Rubus phoenicolasius

INTRODUCTORY

Photograph courtesy of Leslie J. Merhhoff, University of Connecticut, Bugwood.org

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FEIS ABBREVIATION:
RUBPHO

NRCS PLANT CODE [85]:

RUPH

COMMON NAMES:
wineberry
Japanese wineberry
wine raspberry

TAXONOMY:
The accepted scientific name of wineberry is *Rubus phoenicolasius* Maxim. (*Rosaceae*) [47]. Wineberry is in the subgenus *Idaeobatus*, which are raspberries in which the ripe fruit separates from the receptacle (Focke 1914, cited in [91]).

Hybridization within the *Rubus* genus occurs within and between subgenera [2]. Although natural hybrids between wineberry and native *Rubus* species have not been reported as of this writing (2009), wineberry has been intentionally crossed with red raspberry (*R. idaeus*) and black raspberry (*R. occidentalis*) in breeding programs [14,38].

In this review, "blackberry" refers to species in the genus *Rubus* and "raspberry" refers to species in the subgenus *Idaeobatus*.

SYNONYMS:
None

LIFE FORM:
Shrub

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: Rubus phoenicolasius

- GENERAL DISTRIBUTION
- HABITAT TYPES AND PLANT COMMUNITIES

GENERAL DISTRIBUTION:
Wineberry is nonnative in North America. According to a fact sheet, wineberry was introduced to the United States in 1890 as breeding stock for blackberry cultivars [73], although the date of introduction may have been earlier [89]. Its North American distribution is from eastern Canada, New England and New York south to Georgia and west to Michigan, Illinois, and Arkansas. It is considered invasive in Maryland, Pennsylvania, Tennessee, Virginia, North Carolina, West Virginia, and the District of Columbia. Disjunct populations of wineberry may occur in Colorado ([73], a fact sheet) and possibly British Columbia, Canada [69]. In 1950, Fernald [19] described the range of wineberry as extending from Massachusetts to Indiana and south to Virginia and Kentucky, indicating that its range has expanded considerably over the past 50 years (see Impacts and Control). The Plants Database provides a distributional map of wineberry in North America [85]. Wineberry is native to China, Japan, and Korea [42,78].

HABITAT TYPES AND PLANT COMMUNITIES:
Plant community associations of nonnative species are often difficult to describe accurately because detailed survey information is lacking, there are gaps in understanding of nonnative species' ecological relationships, and they may

still be expanding their North American range. Therefore, wineberry may occur in plant communities other than those discussed here and listed in the Fire Regime Table.

Wineberry is a cultivated raspberry that has escaped to a wide variety of habitats and plant communities throughout the eastern United States. It is frequently associated with early- to midsuccessional hardwood species, such as hickory (*Carya* spp.), oak (*Quercus* spp.), maple (*Acer* spp.), and ash (*Fraxinus* spp.). In the inner Coastal Plains region of Mount Vernon, Virginia, wineberry occurred in the "low woods" community dominated by boxelder (*Acer negundo*), red maple (*A. rubrum*), river birch (*Betula nigra*), green ash (*Fraxinus pennsylvanica*), and sycamore (*Platanus occidentalis*) [89]. Wineberry was widely distributed and routinely observed in Great Falls Park in Fairfax County, Virginia, although it was not considered invasive. It was most common in the Northern Piedmont Small-Stream Floodplain Forest dominated by yellow-poplar, red maple, boxelder, and sycamore and the Northern Coastal Plain/Piedmont Basic Mesic Hardwood Forest dominated by American beech (*Fagus grandifolia*), yellow-poplar, and bitternut hickory (*Carya cordiformis*). Wineberry also occurred in the Potomac River Bedrock Terrace Oak-Hickory Forest dominated by pignut hickory (*Carya glabra*), northern red oak, chestnut oak (*Quercus prinus*), and white ash (*Fraxinus americana*); the Northern Piedmont/Lower New England Red Maple Seepage Swamp; and the Piedmont Dry-Mesic Acidic Oak-Hickory Forest dominated by white oak (*Quercus alba*), northern red oak, and mockernut hickory (*Carya alba*) [74]. Along a 250-mile (402 km) reach of the New River Gorge in West Virginia, wineberry was found at 8 of 34 sites; these sites included yellow-poplar-white oak-northern red oak-sugar maple (*Liriodendron tulipifera- Quercus alba-Q. rubra-Acer saccharum*) forest, sycamore-river birch forest, Virginia pine-eastern redcedar-post oak (*Pinus virginiana-Juniperus virginiana-Quercus stellata*) woodland, midelevation quartzite rocky summits and cliff faces, black willow (*Salix nigra*)-river birch streambed, and disturbed areas [79]. At Fernow Experimental Forest in north-central West Virginia wineberry occurred in mixed-mesophytic forest dominated by northern red oak, yellow-poplar, black cherry (*Prunus serotina*), sugar maple, American beech, sweetbirch (*Betula lenta*), red maple, basswood (*Tilia americana*), white ash, chestnut oak, sassafras (*Sassafras albidum*), black gum (*Nyssa sylvatica*), and bitternut hickory [56].

Wineberry is infrequent in many plant communities. At Strounds Run State Park in southeastern Ohio, wineberry was relatively infrequent in mesic ravines and stream terraces dominated by red maple, sugar maple, shagbark hickory (*Carya ovata*), American beech, green ash, tulip-poplar, black cherry, and northern red oak, pine (*Pinus* spp.) plantations, and disturbed areas including roadsides and trail edges [34]. In Baltimore City, Maryland, wineberry occurred relatively infrequently in both urban and rural forest of the Piedmont Plateau physiographic province where vegetation consisted of yellow-poplar, chestnut oak, scarlet oak (*Q. coccinea*), and white oak in the uplands, and red maple, green ash, American elm (*Ulmus americana*), river birch, and sycamore in the lowlands [29]. At the Piscataway and Fort Washington National Parks in Maryland, wineberry was relatively uncommon within 4 physiographic areas: the tertiary slopelands, the Piscataway Creek floodplain, the Potomac River lowland, and deciduous woodland edge [75].

Wineberry occurred in 6 community types in Evansburg State Park, Montgomery County, Pennsylvania: 3 "naturally occurring" communities and 3 anthropogenically influenced communities. Naturally occurring communities included bottomland oak-mixed hardwood palustrine forest dominated by pin oak (*Q. palustris*) and red maple; sugar maple-basswood terrestrial forest; and dry oak-heath terrestrial forest dominated by chestnut, white, northern red, and scarlet oaks and Virginia pine in the overstory and primarily ericaceous shrubs including hillside blueberry (*Vaccinium pallidum*), low sweet blueberry (*V. angustifolium*), and deerberry (*V. stamineum*) in the understory. Anthropogenically influenced communities included successional woodlands characterized by thickets of weedy forbs, shrubs, and vines including multiflora rose (*Rosa multiflora*) and autumn-olive (*Elaeagnus umbellata*); forest fringe-roadside vegetation with multiflora rose, autumn-olive, and other invasive shrubs; and plantation forests composed of monocultures of eastern white pine (*Pinus strobus*), Norway spruce (*Picea abies*), or ash [48].

