August 3, 2005 version

Assessment of Invasive Species in Indiana's Natural Areas

OFFICIAL Common Buckthorn (*Rhamnus cathartica*) ASSESSMENT

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

Assessed August 7, 2003 by Ellen Jacquart, Ken Collins, Bob O'Neill, Paul Labus, Don Miller, Mike Cline, Dave Heckler, Lee Casebere

Invasive Ranking Summary	**Score**	
Ecological Impacts	33	
Potential For Expansion	33	
Difficulty of Management	26	
Total Score:	**92**	**High**
Rankings: Low < 45, Medium 45 – 80, High > 80		

Contents of the Assessment:

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 8.

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).

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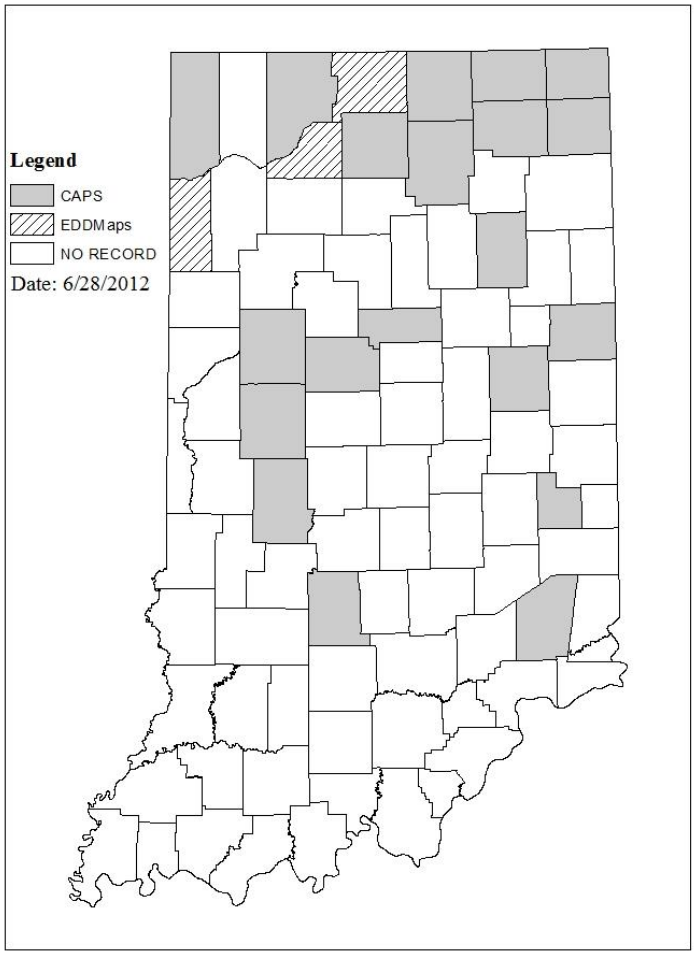
1-b <u>Invasion Status in Indiana</u>

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 Common Buckthorn, Rhamnus cathartica



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 N_2 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.

Points

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). **15**

Inhibits growth under it and thus inhibits fire in fire-adapted communities. Large numbers of seedlings crowd out native plants (Wieseler, 2005). May alter soil properties in a way that promotes and sustains invasion by Eurasian earthworms (Heneghan, et al., 2006). Buckthorn diminishes survival, flowering and growth in understory plant species and these impacts exceed effects attributable to light levels and soil fertility, suggesting allelopathy (Klionsky et al, 2010).

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). 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

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). **4**

Sites like Houghton Lake N.P. in Marshall County have extremely dense areas of common buckthorn.

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. **3**

There are several sites in Marion County alone that have buckthorn covering >15% of the understory (e.g. Ecolab at Marion College)

Total points (place in worksheet page 8): **22**

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**) **3 normal + 3 rare = 9**

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 8.

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. 4 non-rare = 4, plus 3 rare = 8.5

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

a. not observed to complete reproductive cycle	0
b. observed to complete reproductive cycle	**5**

ii. Mode of reproduction

a. reproduces almost entirely by vegetative means	1
b. reproduces only by seeds	**3**
c. reproduces vegetatively and by seed	5

iii. Vegetative reproduction

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

iv. Frequency of sexual reproduction for mature plant

a. almost never reproduces sexually in area	0
b. once every five or more years	1
c. every other year	3
d. one or more times a year	**5**

v. Number of seeds per plant

a. few (0-10)	1
b. moderate (11-l,000)	3
c. many-seeded (> l,000)	**5**

vi. Dispersal ability

a. little potential for long-distance dispersal	0
b. great potential for long-distance dispersal	**5**

Fruits are eaten by birds and other wildlife. Fruits are also dispersed by water. R. cathartica is thought to have greater dispersal ability than the glossy buckthorn, Frangula alnus, as its fruits are retained throughout the winter whereas F. alnus fruits are more readily dropped to the ground after ripening. Most birds cannot tolerate immature fruits (Godwin, 1936; Converse, 1984; Hampe, 2004; Cordeiro, 2006).

vii. Germination requirements

a. requires open soil and disturbance to germinate	0
b. can germinate in vegetated areas but in a narrow range or in special conditions	3
c. can germinate in existing vegetation in a wide range of conditions	**5**

Studies have shown that seedlings can invade apparently stable habitats. However, recruitment is most successful where there is ample light and exposed soil (Converse, 1984; Gill & Marks, 1991). One study found a mean germination rate of 85%; Seeds sown in fall and given 2-3 months cold will germinate; germination in existing vegetation noted (Archibold et al., 1997; Dirr & Heuser 2006; (Moore, 2008).

viii. Competitive ability

a. poor competitor for limiting factors	0
b. moderately competitive for limiting factors	3
c. highly competitive for limiting factors	**5**
Total points for questions i – viii (place in worksheet page 8):	**33**

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.

