Elaeagnus pungens

INTRODUCTORY

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AUTHORSHIP AND CITATION:
Gucker, Corey L. 2011. Elaeagnus pungens. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available: http://www.fs.fed.us/database/feis/ [2011, February 28].

FEIS ABBREVIATION:
ELAPUN

NRCS PLANT CODE [54]:
ELPU2

COMMON NAMES:
thorny-olive
thorny olive
silverthorn
thorny elaeagnus

TAXONOMY:
The scientific name of thorny-olive is *Elaeagnus pungens* Thunb. (Elaeagnaceae) [22,29,60]. Some suggest that thorny-olive could hybridize with native oleaster (*Elaeagnus* spp.) in the United States [35], but hybrids were not reported in the reviewed literature.

SYNONYMS:
None

LIFE FORM:
Shrub

DISTRIBUTION AND OCCURRENCE

SPECIES: Elaeagnus pungens

GENERAL DISTRIBUTION:
Thorny-olive is not native to the United States but was introduced from Asia in 1830 [15,22]. As of 2011, escaped populations were suspected nearly throughout the southeastern United States from Kentucky and Virginia south to Louisiana and Florida [37]. Thorny-olive may also occur in natural areas of Massachusetts and Washington DC [54]. Plants Database provides a map of thorny-olive's US distribution.

Since its introduction as an ornamental, thorny-olive has frequently been planted in hedgerows and along highways [15,37,57]. It has also been used to revegetate mine sites [41,50]. Because thorny-olive grows densely even in harsh conditions, it was "extensively" planted in highway medians in the Southeast. As of 2000, the Virginia Department of Transportation had been planting thorny-olive along roadways for about 20 years [57]. Thorny-olive was also used in highway medians in Texas [16]. Around 1970 in eastern Kentucky, thorny-olive was planted on surface mine spoils and becuase establishment was successful and surival high, it was recommended for further use in mine reclamation [41]. On a coal surface-mined area in Laurel County, Kentucky, thorny-olive was still present and described as growing well or increasing 18 years after planting [50].

Reports on the extent of invasive populations of thorny-olive in the United States were rare, although surveys provided cover estimates in southern forests and indicated US range expansions. Forest Inventory Analysis data from 12 southern states in 2008 indicated that thorny-olive occupied an estimated 6,107 acres (2,471 ha) in forests in 6 states. It was most widespread in forests of Georgia (3,380 acres (1,368 ha)) and South Carolina (about 2,000 acres (800 ha)) [38]. In Florida, thorny-olive was known outside of cultivation only in the panhandle until about 2000, when it was reported in Alachua and Marion counties [28]. In 2003, it was reported as an escape in St Lucie County, 160 miles (250 km) south of Marion County [39]. In 1997, thorny-olive was reported as infrequent but spreading on the barrier islands of northern North Carolina [47].

HABITAT TYPES AND PLANT COMMUNITIES:
Based on the little information available (as of February 2011), thorny-olive occupies a greater diversity of habitats in

its nonnative than its native range.

Native habitats: In Asia, thorny-olive is primarily reported in open areas or shrublands. The Flora of China indicates that thorny-olive occurs on open slopes, along roadsides, and in thickets [59]. In limestone areas of Skikoku, Japan, thorny-olive is common in *Quercus phillyraeoides-Pittoporum tobira* scrub [61].

Nonnative habitats: In the southeastern United States, thorny-olive is reported in shaded woodlands as well as open, disturbed sites. In North Carolina, thorny-olive occurred in oak-hickory (*Quercus-Carya* spp.) woodland understories [4], urban riparian forests [56], maritime evergreen forests [31], and ruderal habitats within the longleaf pine (*Pinus palustris*) ecosystem [45]. In northeastern Tennessee, thorny-olive occurred within and at the edges of woodlands [26]. In Alabama, it was reported in parks, rights-of-way, and managed forests, as well as natural areas [1,17]. In Alabama's Pike County Pocosin Nature Preserve, thorny-olive occurred in hardwood ravines, which were the least disturbed of the Preserve's habitats. Common overstory species in the hardwood ravines included yellow-poplar (*Liriodendron tulipifera*), southern magnolia (*Magnolia grandiflora*), American beech (*Fagus grandifolia*), and white ash (*Fraxinus americana*) [14]. In St Lucie County, Florida, thorny-olive occurred in dry pine woods [39].