Wineberry occurred at various densities in 3 plant communities in Inwood Hill Park in southern New York [54]:

Mean density/ha of wineberry within 3 sites at Inwood Hill Park, New York [54]	
Site	Density/ha
North-facing forest	20
Successional forest	80
Successional field	970

The north-facing forest community was dominated by chestnut oak, northern red oak, and yellow-poplar in the overstory and American witchhazel (*Hamamelis virginiana*) and northern spicebush (*Lindera benzoin*) in the understory. The successional forest community was dominated by yellow-poplar, white oak, and northern red oak in the overstory; wineberry dominated the understory. In the successional field community, young mulberry (*Morus* spp.) and black cherry dominated the overstory and common periwinkle (*Vinca minor*), poison ivy (*Toxicodendron radicans*), jewelweed (*Impatiens capensis*), and garlic mustard (*Alliaria petiolata*) dominated the understory [54].

Wineberry is frequently associated with native blackberries including Allegheny blackberry (*R. allegheniensis*), black raspberry (*R. occidentalis*), sawtooth blackberry (*R. argutus*), and Pennsylvania blackberry (*R. pennsylvanicus*) [4,5,16,20,34,42,48,74,75]. Wineberry also co-occurs with other nonnative blackberries such as evergreen blackberry (*R. laciniatus*) and Himalayan blackberry (*R. discolor*) [16,74].

Because wineberry occurs in many types of disturbed areas, it is frequently associated with other nonnative and invasive species that occur at these sites. Wineberry occurred with princesstree (*Paulownia tomentosa*), Japanese honeysuckle (*Lonicera japanica*), and tree-of-heaven (*Ailanthus altissima*) in disturbed areas in Prentice Cooper State Forest and Wildlife Management Area in Tennessee [5]. In mixed-mesophytic forest in Pennsylvania, wineberry occurred with tree-of-heaven, Japanese barberry (*Berberis thunbergii*), autumn-olive, Japanese stiltgrass (*Microstegium vimineum*), and multiflora rose [92]. In the Wave Hill Natural Area of southern New York, wineberry occurred in 44% of 238 quadrats with an average cover of 1.6% across 4 vegetation associations (oak-maple forest, black locust (*Robinia pseudoacacia*) forest, sweetbirch forest, and open areas) and was associated with other nonnative invasive species such as multiflora rose, Japanese honeysuckle, and tree-of-heaven [95]. Other nonnative associates include oriental bittersweet (*Celastrus orbiculatus*) and white mulberry (*Morus alba*) [16,20,29,34,48,79].

BOTANICAL AND ECOLOGICAL CHARACTERISTICS

SPECIES: Rubus phoenicolasius

The majority of information on wineberry is from research at the Smithsonian Environmental Research Center in Maryland [25,26,42]. It is unclear how broadly applicable the results of these studies are to wineberry in other geographic regions. Much information regarding wineberry ecology is derived from the ecology of blackberries, in general. Although wineberry ecology is likely similar to that of other blackberries, limited information suggests that wineberry may differ from them in potentially important ways, particularly in its physiology and site tolerances. Further research is needed on nearly all aspects of wineberry biology and ecology.

GENERAL BOTANICAL CHARACTERISTICS:

Botanical description: This description provides characteristics that may be relevant to fire ecology and is not meant for identification. Keys for identification are available (e.g., [19,23,60,65,78,93]). Since there are many native raspberries that resemble and co-occur with wineberry (see Habitat Types and Plant Communities), it is recommended that readers seek out these keys for positive identification before any control methods are undertaken.

Wineberry is a deciduous, thicket-forming shrub that produces upright and arching biennial canes from a perennial root system [42]. Canes average 1.6 to 4.9 feet (0.5-1.5 m) in length and may reach 9 feet (2.7 m) tall [23,42,65,73,78]. Canes are bristly and thorny and covered with distinctive glandular red hairs that are 0.1 to 0.2 inch (3-5 mm) long [23,39,65,73,78]. The hairs give the canes a reddish color when seen from a distance ([73], a fact sheet).

Photograph courtesy of Leslie J. Merhhoff, University of Connecticut, Bugwood.org.

Wineberry leaves are compound [65] and consist of 3 serrated, blunt-tipped leaflets with purple veins that are densely white-tomentose underneath ([73], a fact sheet). Petioles are densely hairy [23]. The terminal leaflet is 1.6 to 3.9 inches (4-10 cm) long and about as wide [65]. Lateral leaflets are 1.0 to 3.1 inches (2.5-8.0 cm) long [65]. Wineberry has small greenish flowers with white petals that occur in a terminal panicle on glandular short-hairy pedicels [73,78]. The glandular-hairy calyx lobes envelop the developing fruits and keep them covered until almost ripe [18,39,78].

Wineberry fruit is 0.4 inch (1 cm) thick and shiny red [39,65,78]. Each fruit is composed of an aggregate of large succulent drupelets commonly referred to as a "berry". Each fruit contains numerous seeds that are 0.1 to 0.2 inch (2-4 mm) long [6,42].

Other: Field experiments in mixed-hardwood forest in Maryland suggest that arbuscular mycorrhizal fungi may have no impact or a negative effect on wineberry. Wineberry inoculated with arbuscular mycorrhizal fungi had similar survival rates and lower leaf weight, root weight, and total biomass than noninoculated control seedlings. The author concluded that "an absence of arbuscular mycorrhizal fungi would not limit the establishment of wineberry in new habitats" [42].

SEASONAL DEVELOPMENT:
Growth and development of wineberry is typical of blackberries. Wineberry produces biennial canes from a perennial root system or from underground rhizomes (see Vegetative regeneration) [42]. First year canes (primocane) are unbranched, sterile, entirely vegetative, and develop from rhizominous buds at or below the ground surface [25,42]. In the 1st year, carbon allocation is primarily into leaf production and cane elongation [42]. In the 2nd year, lateral branches develop in the axils of the primocanes and produce leaves, flowers, and fruits [42], but "do not have extensive growth" [25]. Second-year canes are referred to as "floricanes". Unlike primocanes, floricanes are woody [25].

