Dipsacus fullonum, D. laciniatus

INTRODUCTORY

Common teasel
Photo ©Steve Dewey, University of Utah, Bugwood.org

Cut-leaved teasel
Photo ©Chris Evans, River to River CWMA, Bugwood.org

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FEIS ABBREVIATION:
DIPSPP
DIPFUL
DIPLAC

NRCS PLANT CODE [86]:
DIFU2

DILA4

COMMON NAMES:
common teasel
Fuller's teasel
wild teasel
cut-leaved teasel

TAXONOMY:
The genus name for teasels is *Dipsacus* L. (Dipsacaceae) [47]. This review summarizes the information available as of 2009 on the following teasel species:

Dipsacus fullonum L., common teasel
Dipsacus laciniatus L., cut-leaved teasel

In this review, species are identified by their common names. Teasel is used for information that is common to both species.

Hybrids: Common teasel and cut-leaved teasel hybrids occur [30]. Frequency of these hybrids was not reported. In a review, Solecki [80] reports that common teasel and cut-leaved teasel are only occasionally found together.

SYNONYMS:
for *Dipsacus fullonum* L.:
Dipsacus sylvestris Hudson [18,30,63,92]

LIFE FORM:
Forb

FEDERAL LEGAL STATUS:
None

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

DISTRIBUTION AND OCCURRENCE

SPECIES: Dipsacus fullonum, D. laciniatus

GENERAL DISTRIBUTION:
In North America, common teasel and cut-leaved teasel are nonnative. Both the native and nonnative ranges of common teasel are more extensive than those of cut-leaved teasel. Common teasel is native to Europe, temperate Asia, and northern Africa, and cut-leaved teasel is native to Europe and temperate Asia [90]. Common teasel occurs throughout most of the United States except the northern Great Plains and several southeastern states [22,86,87]. Cut-leaved teasel is most common in the northeastern and Midwestern United States [66], although it was reported near Denver, Colorado [91], and in Oregon [86]. Common teasel is generally more common than cut-leaved teasel, but throughout their ranges they are described as occasional, locally common, scattered, or infrequent [18,32,40,48,63,89].

Introduction(s) in North America: A review reports that common teasel was introduced in North America as early as the 1700s [22]. No other references reported cultivation or collection of teasel in the 18th century. Cultivation

of teasel occurred by 1840 in Onondaga County, New York, and by 1907 in Clackamas County, Oregon [20]. Common teasel was collected in Michigan in 1844 [89] and Niagara Falls, Ontario, in 1877 [95]. Cut-leaved teasel was reported in New York before 1900 and in Michigan as early as 1894 [89]. NatureServe provides distributional maps of common teasel and cut-leaved teasel.

Local distribution changes: In the northeastern United States, cut-leaved teasel was present before the 1900s, but it spread more slowly or experienced a longer lag time than common teasel. Common teasel was widespread in the northeastern United States by 1913, but at that time, cut-leaved teasel was known only from New York [80]. Common teasel occurred in northeastern Tennessee as of 1956 and was described as "rather abundant in some places" [44]. By 1945, common teasel occurred in Kansas [28], although populations were not reported from Texas until 2000 [77]. Not until 1973 was cut-leaved teasel collected in West Virginia [43].

In the western United States, common teasel occurred in northern Oregon and southern Washington by 1900. Populations spread east and occurred in Idaho and Montana by 1940 and Wyoming by 1980 [24,25]. Common teasel was likely introduced in Portland, Oregon, an important shipping port [26].

Dispersal along roads and waterways has been important to teasel spread in North America [19,95]. On the Lincoln National Forest in central New Mexico, all common teasel populations in habitats occupied by the threatened endemic, Sacramento Mountain thistle (*Cirsium vinaceum*), occurred adjacent to roads ($P<0.0001$) [42]. In Missouri, teasel populations have "skyrocketed" since the early 1990s. Populations have spread primarily along highways, and researchers suggest that right-of-way mowing operations have been important to seed spread [33]. Since about 1965, cut-leaved teasel spread from New York throughout the Midwest, and much of this spread has occurred along major roadways [19]. By about 1980, cut-leaved teasel was rapidly spreading throughout the Midwest [80,89]. In Illinois, areas with no or few cut-leaved teasel plants supported large populations in 5 to 10 years (Solecki personal observation as cited in [80]). Cut-leaved teasel was first reported in Missouri in 1980, and by about 1990, occurred in 24 Missouri counties. Populations were most common along Interstate 70 [80].

HABITAT TYPES AND PLANT COMMUNITIES:
Teasel occupies similar habitats in its native and nonnative ranges, which include riparian areas, meadows, grasslands, savannas, forest openings, and disturbed sites [90]. Habitats most commonly occupied are open and sunny with limited tree or shrub cover. Common teasel is described throughout western California [64], in big sagebrush/western juniper/cheatgrass-bluebunch wheatgrass (*Artemisia tridentata*/*Juniperus occidentalis*/*Bromus tectorum-Pseudoroegneria*) associations in eastern Oregon [58], quaking aspen (*Populus tremuloides*) woodland types in Colorado [51], and saltmarshes [1] and oak (*Quercus* spp.) woodlands [23] in Ohio. Dense populations of cut-leaved teasel occur in prairies, savannas, seeps, and sedge (*Carex* spp.) meadows in Illinois [80].

BOTANICAL AND ECOLOGICAL CHARACTERISTICS

SPECIES: Dipsacus fullonum, D. laciniatus

Common teasel flower heads

Cut-leaved teasel flower head

Photos ©Richard Old, XID Services Inc., Bugwood.org

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., [30,32,39,84,89]). Many keys describe characteristics used to distinguish common teasel and cut-leaved teasel [3,30,32,84,89,91].

Aboveground description: Common teasel and cut-leaved teasel are robust, prickly, monocarpic perennials that can reach 7 to 10 feet (2-3 m) tall [32,48,64,89]. Stems are erect, hollow, and support erect branches [69,89]. Degree of branching may relate to soil fertility. On "poor", rocky soils, branching may be limited [46]. Teasel plants typically flower after 2 or more years of growth and die after flowering. The only common teasel plants to flower in their first year of growth were sown very early in the spring and grew in "well manured soil" (De Vries 1899 as cited in [49]). Plants grow as a rosette before bolting and flowering. Basal leaves generally die by the middle of the flowering season [18,31,32]. Teasel flowering and life span are discussed more in Flower and seed production and Seedling establishment and plant growth.

Teasel flowers occur in terminal, stiff, egg-shaped heads that are up to 4 inches (10 cm) long [32,52]. Inflorescences contain 250 to 1,500 flowers [14], which bloom for only 1 day [15]. Flowering begins in the middle of the

inflorescence and then progress up and down [32,91]. Often there are few flowers blooming at the same time [91]. Flower heads are subtended by linear bracts that are about 4 times as long as they are wide [89]. Teasel fruits are hairy achenes that measure up to 8 mm long [30,32,39,89].

Common and cut-leaved teasel are distinguished by flower color and leaf morphology. Although both species have opposite, stem-clasping leaves, common teasel leaves are entire with toothed or wavy margins and cut-leaved teasel leaves are pinnatifid. Common teasel typically produces lavender flowers, while cut-leaved teasel flowers are generally white [3,33,76].

