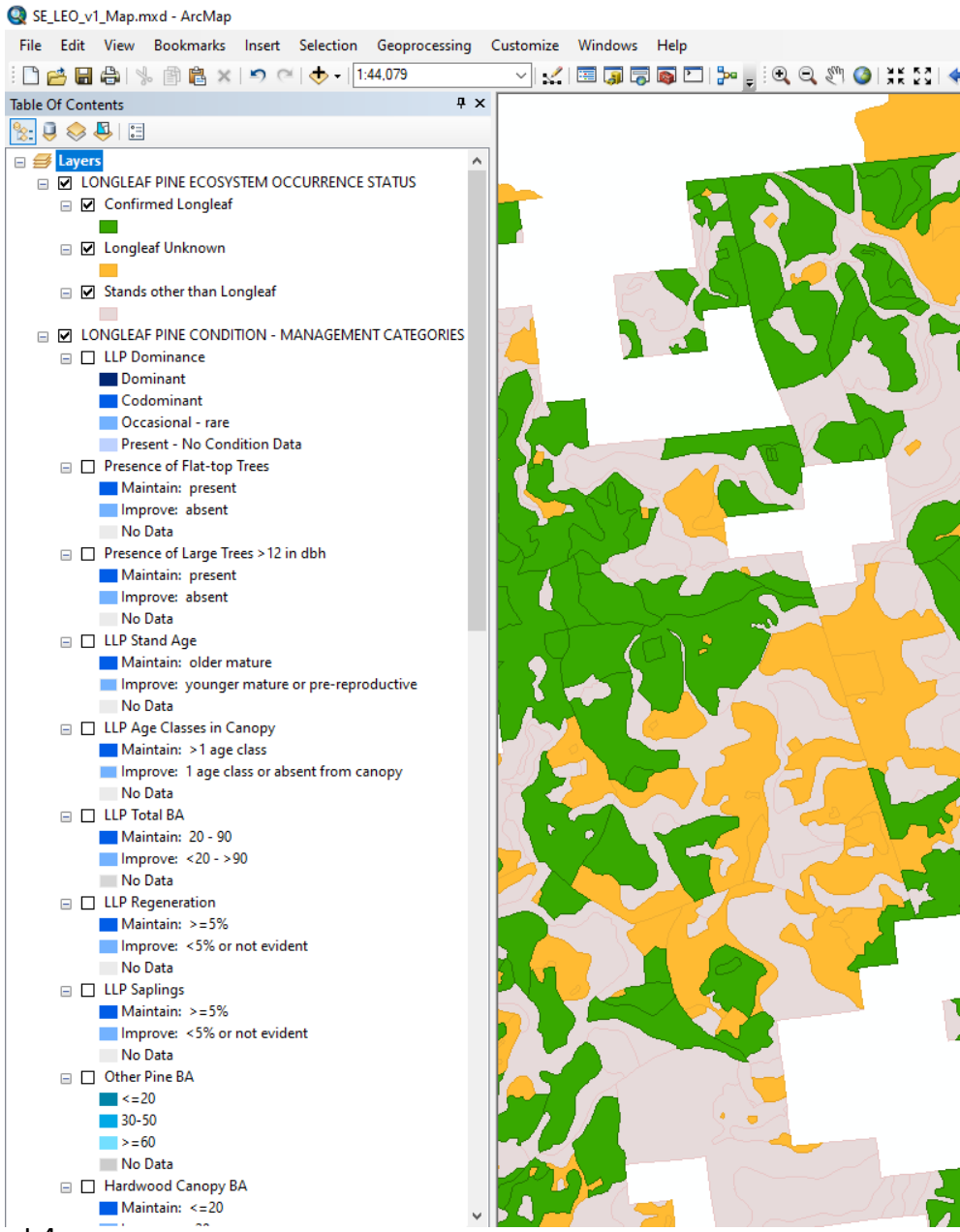
Other layers are available at the bottom of the contents window. Scroll down or collapse the Conditions group to view them:

Longleaf Occurrence by Data Source

Longleaf Occurrence s by Owner Type

Longleaf Pine Occurrences (as a single layer either filled or with outlines only)

All layers in this group are based on the *LLP_Mgmt_Categories_v2* feature class.