BOTANICAL AND ECOLOGICAL CHARACTERISTICS

SPECIES: Elaeagnus pungens

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Because primary literature and original research on thorny-olive were generally lacking, this summary has relied heavily on information presented in floras [12], horticultural references [15,30] weed management guides [37], and fact sheets [21]. Information presented in these sources often lacked supporting documentation and details, but most were written by land managers, botanists, or horticulturalists with experience from invaded areas and likely represent field observations. Additional research on thorny-olive is necessary before much of the information can be properly assessed for accuracy and completeness.

GENERAL BOTANICAL CHARACTERISTICS:

- **Botanical description**
- **Raunkiaer life form**

Botanical description: This description covers characteristics that may be relevant to fire ecology and is not meant for identification. Keys for identification are available (e.g., [22,42]).

Thorny-olive is a multistemmed, freely branched, dense shrub [22,37,42]. It may reach 25 feet (7.6 m) tall and 15 feet (4.6 m) wide [15,37]. Once established, thorny-olive produces prolific, fast-growing stem sprouts which allow shrubs to increase in size and "scramble" through neighboring vegetation [22,37]. Stem bark is armed with "rather nasty", 2- to 3-inch (5-8 cm) long thorns [15]. Leaves are simple, evergreen, arranged alternately, and typically measure 1.6 to 4 inches (4-10 cm) long and less than half as wide [15,42]. The undersides of leaves are ashy white and flecked with brown scales [60]. Thorny-olive produces tubular flowers that are about 1 cm long and occur in clusters of up to 3 [37]. Fruits are single-seeded drupes that are 1 to 1.5 cm long [37,42].

Raunkiaer [43] **life form:**
Phanerophyte

SEASONAL DEVELOPMENT:
In its US range, thorny-olive flowers in the fall (October-December) and produces fruit in the spring (March-June) [15,22,37,42]. Similar seasonal development is reported for thorny-olive in China [59].

REGENERATION PROCESSES:

- **Pollination and breeding system**
- **Seed production**
- **Seed dispersal**
- **Seed banking**
- **Germination**
- **Seedling establishment and plant growth**
- **Vegetative regeneration**

Thorny-olive reproduces by seed [13]. Vegetative sprouting increases shrub size and allows for regeneration after stem damage or top-kill [15,37].

Pollination and breeding system: Thorny-olive produces at least some perfect flowers [12,42]. Perfect flowers are reported by Radford and others [42], but Clewell [12] reports that thorny-olive shrubs are primarily dioecious with some perfect flowers.

Seed production: Actual fruit production and seed yield were not reported in the reviewed literature (as of February 2011). Studies do suggest, however, that seed production is variable. Davison [13] reports that fruit production can be delayed and reduced if winter temperatures are "exceptionally" cold. Based on field observations near thorny-olive roadside plantings in Virginia, researchers suggested that the timing and amount of thorny-olive fruit production vary from year to year. Reasons for these speculations were not given [57]. See Seed dispersal (below) and Importance to Wildlife for information on bird mortality and related field observations around thorny-olive roadside plantings.

Seed dispersal: Many bird species feed on thorny-olive fruits, and because shrubs often occur as single or scattered individuals in natural areas, it is believed that seeds are dispersed in bird droppings [37,40]. In Atlanta, Georgia, cardinals, juncos, cedar waxwings, brown thrashers, and other small birds were observed eating thorny-olive fruits. Bird droppings beneath trees near thorny-olive shrubs contained numerous thorny-olive seeds [13]. Two studies indicate that cedar waxwings are especially attracted to thorny-olive fruits and are susceptible to automobile-induced mortality where thorny-olive has been planted along highways [16,57]. These studies are described in detail in Importance to Wildlife.

Seed banking: No information is available on this topic.

Germination: In the reviewed literature, there was little information about thorny-olive seed germination (as of February 2011). According to a horticultural magazine [30], thorny-olive seeds do not germinate until the second spring following production.