In April, floricanes produce new leaves. In early May, new primocanes originate from the perennial root system [42]. In late May, floricanes undergo lateral branching and may produce flowers and fruit; fruit production occurs in late June to August. Fruits of wineberry ripen together [17]. After producing fruit in late summer, the leaves of floricanes senesce and the cane gradually dies. In Maryland, wineberry loses its leaves in late November [42]. Generalized fruiting and flowering dates are as follows:

Location	Flowering	Fruiting
Maryland	late May-early June	late June-July [42]
Arkansas	May-June	June-July [39]
New England	---	16 July-30 August [70]
New York	20 May-31 May [16]	---
North Carolina	---	July-October, peak in August [27]

Raunkiaer [66] life form:
Hemicryptophyte

REGENERATION PROCESSES:

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

Wineberry reproduces from seeds and vegetatively from rhizomes and tip-rooting, a type of layering. All methods of reproduction are likely important to wineberry's establishment and spread.

Pollination and breeding system: Wineberry flowers are hermaphroditic and pollinated by insects [64]. In field experiments in mixed-hardwood forest in Maryland, wineberry was self-compatible and less dependent upon cross-pollination by pollinators to set fruit than a coexisting native congener, sawtooth blackberry, suggesting that "wineberry could more easily establish itself in habitats with low pollinator service or a lack of mates" than sawtooth blackberry [42].

Seed production: A review of blackberries states that good seed crops occur nearly every year and that environmental factors affect the amount of flowering and fruit production in the genus (see Climate) [98]. As of this writing (2009), little information was available on seed production in wineberry but according to Swearington and others [80], wineberry is capable of producing fruits in "great abundance". Wineberry may not fruit until 3 years of age or more [25]. For example, in Pisgah National Forest, North Carolina, raspberries, including wineberry, did not produce fruit until 3 and 4 years after silvicultural treatments in upland hardwood and cove hardwood forest, respectively; it is unclear whether plants in this study established from seed or by sprouting. Upland hardwood forest was dominated by scarlet oak, chestnut oak, and black oak (*Quercus velutina*) and cove hardwood forest was dominated by yellow-poplar and northern red oak [27].

The number of seeds per fruit in wineberry ranges from 30 to 60 [6,42]. In mixed-hardwood forest in Maryland, the number of wineberry seeds per fruit and the number of fruits per plant were typically greater than those of sawtooth blackberry, a coexisting native congener. In addition, "local frugivores" consumed more wineberry fruits than sawtooth blackberry fruits ($P<0.001$). Wineberry fruits ripen together, are more abundant, and are displayed in tighter drupelets than fruits of sawtooth blackberry; this may partially explain preference for wineberry by frugivores in this study. These data suggest that seeds of wineberry may be more readily produced and more readily dispersed than those of native sawtooth blackberry [42], which may have important implications for the establishment and spread of wineberry in native communities.

Seed dispersal: Birds, reptiles, and mammals may contribute to the establishment and spread of wineberry by dispersing and scarifying seeds. Examination of fecal droppings of box turtles in the laboratory [6] and white-tailed deer in oak (*Quercus* spp.)-sugar maple-yellow- poplar-sweetbirch-American beech forest in southern Connecticut [90] suggest that these species may disperse viable wineberry seeds.

A review suggests that the action of avian gizzards and exposure to mammalian digestive acids may scarify and thus enhance germination of blackberry seeds [30]. However, the importance of ingestion to wineberry germination is unclear. Germination of box turtle-ingested and non-ingested wineberry seeds were similarly low (<10%), suggesting that wineberry seeds were not scarified by box turtle ingestion [6].

Seed banking: As of 2009, little information was available on seed banking of wineberry. Seeds of wineberry are dormant at maturity [63,96] and apparently long-lived [11]. Raspberries are capable of amassing large numbers of seeds in the seed bank that are capable of persisting for 100 years or more (see FEIS review for red raspberry). Seeds of blackberry that were cold-stratified and dry-stored for 22 to 26 years had germination rates as high as 84% in the laboratory; wineberry germination rates in this study were 8%. These data suggest that under some conditions some proportion of wineberry seeds may persist in the seed bank [11]; however, it is unclear how often conditions suitable for long-term storage of wineberry seeds in the seed bank are met in nature.

Germination: Raspberry seeds have a dormant embryo and a hard endocarp that inhibits germination [63,96]. Seeds of wineberry must be scarified and/or stratified for long periods (3-4 months) at cold temperatures (36-41 °F (2-5 °C)) for germination to occur [63]. Scarification using sulfuric acid is frequently performed in experimental studies to stimulate germination of wineberry seeds (e.g., [11]). Several studies provide reviews of treatments used to improve overall germination and rate of germination in blackberries in the laboratory [43,63,98]. In nature, seeds of wineberry may be scarified by passing through an animal's digestive system (see Seed dispersal). Like many blackberries, wineberry germination and seedling establishment may be favored by exposed mineral soil and high light (see Successional Status) [25].

Seedling establishment and plant growth: As of this writing (2009), little information is available regarding wineberry seedling establishment and growth. What information is available suggests that while wineberry is able to persist for decades in shaded areas, best survival and growth are obtained in moderate to high light. In a greenhouse study, leaf relative growth rate of 1-year-old wineberry seedlings was higher in high (22% photosynthetic photo flux density (PPFD)) than in medium (12% PPFD) or low (5-5.5% PPFD) light treatments ($P<0.05$), although "growth was high regardless of light treatment". Conversely, growth of primocanes of 2-year-old wineberry seedlings was greatest in medium light followed by high light and low light treatments ($P=0.006$). These results suggest that although high light is best for wineberry establishment, once established, wineberry is able to grow in medium or even low light [25]. This has important implications for persistence of wineberry in plant communities over time. See Successional Status for additional information.

Vegetative regeneration: Wineberry reproduces clonally from underground rhizomes and by tip-rooting [39,42]. Tip-rooting occurs when arching canes touch the ground and adventitious roots form at the tip, giving rise to new ramets. Only canes =3.3 feet (1 m) tall tip-rooted in mixed-hardwood forest in Maryland; at this site, tip-rooting was the predominant form of vegetative reproduction and typically occurred in large tree-fall gaps with high light. Wineberry may not reach adequate size for tip-rooting until 3 years of age or more [25].

Wineberry may reproduce more by seed than by vegetative regeneration. A lack of asexual reproduction by wineberry in mixed-hardwood forest in Maryland was attributed to advanced age (>5 years) of the perennial root system and to "extreme precipitation years with drought conditions followed by heavy precipitation" [42].

SITE CHARACTERISTICS:
As of this writing (2009), little English-language literature is available on wineberry's native habitats. What information is available indicates that wineberry grows at low to medium elevations in montane valleys and along roadsides in China [94]. In Japan, wineberry occurs in lowland and mountainous regions in clearings associated with spruce (*Picea* spp.), fir (*Abies* spp.), and birch (*Betula* spp.) [82]. In South Korea, wineberry occurs at elevations ranging from 70 to 460 feet (20-140 m) along streambanks [49].

