

**Assessment of Invasive Species in
Indiana's Natural Areas**

*****OFFICIAL Burning Bush (*Euonymus alatus*) ASSESSMENT*****

Answers are underlined and in **bold**, comments are inserted in *italics*

Members of 9/19/07 assessment subcommittee: Ellen Jacquart (TNC), David Gorden, Rebecca Dolan

Invasive Ranking Summary	Score
Ecological Impacts	18
Potential For Expansion	31
Difficulty of Management	20
Total Score:	69 Medium
<i>Rankings: Low < 45, Medium 45 – 80, High > 80</i>	

Contents of the Assessment:

Section I – Invasion Status. Determines whether the species being evaluated is invasive in Indiana.

Section II – Ecological Impacts of Invasion. Evaluates the significance of impacts of the species.

Section III – Potential for Expansion. Evaluates the actual and/or potential expansion of the species.

Section IV – Difficulty of Management. Evaluates how hard it is to control the invasive species.

Section V – Commercial Value. Evaluates how valuable the species is economically in Indiana.

Questions in Sections I – V may direct you to one or more of the following sections for particular invasive species:

Section A. For species which have impacts limited to a few sites, assesses the potential for further spread.

Section B. For species which have medium impacts but high value, assesses whether species could be used in specific circumstances that would prevent escape and invasion.

A worksheet for use with the assessment is found on page 9.

Automatic Exemption From the Assessment

Is this species listed on any federal or on an Indiana state noxious, or prohibited plant lists?

If **YES** then do not proceed with assessment but indicate a conclusion of **Do not use this plant** on the front of the response form.

If **NO** then go to Section I.

Section I

Invasion Status

1-a Current Invasion in Indiana

1. Does this species occur in any natural areas in Indiana?

If **NO** then go to Section III-c.

If **YES** then go to 1-a 2.

2. Does it **ONLY** occur in natural areas of Indiana because it has persisted from its previous cultivation (e.g., in abandoned farmland or homesteads)?

If **YES** then go to Section III-c.

If **NO** then go to Section 1-b (below).

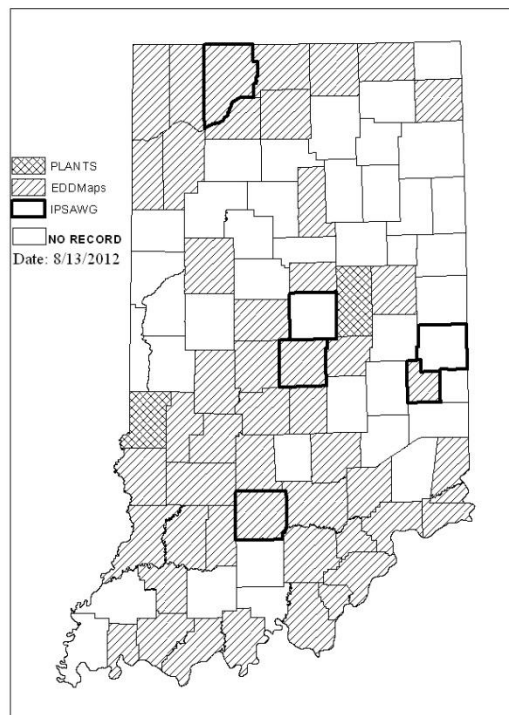
1-b Invasion Status in Indiana

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Evidence of invasion (forming self-sustaining and expanding populations within a plant community with which it had not previously been associated) must be provided. If not available in a published, quantitative form, this evidence must include written observations from at least three appropriate biologists.

1. Is species invasive ONLY when natural disturbance regime and scale have been altered? (e.g. where frequency, extent, or severity of fires have been reduced by human activity).
If YES then go to questions 1-b 2.
If NO – the species is invasive, go to Section II (below).
2. Has this species ever been known to persist, following colonization, when the natural regime is resumed and the natural flora/communities recover? (e.g., is not an early successional species that only temporarily invades disturbed sites.)
If YES (or unknown) - the species is invasive, go to Section II (below).
If NO (known not to persist) the species is currently not invasive in Indiana. Go to Section III-c to assess the species' potential for future invasion.