The cups formed by clasping leaves may be up to 5 inches (13 cm) deep [89]. Although these cups collect water, they are not considered a carnivorous adaptation, but the water-collecting leaf arrangement and leaf and stem bristles may protect teasel from injurious or "nectar-thieving" insects [4].

Common teasel leaves

Cut-leaved teasel leaves

Belowground description: Teasel produces a "stout" taproot [18,40,46]. Most detailed descriptions about root systems are specific to common teasel but may also describe those of cut-leaved teasel. Common teasel taproots may be more than 2 feet (0.6 m) long and 1 inch (2.5 cm) in diameter at the crown [22,95]. Jurica [46] indicated that common teasel taproots support many branching rootlets. While most report a deep taproot, Uva and others [87] described a shallow taproot with a fibrous secondary root system for common teasel.

Raunkiaer [72] life form:
Hemicryptophyte

SEASONAL DEVELOPMENT:
Teasel flowers bloom for only 1 day [15], and plants die after flowering. Teasel first develops a rosette and after 2 or more years, bolts and flowers. Rosette leaves generally die by the middle of the flowering season [18,31,32]. For more on teasel flowering, see Flower and seed production and Seedling establishment and plant growth.

Teasel plants flower from April to October throughout their nonnative ranges [30,33,48]. The earliest flowering dates, April to August, were reported for common teasel in California [64]. Generally teasel flowering dates were later, July to October, in the midwestern and eastern United States and adjacent Canada [63,87,95]. In eastern North America, common teasel seeds mature and disperse from September to late November [69,95].

In the field, common teasel germinates in the spring or the fall. Werner [95] reported that most common teasel seed germinates from early April to early June in Canada, although early September germination also occurs. A small portion of common teasel seeds may remain dormant for a year and germinate the following spring [41]. In a review of common teasel in the northeastern United States, researchers indicated that most common teasel seeds germinated in

late summer or fall and overwintered as rosettes [87].

REGENERATION PROCESSES:
Teasel reproduces by seed, and plants die after flowering. Plants may sprout following damage during the rosette or flowering stage. For more information, see Vegetative regeneration and Physical or mechanical control.

Pollination and breeding system: Teasel flowers are perfect [37] and protandrous. Most fertilization results from cross-pollination by insects. During a field experiment in Michigan, just 4% of common teasel seeds were viable when cross-pollination was prevented. When cross-pollination was allowed, 70% of common teasel seeds were viable [95]. Common teasel flowers monitored in Cambridgeshire, England, were visited most frequently by small hoverflies. Bumblebees were less frequent [15]. In the same area, common teasel flowers were visited by many flower-feeding Lepidopterans (Cheesman 1996 personal observation cited in [14]). At least 41 insect species were collected from common teasel flowers in Dunnville, Ontario. Over half of visitors were Hymenopterans and 25% were Dipterans. The most active pollinators were bumblebees [45].

Flower and seed production: Teasel rosettes must reach a critical size before plants will produce flowers [94]. In abandoned fields, common teasel rosettes that reached 20 inches (51 cm) in diameter in their 1st year flowered in their 2nd year. Teasel plants may produce over 3,000 seeds [79,95]. Loss of seed to birds and small mammals has been reported in several of common teasel's nonnative habitats [50,62,68].

Rosette diameter is highly significant in predicting the probability of common teasel flowering ($P<0.001$). In southwestern Michigan old fields, rosettes that were just 2 inches (5 cm) in diameter had a 65% probability of remaining vegetative and about a 30% chance of dying in the next growing season. Rosettes that reached 12 inches (30 cm) in diameter were 80% or more likely to flower in the next season [94].

Probability of common teasel dying, remaining vegetative, or flowering based on rosette diameter in the previous growing season [94]

Rosette diameter in August of previous year (cm)	Probability of death	Probability of remaining vegetative in the next growing season	Probability of flowering in the next growing season
<2.5	0.81	0.19	0
2.5-7.4	0.33	0.67	0
7.5-12.4	0.19	0.82	0.01
12.5-18.9	0.15	0.86	0.02
19.0-24.9	0.08	0.66	0.32
25-37.9	0.10	0.29	0.80
38-50.9	0.04	0.20	0.86
>51.0	0	0	1.00

In Michigan, common teasel plants produced an average of 854.6 seeds per flower head. Typically, 3 to 9 flower heads were produced per plant, although 1 to 35 flower heads were observed. In Michigan roadside populations, common

teasel produced an average of 3.9 flower heads/plant and an estimated 3,333 seeds/plant [95]. Assuming that cut-leaved teasel seed production and field germination (28%-86%) approximated those reported for common teasel [97], a single cut-leaved teasel plant could produce 716 to 2,292 new plants [79]. Four years after introducing common teasel seed into old fields in Michigan, common teasel seed production was about 4,500 seeds/m² regardless of plant ages or flowering plant densities [95].

Several bird and small mammal species are potential teasel seed predators. Northern bobwhites, California quail [17], ring-necked pheasants [50], white-winged crossbills [68], goldfinches (Ridley 1930 as cited in [95]), and blackbirds (Pohl and Sylwester 1963 as cited in [95]) feed on common teasel seed. In a perennial grass and forb dominated field in southwestern Michigan, an average of 1% of common teasel seeds were removed daily [62]. Based on the appearance of husks left behind, Mittelbach (personal observation as cited in [62]) suspected that mice were the seed predators.

Seed dispersal: Teasel seeds are not morphologically adapted for wind dispersal. In a field in Kalamazoo County, Michigan, 99.9% of common teasel seeds fell within 4.9 feet (1.5 m) of the parent plant [93]. Water (Werner unpublished data as presented in [95]) and human activities [22,67] are the most likely methods of long-distance teasel seed dispersal.

Long-distance teasel seed dispersal by water is likely. Common teasel seeds floated in water for 22 days without losing viability (Werner unpublished data as presented in [95]). Along busy roadways and mowed areas, teasel seed may dispersal 2 to 3 times farther than the maximum passive dispersal distance of 4.9 feet (1.5 m) reported by Werner [93]. In a natural area near Clinton Lake, Illinois, just 1.3% of cut-leaved teasel seeds made it to the farthest seed trap, which occurred 15 feet (4.5 m) from the source population. Along a nearby interstate, 3% of cut-leaved teasel seeds dispersed 20 to 49 feet (6-15 m) from the source population [65]. In the Mascoutin Recreation Area of DeWitt County, Illinois, the size of mowed cut-leaved teasel patches increased by 360 feet² (33 m²) and unmowed patches increased by 45 feet² (4.2 m²) after 2 years of mowing. In mowed areas, 95% of cut-leaved teasel seed dispersed within 20 feet (6 m) of the source population and more than 1% dispersed more than 30 feet (10 m) from the source [67].

Seed dispersal through the collection and use of dried teasel flower heads is probable. Several sources report that flower heads are collected and used in dried-flower decorations [22,32,92]. Reviews report that teasel often occurs in and around cemeteries and likely came from floral arrangements left at gravesides [22,40].

Seed banking: The teasel seed bank is short lived. While common teasel seeds stored indoors remained viable for 6 years or more [16,95], less than 1% of common teasel emerged after 5 years of storage in the soil [75]. Seeds did not persist long in water. After 3 to 9 months in a canal in Prosser, Washington, the maximum germination of common teasel seeds was 2% [16]. In a greenhouse study, common teasel seedlings emerged from soils taken from 3-to 5-inch (8-12 cm) depths in a northern Spain perennial grassland. Common teasel did not occur in the aboveground vegetation [55].

