Tanacetum vulgare

INTRODUCTORY

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AUTHORSHIP AND CITATION:
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FEIS ABBREVIATION:
TANVUL

NRCS PLANT CODE [94]:
TAVU

COMMON NAMES:
common tansy
bitter buttons
garden tansy
golden buttons

TAXONOMY:
The scientific name of common tansy is *Tanacetum vulgare* L. (Asteraceae) [21,43].

Common tansy × feverfew (*Tanacetum parthenium*) hybrids were produced experimentally in the laboratory [9]. In the literature available in 2009, naturally occurring hybrids were not reported.

SYNONYMS:
Chrysanthemum uliginosum Pers. [43]
Chrysanthemum vulgare (L.) Bernh. [39,43]
Chrysanthemum vulgare var. *boreale* [39]
Tanacetum vulgare var. *crispum* DC. [43]

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: Tanacetum vulgare

GENERAL DISTRIBUTION:
Common tansy occurs nearly throughout the United States and Canada. It is reported in all US states except Texas, Alabama, Georgia, South Carolina, and Florida, and in all Canadian provinces except Nunavut [94]. Common tansy is native to Eurasia, specifically subalpine river valleys in Siberia [40]. Other common tansy habitats in Eurasia are likely the result of widespread human introduction [21,40].

In nonnative US habitats, common tansy is generally more common in the North than in the South. It is common along the Pacific Northwest Coast from northern Oregon to southern British Columbia [70]. It is uncommon in California [30] and restricted to the northern parts of Nevada [44] and New Mexico [58]. Although widely distributed throughout the Great Plains, common tansy is still considered infrequent [26]. Common tansy is frequent in the Northeast. It occurs in nearly every county in New England and New York [57] but is infrequent in North Carolina [77] and West Virginia [87]. In many US and Canadian habitats, common tansy is considered widespread or well established, although populations are often infrequent or scattered. Plants Database provides a distribution map of common tansy.

Common tansy seed was brought to the United States as early as 1631 [54], and because of its many medicinal uses (see Other Uses), common tansy was widely cultivated in the gardens of early European settlers [52,62,87]. Common tansy was one of many seeds brought to the New England Plymouth colony by John Winthrop Jr in 1631 [54]. In the 1600s, the governor of Massachusetts referred to common tansy as a necessity in colonial gardens and encouraged extensive cultivation [52]. John Josselyn wrote in 1638 and again in 1663 that common tansy was "flourishing" in New England herb gardens [62]. By 1785, common tansy was considered "naturalized" in the Northeast. In 1895, Darlington wrote that common tansy had escaped cultivation and was becoming "something of a weed-- in many places". In 1892, common tansy was known on Block Island, Rhode Island [5], and in West Virginia [12]. Common tansy occurred in Michigan by at least the 1860s and was widespread by the 1890s [97]. By 1912, common tansy was reported in Iowa and Kansas [40,63]. Likely common tansy was also introduced on the West Coast of North America. Common tansy occurred in Alberta by the late 1800s [101] and in Oregon between 1891 and 1900 [23]. There were reports of common tansy in Wyoming by 1910, in Idaho and Washington by 1921 [23], and in Montana by 1931 [40]. Common tansy was considered widespread in California by 1952 [52] and well established in Utah by the late 1950s

[37].

While no studies measured the spread rate of common tansy, several references provide anecdotal information about its spread. Land owners and managers in Alberta's forested areas reported that common tansy spread has been minimal even though populations have been present for more than 60 years. Land owners and managers in agricultural areas, however, reported increases in common tansy population density and size over time [101]. When western weed scientists were asked to estimate the spread rate of common tansy in the northwestern United States, estimates averaged 11% [95]. It was unclear if these estimates were for increases in population size or density or both. Researchers in Wyoming reported in the 1980s that common tansy was no longer restricted to ditch banks, fence rows, and roadsides and was establishing in rangelands and pastures [20]. Although deliberate human spread of common tansy was more common in early settlement times, more recent inroductions have also occurred. In the mid-1970s, common tansy was planted on reclaimed mine sites in Wyoming [38], and in the mid-1990s, common tansy seed was available in US plant nurseries [55].

HABITAT TYPES AND PLANT COMMUNITIES:
Although detailed information is sparse on common tansy habitats in Europe and North America, in its native and nonnative range common tansy often occupies recently disturbed sites. The *Flora Europaea* indicates that common tansy is most common along roadsides, river banks, and "waste places" [92]. In Britain, common tansy is noted in open, spreading pellitory (*Parietaria judaica*)-dominated communities that occur in crevices, on scree soils, or on spoils [80]. In the Netherlands, common tansy is common in pioneer communities and at field edges and often establishes following soil disturbances [46]. In eastern Central Europe, common tansy occurs in old fields or other "derelict land" as a monoculture or a mixture with chee reedgrass (*Calamagrostis epigejos*) and/or Canada goldenrod (*Solidago canadensis*). Common tansy also occupies sand dunes, river banks, mires, and montane steppe and subalpine grassland vegetation [79].

In North America, habitats invaded by common tansy were rarely described in detail. In Alberta, common tansy populations are often dense but occupy a limited area in ruderal habitats (fence lines, field margins, roadsides, railways, shelterbelts, farm yards, and gravel pits). Along rivers or lake shores, dense monotypic common tansy populations are common. In rangelands and pastures, low- to moderate-density populations are widespread [101]. In western Montana, common tansy was noted in black cottonwood (*Populus balsamifera* subsp. *trichocarpa*) floodplain woodlands [22]. In southern Idaho, common tansy occupied "poor condition" stream banks [82]. In New Brunswick, Canada, common tansy frequency was 20% in 13- to 21-year-old black spruce (*Picea mariana*) plantations [96].

