# Field Guide of Southern Open Pine Rapid Assessment Metrics (v2.0)

NatureServe

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*Metric Name:*

Canopy Southern Yellow Pine Basal Area

**Definition:** Combined basal area of southern yellow pine species appropriate to the Southern Open Pine Grouping (broad ecosystems used in this document) of the site, primarily longleaf pine or shortleaf pine. The cross section area of longleaf pine, slash pine, South Florida slash pine, shortleaf pine, and/or loblolly pine tree stems (defined here as square feet /acre) for trees inches DBH or greater, and measured using a 10x basal area prism or gauge at four (4) locations near the rapid assessment area center and (optionally) also at the center point of the rapid assessment area, or by measuring each longleaf pine tree 5 inches DBH or greater within the defined area plot or assessment area.

**Measurement Protocol**: Basal area is measured for the appropriate southern yellow pine species (such as longleaf pine, slash pine, South Florida slash pine, shortleaf pine, and loblolly pine) 5" diameter or greater at 4.5 feet (54"), diameter at breast height (DBH).

**Option 1**: A 10x factor basal area prism or gauge is used at four (4) locations 33 feet (10 meters) from the outer edge of the assessment area, such as along tapes going north, east, south, and west through the assessment area center, and (optionally) also at the center of the assessment area. If assessment area is smaller than 1/8 acre (500 square meters), then four (4) basal area points should be 10 feet (3.0 meters) from assessment area center, to the north, east, south, and west. Trees are tallied together for the appropriate southern yellow pine species, according to the Southern Open Pine Grouping ecosystem type. At each basal area point, the tallied count of longleaf pine and/or other southern yellow pine is multiplied by the basal area factor of 10 (if using the 10x prism) to get the basal area values in $ft^2$/acre. The final value for the metric is the average of each of the basal areas from the 10x basal area prism points in the assessment area.

**Option 2**: Within the assessment area measure all appropriate southern yellow pines (longleaf pine, slash pine, South Florida slash pine, shortleaf pine, and/or loblolly pine) 5" diameter or greater at 4.5 feet (54"), diameter at breast height (DBH) in inches, then convert diameter measurements to $ft^2$ using formula:

Basal area (in $ft^2$) = 0.005454*$DBH^2$

For the final value of basal area, the value for the plot area must be converted to a value of basal area in $ft^2$/ acre. The conversion math will depend on the assessment area and its units of measure. If basal area prism is not used, the southern yellow pine tree diameters can all be listed for the defined assessment area, and the basal area in $ft^2$/acre can be calculated later. Divide the basal area sum by the plot size in acres to get basal area in square feet per acre. Generally, there is no need to do the basal area calculations in the field.

**Metric Rating**: Specify the narrative and numerical ratings for the metric, from excellent to poor. The values below represent results in ft$^2$/acre. Calculated values other than multiples of 10 are accommodated. The appropriate southern yellow pine species are listed in each table.

| Metric Rating | Dry & Mesic Longleaf Pine Woodlands |
| --- | --- |
| EXCELLENT (A) | 30-80 ft$^2$/acre basal area of longleaf pine (*Pinus palustris*) |
| GOOD (B) | 20 to <30 or >80 to 90 ft$^2$/acre basal area of longleaf pine (*Pinus palustris*) |
| FAIR (C) | 10 to <20 or >90 to 105 ft$^2$/acre basal area of longleaf pine (*Pinus palustris*) |
| POOR (D) | <10 or >105 ft$^2$/acre basal area of longleaf pine (*Pinus palustris*) |

| Metric Rating | Mesic Longleaf Pine Flatwoods |
| --- | --- |
| EXCELLENT (A) | 30-80 ft$^2$/acre basal area of longleaf pine (*Pinus palustris*), slash pine (*Pinus elliottii*), and/or South Florida slash pine (*Pinus elliottii* var. *densa*) |
| GOOD (B) | 20 to <30 or >80 to 90 ft$^2$/acre basal area of longleaf pine (*Pinus palustris*), slash pine (*Pinus elliottii*), and/or South Florida slash pine (*Pinus elliottii* var. *densa*) |
| FAIR (C) | 10 to <20 or >90 to 105 ft$^2$/acre basal area of longleaf pine (*Pinus palustris*), slash pine (*Pinus elliottii*), and/or South Florida slash pine (*Pinus elliottii* var. *densa*) |
| POOR (D) | <10 or >105 ft$^2$/acre basal area of longleaf pine (*Pinus palustris*), slash pine (*Pinus elliottii*), and/or South Florida slash pine (*Pinus elliottii* var. *densa*) |

| Metric Rating | Wet Longleaf & Slash Pine Flatwoods & Savannas |
| --- | --- |
| EXCELLENT (A) | 20-80 ft$^2$/acre basal area of longleaf pine (*Pinus palustris*), slash pine (*Pinus elliottii*), and/or South Florida slash pine (*Pinus elliottii* var. *densa*) |
| GOOD (B) | ≥10 to <20 or >80 to <90 ft$^2$/acre basal area of longleaf pine (*Pinus palustris*), slash pine (*Pinus elliottii*), or South Florida slash pine (*Pinus elliottii* var. *densa*) |
| FAIR (C) | 5 to <10 or 90 to <100 ft$^2$/acre basal area of longleaf pine (*Pinus palustris*), slash pine (*Pinus elliottii*), or South Florida slash pine (*Pinus elliottii* var. *densa*) |
| POOR (D) | <5 or ≥100 ft$^2$/acre basal area of longleaf pine (*Pinus palustris*), slash pine (*Pinus elliottii*), and/or South Florida slash pine (*Pinus elliottii* var. *densa*) |

| Metric Rating | Xeric Longleaf Pine Barrens |
| --- | --- |
| EXCELLENT (A) | 25-80 ft$^2$/acre basal area of longleaf pine (*Pinus palustris*) |
| GOOD (B) | >15 to <25 or >80 to 90 ft$^2$/acre basal area of longleaf pine (*Pinus palustris*) |
| FAIR (C) | 10 to 15 or > 90 to <100 ft$^2$/acre basal area of longleaf pine (*Pinus palustris*) |
| POOR (D) | <10 or ≥100 ft$^2$/acre basal area of longleaf pine (*Pinus palustris*) |

| Metric Rating | Dry & Mesic Highlands Pine Woodlands |
| --- | --- |
| EXCELLENT (A) | >35-75 ft$^2$/acre basal area of shortleaf pine (*Pinus echinata*) |
| GOOD (B) | 30 to 35 or >75 to 90 ft$^2$/acre basal area of shortleaf pine (*Pinus echinata*) |
| FAIR (C) | 10 to <30 or >90 to 110 ft$^2$/acre basal area of shortleaf pine (*Pinus echinata*) |
| POOR (D) | <10 or >110 ft$^2$/acre basal area of shortleaf pine (*Pinus echinata*) |

| Metric Rating | Dry & Mesic Highlands Pine Woodlands (Mountain Longleaf) |
|---|---|
| EXCELLENT (A) | >35-75 ft$^2$/acre basal area of longleaf pine (*Pinus palustris*) and shortleaf pine (*Pinus echinata*) |
| GOOD (B) | 30 to 35 or >75 to 90 ft$^2$/acre basal area of longleaf pine (*Pinus palustris*) and shortleaf pine (*Pinus echinata*) |
| FAIR (C) | 10 to <30 or >90 to 110 ft$^2$/acre basal area of longleaf pine (*Pinus palustris*) and shortleaf pine (*Pinus echinata*) |
| POOR (D) | <10 or >110 ft$^2$/acre basal area of longleaf pine (*Pinus palustris*) and shortleaf pine (*Pinus echinata*) |

| Metric Rating | Dry & Mesic Hilly Pine Woodlands |
|---|---|
| EXCELLENT (A) | 30-85 ft$^2$/acre basal area of shortleaf pine (*Pinus echinata*) and/or loblolly pine (*Pinus taeda*) |
| GOOD (B) | 20 to <30 or >85 to 100 ft$^2$/acre basal area of shortleaf pine (*Pinus echinata*) and/or loblolly pine (*Pinus taeda*) |
| FAIR (C) | 10 to <20 or >100 to 115 ft$^2$/acre basal area of shortleaf pine (*Pinus echinata*) and/or loblolly pine (*Pinus taeda*) |
| POOR (D) | <10 or >115 ft$^2$/acre basal area of shortleaf pine (*Pinus echinata*) and/or loblolly pine (*Pinus taeda*) |

| Metric Rating | Upper Coastal Plain Pine Flatwoods |
|---|---|
| EXCELLENT (A) | 30-80 ft$^2$/acre basal area of shortleaf pine (*Pinus echinata*) and/or loblolly pine (*Pinus taeda*) |
| GOOD (B) | 20 to <30 or >80 to 90 ft$^2$/acre basal area of shortleaf pine (*Pinus echinata*) and/or loblolly pine (*Pinus taeda*) |
| FAIR (C) | 10 to <20 or >90 to 110 ft$^2$/acre basal area of shortleaf pine (*Pinus echinata*) and/or loblolly pine (*Pinus taeda*) |
| POOR (D) | <10 or >110 ft$^2$/acre basal area of shortleaf pine (*Pinus echinata*) and/or loblolly pine (*Pinus taeda*) |

*RANK FACTOR: VEGETATION*

*Metric Name:*

Southern Yellow Pine Canopy Cover

**Definition:** Percentage of the ground within the plot covered by the general extent of southern yellow pine canopy trees, as determined by visual (ocular) estimate. Southern yellow pine canopy is defined as the canopy trees of longleaf pine, slash pine, South Florida slash pine, shortleaf pine, or loblolly pine with stems 5" diameter or greater at 4.5 feet (54"), diameter at breast height (DBH).

**Measurement Protocol**: For assessment area, the percentage of the ground within the plot covered by the general extent of southern yellow pine canopy trees, as determined by visual (ocular) estimate. Cover is defined as the percentage of ground surface obscured by the vertical projection of all aboveground parts of a given species onto that surface, estimated visually by the field researcher (Peet et al. 1998). Spaces between leaves and stems also count as cover. Southern yellow pine canopy is defined as only the canopy trees of longleaf pine, slash pine, South Florida slash pine, shortleaf pine, or loblolly pine with stems 5" diameter or greater at 4.5 feet (54"), diameter at breast height (DBH).

**Metric Rating**:  Specify the narrative and numerical ratings for the metric, from excellent to poor.

| Metric Rating | *Dry & Mesic Longleaf Pine Woodlands* |
|---|---|
| EXCELLENT (A) | 30-65% canopy cover of longleaf pine (*Pinus palustris*) |
| GOOD (B) | >20 to <30% canopy cover or >65 to 75% canopy cover of longleaf pine (*Pinus palustris*) |
| FAIR (C) | 10-20% canopy cover or >75 to 85% canopy cover of longleaf pine (*Pinus palustris*) |
| POOR (D) | <10% cover or >85% canopy cover of longleaf pine (*Pinus palustris*) |

| Metric Rating | *Mesic Longleaf Pine Flatwoods* |
|---|---|
| EXCELLENT (A) | 30 to 65% canopy cover of longleaf pine (*Pinus palustris*), slash pine (*Pinus elliottii*), and/or South Florida slash pine (*Pinus elliottii* var. *densa*) |
| GOOD (B) | 20 to <30% canopy cover or >65 to 75% canopy cover of longleaf pine (*Pinus palustris*), slash pine (*Pinus elliottii*), and/or South Florida slash pine (*Pinus elliottii* var. *densa*) |
| FAIR (C) | 10 to <20% canopy cover or >75 to 85% canopy cover of longleaf pine (*Pinus palustris*), slash pine (*Pinus elliottii*), and/or South Florida slash pine (*Pinus elliottii* var. *densa*) |
| POOR (D) | <10% canopy cover or >85% canopy cover of longleaf pine (*Pinus palustris*), slash pine (*Pinus elliottii*), and/or South Florida slash pine (*Pinus elliottii* var. *densa*) |

| Metric Rating | *Wet Longleaf & Slash Pine Flatwoods & Savannas* |
|---|---|
| EXCELLENT (A) | 20-65% canopy cover of longleaf pine (*Pinus palustris*), slash pine (*Pinus elliottii*), and/or South Florida slash pine (*Pinus elliottii* var. *densa*) |
| GOOD (B) | 15 to <20% canopy cover or >65 to 75% canopy cover of longleaf pine (*Pinus palustris*), slash pine (*Pinus elliottii*), and/or South Florida slash pine (*Pinus elliottii* var. *densa*) |
| FAIR (C) | 10 to <15% canopy cover or >75 to 85% canopy cover of longleaf pine (*Pinus palustris*), slash pine (*Pinus elliottii*), and/or South Florida slash pine (*Pinus elliottii* var. *densa*) |
| POOR (D) | <10% canopy cover or >85% canopy cover of longleaf pine (*Pinus palustris*), slash pine (*Pinus elliottii*), and/or South Florida slash pine (*Pinus elliottii* var. *densa*) |

| Metric Rating | *Xeric Longleaf Pine Barrens* |
|---|---|
| EXCELLENT (A) | >20 to 55% canopy cover of longleaf pine (*Pinus palustris*) |
| GOOD (B) | >15 to 20% canopy cover or >55 to 70% canopy cover of longleaf pine (*Pinus palustris*) |
| FAIR (C) | 5-15% canopy cover or >70 to 80% canopy cover of longleaf pine (*Pinus palustris*) |
| POOR (D) | <5% canopy cover or >80% canopy cover of longleaf pine (*Pinus palustris*) |

