New York
NON-NATIVE PLANT INVASIVENESS RANKING FORM

Scientific name:	Pueraria montana	USDA Plants Code: PUMO
Common names:	Kudzu	
Native distribution:	East Asia	
Date assessed:	November 20, 2008	
Assessors:	Steve Glenn, Gerry Moore	
Reviewers:	LIISMA SRC	
Date Approved:	December 8, 2008	Form version date: 22 October 2008

New York Invasiveness Rank: Very High (Relative Maximum Score >80.00)

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	Very High
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 (30)	30
2	Biological characteristic and dispersal ability	25 (25)	19
3	Ecological amplitude and distribution	25 (25)	19
4	Difficulty of control	10 (10)	8
	Outcome score	100 (90)[b]	76[a]
	Relative maximum score †		84.44
	New York Invasiveness Rank §	Very High (Relative Maximum Score >80.00)	

* 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:
Weldy & Werier, 2005; Brooklyn Botanic Garden, 2008.

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):
See discussion in Long Island PRISM sect. A.2

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, 2008.

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:
RR grades, urban woodlots and fields.

Documentation:
Sources of information:
Mitich, 2000; Lu, 2004;Brooklyn Botanic Garden, 2008; Senesac pers. obs. (beaches and dunes habitat).

B. INVASIVENESS RANKING

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: 10

Documentation:
Identify ecosystem processes impacted (or if applicable, justify choosing answer A in the absence of impact information)
Kudzu increases soil nitrification; substantial reduction in light availability.
Sources of information:
Mitich, 2000; Lu, 2004; Hickman & Lerdau, 2006.

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: 10

Documentation:
Identify type of impact or alteration:
Forms mats that may be more than 2 m thick. Blankets trees with a dense canopy through which little light can penetrate. One study found only 20% as many juvenile trees in invaded sites as in uninvaded sites.
Sources of information:
Lu, 2004; Hickman & Lerdau, 2006.

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 several native species, reducing biodiversity or change the community composition towards species exotic to the natural community)	10
U.	Unknown	

Score: 10

Documentation:
Identify type of impact or alteration:
Can quickly cover shrubs and trees with a dense tangle of stems, smothering and shading out the other vegetation. Able to smother trees up to 35 m tall. Kills or degrades other plants by smothering them under a solid blanket of leaves, girdling woody stems and tree trunks, and breaking branches or uprooting entire trees and shrubs through the sheer force of its weight.
Sources of information:
Lu, 2004.

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:
Soil nitrification may impact soil microflora but no published data known. Native lupines are also suceptible to the rust that is carried by kudzu..
Sources of information:
Lu, 2004.

Total Possible: 30
Section One Total: 30

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: 4

Documentation:
Describe key reproductive characteristics (including seeds per plant):
Spreads mainly by rampant (10 to 30 m in a growing season, up to 30 cm a day) vegetative

growth, but does have some seed spread in areas where a pollinator, the giant resin bee, occurs.
Sources of information:
Mitich, 2000; Lu, 2004.

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:
Seeds reportedly are dispersed by birds and mammals; although some sources (Mitich, 2000) state this is infrequent. Pods have been seen to be floating in water (Entrup, pers. obs.).
Sources of information:
Mitich, 2000; Lu, 2004; Entrup pers. obs.

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:
Formerly for planted soil stabilization and cattle forage- but this practice now discontinued. Has been noted to be grown in people's yards.
Sources of information:
Lu, 2004.

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:

Nitrogen fixing (Rhizobium symbiosis), fast-growing (10 to 30 m in a growing season, up to 30 cm a day) perennial, stems easily root at nodes. One investigation found that shoot growth is maximized in the early part of the growing season (and during seedling growth) which results in greater success in dominating a habitat and outcompeting competitors (Sasek & Strain, 1988). Kudzu's tap roots may burrow 2 m or more into the ground, enabling the plant to survive northeastern winters and act as water reservoirs, allowing kudzu to withstand fairly dry climates.

