NEW YORK
NON-NATIVE PLANT INVASIVENESS RANKING FORM

Scientific name:	Euonymus europaeus L.	USDA Plants Code: EUEU7
Common names:	European spindletree	
Native distribution:	Eurasia	
Date assessed:	April 28, 2009	
Assessors:	Steve Glenn, Gerry Moore	
Reviewers:	LIISMA SRC	
Date Approved:	May 13, 2009	Form version date: 3 March 2009

New York Invasiveness Rank: Moderate (Relative Maximum Score 50.00-69.99)

Distribution and Invasiveness Rank (*Obtain from PRISM invasiveness ranking form*)			
	Status of this species in each PRISM:	Current Distribution	PRISM Invasiveness Rank
1	Adirondack Park Invasive Program	Not Assessed	Not Assessed
2	Capital/Mohawk	Not Assessed	Not Assessed
3	Catskill Regional Invasive Species Partnership	Not Assessed	Not Assessed
4	Finger Lakes	Not Assessed	Not Assessed
5	Long Island Invasive Species Management Area	Widespread	Moderate
6	Lower Hudson	Not Assessed	Not Assessed
7	Saint Lawrence/Eastern Lake Ontario	Not Assessed	Not Assessed
8	Western New York	Not Assessed	Not Assessed

Invasiveness Ranking Summary (see details under appropriate sub-section)		Total (Total Answered*) Possible	Total
1	Ecological impact	40 (20)	6
2	Biological characteristic and dispersal ability	25 (25)	18
3	Ecological amplitude and distribution	25 (25)	21
4	Difficulty of control	10 (10)	3
	Outcome score	100 (80)[b]	48[a]
	Relative maximum score †		60.00
	New York Invasiveness Rank §	Moderate (Relative Maximum Score 50.00-69.99)	

* For questions answered "unknown" do not include point value in "Total Answered Points Possible." If "Total Answered Points Possible" is less than 70.00 points, then the overall invasive rank should be listed as "Unknown."
†Calculated as 100(a/b) to two decimal places.
§Very High >80.00; High 70.00–80.00; Moderate 50.00–69.99; Low 40.00–49.99; Insignificant <40.00

A. DISTRIBUTION (KNOWN/POTENTIAL): Summarized from individual PRISM forms

A1.1. Has this species been documented to persist without cultivation in NY? (reliable source; voucher not required)	
☒	Yes – continue to A1.2
☐	No – continue to A2.1
A1.2. In which PRISMs is it known (see inset map)?	
☐	Adirondack Park Invasive Program
☒	Capital/Mohawk
☒	Catskill Regional Invasive Species Partnership
☒	Finger Lakes
☒	Long Island Invasive Species Management Area
☒	Lower Hudson
☐	Saint Lawrence/Eastern Lake Ontario
☒	Western New York

Documentation:
Sources of information:
Brooklyn Botanic Garden, 2009; Weldy & Werier, 2009.

A2.1. What is the likelihood that this species will occur and persist outside of cultivation, given the climate in the following PRISMs? (obtain from PRISM invasiveness ranking form)

Not Assessed	Adirondack Park Invasive Program
Not Assessed	Capital/Mohawk
Not Assessed	Catskill Regional Invasive Species Partnership
Not Assessed	Finger Lakes
Very Likely	Long Island Invasive Species Management Area
Not Assessed	Lower Hudson
Not Assessed	Saint Lawrence/Eastern Lake Ontario
Not Assessed	Western New York

Documentation:
Sources of information (e.g.: distribution models, literature, expert opinions):
Brooklyn Botanic Garden, 2009.

If the species does not occur and is not likely to occur with any of the PRISMs, then stop here as there is no need to assess the species.

A2.2. What is the current distribution of the species in each PRISM? (obtain rank *from PRISM invasiveness ranking forms*)

	Distribution
Adirondack Park Invasive Program	Not Assessed
Capital/Mohawk	Not Assessed
Catskill Regional Invasive Species Partnership	Not Assessed
Finger Lakes	Not Assessed
Long Island Invasive Species Management Area	Widespread
Lower Hudson	Not Assessed
Saint Lawrence/Eastern Lake Ontario	Not Assessed
Western New York	Not Assessed

Documentation:
Sources of information:
Brooklyn Botanic Garden, 2009.