| Metric Rating | *Dry & Mesic Highlands Pine Woodlands* |
|---|---|
| EXCELLENT (A) | >25 to 70% canopy cover of shortleaf pine (*Pinus echinata*) |
| GOOD (B) | 20-25% canopy cover or >70 to 80% canopy cover of shortleaf pine (*Pinus echinata*) |
| FAIR (C) | 10 to <20% canopy cover or >80 to 90% canopy cover of shortleaf pine (*Pinus echinata)* |
| POOR (D) | <10% canopy cover or >90% canopy cover of shortleaf pine (*Pinus echinata*) |

| Metric Rating | *Dry & Mesic Highlands Pine Woodlands (Mountain Longleaf)* |
|---|---|
| EXCELLENT (A) | >25 to 70% canopy cover of longleaf pine (*Pinus palustris*) and shortleaf pine (*Pinus echinata*) |
| GOOD (B) | 20-25% canopy cover or >70 to 80% canopy cover of longleaf pine (*Pinus palustris*) and shortleaf pine (*Pinus echinata*) |
| FAIR (C) | 10 to <20% canopy cover or >80 to 90% canopy cover of longleaf pine (*Pinus palustris*) and shortleaf pine (*Pinus echinata*) |
| POOR (D) | <10% canopy cover or >90% canopy cover of longleaf pine (*Pinus palustris*) and shortleaf pine (*Pinus echinata*) |

| Metric Rating | *Dry & Mesic Hilly Pine Woodlands* |
|---|---|
| EXCELLENT (A) | >25 to 75% canopy cover of shortleaf pine (*Pinus echinata)* and/or loblolly pine (*Pinus taeda*) |
| GOOD (B) | >15 to 25% canopy cover or >75 to 85% canopy cover of shortleaf pine (*Pinus echinata)* and/or loblolly pine (*Pinus taeda*) |
| FAIR (C) | 10-15% canopy cover or >85 to 95% canopy cover of shortleaf pine (*Pinus echinata)* and/or loblolly pine (*Pinus taeda*) |
| POOR (D) | <10% canopy cover or >95% canopy cover of shortleaf pine (*Pinus echinata*) and/or loblolly pine (*Pinus taeda*) |

| Metric Rating | *Upper Coastal Plain Pine Flatwoods* |
|---|---|
| EXCELLENT (A) | >25 to 70% canopy cover of shortleaf pine (*Pinus echinata*) and/or loblolly pine (*Pinus taeda*) |
| GOOD (B) | >15 to 25% canopy cover or >70 to 80% canopy cover of shortleaf pine (*Pinus echinata)* and/or loblolly pine (*Pinus taeda*) |
| FAIR (C) | 10 to 15% canopy cover or >80 to 90% canopy cover of shortleaf pine (*Pinus echinata)* and/or loblolly pine (*Pinus taeda*) |
| POOR (D) | <10% canopy cover or >90% canopy cover of shortleaf pine (*Pinus echinata*) and/or loblolly pine (*Pinus taeda*) |

*Metric Name:*

## Southern Yellow Pine Stand Age Structure

**Definition:** Southern yellow pine, especially longleaf pine (*Pinus palustris*) and shortleaf pine (*Pinus echinata*) stand age structure, including the presence of old, flat topped longleaf pine and the presence of large (greater than or equal to either 12" DBH or 14" DBH) southern yellow pines characteristic of the assessed ecosystem.

**Measurement Protocol:** In longleaf pine (*Pinus palustris*) stands, determine if flat-top longleaf pines are present in the canopy and measure the basal area of southern yellow pine trees 14" DBH or greater. In addition to longleaf pine and shortleaf pine, in the Wet Longleaf & Slash Pine Flatwoods & Savannas, slash pine is included, in Mesic Longleaf Pine Flatwoods, slash pine and South Florida slash pine is included, in Dry & Mesic Hilly Pine Woodlands and in Upper Coastal Plain Pine Flatwoods, loblolly pine is included. Due to the slow growth of longleaf pine in the Xeric Longleaf Pine Barrens, and regionally in other ecosystems, the presence of large longleaf pine 12" DBH or greater can be used to define large trees and tally their basal area rather than only trees 14" DBH or greater. A 10x factor basal area prism or gauge is used at four (4) locations 33 feet (10 meters) from the outer edge of the assessment area, such as along the north, east, south, and west tapes, and (optionally) also at the center of the data collection area. If assessment area is smaller than 1/8 acre (500 square meters), then four (4) basal area points should be 10 feet (3.0 meters) from assessment area center, to the north, east, south, and west. Large pine trees are tallied by size class. At each basal area point, the tallied count of 12-14" DBH and 14" DBH or greater longleaf pine and other southern yellow pine is multiplied by the basal area factor of 10 to get the basal area values for southern yellow pines of 12-14" DBH and 14" DBH or greater in $ft^2$/acre. With these values this metric can be applied defining large trees as either 12" DBH or greater, or as 14" DBH or greater. The basal area of large trees 12" or greater is the basal area of trees 12-14" DBH plus the basal area of large trees 14" DBH or greater.

**Metric Rating**: Large trees defined as the appropriate southern yellow pine species ≥ 14" DBH

| Metric Rating | *Dry & Mesic Longleaf Pine Woodlands* |
|---|---|
| EXCELLENT (A) | Basal area ≥20 $ft^2$/acre of longleaf pine trees ≥14" DBH class or flat-top longleaf pine is present |
| GOOD (B) | Basal area ≥10 $ft^2$/acre of longleaf pine trees ≥14" DBH class. No flat-top longleaf pine is present. |
| FAIR (C) | Longleaf pine trees ≥14" DBH class are present, but <10 $ft^2$/acre basal area of those large trees. No flat-top longleaf pine is present. |
| POOR (D) | No longleaf pine trees ≥14" DBH nor flat-top longleaf pine are present |

| Metric Rating | Mesic Longleaf Pine Flatwoods |
|---|---|
| EXCELLENT (A) | Basal area ≥20 ft$^2$/acre of longleaf pine, slash pine or South Florida slash pine trees ≥14" DBH class or flat-top longleaf pine or South Florida slash pine is present |
| GOOD (B) | Basal area ≥10 ft$^2$/acre of longleaf pine or South Florida slash pine trees ≥14" DBH class. No flat-top longleaf pine present. |
| FAIR (C) | Longleaf pine or South Florida slash pine trees ≥14" DBH class are present, but <10 ft$^2$/acre basal area of those large trees. No flat-top longleaf pine present. |
| POOR (D) | No longleaf pine or South Florida slash pine trees ≥14" DBH nor flat-top longleaf pine or South Florida slash pine are present |

| Metric Rating | Wet Longleaf & Slash Pine Flatwoods & Savannas |
|---|---|
| EXCELLENT (A) | Basal area ≥20 ft$^2$/acre of longleaf pine or slash pine trees ≥14" DBH class or flat-top longleaf pine or slash pine is present |
| GOOD (B) | Basal area ≥10 ft$^2$/acre of longleaf pine or slash pine trees ≥14" DBH class. No flat-top longleaf pine nor slash pine present. |
| FAIR (C) | Longleaf pine or slash pine trees ≥14" DBH class are present, but <10 ft$^2$/acre basal area of those large trees. No flat-top longleaf pine nor slash pine present. |
| POOR (D) | No longleaf pine or slash pine trees ≥14" DBH nor flat-top longleaf pine or slash pine are present |

| Metric Rating | Xeric Longleaf Pine Barrens |
|---|---|
| EXCELLENT (A) | Basal area ≥20 ft$^2$/acre of longleaf pine trees ≥ 14" DBH class or flat-top longleaf pine is present |
| GOOD (B) | Basal area ≥10 ft$^2$/acre of longleaf pine trees ≥ 14" DBH class |
| FAIR (C) | Longleaf pine trees ≥14" DBH class are present, but <10 ft$^2$/acre basal area of those large trees |
| POOR (D) | No longleaf pine trees ≥14" DBH nor flat-top longleaf pine are present |

| Metric Rating | Dry & Mesic Highlands Pine Woodlands |
|---|---|
| EXCELLENT (A) | Basal area ≥20 ft$^2$/acre of shortleaf pine trees ≥14" DBH class |
| GOOD (B) | Basal area ≥10 ft$^2$/acre of shortleaf pine trees ≥14" DBH class |
| FAIR (C) | Shortleaf pine trees ≥14" DBH class are present, but <10 ft$^2$/acre basal area of those large trees |
| POOR (D) | No shortleaf pine trees ≥14" DBH are present |

| Metric Rating | Dry & Mesic Highlands Pine Woodlands (Mountain Longleaf) |
|---|---|
| EXCELLENT (A) | Basal area ≥20 ft$^2$/acre of longleaf pine and/or shortleaf pine trees ≥14" DBH class or flat-top longleaf pine is present |
| GOOD (B) | Basal area ≥10 ft$^2$/acre of longleaf pine and/or shortleaf pine trees ≥14" DBH class. No flat-top longleaf pine is present. |
| FAIR (C) | Longleaf pine and/or shortleaf pine trees ≥14" DBH class are present, but <10 ft$^2$/acre basal area of those large trees. No flat-top longleaf pine is present. |
| POOR (D) | No longleaf pine and/or shortleaf pine trees ≥14" DBH nor flat-top longleaf pine are present |

| Metric Rating | Dry & Mesic Hilly Pine Woodlands |
|---|---|
| EXCELLENT (A) | Basal area ≥20 ft$^2$/acre of loblolly pine and/or shortleaf pine trees ≥14" DBH class |
| GOOD (B) | Basal area ≥10 ft$^2$/acre of loblolly pine and/or shortleaf pine trees ≥14" DBH class |
| FAIR (C) | Loblolly pine and/or shortleaf pine trees ≥14" DBH class are present, but <10 ft$^2$/acre basal area of those large trees |
| POOR (D) | No loblolly pine and/or shortleaf pine trees ≥14" DBH are present |

| Metric Rating | Upper Coastal Plain Pine Flatwoods |
|---|---|
| EXCELLENT (A) | Basal area ≥20 ft$^2$/acre of loblolly pine and/or shortleaf pine trees ≥14" DBH class |
| GOOD (B) | Basal area ≥10 ft$^2$/acre of loblolly pine and/or shortleaf pine trees ≥14" DBH class |
| FAIR (C) | Loblolly pine and/or shortleaf pine trees ≥14" DBH class are present, but <10 ft$^2$/acre basal area of those large trees |
| POOR (D) | No loblolly pine and/or shortleaf pine trees ≥14" DBH are present |

**Metric Rating:** Large trees defined as the appropriate southern yellow pine species ≥ 12" DBH

| Metric Rating | Dry & Mesic Longleaf Pine Woodlands |
|---|---|
| EXCELLENT (A) | Basal area ≥20 ft$^2$/acre of longleaf pine trees ≥12" DBH class or flat-top longleaf pine is present |
| GOOD (B) | Basal area ≥10 ft$^2$/acre of longleaf pine trees ≥12" DBH class. No flat-top longleaf pine is present. |
| FAIR (C) | Longleaf pine trees ≥12" DBH class are present, but <10 ft$^2$/acre basal area of those large trees. No flat-top longleaf pine is present. |
| POOR (D) | No longleaf pine trees ≥12" DBH nor flat-top longleaf pine are present |

| Metric Rating | Mesic Longleaf Pine Flatwoods |
|---|---|
| EXCELLENT (A) | Basal area ≥20 ft$^2$/acre of longleaf pine, slash pine or South Florida slash pine trees ≥12" DBH class or flat-top longleaf pine or South Florida slash pine is present |
| GOOD (B) | Basal area ≥10 ft$^2$/acre of longleaf pine or South Florida slash pine trees ≥12" DBH class. No flat-top longleaf pine present. |
| FAIR (C) | Longleaf pine or South Florida slash pine trees ≥12" DBH class are present, but <10 ft$^2$/acre basal area of those large trees. No flat-top longleaf pine present. |
| POOR (D) | No longleaf pine or South Florida slash pine trees ≥12" DBH nor flat-top longleaf pine or South Florida slash pine are present |

| Metric Rating | *Wet Longleaf & Slash Pine Flatwoods & Savannas* |
|---|---|
| EXCELLENT (A) | Basal area ≥20 ft$^2$/acre of longleaf pine or slash pine trees ≥12" DBH class or flat-top longleaf pine or slash pine is present |
| GOOD (B) | Basal area ≥10 ft$^2$/acre of longleaf pine or slash pine trees ≥12" DBH class. No flat-top longleaf pine nor slash pine present. |
| FAIR (C) | Longleaf pine or slash pine trees ≥12" DBH class are present, but <10 ft$^2$/acre basal area of those large trees. No flat-top longleaf pine nor slash pine present. |
| POOR (D) | No longleaf pine or slash pine trees ≥12" DBH nor flat-top longleaf pine or slash pine are present |

