Assessment of Invasive Species in Indiana's Natural Areas

******OFFICIAL* Creeping Jenny, Moneywort *(Lysimachia nummularia)* *ASSESSMENT******
Answers are highlighted in yellow, comments are inserted in *italics*

Last assessed by Ellen Jacquart 10/17/2019; Reviewed and approved by IPAC10/30/2019

Invasive Ranking Summary	**Score**	
Ecological Impacts	24	
Potential For Expansion	34	
Difficulty of Management	31.5	
Total Score:	**89.5**	**High**
Rankings: Low < 45, Medium 45 – 80, High > 80		

Contents of the Assessment:

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

Evidence of invasion (forming self-sustaining and expanding populations within a plant

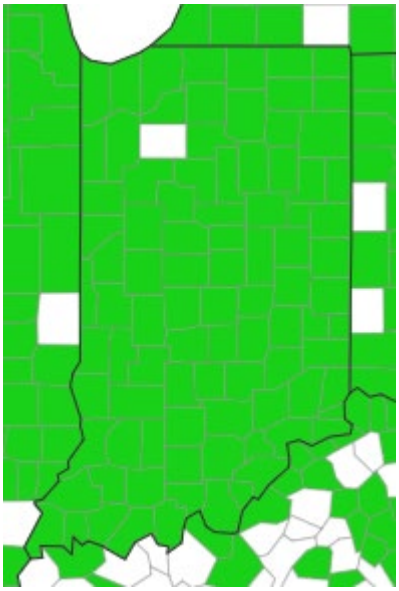
community with which it had not previously been associated) must be provided. If not available in a published, quantitative form, this evidence must include written observations from at least three appropriate biologists.

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 (page 4) to assess the species' potential for future invasion.

***Lysimachia nummularia* Reports in Indiana**

From EDDMaps.org, accessed 7/22/2019. 198 reports (58 with exact location) from 91 counties (all counties except Pulaski).



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 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). *Can disrupt water flow of springs and seeps (Mehrhoff et al. 2004). One study found increased rate of redox reactions in soil (Justin & Armstrong 1987 Table 2) but impacts on soil chemistry (e.g. nutrients, pH etc.) unclear. Another study (Eom et al. 2005) found in study of groundcover plants that the mats of Lysimachia nummularia 'aurea' reduce light hitting*	15

the soil surface by over 80%. SRC noted that the species has been in New England "...at least as early as the 1870s" (Mehrhoff) but there is no evidence of major impacts on ecosystem processes.

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**

L. nummularia is growing in the same spot as Hydrocotyle americana (state endangered, 2 sites in IN) in Jefferson County and with Solidago shortii (state endangered, 1 site in IN) in Harrison County and control efforts have been undertaken (M. Homoya, personal communication) in both cases to protect the rare species. It is growing adjacent to Eurybia furcata (state rare, less than 10 sites in IN) in Warren County (Stuart Orr, personal communication).

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

The total acreage of the 198 reports is 0.16 acres, likely because most reports did not include an estimate of the population size. It is very likely that there is more than 10 acres in the state but there is no documentation of it. Moneywort covers more than 50% of the groundlayer where it occurs (even though other species may grow above it).

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**

Forms a dense groundcover in communities where there is no such layer naturally (Ellen Jacquart, personal observation; Will Drews, personal observation).

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.

It seems likely there are more than 10 acres in the state but we do not have documentation to prove that. 3

Total points (place in worksheet page 8) **16**

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**) Twelve habitats, eleven of them palustrine/aquatic habitat types

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.

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**

Produces flowers and fruits each year (Ellen Jacquart, personal observation).