Seedling establishment and plant growth: Although thorny-olive seedlings have been observed, information regarding the best conditions for successful seedling establishment were not reported in the reviewed literature (February 2011). In Atlanta, Georgia, and Clemson, South Carolina, thorny-olive seedlings were observed beneath older conspecifics [13], suggesting that thorny-olive is likely to persist where established.

Plant growth: Thorny-olive grows "very rapidly". Shoots may grow 3 to 4 feet (0.9-1.2 m) in a single growing season [5]. In a nursery study, stem diameter of thorny-olive increased 5% within 2 growing seasons after planting. Shrubs defoliated in the spring had stem diameter increases of 183% after 2 growing seasons [32].

Vegetative regeneration: Vegetative sprouting increases shrub size and allows for regeneration after stem damage or top-kill [15,37]. However, information regarding regeneration from root fragments and persistence of sprouts following repeated damage or top-kill was not reported in the available literature. Several sources indicate that "root suckering" or "prolific stem sprouts" are responsible for the development of dense thickets [4,15,37].

SITE CHARACTERISTICS:
Thorny-olive occurs in a variety of sites including disturbed, undisturbed, sunny, and shady locations [12,37,60]. In South Carolina, thorny-olive occurs in the mountains, Piedmont, and Coastal Plain regions [46].

Climate: In the United States, thorny-olive is hardy to USDA Hardiness zones 6 to 10, where the average annual minimum temperatures range from -10 °F to 35 °F (-23 to 2 °C) [15,21]. Once established, thorny-olive tolerates heat, wind, coastal conditions, and drought [21,30].

Elevation: Thorny-olive primarily occurs at elevations of less than 3,300 feet (1,000 m) in China [59]. Elevation ranges for thorny-olive habitats in the United States were not reported.

Soils: A variety of soil types, textures, and conditions are tolerated by thorny-olive. Horticultural references indicate that thorny-olive grows on occasionally wet, alkaline to acidic clays, sands, or loams [21]. Well-drained saline soils are also tolerated [30]. Once established, thorny-olive has "considerable" drought tolerance [15].

A field experiment on surface-mined sites in eastern Kentucky indicates that thorny-olive growth and survival may be better in neutral than acidic conditions. Four years after establishment, thorny-olive survival was 63%, and shrubs averaged 5.7 feet (1.7 m) tall on spoils with a pH of 3.8 and phosphorus levels of 1.1 ppm. On spoils with greater pH (7.2) and phosphorus levels (2.7 ppm), thorny-olive survival was 100%, and shrubs averaged 7.8 feet (2.4 m) tall [41].

SUCCESSIONAL STATUS:
Although no studies (as of February 2011) monitored successional change over time in habitats invaded by thorny-olive, field observations suggest that early-seral, late-seral, open, shaded, disturbed, and undisturbed sites are potential thorny-olive habitats [12,37,60]. Thorny-olive is shade tolerant, although shrubs may be "thinner" in shaded areas [15,37]. Thorny-olive occurred in disturbed areas in parts of Tennessee and Georgia [6,62], but in a preserve in Alabama, thorny-olive occurred in hardwood ravines, the least disturbed habitats in the study area [14].

FIRE EFFECTS AND MANAGEMENT

SPECIES: Elaeagnus pungens

FIRE EFFECTS:

Immediate fire effect on plant: The immediate effect of fire on thorny-olive was not reported in the reviewed literature (as of February 2011). Thorny-olive sprouts after cutting [15] and may do the same following top-kill or injury from fire.

Postfire regeneration strategy [48]:
Tall shrub, adventitious buds and/or a sprouting root crown
Secondary colonizer (on- or off-site seed sources)

Fire adaptations and plant response to fire: Fire studies in thorny-olive thickets or habitats were lacking as of the writing of this review (2011). Although thorny-olive sprouts following cutting [15], without additional information on seedling establishment, vegetative regeneration, or fire effects, it is impossible to speculate thorny-olive's response to burning or potential for establishment on burned sites.