Appendix J. Partner Data Sources in LEO GDB v2

Partner Data Sources in LEO GDB v2

Source Name	State	Dataset Description	Data Extent
Alabama Department of Conservation and Natural Resources	AL	Stand polygons with associated attributes for Autauga WMA	LLP stands within Autauga WMA
Alabama Department of Conservation and Natural Resources	AL	Stand polygons with associated attributes for Barbour WMA	LLP stands within Barbour WMA
Alabama Forestry Commission	AL	Stand polygons for stands planted in LLP on 3 State Forests	Subset of stands on Choccolocco, Geneva, and Little River State Forests in AL
Auburn University	AL	Stand polygons with associated attributes for lands owned by Auburn University.	LLP stands within 6 properties owned by Auburn University
Auburn University - Solon Dixon Forestry Education Center	AL	Stand polygons with associated attributes for SDFEC	LLP stands within SDFEC
National Park Service	AL	Burn units of Horseshoe Bend NMP, in which LLP occurrence is categorized by GPSed LLP trees	Burn units within Horseshoe Bend NMP
The Nature Conservancy - Alabama Field Office	AL	Original dataset was boundaries of preserves that contain longleaf pine; FNAI delineated longleaf stands for the Splinter Hill Bog Preserve based on aerial photo interpretation.	TNC preserve boundaries in southern AL
US Dept. of Defense - Fort Rucker	AL	Stand polygons with associated attributes for Fort Rucker	Fort Rucker
Carolina Vegetation Survey Database	FL	Longleaf pine locations mined from plot database; downloaded from BISON; data available for 2000-2003	Multiple sites across FL
Cooperative Land Cover v.3x	FL	Detailed land cover map for Florida with boundaries primarily delineated from aerial photos. Polygon sources vary from CLC v2.3 through v3.2.5	Florida
DEP CE Monitoring Report 2016	FL	Monitoring report for Conservation Easements held by the Florida Department of Environmental Protection with description of natural resources	Florida Conservation Easements
Eglin AFB v3	FL	Eglin Air Force Base - Forest Stand Inventory Database	Eglin AFB
FFS Compiled Longleaf Stands	FL	Florida Forest Service compiled stand data from existing land records (private lands, SRMWD, Tall Timbers, etc) in 2012; spatial data varied by source and precision	Multiple sites across FL
FFS Cooperative Forestry Assistance Database	FL	Database with locations and types of forestry assistance to landowners; includes records of longleaf planting	Multiple sites across FL
FFS State Lands Inventory	FL	Florida Forest Service Forest Stands, including stand statistics, from the Forestry Data Model geodatabase provided in 2014 and 2017	FL State forests
Florida Park Service Management Plan	FL	State Park management plan with description of natural resources on the park	FL State parks

