

<b>NAME OF SPECIES:</b> <i>Euonymus alatus</i> (Thunb.) Sieb.	
<b>Synonyms:</b> <i>Euonymus alata</i> (Thunb.) Sieb., <i>Celastrus alata</i> Thunb., <i>Celastrus striata</i> Thunb., and <i>Euonymus striata</i> (Thunb.) Loes..	
<b>Common Name:</b> winged euonymus, burning bush, winged burning bush, burning bush euonymus, winged wahoo, winged spindle-tree	<b>Cultivars?</b> YES <input checked="" type="checkbox"/> NO <input type="checkbox"/>
<b>A. CURRENT STATUS AND DISTRIBUTION</b>	
I. In Wisconsin?	1. YES <input checked="" type="checkbox"/> NO <input type="checkbox"/>
	2. <u>Abundance:</u> There are at least 14 naturalized populations of <i>E. alata</i> in the state. (1, 2)
	3. <u>Geographic Range:</u> Found in the southwest corner of the state as well as Kenosha County and the Green Bay area. (1, 2)
	4. <u>Habitat Invaded:</u> Most often found in open woods, pastures, prairies, and roadsides. (5) Disturbed Areas <input checked="" type="checkbox"/> Undisturbed Areas <input type="checkbox"/>
	5. <u>Historical Status and Rate of Spread in Wisconsin:</u> Burning bush was introduced to the U.S. around 1860 as an ornamental shrub. (9) The earliest report of this species in WI is from 1922. Today it is naturalized in at least 6 counties in the state. (1)
	6. <u>Proportion of potential range occupied:</u> This species probably only occupies a minor portion of its potential range in WI.
II. Invasive in Similar Climate Zones	1. YES <input checked="" type="checkbox"/> NO <input type="checkbox"/>
	<u>Where (include trends):</u> <i>E. alatus</i> occurs in 23 states from New England south to northern Florida and the Gulf Coast, west to Iowa, and in Montana (3, 7). It has been observed escaping from cultivation in the Northeast and Midwest, notably in Connecticut, Virginia, Pennsylvania, and Illinois.
III. Invasive in Which Habitat Types	1. Upland <input checked="" type="checkbox"/> Wetland <input type="checkbox"/> Dune <input type="checkbox"/> Prairie <input checked="" type="checkbox"/> Aquatic <input type="checkbox"/> Forest <input checked="" type="checkbox"/> Grassland <input checked="" type="checkbox"/> Bog <input type="checkbox"/> Fen <input type="checkbox"/> Swamp <input type="checkbox"/> Marsh <input type="checkbox"/> Lake <input type="checkbox"/> Stream <input type="checkbox"/> Other: Urban green space
	Notes: This species does not usually escape from urban plantings, but it can invade natural areas when planted near pastures, woodlands and forests. (13) Escaped occurrences of <i>E. alatus</i> in WI are most often found in open disturbed areas such as abandoned fields, pastures, forest edges, roadsides and yards. However, <i>E. alatus</i> has invaded forest understories and grasslands in the northeastern states and Illinois. (7, 10) Known populations occur in mature white oak upland forest, open second growth lowland forest, pastures, shady hillsides, small ravines in valley floor forests, and glacial drift hill prairies. (10)
IV. Habitat Affected	1. <u>Soil types favored or tolerated:</u> Prefers well-drained to relatively moist soils; does not tolerate waterlogged soils. (5, 7) This species is salt-tolerant and adaptable to differences in soil pH. (9)
	2. <u>Conservation significance of threatened habitats:</u> WI natural communities that could be affected by this species include rare woodland and savanna communities. (14)
V. Native Range and Habitat	1. <u>List countries and native habitat types:</u> Temperate Asia, including Japan, Korea, and central China. (5, 6, 7) In China, burning bush grows in forests, woodlands, and scrublands. (13)