FUELS AND FIRE REGIMES:
There was almost no information regarding fuels and fire regimes in habitats invaded by thorny-olive. The Virginia Firewise Landscaping Taskforce gave thorny-olive a "medium" flammability rating based on a combination of leaf moisture retention, leaf oil or resin content, litter and debris accumulation, foliage and dead branch production, branching architecture, landscape maintenance needs, and/or drought resistance [2]. Altered fire frequency, severity, and behavior in habitats invaded by thorny-olive were not described in the available literature. See the Fire Regime Table for more information on fire regimes in vegetation communities where thorny-olive may occur.

FIRE MANAGEMENT CONSIDERATIONS:

Potential for postfire establishment and spread: Without more information about the conditions conducive to successful seedling emergence, the potential for thorny-olive establishment and spread in burned areas is unknown. However, likely long-distance seed dispersal by birds means that postfire monitoring for thorny-olive may be necessary even in areas lacking a nearby seed source.

Preventing postfire establishment and spread: Preventing invasive plants from establishing in weed-free burned areas is the most effective and least costly management method. This may be accomplished through early detection and eradication, careful monitoring and follow-up, and limiting dispersal of invasive plant propagules into burned areas. General recommendations for preventing postfire establishment and spread of invasive plants include:

- Incorporate cost of weed prevention and management into fire rehabilitation plans
- Acquire restoration funding
- Include weed prevention education in fire training
- Minimize soil disturbance and vegetation removal during fire suppression and rehabilitation activities
- Minimize the use of retardants that may alter soil nutrient availability, such as those containing nitrogen and phosphorus
- Avoid areas dominated by high priority invasive plants when locating firelines, monitoring camps, staging areas, and helibases
- Clean equipment and vehicles prior to entering burned areas
- Regulate or prevent human and livestock entry into burned areas until desirable site vegetation has recovered sufficiently to resist invasion by undesirable vegetation
- Monitor burned areas and areas of significant disturbance or traffic from management activity
- Detect weeds early and eradicate before vegetative spread and/or seed dispersal
- Eradicate small patches and contain or control large infestations within or adjacent to the burned area
- Reestablish vegetation on bare ground as soon as possible
- Avoid use of fertilizers in postfire rehabilitation and restoration

- Use only certified weed-free seed mixes when revegetation is necessary

For more detailed information on these topics, see the following publications: [3,8,23,53].

Use of prescribed fire as a control agent: Without more information about the vegetative regeneration capacity and postfire response of thorny-olive, the potential for using prescribed fire to control it is unclear.

Altered fuel characteristics: Changes in fuel characteristics or related fire regime characterisitics in habitats invaded by thorny-olive were not described in the available literature (2011).

MANAGEMENT CONSIDERATIONS

SPECIES: Elaeagnus pungens

FEDERAL LEGAL STATUS:
None

OTHER STATUS:
Information on state-level noxious weed status of plants in the United States is available at Plants Database.

IMPORTANCE TO WILDLIFE AND LIVESTOCK:
Thorny-olive fruits are a food source for many bird species. After cardinals, juncos, cedar waxwings, brown thrashers, and other small birds were observed feeding on thorny-olive fruits in Atlanta, Georgia, thorny-olive was suggested for use in southern farmland hedges and borders [13]. Two studies indicate that cedar waxwings are especially attracted to thorny-olive fruits and are susceptible to automobile-induced mortality near thorny-olive roadside plantings. The Virginia Fish and Wildlife Department discovered 145 dead cedar waxwings in a high-traffic area near Richmond where thorny-olive occurred. In a follow-up study, researchers found that European starlings, cedar waxwings, robins, and common grackles commonly fed in thorny-olive highway plantings. Almost 95% of birds were associated with medians that had viable thorny-olive fruits, and those without viable fruit supported very few birds. Bird densities peaked with peak fruit availability [57]. High cedar waxwing mortality was also reported along a highway with thorny-olive plantings in Brazos County, Texas. Between 8 March and 5 April, researchers found 298 dead cedar waxwings. The largest count, 133 dead cedar waxwings, was made on 11 March in an area with 25 individual thorny-olive shrubs planted over a 330-foot (100 m) distance. Researchers also found 2 dead mockingbirds and 1 red-winged blackbird [16].