| Metric Rating | *Xeric Longleaf Pine Barrens* |
|---|---|
| EXCELLENT (A) | Basal area ≥20 ft$^2$/acre of longleaf pine trees ≥ 12" DBH class or flat-top longleaf pine is present |
| GOOD (B) | Basal area ≥10 ft$^2$/acre of longleaf pine trees ≥ 12" DBH class |
| FAIR (C) | Longleaf pine trees ≥12" DBH class are present, but <10 ft$^2$/acre basal area of those large trees |
| POOR (D) | No longleaf pine trees ≥12" DBH nor flat-top longleaf pine are present |

| Metric Rating | *Dry & Mesic Highlands Pine Woodlands* |
|---|---|
| EXCELLENT (A) | Basal area ≥20 ft$^2$/acre of shortleaf pine trees ≥12" DBH class |
| GOOD (B) | Basal area ≥10 ft$^2$/acre of shortleaf pine trees ≥12" DBH class |
| FAIR (C) | Shortleaf pine trees ≥12" DBH class are present, but <10 ft$^2$/acre basal area of those large trees |
| POOR (D) | No shortleaf pine trees ≥12" DBH are present |

| Metric Rating | *Dry & Mesic Highlands Pine Woodlands (Mountain Longleaf)* |
|---|---|
| EXCELLENT (A) | Basal area ≥20 ft$^2$/acre of longleaf pine and/or shortleaf pine trees ≥12" DBH class or flat-top longleaf pine is present |
| GOOD (B) | Basal area ≥10 ft$^2$/acre of longleaf pine and/or shortleaf pine trees ≥12" DBH class. No flat-top longleaf pine is present. |
| FAIR (C) | Longleaf pine and/or shortleaf pine trees ≥12" DBH class are present, but <10 ft$^2$/acre basal area of those large trees. No flat-top longleaf pine is present. |
| POOR (D) | No longleaf pine and/or shortleaf pine trees ≥12" DBH nor flat-top longleaf pine are present |

| Metric Rating | *Dry & Mesic Hilly Pine Woodlands* |
|---|---|
| EXCELLENT (A) | Basal area ≥20 ft$^2$/acre of loblolly pine and/or shortleaf pine trees ≥12" DBH class |
| GOOD (B) | Basal area ≥10 ft$^2$/acre of loblolly pine and/or shortleaf pine trees ≥12" DBH class |
| FAIR (C) | Loblolly pine and/or shortleaf pine trees ≥12" DBH class are present, but <10 ft$^2$/acre basal area of those large trees |
| POOR (D) | No loblolly pine and/or shortleaf pine trees ≥12" DBH are present |

| Metric Rating | Upper Coastal Plain Pine Flatwoods |
|---|---|
| EXCELLENT (A) | Basal area ≥20 ft$^2$/acre of loblolly pine and/or shortleaf pine trees ≥12" DBH class |
| GOOD (B) | Basal area ≥10 ft$^2$/acre of loblolly pine and/or shortleaf pine trees ≥12" DBH class |
| FAIR (C) | Loblolly pine and/or shortleaf pine trees ≥12" DBH class are present, but <10 ft$^2$/acre basal area of those large trees |
| POOR (D) | No loblolly pine and/or shortleaf pine trees ≥12" DBH are present |

*Metric Name:*

Canopy Hardwood Basal Area

**Definition**: Combined basal area of all canopy hardwood trees. While not required, if practical, basal area should be collected separately for both fire intolerant hardwood and fire tolerant hardwood trees. These two values can be then averaged and summed for the basal area points. More importantly, the basal area of fire intolerant hardwoods is the best version of this metric. The cross section area of hardwood tree stems (defined here as square feet /acre) for canopy trees 5 inches DBH or greater, measured using a 10x basal area prism or gauge at four (4) locations near the rapid assessment area center and (optionally) also at the center point of the rapid assessment area, or by measuring the DBH of all hardwood trees 5 inches DBH or greater within an assessment area plot of a defined area.

**Measurement Protocol**: **Option 1**: For an assessment area larger than 1/8 acre (or 500 square meters), a 10x factor basal area prism or gauge is used at four (4) locations 33 feet (10 meters) from the outer edge of the assessment area, such as along the north, east, south, and west tapes, and (optionally) also at the center of the data collection area. If assessment area is smaller than 1/8 acre (500 square meters), then four (4) basal area points should be 10 feet (3.0 meters) from assessment area center, to the north, east, south, and west. Hardwood trees are tallied with the 10x factor basal area prism or gauge. It is not necessary to tally hardwood trees by species, but if possible the trees for determining basal area should be separately tallied for canopy fire intolerant hardwoods and fire tolerant hardwoods. **Fire tolerant hardwood tree species include turkey oak, sand post oak, bluejack oak, blackjack oak, black oak, post oak, southern red oak, black hickory and flowering dogwood.** At each basal area point, the tallied count of hardwood tree species is multiplied by the basal area factor of 10 to get the basal area values in ft$^2$/acre.  The final measure is the average of each of the data taken for each of the prism points in the assessment area.

**Option 2**: Within the defined assessment area measure all fire intolerant hardwood and fire tolerant hardwood tree species 5" diameter or greater at 4.5 feet (54"), diameter in inches at breast height (DBH), then convert diameter measurements to ft$^2$ using formula:

Basal area (in ft$^2$) = 0.005454*DBH$^2$

Then, canopy fire intolerant hardwood and fire tolerant hardwood basal areas are totaled. For the final values of basal area in ft$^2$/acre, the fire intolerant hardwood and fire tolerant hardwood basal area values for the plot area must be converted to a ft$^2$/acre value. The conversion math will depend on the assessment area and units of measure. If basal area prism is not used, the hardwood tree diameters can all be listed for the defined assessment area, and

the basal area in ft$^2$/acre can be calculated later. Generally, there is no need to do the basal area calculations in the field.

**Metric Rating**:  These first values below represent results in ft$^2$/acre using Option 1, the 10x basal area prism or gauge at a single point. Basal area values such as 15, 35, 75, and 95 are not accommodated, only values of multiples of 10 area are accommodated. There is a second set of tables below (Option 2), which accommodate basal area values such as 15, 35, 75, and 95 which result from averaging several basal area points taken with a 10x basal area prism, or from Option 2, measuring all trees within a defined assessment area. Following Option 2 is the Fire Intolerant Hardwood Basal Area (Metric Variant).

**Option 1, Single Basal Area point**

| Metric Rating | *Dry & Mesic Longleaf Pine Woodlands* |
|---|---|
| EXCELLENT (A) | 0 to 10 ft$^2$/acre basal area of hardwood trees |
| GOOD (B) | 20 ft$^2$/acre basal area of hardwood trees |
| FAIR (C) | 30 ft$^2$/acre basal area of hardwood trees |
| POOR (D) | ≥40 ft$^2$/acre basal area of hardwood trees |

| Metric Rating | *Mesic Longleaf Pine Flatwoods* |
|---|---|
| EXCELLENT (A) | 0 to 10 ft$^2$/acre basal area of hardwood trees |
| GOOD (B) | 20 ft$^2$/acre basal area of hardwood trees |
| FAIR (C) | 30 ft$^2$/acre basal area of hardwood trees |
| POOR (D) | ≥40 ft$^2$/acre basal area of hardwood trees |

| Metric Rating | *Wet Longleaf & Slash Pine Flatwoods & Savannas* |
|---|---|
| EXCELLENT (A) | 0 to 10 ft$^2$/acre basal area of hardwood trees |
| GOOD (B) | 20 ft$^2$/acre basal area of hardwood trees |
| FAIR (C) | 30 ft$^2$/acre basal area of hardwood trees |
| POOR (D) | ≥40 ft$^2$/acre basal area of hardwood trees |

| Metric Rating | *Xeric Longleaf Pine Barrens* |
|---|---|
| EXCELLENT (A) | 0 ft$^2$/acre basal area of hardwood trees |
| GOOD (B) | 10 ft$^2$/acre basal area of hardwood trees |
| FAIR (C) | 20 ft$^2$/acre basal area of hardwood trees |
| POOR (D) | ≥30 ft$^2$/acre basal area of hardwood trees |

| Metric Rating | *Dry & Mesic Highlands Pine Woodlands* |
|---|---|
| EXCELLENT (A) | ≤20 ft$^2$/acre basal area of hardwood trees |
| GOOD (B) | 30-40 ft$^2$/acre basal area of hardwood trees |
| FAIR (C) | 50 ft$^2$/acre basal area of hardwood trees |
| POOR (D) | ≥60 ft$^2$/acre basal area of hardwood trees |

| Metric Rating | *Dry & Mesic Hilly Pine Woodlands* |
|---|---|
| EXCELLENT (A) | ≤20 ft$^2$/acre basal area of hardwood trees |
| GOOD (B) | 30 ft$^2$/acre basal area of hardwood trees |
| FAIR (C) | 40 to 50 ft$^2$/acre basal area of hardwood trees |
| POOR (D) | ≥60 ft$^2$/acre basal area of hardwood trees |

| Metric Rating | *Upper Coastal Plain Pine Flatwoods* |
|---|---|
| EXCELLENT (A) | ≤20 ft$^2$/acre basal area of hardwood trees |
| GOOD (B) | 30 ft$^2$/acre basal area of hardwood trees |
| FAIR (C) | 40-50 ft$^2$/acre basal area of hardwood trees |
| POOR (D) | ≥60 ft$^2$/acre basal area of hardwood trees |

These values below represent results in ft$^2$/acre using Option 1 with DBH averaging the basal area values from several points, or by using Option 2. Calculated values other than multiples of 10 are accommodated.

| Metric Rating | *Dry & Mesic Longleaf Pine Woodlands* |
|---|---|
| EXCELLENT (A) | ≤5 ft$^2$/acre basal area of hardwood trees |
| GOOD (B) | >5 to 15 ft$^2$/acre basal area of hardwood trees |
| FAIR (C) | >15 to 25 ft$^2$/acre basal area of hardwood trees |
| POOR (D) | >25 ft$^2$/acre basal area of hardwood trees |

| Metric Rating | *Mesic Longleaf Pine Flatwoods* |
|---|---|
| EXCELLENT (A) | ≤5 ft$^2$/acre basal area of hardwood trees |
| GOOD (B) | >5 to 15 ft$^2$/acre basal area of hardwood trees |
| FAIR (C) | >15 to 25 ft$^2$/acre basal area of hardwood trees |
| 3POOR (D) | >25 ft$^2$/acre basal area of hardwood trees |

| Metric Rating | *Wet Longleaf & Slash Pine Flatwoods & Savannas* |
|---|---|
| EXCELLENT (A) | ≤5 ft$^2$/acre basal area of hardwood trees |
| GOOD (B) | >5 to 15 ft$^2$/acre basal area of hardwood trees |
| FAIR (C) | >15 to 25 ft$^2$/acre basal area of hardwood trees |
| POOR (D) | >25 ft$^2$/acre basal area of hardwood trees |

| Metric Rating | *Xeric Longleaf Pine Barrens* |
|---|---|
| EXCELLENT (A) | ≤5 ft$^2$/acre basal area of hardwood trees |
| GOOD (B) | >5 to 15 ft$^2$/acre basal area of hardwood trees |
| FAIR (C) | >15 to 25 ft$^2$/acre basal area of hardwood trees |
| POOR (D) | >25 ft$^2$/acre basal area of hardwood trees |

| Metric Rating | Dry & Mesic Highlands Pine Woodlands |
|---|---|
| EXCELLENT (A) | ≤20 ft$^2$/acre basal area of hardwood trees |
| GOOD (B) | >20 to 40 ft$^2$/acre basal area of hardwood trees |
| FAIR (C) | >40 to 50 ft$^2$/acre basal area of hardwood trees |
| POOR (D) | >50 ft$^2$/acre basal area of hardwood trees |

| Metric Rating | Dry & Mesic Hilly Pine Woodlands |
|---|---|
| EXCELLENT (A) | ≤20 ft$^2$/acre basal area of hardwood trees |
| GOOD (B) | >20 to 30 ft$^2$/acre basal area of hardwood trees |
| FAIR (C) | >30 to 50 ft$^2$/acre basal area of hardwood trees |
| POOR (D) | >50 ft$^2$/acre basal area of hardwood trees |

| Metric Rating | Upper Coastal Plain Pine Flatwoods |
|---|---|
| EXCELLENT (A) | ≤20 ft$^2$/acre basal area of hardwood trees |
| GOOD (B) | >20 to 30 ft$^2$/acre basal area of hardwood trees |
| FAIR (C) | >30 to 50 ft$^2$/acre basal area of hardwood trees |
| POOR (D) | >50 ft$^2$/acre basal area of hardwood trees |

