Ohio Invasive Plant Assessment Protocol

				Score	Notes	References
Botanical Name:	*Ailanthus altissima*					
Common Name:	Tree-of-Heaven	Step I Outcome:	**Invasive**			
Family Name:	Simaroubaceae	Step II Score:	**56**			
Assessment conducted by:	OIPC Team	Step II Outcome:	**Invasive**			

Step I

Directions: Place an "X" in the Score column next to the selected answer to each of the four questions.

		Score	Notes	References
1. Is this plant known to occur in the state and listed as "noxious" on any federal or Ohio Department of Agriculture plant list?	Yes. *Place on invasive plant list, no further investigation needed.* ***STOP***		Tree-of-heaven is classified as a noxious or invasive plant on National Forest System lands	13
	No. *Continue on to question 2.*	X		
2. Has this plant demonstrated widespread dispersion and establishment (i.e. high numbers of individuals forming dense stands) in natural areas across two or more regions in Ohio?[a]	Yes. *Place on invasive plant list, no further investigation needed.* ***STOP***	x	1=> widespread in forests in 3 regions; 14,15=> naturalized in every county in the state, but number of individuals is not included.	1, 14,15
	No. *Continue on to question 3.*			
3. Does this plant form self-replicating populations outside of cultivation in Ohio and is it documented to alter the composition, structure, or normal processes or functions of a natural ecosystem?	Yes		Forms self-replicated populations outside of cultivation, but effects on ecosystem not fully documented.	1,2,3,14,15
	No			
	Unknown	X		
4. Is the plant listed as invasive in an adjoining state or a nearby state east of the Mississippi within the USDA Plant Hardiness zones 5-6?[b,c]	Yes	x	CT,MA,NH,VT,IN,PA,WV	2,4,13
	No			
	Unknown			

If the answer was yes for both questions 3 and 4, the plant is placed on the invasive plant list and no further research is needed. Stop here. If the answer is no for both questions 3 and 4, the plant is not considered invasive and no further investigation is warranted. Otherwise, proceed to Step II.

Step II: Invasion Status

Directions: Place the appropriate numerical score (or "U") in the Score column next to the selected answer to each of these 18 questions.

	Score	Notes	References
1. Current Invasion in Ohio - plant is not found in natural areas (**0 pts.**) - plant is found in natural areas but only because it persist from previous planting in that location (e.g. old home sites) (**0 pts.**) - plant is only expanding from sites of previous planting (**1 pt.**) - plant occurs in natural areas away from site of planting (**3 pts.**) - Information unknown (**U**)	3		1,3,6
2. State Distribution[a] - plant is not naturalized in any region of Ohio (**0 pts.**) - plant is naturalized in only one region in Ohio (**1 pt.**) - plant is naturalized in two regions in Ohio (**2 pts.**)	5		3,15

- plant is naturalized in three regions in Ohio (**3 pts.**) - plant is naturalized in four regions in Ohio (**4 pts.**) - plant is naturalized in five regions in Ohio (**5 pts.**) - Information unknown (**U**)			
3. Regional/US Distribution - plant is not considered to be a problem in any other state (**0 pts.**) - plant has been reported as a widespread problem in another non-neighboring state within the USDA Plant Hardiness Zones 5-6 (**1 pt.**) - plant has been reported to be a widespread problem in 1-2 adjoining states (**3 pts.**) - plant has been reported to be a widespread problem in 3 or more adjoining states (**5 pts.**) - plant has been reported to be a widespread problem in similar habitat outside the US (**1 pt.**) - Information unknown (**U**)	5	IN,MI,PA,WV [also in KY, but not included here]	4, 5, 6,7,8,9
Step II: Biological Characters			
4. Vegetative Reproduction - no vegetative reproduction (**0 pts.**) - reproduces readily within the original site (**1 pt.**) - has runners or spreading rhizomes that root easily (**3 pts.**) - fragments easily and fragments can be easily dispersed (**4 pts.**) - has runners or spreading rhizomes that root easily AND fragments easily and fragments can be easily dispersed (**5 pts.**) - Information unknown (**U**)	3	12=> can have vegetative regrowth after fragments have floated in water. 13=> creates large clonal colonies from roots, sending up new stems. 17=> produces vegetative root suckers.	9,10,12,13,17
5. Sexual Reproduction - no sexual reproduction (**0 pts.**) - infrequent sexual reproduction (**1 pt.**) - frequent sexual reproduction, but high variation among years in seed production (**3 pts.**) - frequent sexual reproduction (one or more events per year) (**5 pts.**) - Information unknown (**U**)	5	1 event per year- most seeds are viable. 17=> species is dioecious.	9,10,13,17
6. Number of Viable Seeds or Propagules per Plant - few (0-10) (**1 pt.**) - moderate (11-1,000) (**3 pts.**) - prolific (>1,000) (**5 pts.**) - Information unknown (**U**)	5	400,000 - 2 million seeds/plant/year. 20=> species produces wind-dispersed samaras that can also be carried along waterways. 23=> "prolific seed production, with one individual producing up to 300,000 seeds in a single growing season (Bory and Clair-Maczulajtys 1980)."	3,6,7,8,9,10,13,20,23
7. Flowering Period - one month or less per year (**0 pts.**) - two months (**1 pt.**) - three to five months (**2 pts.**) - longer than five months (**3 pts.**) - Information unknown (**U**)	1	13=> 2 months in some places	10,11,13