Mature common teasel seed has little immediate dormancy (see Germination), suggesting short-term persistence in the soil. All common teasel seeds planted in old fields in Michigan germinated within 2 years [97]. In an old field at the University of Toronto Joker's Hill Research Station, 40% to 60% of the common teasel seeds germinated after 4 months in pots buried in the soil, 30% to 50% germinated after 11 months of burial, and 20% to 50% germinated after 16 months of burial in the soil. After 16 months in the soil, germination was greatest from pots that were treated with fungicide before burial [9]. After 5 years, just 0.9% of common teasel emerged from containers buried in southern Warwickshire, England [75].

Germination: Mature teasel seed may germinate immediately [98], but dormancy may be induced by freezing temperatures [34]. Seeds may germinate at high levels in both the laboratory [34,98] and the field [97]. Typically seeds germinate equally well in dark or light conditions [34]. Seed size, litter cover, vegetation cover, and soil disturbances may affect germination, and environments that foster high seed germination percents may not be conducive to seedling growth and survival. For details about the conditions that foster germination, seedling establishment, and/or seedling survival, see the Case study on common teasel development and survival. For information about predominant germination times, see Seasonal Development.

Immature seeds from cut stems may still germinate [79]. This is important when considering potential control methods and site clean-up. For more on this topic, see Physical or mechanical control.

Temperature and light: Warm temperatures, regardless of light conditions, produce high common teasel germination in the laboratory. Common teasel seeds collected in the fall from a field on the Michigan State University campus averaged 99.6% germination without prechilling; 95% of the seeds germinated within 3 days. Seeds kept in the dark at room temperature averaged 95.5% germination. Seeds stored for 2 years in laboratory averaged 96% germination [98]. Common teasel seeds failed to germinate at temperatures below 32 °F (0 °C) [95]. After a hard freeze in Michigan and Ohio, common teasel seed germination was 5.6% to 28% in the light and 0% in the dark in the laboratory. The next fall, 96% to 100% of common teasel seeds collected before freezing germinated, regardless of light or dark conditions [34]. Common teasel seeds collected in August from New Mexico's Lincoln National Forest germinated best (54%) at 72 °F (22 °C) with light. Germination was lower at 50 °F (10 °C) and 86 °F (30 °C). Seeds were refrigerated for about 5 months prior to testing germination [42].

Seed size: Large common teasel seeds germinate best. In a greenhouse study, germination of large-sized common teasel seeds was significantly greater than that of small- or medium-sized seeds ($P<0.05$). At least 70% of large-sized seeds (average 2.01 mg) germinated. Germination of small- and medium-sized seeds (average 1.12 and 1.73 mg, respectively) was less than 20% [34]. Germination and initial seedling growth of common teasel from old field and roadside populations in Ontario, Canada, were positively associated with seed mass. The researcher suggested that "maternal provisioning" within a population may affect germination and seedling establishment [7].

Disturbances, litter, and established vegetation: Soil disturbances may cause flushes of teasel germination, whereas litter and established vegetation may inhibit teasel germination but foster seedling growth and survival.

During a field study in southern Warwickshire, England, flushes of common teasel germination occurred when the soil of buried containers was mixed to simulate soil disturbance [75]. In a 6-year-old field in Michigan, there were germination flushes when litter was removed after planting common teasel seeds, but germination was much greater when litter was removed prior to seed planting. Just 1.2 out of 150 seeds germinated after 2 years on plots with litter. In the greenhouse, common teasel germination was least successful for seeds under quackgrass litter (*Elymus repens*), but seedling survival was greatest in quackgrass litter [98].

Common teasel seed germination and seedling survival in different depths and types of litter [98]

Seed environment	Average number of seeds germinating out of 50 seeds planted	Seedling mortality after 3 weeks
Uncovered	45.2a	1.7%
Under 0.5 cm of vermiculite	44.8a	3.8%
Under 1.5 cm of forb litter	41.8a	15.4%
Under 2.8 cm of quackgrass litter	38.2b	0.1%

Values followed by different letters are significantly different ($P<0.05$).

In another greenhouse study, common teasel germination was reduced by thick (715 g/m²) Kentucky bluegrass (*Poa pratensis*) litter, but a greater number of seedlings developed (92%) with a thin litter layer (123 g/m²) than without (58%) ($P<0.05$). Common teasel seed germination was not significantly affected by 123 g/m² of Kentucky bluegrass litter, but 715 g/m² of Kentucky bluegrass litter decreased germination by 34% to 41%. Additional experiments showed that Kentucky bluegrass leachate may inhibit common teasel germination. About 34% more common teasel

seeds germinated when kept moist with water than when kept moist with Kentucky bluegrass leachate [10,11].

Seedling establishment and plant growth: While teasel seed germination is most likely on open or exposed sites, seedling survival is often best on sites with moderate amounts of litter or beneath sparse vegetation, which decrease the potential of desiccation [41]. However, seedling growth rates may be reduced by the presence of established vegetation. In the greenhouse, the relative growth rate of common teasel seedlings grown in litter or bare soil was about 0.08 mg/mg day, which was significantly greater than the rate in established vegetation and vegetation with litter, which was about 0.02 mg/mg day [34].

In the field, common teasel seedlings often occur in small canopy openings within established vegetation. Canopy openings may be created by mammals, frost heaving, or death of the parent plant [95]. The probability of successful common teasel seedling establishment is several times greater in open sites left by the dead parent plant than in surrounding vegetation (Werner unpublished data cited in [96]). Teasel seedling densities may vary. In a mesic tallgrass prairie in east-central Illinois where cut-leaved teasel was a dominant species, cut-leaved teasel seedling densities ranged from 0 to 1,926 seedlings/3 m² [79].

Case study on common teasel development and survival: Established grass and heavy shrub cover may reduce common teasel germination and survival. Studies conducted in 2- to 3-year-old fields in southwestern Michigan compared these life stages in different vegetation types. In dense quackgrass and deep litter (over 0.4 inch (10 cm)), just 20% of planted common teasel seeds germinated, and all plants died before flowering. In grass-forb vegetation with minimal staghorn sumac (*Rhus typhina*) cover, common teasel germination was variable (25%-57%), rosettes grew rapidly, and the majority of plants flowered by year 2. In forb-dominated fields with heavy shrub shading, common teasel germination was high (58%), but plants did not mature beyond the seedling stage. By the 5th year, common teasel seed production in fields with reproducing plants was about 7 times (4,500 seeds/m²) more than the density of planted seeds (600 seeds/m²) [97].

Fate of common teasel seeds, seedlings, and plants in various old-field habitats in southwestern Michigan (germination, mortality, and survival percentages are averages) [97]

Grass cover	**Forb cover**	**Little to no shrub shading**	**Heavy shrub shading**
Very dense (95-100% quackgrass cover)	Little to none	-low germination (20%) -1st year seedling mortality 96% -no reproduction	no data
Moderate (75-90% quackgrass cover)	Moderate (4-11% forb cover)	-germination 25% to 57%, lowest in fields with more grass -seedling survival high -flowering in year 2 or 3	-low germination (24%) -flowering by year 3
Low	High	-moderate germination (43%) -first year seedling survival high (15%) -flowering by year 4	-high germination (58%) -high first year seedling mortality (97%) -no reproduction

Vegetative regeneration: Teasel reproduces entirely by seed, but plants may regenerate following damage. Following similar damage or stem removal, survival of cut-leaved teasel may exceed that of common teasel. In a review, Werner [95] reported that after cut to ground level, common teasel rosettes over 4 inches (10 cm) in diameter sprouted and regrew about 50% of the time. In another review, Hilty [40] reported that cut-leaved teasel may sprout and regenerate after belowground cutting. For more on regeneration following damage, see Physical or mechanical

control.