## Fire Intolerant Hardwood Basal Area (Metric Variant)

| Metric Rating | Dry & Mesic Longleaf Pine Woodlands |
|---|---|
| EXCELLENT (A) | ≤5 ft$^2$/acre basal area of fire intolerant hardwood trees |
| GOOD (B) | >5 to 10 ft$^2$/acre basal area of fire intolerant hardwood trees |
| FAIR (C) | >10 to 20 ft$^2$/acre basal area of fire intolerant hardwood trees |
| POOR (D) | >20 ft$^2$/acre basal area of fire intolerant hardwood trees |

| Metric Rating | Mesic Longleaf Pine Flatwoods |
|---|---|
| EXCELLENT (A) | ≤5 ft$^2$/acre basal area of fire intolerant hardwood trees |
| GOOD (B) | >5 to 10 ft$^2$/acre basal area of fire intolerant hardwood trees |
| FAIR (C) | >10 to 20 ft$^2$/acre basal area of fire intolerant hardwood trees |
| 3POOR (D) | >20 ft$^2$/acre basal area of fire intolerant hardwood trees |

| Metric Rating | Wet Longleaf & Slash Pine Flatwoods & Savannas |
|---|---|
| EXCELLENT (A) | ≤5 ft$^2$/acre basal area of fire intolerant hardwood trees |
| GOOD (B) | >5 to 10 ft$^2$/acre basal area of fire intolerant hardwood trees |
| FAIR (C) | >10 to 20 ft$^2$/acre basal area of fire intolerant hardwood trees |
| POOR (D) | >20 ft$^2$/acre basal area of fire intolerant hardwood trees |

| Metric Rating | *Xeric Longleaf Pine Barrens* |
|---|---|
| EXCELLENT (A) | ≤5 ft$^2$/acre basal area of fire intolerant hardwood trees |
| GOOD (B) | >5 to 10 ft$^2$/acre basal area of fire intolerant hardwood trees |
| FAIR (C) | >10 to 20 ft$^2$/acre basal area of fire intolerant hardwood trees |
| POOR (D) | >20 ft$^2$/acre basal area of fire intolerant hardwood trees |

| Metric Rating | *Dry & Mesic Highlands Pine Woodlands* |
|---|---|
| EXCELLENT (A) | ≤10 ft$^2$/acre basal area of fire intolerant hardwood trees |
| GOOD (B) | >10 to 20 ft$^2$/acre basal area of fire intolerant hardwood trees |
| FAIR (C) | >20 to 30 ft$^2$/acre basal area of fire intolerant hardwood trees |
| POOR (D) | >30 ft$^2$/acre basal area of fire intolerant hardwood trees |

| Metric Rating | *Dry & Mesic Hilly Pine Woodlands* |
|---|---|
| EXCELLENT (A) | ≤10 ft$^2$/acre basal area of fire intolerant hardwood trees |
| GOOD (B) | >10 to 20 ft$^2$/acre basal area of fire intolerant hardwood trees |
| FAIR (C) | >20 to 30 ft$^2$/acre basal area of fire intolerant hardwood trees |
| POOR (D) | >30 ft$^2$/acre basal area of fire intolerant hardwood trees |

| Metric Rating | *Upper Coastal Plain Pine Flatwoods* |
|---|---|
| EXCELLENT (A) | ≤10 ft$^2$/acre basal area of fire intolerant hardwood trees |
| GOOD (B) | >10 to 20 ft$^2$/acre basal area of fire intolerant hardwood trees |
| FAIR (C) | >20 to 30 ft$^2$/acre basal area of fire intolerant hardwood trees |
| POOR (D) | >30 ft$^2$/acre basal area of fire intolerant hardwood trees |

*RANK FACTOR: VEGETATION*

*Metric Name:*

Stand Density Index (Optional)

**Definition:** Stand Density Index (SDI) is a measure of tree density which incorporates the size (quadratic mean diameter) and density (trees per acre) of trees in a stand. Trees per acre (TPA) alone is not as useful a measure of stand density since it does not account for differences in tree diameter (Ziede 2005). The tree count must incorporate some measure of tree size to have meaning in forest management. SDI has two significant advantages over basal area (BA): 1) BA varies in equally dense stands (stands of equal BA can have differing amounts of competition for resources since TPA may vary), and 2) BA is not independent of site and age (BA values that indicate a need for thinning vary with stand age and site quality). A primary benefit to SDI is its independence of stand age and site quality (Harrington 2001, Ziede 2005).

**Rationale for Selection of the Variable**: Forest managers who have been managing southern open pine for wildlife have found that Stand Density Index (Shaw and Long 2007) has many advantages over basal area, or measures of canopy cover (such as visual estimates, or spherical densiometer). Research indicates that Stand Density Index has a predicable relationship to grassy herbaceous groundcover conditions in open pine stands (Moore and Deiter 1992, Mulligan et al. 2002).

Stand Density Index (SDI) was first developed in the 1930s (Reineke 1933), and it has been used more in forestry during recent years (Ducey and Valentine 2008, Shaw and Long 2010). SDI has been used in the assessment and management of goshawk nesting habitat (Lilieholm et al. 1993, Lilieholm et al. 1994) and elk thermal cover, in both ponderosa pine (McTague and Patton 1989) and lodgepole pine (Smith and Long 1987). More recently, SDI has been shown to be useful in managing longleaf pine for the recovery of red-cockaded woodpecker (Shaw and Long 2007) and as a measure of canopy trees in relation to functioning herbaceous groundcover in longleaf pine woodlands in Georgia (Mulligan et al. 2002). Commercial forestry uses SDI for scheduling thinning in intensively managed southern pine stands (Doruska and Nolan 1999, Harrington 2001, Williams 1996).

Stand Density Index (SDI) is calculated:

SDI = TPA * $(Dq/10)^{1.6}$

where  TPA is the density, in trees per acre
   $Dq$ is quadratic mean stand diameter in inches at breast height
   10 is the reference diameter in inches
   1.6 is the slope factor

Quadratic mean diameter is different from the common arithmetic mean diameter. Quadratic mean diameter is the diameter of a tree of average basal area, and is calculated:

$$Dq = \sqrt{BA/(0.005454 * n)}$$

Where *BA* is the basal area in square feet per acre
$n$ is the corresponding number of trees

Quadratic mean diameter is also simply calculated as the square root of the average of the squared diameters of the tallied trees, calculated:

$$Dq = \sqrt{(\sum d_i^2)/n}$$

Where *d* is the diameter of each tree
$n$ is the number of trees

Stand Density Index is grounded in the "-3/2 self-thinning law", which describes the inverse relationship between the average mass of plants, and their density (Shaw and Long 2010). For use in forestry, the quadratic mean diameter (*Dq*) is substituted for average mass of trees.

For many kinds of trees, maximum SDI values have been calculated. The maximum SDI values for longleaf pine and slash pine are 400 (Harrington 2001, Reineke 1933, Shaw and Long 2007), and the maximum SDI values for shortleaf pine and loblolly pine are 450 (Harrington 2001, Reineke 1933). Various percentages of the maximum SDI values relate to levels of canopy closure, effects of canopy trees on understory plants, and density dependent mortality in forest stands. For instance:

- 25% SDI is where the overstory begins to have significant negative effects on the understory (Mulligan et al. 2002, Shaw and Long 2007), and is associated with the transition from open-grown to competing trees (Long 1985, Shaw and Long 2007)
- 35% SDI is the lower limit of full site occupancy, i.e. stand growth continues to increase with increasing relative density above this point, but at a decreasing rate (Long 1985)
- 35 – 40% SDI is the range of maximum stand tree growth (Long 1985, Shaw and Long 2007)
- 60% SDI is the onset of self-thinning, i.e. density dependent tree mortality (Long 1985, Shaw and Long 2007)

In practice, larger diameter stands of southern pines do not follow the maximum SDI, but follow a lower curve called mature stand boundary (Shaw and Long 2007, Shaw and Long 2010). This relates to higher mortality of large trees which is not density dependent, and perhaps is due to the inability of tree growth to quickly recapture the canopy gaps were large pines have died (Shaw and Long 2010).

**Measurement Protocol**: Stand Density Index is calculated from the density in trees per acre (TPA) and the quadratic mean diameters (*Dq*) at breast height of the pine trees in sample plots. Within a stand, SDI can be calculated from either a set of fixed area plots or variable area plots (i.e. prism sampling), where trees are tallied, and the diameters of each tree is measured. Both are easy to apply. Simple calculations in the office can average values across the stand, spreadsheets make this easier. Silvicultural treatments occur at the scale of the stand, not a specific point within a stand, so the stand level data is most useful for informing management.

**Metric Rating**:  Values are calculated and averaged from sample plots within a stand.

| Metric Rating | ***Dry & Mesic Longleaf Pine Woodlands*** applies to longleaf pine (*Pinus palustris)* |
|---|---|
| EXCELLENT (A) | SDI = 60 – 125 (15 - 31% of Maximum SDI of 400) |
| GOOD (B) | SDI = 40 – 60 or 125 -160 (10-15% or 31-40% of Maximum SDI of 400, *35 – 40% SDI is near maximum of stand growth*) |
| FAIR (C) | SDI = 20 – 40 or 160 - 200 (5-10% or 40-50% of Maximum SDI, 240 is 60% of Maximum SD of 400, *which is the onset of self-thinning*) |
| POOR (D) | SDI <20 or >200 (<5% or > 50%, 240 is 60% of Maximum SD of 400, *the onset of self-thinning*) |

| Metric Rating | ***Mesic Longleaf Pine Flatwoods*** applies to longleaf pine (*Pinus palustris*), slash pine (*Pinus elliottii*), and/or South Florida slash pine (*Pinus elliottii* var. *densa*) |
|---|---|
| EXCELLENT (A) | SDI = 60 – 125 (15-31% of Maximum SDI of 400) |
| GOOD (B) | SDI = 40 – 60 or 125 -160 (10-15% or 31-40% of Maximum SDI of 400, *35 – 40% SDI is near maximum of stand growth*) |
| FAIR (C) | SDI = 20 – 40 or 160 - 190 (5-10% or 40-48% of Maximum SDI, 240 is 60% of Maximum SD of 400, *which is the onset of self-thinning*) |
| POOR (D) | SDI <20 or >190 (<5% or > 48%, 240 is 60% of Maximum SD of 400, *the onset of self-thinning*) |

| Metric Rating | ***Wet Longleaf & Slash Pine Flatwoods & Savannas*** applies to longleaf pine (*Pinus palustris*), slash pine (*Pinus elliottii*), and/or South Florida slash pine (*Pinus elliottii* var. *densa*) |
|---|---|
| EXCELLENT (A) | SDI = 35 – 120 (9-30% of Maximum SDI of 400) |
| GOOD (B) | SDI = 20 – 35 or 120 -155 (5-9% or 30-39% of Maximum SDI of 400, *35 – 40% SDI is near maximum of stand growth*) |
| FAIR (C) | SDI = 10 – 20 or 155 - 180 (2.5-5% or 39-45% of Maximum SDI, 240 is 60% of Maximum SD of 400, *which is the onset of self-thinning*) |
| POOR (D) | SDI <10 or >180 (<2.5% or > 45%, 240 is 60% of Maximum SD of 400, *the onset of self-thinning*) |

| Metric Rating | *Xeric Longleaf Pine Barrens* applies to longleaf pine (*Pinus palustris)* |
|---|---|
| EXCELLENT (A) | SDI = 50 – 120 (13-30% of Maximum SDI of 400) |
| GOOD (B) | SDI = 30 – 50 or 120 -160 (8-13% or 30-40% of Maximum SDI of 400, *35 – 40% SDI is near maximum of stand growth*) |
| FAIR (C) | SDI = 20 – 30 or 160 - 180 (5-8% or 40-45% of Maximum SDI, 240 is 60% of Maximum SD of 400, *which is the onset of self-thinning*) |
| POOR (D) | SDI <20 or >180 (<5% or > 45%, 240 is 60% of Maximum SD of 400, *the onset of self-thinning*) |

| Metric Rating | *Dry & Mesic Highlands Pine Woodlands* applies to shortleaf pine (*Pinus echinata)* |
|---|---|
| EXCELLENT (A) | SDI = 65 – 135 (14-30% of Maximum SDI of 450) |
| GOOD (B) | SDI = 45 – 65 or 135 -180 (10-14% or 30-40% of Maximum SDI of 450, *35 – 40% SDI is near maximum of stand growth*) |
| FAIR (C) | SDI = 20 – 45 or 180 - 225 (4-10% or 40-50% of Maximum SDI, 270 is 60% of Maximum SD of 450, *which is the onset of self-thinning*) |
| POOR (D) | SDI <20 or >225 (<4% or > 50%, 270 is 60% of Maximum SD of 450, *the onset of self-thinning*) |

| Metric Rating | *Dry & Mesic Highlands Pine Woodlands* applies to mountain longleaf pine (*Pinus palustris*) |
|---|---|
| EXCELLENT (A) | SDI = 55 – 120 (14-30% of Maximum SDI of 400) |
| GOOD (B) | SDI = 40 – 55 or 120 -160 (10-14% or 30-40% of Maximum SDI of 400, *35 – 40% SDI is near maximum of stand growth*) |
| FAIR (C) | SDI = 15 – 40 or 160 - 200 (4-10% or 40-50% of Maximum SDI, 240 is 60% of Maximum SD of 400, *which is the onset of self-thinning*) |
| POOR (D) | SDI <15 or >200 (<4% or > 50%, 240 is 60% of Maximum SD of 400, *the onset of self-thinning*) |

| Metric Rating | *Dry & Mesic Hilly Pine Woodlands* applies to shortleaf pine (*Pinus echinata*) and/or loblolly pine (*Pinus taeda*) |
|---|---|
| EXCELLENT (A) | SDI = 55 – 155 (12-34% of Maximum SDI of 450) |
| GOOD (B) | SDI = 35 – 55 or 155 -205 (8-12% or 34-45% of Maximum SDI of 450, *35 – 40% SDI is near maximum of stand growth*) |
| FAIR (C) | SDI = 20 – 35 or 205 - 225 (4-8% or 45-50% of Maximum SDI, 270 is 60% of Maximum SD of 450, *which is the onset of self-thinning*) |
| POOR (D) | SDI <20 or >225 (<4% or > 50%, 270 is 60% of Maximum SD of 450, *the onset of self-thinning*) |

| Metric Rating | *Upper Coastal Plain Pine Flatwoods* applies to shortleaf pine (*Pinus echinata*) and/or loblolly pine (*Pinus taeda*) |
|---|---|
| EXCELLENT (A) | SDI = 55 – 145 (12-32% of Maximum SDI of 450) |
| GOOD (B) | SDI = 35 – 55 or 145 -180 (8-12% or 32-40% of Maximum SDI of 450, *35 – 40% SDI is near maximum of stand growth*) |
| FAIR (C) | SDI = 20 – 35 or 180 - 225 (4-8% or 40-50% of Maximum SDI, 270 is 60% of Maximum SD of 450, *which is the onset of self-thinning*) |
| POOR (D) | SDI <20 or >225 (<4% or > 50%, 270 is 60% of Maximum SD of 450, *the onset of self-thinning*) |

*RANK FACTOR: VEGETATION*

*Metric Name:*

Midstory Fire Tolerant Hardwood Cover

**Definition:** Midstory Fire Tolerant Hardwood Cover. Percentage of the ground within the plot or assessment area covered by fire tolerant hardwood midstory foliage, branches, and stems as determined by ocular (visual) estimate. Midstory is defined as woody stems (including tall shrubs, small trees, and vines) that are > 10 feet tall, up to the height of the bottom of the tree canopy. **Fire tolerant hardwood tree species include turkey oak, sand post oak, bluejack oak, blackjack oak, black oak, post oak, southern red oak, black hickory and flowering dogwood.** Individuals that reach canopy size are included in the canopy basal area metrics.