In the eastern United States, wineberry occupies a wide range of habitats including early- to midsuccessional forest, floodplain forest, herbaceous and shrub wetland, wet meadows, riparian corridors, old fields, open disturbed areas, burned areas, trailsides, roadsides, ditches, and vacant lots, as well as ecotones between these habitats [4,5,22,28,42,58,59,64,65,70,80,91,93].

According to reviews, wineberry prefers open, mesic conditions with rich soils but tolerates a wide range of soil types, textures, and pH values [15,22,73,87]. At Great Falls Park in northeastern Virginia, wineberry occurred on soils ranging from "relatively fertile", with basic pH, and silt loam to silty clay loam textures to dry, "extremely acidic, infertile" silty clay loams. At this site, wineberry occurred on very dry upper slopes and ridge crests with "high solar exposure and low moisture potential" as well as seasonally flooded swamps [74]. Wineberry was found in Sussex County, New Jersey on trails and roadsides where soils were thin and rocky though moist [4]. In Chittenden County, Vermont, wineberry established on a limy talus slope in the dense shade of northern whitecedar (*Thuja occidentalis*) [99]. Wineberry occurred relatively infrequently in sweetgum (*Liquidambar styraciflua*) -sycamore streambank habitat with sandy soils in Newton County, Arkansas; this site was regularly disturbed by spring and fall flooding and anthropogenic influences [81]. In New Jersey, wineberry occurred in constructed wetlands with coarse soil [53]. In Inwood Hill Park in New York, wineberry occurred on some sites with "deep soils" [54]. Wineberry occurred on wet, seasonally flooded and mesic soils at the Piscataway and Fort Washington National Parks in Maryland [75]. Along a 250-mile (402 km) reach of the New River Gorge in West Virginia, wineberry was found at a variety of sites including regularly flooded streambeds, riverside beach areas, and wooded upper beach areas with soils ranging from cobblestone and gravel to sand and mudflats. Additional sites occupied by wineberry in this study included rocky summits and cliff faces and woodlands with shallow and sandy soils [79].

Photograph courtesy of John M. Randall, The Nature

According to reviews, wineberry tolerates a range of light levels, with light availability in suitable habitat ranging from full sun to partial shade [22,64,73,87]. Although established plants may persist in low light, wineberry germination and survival appear best in moderate to high light environments (see Seedling establishment and plant growth) [25]. In field experiments in mixed-hardwood forest in Maryland, wineberry seedling survival was significantly reduced under leaf litter ($P<0.001$); this was attributed to a lack of light and increased potential for root rot as a result of increased moisture levels [42]. Although wineberry tolerates a variety of light levels and soil conditions, like other blackberries, adequate soil moisture and light appear important for best growth and fruit production (see Successional Status) [12,64].

Conservancy, Bugwood.org

Elevation/Topography: Wineberry occurs in lowlands and mountainous terrain on slopes ranging from 0% to 60%. At Evansburg State Park, wineberry occurred between 98 and 397 feet (30-121 m) elevation. Wineberry occurred at Fernow Experimental Forest in north-central West Virginia at elevations ranging from 1,749 to 3,648 feet (533-1,112 m) and slopes ranging from 10% to 60% [56]. In Inwood Hill Park in southern New York, wineberry occurred on sites with slopes >10% [54]. Wineberry occurred on sites where slopes averaged >30% in Great Falls Park in Virginia .

Climate: Wineberry is hardy to USDA hardiness zone 5, where average annual minimum temperatures are as low as -20 °F (-26 °C) [46,64]; although some damage may be caused to the plant at this temperature, the plants "usually recover well" (Davis 1990, as cited in [64]).

Precipitation may affect wineberry density. In Maryland, drought reduced the density of wineberry and sawtooth blackberry, with greater mortality in forest edge sites than in intact forest (P=0.034). The subsequent year's precipitation was average; although wineberry density increased during that year, its density did not return to pre-drought levels [42].

Wineberry occurred throughout Great Falls Park in Virginia and Piscataway and Fort Washington National Parks in Maryland where there is no distinct dry season, summers are hot, and winters are mild [74,75]. Mean annual precipitation at these Parks was approximately 45 inches (115 cm), and mean annual temperature was approximate 56 °F (13 °C) [74]. At Evansburg State Park in Pennsylvania, annual rainfall averaged 40 inches (103 cm) and annual temperatures averaged 51 °F (10 °C) [48]. Wineberry occurred in Baltimore City, Maryland, where average annual precipitation was 42 inches (1060 mm) [29].

SUCCESSIONAL STATUS:
According to reviews, blackberries in North America occur on a range of sites at all stages of succession, but the majority of blackberries are considered pioneers of open and disturbed habitats and are capable of invading and rapidly occupying burns, eroded areas, old fields, and logged areas [12,18,86,98]. A review states that dense stands of blackberries can prevent or greatly delay establishment of trees and other species (see Impacts and Control) [98].

Like many other blackberries, wineberry is generally considered a pioneer or early-successional species that flourishes after disturbance, often forming dense thickets and dominating sites ([73], a fact sheet). For example, in Inwood Hill Park in southern New York, wineberry dominated the understory of yellow-poplar-white oak-northern red oak forest [54]. Although wineberry frequently establishes after disturbance, stem density typically decreases over time as the canopy closes and shade increases. However, wineberry apparently tolerates shade and may persist in shaded environments for several decades after disturbance [12]. Wineberry's relatively high phenotypic plasticity (see Impacts) [42] may allow it to survive a wide range of environmental conditions and successional stages [68]. In its native Japan, wineberry cover ranged from 0.5% to 1.9% at 3 ski areas 7 to 20 years after clearcutting [82]. Wineberry was considered a "typical successional species in the more mesic sites of northern New Jersey"; at these sites, wineberry was a relatively common component of some upland forest stands that had been free of major disturbance for at least 60 years. Although present in shaded, undisturbed habitat, the authors considered the occurrence of wineberry at this site as "vegetative holdovers from earlier successional stages" and as "chance establishment in gaps formed by wind throw or other catastrophe" [15].