Source Name	State	Dataset Description	Data Extent
Florida Park Service v3	FL	Natural community labels and boundaries for state parks	FL State parks
FNAI Compiled Data	FL	Includes a variety of data types compiled by FNAI, including Element Occurrence records and RCW cluster centers	Multiple sites across FL
FNAI Field Survey	FL	Includes a variety of FNAI field surveys, including detailed natural community mapping on many state and federal conservation lands	Multiple sites across FL
FNAI Review	FL	Indicates that longleaf information is derived from expert knowledge by FNAI staff	Multiple sites across FL
Fox Lake Sanctuary Management Plan, Brevard Co	FL	County management plan with natural resource information	Fox Lake Sanctuary
FWC Landowner Assistance Program (non-NRCS) v3	FL	Non-NRCS Longleaf Plantings on LAP Management Units; Non-NRCS Sandhill Management Units	Multiple sites across FL
FWC v3	FL	Longleaf Plantings on Wildlife Management Areas	FL Wildlife Management Areas
Geoform v4	FL	Online data collection tool for longleaf pine developed for the LPEGDB.	Multiple sites across FL
INaturalist 2016	FL	Citizen scientist database for species information; research-grade records downloaded from BISON	Multiple sites across FL
NWFWMD LL Stands 2018	FL	Northwest Florida Water Management District Longleaf Pine stands; includes stands where longleaf pine was >50% of canopy species	Sites managed by Northwest Florida Water Management District
Pasco Co.	FL	Map of longleaf stands on lands managed by Pasco County	Sites managed by Pasco County
RCW Data	FL	RCW cavity tree records from Apalachicola National Forest, provided in 2015	Apalachicola NF
Resource Management Service, LLC (RMS) v3	FL	Longleaf polygons provided by RMRS within the Coastal Headwaters Longleaf Forest Florida Forever Project	Coastal Headwaters Longleaf Forest Florida Forever Project
SJRWMD Stands v4	FL	St. Johns River Water Management District Forest Stands (2014 and 2018); Inventory Plot Data and Fire Mangement Unit data were also provided in 2014	Sites managed by St. Johns River Water Management District
SRWMD Stands v4	FL	Suwannee River Water Management District - Longleaf planting data	Sites managed by Suwannee River Water Management District
USFS ECM v3	FL	Ecological Condition Model for 3 National Forests (2014)	National Forests in FL
USFS Stands	FL	National Forest Stands provided in 2014 and 2018	National Forests in FL
Georgia Department of Natural Resources	GA	Stand polygons with associated attributes for WMAs	Forest stands within GA WMAs
Georgia Department of Natural Resources	GA	Vegetation Classification with associated attributes	Multiple WMAs in GA

Source Name	State	Dataset Description	Data Extent
Georgia Department of Natural Resources, Wildlife Division	GA	Vegetation Classification with associated attributes for the coast of GA	Five counties along the coast of GA; excluded overlaps with all other existing datasets including Ft. Stewart, GA State Parks, GA Wildlife Management Areas, and Okefenokee NWR
Georgia Department of Natural Resources, Wildlife Division	GA	Vegetation Classification with associated attributes for state parks in GA	Boundaries of multiple state parks in GA; excluded overlaps with GADNR_WMA_Stands
Georgia Forestry Commission	GA	Stand polygons with associated attributes for DMSF	LLP stands within DMSF
Tall Timbers Research Station & Land Conservancy	GA	Polygons for areas of native groundcover surveyed by TTRS with associated attributes. **Excluded from web map.*	Discrete sites in southwest GA - Grady and Thomas Counties
Tall Timbers Research Station & Land Conservancy	GA	Polygons for Special Natural Areas within TTRS Conservation Easements, with associated attributes	Discrete sites in southwest GA
The Jones Center at Ichauway	GA	Stand polygons with associated attributes for The Jones Center	Forest stands in The Jones Center
The Nature Conservancy - Georgia Field Office	GA	Forest inventory of stands in TNC-GA preserves	Forest stands within multiple TNC preserves in western GA; excl.d overlaps with GADNR WMA Stands
U.S. Army - Fort Gordon	GA	Stand polygons with associated attributes for Ft. Gordon, GA	Fort Gordon
US Army Garrison Ft. Stewart	GA	Stand polygons with associated attributes for Fort Stewart	Fort Stewart
US Dept. of Defense, Fort Benning	GA	Stand polygons with associated attributes for Fort Benning	Forest stands within Fort Benning
US Fish and Wildlife Service, Okefenokee National Wildlife Refuge	GA	Stand polygons with associated attributes for Okefenokee NWR	Forest stands associated with upland habitats within Okefenokee NWR
LA Dept Wildlife & Fisheries	LA	Stand polygons with associated attributes	Multiple WMAs in LA
LA Dept Wildlife & Fisheries	LA	LLP occurrence polygons for two WMAs managed by LA Dept Wildlife & Fisheries	Polygons with LLP on Alexander State Forest WMA and Marsh Bayou WMA
The Nature Conservancy - Louisiana	LA	LLP occurrence polygons for TNC preserves	LLP sites within multiple TNC preserves in LA
US Dept. of Defense, Fort Polk Army Base	LA	Stand polygons with associated attributes for Fort Polk	Forest stands in Fort Polk; excluded overlaps with FS_VEG
Mississippi Dept of Wildlife, Fisheries, and Parks	MS	Longleaf pine planting sites associated with MSDWFP Landowner Incentive Program	Discrete sites throughout MS
Mississippi Dept of Wildlife, Fisheries, and Parks	MS	Original dataset was boundaries of WMAs that contain longleaf pine; FNAI delineated longleaf stands for Ward Bayou WMA based on pdf map provided by MSDWFP, and extracted pinelands based on aerial photo interpretation for Marion and Mars WMAs.	Pine stands within boundaries of 4 WMAs
U. S. Fish and Wildlife Service	MS	Longleaf pine planting sites within Bogue Chitto National Wildlife Refuge	Discrete sites within refuge boundary