Reported Status of Winged Burning Bush, *Euonymus alatus*



Section II

Ecological Impacts of Invasion

Impact Index

II-a Known Impacts at WORST SITE(S) (without, or before, any control effort)

Add up points for ALL impact statements (i through vi) that are true at the worst affected site(s) then go to question II-b. Evidence of impacts must be provided. If not available in published, quantitative form, this evidence must include written observations from at least *three* appropriate biologists, including specific locations of observations. Scientific names of impacted species (e.g., State-listed or native species with which hybridization occurs) must be included on the response form. If there is no evidence of an impact, then assign 0 points unless the impact is considered very likely (e.g., fixes N₂ in low nutrient soil that can

change the flora) or the impact (except vi) has been demonstrated in similar habitats in states. In these cases assign 0.5 points.

	<u>Points</u>
i) Causes long-term, broad alterations in ecosystem processes changing the community as a whole (e.g. invasion of cattails changes hydrology, drying the site and allowing open aquatic systems to become forested). <i>Heffernan (2004): "No reported impact in referenced literature (Martin 2002; Ebinger et al. 1984). "However, ecological studies on the species are limited. Sources of information: Ebinger et al., 1984; Martin, 2002; Heffernan, 2004.</i>	15
ii) Has negatively impacted Indiana State-listed or Federal-listed plants or animals (choose one of the following): Displacement, death or hybridization has been documented AND occurs in at least 20% of known locations of the listed species, OR these effects occur in less than 20% of known locations of the listed species, but at least 4 different listed species are affected.	12
Displacement, death or hybridization occurs in less than 20% of locations of the listed species OR impacts are considered likely because the listed and invasive species closely co-habit (e.g., compete for light). <i>None reported</i>	4
iii) Displaces or precludes native vegetation (affecting mortality and/or recruitment) by achieving infestations in the state that have at least 50% coverage of this species (as defined in the glossary) in the affected stratum that meet any of the following criteria: a) collectively add up to at least 10 acres b) are 5 infestations of at least 0.25 acres c) are 5 infestations that cover an entire localized community (e.g. sinkhole, seeps, fens, bogs, barrens, cliffs) d) are 5 infestations some of which are at least 0.25 acres and others of which cover entire localized communities.	12
<i>Based on reports from the field, we do not have more than 10 acres at >50% cover; however, adding together the 13 reported infestations from six counties there are 5 infestations of at least 0.25 acres</i>	
iv) Changes community structure in ways other than vegetation displacement (e.g., alters wildlife abundance, adds a new stratum, or increases stem density within a stratum by more than 5-fold). <i>Can increase the density of the shrub layer, but not reported to be creating a new layer or causing major alteration of community structure.</i> <i>Sources of information: Ebinger et al., 1984; Martin, 2002; Heffernan, 2004.</i>	4
v) Hybridizes with native Indiana plants or commercially-available species.	4
vi) Covers over 15% of invaded stratum (but if 12 points were assigned for statement iii, do not assign points here) on > 10 acres in the state. <i>Again, based on reports, we don't have over 10 acres (we are being conservative in interpreting the acreage ranges on the reports)</i>	3
Total points (place in worksheet page 9): <u>12</u>	

II-b Range of Habitats in Which Species is Invasive

Forest: 1)Dry upland, 2)Dry-mesic upland, 3)Mesic upland, 4)Mesic floodplain, 5)Wet-mesic floodplain, 6)Wet floodplain, 7)Bluegrass till plain flatwoods*, 8)Boreal flatwoods*, 9)Central till plain flatwoods, 10)Dry flatwoods*, 11)Sand flatwoods*, 12)Southwestern lowland mesic flatwoods*