**Measurement Protocol**: For assessment area, separately estimate percentage within the plot covered by fire intolerant hardwood and fire tolerant hardwood midstory foliage, branches, and stems as determined by ocular (visual) estimate. Cover is defined as the percentage of ground surface obscured by the vertical projection of all aboveground parts of a given species onto that surface, estimated visually by the field researcher (Peet et al. 1998). Spaces between leaves and stems also count as cover. Midstory is defined to include any woody stems (including tall shrubs, small trees and vines) which are greater than 10 feet tall, up to the height of the bottom of the tree canopy (Blaney et al. 2015). Measure fire tolerant hardwood cover (cover of turkey oak, sand post oak, bluejack oak, blackjack oak, black oak, post oak, southern red oak, black hickory and flowering dogwood). Ocular (visual) estimate of the percent of ground within the plot covered by all aboveground parts of the midstory fire tolerant hardwoods.

**Metric Rating**: This metric might not apply well to Wet Longleaf & Slash Pine Flatwoods & Savannas, since the fire tolerant hardwoods listed are upland species, not generally found in wetter areas.

| Metric Rating | *Dry & Mesic Longleaf Pine Woodlands* |
|---|---|
| EXCELLENT (A) | 2 to 15% cover of midstory fire tolerant hardwoods |
| GOOD (B) | 15 to <20%, or <2% cover of midstory fire tolerant hardwoods |
| FAIR (C) | 20 to 25% cover of midstory fire tolerant hardwoods |
| POOR (D) | >25% cover of midstory fire tolerant hardwoods |

| Metric Rating | *Mesic Longleaf Pine Flatwoods* |
|---|---|
| EXCELLENT (A) | 2 to 5% cover of midstory fire tolerant hardwoods |
| GOOD (B) | 5 to 10%, or <2% cover of midstory fire tolerant hardwoods |
| FAIR (C) | >10 to 15% cover of midstory fire tolerant hardwoods |
| POOR (D) | >15% cover of midstory fire tolerant hardwoods |

| Metric Rating | *Wet Longleaf & Slash Pine Flatwoods & Savannas* |
|---|---|
| EXCELLENT (A) | 2 to 10% cover of midstory fire tolerant hardwoods |
| GOOD (B) | 10-15%, or <2% cover of midstory fire tolerant hardwoods |
| FAIR (C) | >15 to 25% cover of midstory fire tolerant hardwoods |
| POOR (D) | >25% cover of midstory fire tolerant hardwoods |

| Metric Rating | *Xeric Longleaf Pine Barrens* |
|---|---|
| EXCELLENT (A) | 2 to 10% cover of midstory fire tolerant hardwoods |
| GOOD (B) | 10-20% cover, or <2% cover of midstory fire tolerant hardwoods |
| FAIR (C) | >20 to 25% cover of midstory fire tolerant hardwoods |
| POOR (D) | >25% cover of midstory fire tolerant hardwoods |

| Metric Rating | *Dry & Mesic Highlands Pine Woodlands* |
|---|---|
| EXCELLENT (A) | 2 to 10% cover of midstory fire tolerant hardwoods |
| GOOD (B) | 10-30%, or <2% cover of midstory fire tolerant hardwoods |
| FAIR (C) | >30 to 40% cover of midstory fire tolerant hardwoods |
| POOR (D) | >40% cover of midstory fire tolerant hardwoods |

| Metric Rating | *Dry & Mesic Hilly Pine Woodlands* |
|---|---|
| EXCELLENT (A) | 2 to 10% cover of midstory fire tolerant hardwoods |
| GOOD (B) | 10-20%, or <2% cover of midstory fire tolerant hardwoods |
| FAIR (C) | >20 to 35% cover of midstory fire tolerant hardwoods |
| POOR (D) | >35% cover of midstory fire tolerant hardwoods |

| Metric Rating | *Upper Coastal Plain Pine Flatwoods* |
|---|---|
| EXCELLENT (A) | 2 to 10% cover of midstory fire tolerant hardwoods |
| GOOD (B) | 10 to 20%, or <2% cover of midstory fire tolerant hardwoods |
| FAIR (C) | >20 to 35% cover of midstory fire tolerant hardwoods |
| POOR (D) | >35% cover of midstory fire tolerant hardwoods |

*Metric Name:*

Midstory Overall Cover

**Definition:** Midstory Overall Cover. Percentage of the ground within the plot covered by midstory foliage, branches, and stems as determined by ocular (visual) estimate. Spaces between leaves and stems count as cover. Midstory is defined to include any woody stem (including tall shrubs, trees and vines) that are greater than 10 feet tall, up to the height of the bottom of the tree canopy.

**Measurement Protocol**: For the assessment area, estimate the percent of the ground within the plot covered by midstory foliage, branches, and stems as determined by ocular (visual) estimate. Cover is defined as the percentage of ground surface obscured by the vertical projection of all aboveground parts of a given species onto that surface, estimated visually by the field researcher (Peet et al. 1998). Spaces between leaves and stems also count as cover. Midstory is defined to include any woody stem (including tall shrubs, trees and woody vines) that are greater than 10 feet tall, up to the height of the bottom of the tree canopy (Blaney et al. 2015). Ocular (visual) estimate of the percent of ground within the plot covered by all above ground parts of the midstory woody plants. Because forest vegetation layers can overlap, total percent cover of the canopy, midstory and shrub layers may exceed 100%.

**Metric Rating**:  Specify the narrative and numerical ratings for the metric, from excellent to poor.

| Metric Rating | *Dry & Mesic Longleaf Pine Woodlands* |
|---|---|
| EXCELLENT (A) | 2 to <15% cover of woody midstory |
| GOOD (B) | 15 – 25%, or <2% cover of woody midstory |
| FAIR (C) | >25 to 35% cover of woody midstory |
| POOR (D) | >35% cover of woody midstory |

| Metric Rating | *Mesic Longleaf Pine Flatwoods* |
|---|---|
| EXCELLENT (A) | 2 to <5% cover of woody midstory |
| GOOD (B) | 5 – 15%, or <2% cover of woody midstory |
| FAIR (C) | >15 to 30% cover of woody midstory |
| POOR (D) | >30% cover of woody midstory |

| Metric Rating | *Wet Longleaf & Slash Pine Flatwoods & Savannas* |
|---|---|
| EXCELLENT (A) | <10% cover of woody midstory |
| GOOD (B) | 10 – 15% cover of woody midstory |
| FAIR (C) | >15 to 30% cover of woody midstory |
| POOR (D) | >30% cover of woody midstory |

| Metric Rating | *Xeric Longleaf Pine Barrens* |
|---|---|
| EXCELLENT (A) | 2 to <10% cover of woody midstory |
| GOOD (B) | 10 – 25%, or <2% cover of woody midstory |
| FAIR (C) | >25 to 35% cover of woody midstory |
| POOR (D) | >35% cover of woody midstory |

| Metric Rating | *Dry & Mesic Highlands Pine Woodlands* |
|---|---|
| EXCELLENT (A) | 2 to <20% cover of woody midstory |
| GOOD (B) | 20-25%, or <2% cover of woody midstory |
| FAIR (C) | >25 to 35% cover of woody midstory |
| POOR (D) | >35% cover of woody midstory |

| Metric Rating | *Dry & Mesic Hilly Pine Woodlands* |
|---|---|
| EXCELLENT (A) | 2 to <20% cover of woody midstory |
| GOOD (B) | ≥20 to 30%, or <2% cover of woody midstory |
| FAIR (C) | >30 to 50% cover of woody midstory |
| POOR (D) | >50% cover of woody midstory |

| Metric Rating | *Upper Coastal Plain Pine Flatwoods* |
|---|---|
| EXCELLENT (A) | 2 to <20% cover of woody midstory |
| GOOD (B) | 20 to 30%, or <2% cover of woody midstory |
| FAIR (C) | >30 to 50% cover of woody midstory |
| POOR (D) | >50% cover of woody midstory |

*RANK FACTOR: VEGETATION*

*Metric Name:*

Midstory Fire Intolerant Hardwood Cover (Optional)

**Definition:** Midstory Fire Intolerant Hardwood Cover. Fire intolerant hardwood trees, include red maple (*Acer rubrum),* sweetgum (*Liquidambar styraciflua),* tulip-tree (*Liriodendron tulipifera),* blackgum (*Nyssa sylvatica),* water oak (*Quercus nigra),* and especially in wet flatwoods and savannas, the exotic Chinese tallow tree (*Triadica sebifera)* (Bragg 2014, NatureServe 2011)*.* Other trees which are not naturally part of the fire maintained ecosystem are also included. The metric is the percentage of the ground within the plot covered by midstory foliage, branches, and stems as determined by ocular (visual) estimate. Spaces between leaves and stems count as cover. Midstory is defined to include any fire intolerant woody stem (including tall shrubs, trees and vines) that are greater than 10 feet tall, up to the height of the bottom of the tree canopy.

**Measurement Protocol**: For the assessment area, estimate the percent of the ground within the plot covered by fire intolerant hardwood midstory foliage, branches, and stems as determined by ocular (visual) estimate. Cover is defined as the percentage of ground surface obscured by the vertical projection of all aboveground parts of a given species onto that surface, estimated visually by the field researcher (Peet et al. 1998). Spaces between leaves and stems also count as cover. Midstory is defined to include any fire intolerant woody stem (including tall shrubs, trees and woody vines) that are greater than 10 feet tall, up to the height of the bottom of the tree canopy (Blaney et al. 2015). Ocular (visual) estimate of the percent of ground within the plot covered by all above ground parts of the midstory woody plants. Because forest vegetation layers can overlap, total percent cover of the canopy, midstory and shrub layers may exceed 100%.

**Metric Rating**:  Specify the narrative and numerical ratings for the metric, from excellent to poor.

| Metric Rating | *Dry & Mesic Longleaf Pine Woodlands* |
| --- | --- |
| EXCELLENT (A) | <5% cover of fire intolerant hardwood midstory |
| GOOD (B) | 5 – 10% cover of fire intolerant hardwood midstory |
| FAIR (C) | >10 to 20% cover of fire intolerant hardwood midstory |
| POOR (D) | >20% cover of fire intolerant hardwood midstory |

| Metric Rating | *Mesic Longleaf Pine Flatwoods* |
| --- | --- |
| EXCELLENT (A) | 0% cover of fire intolerant hardwood midstory |
| GOOD (B) | >0 – 5% cover of fire intolerant hardwood midstory |
| FAIR (C) | >5 to 15% cover of fire intolerant hardwood midstory |
| POOR (D) | >15% cover of fire intolerant hardwood midstory |

| Metric Rating | *Wet Longleaf & Slash Pine Flatwoods & Savannas* |
| --- | --- |
| EXCELLENT (A) | <5% cover of fire intolerant hardwood midstory |
| GOOD (B) | 5 – 10% cover of fire intolerant hardwood midstory |
| FAIR (C) | >10 to 20% cover of fire intolerant hardwood midstory |
| POOR (D) | >20% cover of fire intolerant hardwood midstory |

| Metric Rating | *Xeric Longleaf Pine Barrens* |
| --- | --- |
| EXCELLENT (A) | 0% cover of fire intolerant hardwood midstory |
| GOOD (B) | <5% cover of fire intolerant hardwood midstory |
| FAIR (C) | 5 to 15% cover of fire intolerant hardwood midstory |
| POOR (D) | >15% cover of fire intolerant hardwood midstory |

| Metric Rating | *Dry & Mesic Highlands Pine Woodlands* |
| --- | --- |
| EXCELLENT (A) | <5% cover of fire intolerant hardwood midstory |
| GOOD (B) | 5 – 10% cover of fire intolerant hardwood midstory |
| FAIR (C) | >10 to 20% cover of fire intolerant hardwood midstory |
| POOR (D) | >20% cover of fire intolerant hardwood midstory |

| Metric Rating | *Dry & Mesic Hilly Pine Woodlands* |
| --- | --- |
| EXCELLENT (A) | <10% cover of fire intolerant hardwood midstory |
| GOOD (B) | ≥10 to 20% cover of fire intolerant hardwood midstory |
| FAIR (C) | >20 to 30% cover of fire intolerant hardwood midstory |
| POOR (D) | >30% cover of fire intolerant hardwood midstory |

| Metric Rating | *Upper Coastal Plain Pine Flatwoods* |
| --- | --- |
| EXCELLENT (A) | <15% cover of fire intolerant hardwood midstory |
| GOOD (B) | 15 to 25% cover of fire intolerant hardwood midstory |
| FAIR (C) | >25 to 35% cover of fire intolerant hardwood midstory |
| POOR (D) | >35% cover of fire intolerant hardwood midstory |

*RANK FACTOR: VEGETATION*

*Metric Name:*

Short Shrub (<3 feet tall) Cover and Tall Shrub (3-10 feet tall) Cover

**Definition**: An assessment of cover by shrubs and small broad-leaved trees less than 10 feet tall. Percentage of the ground within the plot covered by the general extent of woody plants including small broad-leaved trees and short shrubs (less than 3 feet tall) and tall shrubs (3-10 feet tall).