BOTANICAL AND ECOLOGICAL CHARACTERISTICS

SPECIES: Tanacetum vulgare

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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. Because common tansy can be confused with threatened native tansy species, correct identification is necessary prior to control treatments (see Common tansy look-alikes). Keys for identification are available (e.g., [24,26,32,57,77]).

Aboveground description: Common tansy is a robust perennial with erect stems that may reach 7 feet (2 m) tall [32,39,65,100]. Coarse stems generally branch only at the top and are somewhat woody at the base. Stems may grow singly or in clusters [11,26,30,83,88] and are lined with alternate leaves [65,77]. When crushed, leaves produce a "rank" smell [99]. Leaves are finely dissected and toothed. They measure 2 to 12 inches (6-30 cm) long and are generally half as wide [2,26,44,58,81,83]. Climate and/or site conditions may affect plant growth, development, and life span. When 20 common tansy ecotypes collected throughout Finland were grown in a common garden in Helsinki, average ecotype height ranged from 23.8 to 45.5 inches (60.5-115.4 cm) [45]. In Minnesota, common tansy generally grew to 3 feet (1 m) tall but could reach 5 feet (1.5 m) tall in shaded areas [61]. In Alberta, common tansy plants along roadsides and riparian areas were 41 to 63 inches (105-160 cm) tall. There were no significant height differences between the 2 habitats, but during the 3-year study, plant height decreased in the riparian area and increased along the roadside. Stem diameters were significantly less in the riparian area than on the roadside ($P<0.01$) [101]. In early-seral habitats in South Bohemia in the Czech Republic, common tansy "showed signs of senescence" at 3 to 4 years old [66].

In Gallatin County, Montana, common tansy plants on moist stream banks averaged 3 to 4 years old, and 10-year-old plants occurred on drier sites. Plant age was estimated from rhizome growth rings [40].

Common tansy flower heads are comprised of daisy-like disk florets and measure up to 0.5 inch (1.2 cm) wide [39,61]. Within the flower head there may be as many as 100 individual florets [40]. Florets are perfect except for the outermost, which are pistillate [17,26]. Generally florets are without ray flowers, but in some cases, reduced ray flowers are present [28,57,81,83]. Flower heads are densely clustered in flat-topped terminal inflorescences [11,49]. Sources report that common tansy may produce more than 8 flower heads/stem [57] and between 20 and 200 flower heads/plant [1,26]. When common tansy ecotypes from Finland were grown in a common garden, the average number of flower heads/stem ranged from 17.6 to 79.8 [45]. Common tansy produces achenes that measure 1 to 1.8 mm long; the pappus, if present, is a reduced 5-toothed crown [1,14,17,30,40,77]. In Alberta, common tansy seeds collected from plants along a roadside weighed significantly less than seeds collected from plants in a riparian area (P=0.046) [101].

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Belowground description: Anecdotal descriptions of common tansy roots and rhizomes are more common than measurements. Common tansy rhizomes have been described as "leafy", "robust" [32], "sturdy" [49], and "stout" [26,30]. Rhizome growth has been described as "vigorous" [49]. Rhizomes branch extensively and produce many fibrous roots [85]. Common tansy plants along roadsides and in riparian areas in Alberta produced "tightly coiled" rhizomes with diameters of 0.4 to 1 inch (1.0-2.7 cm) and "extremely woody" roots with diameters that averaged 0.4 cm. Roots extended more than 51 inches (130 cm) below ground [101]. In Gallatin County, Montana, common tansy rhizomes measured 0.5 to 0.75 inch (1-2 cm) thick. Roots were extensive but shallow, and most occurred in the top 23 inches (60 cm) of soil [40].

Common tansy look-alikes: In several parts of common tansy's nonnative North American range, there are similar-looking plants that are threatened, endangered, or occur in threatened habitats (as of 2009). Lake Huron tansy (*Tanacetum bipinnatum* subsp. *huronense*), a native North American species, is endangered in Wisconsin, threatened in Michigan, and a species of concern in Maine. Lake Huron tansy is shorter (16 to 32 inches (41-81 cm)) and generally produces fewer and smaller flowers than common tansy [94,102]. Lake Huron tansy also occurs in Canada and Alaska and is often distinguished from common tansy by its lack of a creosote-like odor [1,94]. Camphor tansy (*T. camphoratum*) is native to Washington, Oregon, and California, and although not listed as a threatened or endangered, grows in habitats described as threatened. Camphor tansy is typically distinguished from common tansy by the more rounded teeth on its leaves and shorter stature (only about 2 feet (0.6 m) tall) [40].

Raunkiaer [78] life form:
Hemicryptophyte
Geophyte

SEASONAL DEVELOPMENT:
Common tansy flowers from July to October throughout its North American range [24,26,32,44,77]. Although patterns in flowering date were not evident from the broad phenological descriptions in North American floras, they were described for common tansy genotypes collected throughout Finland and grown in a common garden. Plants collected from western and central Finland flowered earlier than those from southern and eastern Finland [45].

Seasonal development of common tansy was reported from populations in Gallatin County, Montana [40]:

- some stems grew from rhizomes in November
- most stems emerged in the spring, after the emergence of many perennial grasses in the area
- leaf expansion began in mid-May
- plants were 3 feet (1 m) tall or more by mid-June
- flower buds began forming in June
- flowers were present through most of August, some flowers persisting until early November
- leaves and stems began senescing as early as August on dry sites
- leaves were still green in October or November on moist sites
- flower heads remained intact and held most seeds through the fall

REGENERATION PROCESSES:
Seed dispersal and seedling establishment are largely responsible for the spread of common tansy populations. However, extensive rhizome growth can be important in the development of large plants and colonies over a small area [40,71,88,97,101]. See Vegetative regeneration for more information.