A2.3. Describe the potential or known suitable habitats within New York. Natural habitats include all habitats not under active human management. Managed habitats are indicated with an asterisk.

Aquatic Habitats	Wetland Habitats	Upland Habitats
☐ Salt/brackish waters	☐ Salt/brackish marshes	☒ Cultivated*
☐ Freshwater tidal	☐ Freshwater marshes	☒ Grasslands/old fields
☐ Rivers/streams	☐ Peatlands	☒ Shrublands
☐ Natural lakes and ponds	☒ Shrub swamps	☒ Forests/woodlands
☐ Vernal pools	☒ Forested wetlands/riparian	☐ Alpine
☐ Reservoirs/impoundments*	☐ Ditches*	☒ Roadsides*
	☒ Beaches and/or coastal dunes	

Other potential or known suitable habitats within New York:
Forest edges; mixed disturbed woods; mesic edge of marsh, fencerows, waste ground.

Documentation:
Sources of information:
Kelly, 1981; van der Meijden et al., 1988; Lee et al., 1991; Dzwonko & Loster, 1992; Higler, 1993; van der Laan et al., 1997; Siebel et al., 1998; de Bonte et al., 1999; Kollmann & Schneider, 1999; Garbary & Deveau, 2007; Brooklyn Botanic Garden, 2009.

B. INVASIVENESS RANKING

Questions apply to areas similar in climate and habitats to New York unless specified otherwise.

1. ECOLOGICAL IMPACT

1.1. Impact on Natural Ecosystem Processes and System-Wide Parameters (e.g. fire regime, geomorphological changes (erosion, sedimentation rates), hydrologic regime, nutrient and mineral dynamics, light availability, salinity, pH)

A.	No perceivable impact on ecosystem processes based on research studies, or the absence of impact information if a species is widespread (>10 occurrences in minimally managed areas), has been well-studied (>10 reports/publications), and has been present in the northeast for >100 years.	0
B.	Influences ecosystem processes to a minor degree (e.g., has a perceivable but mild influence on soil nutrient availability)	3
C.	Significant alteration of ecosystem processes (e.g., increases sedimentation rates along streams or coastlines, reduces open water that are important to waterfowl)	7
D.	Major, possibly irreversible, alteration or disruption of ecosystem processes (e.g., the species alters geomorphology and/or hydrology, affects fire frequency, alters soil pH, or fixes substantial levels of nitrogen in the soil making soil unlikely to support certain native plants or more likely to favor non-native species)	10
U.	Unknown	

Score: U

Documentation:
Identify ecosystem processes impacted (or if applicable, justify choosing answer A in the absence of impact information)
No studies on the impact on natural ecosystem processes located.
Sources of information:
Authors' pers. comm.

1.2. Impact on Natural Community Structure

A.	No perceived impact; establishes in an existing layer without influencing its structure	0
B.	Influences structure in one layer (e.g., changes the density of one layer)	3
C.	Significant impact in at least one layer (e.g., creation of a new layer or elimination of an existing layer)	7
D.	Major alteration of structure (e.g., covers canopy, eradicating most or all layers below)	10
U.	Unknown	

Score: 3

Documentation:
Identify type of impact or alteration:
Increases the density in the shrub layer. No evidence for significant or major alteration of structure.
Sources of information:
Authors' pers. obs.

1.3. Impact on Natural Community Composition

A.	No perceived impact; causes no apparent change in native populations	0
B.	Influences community composition (e.g., reduces the number of individuals in one or more native species in the community)	3
C.	Significantly alters community composition (e.g., produces a significant reduction in the population size of one or more native species in the community)	7
D.	Causes major alteration in community composition (e.g., results in the extirpation of one or	10

several native species, reducing biodiversity or change the community composition towards species exotic to the natural community)

U. Unknown

Score 3

Documentation:
Identify type of impact or alteration:
Reduces the number of individuals of native species in the community. No evidence for siginifcant or major alteration in native community composition.
Sources of information:
Authors' pers. obs.