Step II

8. Dispersal Ability

- low potential for long-distance seed/propagule dispersal (>1km) (**0 pts.**)
- medium potential for long-distance seed/propagule dispersal (**3 pts.**)
- high potential for long-distance seed/propagule dispersal (**5 pts.**)
- Information unknown (**U**)

3	Seeds disperse through water and indirectly by human transportation but mainly wind dispersed [answer here is conservative]. 17=> "Seeds are normally broken loose in high turbulent winds and can be blown over 450 m (1,476 ft) (Kowarik and von der Lippe 2011; Landenberger et al. 2007)." 20=> In Germany, seeds moved down waterways for at least 10 days. 21=> Table 1 provides nice review: wind and related dispersal distance approx. 200-300m but secondary dispersal in waterways can be 1,200-4,000m.	12,13,17,20,21

9. Generation Time

- long juvenile period (>5 or more years for trees, 3 or more years for other growth forms) (**0 pts.**)
- short juvenile period (<5 years for trees, <3 years for other forms) (**3 pts.**)
- Information unknown (**U**)

3	1-2 years. Flowering 6 week-old seedlings have been suggested.	13

10. Establishment

- unable to invade natural areas (**0 pts.**)
- can only colonize certain habitat stages (e.g. early successional habitats) (**1 pt.**)
- aggressively colonizes and establishes in edge habitats (**3 pts.**)
- aggressively colonizes and establishes in intact and healthy natural areas (**6 pts.**)
- Information unknown (**U**)

6	17=> found along roadsides [in VA] and is "common in fields, along roads, fencerows, woodland edges, and forest openings (Knapp and Canham 2000; Kostel-Hughes et al. 2005; Kowarik 1995; Patterson 1976). It has also been reported in gaps in old-growth forests (Knapp and Canham 2000) and is frequently found spreading into forests (Espenschied-Reilly and Runkle 2008; Martin et al. 2010)." 18=> shade-tolerant and can invade natural areas from an edge; also found along edges and particularly along railroad right-of-ways in the Piedmont area in NC. 19=> in France: "A. altissima was present in the Fontainebleau forest, not only along roads and railways but also penetrating the forest due to natural or artificial gaps." 25=> Ohio populations of Tree-of-Heaven have been found with verticillium wilt, a pathogen.	6,13,17,18,19,25

Step II: Ecological Importance

11. Impact on Ecosystem Processes

- no known effect on ecosystem-level processes (**0 pts.**)
- moderate effects on ecosystem-level processes (e.g., changes in nutrient cycling)(**3 pts.**)
- causes long-term, substantial alterations in the ecosystem (e.g., changing fire regime of an area, changing hydrology of wetlands) (**6 pts.**)

3	Species can form dense monocultures leading to crowding-out events that could be considered substantial. 19=> dense patches can prevent regeneration of native tree species (especially after sp. invades following a disturbance).	6, 13,19

12. Impact on Rare Organisms

- no known negative impact on Ohio State-listed or federal-listed plants or animals (**0 pts.**)
- negatively impacts listed species, such as through displacement or interbreeding (**3 pts.**)

0 — No evidence

13. Impact on Native Animals

- no known negative impact on animals (**0 pts.**)
- documented direct or indirect negative effects on animal taxa (**3 pts.**)

0 — No evidence

14. Impact on Native Plants

- no known negative effects on native plants (**0 pts.**)
- negatively impacts some native plants (increasing their mortality and/or recruitment of certain taxa) (**3 pts.**)
- impacts native plants to such an extent that community structure is greatly altered (**6 pts.**)