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

Pollination and breeding system: Most common tansy florets are perfect, although the outermost florets are female [14,26]. Cross pollination of common tansy flowers is predominant [45]. When experimental fertilization tests were conducted in Finland, most self-pollinated plants failed to produce seeds. The maximum level of seed production for self-pollinated plants was 4% [53]. "Primitive" flies, hover flies, butterflies, moths, and honey bees visit common tansy flowers [52,88].

Seed production: Reviews report "prolific" and "profuse" seed production by common tansy plants [11,19]. In a gardening guide, Sperka [85] reports that common tansy "self sows readily". Another review suggests that if 20 to 200 flower heads are produced per stem, common tansy plants may produce 50,000 seeds [1].

Based on field studies in the Czech Republic and a review of available literature, Prach and Wade [71] indicated that common tansy typically produces seed in its 2nd year and that populations produce 10,000 to 100,000 seeds/m²/year. No other studies reported common tansy's reproductive age. In Gallatin County, common tansy produced an average of 67 flower heads/inflorescence, an estimated 9,966 flowers/stem, an estimated 2,553 filled achenes/plant, and an estimated 198,625 filled achenes/m² [40]. Provided below is information about seed germination as related to seed production and/or collection time.

Seed dispersal: Many passive and active dispersal methods are reported for light-weight (<0.05 g) common tansy seed [101]. Because common tansy seeds lack a pappus [71], long-distance wind dispersal is unlikely unless seeds fall on crusty snow. Winter seed dispersal is likely since seeds are typically attached to flower heads through the fall, but movement of the stiff, dry stems can dislodge common tansy seeds from the flower head and contribute to dispersal anytime seeds are mature [40]. White [101] reports that common tansy seed may remain in flower heads on dead stems for up to 3 years.

Several researchers report that common tansy seed is also transported by water [19,101,102]. Common tansy seeds have high oil content and floating has been observed, although floating duration was not reported [101]. In Wisconsin, common tansy is especially common along ditch banks, and water-dispersed seed is considered important to the colonization of waterways [102].

Animals and humans are also likely dispersers of common tansy seed. According to Sperka [85], birds feed on common tansy seeds; however, viability of seed passing through the digestive tract was not tested. Common tansy seed in animal fur, bird feathers, and soil caught in paws, hooves, or shoes may also contribute to dispersal. Seed dispersal by equipment used in areas with common tansy is also likely [40]. White [101] reports that common tansy is often found in gravel pits and roadside habitats, where equipment use is generally heavy. If common tansy flower heads are present in hay fields, they could also be transported in hay bales [40]. Dispersal of rhizome fragments also contributes to the spread of common tansy (see Vegetative regeneration).

Seed banking: Common tansy seed viability in the seed bank is largely unknown [11], but speculation suggests a short-lived seed bank. White [101] reports that common tansy seed may remain in flower heads on dead stems for up to 3 years, but germination studies on 3-year-old seed were not conducted. Based on field studies conducted in the Czech Republic and a review of available literature, Prach and Wade [71] suggested that common tansy seed is generally viable for just one season.

Germination: Common tansy seeds generally germinate best when near the soil surface, cold stratified, and then exposed to warm temperatures. Prach and Wade [71] reported that common tansy seed germinates under a wide range of environmental conditions and lacks complicated dormancy mechanisms. A review reports that germination of common tansy seeds is best from the top 0.8 inch (2 cm) of soil [83]. About 75% of seeds collected in October from Gallatin County, Montana, germinated in the laboratory after 1 month of cold stratification [40].

Cold temperatures increased the germination rate of common tansy seed collected from populations in Alberta. Just 10% to 20% of seeds collected in late-July through mid-August germinated without cold treatments. Seeds produced in August or September and collected in October germinated at a rate of 10% without cold stratification and 40% with cold stratification. Seeds collected from overwintering stems germinated at a rate of 70%, and this rate increased to 90% with additional cold treatments. Dispersal of some viable seed in August, and even more after winter, suggests that common tansy seedlings emerge in both the fall and spring, although numbers are likely much greater in the spring [101].

Warmer temperatures led to significantly (P<0.05) greater emergence of common tansy from soil samples collected in June from willow (*Salix* spp.) savannas in the Peace-Athabasca Delta of northeastern Alberta. Just 2 common tansy seedlings emerged from 85 cm² × 10 cm soil samples at alternating temperatures of 68 and 50 °F (20/10 ° C), but 19 seedlings emerged at temperatures of 86 and 59 °F (30/15 °C). Common tansy emergence from wetter habitat types that included a wheat sedge (*Carex atherodes*) marsh and a bluejoint reedgrass (*Calamagrostis canadensis*) meadow was very low regardless of temperature. Researchers suggested that increases in temperature, evapotranspiration, and disturbance expected with climate change in the area may favor common tansy reproduction and persistence [35,36].

Seedling establishment and plant growth: Common tansy seedling establishment and growth are generally best on open sites with limited litter, little established vegetation, and high light levels.

During seeding trials in Thorhild County, Alberta, researchers reported that common tansy establishment and growth were best on sites with low amounts of ground cover and little to no litter. Common tansy failed to establish on sites with high cover of established vegetation and litter [101]. In the Netherlands, common tansy often establishes after

large soil disturbances and is common in pioneer communities and at field edges. During a field study conducted in Wageningen, Netherlands, common tansy seedling growth and survival were better on bare ground than on 1-year-old and 2-year-old fields. Light levels were highest and total vegetation biomass was lowest on bare sites. Researchers planted 750 common tansy seeds, and establishment was poor, although 81% of seeds germinated [46].