Kudzu flourishes on many soil types, including nutrient-deficient, sandy, clayey, or loamy soils.

One Chinese study isolated an aciduric Rhizobium strain from a kudzu nodule which could grow under pH 4.6- distinct from the optimal pH 6.5 to 7.5 for Rhizobium (Gu et al., 2006).

Possesses superior hydraulic conductance, one study suggest that kudzu has a large capacity for the transverse movement of water in xylem (Taneda & Tateno, 2007).

Population studies of Pueraria from the southeastern US have shown high levels of genetic diversity (Pappert, et al., 2000; Jewett et al., 2003; Sun et al., 2005), which may enchance ecological amplitude.

Sources of information:
Sasek & Strain, 1988; Mitich, 2000; Pappert, et al., 2000; Jewett et al., 2003; Lu, 2004; Sun et al., 2005; Gu et al., 2006; Taneda & Tateno, 2007.

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: 2

Documentation:
Describe growth form:
Has climbing and smothering habit.
Sources of information:
Mitich, 2000; Lu, 2004.

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:

The reports of germination have been mixed- Mitich reported the seeds are difficult to germinate and kudzu seedlings are surprisingly delicate, competing poorly with aggressive weeds.

Susko and McClain reported that while Pueraria seed possesses physical dormancy; seed is capable of germinating in a variety of climatic and edaphic conditions. Scarified kudzu seed germinated at 94-100% across all temperature regimes, whereas germination for nonscarified seed was at 17% or less. Seed does not require light for germination and should germinate when shaded by litter or a leaf canopy or following burial in soil. Seed germinates over a wide range of pH.

Recent (2007-2008) germination tests of Pueraria seed collected on Long Island by staff of The Nature Conservancy found germination rates up to 33% without seed scarification, and up to 95% with scarification (Jordan, pers. comm.).

Sources of information:
Susko et al., 1999; Susko et al., 2001; Mitich, 2000; McClain et al., 2006; Jordan, pers. comm.).

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

A.	No	0
B.	Yes	3
U.	Unknown	

Score 0

Documentation:
Species:
Weldy & Werier, 2005; USDA, 2008.

Total Possible 25
Section Two Total 19

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 2

Documentation:
Identify reason for selection, or evidence of weedy history:
Large patches seen in the NY metro area in disturbed areas with other invasives.
Sources of information:
Authors' personal observations; Frankel, E. 1989.

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:
Mitich, 2000; Lu, 2004;Brooklyn Botanic Garden, 2008.

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 2

Documentation:
Identify type of disturbance:
Usually invades habitats with disturbance but may occasionally invade an undisturbed area (e.g., natural forest) from the disturbed region where it originally established.
Sources of information:
Lu, 2004; 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 1

Documentation:
Describe what part of the native range is similar in climate to New York:
China, Japan. Not clear if it will grow and persist in all regions of New York. Pueraria seed collected from Long Island NY, Westchester NY, and Beltsville MD remained viable down to -40 degrees (C and F) in laboratory freezer tests (Ziska).
Sources of information:
Mitich, 2000; Lu, 2004; Lewis Ziska (USDA_ARS unpub. data provided to M. Jordan).

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, DC, DE, IL, IN, KY, MA, MD, ME, NJ, NY, OH, PA, VA, WV.
Sources of information: See known introduced range in plants.usda.gov, and update with information from states and Canadian provinces.
U.S.D.A., 2008.

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:
Capital, Lower Hudson, Long Island; federal noxious weed list.
Sources of information:
Weldy & Werier, 2005; Brooklyn Botanic Garden, 2008.

Total Possible: 19
Section Three Total: 25

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:
No definitive studies located- one study suggests that because the seed possesses physical dormancy, a persistent seedbank may result once P. montana becomes established at a site. Marilyn Jordan has observed seeds remaining viable for over a year in laboratory tests; no evidence for viability beyond ten years.
Sources of information:
Susko et al., 1999; Marilyn Jordan, pers. obs..

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: 2

Documentation:
Describe vegetative response:
Easily roots at nodes and from large tuberous undergound system.
Sources of information:
Lu, 2004.