Source Name	State	Dataset Description	Data Extent
U. S. Fish and Wildlife Service	MS	Compartment boundaries containing longleaf pine on MSCNWR and GBNWR	Subset of compartments within refuge boundary
U. S. Forest Service	Multi	Stand polygons with associated attributes for National Forests	Fee boundaries of National Forests - Region 8; extracted subset within longleaf pine range
Other	n/a	Restricted source(s)	n/a
Camp Lejeune	NC	Stand polygons with associated attributes for Camp Lejeune	Forest stands on Camp Lejeune
NCFS LLP Occurrence Database	NC	Polygons for LLP management areas/stands on private lands, compiled by NC Forest Service; only non-sensitive data are shared	Forest stands thoughout NC
North Carolina Forest Service	NC	Stand polygons with associated attributes for Bladen Lakes SF	Bladen Lakes SF; excluded overlaps with NC_TNC
North Carolina State Parks & Recreation	NC	Vegetation Classification with associated attributes for state parks in NC	Multiple state parks in NC; excluded overlaps with NC_TNC_Bladen
North Carolina Wildlife Resources Commission	NC	Stand polygons with associated attributes for NCWRC managed lands	Multiple NCWRC managed lands
North Carolina Wildlife Resources Commission - Corporate Cooperative Upland habitat Restoration and Enhancement	NC	LLP occurrence polygons	Discrete sites in southern NC
The Nature Conservancy - North Carolina	NC	Spatial condition class data from field-based surveys for multiple sites in NC	Discrete sites in southern NC
The Nature Conservancy - North Carolina	NC	Potential Upland Habitat assessement within the NCSCP	Descrete sites in NC; excluded overlaps with Ft. Bragg and NC WRC Stands
US Dept. of Defense, Fort Bragg Army Base	NC	Stand polygons with associated attributes for Fort Bragg	Forest stands in Fort Bragg; excluded overlaps with NC_TNC, NC_WRC, NC_SP
National Park Service	SC	Vegetation Classification with associated attributes for Congaree NP	Congaree NP
SC DNR, Wildlife and Freshwater Fisheries Division	SC	Stand polygons with associated attributes for SC Heritage Preserves	Preserves throughout SC
SC DNR, Wildlife and Freshwater Fisheries Division; and The National Wild Turkey Federation	SC	Stand polygons and associated attributes for Hitchcock Woods	Forest stands on Hitchcock Woods
South Carolina Department of Natural Resources, Wildlife and Freshwater Fisheries Division	SC	Stand polygons with associated attributes for SC DNR owned and managed lands	Multple WMAs and reserves in SC; erased edge overlap with FSVEG
South Carolina State Forest	SC	Stand polygons with associated attributes for two state forests in SC	Forest stands within Manchester SF and Sandhills SF