Environmental characteristics and outcomes of common tansy seeded on 1×1-m field plots [46]			
Plot characteristics, ~1 year after seeding	Bare ground	1-year-old field	2-year-old field
Average vegetation biomass (g/m²)	473a	628b	588ab
Ambient light at ground level (%)	7.3a	1.4b	1.7b
Common tansy seedling characteristics, 1 year after seeding			
Number of common tansy seedlings/m²	21	<5	<5
Seedling mortality (%)	~50	~100	~20
Average seedling dry weight (mg)	~150	~0	<15
Final seedling biomass (g)	1.650	0	0.02
Plot characterisitics within a row followed by different letters are significantly different (P<0.05)			

Vegetative regeneration:

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Although several sources report that rhizomatous growth has not been as important to common tansy spread and range expansion as seed dispersal and establishment [71,101], many report that large colonies and dense clumps are primarily the result of spreading rhizomes [40,88,97]. Voss [97] reports that common tansy "forms large colonies from strong rhizomes", and a review reports that common tansy spreads "quite aggressively by vegetative means" [1].

Although seed dispersal may be the primary method for long-distance spread, common tansy regenerates from rhizome fragments [11,61,102] that can be dispersed by soil movement or equipment [11,31,40].

In early-seral habitats in South Bohemia, Czech Republic, central common tansy ramets invested less in flowering and had lower survival rates than peripheral ramets within the same clump. Increasing plant age negatively affected ramet survival (P<0.001) and positively affected flowering probability (P<0.05) [66].

SITE CHARACTERISTICS:
Throughout its nonnative North American range, common tansy is often described on recently and/or periodically disturbed sites that include vacant lots, gardens, pastures, railroads, roadsides, irrigation ditches, stream banks, and lake shores [30,37,40,64,97,100]. Common tansy is also reported in marshes, swamps, rangelands [40], prairies [15,31], meadows, and woodlands [97].

In the northwestern United States, a review reports that given a disturbance event and propagules, common tansy could invade any forested type in the Cascade, Sierran Steppe, and Northern, Southern, and Middle Rocky Mountain ecoregions [69]. In Minnesota, southern exposures are considered most susceptible to invasion by common tansy [61].

Climate: Common tansy's distribution in North America suggests a wide climatic tolerance but also a preference for cooler continental climates (see Distribution and Occurrence). Based on common tansy's wide temperature and precipitation tolerances, researchers predicted it could grow in any Montana county [52]. Because common tansy seed generally germinates better with cold stratification (see Germination), some low-elevation and extreme southern US habitats may not support common tansy growth and persistence.

Elevation: In North America, common tansy typically occupies habitats between 30 and 5,200 feet (10–1600 m) [21]. In the western United States, common tansy occupies high-elevation sites:

State	Elevation (feet)
Colorado	about 5,000* [28]
northern Nevada	4,500-6,700 [44]
northern New Mexico	4,500-5,500 [58]
Utah	4,490-6,510 [100]
*as of 1964, in north-central Colorado	

Soils: In its European and North American habitats, common tansy occurs on loams and sands described as dry to moist with low to high fertility. In the Netherlands, it is common on dry soils and often establishes after large soil disturbances [46]. In the United Kingdom, common tansy is considered characteristic of nutrient-rich, well-watered soils [13]. During studies conducted in the Czech Republic and in Germany, researchers found that common tansy growth characteristics and dominance may differ by soil type and characteristics. Common tansy was dominant on nutrient-rich soils in abandonded fields and on shallow, dry, nutrient-poor soils of a debris deposit in South Bohemia. However, common tansy plants were taller and had larger diameters in the old field than on the debris deposit [66]. In a field experiment conducted in the Kehler Weg garden southwest of Berlin, growth of common tansy was monitored for 5 years in monocultures and with other species in nutrient-rich topsoil, ruderal landfill soil with moderate nutrient levels, and nutrient-poor sand (additional soil characteristics provided in table below). As a monoculture or mixture in nutrient-rich soils, common tansy cover was high for up to 4 years then decreased dramatically, due to damage from slugs. In species mixtures, common tansy was often dominant only on nutrient-poor soils. After 5 years in a mixture with chee reedgrass, chee reedgrass cover exceeded common tansy cover by at least 10% in nutrient-rich and moderate-nutrient soils. Chee reedgrass and common tansy were codominant on nutrient-poor soils. After 5 years of growth with Canada goldenrod, cover of Canada goldenrod exceeded that of common tansy by at least 10% on nutrient-rich and moderate-nutrient soils. In nutrient-poor soils, common tansy cover exceeded Canada goldenrod cover by at least 10% [79].

Field soil types utilized in the Kehler Weg garden experiment [79]				
Soil type	Soil texture	Organic carbon (%)	Total nitrogen (%)	pH
Topsoil with litter compost and dung	loamy sand with 14.9% coarse fragments	2.00	0.102	7.6
Ruderal landfill soil	sand with 23.1% coarse fragments	0.94	0.027	7.5
Sand	fine sand with 1% coarse fragments	0.12	0.008	7.5

Although described on a variety of soils in North America, common tansy growth was considered best on moist but well-drained, fertile soils [11,21,40]. A review reports that common tansy grows on all soil textures and tolerates acidic, neutral, and basic conditions in Alaska [1]. In southern Idaho, common tansy often occurs on periodically flooded, silty soils along "poor condition", low-elevation streams [82]. In Illinois, common tansy is reported on moist

to slightly dry loams and clay loams [31], and Czarapata [15] reports common tansy on sandy soils in the Upper Midwest. In the Cayuga Lake Basin in New York, common tansy occupied neutral to slightly alkaline silt loams and silty clay loams [91].

SUCCESSIONAL STATUS:
In both Europe and North America, common tansy is most common on open, recently or periodically disturbed sites. Early-seral habitats are the most likely habitat for common tansy throughout its range.