SITE CHARACTERISTICS:
Teasel is frequent on roadsides and ditches and in pastures, old fields, meadows, riparian areas, savannas, and forest edges [3,32,37,39,40,89]. Teasel occurs in various habitat and soil types. In the John Day River Basin of eastern Oregon, common teasel was abundant in big sagebrush/western juniper/cheatgrass-bluebunch wheatgrass vegetation on dry, low-elevation sites. Canopy gaps are common in this vegetation type [58]. Along the James River in the central Blue Ridge Mountains of Virginia, common teasel occurred on floodplains that experienced frequent overflows and erosion [70]. Climate and soil conditions in cut-leaved teasel habitats were rarely described in detail. Based on the similarities between common teasel's long-occupied habitats and cut-leaved teasel's newly occupied habitats, differences in environmental tolerances between the 2 species are likely subtle or disappearing over time.

Climate: Prevailing climates in teasel habitats were rarely described. In a review, Werner [95] reported that common teasel's northernmost North American distribution is generally that region where less than 1% of the minimum daily temperatures fall below 32 °F (0° C) in May and 50 °F (10° C) in July. Some suggest that common teasel grows best in areas receiving summer moisture (Clapham and others 1962 as cited in [2]). Another review notes that cut-leaved teasel occupies wetter sites than common teasel [66].

Elevation: The elevational range for common teasel is available for several western states.

Elevation range for common teasel in western United States	
State	Elevation (feet)
California	< 5,600 [39]
Colorado	6,000-8,000 [37]
Nevada	4,000-6,500 [48]
New Mexico	4,000-7,000 [59]
Utah	4,690-8,730 [92]

Soils: Reviews report that cut-leaved teasel and common teasel grow best on similar soils. Hilty [40] reports that cut-leaved teasel reaches its largest size on mesic, fertile, loamy soils and that size is reduced in "poor" soils. Uva and others [87] report that common teasel is frequent on damp, rich soils.

Although mesic conditions are typical, teasel sometimes occurs in dry areas [22,66,80]. The 2 species are only occasionally found together [80]. Common teasel may occupy sandy soils if moisture is not limited. Common teasel also occurs in heavy clay soils with poor drainage and tolerates spring flooding [95]. In west-central Montana, common teasel frequently occurs on disturbed soils with "appreciable water holding capacity" [52]. Along Boulder Creek in Colorado, common teasel occurred with several other tall nonnative species on silty-sand deposits [27]. In Kentucky and New Jersey, researchers noted that common teasel was especially common on limestone soils [36,78].

Salinity: Both common teasel and cut-leaved teasel tolerate saline conditions [66,80]. However, many common teasel plants died before producing seed on an upper saltmarsh in Rittman, Ohio, where salinity levels reached 1.0% (Badger and Ungar personal observation 1988 cited in [1]).

Studies in Ontario, Canada, showed that site conditions may affect common teasel seed and seedling tolerances. When the germination and first 10 days of seedling growth were compared for common teasel seeds collected from roadside and old-field populations in Ontario, Canada, seeds from roadside plants were more salt tolerant than old-field seeds, and some roadside seedlings produced longer roots when grown in the presence of salt [5]. Researchers suggested seed and seedling salinity tolerance was related to the salinity levels experienced by the parent plants. Seedlings that produced the longest roots in the presence of salt developed from seeds collected in the highest salinity environment. Seedlings grown from old-field seeds had decreased root development with salt exposure [6]. Although emergence

and first-year survival were similar for all seeds planted in old field and roadside habitats, regardless of source, no common teasel plants on the roadside reproduced within 4 years of seeding. Just 15% of plants were reproductive in the old field. A drought in June and July resulted in high seedling mortality in both habitats, but mortality was significantly greater on the roadside than in the old field ($P<0.1$) [7].

SUCCESSIONAL STATUS:
Teasel is common on disturbed sites and in early-seral habitats. While large, dense teasel populations are possible, without periodic disturbances they are likely to be replaced by slow-growing, late-seral species. Both teasel species grow best in full sun to partial shade and are common in canopy openings [22,40,95]. Because both species require 2 or more years to complete their life cycle, severe annual disturbances may not be tolerated.

The literature often describes teasel in disturbed habitats. Reviews report that teasel is common on open, disturbed sites [22,33,40,95], and some describe common teasel as "an aggressive competitor in disturbed areas" [22]. While teasel establishment and spread are common on disturbed sites, teasel may also occur in established vegetation [33] and "high quality natural areas" [40].

Common teasel appeared or increased in abundance with dredging, plowing, and grazing in its native and nonnative ranges. Common teasel occurred 1 to 2 years after soils dredged from the Seneca Canal were deposited on an unnamed island in Cayuga Lake, New York [60]. Five months after deep plowing (20 inches (50 cm)) occurred in a northern Spain perennial grassland, common teasel cover averaged 5.3%. Common teasel did not occur in aboveground vegetation before plowing, but seed was present in the soil [55]. In Washington, cattle grazing in black hawthorn (*Crataegus douglasii*) habitats often leads to an increase in common teasel abundance [21].

Studies of old-field succession show that although teasel may be abundant in recently disturbed, open sites, abundance typically decreases as time since disturbance increases. When the species composition of southwestern Ohio old fields was compared, common teasel was absent from 2-year-old fields, occurred in 10- and 50-year-old fields, but did not occur in fields older than 90 years old. Shrub cover in the 50-year-old field was about 30%, and fields abandoned 90 years or more were dominated by deciduous trees and shrubs [88].

After conducting multiple field studies and making many observations in Michigan old fields, Werner [96] concluded that common teasel is not a "climax species" and in undisturbed fields is replaced by slow-growing perennials. Although death of the parent plant provides open sites for seedling establishment, the number and size of these openings decreases without periodic disturbances [96]. Werner [97] observed near monocultures of common teasel locally in Michigan and noted that "when favorable conditions are present, (common teasel) will totally exclude other species". Even in monocultures, however, a lack of disturbances facilitates replacement by late-seral species. During old-field succession, late-seral species such as American elm (*Ulmus americana*) and summer grape (*Vitis aestivalis*) established in openings left by dying common teasel plants [97].

FIRE EFFECTS AND MANAGEMENT

SPECIES: Dipsacus fullonum, D. laciniatus

FIRE EFFECTS:
Immediate fire effect on plant: Studies on the effects of fire on teasel are lacking. It is likely that low-severity fires only top-kill teasel plants [80]. Since meristematic tissue occurs just below the soil surface [95], high-severity fires that produce high belowground temperatures may kill teasel plants.

Postfire regeneration strategy [83]:

Caudex or an herbaceous root crown, growing points in soil
Ground residual colonizer (on site, initial community)
Secondary colonizer (on- or off-site seed sources)

Fire adaptations and plant response to fire:
In the reviewed literature (as of 2009), studies on the recovery of teasel on burned sites were lacking. Sprouting is likely on burned sites, unless high temperatures penetrate and persist in the soil. Reviews report that both common teasel and cut-leaved teasel sprouted after cutting to ground level or below [40,95]. The teasel seed bank is short lived [75], but buried seed may survive low-severity fire. Seed germination would likely be successful on burned sites. Seedlings, though, may require some protection from desiccation in order to survive [41]. Other sprouting vegetation on burned sites may provide this protection.