- Savanna: 13)Mesic savanna*, 14)Dry sand savanna*, 15)Dry-mesic sand savanna*
- Barrens: 16)Limestone bedrock*, 17)Sandstone bedrock*, 18)Siltstone bedrock*, 19)Chert*, 20)Gravel*, 21)Sand*, 22) Clay*
- Prairie: 23)Dry-mesic prairie*, 24)Mesic prairie*, **25)Wet prairie***, 26)Dry sand prairie*, 27)Dry-mesic sand prairie*, 28)Wet-mesic sand prairie*, **29)Wet sand prairie***
- Wetland: **30)Marl beach***, **31)Acid bog***, **32)Circumneutral bog***, **33)Fen***, **34)Forested fen***, **35)Muck and Sand flats***, **36)Marsh**, **37)Sedge meadow***, **38)Panne***, **39)Acid seep***, **40)Calcareous seep***, **41)Circumneutral seep***, **42)Forest swamp**, **43)Shrub swamp**
- Lake: **44)Lake**, **45)Pond**
- Stream: **46)Low-gradient creek**, **47)Medium-gradient creek**, **48)High-gradient creek**, **49)Low-gradient river**, **50)Medium-gradient river**, **51)Major river**
- Primary: **52)Aquatic cave***, 53)Terrestrial cave*, 54)Eroding cliff*, 55)Limestone cliff*, 56)Overhang cliff*, 57)Sandstone cliff*, 58)Lake dune*, 59)Gravel wash*

Is this species known to be invasive in at least four habitat-types (note – rare habitat-types are marked with a * and count as 2 when adding) OR does it occur in at least one habitat-type of each of the terrestrial and palustrine/aquatic lists (palustrine/aquatic habitats are shown in **bold**) *7 habitat types affected*.

If YES then multiply total score from II-a by 1.5
then go to Section II-c (Below)

If NO then multiply total score from II-a by 1
then go to Section II-c (Below)

Place point total in worksheet, page 9.

II-c Proportion of Invaded Sites with Significant Impacts

Of the invaded sites, might any of the worst impacts [items i-v in section II-a] only occur under a few, identifiable, environmental conditions (i.e., edaphic or other biological conditions occurring in 1-10% of the sites)? Documentation of evidence must be provided for a **YES** answer.

If NO or NO SCORE on items i to v in section II-a
then go to Section III

If YES then go to Section A

Section III

Potential for Expansion

Potential Index

This section evaluates a species' actual and/or potential for expansion in Indiana.

III-a Potential for Becoming Invasive in Indiana

1. Is information available on the occurrence of new populations of this species in Indiana over the last 5 years?

If **YES** then go to section III-b

If NO go to Section III-c to estimate potential for expansion based on the biology of the species.

III-b. Known Rate of Invasion.

1. Was this species reported in more than two new discrete sites (e.g., lakes, parks, fragments of habitats at least 5 miles apart) in any 12 month period within the last 5 years?

If **NO** then P = Low; then go to Section IV

If **YES** then P = High; then go to Section IV

III-c. Estimated Rate of Invasion. This section is used to predict the risk of invasion for species that are 1) not currently invasive in the state, and 2) invasive in the state but for which no data on current rate of spread exists. These questions are based on Hiebert et al. 1995.

1. Does this species hybridize with any State-listed plants or commercially-important species? (E.g., exhibit pollen / genetic invasion.)

If **YES** then go to Section B

If **NO** then go to question III-c 2.

2. Add up all points from statements that are true for this species. Points

i. Ability to complete reproductive cycle in area of concern 0
a. not observed to complete reproductive cycle 5
b. observed to complete reproductive cycle

ii. Mode of reproduction 1
a. reproduces almost entirely by vegetative means 3
b. reproduces only by seeds 5
c. reproduces vegetatively and by seed

iii. Vegetative reproduction 0
a. no vegetative reproduction 1
b. vegetative reproduction rate maintains population 3
c. vegetative reproduction rate results in moderate increase in population size 5
d. vegetative reproduction rate results in rapid increase in population size

iv. Frequency of sexual reproduction for mature plant 0
a. almost never reproduces sexually in area 1
b. once every five or more years 3
c. every other year 5
d. one or more times a year

Seeds can remain viable for up to two years; no evidence for ten years.

Sources of information:

Catalpa Tree Seed Company, 2007.

v. Number of seeds per plant 1
a. few (0-10) 3
b. moderate (11-1,000) 5
c. many-seeded (> 1,000)

vi. Dispersal ability 0
a. little potential for long-distance dispersal 5
b. great potential for long-distance dispersal

Birds and small animals provide numerous opportunities for long-distance dispersal.