Shade tolerance: Several reports note that common tansy is intolerant of shade or prefers sites in full sun [1,40,97]. Although common tansy growth may be best in full sun [11,85], it is reported on sites with full sun to partial shade in Illinois [31], shaded riparian sites in Alberta [101], and generally grows taller in shaded than unshaded sites in Minnesota [61]. Common tansy frequency was 20% in 13- to 21-year-old black spruce (*Picea mariana*) plantations in New Brunswick, Canada [96].

Succession in European habitats: Common tansy tolerates pioneer habitat conditions and is most likely dominant in early-seral European habitats. In the northwestern Czech Republic, coal mining operations create soil heaps from deep (up to 660 feet (200 m)) excavation operations. These heaps are considered a good environment for studying primary succession, since the top of the heap is undeveloped soil from the deepest excavation that typically lacks plant propagules [72]. Common tansy cover was typically low on 6- to 10-year-old heaps [34]. However, common tansy dominated some 15- and 16-year-old heaps [75] and persisted on heaps 26 years old and older [34]. In South Bohemia, common tansy is often dominant in early-seral habitats [66], including abandoned fields and urban sites [73]. In southwestern Poland, common tansy was often abundant in abandoned fields that ranged from 3 to 20 years old [67]. In the Netherlands, researchers consider common tansy typical of pioneer communities that establish after large soil disturbances [46]. In eastern Central Europe, Rebele [79] reports that old fields and other "derelict land" are commonly dominated by chee reedgrass, Canada goldenrod, and common tansy in monocultures or mixtures. Woody vegetation typically replaces these stands within 20 years.

Common tansy is common on recently disturbed and periodically disturbed sites throughout its native and nonnative ranges. In wildflower strips between agricultural crops in northern Switzerland, common tansy occurred in severely disturbed and mowed strips. Common tansy cover averaged 70% in mowed strips, 59% in strips left fallow, and 44% in strips that were mowed and harrowed [47]. In Plzen, western Bohemia, Czech Republic, researchers considered common tansy a "late successional dominant" in the early succession of urban habitats. Sampled urban habitats included riparian areas, dumps, railways, soil heaps, and areas for manure and silage seepage deposits. In over half of the plots where common tansy was present in 1969, plants were still present in 1974 [76]. When the findings from successional studies of 12- to 76-year seres on human-disturbed sites in the Czech Republic were evaluated together, common tansy cover was greatest on sites disturbed 10 years earlier [74]. Common tansy was a "strong dominant" in the herb stage that preceded scrubland development (Pysek 1977 and 1978 cited in [74]).

Succession in North American habitats: Reports suggest that common tansy primarily occupies disturbed sites in North America; however, these reports are mostly anecdotal and represent only a fraction of common tansy's US range. In southern Idaho, common tansy is considered an "increaser" along periodically flooded streams [82]. In northwestern Montana, common tansy often occurred on logged and/or grazed sites [98]. Several studies indicate common tansy abundance may increase or populations may spread in areas grazed heavily by cattle, because cattle typically avoid feeding on common tansy [31,52]. In eastern Washington, Daubenmire [16] reported that common tansy was frequent in heavily grazed Douglas hawthorn/cow parsnip (*Crataegus douglasii*/*Heracleum lanatum*) vegetation, because cattle preferentially feed on cow parsnip, which recovers slowly after grazing.

FIRE EFFECTS AND MANAGEMENT

SPECIES: Tanacetum vulgare

FIRE EFFECTS:

Immediate fire effect on plant: Common tansy is likely only top-killed by fire [40]. Fire effects studies on common tansy seeds and plants are lacking, but descriptions of common tansy rhizomes as "robust" [32], "sturdy" [49], and "stout" [26,30] suggest that rhizome survival on burned sites is likely.

Postfire regeneration strategy [86]:
Rhizomatous herb, rhizome in soil
Secondary colonizer (on- or off-site seed sources)

Fire adaptations and plant response to fire: On sites with established common tansy plants, postfire sprouting from rhizomes is likely the predominant regeneration method. Because common tansy seedlings establish best on sites with bare ground, little established vegetation, and high light levels [46,101], burned areas could provide suitable establishment sites, given a seed source. See Germination and Seedling establishment and plant growth for more on these topics.

Studies documenting common tansy recovery, establishment, and/or increases or decreases in abundance on burned sites are lacking. Common tansy was reported within or adjacent to burned areas in Interior Alaska that burned in 2004 (Burned Area National-Interagency Team 2004, cited in [3]). Common tansy abundance was not reported and comparisons between pre- and postfire or burned and unburned sites were lacking. Although no studies (as of 2009) directly report on common tansy's response to fire, some sources suggest that prescribed fire alone would not control common tansy, and burning may provide habitat suitable for seedling establishment [19,40]. These sources suggest that fire may result in increased abundance or facilitate spread of common tansy.

If common tansy plants are burned at the flowering stage, surviving seeds may produce mutated seedlings. During a controlled experiment, common tansy flowers were heated with a magnifying glass until discolored (up to 15 seconds). Seeds from scorched flower buds sometimes produced seedlings that were mutated in some way. Common tansy seedlings were not specifically described, and potential growth changes, beneficial or not, are unknown (Petterson 1961 as cited in [48]).

FUELS AND FIRE REGIMES:

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Two reviews report that dense patches of dried common tansy stems burn "very hot and fast" [19,102]. Prescribed fire in the spring may reduce future fire potential in common tansy stands [19].

Altered fire regimes in common tansy habitats were not reported, but fuels in dense patches of the previous year's stems may change fire behavior or increase fire severity in areas with an abundance of common tansy. Fire studies on sites with dense common tansy populations are needed.