1.4. Impact on other species or species groups (cumulative impact of this species on the animals, fungi, microbes, and other organisms in the community it invades. Examples include reduction in nesting/foraging sites; reduction in habitat connectivity; injurious components such as spines, thorns, burrs, toxins; suppresses soil/sediment microflora; interferes with native pollinators and/or pollination of a native species; hybridizes with a native species; hosts a non-native disease which impacts a native species)

A. Negligible perceived impact 0
B. Minor impact 3
C. Moderate impact 7
D. Severe impact on other species or species groups 10
U. Unknown

Score U

Documentation:
Identify type of impact or alteration:
No studies on the impact on other species located.
Sources of information:
Authors' pers. comm.

Total Possible 20
Section One Total 6

2. BIOLOGICAL CHARACTERISTICS AND DISPERSAL ABILITY

2.1. Mode and rate of reproduction (provisional thresholds, more investigation needed)

A. No reproduction by seeds or vegetative propagules (i.e. plant sterile with no sexual or asexual reproduction). 0
B. Limited reproduction (fewer than 10 viable seeds per plant AND no vegetative reproduction; if viability is not known, then maximum seed production is less than 100 seeds per plant and no vegetative reproduction) 1
C. Moderate reproduction (fewer than 100 viable seeds per plant - if viability is not known, then maximum seed production is less than 1000 seeds per plant - OR limited successful vegetative spread documented) 2
D. Abundant reproduction with vegetative asexual spread documented as one of the plants prime reproductive means OR more than 100 viable seeds per plant (if viability is not known, then maximum seed production reported to be greater than 1000 seeds per plant.) 4
U. Unknown

Score 2

Documentation:
Describe key reproductive characteristics (including seeds per plant):
Capable of large flower production, but perhaps low viable seed production. One observation of a naturalized population in North America found over 95% of the plants had well

developed buds and flowers (Garbary & Deveau, 2007). Likewise, one European study found 100% of the flowers had ovaries, but the later study found only about 30% developed mature fruit (Lloyd et al., 1980). Another European study also found a low seed set of less than 10% (Webb, C. J. 1979). Personal observations indicate limited fruit set with less than 1000 seeds, especially in shadier habitats.
Reported to be able to spread clonaly to some extent via layered branches or root suckering (Koop, 1987;Siebel et al., 1998).
Sources of information:
Lloyd et al., 1980; Koop, 1987; Webb, 1979; Siebel et al., 1998; Garbary & Deveau, 2007; authors' pers. obs.

2.2. Innate potential for long-distance dispersal (e.g. bird dispersal, sticks to animal hair, buoyant fruits, pappus for wind-dispersal)

A.	Does not occur (no long-distance dispersal mechanisms)	0
B.	Infrequent or inefficient long-distance dispersal (occurs occasionally despite lack of adaptations)	1
C.	Moderate opportunities for long-distance dispersal (adaptations exist for long-distance dispersal, but studies report that 95% of seeds land within 100 meters of the parent plant)	2
D.	Numerous opportunities for long-distance dispersal (adaptations exist for long-distance dispersal and evidence that many seeds disperse greater than 100 meters from the parent plant)	4
U.	Unknown	

Score 4

Documentation:
Identify dispersal mechanisms:
Endozoochory: birds eat fruits and disperese seeds; possibly by regurgitation due to the seeds possible poisonous properties, instead of passage through the gut. Large fleshy aril is what attracks birds to the plant.
Hydrochory: Ridley (1930) reports dry fruit floats for two months, the seed for 2.5 days.

Sources of information:
Ridley, 1930; Blakelock, 1951; Sorensen, 1981; Lee et al., 1991; Fuentes, 1994; Dzwonko & Loster, 1992; Dzwonko, 2001.

2.3. Potential to be spread by human activities (both directly and indirectly – possible mechanisms include: commercial sales, use as forage/revegetation, spread along highways, transport on boats, contaminated compost, land and vegetation management equipment such as mowers and excavators, etc.)