Treefall gaps and other local disturbances may play important roles in the establishment and persistence of wineberry. A field study at the Smithsonian Environmental Research Center in Maryland found wineberry ramets and seedlings occurred more frequently in 2-year-old, storm-created gaps than in random plots in 135-year-old ("old") forest dominated by yellow-poplar, oak, hickory, American beech, and sweetgum and 45-year-old ("young") forest dominated by yellow-poplar [26]:

Frequency (%) of wineberry ramets and seedlings in young and old forests in Maryland [26]				
	Old forest		Young forest	
Type	Gaps (*n*=20)	Random (*n*=19)	Gaps (*n*=4)	Random (*n*=5)
Ramets	50	11	100	80
Seedlings	50	0	75	50

Greater establishment of wineberry seedlings at sites with high light and exposed mineral soil (i.e., large gaps with uprooted trees) indicates that disturbance may be important for seedling establishment. In old forest gaps, density of wineberry ramets was 34 times greater and primocane length was 2 times greater in large gaps (size range: 290-939 m^2) than in small gaps (size range: 38-200 m^2). In addition, sexual and asexual reproduction were more common in large gaps than in small gaps. In old stands, fruits were present in 15% of large gaps but not in small gaps or random plots, and tip-rooting was most common in large gaps [25]. In young stands, fruits were found in 100% of all gaps and 20% of random plots, but tip-rooting was "extremely rare". Wineberry seedling density was 4 times greater in gaps associated with uprooted trees compared to gaps with "snapped" trees [26]. Once established, measures of survivorship indicated that wineberry individuals persisted despite canopy closure [25].

Treefall gaps appear less important for wineberry seedling establishment, vegetative reproduction, and fruiting in early than in late succession [25,26]. For example, in the young forest, seedling establishment and fruiting was not limited to gaps. Although wineberry ramets were more likely to occur at sites with high light and large gaps, ramets that occurred in low light were more likely to occur in the young forest than in the old forest. Greater proportion of bare mineral soil and fewer layers of leaf litter in the young forest compared to the old forest may partially explain seedling establishment and fruiting outside of gaps in the young forest. These data suggest that in young forest wineberry may establish and spread without canopy-opening disturbances [25].

FIRE EFFECTS AND MANAGEMENT

SPECIES: Rubus phoenicolasius

FIRE EFFECTS:

Immediate fire effect on plant: Like some other blackberries, wineberry is probably top-killed by fire, while some portion of the roots and rhizomes are likely to remain unharmed and enable wineberry to sprout after fire. Depth of wineberry's regenerative structures within the soil profile has not been reported as of this writing (2009), but regenerative structures of other blackberries occur within the mineral soil where they would "probably survive fire" [21]. In Elk Island National Park, Alberta, the root system of red raspberry growing in a trembling aspen-balsam poplar (*Populus tremuloides*-*Populus balsamifera*) forest appeared to be well protected from the damaging effects of heat. In this study, red raspberry was experimentally subjected to 5 levels of fire severity by adjusting fuel load (range: 0-9.65 kg/m^2) such that flame lengths ranged from 1.6 to 8.2 feet (0.5-2.5 m), frontal fire intensity ranged from 57 to 1905 kW/m, and residence time ranged from 1.5 to 10 minutes. Other characteristics of the fire are provided in [45]. In this study, all red raspberry canes and foliage were extremely susceptible to fire-induced mortality and were partially or completely killed at all fire severity levels; no aboveground biomass remained with fuel loadings >3.94 kg/m². Mortality of underground regenerative structures occurred only in areas of relatively high surface fuel loading (>3.9 kg/m²). At these sites, tissue mortality extended as far as 0.4 to 1.2 inches (1-3 cm) below the duff surface, but red raspberry rhizomes extended as deep as 2.0 inches (5 cm) below the duff surface so many rhizomes were protected. Sprouting occurred from the more deeply buried rhizomes that survived the fire. High duff moisture content (120%) likely contributed to protection of underground structures in this study [45].

Under certain environmental conditions, seeds of some blackberries may be protected from fire. Although no studies have been conducted on wineberry seeds, blackberry seeds subjected to a simulated prescribed summer burn in southeastern Arkansas were likely to remain unharmed by fire when protected by soil but unlikely to survive if they were located within the portion of the litter layer consumed by fire. Air-dried blackberry seeds of unspecified species were placed at 3 depths in a reconstructed forest floor within a loblolly pine (*Pinus taeda*) forest and subjected to fire. Mean fireline intensity was 6.4 Btu/ft-sec and rate of spread was 3.2 feet/minute. Fire consumed all of the litter (L) and upper fermentation (upper-F) layers and a portion of the lower fermentation (lower-F) layer. Other characteristics of the fire are provided in [10]. Postfire seed viability was assessed by germinating seeds in a greenhouse. Germination rates of seeds from the L layer (0.03%) and the upper-F/lower-F interface (0.33%) were low, and seeds tended to be charred. Germination rates of seeds from the lower-F/mineral soil interface were significantly higher (23.43%) than at the upper 2 layers ($P<0.01$) and did not differ from germination rates of seeds from unburned control plots. These results suggest that survival of blackberry seeds increases as depth of burial in the soil profile increases. The authors caution that fresh blackberry seeds or those consumed by animals may have a different response to fire than the air-dried seeds used in this study [10].

Postfire regeneration strategy [77]:
Tall shrub, adventitious buds and a sprouting root crown
Rhizomatous shrub, rhizome in soil
Geophyte, growing points deep in soil
Ground residual colonizer (on site, initial community)
Initial off-site colonizer (off site, initial community)

Fire adaptations and plant response to fire: Blackberries frequently respond to fire by rapidly increasing in abundance, but the response of blackberries to fire differs among species. Little information is available regarding wineberry's response to fire, but wineberry is often found on disturbed sites and, like some other blackberries, is likely to quickly occupy postfire habitat and persist for decades after fire (see Successional Status). In clearcut and burned sub-boreal spruce (*Picea* spp.) forest in northern British Columbia, red raspberry established rapidly after fire, peaking in cover during postfire year 3 (27.5%). Its cover declined over time, but mean percent cover 10 years after fire (0.95%) was higher than prefire cover (0.02%). The fire was low to moderate severity and consumed 22% of the forest floor [32]. In the Superior National Forest in Minnesota, vegetation changes were observed 11 and 14 years after fire in jack pine-black spruce (*Pinus banksiana*-*Picea mariana*) forest and jack pine plantation forest, respectively. These fires were "patchy", "hot", and resulted in "little or no soil burn". In this study, frequency of red raspberry at burned areas 11 and 14 years after fire (range: 53-87%) was greater than at unburned control areas (range: 20-23%). In contrast, dwarf raspberry (*Rubus pubescens*) responded differently at different areas of the burn, and no consistent response was detected for this species [50]. In white oak-bur oak (*Quercus marcocarpa*) woodlands in southwestern Wisconsin, stem densities of blackberries (red raspberry, black raspberry, and Allegheny blackberry) were not changed after 2 consecutive years of prescribed fire; however, no information was provided on fire severity [35]. Allegheny blackberry cover increased from nearly 10% before fire to over 50% after a low-severity surface fire in northern pin oak (*Quercus ellipsoidalis*) forest in Stevens Point, Wisconsin. In this study, mean flame height was <1 foot (0.3 m) and mean rate of spread for the headfire was 3.3 m/min [67]. Areas with annual (burned each year from 1995 to 1999) and periodic (burned in 1996 and 1999) spring prescribed fires in mixed-oak forest in Ohio typically had higher mean frequencies (approximate range: 22-45%) of blackberries than unburned sites (approximate range: 18-22%). Frequency of blackberries in annually and periodically burned areas were similar and tended to increase over time, while frequency at unburned sites remained relatively stable during the same time period. In this study, blackberries were a significant indicator of burned sites ($P<0.01$); however, the species of blackberry were not specified. Flame lengths were typically <0.5 m and fuel consumption was generally limited to unconsolidated leaf litter and small woody debris