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**

Spreads vegetatively by plant fragments moving down stream and by seed though reproduction by seed is less common. Often high degree of seed sterility reported, although one study did find some germinating seeds of L. nummularia from flood debris samples. Ray 1956; Salisbury 1976; Salisbury 1978; Bittrich et al., 1988; Mack, 1991; Hughes et al. 1997; Mehrhoff et al. 2004.
From the literature review in the USDA Forest Service Fire Effects Information System for Lysimachia nummularia: Seed production by creeping jenny is rare in the United States (Hilty 2010, Ray 1956) and in its native range (Bittrich et al 1988). When seeds are produced, they are often inviable (Hilty 2010, Fryxell 1957). Ray (1956) found no viable seeds in North American populations of creeping jenny in 1956. Despite low viable seed production in many populations, some researchers reported viable creeping jenny seeds in seed banks (e.g., Blood et al. 2010; Fitter et al. 2010; Kjellson 1992). Each seed capsule has 1 to 5 seeds.

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**

Vigorous vegetative spread (Jacquart, personal observation; Drews, personal observation).

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

From the literature review in the USDA Forest Service Fire Effects Information System for Lysimachia nummularia: Seed production by creeping jenny is rare in the United States (Hilty 2010, Ray 1956) and in its native range (Bittrich et al 1988). When seeds are produced, they are often inviable (Hilty 2010, Fryxell 1957). Ray (1956) found no viable seeds in North American populations of creeping jenny in 1956. Despite low viable seed production in many populations, some researchers reported viable creeping jenny seeds in seed banks (e.g., Blood et al. 2010; Fitter et al. 2010; Kjellson 1992). Each seed capsule has 1 to 5 seeds.

vi. Dispersal ability

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

Commonly invades riparian areas and can have vegetative or seed spread by water (Jacquart, personal observation; Drews, personal observation).

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

Little information exists on germination requirements. In the laboratory, creeping jenny seeds collected in Vermont were planted under mesic, well-drained conditions and under hydric, saturated conditions, and only seeds in hydric conditions germinated (Hughes et al. 1997).

viii. Competitive ability

a. poor competitor for limiting factors 0
b. moderately competitive for limiting factors 3
c. highly competitive for limiting factors **5**

Able to rapidly colonize areas by growing under other plants due to high shade tolerance (Jacquart, personal observation; Drews, personal observation).

Total points for questions i – viii (place in worksheet page 8): **34**

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

Because it grows under native plants and has the same phenology as those natives it is not possible to use chemical methods without killing the overlying vegetation (Jacquart, personal observation; Drews, personal observation)

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**

Because chemical control kills existing native vegetation, further site restoration is often needed.

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**

Though there are nearly 200 reports of this species in Indiana, we do not have documentation of how many acres are covered by it.

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

Because it grows under other plants it is difficult to find and treat all plants, requiring multiple years of treatment (Jacquart, personal observation). One treated population in Knox County had new starts the next year (Drews, personal observation).

vii) Occurs in more than 20 discrete sites (e.g., water-basins, parks, fragments of habitats at least 5 miles apart). **3**
198 reports in Indiana, per EDDMaps.org

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**
Commonly spread by water (Jacquart, personal observation)

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): **31.5**

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 [9]): **13**

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: __16__ X (1 or **1.5**) = ___24____ **Impacts**
Section III:
Potential = High Medium or Low ___34_____ **Potential for Expansion**
Section IV:
Difficulty of Management Point Total: ___31.5_____ **Difficulty of Management**
Section V:
Commercial Value Point Total: ___13_____ **Value**

Total Score is Impacts + Potential for Expansion + Difficulty of Management = __89.5_____

Conversion of Total Score to Rank

Invasive Ranking Summary	**Score**
Ecological Impacts	16x1.5= 24
Potential For Expansion	34

Difficulty of Management	31.5	
Total Score:	**89.5**	**High**
Rankings: Low < 45, Medium 45 – 80, High > 80		

Assessment History

Assessed by Ellen Jacquart 9/30/19
Reviewed by Will Drews and Stuart Orr 10/17/19
Approved by IPAC 10/30/2019

Literature Cited:

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