A.	Does not occur	0
B.	Low (human dispersal to new areas occurs almost exclusively by direct means and is infrequent or inefficient)	1
C.	Moderate (human dispersal to new areas occurs by direct and indirect means to a moderate extent)	2
D.	High (opportunities for human dispersal to new areas by direct and indirect means are numerous, frequent, and successful)	3
U.	Unknown	

Score 1

Documentation:
Identify dispersal mechanisms:
Used as an ornamental; wood also utilized for miscellaneous objects; and for extraction of gutta-percha (e.g., center of golf balls). Not widely planted though.
Sources of information:
Blakelock, 1951.

2.4. Characteristics that increase competitive advantage, such as shade tolerance,

ability to grow on infertile soils, perennial habit, fast growth, nitrogen fixation, allelopathy, etc.

A. Possesses no characteristics that increase competitive advantage 0
B. Possesses one characteristic that increases competitive advantage 3
C. Possesses two or more characteristics that increase competitive advantage 6
U. Unknown

Score 6

Documentation:
Evidence of competitive ability:
Perennial habit, shade tolerant, able to grow on poor soils. Reportedly tolerant of dry to wet soils (Lee et al., 1991). Plants and seedlings reportedly have high shade tolerance (Dzwonko & Loster, 1992; Grubb et al., 1996; Siebel et al., 1998).Adaptable to fairly wide range of soil pH (Way & Cammell, 1982): soil pH as low as 4.4 to 4.5 (Brunet et al., 1997; Dzwonko, Z. 2001) and calcaerous soils (Simpson, 1938; Webb, 1947; Kelly, 1981; Lee et al., 1991; Dzwonko & Loster, 1992; Doing, 1995; Grubb et al., 1996). One study suggests European spindletree is capable of "appreciable nitrate assimilation" (Al Gharbi & Hipkin, 1984). Reportedly has strong resilence to herbivory in its native range (van der Meijden et al., 1988).
Sources of information:
Simpson, 1938; Webb, 1947; Kelly, 1981; Way & Cammell, 1982; Al Gharbi & Hipkin, 1984; van der Meijden et al, 1988; Lee et al., 1991; Dzwonko & Loster, 1992; Doing, 1995; Grubb et al., 1996; Brunet et al., 1997; Siebel et al., 1998; Ma, 2001.

2.5. Growth vigor

A. Does not form thickets or have a climbing or smothering growth habit 0
B. Has climbing or smothering growth habit, forms a dense layer above shorter vegetation, forms dense thickets, or forms a dense floating mat in aquatic systems where it smothers other vegetation or organisms 2
U. Unknown

Score 0

Documentation:
Describe growth form:
No climbing or smothering habit or thickets observed.
Sources of information:
Authors' personal observations

2.6. Germination/Regeneration

A. Requires open soil or water and disturbance for seed germination, or regeneration from vegetative propagules. 0
B. Can germinate/regenerate in vegetated areas but in a narrow range or in special conditions 2
C. Can germinate/regenerate in existing vegetation in a wide range of conditions 3
U. Unknown (No studies have been completed)

Score 2

Documentation:
Describe germination requirements:
Field germination experiments of untreated seeds found a germination rate of 67%
Seedlings not commonly observed in the field in existing populations.
Sources of information:
Kollmann, 1996; Takos & Efthimiou, 2003.

2.7. Other species in the genus invasive in New York or elsewhere

A. No 0
B. Yes 3
U. Unknown

Score 3

Documentation:
Species:
Euonymus alatus, E. fortunei. Heffernan, rev.Gravuer, 2008; U.S.D.A., 2009; Weldy & Werier, 2009..