OTHER USES:
Thorny-olive has been used as an herbal treatment for asthma and chronic bronchitis in traditional Chinese medicine. In a laboratory study, treatments from extracts or fractions from thorny-olive leaves significantly prolonged the time to respiratory distress ($P<0.05$), lengthened the period between coughing spells ($P<0.05$), and decreased coughing frequency ($P<0.01$) in guinea pigs sensitive to artificially created asthmatic conditions [19].

IMPACTS AND CONTROL:

Impacts: Thorny-olive's growth rate and habit suggest that infestations could exclude native

vegetation and restrict human and wildlife movements. Rapid thorny-olive growth has been reported by many [5,15,37]. One horticultural reference suggests that "fast" is an inadequate description of thorny-olive's growth rate [15], while another describes growth as "aggressive" and "rampant" [21]. Thorny-olive produces dense, thorny stems, which can climb into other vegetation. Dirr [15] described the thorny-olive growth form as "a genuine horror" and observed thorny-olive stems growing 30 feet (9 m) into nearby tree branches.

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While it seems that dense, rapid, and sometimes climbing growth would inevitably shade other vegetation, reduce native plant recruitment, and restrict human and animal movements, the citations that suggest such [11,35] lack documentation of these effects. Some suggest that thorny-olive could hybridize with native oleaster (*Elaeagnus* spp.) in the United States [35], but hybrids were not reported in the reviewed literature.

Although impacts have not been documented in any detail, many southern states treat thorny-olive as a serious threat to native plant communities. When invasive shrubs of Kentucky were compared, thorny-olive had many characteristics in common with the most widespread invasive shrubs, suggesting it could become widespread in the state [7]. As of 2008, thorny-olive was considered a severe threat by the South Carolina Exotic Pest Plant Council. Severe threat species are those known to severely threaten the composition, structure, or function of natural areas [46]. Thorny-olive is also listed as a moderate or significant threat to natural areas by other southern states including Tennessee [49], Georgia [20], and Florida [18].

Control: Studies involving the control of thorny-olive were generally lacking, but there are some recommendations with regard to the timing of control. Control measures prior to fruit ripening are recommended to limit seed dispersal [11]. Defoliation control measures may be more successful in the fall than in the spring. In a nursery study, all thorny-olive plants survived spring defoliation, and growth of spring-defoliated plants was not significantly different from that of controls. However, just 3 of 8 plants survived fall defoliation in "good condition" [32].

Control of biotic invasions is most effective when it employs a long-term, ecosystem-wide strategy rather than a tactical approach focused on battling individual invaders [36]. In all cases where invasive species are targeted for control, no matter what method is employed, the potential for other invasive species to fill their void must be considered [9].

Prevention: Establishment and spread of thorny-olive may be prevented by restricting its sale and use for landscape and roadside plantings in or near invasible habitats. As of 2009, thorny-olive was still available for sale in nurseries. The use of thorny-olive in ornamental, hedgerow, and roadside plantings is a major means for dispersal [11,37]. In a 1984 edition of the Pacific Horticulture magazine, thorny-olive was highlighted as an "excellent plant for the

California landscape" [30], an area in which it may not occur outside of cultivation (as of 2011).

It is commonly argued that the most cost-efficient and effective method of managing invasive species is to prevent their establishment and spread by maintaining "healthy" natural communities [36,44] (e.g., avoid road building in wildlands [52]) and by monitoring several times each year [27]. Managing to maintain the integrity of the native plant community and mitigate the factors enhancing ecosystem invasibility is likely to be more effective than managing solely to control the invader [25]. Weed prevention and control can be incorporated into many types of management plans, including those for logging and site preparation, grazing allotments, recreation management, research projects, road building and maintenance, and fire management [53]. See the Guide to noxious weed prevention practices [53] for specific guidelines in preventing the spread of weed seeds and propagules under different management conditions.

Fire: For information on the use of prescribed fire to control this species, see Fire Management Considerations.

Cultural control: No information is available on this topic.