(1-hr fuels). Over 80% of the sites were burned, resulting in "relatively minor" reductions in overstory density. Other characteristics of the fires are provided in [40]. In a chronosequence study in mixed-coniferous forest on the western redcedar/queencup beadlily (*Thuja plicata*/*Clintonia uniflora*) habitat type in Idaho, cover and density of Pacific blackberry (*Rubus ursinus*) and blackcap raspberry (*Rubus leucodermis*) did not differ with burn severity ("high severity" and "low severity") or burn age (postfire year 1, 2, 3, 4, 5, and 15) [61].

Wineberry may occupy postfire habitat by sprouting and/or seedling establishment as do many blackberries (e.g., [1,31,32,50,61,76]). For example, red raspberry in clearcut and burned sub-boreal spruce forest in northern British Columbia established after fire from buried seeds and from sprouting of plants present before the fire [31,32]. Presence of wineberry after prescribed fire was reported in Prentice Cooper State Forest and Wildlife Management Area in Tennessee [5]; in this study it was unclear whether wineberry established through on- or off-site sources. Wineberry seeds may accumulate in soil seed banks, so establishment of wineberry from the seed bank may be possible (see Seed banking). Wineberry may also establish after fire from seed brought on site by animals (see Seed dispersal). Fire may favor wineberry, like other blackberries, by increasing available nutrients [13,67]. Many blackberries require exposed mineral soil and light for germination [71], and fire may create a favorable seedbed for blackberries by creating these conditions (see [62] for a review).

FUELS AND FIRE REGIMES:

Fuels: Little information is available on the fuel characteristics of wineberry invaded sites as of 2009. Like some other blackberries, the canes and foliage of wineberry are likely highly flammable (see Immediate fire effect on plant). In addition, wineberry may form dense thickets ([73], a fact sheet), leading to complete change of physical structure in invaded communities. Thus, wineberry has the potential to substantially alter fuel loads and fire behavior. More information is needed on these topics.

Fire regimes: Little information is available on the fire regimes of plant communities in wineberry's native habitat. Its ability to sprout from rhizomes and the possibility of establishment from on-site seeds stored in the soil seed bank suggest that wineberry may be favored by fires of low severity and short duration that remove little of the surface organic layer [68]. In addition, the possibility of establishment from off-site, animal-dispersed seeds, its ability to grow rapidly in high light and on exposed mineral soil, and its appearance in early-successional plant communities in North America (see Habitat Types and Plant Communities) suggest that the species would be tolerant of short fire-return intervals and stand-replacing disturbances. However, because wineberry may not reach adequate size for fruiting or tip-rooting until 3 years of age or more [25], fire-return intervals >3 years are likely most favorable to wineberry persistence. Persistence into midsuccessional stages and probable longevity in the soil seed bank suggest that moderate to long fire-return intervals may be tolerated. The Fire Regime Table summarizes characteristics of fire regimes for vegetation communities in which wineberry may occur.

FIRE MANAGEMENT CONSIDERATIONS:

The information available (2009) provides no clear direction for using fire as a management tool for wineberry. Because wineberry frequently invades after disturbance, prescribed fire and fuels management activities may increase its abundance [12]. The mechanisms by which wineberry establishes after fire are not completely understood, but establishment of wineberry through sprouting and/or seedling establishment from on- and off-site sources after fire is likely.

Preventing invasive plants from establishing in weed-free burned areas is the most effective and least costly management method. This may be accomplished through early detection and eradication, careful monitoring and follow-up, and limiting dispersal of invasive plant seed into burned areas. Specific recommendations 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 containing nitrogen and phosphorus
- Avoid areas dominated by high priority invasive plants when locating firelines, monitoring camps, staging areas, and helibases

- Clean equipment and vehicles prior to entering burned areas
- Regulate or prevent human and livestock entry into burned areas until desirable site vegetation has recovered sufficiently to resist invasion by undesirable vegetation
- Monitor burned areas and areas of significant disturbance or traffic from management activity
- Detect weeds early and eradicate before vegetative spread and/or seed dispersal
- Eradicate small patches and contain or control large infestations within or adjacent to the burned area
- Reestablish vegetation on bare ground as soon as possible
- Avoid use of fertilizers in postfire rehabilitation and restoration
- Use only certified weed-free seed mixes when revegetation is necessary

For more detailed information on these topics see the following publications: [3,7,24,84].

MANAGEMENT CONSIDERATIONS

SPECIES: Rubus phoenicolasius

IMPORTANCE TO WILDLIFE AND LIVESTOCK:
Wineberry may be of limited importance to domestic livestock, but the fruit, foliage, and stems of wineberry provide food and cover for many wildlife species.

Palatability/nutritional value: Wineberry produces fruits that are readily consumed by birds, reptiles, and mammals ([73], a fact sheet). Wineberry was documented in fecal droppings of white-tailed deer in southern Connecticut [90] and was considered a preferred food of box turtles in the laboratory [6]. Although not reported for wineberry specifically, fruits of raspberry are eaten by many eastern birds including ruffed grouse, American woodcock, ring-necked pheasant, northern bobwhite, wild turkey, gray catbird, northern cardinal, brown thrasher, American robin, thrushes, and towhees. Mammals such as coyote, raccoon, black bear, white-tailed deer, common opossum, squirrels, chipmunks, skunks, and foxes also eat the fruits of raspberries [12,30,57,86].

Palatability of wineberry browse has not been determined. According to a review, raspberries generally have little forage value for domestic livestock [86]. However, stem densities and heights of blackberries (red raspberry, black raspberry, and Allegheny blackberry) in paddocks grazed by cattle in white oak-bur oak woodlands in southwestern Wisconsin were significantly lower than in ungrazed paddocks (P<0.03 for all variables), suggesting that blackberries were a preferred forage species there [35]. Forage value of raspberry fruit and browse to wildlife apparently varies among species [86]. Deer and rabbits eat the foliage and stems of raspberries, and porcupine and beaver occasionally consume the buds, twigs, or cambium of raspberries [12,57,86].