**Measurement Protocol**: This metric consists of a visual evaluation of the cover and height of shrubs and small broad-leaved trees (less than 10 feet tall) within a delimited assessment area, including small broad-leaved trees and short shrubs (less than 3 feet tall) and small trees and tall shrubs (3-10 feet tall). This assessment area should be at least 0.1 acre or 400 m$^2$ and can be delimited either with tapes, by pacing distances, or with a range-finder. Within this area, a visual assessment is made of the cover of shrubs, including small individuals of broad-leaved trees. Visually assess the percentage of the ground within the plot covered by the general extent of woody plants including small broad-leaved trees and short shrubs (less than 3 feet tall) and tall shrubs (3-10 feet tall). This should not include longleaf pine or shortleaf pine regeneration. For assessment area, estimate percentage of the ground within the plot covered by the general extent of the foliage, branches, and stems from all shrubs (all woody plants, single- or multi-stemmed, including woody seedlings, tree saplings, short shrubs, saw palmetto, scrub palmetto and woody vining plants). Spaces between leaves and stems count as cover. Because forest vegetation layers can overlap, the total of short shrub percent cover and tall shrub percent cover may exceed 100%.

**Shrub Cover Metric Rating**:  Specify the narrative and numerical ratings for the metric, from excellent to poor. Variants are provided.

**Short Shrubs (<3 feet tall)**

| Metric Rating | *Dry & Mesic Longleaf Pine Woodlands* |
|---|---|
| EXCELLENT (A) | Shrubs < 3 feet in height average <30% cover in the assessment area |
| GOOD (B) | Shrubs < 3 feet in height average 30 to 35% cover in the assessment area |
| FAIR (C) | Shrubs < 3 feet in height average >35 to 45% cover in the assessment area |
| POOR (D) | Shrubs < 3 feet in height average >45% cover in the assessment area |

| Metric Rating | *Mesic Longleaf Pine Flatwoods* |
|---|---|
| EXCELLENT (A) | Shrubs < 3 feet in height average <30% cover in the assessment area |
| GOOD (B) | Shrubs < 3 feet in height average 30 to <40% cover in the assessment area |
| FAIR (C) | Shrubs < 3 feet in height average 40 to 45% cover in the assessment area |
| POOR (D) | Shrubs < 3 feet in height average >45% cover in the assessment area |

| Metric Rating | *Wet Longleaf & Slash Pine Flatwoods & Savannas* |
|---|---|
| EXCELLENT (A) | Shrubs < 3 feet in height average <30% cover in the assessment area |
| GOOD (B) | Shrubs < 3 feet in height average 30 to <40% cover in the assessment area |
| FAIR (C) | Shrubs < 3 feet in height average 40 to 45% cover in the assessment area |
| POOR (D) | Shrubs < 3 feet in height average >45% cover in the assessment area |

| Metric Rating | *Xeric Longleaf Pine Barrens* |
|---|---|
| EXCELLENT (A) | Shrubs < 3 feet in height average <25% cover in the assessment area |
| GOOD (B) | Shrubs < 3 feet in height average 25 to 35% cover in the assessment area |
| FAIR (C) | Shrubs < 3 feet in height average >35 to 45% cover in the assessment area |
| POOR (D) | Shrubs < 3 feet in height average >45% cover in the assessment area |

| Metric Rating | *Dry & Mesic Highlands Pine Woodlands* |
|---|---|
| EXCELLENT (A) | Shrubs < 3 feet in height average <20% cover in the assessment area |
| GOOD (B) | Shrubs < 3 feet in height average 20 to 25% cover in the assessment area |
| FAIR (C) | Shrubs < 3 feet in height average >25 to 40% cover in the assessment area |
| POOR (D) | Shrubs < 3 feet in height average >40% cover in the assessment area |

| Metric Rating | *Dry & Mesic Hilly Pine Woodlands* |
|---|---|
| EXCELLENT (A) | Shrubs < 3 feet in height average <20% cover in the assessment area |
| GOOD (B) | Shrubs < 3 feet in height average 20 to 30% cover in the assessment area |
| FAIR (C) | Shrubs < 3 feet in height average >30 to 45% cover in the assessment area |
| POOR (D) | Shrubs < 3 feet in height average >45% cover in the assessment area |

| Metric Rating | *Upper Coastal Plain Pine Flatwoods* |
|---|---|
| EXCELLENT (A) | Shrubs < 3 feet in height average <20% cover in the assessment area |
| GOOD (B) | Shrubs < 3 feet in height average 20 to 30% cover in the assessment area |
| FAIR (C) | Shrubs < 3 feet in height average >30 to 45% cover in the assessment area |
| POOR (D) | Shrubs < 3 feet in height average >45% cover in the assessment area |

**Tall Shrubs (3-10 feet tall)**

| Metric Rating | *Dry & Mesic Longleaf Pine Woodlands* |
|---|---|
| EXCELLENT (A) | Shrubs 3-10 feet in height average <10% cover. |
| GOOD (B) | Shrubs 3-10 feet in height average 10 to 20% cover. |
| FAIR (C) | Shrubs 3-10 feet in height average >20 to 30% cover. |
| POOR (D) | Shrubs 3-10 feet in height average >30% cover. |

| Metric Rating | *Mesic Longleaf Pine Flatwoods* |
|---|---|
| EXCELLENT (A) | Shrubs 3-10 feet in height average <5% cover. |
| GOOD (B) | Shrubs 3-10 feet in height average 5 to <15% cover. |
| FAIR (C) | Shrubs 3-10 feet in height average 15 to 25% cover. |
| POOR (D) | Shrubs 3-10 feet in height average >25% cover. |

| Metric Rating | *Wet Longleaf & Slash Pine Flatwoods & Savannas* |
|---|---|
| EXCELLENT (A) | Shrubs 3-10 feet in height average <5% cover. |
| GOOD (B) | Shrubs 3-10 feet in height average 5 to <15% cover. |
| FAIR (C) | Shrubs 3-10 feet in height average 15-25% cover. |
| POOR (D) | Shrubs 3-10 feet in height average >25% cover. |

| Metric Rating | *Xeric Longleaf Pine Barrens* |
|---|---|
| EXCELLENT (A) | Shrubs 3-10 feet in height average <5% cover. |
| GOOD (B) | Shrubs 3-10 feet in height average 5 to <15% cover. |
| FAIR (C) | Shrubs 3-10 feet in height average 15 to 30% cover. |
| POOR (D) | Shrubs 3-10 feet in height average >30% cover. |

| Metric Rating | *Dry & Mesic Highlands Pine Woodlands* |
|---|---|
| EXCELLENT (A) | Shrubs 3-10 feet in height average <15% cover. |
| GOOD (B) | Shrubs 3-10 feet in height average 15 to 20% cover. |
| FAIR (C) | Shrubs 3-10 feet in height average >20 to 30% cover. |
| POOR (D) | Shrubs 3-10 feet in height average >30% cover. |

| Metric Rating | *Dry & Mesic Hilly Pine Woodlands* |
|---|---|
| EXCELLENT (A) | Shrubs 3-10 feet in height average <15% cover. |
| GOOD (B) | Shrubs 3-10 feet in height average 15 to 20% cover. |
| FAIR (C) | Shrubs 3-10 feet in height average >20 to 30% cover. |
| POOR (D) | Shrubs 3-10 feet in height average >30% cover. |

| Metric Rating | *Upper Coastal Plain Pine Flatwoods* |
|---|---|
| EXCELLENT (A) | Shrubs 3-10 feet in height average <15% cover. |
| GOOD (B) | Shrubs 3-10 feet in height average 15 to 20% cover. |
| FAIR (C) | Shrubs 3-10 feet in height average >20 to 30% cover. |
| POOR (D) | Shrubs 3-10 feet in height average >30% cover. |

*Metric Name:*

Overall Native Herbaceous Ground Cover

**Definition:** Percentage cover of all (native) herbaceous species in the ground layer.

**Measurement Protocol**: For assessment area, estimate the cover of all native herbaceous ground cover (FNAI and FFS 2014). This includes all native non-woody, soft-tissued plants regardless of height, including non-woody vines, legumes, composites, graminoids (grasses, sedges, and rushes, including beaked rushes), and other herbaceous plants. Visually assess the percentage of the ground within the plot covered by the general extent of native herbaceous plants. Cover is defined as the percentage of ground surface obscured by the vertical projection of all aboveground parts of a given species onto that surface, estimated visually by the field researcher (Peet et al. 1998). Spaces between leaves and stems count as cover.

**Metric Rating**: Specify the narrative and numerical ratings for the metric, from excellent to poor.

| Metric Rating | *Dry & Mesic Longleaf Pine Woodlands* |
|---|---|
| EXCELLENT (A) | 40-98% herbaceous cover |
| GOOD (B) | 30 to <40% or >98% herbaceous cover |
| FAIR (C) | 20 to <30% herbaceous cover |
| POOR (D) | <20% herbaceous cover |

| Metric Rating | *Mesic Longleaf Pine Flatwoods* |
|---|---|
| EXCELLENT (A) | 40-98% herbaceous cover |
| GOOD (B) | 30 to <40% or >98% herbaceous cover |
| FAIR (C) | 20 to <30% herbaceous cover |
| POOR (D) | <20% herbaceous cover |

| Metric Rating | *Wet Longleaf & Slash Pine Flatwoods & Savannas* |
|---|---|
| EXCELLENT (A) | 40-100% herbaceous cover |
| GOOD (B) | 30 to <40% herbaceous cover |
| FAIR (C) | 20 to <30% herbaceous cover |
| POOR (D) | <20% herbaceous cover |

| Metric Rating | *Xeric Longleaf Pine Barrens* |
|---|---|
| EXCELLENT (A) | 40-100% herbaceous cover |
| GOOD (B) | >25 to <40% herbaceous cover |
| FAIR (C) | >15 to 25% herbaceous cover |
| POOR (D) | 0-15% herbaceous cover |

| Metric Rating | Dry & Mesic Highlands Pine Woodlands |
|---|---|
| EXCELLENT (A) | >45 to 80% herbaceous cover |
| GOOD (B) | 30-45% or >80% herbaceous cover |
| FAIR (C) | 15 to <30% herbaceous cover |
| POOR (D) | <15% herbaceous cover |

| Metric Rating | Dry & Mesic Hilly Pine Woodlands |
|---|---|
| EXCELLENT (A) | 35-80% herbaceous cover |
| GOOD (B) | 20 to <35% or >80% herbaceous cover |
| FAIR (C) | 10 to <20% herbaceous cover |
| POOR (D) | <10% herbaceous cover |

| Metric Rating | Upper Coastal Plain Pine Flatwoods |
|---|---|
| EXCELLENT (A) | 35-80% herbaceous cover |
| GOOD (B) | 20 to <35% or >80% herbaceous cover |
| FAIR (C) | 10 to <20% herbaceous cover |
| POOR (D) | <10% herbaceous cover |

*Metric Name:*

Longleaf Pine Regeneration

**Definition:** This metric has two parts, longleaf pine regeneration at the larger stand level and at the smaller rapid assessment locations. Regeneration includes grass stage or saplings <2" DBH (Longleaf Partnership Council 2014). Advance longleaf pine regeneration is present in patches across the stand, these patches make up 5-15% of stand. At rapid assessment locations, cover of longleaf pine regeneration should be ≥1% cover (Nordman et al. 2016).