Total Possible 25
Section Two Total 18

3. ECOLOGICAL AMPLITUDE AND DISTRIBUTION

3.1. Density of stands in natural areas in the northeastern USA and eastern Canada (use same definition as Gleason & Cronquist which is: "The part of the United States covered extends from the Atlantic Ocean west to the western boundaries of Minnesota, Iowa, northern Missouri, and southern Illinois, south to the southern boundaries of Virginia, Kentucky, and Illinois, and south to the Missouri River in Missouri. In Canada the area covered includes Nova Scotia, Prince Edward Island, New Brunswick, and parts of Quebec and Ontario lying south of the 47th parallel of latitude")

A. No large stands (no areas greater than 1/4 acre or 1000 square meters) 0
B. Large dense stands present in areas with numerous invasive species already present or disturbed landscapes 2
C. Large dense stands present in areas with few other invasive species present (i.e. ability to invade relatively pristine natural areas) 4
U. Unknown

Score 0

Documentation:
Identify reason for selection, or evidence of weedy history:
No large stands observed or reported in literature.
Sources of information:
Authors' pers. obs.

3.2. Number of habitats the species may invade

A. Not known to invade any natural habitats given at A2.3 0
B. Known to occur in two or more of the habitats given at A2.3, with at least one a natural habitat. 1
C. Known to occur in three or more of the habitats given at A2.3, with at least two a natural habitat. 2
D. Known to occur in four or more of the habitats given at A2.3, with at least three a natural habitat. 4
E. Known to occur in more than four of the habitats given at A2.3, with at least four a natural habitat. 6
U. Unknown

Score 6

Documentation:
Identify type of habitats where it occurs and degree/type of impacts:
See A2.3.
Sources of information:
Kelly, 1981; van der Meijden et al., 1988; Lee et al., 1991; Dzwonko & Loster, 1992; Higler, 1993; van der Laan et al., 1997; Siebel et al., 1998; de Bonte et al., 1999; Kollmann & Schneider, 1999; Garbary & Deveau, 2007; Brooklyn Botanic Garden, 2009.

3.3. Role of disturbance in establishment

A. Requires anthropogenic disturbances to establish. 0
B. May occasionally establish in undisturbed areas but can readily establish in areas with natural or anthropogenic disturbances. 2
C. Can establish independent of any known natural or anthropogenic disturbances. 4
U. Unknown

Score 4

Documentation:
Identify type of disturbance:
Plants and seedlings reportedly have high shade tolerance (Dzwonko & Loster, 1992; Grubb et al., 1996; Siebel et al., 1998). Also reportely a component of dense woodlands in its native Europe (Dzwonko & Loster, 1992). These traits may infer ability to colonize pristine woods. Plant has been observed in dense woodlands lacking any recent disturbance.
Sources of information:
Dzwonko & Loster, 1992; Grubb et al., 1996; Siebel et al., 1998; authors' pers. obs.

3.4. Climate in native range

A. Native range does not include climates similar to New York 0
B. Native range possibly includes climates similar to at least part of New York. 1
C. Native range includes climates similar to those in New York 3
U. Unknown

Score 3

Documentation:
Describe what part of the native range is similar in climate to New York:
Europe, as far north as Norway and Sweden.
Sources of information:
Blakelock, 1951; Brunet et al., 1997; Ma, 2001.

3.5. Current introduced distribution in the northeastern USA and eastern Canada (see question 3.1 for definition of geographic scope)

A. Not known from the northeastern US and adjacent Canada 0
B. Present as a non-native in one northeastern USA state and/or eastern Canadian province. 1
C. Present as a non-native in 2 or 3 northeastern USA states and/or eastern Canadian provinces. 2
D. Present as a non-native in 4–8 northeastern USA states and/or eastern Canadian provinces, and/or categorized as a problem weed (e.g., “Noxious” or “Invasive”) in 1 northeastern state or eastern Canadian province. 3
E. Present as a non-native in >8 northeastern USA states and/or eastern Canadian provinces. and/or categorized as a problem weed (e.g., “Noxious” or “Invasive”) in 2 northeastern states or eastern Canadian provinces. 4
U. Unknown

Score 4

Documentation:
Identify states and provinces invaded:
CT, IL, KY, MA, ME, MI, NH, NJ, NY, OH, PA, RI, VA, VT, WI; New Brunswick, Ontario, Quebec.
Sources of information: See known introduced range in plants.usda.gov, and update with information from states and Canadian provinces.
U.S.D.A., 2009.