Source Name	State	Dataset Description	Data Extent
The Belle W. Baruch Foundation, Hobcaw Barony	SC	Stand polygons with associated attributes for Hobcaw Barony	Forest stands on Hobcaw Barony
U.S. Forest Service - Francis Marion National Forest	SC	Stand polygons with condition attributes derived from rapid assessement plots, LLP condition model, & prescribed fire data for Francis Marion National Forest	Forest stands on Francis Marion National Forest
US Dept. of Defense, Fort Jackson Army Base	SC	Stand polygons with associated attributes for Fort Jackson	Forest stands in Fort Jackson
US Fish and Wildlife Service, Carolina Sandhills National Wildlife Refuge	SC	Stand polygons with associated attributes for CSNWR	Forest stands within CSNWR
Texas A&M Forest Service	TX	LLP occurrence polygons for TX state forests	Subset of stands within state forests in eastern TX
Texas Parks and Wildlife Department, Nongame and Rare Species Program	TX	Vegetation Classification with associated attributes	Discrete sites in eastern TX
TexMark Timber Treasury, L.P.	TX	LLP stand polygons for stands owned by TexMark Timber Treasury, L.P.	Forest stands for multiple locations in east Texas.
The Nature Conservancy - Texas	TX	Longleaf pine assessment data for TNC preserves in TX.	TNC preserves in east Texas
U.S. Park Service - Big Thicket National Preserve	TX	LLP occurrence polygons for Big Thicket National Preserve	Polygons with LLP on Big Thicket National Preserve

Appendix K. Rapid Assessment Results for LEO Phase 2

Rapid Assessment Field Survey Results for LEO Phase 2

This Appendix focuses on the results of field surveys for LEO Rapid Assessment (RA) Phase 2 sites. For a summary of all LEO RA data, including LEO Phase 1 and 2 and the Florida LPEGDB, see the main report. Phase 2 surveys were completed for 7,073 sites covering over 491,000 acres. Of this total, 31% were inaccessible (e.g., not viewable from a public road) and assigned a survey status of 'no access'; these were counted as surveyed but longleaf occurrence status remains unknown. Of the remaining accessible sites, 83% contained longleaf pine (Table K-1). The Rapid Assessment Phase 2 confirmed 278,873 acres of longleaf pine, mostly on private lands through roadside surveys.

Table K-1. The survey status of potential longleaf pine sites evaluated during the Phase 2 Rapid Assessment.

Survey Status	**Number of RA sites**	**% of all sites**	**% of accessible sites**
Longleaf Pine Present – Assessed	3,695	*52*	*76*
Longleaf Pine Present – Not Assessed	347	*5*	*7*
Longleaf Absent	811	*12*	*17*
No Access	2,220	*31*	n/a
Total	7,073		

Rapid Assessment Attributes – Phase 2

Longleaf dominance

Where longleaf pine was observed it was mostly dominant (57%) or codominant (23%) (Table K-2). The field surveys also documented more than 41,108 acres (15% of RA acreage) where longleaf was occasional to rare, indicating potentially restorable sites.

Table K-2. Relative dominance of longleaf pine within RA sites – Phase 2.

Longleaf Dominance	**Acres**	***%***
Dominant	160,161	*57*
Codominant	63,957	*23*
Occasional – Rare	41,108	*15*
Present - No condition data	13,647	*5*
Total	**278,873**	***100***

Natural vs. planted longleaf

Initial delineation of RA survey sites focused on natural stands where potential longleaf could be interpreted from aerial photo signatures. Phase 2 focused on natural stands but included the delineation of more planted stands than Phase 1. Planted stands make up 37% by acreage of RA longleaf sites surveyed in Phase 2. Planted longleaf, especially young plantation, was difficult to discern and we relied on opportunistic observations by field surveyors to capture these stand types.

Fire evidence

Evidence of frequent or recent fire was recorded on 44% of Rapid Assessment Phase 2 sites (by acreage); 36% of longleaf acres confirmed by RA Phase 2 had no visible evidence of fire (Table K-3).

Table K-3. Fire evidence observed within RA survey sites – Phase 2 (longleaf pine present).