VI. Legal Classification	<p>1. <u>Listed by government entities?</u> Connecticut: Invasive, not banned. Massachusetts: Prohibited. (3)</p> <p>2. <u>Illegal to sell?</u> YES <input type="checkbox"/> NO <input checked="" type="checkbox"/> Notes: Legal to sell except in MA.</p>
<b>B. ESTABLISHMENT POTENTIAL AND LIFE HISTORY TRAITS</b>	
I. Life History	<p>1. <u>Type of plant:</u> Annual <input type="checkbox"/> Biennial <input type="checkbox"/> Monocarpic Perennial <input type="checkbox"/> Herbaceous Perennial <input type="checkbox"/> Vine <input type="checkbox"/> Shrub <input checked="" type="checkbox"/> Tree <input type="checkbox"/></p> <p>2. <u>Time to Maturity:</u> 10-20 years.</p> <p>3. <u>Length of Seed Viability:</u> Burning bush seed has limited persistence in the soil. In a study in KY, seed from the cultivar 'Compactus' had an estimated viability of 2% after 1 year. (11) Further study on seed viability by Mark Renz and Laura Jull is expected to be completed in 2013. (19)</p> <p>4. <u>Methods of Reproduction:</u> Asexual <input type="checkbox"/> Sexual <input checked="" type="checkbox"/> <u>Notes:</u> Reproduces prolifically by seed. The seed is often spread by birds, who ingest the fruit. (5)</p> <p>5. <u>Hybridization potential:</u></p>
II. Climate	<p>1. <u>Climate restrictions:</u> Hardy in zones 4-9. Sensitive to drought. (4) Appears to be limited by cold temperatures at the northern edge of its naturalized range in the U.S. (6)</p> <p>2. <u>Effects of potential climate change:</u> Warmer temperatures may extend the range of this species further north, and increased precipitation may promote range expansion.</p>
III. Dispersal Potential	<p>1. <u>Pathways - Please check all that apply:</u></p> <p><u>Unintentional:</u> Bird <input checked="" type="checkbox"/> Animal <input type="checkbox"/> Vehicles/Human <input type="checkbox"/> Wind <input type="checkbox"/> Water <input type="checkbox"/> Other: gravity</p> <p><u>Intentional:</u> Ornamental <input checked="" type="checkbox"/> Forage/Erosion control <input type="checkbox"/> Medicine/Food: Other:</p> <p>2. <u>Distinguishing characteristics that aid in its survival and/or inhibit its control:</u> <i>E. alatus</i> escapes cultivation easily by producing many seeds. The plants create a seed shadow under which hundreds of seeds can be found. (7) The seeds germinate readily, and can disperse long distances via birds. (9) The largest factor related to the spread of this species, however, is the wide use of the plant as an ornamental, increasing the probability that it will escape from cultivation. (10) Birds can disperse seeds from planted areas to nearby natural areas. (9) <i>Once established, E. alatus</i> tolerates full shade and full sun, and grows well in different soil types and pH levels. It has no serious pest problems. (13) <u>Vegetative regeneration:</u> This species has been shown to sprout from the root crown following top-kill by herbicides. It is likely that it will resprout following other types of top-killing events. (13)</p>