The limited fire studies in teasel habitats suggest that aboveground teasel vegetation has low flammability, and if present in the prefire vegetation, teasel will likely be present in postfire vegetation. In east-central Illinois' Loda Cemetery Prairie, spring burning occurred biennially for about 7 years in an area where cut-leaved teasel was dominant. In dense patches of cut-leaved teasel rosettes, fire spread was poor. Isolated rosettes typically showed some fire damage, but in many cases, the core of the rosette was unburned and plants sprouted [80]. For more on the management of this area and its success in controlling cut-leaved teasel, see Fire Management Considerations and Physical or mechanical control.

In a denseflower cordgrass (*Spartina densiflora*) marsh in Venezuela, common teasel was present with low cover before and 1 year after a summer fire. On an adjacent unburned site, common teasel cover increased considerably over the same time. The large differences between common teasel cover on burned and unburned sites were not discussed [57]. Without additional information it is unclear whether fire effects, a patchy distribution, and/or possible salinity differences between the sites influenced common teasel cover most.

FUELS AND FIRE REGIMES:
Fire regimes in teasel's native range were not described in the reviewed literature. Teasel's preference for moist sites suggests that fires may be infrequent and of low severity in nonnative North American habitats. Teasel would likely persist in periodically burned habitats [80]. Annual burning would limit teasel reproduction, and long fire-free intervals would likely limit teasel establishment, which is best in canopy gaps and in early- to mid-seral habitats [95]. This topic is discussed more in Successional Status. See the Fire Regime Table for further information on fire regimes in vegetation communities where teasel may occur.

FIRE MANAGEMENT CONSIDERATIONS:
Potential for postfire establishment and spread: Although information about fire in teasel habitats is lacking, managers could expect teasel to sprout following fire [80]. Teasel germination levels could be high on open, burned areas, and given some protection by sprouting vegetation, teasel seedling establishment could be high. In the Loda Cemetery Prairie where spring fires occurred biennially and cut-leaved teasel stems were cut annually, there were up to 1,926 seedlings/3 m² plots in the first or second postfire season [80]. Teasel is dispersed by a variety of vectors (see Seed dispersal). Burned sites in the vicinity of established teasel populations should be monitored for seedling establishment, and appropriate control measures should be taken.

Use of prescribed fire as a control agent: While fire alone is unlikely to control dense teasel populations, it may be useful in conjunction with other control methods. Some suggest that periodic spring or fall fires may help control teasel populations [29,81]. Solecki [81] suggested that late-spring prescribed fires may control sparse teasel populations. The method by which fire provides teasel control was not described. It was unclear whether or not fire killed some teasel plants, consumed teasel seed, or improved conditions for more desirable prairie species. While "burning alone will not eradicate (teasel) populations" [22], fires may expose teasel rosettes, potentially increasing the effectiveness of other treatments [33].

Burning areas where teasel was cut should limit seed production and dispersal [33]. Cut-leaved teasel seeds matured on and germinated from stems cut in Illinois. Stems were cut before any mature seed production, and after 1 month of storage at room temperature, 41% of seeds from cut stems germinated; after 7 months of storage, 97% germinated

[79]. Because viable seed can be produced on cut stems and seed may be shed during the transport of flowering or fruiting stems from an invaded site, fire may be useful in disposing of cut teasel stems.

Several studies indicate that burning may be difficult in teasel habitats. In dense stands of teasel rosettes or mature plants, fire does not spread well [22,79]. In moist habitats where teasel is common, fire spread and temperatures lethal to plant tissue are rare. Prescribed fire may be impossible along high-traffic roadside habitats, which are important to teasel spread [73].

MANAGEMENT CONSIDERATIONS

SPECIES: Dipsacus fullonum, D. laciniatus

IMPORTANCE TO WILDLIFE AND LIVESTOCK:
Spines and bristles on teasel leaves and stems discourage large herbivore grazing [95], but small mammals and birds feed on teasel seeds and in teasel habitats [50,62].

Mice and voles may consume teasel seeds. During a study in southwestern Michigan old fields, the seed litter left at trays with common teasel seed suggested consumption by mice (Mittelbach personal observation as cited in [62]). On the Purdue University campus in west Lafayette, Indiana, American kestrels often hunted in grasslands where common teasel was abundant. American kestrels fed primarily on voles [12].

In the western United States, several game birds feed on common teasel seeds. On the Colville Confederated Tribal Reservation in Okanogan County, Washington, common teasel seeds were important in the winter diets of California quail and ring-necked pheasants. The frequency and volume of common teasel in California quail crops averaged 20% and 1.9%, respectively, in winter. The frequency and volume of common teasel in ring-necked pheasant crops averaged 16.7% and 5.8%, respectively, in the winter [50]. In eastern Washington, common teasel seeds comprised over 5% of the winter diets of California quail [17]. On the Palouse Prairie near Pullman, Washington, the winter stomach contents of northern bobwhites were 6% common teasel seed [61].

In other parts of North America, researchers have observed crossbills, goldfinches, and blackbirds feeding on teasel seed. In late December at Vineland Station, Ontario, Putnam [68] observed white-winged crossbills feeding on common teasel seeds. Others observed goldfinches (Ridley 1930 as cited in [95]) and blackbirds (Pohl and Sylwester 1963 as cited in [95]) feeding on teasel seeds.

Palatability and/or nutritional value: No information is available on this topic.

OTHER USES:
Teasel is best known in the textile industry for its use in raising the nap of fabrics [18,20,64,91], but teasel also has some medicinal uses. Water that collects in stem-clasping leaves has been used to soothe eye inflammation [36]. Teasel roots have been used to treat ulcers, jaundice, warts, and cleanse wounds [22,36].

IMPACTS AND CONTROL:
Impacts: Although few studies indicate the methods by which teasel impacts its nonnative habitats, several studies report that teasel may develop large monocultures [90], negatively impact riparian area integrity [74], and occupy habitats important to sensitive or threatened plant species [78]. However in Michigan old fields, diversity and species richness were higher in early-seral old-fields with common teasel than in those without [97].

Several sources provide anecdotal information about teasel impacts. In northwestern North America, Taylor [85]

describes common teasel as "truly noxious" in moist areas and capable of displacing native vegetation. Weber [90] notes that monotypic teasel stands can exclude other vegetation and may restrict wildlife movements. In a review, Glass [29] indicates that cut-leaved teasel is "more aggressive" than common teasel and that cut-leaved teasel has "severely threatened" the "natural quality" of several "high quality" prairies, savannas, seeps, and sedge meadows in northern and central Illinois. In these parts of Illinois, cut-leaved teasel spread, since 1990 or earlier, was substantial (Solecki personal observation as cited in [80]). For more on the localized spread of teasel, see Local distribution changes.