3.6. Current introduced distribution of the species in natural areas in the eight New York State PRISMs (Partnerships for Regional Invasive Species Management)

A. Present in none of the PRISMs 0
B. Present in 1 PRISM 1

C. Present in 2 PRISMs 2
D. Present in 3 PRISMs 3
E. Present in more than 3 PRISMs or on the Federal noxious weed lists 4
U. Unknown

Score 4

Documentation:
Describe distribution:
See A1.1.
Sources of information:
Brooklyn Botanic Garden, 2009; Weldy & Werier, 2009.

Total Possible 25
Section Three Total 21

4. DIFFICULTY OF CONTROL

4.1. Seed banks

A. Seeds (or vegetative propagules) remain viable in soil for less than 1 year, or does not make viable seeds or persistent propagules. 0
B. Seeds (or vegetative propagules) remain viable in soil for at least 1 to 10 years 2
C. Seeds (or vegetative propagules) remain viable in soil for more than 10 years 3
U. Unknown

Score 2

Documentation:
Identify longevity of seed bank:
One European study found germination of spindletree seeds manly occurred in the second spring following fruit maturation, suggesting a seed banking capacity of at least one year (Lee et al., 1991).

Sources of information:
Lee et al., 1991; Kollmann, 1996.

4.2. Vegetative regeneration

A. No regrowth following removal of aboveground growth 0
B. Regrowth from ground-level meristems 1
C. Regrowth from extensive underground system 2
D. Any plant part is a viable propagule 3
U. Unknown

Score 1

Documentation:
Describe vegetative response:
Perennial, able to regenerate via the ground-level meristem.
Sources of information:
Koop, 1987; Siebel et al., 1998; SRC pers. obs.

4.3. Level of effort required

A. Management is not required: e.g., species does not persist without repeated anthropogenic disturbance. 0
B. Management is relatively easy and inexpensive: e.g. 10 or fewer person-hours of manual effort (pulling, cutting and/or digging) can eradicate a 1 acre infestation in 1 year (infestation averages 50% cover or 1 plant/100 ft^2). 2
C. Management requires a major short-term investment: e.g. 100 or fewer person-hours/year of 3

manual effort, or up to 10 person-hours/year using mechanical equipment (chain saws, mowers, etc.) for 2-5 years to suppress a 1 acre infestation. Eradication is difficult, but possible (infestation as above).

D. Management requires a major investment: e.g. more than 100 person-hours/year of manual effort, or more than 10 person hours/year using mechanical equipment, or the use of herbicide, grazing animals, fire, etc. for more than 5 years to suppress a 1 acre infestation. Eradication may be impossible (infestation as above). 4

U. Unknown

Score	0

Documentation:
Identify types of control methods and time-term required:
No management studies located for Euonymus europaeus. Due to the small stands in New York, the species currently does not require management.

Sources of information:
LIISMA SRC, 2009.

Total Possible	10
Section Four Total	3
Total for 4 sections Possible	80
Total for 4 sections	48

C. STATUS OF CULTIVARS AND HYBRIDS:

At the present time (May 2008) there is no protocol or criteria for assessing the invasiveness of cultivars independent of the species to which they belong. Such a protocol is needed, and individuals with the appropriate expertise should address this issue in the future. Such a protocol will likely require data on cultivar fertility and identification in both experimental and natural settings.

Hybrids (crosses between different parent species) should be assessed individually and separately from the parent species wherever taxonomically possible, since their invasiveness may differ from that of the parent species. An exception should be made if the taxonomy of the species and hybrids are uncertain, and species and hybrids can not be clearly distinguished in the field. In such cases it is not feasible to distinguish species and hybrids, and they can only be assessed as a single unit.

Some cultivars of the species known to be available: Albus, Aldenhamensis, Nana, Red Ace, Red Cascade, Red Caps

References for species assessment:

Al Gharbi, A. & C. R. Hipkin. 1984. Studies on nitrate reductase in British angiosperms. I. A comparison of nitrate reductase activity in ruderal, woodland-edge and woody species. New Phytologist. 97(4):629-639.