	Points
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)	**5**
iv) Further site restoration is *usually* necessary following plant control to reverse ecosystem impacts and to restore the original habitat-type or to prevent immediate re-colonization of the invader.	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. 1
≤10 acres ½

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; 6
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). **3**

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 (fleshy coverings, 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 ¼ mile. **3**

ix) Age at first reproduction is within first 10% of likely life-span and/or less than 3 months. 2

Total points (place in worksheet page 8): **26**

Section V — Commercial Value — Value Index

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.

Points

i) This species is sold in national or regional retail stores (e.g., WalMart, Home Depot, Publix). 10

ii) State-wide there are more than 20 commercial growers of this species. 7

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 3

vi) There are more than 100 retail seed outlets statewide 3

Total points (place in worksheet page 8): **0**

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: 22 X (1 or **1.5**) = 33 **Impacts**
Section III:
Potential = High Medium or Low 33 **Potential for Expansion**
Section IV:

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Difficulty of Management Point Total: 26 **Difficulty of Management**

Section V:

Commercial Value Point Total: 0 **Value**

Invasive Ranking Summary:

Invasive Ranking Summary	**Score**	
Ecological Impacts	33	
Potential For Expansion	33	
Difficulty of Management	26	
Total Score:	**92**	**High**
Rankings: Low < 45, Medium 45 – 80, High > 80		

Literature Cited

Adams, J. 1927. The germination of the seeds of some plants with fleshy fruits. American Journal of Botany. 14(8):415-428.

Converse, C. 1984. TNC Element Stewardship Abstract for Rhamnus cathartica, Rhamnus frangula (syn. Frangula alnus). < http://www.imapinvasives.org/GIST/ESA/esapages/franalnu.html> [Accesssed on May 20, 2012].

Cordeiro, J. 2006. Frangula alnus. U.S. Invasive Species Impact Rank (I-Rank). NatureServe Explorer. <www.natureserve.org>. [Accessed on May 20, 2012].

Dirr, M. and C.W. Heuser. 2006. The Reference Manual of Woody Plant Propagation: From Seed to Tissue Culture : A Practical Working Guide to the Propagation of over 1100 Species.

Frappier, B., R.T. Eckert, and T.D. Lee. 2003. Potential impacts of the invasive exotic shrub Rhamnus frangula L. (glossy buckthorn) on forests of southern New Hampshire. Northeastern Naturalist, 10(3): 277-296.

Frappier, B., R.T. Eckert, and T.D. Lee. 2004. Experimental removal of the non-indigenous shrub Rhamnus frangula (Glossy buckthorn): effects on native herbs and woody seedlings. Northeastern Naturalist, 11(3): 333-342.

Godwin, H. 1936. Studies in the ecology of Wicken Fen: III. The establishment and development of fen scrub (Carr). The Journal of Ecology, 24(1): 82-116.

Godwin, H., D.R. Clowes, and B. Huntley. 1974. Studies in the ecology of Wicken Fen: V. Development of Fen Charr. The Journal of Ecology, 62(1):197-214.

Hampe, A. 2004. Extensive hydrochory uncouples spatiotemporal patterns of seedfall and seedling recruitment in a 'bird-dispersed' riparian tree. Journal of Ecology. 92(5):797-807.

Jacquart, E.M. and T.M. Knight, 2010. Are There Non-invasive Cultivars of Buckthorn? Indiana Nursery and Landscape News, May/June 2010, pp. 16-17.

Klionsky, S.M., K.L. Amatangelo, and D.M. Waller. 2010. Above- and Belowground Impacts of European

Buckthorn (*Rhamnus cathartica)* on Four Native Forbs. Restoration Ecology, Vol. 19, No. 6, pp. 728-737.

Krock, S.L. and C.E. Williams. 2002. Allelopathic potential of the alien shrub glossy buckthorn, Rhamnus frangula L.: a laboratory bioassay. Journal of the Pennsylvania Academy of Science, 76: 17-21.

Massachusetts Invasive Plant Advisory Group (MIPAG). 2005. Strategic recommendations for managing invasive plants in Massachusetts. Final Report. Massachusetts Invasive Plant Advisory Group, 28 February 2005. 23 pp.

Medan, D. Reproductive biology of Frangula alnus (Rhamnaceae) in southern Spain. Plant Systematics and Evolution. 194:173-186

Possessky, S.L., C.E. Williams, and W.J. Moriarity. 2000. Glossy buckthorn, Rhamnus frangula: a threat to riparian plant communities of the northern. Allegheny Plateau. Natural Areas Journal, 20: 290-292.

Ridley, H.N. 1930. The Dispersal of Plants Throughout the World. Ashford, Kent, England: Reeve and Co.

Klionsky, S.M., K.L. Amatangelo, and D.M. Waller. 2010. Above- and Belowground Impacts of European Buckthorn (*Rhamnus cathartica)* on Four Native Forbs. Restoration Ecology, Vol. 19, No. 6, pp. 728-737.

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.

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).