Although several researchers and land managers consider teasel a potentially invasive nonnative species, common teasel was not a high-priority species in a list ranking those species thought to seriously reduce biodiversity. Common teasel was listed number 80 in a prioritized list of 81 nonnative invasive species in natural Canadian habitats [13]. However, several morphological and reproductive characteristics suggest teasel has the potential to be a problematic invasive species. A review reports that teasel's thick, well-developed taproot allows for substantial nutrient and water storage, which increases the potential for regrowth after damage and/or survival of inclement conditions. Barbs and spines defend teasel against herbivory and may focus grazing or browsing on unprotected associated vegetation. High levels of seed production, high seed germinability, and little dormancy in fresh seed allows for rapid establishment in open areas, and death of the parent provides habitat for future seedling recruitment [80].

Potential allelopathy: The leachate from common teasel seeds may affect germination of other common teasel seeds and may vary between common teasel populations. When seeds from old-field and roadside populations in Ontario, Canada, were germinated together, the initial root growth of old-field seeds was significantly shorter in the presence of roadside seeds than in the presence of other old-field seeds (P=0.02). Researchers found that roadside seeds leached significantly greater levels of sodium ions than old-field seeds (P<0.01) [7].

Riparian biotic integrity: In a survey of western riparian habitats, common teasel occurred more often in disturbed than undisturbed riparian areas (P<0.001). Riparian area biotic integrity, as measured by macroinvertebrate and vertebrate aquatic communities, was lower when common teasel was present than when it was absent (P<0.05) [74]. Researchers did not distinguish the degree to which common teasel or past disturbance was impacting biotic integrity.

Other vegetation: In the early successional development of old fields in Michigan, the introduction of common teasel led to increased species richness overall, but the abundance of some native and nonnative forbs decreased with the introduction. In fields in Kalamazoo County, Michigan, species richness was significantly greater in fields with common teasel than in fields without (P<0.005). Typically species number increased in each of the 3 years after common teasel seeding. The introduction of common teasel increased the diversity in 87.5% of old-field plots. When common teasel reached flowering stage, community productivity was significantly greater in common teasel fields than in control fields (P=0.027) [99]. Although diversity and species richness were higher in old fields with common teasel, desirability or nativity of the additional species was not assessed. During observations made up to 5 years after the introduction of common teasel in Michigan old fields, Werner [97] noted that abundance of the native hairy white oldfield aster (*Symphyotrichum pilosum*), native eastern daisy fleabane (*Erigeron annuus*), and nonnative Canada thistle (*Cirsium arvense*) decreased with increased common teasel abundance. However, another species, garden yellowrocket (*Barbarea vulgaris*), a nonnative winter annual, established in spaces created by dead common teasel plants and was restricted to common teasel fields [97].

In New Jersey and New Mexico, studies indicate that teasel populations may monopolize habitats utilized by threatened or endangered species. In a limestone fen in New Jersey's Warren County, dense teasel populations occupy habitats important to 2 state endangered species, American globeflower (*Trollius laxus*) and water speedwell (*Veronica anagallis-catenata*) [78]. Over a 3- to 4-year period in central New Mexico, density of and area occupied by common teasel increased in habitat of the threatened Sacramento Mountain thistle. In about 20% of quadrats, common teasel and Sacramento Mountain thistle occurred within a 1 m² area. In several quadrats, seedling densities of common teasel exceeded 150 seedlings/m², whereas Sacramento Mountain thistle seedling densities rarely exceeded 20/m². A greenhouse study established that the 2 species had similar germination requirements, but that the germination of Sacramento Mountain thistle was significantly lower in dark than in light (P<0.05), while common teasel germinated equally well in dark and light conditions. When plant growth was monitored, Sacramento Mountain thistle was significantly smaller in pots with common teasel than in pots with only itself (P=0.02). Common teasel growth was

unaffected by the presence of Sacramento Mountain thistle [42]. Grazing in Sacramento Mountain thistle habitats may foster establishment and persistence of common teasel [82].

Control: Several sources indicate that teasel control should focus on decreasing the density of established plants while preventing seed production and dispersal [22,80]. Early detection of teasel populations reduces the effort necessary to reduce established plant densities [80]. Based on demography studies, researchers suggest that control of short-lived, rapidly growing nonnative plants should focus on limiting growth and reproduction rather than trying to impact survival of established plants [71].

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

Prevention: Maintenance or restoration of wetlands, minimizing soil disturbances, and improving public education and behaviors could help to prevent teasel introductions and spread. When areas of Swavesey in Camridgeshire, England, were drained, common teasel established within 3 years in the lowland meadow [38]. Teasel is often described in association with disturbed sites. Minimizing disturbances may decrease its establishment and spread [22]. Changing human behaviors that encourage teasel seed dispersal could prevent teasel seed spread; however, from 1995 and 2000, common teasel seeds were available for sale in US plant nurseries [56].

Physical or mechanical: While some teasel plants may be killed by cutting or mowing, many sprout and some may still produce seed [29]. Available literature (as of 2009) suggests that common teasel may be more susceptible to cutting than cut-leaved teasel. Werner (Werner unpublished data cited in [95]) reported that repeated cutting eliminated common teasel stands, but no details were provided about the timing, frequency, or disposal methods used. Typically, researchers and land managers suggest that belowground cutting is most effective [29,90], but plants may still regenerate [40]. Reduced seed production and plant death are most likely if plants are cut just before or as they flower [33]. However, viable seeds may be produced on cut stems, making disposal of flowering stems in cut areas important to successful teasel control [79].

Although common teasel is not often the target of control efforts in the United Kingdom, Cheesman [14] conducted an experiment in field boundaries that provides potentially useful control information. Common teasel stems were cut to height of 2 inches (5 cm) when they had flower buds, were beginning to flower, or producing mature seeds. Flower head production on the regrowth of stems cut at the bud stage was 78% to 94% lower than that of uncut common teasel stems. Twenty percent of plants regrew following cutting at the flowering stage but no cut stems produced seed. Stems cut when seed was maturing produced no new growth in the treatment or following year [14].

In the Loda Cemetery Prairie in Illinois, managers cut cut-leaved teasel stems annually for 7 years and burned sites biennially. Cutting occurred when flower buds were present but before peak flowering. Cut stems were left on the treatment site. Cut-leaved teasel populations were not reduced by this management (Harty and White personal communication cited in [79]). Seeds from the cut stems germinated. After 1 and 7 months of room-temperature storage, 41% and 97%, respectively, of the seeds from cut stems germinated [79].

Mowing failed to control cut-leaved teasel in the Mascoutin Recreation Area of DeWitt County, Illinois. When patches of similar size and plant density were mowed or undisturbed, the size of mowed patches increased by 33 m^2, while control patches increased by 4.2 m^2. Seed dispersal by mowing was considered the reason for increased patch size [67].

Biological: A review reported that moderate to heavy grazing can limit teasel establishment [33]. It is unclear whether grazing and/or trampling restrict establishment. In 2006, insect, fungal, and viral biocontrols were being evaluated for potential biological control of teasel. Researchers predicted that organisms attacking the taproot or rosette may provide the most effective control [73].

Chemical: Early-spring or late-fall herbicide applications may allow managers to better target teasel plants, since much of the associated vegetation is dormant at this time [81]. In Missouri, several herbicides used to treat cut-leaved teasel provided some initial control. Residual herbicides did not prevent the next year's seedling emergence. In many

cases, emergence on treated plots exceeded that on untreated plots. Openings created through herbicide-induced mortality may have provided suitable sites for germination [8]. Survival of other plants on the site may have offered protection for seedlings and thus provided for seedling survival. See germination, seedling establishment, and the case study summary for additional information on these topics.