Blakelock, R. A. 1951. A synopsis of the genus Euonymus L. Kew Bulletin. 6(2):210-290.

de Bonte, A. J., A. Boosten, H. G. J. M. van der Hagen & K. V. Sýkora. 1999. Vegetation development influenced by grazing in the coastal dunes near the Hague, the Netherlands. J. Coastal Conservation. 5(1):59-68.

Brooklyn Botanic Garden. 2009. AILANTHUS database. [Accessed on 28 April 2009].

Brunet, J., U. Falkengren-Grerup & G. Tyler. 1997. Pattern and dynamics of the ground vegetation in south Swedish Carpinus betulus forests: Importance of soil chemistry and management. Ecography. 20(5):513-520.

Buzinova, A. I. 1956. The relation between the productivity of the European spindle tree (Euonymus europaeus) and the weight of the seed. Sb. Rab. Lesn. Khoz. 32:157-160. [NOT SEEN]

Doing, H. 1995. Landscape ecology of the Dutch coast. J. Coastal Conservation. 1(2):145-172.

Dzwonko, Z. 2001. Assessment of light and soil conditions in ancient and recent woodlands by Ellenberg Indicator Values. Journal of Applied Ecology. 38(5):942-951.

Dzwonko, Z. & S. Loster. 1992. Species richness and seed dispersal to secondary woods in southern Poland. J. Biogeography. 19(2):195-204.

Fuentes, M. 1994. Diets of fruit-eating birds: What are the causes of interspecific differences? Oecologia. 97(1):134-142.

Garbary, D. J. & A. E. Deveau. 2007. The Spindle Tree, Euonymus europaea L. (Celastraceae): A newly naturalized shrub in Nova Scotia. Canadian Field-Naturalist. 121(1):85-88.

Grubb, P. J., W. G. Lee, J. Kollmann &J. B. Wilson. 1996. Interaction of irradiance and soil nutrient supply on growth of seedlings of ten European tall-shrub species and Fagus sylvatica. J. Ecology. 84(6):827-840.

Heffernan, K., rev. K. Gravuer (2008). Euonymus alatus. U.S. Invasive Species Impact Rank (I-Rank). NatureServe Explorer. <www.natureserve.org>. [Accessed on 28 April 2009].

Higler, L. W. G. 1993. The riparian community of northwest European lowland streams. Freshwater Biology. 29:229-241.

Kelly, D. L. 1981. The native forest vegetation of Killarney, southwest Ireland: An ecological account. J. Ecology. 69(2):437-472.

Kollmann, J.1996. Differences in the regeneration niche of endozoochorous species. Jahreshefte der Gesellschaft fuer Naturkunde in Wuerttemberg. 152:85-113. [NOT SEEN]

Kollmann, J. & B. Schneider. 1999. Landscape structure and diversity of fleshy-fruited species at forest edges. Plant Ecology. 144(1):37-48.
Koop, H. 1987. Vegetative reproduction of trees in some European natural forests. Vegetatio. 72(2):103-110.

Lee, W. G., P. J. Grubb, & J. B. Wilson . 1991. Patterns of resource allocation in fleshy fruits of nine European tall-shrub species. Oikos. 61(3):307-315.

Lloyd, D. G., C. J. Webb, & R. B. Primack. 1980. Sexual strategies in plants. II. Data on the temporal regulation of maternal investment. New Phytologist. 86(1):81-92.

Ma, J. 2001. A revision of Euonumus (Celastraceae). Thaiszia. 11(1-2):1-264.

Ridley, H. N. 1930. The dispersal of plants throughout the world. L. Reeve & Co. Ltd., Ashford, Kent, UK. 744 pp.

Siebel, H. N. & I. M. Bouwma. 1998. The occurrence of herbs and woody juveniles in a hardwood floodplain forest in relation to flooding and light. J. Vegetation Science. 9(5):623-630.

Simpson, J. F. H. 1938. A chalk flora on the Lower Greensand: Its use in interpreting the calcicole habit. J. Ecology. 26(1):218-235.