Cover value: According to reviews, many species of birds and mammals use the brambles of raspberries for protective cover and nesting [12,57,73]. Veery frequently placed nests on or near wineberry plants in mixed-hardwood forest in the middle-Atlantic Piedmont forest physiographic province in New Castle County, Delaware [36]. Similarly, crow tits nested in the brambles of wineberry along streambanks in wineberry's native range in South Korea [49].

OTHER USES:
Wineberry was introduced into the United States in 1890 as breeding stock for new blackberry cultivars; as of 2002, wineberry was still used for that purpose [80]. Wineberry produces edible fruits, which can be used and consumed as raspberries (e.g., see FEIS species review for red raspberry) [18]; for example, berries are eaten fresh, cooked, or used in making jams, jelly, syrup, juice, desserts, and wine [18,39]. In addition, wineberry has been used as a virus indicator, and numerous plant viruses have been isolated from it ([73], a fact sheet).

IMPACTS AND CONTROL:

Impacts: The range of wineberry has expanded considerably since its introduction in the 1890s (see General Distribution). Despite its long history in North America, Innis [42] commented that it was not until the 1970s that it became a problem in Maryland. In Inwood Hill Park, Manhattan, New York, populations of wineberry, as well as 14 other nonnative invasive species were said to be expanding as of 2008 and wineberry was described as a "problem species" there [20]. Currently, wineberry is considered invasive in the Appalachian Mountain and Coastal regions of the east-central United States ([73], a fact sheet).

Where infestations are dense, wineberry is capable of limiting regeneration of forests, pastures, and croplands [42,80]. Wineberry is considered a threat to native flora in parts of the eastern United States largely because of its rapid growth, which allows it to crowd out native plants and establish extensive patches. In field experiments in Maryland, fewer individuals (P=0.040) and fewer ramets/m² (P=0.034) of nonnative Indian strawberry (*Duchesnea indica*) in plots with wineberry than without suggested that wineberry excluded Indian strawberry from the understory. There was no difference in Indian strawberry density in plots with or without native sawtooth blackberry [42].

Wineberry may occur at higher densities than its native congenerics. For example, in Inwood Hill Park in southern New York, wineberry was consistently recorded at higher densities than Allegheny blackberry or black raspberry where these species were found together [20]:

Density/ha of wineberry and 2 native blackberries in 3 forest site types in Inwood Hill Park, New York [20]

	Forest site type		
Species	East ridge and slopes	East and west ridgetops	West ridge and slopes
Allegheny blackberry	38	0	117
black raspberry	0	113	211
wineberry	469	469	972

Wineberry's growth habit may contribute to its establishment and spread. Wineberry may form longer and stouter canes than some native raspberries, such as red raspberry (e.g., [18,41]). Comparison of wineberry growth and that of 9 other blackberries in field experiments in Japan found that wineberry produced the longest primocanes. Wineberry produced the 3rd largest diameter primocane and the 5th largest number of floricanes [41]:

Growth of field-planted wineberry, red raspberry, and black raspberry in Japan [41]

Species	Primocane length (cm)	Primocane diameter (mm)	Number of floricanes
wineberry	370.4	22.1	17.7
red raspberry	272.7	15.6	25.0
black raspberry	309.0	21.5	4.0

Wineberry's physiological efficiency may enhance its establishment and spread. Wineberry exhibited a higher ratio of maximum photosynthetic rates to dark respiration (P=0.10), higher leaf nitrogen concentration (P=0.02), and higher specific leaf area (P<0.01) than native sawtooth blackberry in the coastal plain region of Maryland. These results indicated a greater rate of leaf-level photosynthesis and higher resource use efficiency in wineberry than sawtooth blackberry. The manner in which these characteristics varied across habitats indicated greater phenotypic plasticity in wineberry relative to sawtooth blackberry. High phenotypic plasticity, low tissue costs, ability to utilize high resource levels for rapid growth, and high seed production may partially explain wineberry's ability to be an "aggressive" invader in some areas [42].

Control: Wineberry may be controlled through mechanical and chemical means [80]. In all cases where invasive species are targeted for control, no matter what method is employed, the potential for other invasive species to fill their void must be considered [8]. For example, removal of nonnative Norway maple (*Acer platanoides*) from the canopy of an even-aged sugar maple-Norway maple forest in New Jersey resulted in the establishment of wineberry and other nonnative species including tree-of-heaven, Japanese barberry (*Berberis thunbergii*), winged burning bush (*Euonymous alata*), Japanese honeysuckle, and black locust 2 years after treatment; it was unclear whether these species established from the seed bank or from off-site sources [88]. Wineberry and other nonnative invasive species including tree-of-heaven and oriental bittersweet invaded large, herbicide-treated areas on the western ridge of Inwood Hill Park, New York 3 years after invasive species control efforts were abandoned [20]. These examples underscore the importance of long-term maintenance and monitoring of treatment areas to restore native communities and reduce nonnative species in the long term. Control efforts that keep disturbed areas small and native plants available to colonize openings may help prevent the establishment and spread of wineberry and other nonnative species [88]. Ultimately, management of biotic invasions is most effective when it employs a long-term, ecosystem-wide strategy rather than a tactical approach focused on battling individual invaders [55].

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

Prevention: It is commonly argued that the most cost-efficient and effective method of managing invasive species is to prevent their establishment and spread by maintaining "healthy" natural communities [55,72], for example, by avoiding road building in wildlands [83] and by conducting monitoring several times each year [44]. Managing to maintain the integrity of the native plant community and mitigate the factors enhancing ecosystem invasibility are likely to be more effective than managing solely to control the invader [37]. 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 [84]. See the "Guide to noxious weed prevention practices" [84] for specific guidelines in preventing the spread of weed seeds and propagules under different management conditions.

Cultural control: No information is available on this topic.

Physical or mechanical control: Removal of plants by hand-pulling or use of a spading fork can be an effective means of controlling wineberry, especially if the soil is moist and the roots and any cane fragments are completely removed. Removal and destruction of branches with fruits is recommended to reduce the number of seeds in the seed bank ([73], a fact sheet).

Like other blackberries, wineberry is likely encouraged by practices such as mowing or deep cultivation; thus, these methods are not recommended for wineberry control, and are not usually appropriate for wildlands and natural areas. In general, mowing of raspberries stimulates sprouting and reduces interference from neighboring vegetation. Deep cultivation (6-9 inches (15-23 cm)) cuts the roots of existing blackberry plants and causes the formation of large numbers of "sucker" plants [12]. However, if mowing is conducted 2 to 3 times per season for 2 or more years, eradication may be accomplished by exhausting the plant's carbohydrate reserves [86].