See the Fire Regime Table for further information on fire regimes of vegetation communities in which common tansy may occur.

FIRE MANAGEMENT CONSIDERATIONS:
Use of prescribed fire as a control agent: Prescribed fire alone is not likely to control common tansy [40]. However, fire may be useful in removing dead stems and litter and increasing common tansy's exposure to herbicide treatments or grazing [19,40]. Fire may also be used to dispose of stems with flowers or seeds on mowed or cut sites, because on-site destruction of reproductive stems should decrease the potential for dispersal and spread [89].

Fire and chemical control: In a pasture with dense common tansy populations near Potlach, Idaho, researchers burned the pasture in spring to remove the previous year's seed stalks and improve the effectiveness of herbicide treatments made about a week later and again a year later. A little over a year after treatments, control of common tansy ranged from 68% to 98%, depending on the herbicide used [60]. The use of fire to control common tansy is also briefly discussed in Integrated management.

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 can be accomplished through early detection and eradication, careful monitoring and follow-up, and limiting dispersal of invasive plant seed or rhizome fragments 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: [4,7,25,93].

MANAGEMENT CONSIDERATIONS

SPECIES: Tanacetum vulgare

IMPORTANCE TO WILDLIFE AND LIVESTOCK:
Several sources report that animals feed on common tansy. Sperka [85] reports that birds feed on common tansy seeds. Horses and cattle may feed on young common tansy but avoid maturing and mature plants. Domestic sheep and goats feed on common tansy with "great enthusiasm" [19]. In Montana, most classes of livestock and some wildlife species,

including elk, have been observed feeding on common tansy [40]. Grazing of common tansy by domestic sheep is discussed more in Biological control.

Palatability and/or nutritional value: Although some report that common tansy is "mildly" to very poisonous to animals [88,103], no direct link between consumption of common tansy and cattle death or abortions has been established in the United States or Canada (personal communications cited in [101]). In Montana, livestock and wildlife species observed feeding on common tansy displayed no adverse effects [40]. It is reported that dairy cows feeding on common tansy may produce "unpleasant" tasting milk [31].

Cover value: No information is available on this topic.

OTHER USES:
Common tansy had a variety of medicinal and household uses that led to multiple and widespread introductions throughout Europe and North America. In Great Britain, portions of common tansy plants were put in shoes to relieve fevers. Common tansy was also buried with bodies to repel vermin [70]. Common tansy was also used as an embalming substitute by early US settlers. Corpses were wrapped in common tansy from the 1660s into the 19th century. In some areas of New England, it is still customary to bring a common tansy bouquet to the cemetery [62]. Common tansy leaves were also used on meat to discourage insects in the days before refrigerators [57].

Although common tansy may be toxic or lethal in large doses or with long-term consumption [19,30,52], it was used to treat a variety of ailments. Europeans and colonial Americans used common tansy in a face wash to lighten and purify skin [63]. Common tansy tea was used to treat ulcers, constipation, and hysteria [62]. Common tansy was also used to restore menstrual flow [57], treat intestinal worms, rheumatism, jaundice, and digestive problems. Common tansy in large doses was used to induce abortion but in smaller doses was thought to prevent miscarriage and increase fertility [19,52,63]. The northern Cheyenne of Montana called common tansy "yellow medicine", and its leaves and flowers were made into a tea and given to those feeling weak [29].

More recently, researchers have been testing common tansy for its use as a repellent or insecticide for mosquitoes and Colorado potato beetles [52]. For more information on the essential oils and uses of common tansy, see [40].

IMPACTS AND CONTROL:
Impacts: Most predictions and descriptions of common tansy's impacts on water resources, vegetation, and wildlife are anecdotal (e.g. [1,40,52,85,89]). Although many suggest that impacts are likely because of common tansy's sometimes aggressive establishment and growth, detailed study and documentation are lacking. However, in one study [18], researchers found that common tansy ecotypes from Canada grew larger and produced more flowers than ecotypes from Norway, suggesting that common tansy may have greater growth and reproductive potential in its nonnative habitats. In another study [13], common tansy dominated other forbs after seeding and successfully invaded plots with established grasses.

General: Reviews often report that dense common tansy populations may negatively impact water flow, native vegetation, and wildlife habitat, although documentation of these impacts is typically lacking. A review reports that dense common tansy patches can restrict water flow along irrigation ditches and streams in Alaska [1]. In a gardening guide, Sperka [85] reports that in Wisconsin she has "seen acres taken over" by common tansy. According to other reviews, thick common tansy clumps and dense populations may crowd out other forbs, grasses, and shrubs, potentially reducing the forage value of pasture or rangelands, decreasing wildlife habitat, and reducing species diversity [40,52,89]. Western weed scientists estimated that common tansy infestations lead to an average 50% reduction in carrying capacity on public lands [95]. It was not clear whether this estimation was specific to cattle, all livestock, or livestock and wildlife. It is important to note that some report heavy grazing of common tansy by domestic sheep; however, supplemental feed may be necessary. For more information, see Biological control.

Several sources have predicted common tansy's potential to invade certain areas and habitat based on general information on reproduction, establishment, growth, and dispersal potential. Based on common tansy's climatic tolerances, biological traits, and invasiveness in other natural areas, researchers expected Canada's Riding Mountain National Park was at high risk for establishment and proliferation of common tansy, especially if there were persistent

disturbances in the park [68]. Based on occurrence and distribution data and an analysis of factors influencing plant invasions, researchers predicted that given a disturbance, common tansy could grow in any forest type in the Cascade, Sierran Steppe, and Northern, Southern, and Middle Rocky Mountain ecoregions in the northwestern. In riparian areas in the same region, disturbances may not be required for common tansy establishment and growth [69].