Sorensen, A. E. 1981. Interactions between birds and fruit in a temperate woodland. Oecologia. 50(2):242-249.

Takos, I. A. & G. S. Efthimiou. 2003. Germination results on dormant seeds of fifteen tree species autumn sown in a northern Greek nursery. Silvae Genetica. 52(2):67-71.

United States Department of Agriculture, National Resources Conservation Service. 2009. The PLANTS Database. National Plant Data Center, Baton Rouge, Louisiana [Accessed on 28 April 2009].

van der Laan, D., O. F. R. van Tongeren, W. H. van der Putten & G. Veenbaas. 1997. Vegetation development in coastal foredunes in relation to methods of establishing marram grass (Ammophila arenaria). J. Coastal Conservation. 3(2):179-190.

van der Meijden, E., M. Wijn & H. J. Verkaar. 1988. Defence and regrowth, alternative plant strategies in the struggle against herbivores. Oikos. 51(3):355-363.

Way, M. J. & M. E. Cammell. 1982. The distribution and abundance of the spindle tree, Euonymus europaeus, in southern England with particular reference to forecasting infestations of the black bean aphid, Aphis fabae. J. Applied Ecology. 19(3):929-940.

Webb, C. J. 1979. Breeding system and seed set in Euonymus europaeus (Celastraceae). Plant Systematics & Evolution. 132(4):299-304.

Webb, D. A. 1947. The vegetation of Carrowkeel, a limestone hill in northwest Ireland. J. Ecology. 35(1/2):105-129.

Weldy, T. & D. Werier. 2009. New York Flora Atlas. [S. M. Landry and K. N. Campbell (original application development), Florida Center for Community Design and Research. University of South Florida]. New York Flora Association, Albany, New York. [Accessed on 28 April 2009].

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References for ranking form:

Carlson, Matthew L., Irina V. Lapina, Michael Shephard, Jeffery S. Conn, Roseann Densmore, Page Spencer, Jeff Heys, Julie Riley, Jamie Nielsen. 2008. Invasiveness ranking system for non-native plants of Alaska. Technical Paper R10-TPXX, USDA Forest Service, Alaska Region, Anchorage, AK XX9. Alaska Weed Ranking Project may be viewed at: http://akweeds.uaa.alaska.edu/akweeds_ranking_page.htm.

Heffernan, K.E., P.P. Coulling, J.F. Townsend, and C.J. Hutto. 2001. Ranking Invasive Exotic Plant Species in Virginia. Natural Heritage Technical Report 01-13. Virginia Dept. of Conservation and Recreation, Division of Natural Heritage, Richmond, Virginia. 27 pp. plus appendices (total 149 p.).

Morse, L.E., J.M. Randall, N. Benton, R. Hiebert, and S. Lu. 2004. An Invasive Species Assessment Protocol: Evaluating Non-Native Plants for Their Impact on Biodiversity. Version 1. NatureServe, Arlington, Virginia. http://www.natureserve.org/getData/plantData.jsp

Randall, J.M., L.E. Morse, N. Benton, R. Hiebert, S. Lu, and T. Killeffer. 2008. The Invasive Species Assessment Protocol: A Tool for Creating Regional and National Lists of Invasive Nonnative Plants that Negatively Impact Biodiversity. Invasive Plant Science and Management 1:36–49

Warner, Peter J., Carla C. Bossard, Matthew L. Brooks, Joseph M. DiTomaso, John A. Hall, Ann M.Howald, Douglas W. Johnson, John M. Randall, Cynthia L. Roye, Maria M. Ryan, and Alison E. Stanton. 2003. Criteria for Categorizing Invasive Non-Native Plants that Threaten Wildlands. Available online at www.caleppc.org and www.swvma.org. California Exotic Pest Plant Council and Southwest Vegetation Management Association. 24 pp.

Williams, P. A., and M. Newfield. 2002. A weed risk assessment system for new conservation weeds in New Zealand. Science for Conservation 209. New Zealand Department of Conservation. 1-23 pp.