Physical or mechanical control: Some suggest that aggressive tillage or mowing may control thorny-olive [35], but others report that mechanical control of thorny-olive is slow and labor intensive [11]. These methods may not be appropriate for wildland management.

Biological control: As of 2011, no biological control agents had been tested or released for control of thorny-olive. There are few known thorny-olive pests in the United States [11].

Biological control of invasive species has a long history that indicates many factors must be considered before using biological controls. Refer to these sources: [55,58] and the Weed control methods handbook [51] for background information and important considerations for developing and implementing biological control programs.

Chemical control: The following references: [11,35,38] provide some guidelines for chemical control of thorny-olive. Byrd and Westbrooks [11] suggest that chemical control of thorny-olive can be slow, and signs of effectiveness may not be visible for "some time" after herbicide treatments. Herbicides are effective in gaining initial control of a new invasion or a severe infestation, but they are rarely a complete or long-term solution to weed management [10]. See the Weed control methods handbook [51] for considerations on the use of herbicides in natural areas and detailed information on specific chemicals.

Integrated management: No information is available on this topic.

APPENDIX: FIRE REGIME TABLE

SPECIES: Elaeagnus pungens

The following table provides fire regime information that may be relevant to thorny-olive habitats. Follow the links in the table to documents that provide more detailed information on these fire regimes.

Fire regime information on vegetation communities in which thorny-olive may occur. This information is taken from the LANDFIRE Rapid Assessment Vegetation Models [34], which were developed by local experts using available literature, local data, and/or expert opinion. This table summarizes fire regime characteristics for each plant community listed. The PDF file linked from each plant community name describes the model and synthesizes the knowledge available on vegetation composition, structure, and dynamics in that community. Cells are blank where information is not available in the Rapid Assessment Vegetation Model.		
South-central US	Southern Appalachians	Southeast

South-central US

- South-central US Grassland
- South-central US Forested

Vegetation Community (Potential Natural Vegetation Group)	Fire severity*	Fire regime characteristics			
		Percent of fires	Mean interval (years)	Minimum interval (years)	Maximum interval (years)
South-central US Grassland					
Bluestem-sacahuista	Replacement	70%	3.6	1	
	Mixed	30%	7.7	2	
South-central US Forested					
Gulf Coastal Plain pine flatwoods	Replacement	2%	190		
	Mixed	3%	170		
	Surface or low	95%	5		
West Gulf Coastal plain pine (uplands and flatwoods)	Replacement	4%	100	50	200
	Mixed	4%	100	50	
	Surface or low	93%	4	4	10
West Gulf Coastal Plain pine-hardwood woodland or forest upland	Replacement	3%	100	20	200
	Mixed	3%	100	25	
	Surface or low	94%	3	3	5
Southern floodplain	Replacement	42%	140		
	Surface or low	58%	100		
	Replacement	42%	≥1,000		

Southern floodplain (rare fire)					
	Surface or low	58%	714		

Southern Appalachians

- Southern Appalachians Grassland
- Southern Appalachians Woodland
- Southern Appalachians Forested

Vegetation Community (Potential Natural Vegetation Group)	Fire severity*	Fire regime characteristics			
		Percent of fires	Mean interval (years)	Minimum interval (years)	Maximum interval (years)
Southern Appalachians Grassland					
Bluestem-oak barrens	Replacement	46%	15		
	Mixed	10%	69		
	Surface or low	44%	16		
Eastern prairie-woodland mosaic	Replacement	50%	10		
	Mixed	1%	900		
	Surface or low	50%	10		
Southern Appalachians Woodland					
Appalachian shortleaf pine	Replacement	4%	125		
	Mixed	4%	155		
	Surface or low	92%	6		
Table Mountain-pitch pine	Replacement	5%	100		
	Mixed	3%	160		
	Surface or low	92%	5		
	Replacement	23%	119		