Sources of information:

Goo et al., 1995; Heffernan, 2004; Ma & Moore, 2004.

vii. Germination requirements 0
a. requires open soil and disturbance to germinate 3
b. can germinate in vegetated areas but in a narrow range or in special conditions

- c. can germinate in existing vegetation in a wide range of conditions

5

Personal observation (Jacquart).

viii. Competitive ability

- a. poor competitor for limiting factors
 b. moderately competitive for limiting factors
 c. highly competitive for limiting factors

0

3

5

Perennial habit, shade tolerant.

Sources of information:

Heffernan, 2004; Ma & Moore, 2004.

Total points for questions i – viii (place in worksheet page 9): 31

Section IV

Difficulty of Management

Management Index

IV Factors That Increase the Difficulty of Management

Add up all points from statements that are true for this species then go to Section V. Assign 0.5 point for each statement for which a true/false response is not known.

	<u>Points</u>
i) Control techniques that would eliminate the worst-case effects (as listed in Section II) have been investigated but none has been found.	15
ii) This species is difficult to control without significant damage to native species because: it is widely dispersed throughout the sites (i.e., does not occur within discrete clumps nor monocultures); it is attached to native species (e.g., vine, epiphytes or parasite); or there is a native plant which is easily mistaken for this invader in: (choose one)	
≥ 50% of discrete sites in which this species grows;	10
25% to 50% of discrete sites in which this species grows.	7
iii) Total contractual costs of known control method per acre in first year, including access, personnel, equipment, and materials (any needed re-vegetation is not included) > \$2,000/acre (estimated control costs are for acres with a 50% infestation)	<u>5</u>
<i>Control is complicated by the fact that pulled stems can root from the stem nodes and so must be removed from the site.</i>	
iv) Further site restoration is <i>usually</i> necessary following plant control to reverse ecosystem impacts and to restore the original habitat-type or to prevent immediate re-colonization of the invader. <i>Not in our experience.</i>	5
v) The total area over which management would have to be conducted is: (choose one).	
≥ 100 acres;	5
< 100 but > 50 acres.	2
≤ 50 but > 10 acres.	<u>1</u>
≤10 acres	½
<i>Based on survey reports</i>	
vi) Following the first year of control of this species, it would be expected that individual sites would require re-survey or re-treatment, due to recruitment from persistent seeds, spores, or vegetative structures, or by dispersal from outside the site: (choose one)	
at least once a year for the next 5 years;	10
one to 4 times over the next 5 years;	<u>6</u>

regrowth not known	2
vii) Occurs in more than 20 discrete sites (e.g., water-basins, parks, fragments of habitats at least 5 miles apart). <i>Overlease et al. 2002 notes it is naturalized throughout the state.</i>	<u>3</u>
viii) The number of viable, independent propagules per mature plant (e.g., seeds, spores, fragments, tubers, etc. detached from parent) is > 200 per year AND one or more of the following: A. the propagules can survive for more than 1 year; B. the propagules have structures (<u>fleshy coverings</u> , barbs, plumes, or bladders) that indicate they may spread widely by birds, mammals, wind or water; C. the infestations at 3 or more sites exhibit signs of long distance dispersal. Some possible indicators of long distance dispersal include: the infestation has outlier individuals distant [>50 yards] from the core population; the infestation apparently lacks sources of propagules within $\frac{1}{4}$ mile.	<u>3</u>
ix) Age at first reproduction is within first 10% of likely life-span and/or less than 3 months. <i>50 year estimated life span: plant flowers by five.</i>	<u>2</u>
Total points (place in worksheet page 9):	<u>20</u>

Section V	Commercial Value	Value Index
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V-a Commercial Value

Does this species have any commercial value?

If response is **NO** then V = 0 and Go to Conversion of Index Scores to Index Categories

If response is **YES** then go to Section V-b

V-b Factors that Indicate a Significant Commercial Value

Add up all points from statements that are true for this species. Assign 0.5 point for each statement for which a true/false response is not known.