**Measurement Protocol**: This includes both a metric for the rapid assessment location and a stand level metric. Advance longleaf pine regeneration includes grass stage longleaf pine and small longleaf pine regeneration less than 2" DBH (Longleaf Partnership Council 2014). Grass stage longleaf pine can be difficult to see when sparse. The percent cover of advance regeneration of longleaf pine is assessed at the rapid assessment location, generally a circular or rectangular plot. The assessment area should be at least 0.1 acre or 400 m2, this is the same rapid assessment area used for other metrics. Advance longleaf pine regeneration cover is 1% or greater at rapid assessment locations.  At the stand level, longleaf pine recruitment may be very patchy, and regeneration might not be found in small assessment plots. At the stand level the percent cover of longleaf regeneration is not assessed, look only for the presence of longleaf pine regeneration in patches in the larger stand. Adequate advance regeneration should be in patches across the larger stand, and these patches should make up 5-15% (patches are 1/20 and 1/6) of the larger stand (Longleaf Partnership Council 2014).

**Metric Rating**: Specify the narrative and numerical ratings for the metric, from excellent to poor. The rapid assessment location (percent cover of longleaf pine regeneration) and stand level (presence of longleaf pine regeneration in patches) metric values are averaged for summarizing with the other ground layer metrics.

| Metric Rating | *All Open Longleaf Pine Ecosystems* |
|---|---|
| | **Rapid Assessment Location (percent cover of longleaf pine regeneration)** |
| EXCELLENT (A) | Longleaf pine regeneration (<2" DBH) cover is ≥1% at rapid assessment location |
| GOOD (B) | Longleaf pine regeneration (<2" DBH) cover is present but is <1% at rapid assessment location |
| FAIR (C) | No regeneration seen, but cone producing longleaf pine or longleaf pine >10" DBH are present rapid assessment location |
| POOR (D) | Longleaf pine regeneration (<2" DBH) cover is apparently absent, and no cone producing longleaf pine or any mature longleaf pine >10" DBH are present at the rapid assessment location |

| Metric Rating | *All Open Longleaf Pine Ecosystems* |
|---|---|
| | **Stand Level (presence of longleaf pine regeneration in patches)** |
| EXCELLENT (A) | Longleaf pine regeneration is present in patches across the stand, these patches are 5-15 % of the stand (about 1/20 to 1/6 of the stand) |
| GOOD (B) | Longleaf pine regeneration is present in patches across the stand, these patches are 1-5 % of the stand or >15% of the stand (less than 1/20 or more than 1/6 of the stand) |
| FAIR (C) | Longleaf pine regeneration is very sparse across stand, patches of longleaf pine regeneration are <1% of stand, or cone producing longleaf pine or longleaf pine >10" DBH are present |
| POOR (D) | Longleaf pine regeneration is apparently absent in stand, and apparently no cone producing longleaf pine or any mature longleaf pine >10" DBH are present in the stand |

## Native Warm Season Grass Cover

**Definition:** Native warm season grass cover may also be called cover of pyrophytic graminoids which include grasses and grass-like plants (sedges etc.). This metric is the percent cover of native warm season grasses and other perennial graminoids that are maintained by periodic fire. These native grasses and grass-like plants (mostly native warm season grasses) are the natural groundcover in southern open pine stands.  For a list of example species to include and which to exclude, see the Measurement Protocol below.

**Measurement Protocol**: For the assessment area, estimate total cover of all native warm season grass and grass-like species (FNAI and FFS 2014, NatureServe 2011). Visually assess the percentage of the ground within the plot covered by the general extent of native herbaceous plants. Cover is defined as the percentage of ground surface obscured by the vertical projection of all aboveground parts of a given species onto that surface, estimated visually by the field researcher (Peet et al. 1998). Spaces between leaves and stems also count as cover.

Few-flowered beaksedge (*Rhynchospora rariflora*) is an example of a graminoid, which is difficult to distinguish from wiregrass (*Aristida stricta*)*.* In Wet Pine Savannas and Flatwoods various graminoids (e.g. *Juncus spp., Rhynchospora spp.*) other than native warm season grasses are included here and have similar functions. For open longleaf pine woodlands in Florida, these include wiregrass (*Aristida stricta, Aristida beyrichiana*), pineywoods dropseed (*Sporobolus junceus*), Florida dropseed (*Sporobolus floridanus*), Chapman's beaksedge (*Rhynchospora chapmanii*), cutover muhly (*Muhlenbergia capillaris* var. *trichopodes*), toothache grass (*Ctenium aromaticum*), little bluestem (*Schizachyrum scoparium*) and Florida toothache grass (*Ctenium floridanum*). However, switchgrass (*Panicum virgatum*) and broomsedge (*Andropogon virginicus*) are not included. Switchgrass (*Panicum virgatum*) can become so dominant that other grasses, legumes and small bare ground areas are crowded out. Broomsedge (*Andropogon virginicus*) is excluded, because it is weedy and ruderal, commonly found in old fields, pastures and in recently logged pine stands. Some typical wide ranging southern native warm season grasses of Dry & Mesic Longleaf Pine Woodlands include splitbeard bluestem (*Andropogon ternarius*), Elliott's bluestem (*Andropogon gyrans var. gyrans*), pineywoods dropseed (*Sporobolus junceus*), rough dropseed (*Sporobolus clandestinus*), little bluestem (*Schizachyrium scoparium*), slender little bluestem (*Schizachyrium tenerum*), Indiangrass (*Sorghastrum nutans*), slender Indiangrass (*Sorghastrum elliottii*), and lopsided Indiangrass (*Sorghastrum secundum*). In the Wet Longleaf & Slash Pine Flatwoods & Savannas, Carolina wiregrass or pineland threeawn (*Aristida stricta*) or Southern wiregrass or Beyrich's threeawn (*Aristida beyrichiana*) often dominates, but toothache grass (*Ctenium aromaticum*), cutover muhly (*Muhlenbergia expansa*), little bluestem (*Schizachyrium scoparium*), Florida dropseed (*Sporobolus floridanus*), Carolina dropseed (*Sporobolus pinetorum*), wireleaf dropseed (*Sporobolus teretifolius*), chalky bluestem (*Andropogon capillipes*), other bluestems (*Andropogon* spp.), or other grasses may also dominate. In the Ozarks and Ouachitas (Interior

Highlands), native warm season grasses include little bluestem (*Schizachyrum scoparium*), big bluestem (*Andropogon gerardii*), Indian grass (*Sorghastrum nutans*), bearded shorthusk (*Brachyelytrum erectum*), Elliott's bluestem (*Andropogon gyrans*), blackseed speargrass (*Piptochaetium avenaceum*), composite dropseed (*Sporobolus compositus*), and other grasses (Blaney et al. 2015, Farrington 2010, Nelson 1985). In open shortleaf pine woodlands in northern Mississippi, native warm season grasses include little bluestem (*Schizachyrum scoparium*) and broomsedge (*Andropogon virginicus*), but broomsedge is excluded here due to its weediness (Brewer et al. 2015, Maynard and Brewer 2013).

A summary of species in two tables:

| 🚫 **Always exclude** | |
|---|---|
| switchgrass | *Panicum virgatum* |
| broomsedge | *Andropogon virginicus* |

| ☑ **Examples of typical warm season grasses, not an exhaustive list** | |
|---|---|
| chalky bluestem | *Andropogon capillipes* |
| big bluestem | *Andropogon gerardii* |
| Elliott's bluestem | *Andropogon gyrans* |
| other bluestems | *Andropogon* spp. |
| splitbeard bluestem | *Andropogon ternarius* |
| Southern wiregrass or Beyrich's threeawn | *Aristida beyrichiana* |
| Carolina wiregrass or pineland threeawn | *Aristida stricta* |
| wiregrass | *Aristida stricta, Aristida beyrichiana* |
| bearded shorthusk | *Brachyelytrum erectum* |
| toothache grass | *Ctenium aromaticum* |
| Florida toothache grass | *Ctenium floridanum* |
| cutover muhly | *Muhlenbergia capillaris* var. *trichopodes, Muhlenbergia expansa* |
| blackseed speargrass | *Piptochaetium avenaceum* |
| Chapman's beaksedge | *Rhynchospora chapmanii* |
| little bluestem | *Schizachyrium scoparium* |
| slender little bluestem | *Schizachyrium tenerum* |
| slender Indiangrass | *Sorghastrum elliottii* |
| Indiangrass | *Sorghastrum nutans* |
| lopsided Indiangrass | *Sorghastrum secundum* |
| rough dropseed | *Sporobolus clandestinus* |
| composite dropseed | *Sporobolus compositus* |
| Florida dropseed | *Sporobolus floridanus* |
| pineywoods dropseed | *Sporobolus junceus* |
| Carolina dropseed | *Sporobolus pinetorum* |
| wireleaf dropseed | *Sporobolus teretifolius* |

There are many other native warm season grasses in these genera: *Andropogon, Anthaenantia, Aristida, Calamovilfa, Coelorachis, Ctenium, Gymnopogon, Muhlenbergia, Panicum, Paspalum,*

*Saccharum, Schizachyrium, Sorghastrum, Sporobolus, Steinchisma, Tridens, Triplasis,* and *Tripsacum* (Osborne et al. 2014).

**Metric Rating**: Specify the narrative and numerical ratings for the metric, from excellent to poor.

| Metric Rating | *Dry & Mesic Longleaf Pine Woodlands* |
|---|---|
| EXCELLENT (A) | >25 to 97% cover of all native warm season grasses |
| GOOD (B) | >15 to 25% or >97% cover of all native warm season grasses |
| FAIR (C) | 10-15% cover of all native warm season grasses |
| POOR (D) | <10% cover of all native warm season grasses |

| Metric Rating | *Mesic Longleaf Pine Flatwoods* |
|---|---|
| EXCELLENT (A) | >25 to 97% cover of all native warm season grasses |
| GOOD (B) | >15 to 25% or >97% cover of all native warm season grasses |
| FAIR (C) | 10-15% cover of all native warm season grasses |
| POOR (D) | <10% cover of all native warm season grasses |

| Metric Rating | *Wet Longleaf & Slash Pine Flatwoods & Savannas* |
|---|---|
| EXCELLENT (A) | 25-97% cover of all native warm season grasses |
| GOOD (B) | >15 to <25% or >97% cover of all native warm season grasses |
| FAIR (C) | 10-15% cover of all native warm season grasses |
| POOR (D) | <10% cover of all native warm season grasses |

| Metric Rating | *Xeric Longleaf Pine Barrens* |
|---|---|
| EXCELLENT (A) | 25-95% cover of all native warm season grasses |
| GOOD (B) | 15 to <25% or >95% cover of all native warm season grasses |
| FAIR (C) | 10 to <15% cover of all native warm season grasses |
| POOR (D) | <10% cover of all native warm season grasses |

| Metric Rating | *Dry & Mesic Highlands Pine Woodlands* |
|---|---|
| EXCELLENT (A) | >25 to 85% cover of all native warm season grasses |
| GOOD (B) | >15 to 25% or >85% cover of all native warm season grasses |
| FAIR (C) | 10 -15% cover of all native warm season grasses |
| POOR (D) | <10% cover of all native warm season grasses |

| Metric Rating | *Dry & Mesic Highlands Pine Woodlands (Mountain Longleaf)* |
|---|---|
| EXCELLENT (A) | >25 to 85% cover of all native warm season grasses |
| GOOD (B) | 20 to 25% or >85% cover of all native warm season grasses |
| FAIR (C) | 10 to <20% cover of all native warm season grasses |
| POOR (D) | <10% cover of all native warm season grasses |

| Metric Rating | Dry & Mesic Hilly Pine Woodlands |
|---|---|
| EXCELLENT (A) | 25- 100% cover of all native warm season grasses |
| GOOD (B) | >15 to <25% cover of all native warm season grasses |
| FAIR (C) | 10-15% cover of all native warm season grasses |
| POOR (D) | <10% cover of all native warm season grasses |

| Metric Rating | Upper Coastal Plain Pine Flatwoods |
|---|---|
| EXCELLENT (A) | >25% cover of all native warm season grasses |
| GOOD (B) | 20 to 25% cover of all native warm season grasses |
| FAIR (C) | 10 to <20% cover of all native warm season grasses |
| POOR (D) | <10% cover of all native warm season grasses |

*RANK FACTOR: VEGETATION*

*Metric Name:*

Native Wiry Graminoid Cover

**Definition:** Percent cover of wiregrass (*Aristida stricta,* or *Aristida beyrichiana*), and other similar native wiry graminoid plants. Native wiry graminoids are grasses or grass-like plants which have very narrow, wiry leaves. Native wiry graminoid plants include grasses, and beakrushes that resemble wiregrass, and have wiry, rolled, or round in cross section (involute) leaves. Some native wiry graminoids are hairgrass muhly (*Muhlenbergia capillaris*), southern arrowfeather three-awn grass (*Aristida tenuispica*)*,* dropseeds (*Sporobolus junceus, Sporobolus teretifolius),* and beakrushes (*Rhynchospora chapmanii, Rhynchospora debilis, Rhynchospora rariflora, Rhynchospora oligantha, Rhynchospora stenophylla, Rhynchospora capillacea, Rhynchospora gracilenta*)*.*

**Measurement Protocol:** For the assessment area, estimate the percent cover of all native wiry graminoid herbaceous ground cover (FNAI and Florida FWC 2007). This includes wiregrass (*Aristida stricta, Aristida beyrichiana*), and all native wiry graminoids (including some grasses and beakrushes). Visually assess the percentage of the ground within the plot covered by the general extent of the wiregrass and other native wiry graminoids. Cover is defined as the percentage of ground surface obscured by the vertical projection of all aboveground parts of a given species onto that surface, estimated visually by the field researcher (Peet et al. 1998). Spaces between leaves and stems count as cover.