Integrated management: Burning or mowing to expose rosettes before mechanical or chemical treatments may increase effectiveness [33].

APPENDIX: FIRE REGIME TABLE

SPECIES: Dipsacus fullonum, D. laciniatus

The following table provides fire regime information that may be relevant to teasel habitats. Follow the links in the table to documents that provide more detailed information on these fire regimes. If you are interested in fire regimes of plant communities not listed here, see the Expanded FEIS Fire Regime Table.

Fire regime information on vegetation communities in which teasel may occur. This information is taken from the LANDFIRE Rapid Assessment Vegetation Models [54], 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.

Pacific Northwest | California | Southwest | Great Basin | Northern and Central Rockies
Northern Great Plains | Great Lakes | Northeast | South-central US | Southern Appalachians
Southeast

Pacific Northwest

- Northwest Grassland
- Northwest Shrubland
- Northwest Woodland
- Northwest Forested

Vegetation Community (Potential Natural Vegetation Group)	Fire severity*	Fire regime characteristics			
		Percent of fires	Mean interval (years)	Minimum interval (years)	Maximum interval (years)
Northwest Grassland					
Marsh	Replacement	74%	7		
	Mixed	26%	20		
Bluebunch wheatgrass	Replacement	47%	18	5	20
	Mixed	53%	16	5	20

Idaho fescue grasslands	Replacement	76%	40		
	Mixed	24%	125		
Northwest Shrubland					
Wyoming big sagebrush semidesert	Replacement	86%	200	30	200
	Mixed	9%	>1,000	20	
	Surface or low	5%	>1,000	20	
Wyoming sagebrush steppe	Replacement	89%	92	30	120
	Mixed	11%	714	120	
Mountain big sagebrush (cool sagebrush)	Replacement	100%	20	10	40
Northwest Woodland					
Oregon white oak-ponderosa pine	Replacement	16%	125	100	300
	Mixed	2%	900	50	
	Surface or low	81%	25	5	30
Ponderosa pine	Replacement	5%	200		
	Mixed	17%	60		
	Surface or low	78%	13		
Oregon white oak	Replacement	3%	275		
	Mixed	19%	50		
	Surface or low	78%	12.5		
Northwest Forested					
Dry ponderosa pine (mesic)	Replacement	5%	125		
	Mixed	13%	50		
	Surface or low	82%	8		
Mixed conifer (southwestern Oregon)	Replacement	4%	400		
	Mixed	29%	50		
	Surface or low	67%	22		
California mixed evergreen (northern California)	Replacement	6%	150	100	200
	Mixed	29%	33	15	50
	Surface or low	64%	15	5	30
Mixed conifer (eastside mesic)	Replacement	35%	200		
	Mixed	47%	150		
	Surface or low	18%	400		

California

- California Grassland
- California Shrubland

- California Woodland
- California Forested

Vegetation Community (Potential Natural Vegetation Group)	Fire severity*	Fire regime characteristics			
		Percent of fires	Mean interval (years)	Minimum interval (years)	Maximum interval (years)
California Grassland					
California grassland	Replacement	100%	2	1	3
Herbaceous wetland	Replacement	70%	15		
	Mixed	30%	35		
California Shrubland					
Coastal sage scrub-coastal prairie	Replacement	8%	40	8	900
	Mixed	31%	10	1	900
	Surface or low	62%	5	1	6
California Woodland					
California oak woodlands	Replacement	8%	120		
	Mixed	2%	500		
	Surface or low	91%	10		
Ponderosa pine	Replacement	5%	200		
	Mixed	17%	60		
	Surface or low	78%	13		
California Forested					
California mixed evergreen	Replacement	10%	140	65	700
	Mixed	58%	25	10	33
	Surface or low	32%	45	7	
Mixed conifer (North Slopes)	Replacement	5%	250		
	Mixed	7%	200		
	Surface or low	88%	15	10	40
Mixed conifer (South Slopes)	Replacement	4%	200		
	Mixed	16%	50		
	Surface or low	80%	10		
Aspen with conifer	Replacement	24%	155	50	300
	Mixed	15%	240		
	Surface or low	61%	60		
	Replacement	9%	250		

Jeffrey pine	Mixed	17%	130		
	Surface or low	74%	30		

Southwest

- Southwest Grassland
- Southwest Shrubland
- Southwest Woodland
- Southwest Forested

Vegetation Community (Potential Natural Vegetation Group)	Fire severity*	Fire regime characteristics			
		Percent of fires	Mean interval (years)	Minimum interval (years)	Maximum interval (years)
Southwest Grassland					
Desert grassland	Replacement	85%	12		
	Surface or low	15%	67		
Desert grassland with shrubs and trees	Replacement	85%	12		
	Mixed	15%	70		
Shortgrass prairie	Replacement	87%	12	2	35
	Mixed	13%	80		
Shortgrass prairie with shrubs	Replacement	80%	15	2	35
	Mixed	20%	60		
Shortgrass prairie with trees	Replacement	80%	15	2	35
	Mixed	20%	60		
Southwest Shrubland					
Southwestern shrub steppe	Replacement	72%	14	8	15
	Mixed	13%	75	70	80
	Surface or low	15%	69	60	100
Southwestern shrub steppe with trees	Replacement	52%	17	10	25
	Mixed	22%	40	25	50
	Surface or low	25%	35	25	100
Mountain sagebrush (cool sage)	Replacement	75%	100		
	Mixed	25%	300		
Southwest Woodland					
Pinyon-juniper (mixed fire regime)	Replacement	29%	430		
	Mixed	65%	192		

	Surface or low	6%	>1,000		
Ponderosa pine/grassland (Southwest)	Replacement	3%	300		
	Surface or low	97%	10		
Southwest Forested					
Riparian forest with conifers	Replacement	100%	435	300	550
Riparian deciduous woodland	Replacement	50%	110	15	200
	Mixed	20%	275	25	
	Surface or low	30%	180	10	
Stable aspen without conifers	Replacement	81%	150	50	300
	Surface or low	19%	650	600	>1,000

Great Basin

- Great Basin Grassland
- Great Basin Shrubland
- Great Basin Woodland
- Great Basin Forested

Vegetation Community (Potential Natural Vegetation Group)	Fire severity*	Fire regime characteristics			
		Percent of fires	Mean interval (years)	Minimum interval (years)	Maximum interval (years)
Great Basin Grassland					
Great Basin grassland	Replacement	33%	75	40	110
	Mixed	67%	37	20	54
Mountain meadow (mesic to dry)	Replacement	66%	31	15	45
	Mixed	34%	59	30	90
Great Basin Shrubland					
Basin big sagebrush	Replacement	80%	50	10	100
	Mixed	20%	200	50	300
Wyoming big sagebrush semidesert	Replacement	86%	200	30	200
	Mixed	9%	>1,000	20	>1,000
	Surface or low	5%	>1,000	20	>1,000
Wyoming big sagebrush semidesert with trees	Replacement	84%	137	30	200
	Mixed	11%	≥1,000	20	>1,000
	Surface or low	5%	>1,000	20	>1,000
	Replacement	89%	92	30	120