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 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).	3
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: 4

Documentation:

Identify types of control methods and time-term required:
Once established, this plant is difficult to control- can take up to ten years to control well-established stands. Persistent eradication of all root material is the key to its control. Control includes grazing by goats, persistent weeding or mowing, and chemical control. This can be accomplished through using systemic herbicides, cutting vines, or close mowing every month for two growing seasons. Also can be controlled by flaming to defoliate the plant (Mitich, 2000; Lu, 2004).

Biocontrol: one investigation found the bacterial plant pathogen Pseudomonas syringae pv. phaseolicola was ineffective in controlling kudzu (Zidack & Backman, 1996).

Several indigenous Chinese species are being investigated for potential as biological control agents for kudzu in the US- the cerambycid beetle Paraleprodera diophthalma (Pascoe), which caused considerable damage to roots; and the imitation rust, caused by Synchytrium ininutinn, was the most commonly observed disease of kudzu (Sun et al., 2006).

Two insect species from China, Gonioctena tredecimmaculata (Jacoby) (Coleoptera: Chrysomelidae) and Ornatalcides (Mesalcidodes) trifidus (Pascoe) (Coleoptera: Curculionidae) are also currently being evaluated for kudzu control (Frye et al., 2007).

One study suggests that the fungus Myrothecium verrucaria, when properly formulated, has potential for controlling kudzu (Boyette et al., 2002).

Other studies focused on integrated methods of kudzu control:
1. Combinations of herbicides and induced pine competition- none of the treatments eradicated kudzu, but did delayed its recovery (Harrington et al., 2003).
2. Combinations of the fungal pathogen, Myrothecium verrucaria, with the commercial formulations of the herbicides: amniopyralid (Milestone*), metsulfuron (Escort XP), and fluroxypyr (Vista) is currently under investigation. M. verrucaria was highly tolerant to all concentrations of amniopyralid and metsulfuron for up to two days in simulated tank-mixes, while mixtures with fluroxypyr resulted in a gradual loss of spore viability (Weaver & Lyn, 2007).
3. Aplication of Myrothecium verrucaria with glyphosate [N-(phosphonomethyl) glycine]. Results suggest that timing of glyphosate application in relation to combined treatment with M. verrucaria can improve the control of kudzu (Boyette et al., 2006).

Sources of information:
Zidack & Backman, 1996; Mitich, 2000; Boyette et al., 2002; Harrington et al., 2003; Lu, 2004; Boyette et al., 2006; Sun et al., 2006: Frye et a., 2007: Weaver & Lyn, 2007.

Total Possible	10
Section Four Total	8

Total for 4 sections Possible	90
Total for 4 sections	76

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:

References for species assessment:

Boyette, C. D., H. L.Walker, & H. K. Abbas. 2002. Biological control of kudzu (Pueraria lobata) with an isolate of Myrothecium verrucaria. Biocontrol Science & Technology. 12(1):75-82.

Boyette, C. D., K. N. Reddy, & R. E. Hoagland. 2006. Glyphosate and bioherbicide interaction for controlling kudzu (Pueraria lobata), redvine (Brunnichia ovata), and trumpetcreeper (Campsis radicans). Biocontrol Science & Technology. 16(10):1067-1077.

Brooklyn Botanic Garden. 2008. AILANTHUS database. [Accessed on November 20, 2008].

Frankel, E. 1989. Distribution of Pueraria lobata in and around New York City. Bulletin of the Torrey Botanical Club. 116(4):390-394.

Frye, M. J., J. Hough-Goldstein, & J. H. Sun. 2007. Biology and preliminary host range assessment of two potential kudzu biological control agents. Environmental Entomology. 36(6):1430-1440.

Gu J. P., L. Zhang, S. Q. Wei, Q. Zhang, & D. H. Qin. 2006. Primary study on acid tolerance mechanism of a wild aciduric Rhizobium strain isolated from Pueraria lobata. Weishengwu Xuebao. 46(4):653-656.