**Metric Rating**: Specify the narrative and numerical ratings for the metric, from excellent to poor.

| Metric Rating | *Dry & Mesic Longleaf Pine Woodlands* |
|---|---|
| EXCELLENT (A) | 20-95% cover of all wiry graminoids |
| GOOD (B) | 10 to <20% or >95% cover of all wiry graminoids |
| FAIR (C) | 2 to <10% cover of all wiry graminoids |
| POOR (D) | <2% cover of all wiry graminoids |

| Metric Rating | *Mesic Longleaf Pine Flatwoods* |
|---|---|
| EXCELLENT (A) | 20-95% cover of all wiry graminoids |
| GOOD (B) | 10 to <20% or >95% cover of all wiry graminoids |
| FAIR (C) | 2 to <10% cover of all wiry graminoids |
| POOR (D) | <2% cover of all wiry graminoids |

| Metric Rating | *Wet Longleaf & Slash Pine Flatwoods & Savannas* |
|---|---|
| EXCELLENT (A) | 20-95% cover of all wiry graminoids |
| GOOD (B) | 15 to <20% or >95% cover of all wiry graminoids |
| FAIR (C) | 5 to <15% cover of all wiry graminoids |
| POOR (D) | <5% cover of all wiry graminoids |

| Metric Rating | *Xeric Longleaf Pine Barrens* |
|---|---|
| EXCELLENT (A) | 20-95% cover of all wiry graminoids |
| GOOD (B) | 10 to <20% or >95% cover of all wiry graminoids |
| FAIR (C) | 2 to <10% cover of all wiry graminoids |
| POOR (D) | <2% cover of all wiry graminoids |

*Metric Name:*

Herbaceous Indicators of Soil Disturbance (Optional)

**Definition:** Presence of certain plant species considered to be indicators of soil disturbance.

**Measurement Protocol**: These species are considered herbaceous indicators of soil disturbance, followed by the references, **exotic species are bold**:

| | |
|---|---|
| *Bulbostylis barbata* | Archer 2003 |
| *Bulbostylis ciliatifolia* | Dale et al. 2002 |
| *Chrysoma pauciflosculosa* | Personal observation (Brett Williams Eglin AFB) |
| ***Cynodon dactylon*** | Dale et al. 2002 |
| *Cyperus croceus* | Archer 2003 |
| *Dichanthelium aciculare* | Dale et al. 2002, Kindell et al. 1997 |
| *Diodia teres* | Archer 2003, Dale et al. 2002 |
| ***Eragrostis curvula*** | Dale et al. 2002, Provencher et al 2001 |
| *Eragrostis refracta* | Personal observation (Gary Kaufmann, NFs in NC) |
| ***Eremochloa ophiuroides*** | Rasser 2003 |
| *Eupatorium capillifolium* | Archer 2003, Kindell et al. 1997, Rasser 2003 |
| *Eupatorium compositifolium* | Kindell et al. 1997, Provencher et al 2001 |
| *Froelichia gracilis* | Archer 2003, Dale et al. 2002 |
| *Haplopappus divaricatus* | Dale et al. 2002 |
| *Hypericum gentianoides* | Dale et al. 2002, Hiers et al. 2003, Provencher et al 2001 |
| ***Lespedeza cuneata*** | Dale et al. 2002 |
| *Liatris elegans* | Archer 2003 |
| ***Mollugo verticillata*** | Archer 2003, Dale et al. 2002 |
| *Panicum verrucosum* | Personal observation (Gary Kaufmann, NFs in NC) |
| *Paronychia patula* | Provencher et al. 2001 |
| ***Paspalum notatum*** | Archer 2003, Dale et al. 2002 |
| *Polypremum procumbens* | Archer 2003, Dale et al. 2002 |
| *Rubus cuniefolius, Rubus argutus* | Rasser 2003 |
| *Triplasis purpurea* | Dale et al. 2002 |

Measurement protocol is to record the presence/absence and percent cover (Brakenhielm and Qinghong 1995) of any of these species encountered.

**Metric Rating**: Specify the narrative and numerical ratings for the metric, from excellent to poor. The percent covers used here are rather low, but the list of indicators of soil disturbance does not include Broomsedge (*Andropogon virginicus*) which is commonly associated with soil disturbance and early succession, but which has a variable role in Longleaf Pine (Pinus palustris) ecosystems, and is sometimes found at high cover in areas which otherwise have high quality ground cover.

| Metric Rating | *All Southern Open Pine Ecosystems* |
|---|---|
| EXCELLENT (A) | Total cover for herbaceous indicators of soil disturbance <2% |
| GOOD (B) | Total cover for herbaceous indicators of soil disturbance 2-5% |
| FAIR (C) | Total cover for herbaceous indicators of soil disturbance >5-10% |
| POOR (D) | Total cover for herbaceous indicators of soil disturbance >10% |

*RANK FACTOR: VEGETATION*

*Metric Name:*

Invasive Plant Presence/Distribution

**Definition**: Invasive plant presence/distribution. Describes the extent and distribution of invasive exotic plants within or along the perimeter of the polygon; includes only Florida EPPC category I and II listed species <http://www.fleppc.org/list/list.htm> but references are available for other states.

**Measurement Protocol**: Describe the extent and distribution of invasive exotic plants within the site and/or along the perimeter of the site. In particular, estimate a percent cover value for your assessment area of invasive plant species. Cover is defined as the percentage of ground surface obscured by the vertical projection of all aboveground parts of a given species onto that surface, estimated visually by the field researcher (Peet et al. 1998). Spaces between leaves and stems also count as cover. Determine the presence only of Florida EPPC category I and II listed species. For areas outside of Florida, refer to those invasive exotic species listed for north Florida. <http://www.fleppc.org/list/list.htm> There also are other references for outside Florida (Lund et al. 2015, Miller 2003).

**Metric Rating**:  Specify the narrative and numerical ratings for the metric, from excellent to poor.

| Metric Rating | *All Southern Open Pine Ecosystems* |
|---|---|
| EXCELLENT (A) | Invasive nonnative plant species absent |
| GOOD (B) | Invasive nonnative plant species present in any stratum but sporadic (<5 % cover) |
| FAIR (C) | Invasive nonnative plant species in any stratum uncommon (5-10% cover) |
| POOR (D) | Invasive nonnative plant species in any stratum common (>10% cover) |

*Metric Name:*

Absolute Patch Size

**Definition**: A measure of the current absolute size of the contiguous open pine/longleaf pine polygon or patch, which may be larger than the assessment area. The metric is assessed with respect to expected patch sizes for the type across its range. This metric is one aspect of the size of specific occurrences of an open pine/longleaf type. The metric rating is taken from NatureServe's Ecological Integrity Assessment Working Group (Faber-Langendoen et al. 2008). Assessors are sometimes hesitant of using absolute size as part of an EIA out of concern that a small, high quality example will be down-ranked unnecessarily. We address these concerns to a degree by providing a pattern-type scale, so that types that typically occur as small patches (seepage fens) can use a different rating than types that may occur over large, extensive areas (e.g., marshes or boreal bogs/fens). Size is also more accurately assessed at finer scales of classification (e.g., Systems or Groups). Then, for example, Midwest fens are compared separately from boreal fens.

**Measurement Protocol**: The choice of patch type for the particular vegetation being assessed is an important first step and should be based on knowledge of the typical sizes of mid to broad scale ecological types (Formations, Groups, Systems) found in excellent sites. Knowledgeable ecologists in the state or region should be consulted. Ecological System and Group types have all been assigned to a pattern type, so if the site is classified to Ecological System or Group, that information can be readily attained ([www.natureserve.org/explorer](www.natureserve.org/explorer)).

Absolute Size can be measured in GIS using aerial photographs, orthophoto quads, National Wetland Inventory maps, or other data layers. Size can also be estimated in the field using 7.5 minute topographic quads, NPS Vegetation Mapping maps, National Wetland Inventory maps, or a global positioning system. Boundaries are not delineated using jurisdictional methods (U.S. Army Corps of Engineers 1987); rather, they are delineated by ecological guidelines for delineating the boundaries of the vegetation type, based on the International Vegetation Classification, equivalent National Vegetation Classifications, National Wetland Inventory, or other classifications.

**Metric Rating**:  Specify the narrative and numerical ratings for the metric, from excellent to poor.

| Metric Rating | *All Southern Open Pine Ecosystems* |
|---|---|
| EXCELLENT (A) | >10,000 acres |
| GOOD (B) | 2,000-10,000 acres |
| FAIR (C) | 500-2,000 acres |
| POOR (D) | 0-500 acres |

RANK FACTOR: LANDSCAPE CONTEXT

*Metric Name:*

Contiguous Natural Land Cover

**Definition**: This metric measures the percent of the landscape within 500 meters of the assessment area that is contiguous with (and thus forms an unfragmented connection to) the assessment area itself. Fragmentation can dramatically impact natural processes such as seed dispersal, animal movement, and genetic diversity (Lindenmayer and Fischer 2006).

**Measurement Protocol**: To assess this metric, examine land use patterns within a 500 m envelope of the assessment area. This is best done using the most recent aerial photography available. GIS layers of land use or land cover can also be used, but may not be as accurate as interpretation of aerial photography. When possible, walk through portions of the 500 m envelop to ground truth the photo. Identify the largest unfragmented block that contains the assessment area and estimate its percentage of the total area within the 500 m envelope. This percent of unfragmented landscape can have small fragmentation inclusions (e.g., individual houses in a forested landscape, etc.), but roads that bisect the landscape form a hard boundary to the unfragmented block. Well-traveled dirt roads and major canals count as fragmentation, but hiking paths, non-tilled hayfields, open fences, and small lateral ditches can be included in unfragmented blocks. For larger roads, such as highways where road fill and trash borders the road, the zone of the road's influence should also be considered as fragmentation.

**Metric Rating**: Assign the metric rating and associated score based on the thresholds below.

| Metric Rating | *All Southern Open Pine Ecosystems* |
|---|---|
| EXCELLENT (A) | Intact: embedded in 90–100% contiguous natural landscape. |
| GOOD (B) | Variegated: embedded in 60–90% contiguous natural landscape |
| FAIR (C) | Fragmented: embedded in 20–60% contiguous natural landscape |
| POOR (D) | Relictual: embedded in <20% contiguous natural landscape. |

*Metric Name:*

Land Use Index

**Definition**: This metric measures the intensity of human dominated land uses in the surrounding landscape and is based on Hauer et al. (2002) and Mack (2006).

**Measurement Protocol**: The Land Use Index is measured by documenting surrounding land uses within 500 m of the assessment area. The assessment should be completed in the office using remote sensing imagery, such as aerial photographs, satellite imagery, or landcover datasets. Where feasible, the rating should be verified in the field, using roads or transects to verify land use categories. Ideally, both field data as well as remote sensing tools are used to identify an accurate percent of each land use within the landscape area, but remote sensing data alone can be used. This metric can be calculated as an automated GIS process using the National Land Cover Dataset or the LANDFIRE Dataset, though both should be reviewed for accuracy.

To calculate a Land Use Index, estimate the percent of each land use category and calculate the corresponding category score based on land use coefficients and the following equation:
Land use category score = $\sum$ LU x PC/100
LU = Land use coefficient for each category
PC = % of adjacent area in each category
Do this for each land use category separately, then sum each category score to calculate the Total Land Use Score. If land uses overlap, use the more intensive land use for the calculation. For example, if 10% of the landscape contains unpaved roads (1 * 0.10 = 0.1), 30% is under moderate grazing (6 * 0.30 = 1.8), and 60% is natural vegetation (10 * 0.60 = 6.0), the Total Land Use Score would be 7.9 (0.1 + 1.8 + 6.0), for a rating of C.

**Metric Rating**: Specify the narrative and numerical ratings for the metric, from excellent to poor.

| Metric Rating | *All Southern Open Pine Ecosystems* |
|---|---|
| EXCELLENT (A) | Land Use Index = 9.5–10.0. |
| GOOD (B) | Land Use Index = 8.0–9.49. |
| FAIR (C) | Land Use Index = 4.0–7.99. |
| POOR (D) | Land Use Index = <4.0. |

*RANK FACTOR: LANDSCAPE*

*Metric Name:*

Perimeter with Natural Buffer

**Definition**: This metric measures the percent of the assessment area perimeter that is immediately surrounded by natural buffer land covers.

**Measurement Protocol**: Estimate the length of the assessment area perimeter contiguous with a natural buffer. Use a 5 m minimum buffer width. Perimeter includes open water. Metric is adapted from Collins et al. (2006) and US EPA (2011).

**Metric Rating**:  Specify the narrative and numerical ratings for the metric, from excellent to poor.

| Metric Rating | *All Southern Open Pine Ecosystems* |
|---|---|
| EXCELLENT (A) | Natural buffer surrounds 100% of the site perimeter |
| GOOD (B) | Natural buffer surrounds 75–99% of the site perimeter |
| FAIR (C) | Natural buffer surrounds 25–74% of the site perimeter |
| POOR (D) | Natural buffer surrounds <25% of the site perimeter |