Biological control: Numerous diseases and insects affect wineberry, including wineberry latent virus. See Ellis and others [17] for a review.

Chemical control: A review states that wineberry can be controlled with a systemic herbicide like glyphosate or triclopyr [80]. Herbicides may be effective in gaining initial control of a new invasion or a severe infestation, but they are rarely a complete or long-term solution to weed management [9]. Herbicides are more effective on large infestations when incorporated into long-term management plans that include replacement of weeds with desirable species, careful land use management, and prevention of new infestations. Control with herbicides is temporary, as it does not change conditions that allow infestations to occur [97]. See the Weed Control Methods Handbook for considerations on the use of herbicides in natural areas and detailed information on specific chemicals.

Integrated management: Increased effectiveness generally occurs when multiple approaches are combined to control an invasive species. For wineberry, mowing or cutting prior to herbicide application may be more effective than either method alone [80]. Integrated management should include considerations of not only killing the target plant but also of establishing desirable species and maintaining weed-free systems over the long term.

APPENDIX: FIRE REGIME TABLE

SPECIES: Rubus phoenicolasius

Fire regime information on vegetation communities in which wineberry may occur. This information is taken from the LANDFIRE Rapid Assessment Vegetation Models [52], 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.

Southeast Great Lakes Northeast South-central US Southern Appalachians

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					
Northern hardwood maple-beech-eastern hemlock	Replacement	60%	>1,000		
	Mixed	40%	>1,000		
Great Lakes floodplain forest	Mixed	7%	833		
	Surface or				

	Surface or low	93%	61		
[Maple-basswood](#)	Replacement	33%	≥1,000		
	Surface or low	67%	500		
[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		
[Oak-hickory](#)	Replacement	13%	66	1	
	Mixed	11%	77	5	
	Surface or low	76%	11	2	25

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
Rocky outcrop pine (Northeast)	Replacement	16%	128		
	Mixed	32%	65		
	Surface or low	52%	40		
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		
	Replacement	72%	475		

Eastern white pine-northern hardwoods	Surface or low	28%	>1,000		
Northern hardwoods-eastern hemlock	Replacement	50%	≥1,000		
	Surface or low	50%	≥1,000		
Appalachian oak forest (dry-mesic)	Replacement	2%	625	500	≥1,000
	Mixed	6%	250	200	500
	Surface or low	92%	15	7	26
Beech-maple	Replacement	100%	>1,000		

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					
Interior Highlands dry oak/bluestem woodland and glade	Replacement	16%	25	10	100
	Mixed	4%	100	10	
	Surface or low	80%	5	2	7
Interior Highlands oak-hickory-pine	Replacement	3%	150	100	300
	Surface or low	97%	4	2	10
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
Gulf Coastal Plain pine flatwoods	Replacement	2%	190		
	Mixed	3%	170		
	Surface or low	95%	5		
West Gulf Coastal plain pine (uplands and flatwoods)	Replacement	4%	100	50	200
	Mixed	4%	100	50	
	Surface or low	93%	4	4	10
West Gulf Coastal Plain pine-hardwood woodland or forest upland	Replacement	3%	100	20	200
	Mixed	3%	100	25	
	Surface or low	94%	3	3	5
Southern floodplain	Replacement	42%	140		
	Surface or low	58%	100		
Southern floodplain (rare fire)	Replacement	42%	≥1,000		
	Surface or low	58%	714		

Southern Appalachians

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

Vegetation Community (Potential Natural Vegetation Group)	Fire severity*	Fire regime characteristics			
		Percent of fires	Mean interval (years)	Minimum interval (years)	Maximum interval (years)
Southern Appalachians Grassland					
Bluestem-oak barrens	Replacement	46%	15		
	Mixed	10%	69		
	Surface or low	44%	16		
Eastern prairie-woodland mosaic	Replacement	50%	10		
	Mixed	1%	900		
	Surface or low	50%	10		
Southern Appalachians Woodland					

Appalachian shortleaf pine	Replacement	4%	125		
	Mixed	4%	155		
	Surface or low	92%	6		
Oak-ash woodland	Replacement	23%	119		
	Mixed	28%	95		
	Surface or low	49%	55		
Southern Appalachians Forested					
Bottomland hardwood forest	Replacement	25%	435	200	≥1,000
	Mixed	24%	455	150	500
	Surface or low	51%	210	50	250
Mixed mesophytic hardwood	Replacement	11%	665		
	Mixed	10%	715		
	Surface or low	79%	90		
Appalachian oak-hickory-pine	Replacement	3%	180	30	500
	Mixed	8%	65	15	150
	Surface or low	89%	6	3	10
Eastern hemlock-eastern white pine-hardwood	Replacement	17%	≥1,000	500	>1,000
	Surface or low	83%	210	100	>1,000
Oak (eastern dry-xeric)	Replacement	6%	128	50	100
	Mixed	16%	50	20	30
	Surface or low	78%	10	1	10
Appalachian Virginia pine	Replacement	20%	110	25	125
	Mixed	15%	145		
	Surface or low	64%	35	10	40
Appalachian oak forest (dry-mesic)	Replacement	6%	220		
	Mixed	15%	90		
	Surface or low	79%	17		
Southern Appalachian high-elevation forest	Replacement	59%	525		
	Mixed	41%	770		

Southeast

- Southeast Grassland

- Southeast 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		
Southeast Woodland					
Longleaf pine (mesic uplands)	Replacement	3%	110	40	200
	Surface or low	97%	3	1	5
Pond pine	Replacement	64%	7	5	500
	Mixed	25%	18	8	150
	Surface or low	10%	43	2	50
Southeast Forested					
Coastal Plain pine-oak-hickory	Replacement	4%	200		
	Mixed	7%	100		
	Surface or low	89%	8		
Loess bluff and plain forest	Replacement	7%	476		
	Mixed	9%	385		
	Surface or low	85%	39		
Southern floodplain	Replacement	7%	900		
	Surface or low	93%	63		

*Fire Severities—
Replacement: Any fire that causes greater than 75% top removal of a vegetation-fuel type, resulting in general replacement of existing vegetation; may or may not cause a lethal effect on the plants.
Mixed: Any fire burning more than 5% of an area that does not qualify as a replacement, surface, or low-severity fire; includes mosaic and other fires that are intermediate in effects.
Surface or low: Any fire that causes less than 25% upper layer replacement and/or removal in a vegetation-fuel class but burns 5% or more of the area [33,51].

Rubus phoenicolasius: REFERENCES

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