Studies: Plant size and reproductive capacity were greater for common tansy ecotypes in Canada than for ecotypes in Norway. Common tansy seed collected from 3 Norwegian ecotypes and 2 Canadian ecotypes was grown in a greenhouse, and when seedlings were about 4 inches (10 cm) tall, they were planted in June in an experimental field in Hedmark, Norway. By September, Canadian ecotypes were significantly taller and produced significantly more biomass ($P<0.05$) than Norwegian ecotypes. Proportion of dry matter that was stems, leaves, and flowers was not significantly different between ecotypes, but the dry weight of stems and flowers was generally greater for Canadian than Norwegian ecotypes [18].

During a field experiment conducted in Silwood Park in Ascot, England, within 7 years common tansy dominated 11 of 18 plots where it was seeded with up to 79 other herbaceous species. Common tansy also successfully invaded nearby plots seeded with up to 4 perennial grass species. Researchers suggested that a variety of common tansy growth characteristics made it competitive [13]:

- leaves often remained green through the winter
- shoot growth was rapid by early spring
- common tansy canopies produced dense shade
- "bulky" roots and rhizomes monopolized underground space soon after establishment

Allelopathy: Based on controlled studies conducted on seed collected from fields near Keszthely, Hungary, common tansy may affect germination of associated plant species but may not affect plant growth. Common tansy extracts did not affect germination of winter wheat but reduced soybean, corn, and sunflower germination by 20%, 30%, and 96%, respectively. Common tansy extracts rarely reduced the fresh or dry weight of crop plants and often stimulated crop growth [6].

Control: Preventing establishment and spread of common tansy is likely the most cost-effective control method [11,52]. If control methods are necessary, the potential for the establishment of other invasive species must be considered and their success mitigated [8]. Monitoring in control areas is necessary to eliminate common tansy sprouts or seedlings [41]. A photo of common tansy seedlings and descriptions of seedling characteristics are provided by Royer and Dickinson [83]. As with most biotic invasions, common tansy control is likely most effective when it employs a long-term, ecosystem-wide strategy rather than a tactical approach focused on battling individual invaders [56].

Prevention: Several practices may limit common tansy establishment and spread. These include: maintenance of desired vegetation [11,56,84], limiting grazing to less than 60% defoliation in areas with common tansy, holding livestock for 2 weeks after grazing in infested areas, minimizing disturbances in areas with and without common tansy, and washing mowing or tilling equipment [52,89]. Although common tansy is rarely a problem in crop fields, it is often common along field margins, and rhizome pieces may be spread within and between fields. It is recommended that equipment be cleaned after use in fields with common tansy [40]. Managing to maintain the integrity of native plant communities and limiting those factors that increase an ecosystem's invasibility are likely to be more effective than managing solely to control the invader [33].

Another important measure in preventing common tansy establishment and spread should include making seed and plants unavailable for purchase. As of 1990, common tansy seed was available for purchase from US plant nurseries [55].

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 [93]. See the Guide to noxious weed prevention practices [93] 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 and Integrated management.

Physical or mechanical control: Hand-pulling small common tansy populations and mowing larger populations prior to flower and seed development are potentially useful control methods; however, both may be more effective when paired with seeding of desired species, maintenance of associated established vegetation, and/or other control methods [11,40,52]. Because common tansy regenerates from rhizome fragments, cultivation may increase population size [102].

Persistent hand-pulling may be effective in controlling small populations if most or all rhizomes are removed. Seeding areas disturbed by hand-pulling with desired species may decrease the potential for reestablishment [40]. Common tansy can cause dermatitis [30], so precautions should be taken when hand-pulling.

Several sources indicate that common tansy populations may be controlled through mowing. Lackschewitz [49] reported that in Montana common tansy became "less common" with the implementation of right-of-way mowing. Mowing operations should be timed to prevent common tansy flowering or seed set, and mowing heights should be set at a height that limits damage to native and other desirable species [40,52]. Mowing common tansy populations after seed set may increase seed and population spread [40]. In northern Switzerland, common tansy cover was 70% in mowed wildflower strips and 59% in strips left fallow. Mowing occurred in late winter [47] and likely increased the dispersal distance of the previous season's fallen and still attached seed.

Reproductive potential of common tansy was decreased by single high-intensity defoliation and muliple low-intensity defoliation events in roadside and riparian habitats near George Lake, Alberta. Flower head production was significantly lower for plants with 100% of leaves removed than for control plants ($P<0.05$). Effects of 50% leaf removal, however, were not significant. Defoliation when flower buds were fully formed did not disrupt flower formation. The researcher suggested that mowing may be most effective before flower bud development but may need to be repeated when 50% or more of flowers have bloomed to prevent late flower head development [101].

Biological control: There have been no insect, disease, or fungal biocontrols released for common tansy [101], but potential biocontrol insects have been identified and are being studied [40]. Domestic sheep and goats, however, may be useful biolgical control agents [19]. Cattle typically avoid common tansy; by grazing associated grasses and other vegetation, they may increase the area available for common tansy establishment and/or spread via rhizome growth [52].

Domestic sheep grazing in dense common tansy patches can release grasses by allowing light through the canopies. In Montana, a researcher used sheep to graze common tansy and suggested that "if we can increase the number of sheep in that community then we will never have to worry about tansy again" [19]. Common tansy biomass and spread were reduced by sheep grazing on 2 ranches in Lemhi County, Idaho. In enclosures with dense common tansy populations, repeated sheep grazing was monitored. Enclosures were grazed first in the spring and again when immature flower heads were forming. Common tansy biomass decreased after the first few grazing visits, and the researchers noted that spread of common tansy into adjacent pastures also decreased. When plants were maintained in a vegetative state by sheep, cattle also fed on common tansy plants. During this study, sheep were supplied lots of water to flush the highly fibrous common tansy plant material through their digestive systems. Since common tansy provides only 4% crude protein, the researcher noted that dietary supplements may also be necessary [59].