Harrington, T. B., L. T. Rader-Dixon, & J. W. Taylor. 2003. Kudzu (Pueraria montana) community responses to herbicides, burning, and high-density loblolly pine. Weed Science. 51(6):965-974.

Hickman, J. E. & M. Lerdau. 2006. Nitrogen fixation by kudzu: impacts on invaded communities and ecosystems. Ecological Restoration. 24(3):200-201.

Jewett, D. K., C. J. Jiang, K. O. Britton, J. H. Sun, & J. Tang. 2003. Characterizing specimens of kudzu and related taxa with RAPD's. Castanea. 68(3):254-260.

Lu, S. 2004. Pueraria montana. U.S. Invasive Species Impact Rank (I-Rank). NatureServe Explorer. <www.natureserve.org>. [Accessed on November 20, 2008].

McClain, W. E., J. Shimp, T. L. Esker, J. M. Coons E. T. Adler. & J. E. Ebinger 2006. D istribution and reproductive potential of kudzu (Pueraria lobata, fabaceae) in Illinois, USA. Transactions of the Illinois State Academy of Science. 99(1-2):17-30.

Mitich, L. W. 2000. Kudzu [Pueraria lobata (Willd.) Ohwi]. Weed Technology. 14(1):231-235.

Pappert, R. A., J. L. Hamrick, & L. A. Donovan. 2000. Genetic variation in Pueraria lobata (Fabaceae), an introduced, clonal, invasive plant of the southeastern United States. American Journal of Botany. 87(9):1240-1245.

Sasek, T. W. & B. R. Strain. 1988. Effects of carbon dioxide enrichment on the growth and morphology of kudzu (Pueraria lobata). Weed Science. 36(1):28-36 .

Sun, J. H., Z. C. Li, D. K. Jewett, K. Britton, W. H. Ye, & X. J. Ge. 2005. Genetic diversity of Pueraria lobata (kudzu) and closely related taxa as revealed by inter-simple sequence repeat analysis. Weed Research (Oxford). 45(4):255-260.

Sun, J. H., Z. D. Liu, K. O. Britton, P. Cai, Ping, D. Orr, & J. Hough-Goldstein. 2006. Survey of phytophagous insects and foliar pathogens in China for a biocontrol perspective on kudzu, Pueraria montana var. lobata (Willd.) Maesen and S. almeida (Fabaceae). Biological Control. 36(1):22-31.

Susko, D. J., J. P. Mueller, & J. F. Spears. 1999. Influence of environmental factors on germination and emergence of Pueraria lobata. Weed Science. 47(5):585-588.

Susko, D. J., J. P. Mueller, & J. F. Spears. 2001. An evaluation of methods for breaking seed dormancy in kudzu (Pueraria lobata). Canadian Journal of Botany. 79(2):197-203.

Taneda, H. & M. Tateno. 2007. Effects of transverse movement of water in xylem on patterns of water transport within current-year shoots of kudzu vine, Pueraria lobata. Functional Ecology. 21(2):226-234.

United States Department of Agriculture, National Resources Conservation Service. 2008. The PLANTS Database. National Plant Data Center, Baton Rouge, Louisiana. <plants.usda.gov>. [Accesssed on November 20, 2008].

Weaver, M. A. & M. E. Lyn. 2007. Compatibility of a biological control agent with herbicides for control of invasive plant species. Natural Areas Journal. 27(3):264-268.

Weldy, T. & D. Werier. 2005. New York Flora Atlas. [S.M. Landry, K.N. Campbell, and L.D. Mabe (original application development), Florida Center for Community Design and Research. University of South Florida]. New York Flora Association, Albany, New York. <atlas.nyflora.org/>. [Accesssed on November 20, 2008].

Zidack, N. K. & P. A. Backman. 1996. Biological control of kudzu (Pueraria lobata) with the plant pathogen Pseudomonas syringae pv. phaseolicola. Weed Science. 44(3):645-649.

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NEW YORK
NON-NATIVE PLANT INVASIVENESS RANKING FORM

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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.