Fire Evidence Category	**Total Acres**	***%***
Frequent	113,724	*41*
Recent, Not Frequent	7,617	*3*
Infrequent	27,570	*10*
No Evidence	102,331	*36*
No Data	27,631	*10*
Total	**278,873**	***100***

Other LEO condition attributes

As described in the methods, 17 of the LEO Rapid Assessment condition attributes were crosswalked into categories for maintain or improve (see Appendix F for crosswalk) so that the RA data could be displayed and interpreted along with data from other sources in the LEO GDB. The proportion of RA acreage in maintain vs. improve status for each attribute is shown in Figure K-1.

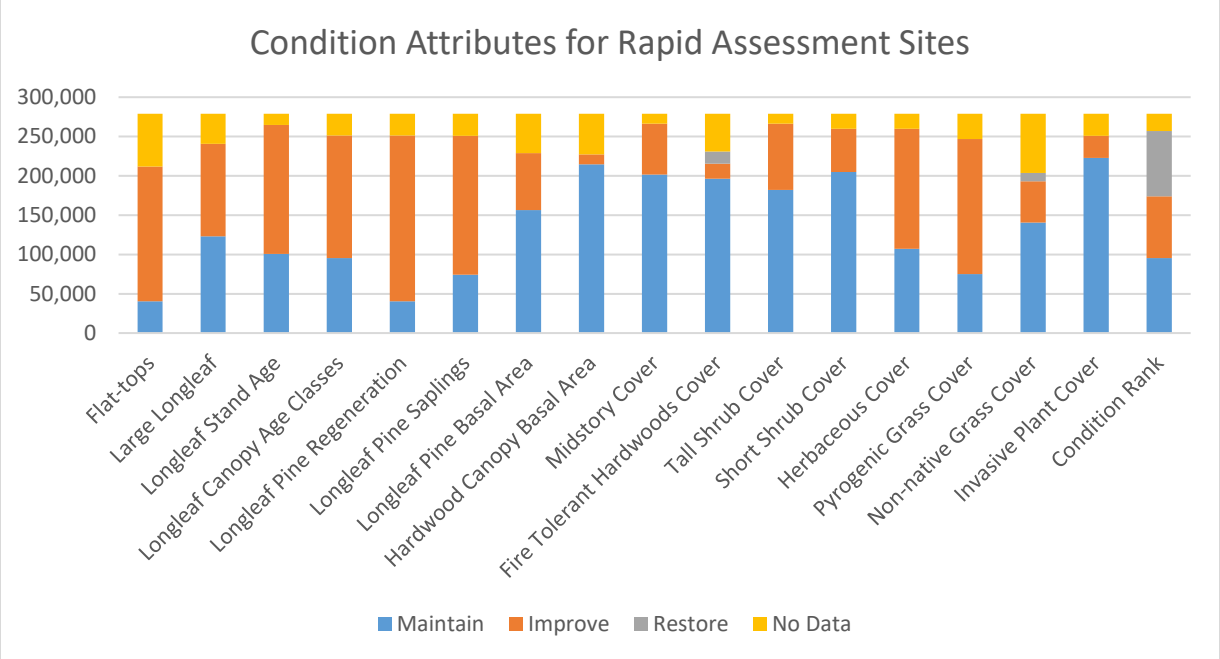


Figure K-1. Longleaf pine acreage within management categories for each of 17 condition attributes derived from the LEO Rapid Assessment (RA) Phase 2.

Other grassland ecosystems

For sites where longleaf pine was absent, surveyors had the option to record the occurrence of functioning grassland ecosystems. For example, “Other pine grassland” was used to indicate several conditions including other natural pine systems (e.g., shortleaf or pond pine dominated systems), or areas where longleaf had been extirpated and replaced with other species such as loblolly or slash pine, but that are maintained as open pine grasslands (e.g., lands managed with fire for wildlife such as quail). Similarly, they could also note other pyrogenic grassland natural communities; and sites where the vegetation was clearly that of a longleaf ecosystem although pines were not observed. Identification of these sites was not comprehensive but may be useful at a local scale. There were 129 sites (ca. 23,000 acres) in these categories, recorded in Phase 2.