	<u>Points</u>
i) This species is sold in national or regional retail stores (e.g., WalMart, Home Depot, Publix).	<u>10</u>
ii) State-wide there are more than 20 commercial growers of this species.	<u>7</u>
iii) More than five growers in Indiana rely on this species as more than 10% of their production.	3
iv) This species has provided a crop, turf, or feed source (e.g., forage, nectar) that has been, or resulted in, a significant source of income for at least five farmers for over 20 years.	3
v) This species is utilized statewide.	<u>3</u>
vi) There are more than 100 retail seed outlets statewide	3
Total points (place in worksheet page 9):	<u>20</u>

August 3, 2005 template version

Per David Gorden, there is great variability in fruit production between cultivars. For instance, he and others have noted very few fruits on cv. Compactus. He is not as familiar with 'Rudy Haag' but that has been reported as having few/no fruits (see email from Paul Cappiello below). 'Nordine Strain' is a cultivar known for heavy fruit production. Dirr (1998) states that birds have moved this species around by consuming fruits. He also cites Ebinger's work in Illinois documenting invasion into northeast Illinois natural areas (this is all summarized in J. Peter's assessment).

Email from Paul Cappiello re. 'Rudy Haag' cv.

>>> Charles Tubesing 11/23/2005 4:05:19 PM >>>
Jennifer,

I queried Paul Cappiello about *Euonymus alatus* 'Rudy Haag', and his reply is highlighted in blue. The original plants at Bernheim Forest have been there for 50 years:

>>> "Paul Cappiello" <paulc@yewdellgardens.org> 11/23/2005 3:57:52 PM >>>
Charles:

I've inserted my responses into your note below. Hope this helps.

Hi Paul,

The Ohio Nursery and Landscape Association's Plant Selection Committee visited Bernheim in 2002,. After this visit, a publication was issued that credits *Euonymus alatus* 'Rudy Haag' with not producing viable seeds, and consequently not being an invasive plant: Can you clarify, based on your observations at Bernheim?

Does it produce fruit?

Yes, but very little. The large 3-plant mass at Bernheim measures approximately 6' tall x 15' wide (remember, these are three 50 year old plants) The largest quantity of seed I ever collected off this planting in a single year was, I think, 9. We have some smaller plants here and they may produce 10 seeds per year.

If it produces fruit, are the seeds viable?

I have collected perhaps 50 seeds over the last several years. In that time, I had 2 germinate and live for a maximum of maybe 4 days before they dried up and fell over. On cut test, they appear to be viable but I can't get them to germinate. In addition, Bob Geneve/Win Dunwell at UK have been working on this for the last two seasons. They have done hand pollinations, both selfs and outcrosses and have had next to no success in producing more seed than the plant forms on its own. They have not had any luck germinating any of the seed that they have collected or that I have sent to them.

I'm always a little nervous making grand statements about things such as seed viability. It is such a variable feature from one year to the next. However in this case, I've been at it for 8 years now and have had the same result each year and the same result as others. At this point I feel fairly comfortable recommending 'Rudy Haag' as a noninvasive form of *Ea*.

Email from Charles Tubesing re. 'Rudy Haag' and 'Compactus' cvs.:

>>> Charles Tubesing 11/23/2005 2:50:46 PM >>>
Hi Jennifer,

I believe the following is the source of the repeated claims that the cultivar Rudy Haag is not a threat. I will ask the former Director of Horticulture at Bernheim Forest to learn what he knows. Rudy Haag is a very slow-growing, non vigorous clone.

http://www.onla.org/ps_02euonymus.html

I have not heard anyone claim that 'Compactus' is any less prone to throw spontaneous seedlings. If you google it, you will find numerous references to fruit production. I did find an OSU Fact Sheet written by Jane Martin that claims that both 'Rudy Haag' and 'Compactus' are non-invasive, but considering that no one else has claimed this for 'Compactus', I'm inclined to believe that she made this claim in error, and is now reluctant to admit it.

Charles

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Section A (from Section II-c)

A1 Can the habitats in which the worst-case ecological impacts occur (items i to v in Section II-a) be clearly defined as different from invaded sites where there are no such impacts (e.g., defined by edaphic or biological factors)? (If ecological impacts include negative effects on a State-listed species, then the specific habitats in which that State-listed species occurs must be clearly distinguishable from habitats in which it does not occur.)

If **NO** then return to Section III

If **YES** then Go to question A2 and prepare such a site definition

A2 Can an estimate be made of the maximum distance that propagules (or pollen if hybridization is a concern) might reasonably be expected to disperse?