Oak-ash woodland	Mixed	28%	95		
	Surface or low	49%	55		
Southern Appalachians Forested					
Bottomland hardwood forest	Replacement	25%	435	200	≥1,000
	Mixed	24%	455	150	500
	Surface or low	51%	210	50	250
Mixed mesophytic hardwood	Replacement	11%	665		
	Mixed	10%	715		
	Surface or low	79%	90		
Appalachian oak-hickory-pine	Replacement	3%	180	30	500
	Mixed	8%	65	15	150
	Surface or low	89%	6	3	10
Eastern hemlock-eastern white pine-hardwood	Replacement	17%	≥1,000	500	>1,000
	Surface or low	83%	210	100	>1,000
Red pine-eastern white pine (frequent fire)	Replacement	38%	56		
	Mixed	36%	60		
	Surface or low	26%	84		
Eastern white pine-northern hardwood	Replacement	72%	475		
	Surface or low	28%	>1,000		
Oak (eastern dry-xeric)	Replacement	6%	128	50	100
	Mixed	16%	50	20	30
	Surface or low	78%	10	1	10

Appalachian Virginia pine	Replacement	20%	110	25	125
	Mixed	15%	145		
	Surface or low	64%	35	10	40
Appalachian oak forest (dry-mesic)	Replacement	6%	220		
	Mixed	15%	90		
	Surface or low	79%	17		
Southern Appalachian high-elevation forest	Replacement	59%	525		
	Mixed	41%	770		

Southeast

- Southeast Grassland
- Southeast Shrubland
- Southeast Woodland
- Southeast Forested

Vegetation Community (Potential Natural Vegetation Group)	Fire severity*	Fire regime characteristics			
		Percent of fires	Mean interval (years)	Minimum interval (years)	Maximum interval (years)
Southeast Grassland					
Southeast Gulf Coastal Plain Blackland prairie and woodland	Replacement	22%	7		
	Mixed	78%	2.2		
Gulf Coast wet pine savanna	Replacement	2%	165	10	500
	Mixed	1%	500		
	Surface or low	98%	3	1	10
Southeast Shrubland					
Pocosin	Replacement	1%	>1,000	30	>1,000

	Mixed	99%	12	3	20
Southeast Woodland					
Longleaf pine/bluestem	Replacement	3%	130		
	Surface or low	97%	4	1	5
Longleaf pine (mesic uplands)	Replacement	3%	110	40	200
	Surface or low	97%	3	1	5
Longleaf pine-Sandhills prairie	Replacement	3%	130	25	500
	Surface or low	97%	4	1	10
Pond pine	Replacement	64%	7	5	500
	Mixed	25%	18	8	150
	Surface or low	10%	43	2	50
South Florida slash pine flatwoods	Replacement	6%	50	50	90
	Surface or low	94%	3	1	6
Atlantic wet pine savanna	Replacement	4%	100		
	Mixed	2%	175		
	Surface or low	94%	4		
Southeast Forested					
Sand pine scrub	Replacement	90%	45	10	100
	Mixed	10%	400	60	
Coastal Plain pine-oak-hickory	Replacement	4%	200		
	Mixed	7%	100		
	Surface or				

	low	89%	8		
Atlantic white-cedar forest	Replacement	34%	200	25	350
	Mixed	8%	900	20	900
	Surface or low	59%	115	10	500
Maritime forest	Replacement	18%	40		500
	Mixed	2%	310	100	500
	Surface or low	80%	9	3	50
Mesic-dry flatwoods	Replacement	3%	65	5	150
	Surface or low	97%	2	1	8
Loess bluff and plain forest	Replacement	7%	476		
	Mixed	9%	385		
	Surface or low	85%	39		
South Florida coastal prairie-mangrove swamp	Replacement	76%	25		
	Mixed	24%	80		
Southern floodplain	Replacement	7%	900		
	Surface or low	93%	63		

*Fire Severities—
Replacement: Any fire that causes greater than 75% top removal of a vegetation-fuel type, resulting in general replacement of existing vegetation; may or may not cause a lethal effect on the plants.
Mixed: Any fire burning more than 5% of an area that does not qualify as a replacement, surface, or low-severity fire; includes mosaic and other fires that are intermediate in effects.
Surface or low: Any fire that causes less than 25% upper layer replacement and/or removal in a vegetation-fuel class but burns 5% or more of the area [24,33].

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