IV. Ability to go Undetected	1. HIGH <input type="checkbox"/> MEDIUM <input type="checkbox"/> LOW <input checked="" type="checkbox"/> Notes: Long-distance dispersals of individuals into forests may go unnoticed until they have established a new population.
<b>C. DAMAGE POTENTIAL</b>	
I. Competitive Ability	1. <u>Presence of Natural Enemies</u> : Two-spotted mites and nematodes may minimally affect this species. Dieback may be caused by the fungus <i>Whetzelinia sclerotiorum</i> . (4) 2. <u>Competition with native species</u> : Shades out native herbs and crowds out native shrubs. (10) <i>E. alatus</i> forms a broad, closed crown and creates a dense stand of seedlings under the parent plant, resulting in a thicket-like shrub. The nearly impenetrable mat-like root system also gives it a competitive advantage over some understory species. (6, 10) 2. <u>Rate of Spread</u> : This species is variously described as a fast-growing or slow-growing species. (13) -change in acreage over time: HIGH(1-3 yrs) <input type="checkbox"/> MEDIUM (4-6 yrs) <input type="checkbox"/> LOW (7-10 yrs) <input type="checkbox"/> Notes: ?
II. Environmental Effects	1. <u>Alteration of ecosystem/community composition?</u> YES <input checked="" type="checkbox"/> NO <input type="checkbox"/> Notes: This species can replace shrubs in woodlands, and may reduce the number of native herbs in the forest understory. (4, 6) 2. <u>Alteration of ecosystem/community structure?</u> YES <input checked="" type="checkbox"/> NO <input type="checkbox"/> Notes: <i>E. alatus</i> is shade-tolerant and may have the potential to dominate the understory of mature forests by outcompeting native shrubs and herbs.  <u>Herbivory</u> : This species is browsed by birds and rabbits, but is probably not palatable to white-tailed deer. It is unknown if preference for other species by deer helps facilitate the growth of burning bush. (13) 3. <u>Alteration of ecosystem/community functions and processes?</u> YES <input checked="" type="checkbox"/> NO <input type="checkbox"/> Notes: Creates dense shade, limiting growth and survival of anything else under it. 4. <u>Allelopathic properties?</u> YES <input type="checkbox"/> NO <input checked="" type="checkbox"/> Notes: unknown
<b>D. SOCIO-ECONOMIC EFFECTS</b>	
I. Positive aspects of the species to the economy/society:	Notes: Prized by landscapers for its brilliant fall foliage. (5) Commonly used in landscaping, especially malls and highways. (9)  Based on the 2011 WNA Economic Impact Survey, the following information was reported for this plant. Out of the 204 nurseries responding, 62 reported selling this plant. 37 reported it comprised <1% of their gross plant sales. 18 reported it comprised 1 – 2.9% of their gross plant sales. The estimated total dollar amount contributed to Wisconsin’s economy by this plant is \$739,445 . It ranks 3rd among the 63 taxa surveyed. The estimated wholesale

	value of plants in production is \$202,250. The majority of respondents said it took <6 months to produce this plant. The trend for the 2011 season was to remain unchanged. (18)
II. Potential Socio-Economic Effects of Requiring Controls:	Positive: Negative: Prohibiting the sale of <i>E. alatus</i> would cause a loss of sales to nurseries and landscapers. However native or non-invasive alternatives are available, such as spicebush ( <i>Lindera benzoin</i> ), Strawberry bush ( <i>Euonymus americanus</i> ), maple-leaf viburnum ( <i>Viburnum acerifolium</i> ), wild hydrangea ( <i>Hydrangea arborescens</i> ), highbush blueberry ( <i>Vaccinium corymbosum</i> ), native red chokeberry (especially the cultivar <i>Aronia arbutifolia</i> 'Brilliantissima') or the non-invasive exotic Korean spice viburnum ( <i>Viburnum carlesii</i> ). (10)
III. Direct and indirect Socio-Economic Effects of Plant :	Notes:
IV. Increased Costs to Sectors Caused by the Plant:	Notes:
V. Effects on human health:	Notes: Possible medicinal properties of this species include cytotoxic activity against tumor cells, and treatment against stomach aches. (4)
VI. Potential socio-economic effects of restricting use:	Positive: Negative:
<b>E. CONTROL AND PREVENTION</b>	
I. Costs of Prevention (please be as specific as possible):	Notes:
II. Responsiveness to prevention efforts:	Notes:
III. Effective Control tactics:	Mechanical <input checked="" type="checkbox"/> Biological <input type="checkbox"/> Chemical <input checked="" type="checkbox"/> Times and uses: <u>Mechanical:</u> Hand-pull seedlings up to 2' tall. Use a spading fork or weed wrench for larger plants and their root systems. Larger plants can be cut, but the stump must be ground out or the regrowth clipped. Mowing small plants has been unsuccessful. An alternative method is to clip all the flowers, but this is extremely labor-intensive. (10)  <u>Chemical:</u> Cut stumps can also be painted with herbicide. (5) If populations are too large for cutting to be practical, foliar spray can be applied in the early summer months. (10)
IV. Costs of Control:	Notes:
V. Cost of prevention or control vs. Cost of allowing invasion to occur:	Notes: Abstaining from use of the plant is the most important method of control. (9) Control of infestations by cutting and herbicide probably requires a 5-year commitment. (6)
VI. Non-Target Effects of Control:	Notes: Foliar herbicide applications may affect native species, and digging out the stumps of larger plants can cause soil disturbance.
VII. Efficacy of monitoring:	Notes:

VIII. Legal and landowner issues:	Notes: Because of the extensive use of this species as an ornamental, some populations targeted for control may occur on private lands. Cooperation with landowners will be necessary.
<b>F. HYBRIDS AND CULTIVARS</b>	
I. Known hybrids?  YES <input checked="" type="checkbox"/> NO <input type="checkbox"/>	Names of hybrids: Worldwide, 5 poorly differentiated varieties are recognized based on leaf color and relative hairiness. The following varieties occur in North America:  <i>Euonymus alatus</i> var. <i>alatus</i> . This variety is present in the same states as <i>E. alatus</i> .  <i>Euonymus alatus</i> var. <i>apterus</i> , common name corky spindletree. This variety is present in Kentucky and Pennsylvania. (3, 13) <hr/> Names of hybrid cultivars:
II. Species cultivars	Names of cultivars: 'Compactus,' 'Rudy Haag,' 'Nordine Strain,' 'Chicago Fire,' 'Timber Creek' Notes:  There are at least 10 cultivars of burning bush, but probably many more than 10. 'Compactus' is among the most popular. This cultivar tends to grow slowly and in short spurts (8)  'Rudy Haag' is a nearly seedless cultivar. In a study comparing seed production of the cultivars 'Rudy Haag' and 'Compactus', 'Rudy Haag' was shown to have relatively low invasive risk based on seed production. Across three years, 'Compactus' and 'Rudy Haag' produced an average of 1238 and 12 seeds per plant, respectively. (11) 'Rudy Haag' had very low fruit numbers in the 2011 UW Agronomy Dept. study. 'Compactus' and 'Select' ('Fireball' TM) had more fruits than 'Rudy Haag', but much less than 'Nordine' and 'Timber Creek' (20) In general, the low seed producers tend to be slow growing. (20)  'Nordine Strain,' and 'Timber Creek' ('Chicago Fire' TM) are cultivars known for heavy fruit production. (15, 20)  From the nursery survey, 36 nurseries provided data – frequencies of each taxon as follows: 'Compactus' 15, species 15, Chicago Fire TM 9, Grove Compact' 7, 'Fireball' 6, "dwarf" 4, "compact" 3, 'Nordine' 3; 2 each - 'Timber Creek', Tures, and Little Moses; 1 each – 'Rudy Haag', "Japanese strain", Velvet Blazer, Bailey, and Densata. (18)  Varied degree of invasiveness reported by nursery survey respondents. Many growers of various varieties report seedlings, many report no re-seeding, some report no invasiveness problems, and one reports rabbits as a biocontrol for seedlings (18)

	<p><u>Industry attitudes:</u> To reduce the sale of invasive ornamental plants (including <i>E. alatus</i>), members of the Connecticut Nursery and Landscape industry preferred the following approaches: marketing non-invasive alternate plants, and development of genetically altered sterile forms of invasive ornamentals (14).</p> <p>Nordine- says low availability commercially.</p> <p>Sterile, seedless variety was developed using 'compactus', not yet patented. (17)</p> <p>'Bailey Strain' – hardy to zone 4; 'Phellomanus' – hardy to zone 4; 'Synnestvedt' – hardy to zone 4;(16)</p>
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- TNC
- Native Plant Conservation Alliance
- IPANE
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**Reviewer(s) and date reviewed:** Tom Boos, 11/10/11

**Approved and Completed Date:** Tom Boos, 12/19/2011