If **NO** then return to Section III

If **YES** then prepare instructions for Specified and Limited Use based on maximum dispersal distance (e.g., may be acceptable for use in specific areas but not near habitats where impacts are high.) Reassess if the incidence of worst-case impacts increases above 10% or within 10 years, whichever is earlier. THEN resume the assessment at Section III to provide scores for the other indices.

Section B (from Section III-c or if Value = High and Impact = Medium)

B1 Are there specific circumstances in which this species could be used that would not be expected to result in escape and invasion? (E.g., foliage plants that are only used indoors and which can be reasonably prevented, by conspicuous labeling, from use or disposal in the landscape.)

If **NO**, then retain the previously derived Conclusion.

If **YES**, then Acceptable for Specified and Limited Use where regulations and educational programs for penalties and enforcement of misuse exist. Reassess this species every 2 years.

Worksheet for Assessment

Section I:

Follow directions to different sections.

Section II:

Impacts Point Total: 12 X (1 or 1.5) = 18 **Impacts**

Section III:

Potential = High Medium or Low 31 **Potential for Expansion**

Section IV:

Difficulty of Management Point Total: 20 **Difficulty of Management**

Section V:

Commercial Value Point Total: 20 **Value**

Invasive Ranking Summary:

Invasive Ranking Summary	Score
Ecological Impacts	18
Potential For Expansion	31
Difficulty of Management	20
Total Score:	69
	Medium
<i>Rankings: Low < 45, Medium 45 – 80, High > 80</i>	

Literature Cited

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Glossary

Anthropogenic disturbance. Human-induced disturbance (e.g., mowing) or human-induced changes in natural disturbance regime (e.g., changing the frequency, extent, or severity of fires).

Coverage. Visual or quantitative estimate of the relative amount of area in a stratum where the canopy of the non-native species intercepts the light that would otherwise be available for other species in or below that stratum. Estimated cover may be dispersed or continuous in a site. Cover is usually measured when foliage is fully expanded. In the case of species that form a dense, continuous mat of rhizomes or stolons, the percent of the soil surface or upper level occupied by that root mat can be estimated as soil, rather than canopy, cover.

Disturbance. Mechanisms that limit biomass by causing its partial or total destruction.

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Discrete sites. Disjunct habitat-types or fragments of habitats at least 1 mile apart that support invasive plant populations that likely arose by separate long-distance dispersal mechanisms.

Documentation of evidence. One publication including relevant, original research will suffice if data are specific to the taxon and zone(s) under evaluation. If such documentation is not available or needs to be up-dated, at least three individuals who have the expertise on the particular species and zone in question must be identified.

Federal- or Indiana -listed. Species that are listed by Federal laws or Indiana statutes or rules as threatened or endangered within the State of Indiana. This list with notes is available at <http://www.state.in.us/dnr/naturepr/endanger/plant.htm>

Formal Risk Benefit Analysis. Detailed economic studies of impact and management costs and commercial value for present and future infestations.

Invasive. A species that forms self-sustaining and expanding populations within a natural plant community with which it had not previously been associated (Vitousek *et al.* 1995).

Long-term alterations in ecosystem processes. Examples of ecosystem processes that could be altered: erosion and sedimentation rates; land elevation; water channels; water-holding capacity; water-table depth; surface flow patterns; rates of nutrient mineralization or immobilization; soil or water chemistry; and type, frequency, intensity, or duration of disturbance. For further explanation see Gordon (1998).

Native. Species within its natural range or natural zone of dispersal (i.e., within the range it could have, or would have, occupied without direct or indirect introduction and/or care by humans. Excludes species descended from domesticated ancestors) (Vitousek *et al.* 1995).

Natural areas. Natural areas: Areas with native plant communities supporting native plant and animal species, with long undisturbed soil systems, and hydrological regimes relatively intact or under restoration. Edges of historically or currently disturbed areas (roadsides, trails, adjacent to historically disturbed locations, etc.) should not be included in the assessment of invasion into natural areas. That invasion may have been facilitated by the edges, but has to have extended into the native communities for inclusion in this category.

Pollen or genetic invasion. When a native species is displaced by a non-native species through hybridization.

Stratum. A distinct layer in the architecture of vegetation (e.g., tree canopy or understory shrubs).