3 — Species is considered potentially allelopathic. It can form dense monocultures which displace native vegetation. 13=> "It may affect natural successional trajectories, in part from competition for light and nutrients in early-successional environments, and possibly from allelopathy." 17=> produces allelopathic compounds [gives other supporting references] and outcompetes native plant species and displaces native trees. 19=> in France, A. altissima root suckers growing in the plots was significantly negatively correlated with floristic richness." and is considered allelopathic. 19=> "understory vegetation under A. altissima was significantly poorer and more common per plot than under native trees." 23=> species negatively affected Verbesina occidentalis [but not teasel] in terms of seed germination, seedling height, leaf production, and root:shoot ratio; "may differentially affect resident native versus non-native species, potentially facilitating the spread of other nonnatives in the invaded community." — 5,7,9,11,12,13,17,19,23

15. Hybridization

- no known instances of hybridization with other plant species (**0 pts.**)
- can hybridize with native Ohio plants or commercially-available species, but seeds are inviable (**1 pt.**)
- can hybridize with native Ohio plants or commercially-available species, producing viable seed (**3 pts.**)

0 — No evidence

16. Population Density

- occurs only as small, sporadic populations or individuals (**1 pt.**)
- typically forms small, monospecific patches (**3 pts.**)
- is a dominant plant in area where population occurs (absolute cover 15-50%) (**4 pts.**)
- forms an extensive, monospecific stand (absolute cover >50%) (**5 pts.**)

3 — 9,10,10=> Forms "dense thickets". 17=> In VA, mean density along roads was 39 per km2 (85 [per km2 along interstate highways in the mountains, 63 per km2 in the tidewater, and 46 per km2 in the piedmont (46 km21) and "invades newly disturbed areas and forms large monospecific stands." — 9,10,13,17

17. Role in Succession in Natural Areas

- successional information is unknown (**0 pts.**)
- is an early successional species that temporarily invades a disturbed site but does not persist as the site matures (**0 pts.**)
- readily invades disturbed sites and persists, but does not interfere with succession (**1 pt.**)
- readily invades disturbed sites, persists and interferes with succession of native plants (**4 pts.**)

4	17=> invades newly disturbed areas and forms large monospecific stands. 19=> dense patches can prevent regeneration of native tree species (especially after sp. invades following a disturbance).	13,17,19

18. Number of Habitats Invaded

Forestlands: Floodplain forest, hemlock-hardwood forest, mixed mesophytic forest, beech-maple forest, oak-maple forest, oak-hickory forest.
Grasslands: Alvar*, beach-dune community*, bur oak savanna*, slough-grass-bluejoint prairie*, sand barren*, big bluestem prairie, little bluestem prairie
Wetlands: Bog*, fen*, twigrush-wiregrass wet prairie*, marsh, buttonbush swamp, mixed shrub swamp, hemlock-hardwood swamp*, maple-ash-oak swamp,
* Considered a rare plant community in Ohio by ODW's Biodiversity Database Program.
+ – xeric limestone prairies or cedar glades and post oak openings are unique to the Interior Low Plateau Region of Adams, Highland and Pike counties, and are not included in Schneider and Cochrane (1997)

- not found in any natural habitats in Ohio (**0 pts.**)
- only found in 1 broad category (**1 pt.**)
- found in 2 broad categories or 2 rare habitat types (**3 pts.**)
- found in 3 broad categories or 3 rare habitat types (**4 pts.**)
- found in 4 or more rare habitat types (**5 pts.**)

4	13=> Forests and wetlands. 16=> In TN, found occasionally in glade-forming limestone areas. 17=> "In rural areas it is common in fields, along roads, fencerows, woodland edges, and forest openings (Knapp and Canham 2000; Kostel-Hughes et al. 2005; Kowarik 1995; Patterson 1976). It has also been reported in gaps in old-growth forests (Knapp and Canham 2000) and is frequently found spreading into forests (Espenschied-Reilly and Runkle 2008; Martin et al. 2010)." 22=> in VA, species usually found in disturbed forested areas in clay/sandy soils. 24=> species found in wetland areas in NY.	13,16,17,22,24

Total Score: **56**
Number of Unknowns: **0**

Outcome: **Invasive**

Total Points	Assessment Decision
4 or more U	Insufficient Data
0-34	Not Known to be Invasive
35-44	Pending Further Review
45-80	Invasive