Wyoming sagebrush steppe	Mixed	11%	714	120	
Mountain big sagebrush	Replacement	100%	48	15	100
Mountain big sagebrush with conifers	Replacement	100%	49	15	100
Mountain sagebrush (cool sage)	Replacement	75%	100		
	Mixed	25%	300		
Mountain shrubland with trees	Replacement	22%	105	100	200
	Mixed	78%	29	25	100
Great Basin Woodland					
Juniper and pinyon-juniper steppe woodland	Replacement	20%	333	100	≥1,000
	Mixed	31%	217	100	≥1,000
	Surface or low	49%	135	100	
Ponderosa pine	Replacement	5%	200		
	Mixed	17%	60		
	Surface or low	78%	13		
Great Basin Forested					
Interior ponderosa pine	Replacement	5%	161		800
	Mixed	10%	80	50	80
	Surface or low	86%	9	8	10
Aspen with conifer (low to midelevation)	Replacement	53%	61	20	
	Mixed	24%	137	10	
	Surface or low	23%	143	10	
Stable aspen-cottonwood, no conifers	Replacement	31%	96	50	300
	Surface or low	69%	44	20	60
Stable aspen without conifers	Replacement	81%	150	50	300
	Surface or low	19%	650	600	>1,000

Northern and Central Rockies

- Northern and Central Rockies Grassland
- Northern and Central Rockies Shrubland
- Northern and Central Rockies Forested

Vegetation Community (Potential Natural Vegetation	Fire severity*	Fire regime characteristics			
		Percent of	Mean interval	Minimum interval	Maximum interval

Group)		fires	(years)	(years)	(years)
Northern and Central Rockies Grassland					
Northern prairie grassland	Replacement	55%	22	2	40
	Mixed	45%	27	10	50
Mountain grassland	Replacement	60%	20	10	
	Mixed	40%	30		
Northern and Central Rockies Shrubland					
Riparian (Wyoming)	Mixed	100%	100	25	500
Wyoming big sagebrush	Replacement	63%	145	80	240
	Mixed	37%	250		
Basin big sagebrush	Replacement	60%	100	10	150
	Mixed	40%	150		
Mountain shrub, nonsagebrush	Replacement	80%	100	20	150
	Mixed	20%	400		
Northern and Central Rockies Forested					
Ponderosa pine (Northern and Central Rockies)	Replacement	4%	300	100	≥1,000
	Mixed	19%	60	50	200
	Surface or low	77%	15	3	30
Mixed conifer-upland western redcedar-western hemlock	Replacement	67%	225	150	300
	Mixed	33%	450	35	500

Northern Great Plains

- Northern Plains Grassland
- Northern Plains Shrubland
- Northern Plains Woodland

Vegetation Community (Potential Natural Vegetation Group)	Fire severity*	Fire regime characteristics			
		Percent of fires	Mean interval (years)	Minimum interval (years)	Maximum interval (years)
Northern Plains Grassland					
Nebraska Sandhills prairie	Replacement	58%	11	2	20
	Mixed	32%	20		
	Surface or low	10%	67		

Southern mixed-grass prairie	Replacement	100%	9	1	10
Central tallgrass prairie	Replacement	75%	5	3	5
	Mixed	11%	34	1	100
	Surface or low	13%	28	1	50
Southern tallgrass prairie (East)	Replacement	96%	4	1	10
	Mixed	1%	277		
	Surface or low	3%	135		
Oak savanna	Replacement	7%	44		
	Mixed	17%	18		
	Surface or low	76%	4		
Northern Plains Woodland					
Oak woodland	Replacement	2%	450		
	Surface or low	98%	7.5		
Northern Great Plains wooded draws and ravines	Replacement	38%	45	30	100
	Mixed	18%	94		
	Surface or low	43%	40	10	
Great Plains floodplain	Replacement	100%	500		
Great Lakes • Great Lakes Grassland • Great Lakes Woodland • Great Lakes Forested					
Vegetation Community (Potential Natural Vegetation Group)	Fire severity*	Fire regime characteristics			
		Percent of fires	Mean interval (years)	Minimum interval (years)	Maximum interval (years)
Great Lakes Grassland					
Mosaic of bluestem prairie and oak-hickory	Replacement	79%	5	1	8
	Mixed	2%	260		
	Surface or low	20%	2		33
Great Lakes Woodland					
Northern oak savanna	Replacement	4%	110	50	500
	Mixed	9%	50	15	150
	Surface or low	87%	5	1	20
Great Lakes Forested					

Great Lakes floodplain forest	Mixed	7%	833		
	Surface or low	93%	61		
Great Lakes pine forest, jack pine	Replacement	67%	50		
	Mixed	23%	143		
	Surface or low	10%	333		
Maple-basswood mesic hardwood forest (Great Lakes)	Replacement	100%	>1,000	≥1,000	>1,000
Maple-basswood-oak-aspen	Replacement	4%	769		
	Mixed	7%	476		
	Surface or low	89%	35		
Northeast • Northeast Grassland • Northeast Woodland • Northeast Forested					
Vegetation Community (Potential Natural Vegetation Group)	Fire severity*	Fire regime characteristics			
		Percent of fires	Mean interval (years)	Minimum interval (years)	Maximum interval (years)
Northeast Grassland					
Northern coastal marsh	Replacement	97%	7	2	50
	Mixed	3%	265	20	
Northeast Woodland					
Eastern woodland mosaic	Replacement	2%	200	100	300
	Mixed	9%	40	20	60
	Surface or low	89%	4	1	7
Oak-pine (eastern dry-xeric)	Replacement	4%	185		
	Mixed	7%	110		
	Surface or low	90%	8		
Northeast Forested					
Northern hardwoods (Northeast)	Replacement	39%	≥1,000		
	Mixed	61%	650		
South-central US • South-central US Grassland • South-central US Forested					
		Fire regime characteristics			

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					
Southern shortgrass or mixed-grass prairie	Replacement	100%	8	1	10
Southern tallgrass prairie	Replacement	91%	5		
	Mixed	9%	50		
Oak savanna	Replacement	3%	100	5	110
	Mixed	5%	60	5	250
	Surface or low	93%	3	1	4
South-central US Forested					
Interior Highlands dry-mesic forest and woodland	Replacement	7%	250	50	300
	Mixed	18%	90	20	150
	Surface or low	75%	22	5	35
Gulf Coastal Plain pine flatwoods	Replacement	2%	190		
	Mixed	3%	170		
	Surface or low	95%	5		

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					
Eastern prairie-woodland mosaic	Replacement	50%	10		
	Mixed	1%	900		
	Surface or low	50%	10		
Southern Appalachians Woodland					
Oak-ash woodland	Replacement	23%	119		
	Mixed	28%	95		
	Surface or low	49%	55		
Southern Appalachians Forested					
	Replacement	3%	180	30	500

Appalachian oak-hickory-pine	Mixed	8%	65	15	150
	Surface or low	89%	6	3	10
Appalachian oak forest (dry-mesic)	Replacement	6%	220		
	Mixed	15%	90		
	Surface or low	79%	17		

Southeast

- Southeast Grassland
- 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		
Southern tidal brackish to freshwater marsh	Replacement	100%	5		
Gulf Coast wet pine savanna	Replacement	2%	165	10	500
	Mixed	1%	500		
	Surface or low	98%	3	1	10
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
Southeast Forested					
Atlantic white-cedar forest	Replacement	34%	200	25	350
	Mixed	8%	900	20	900
	Surface or low	59%	115	10	500
Mesic-dry flatwoods	Replacement	3%	65	5	150
	Surface or low	97%	2	1	8

*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 [35,53].

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