In a sheep-grazed pasture in Alberta, the shoot number for established common tansy plants steadily and significantly decreased. These decreases did not occur on the cattle-grazed pasture. In the sheep pasture, however, common tansy seedling densities were high. The researcher suggested that decreased litter and increased bare ground on sheep-grazed pasture facilitated the establishment of common tansy seedlings [101].

Chemical control: While several sources provide information on herbicides that may be useful in controlling common tansy [20,52], herbicide use may be restricted along ditch banks or in other riparian habitats and may not be the best option in areas where associated desirable species may be harmed [19].

If herbicide use is considered the best option or is used in conjunction with other control methods, applications should be timed to maximize herbicide effectiveness. Studies in Alberta tracked patterns in the allocation of carbohydrates to roots and rhizomes and suggested that in ungrazed habitats, herbicide applications before flower heads bloom should be most effective [101].

Herbicides may be effective in gaining initial control of a new invasion or a severe infestation, but rarely do they provide complete or long-term weed management [10]. See the Weed Control Methods Handbook [90] for considerations on the use of herbicides in natural areas and detailed information on specific chemicals.

Integrated management: Utilizing multiple control strategies may provide the most successful and long-term control of common tansy. Jacobs [40] suggests that integrated management options should be determined by invasion stage. For small populations or at the early stage of invasion, he suggests herbicide applications, then cultural practices to encourage growth of native plants. For large-scale infestations or large populations, prioritized treatments are recommended. The first priority should be treatment and control of satellite populations to decrease spread rates. Next, parent populations should be treated with a combination of fire, mowing, grazing and/or herbicides. Populations should be monitored to evaluate treatment effectiveness, locate regenerating populations, and plan future treatments [40]. The use of fire with other control methods is discussed more in Fire Management Considerations.

APPENDIX: FIRE REGIME TABLE

SPECIES: Tanacetum vulgare

The following table provides fire regime information in communities where common tansy may occur. Follow the links in the table to documents that provide more detailed information on these fire regimes. Because common tansy is widespread and may be transient in many North American communities, please see the the complete FEIS Fire Regime Table for information on communities not listed here.

Fire regime information for vegetation communities in which common tansy may occur. This information is taken from the LANDFIRE Rapid Assessment Vegetation Models [51], 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

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	Minimum interval	Maximum interval

			(years)	(years)	(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		
	Replacement	4%	400		

Mixed conifer (southwestern Oregon)	Mixed	29%	50		
	Surface or low	67%	22		
Mixed conifer (eastside mesic)	Replacement	35%	200		
	Mixed	47%	150		
	Surface or low	18%	400		

California

- California Grassland
- 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 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					
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		
Jeffrey pine	Replacement	9%	250		
	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					
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	
Southwest mixed conifer (cool, moist with aspen)	Replacement	29%	200	80	200
	Mixed	35%	165	35	
	Surface or low	36%	160	10	
Aspen with spruce-fir	Replacement	38%	75	40	90
	Mixed	38%	75	40	
	Surface or low	23%	125	30	250
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
Wyoming sagebrush steppe	Replacement	89%	92	30	120
	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		
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
Ponderosa pine-Douglas-fir	Replacement	10%	250		≥1,000
	Mixed	51%	50	50	130
	Surface or low	39%	65	15	
	Replacement	53%	61	20	

Aspen with conifer (low to midelevation)	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 Group)	Fire severity*	Fire regime characteristics			
		Percent of fires	Mean interval (years)	Minimum interval (years)	Maximum interval (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		
Mountain big sagebrush steppe and shrubland	Replacement	100%	70	30	200
Northern and Central Rockies Forested					
Ponderosa pine (Northern	Replacement	5%	300		
	Mixed	20%	75		

Great Plains)	Surface or low	75%	20	10	40
Ponderosa pine-Douglas-fir	Replacement	10%	250		≥1,000
	Mixed	51%	50	50	130
	Surface or low	39%	65	15	

Northern Great Plains

- Northern Plains Grassland
- 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					
Northern mixed-grass prairie	Replacement	67%	15	8	25
	Mixed	33%	30	15	35
Central tallgrass prairie	Replacement	75%	5	3	5
	Mixed	11%	34	1	100
	Surface or low	13%	28	1	50
Northern tallgrass prairie	Replacement	90%	6.5	1	25
	Mixed	9%	63		
	Surface or low	2%	303		
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		
Pine-oak	Replacement	19%	357		
	Surface or low	81%	85		

Northeast

- 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 Woodland					
Eastern woodland mosaic	Replacement	2%	200	100	300
	Mixed	9%	40	20	60
	Surface or low	89%	4	1	7
Northeast Forested					

Northern hardwoods (Northeast)	Replacement	39%	≥1,000		
	Mixed	61%	650		
Appalachian oak forest (dry-mesic)	Replacement	2%	625	500	≥1,000
	Mixed	6%	250	200	500
	Surface or low	92%	15	7	26
South-central US • South-central US Grassland • South-central US Woodland • 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					
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 Woodland					
Pine bluestem	Replacement	4%	100		
	Surface or low	96%	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
Southern floodplain	Replacement	42%	140		
	Surface or low	58%	100		
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					
Oak-ash woodland	Replacement	23%	119		
	Mixed	28%	95		
	Surface or low	49%	55		
Southern Appalachians Forested					
Appalachian oak forest (dry-mesic)	Replacement	6%	220		
	Mixed	15%	90		
	Surface or low	79%	17		

*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 [27,50].

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