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Range-Wide Quantitative Habitat Characterization of Critically Imperiled *Ludwigia ravenii* (Onagraceae)

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SUPPLEMENTAL DATA

Supplemental Table 1. Herbarium vouchers of *Ludwigia ravenii* as referenced from digitized specimens in SERNEC (2021) and Peng (1984). Herbarium (Herb.) codes follow *Index Herbariorum* (Thiers 2023).

Year of Collection	Habitat Description	State	Collectors & Number	Herb. Code
1800s	Without detailed locality.	NC	Curtis s.n.	GH
7/25/1894	On voucher with *L. sphaerocarpa* from Delaware (Peng 1984).	Unk.	Biltmore Herbarium 602	US
10/2/1908	Unknown	NC	Bartram s.n.	PH
8/4/1934	Wet peaty clearings in woods of *Pinus serotina*.	VA	Fernald & Long 4074	GH
8/28/1938	Drainage ditch.	NC	Godfrey 6240	NCSC
8/20/1939	Along ditches, Wet peaty clearings in woods of *Pinus serotina*.	VA	Fernald & Long 11091	GH
9/12/1946	Sphagnous and peaty bog (Magnolia Swamp).	VA	Fernald, Long & Clement 15316	GH
9/14/1946	Wet hollow in old wood road.	VA	Fernald, Long & Clement 15317	GH
9/14/1946	Wet hollow in old wood road.	VA	Fernald, Long & Clement 15318	GH
9/14/1946	Swampy pineland.	VA	Fernald, Long & Clement 15319	GH
8/20/1948	Exsiccated pool, near inland waterway.	NC	Godfrey 48407	NCSC
10/4/1954	Roadside ditch.	NC	Duke 54-226	NCU
9/1956	Stream margin.	NC	Beal 2631	NCSC
8/1/1957	Pond margin.	NC	Beal 3598	NCSC

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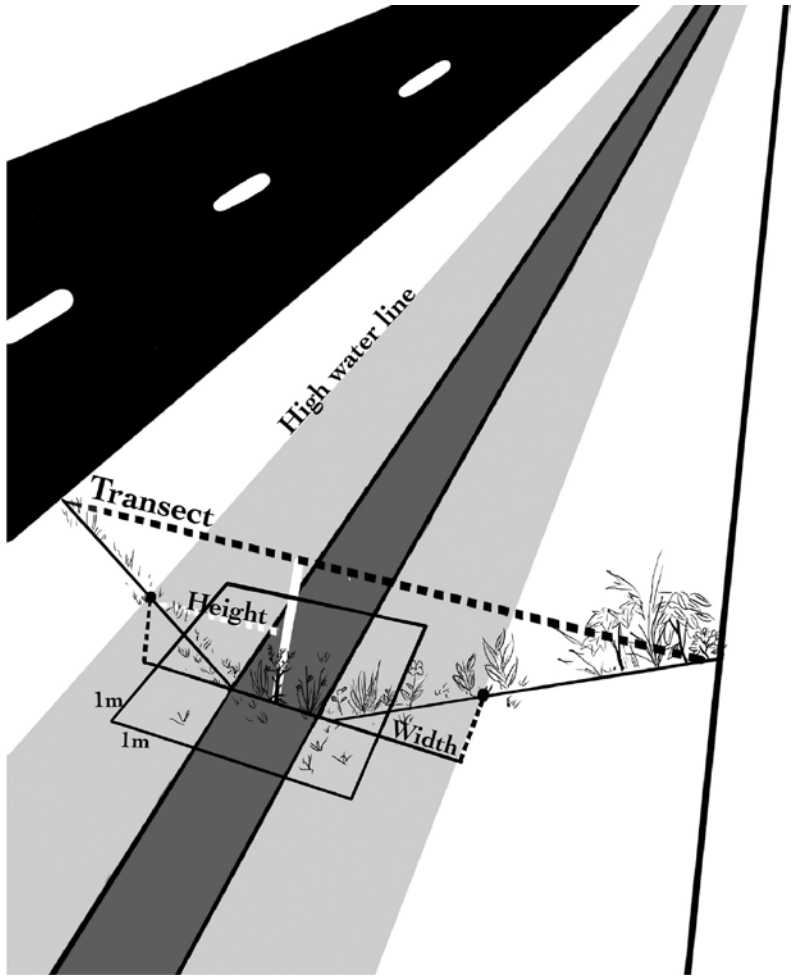
Supplemental Table 1. continued

Year of Collection	Habitat Description	State	Collectors & Number	Herb. Code
8/2/1957	Marshy pond borders.	NC	Ahles & Leisner 33210	NCU
9/28/1957	Savannah.	SC	Ahles 35485	NCU
7/19/1958	Savannah.	NC	Radford 37586	NCU
7/30/1958	Swamp forest border.	NC	Ahles & Duke 47982	NCU
8/1/1958	Pocosin on sand ridge.	NC	Ahles & Duke 48407	NCU
8/1/1958	Low woods border.	NC	Ahles & Duke 48303	NCU
10/14/1958	Woodland border.	NC	Ahles & Duke 51133	NCU
10/16/1958	Pocosin on sand ridge.	NC	Ahles & Duke 51539	CM
8/19/1963	Shaded creek in pine woodland.	FL	Raven 18690	USF
8/19/1963	Unknown	FL	Raven 18685	DS
9/15/1963	Roadside ditch.	NC	McCrary 1071	NCU
9/10/1976	Roadside ditch.	NC	Boufford & Wood 18898	CM
*__9/9/1982__	Plants scattered in roadside sedgy, sandy ditch; on loam which is densely covered by *Sphagnum subsecundatum* with *Cyperus, Xyris, Eriocaulon, Paspalum, Panicum, Hypericum, Polygonum, Rhexia, Liatris, Eupatorium, Ludwigia linearis, Ludwigia hirtella.*	SC	Peng 4402	MO
8/29/1994	Old woodland road.	NC	LeBlond 4038	NCU
9/27/1994	Wet, peaty ditch	VA	Fleming & Ludwig 9961	GMUF
10/3/1995	Wet, peaty ditch.	VA	Fleming 11447	GMUF
9/3/1997	Sandy, peaty depressions in low, boggy powerline clearing.	VA	Fleming, Belden & Willis 13951	VPI
8/26/2015	Roadside ditch.	NC	Callahan 267	NCSC
Unknown	Unknown	SC	Porcher s.n.	F

*Denotes type specimen.

Supplemental Figure 1. Comparison of the flowers of studied species of *Ludwigia*: *Ludwigia alternifolia* (left; note green sepals and yellow petals), *Ludwigia ravenii* (middle; note green sepals and absence of petals), and *Ludwigia pilosa* (right; note white sepals and absence of petals). Photos by Merry Conlin. Plants observed in South Carolina.



Supplemental Figure 2. Diagram of plot sampling design, 1 m x 1 m quadrat centered on a stem of *Ludwigia* sp. and bisected by a transect with 1 meter buffer on either side of maximum ditch width.

Supplemental Table 2. Vegetation cover classes as described in Carolina Vegetation Survey (Peet et al. 1998) and median values used in analysis.

Scale	Cover Range	Median
1	trace	0.05%
2	0–1%	0.50%
3	1–2%	1.50%
4	2–5%	3.50%
5	5–10%	7.50%
6	10–25%	17.50%
7	25–50%	37.50%
8	50–75%	62.50%
9	75–95%	85%
10	>95%	97.50%

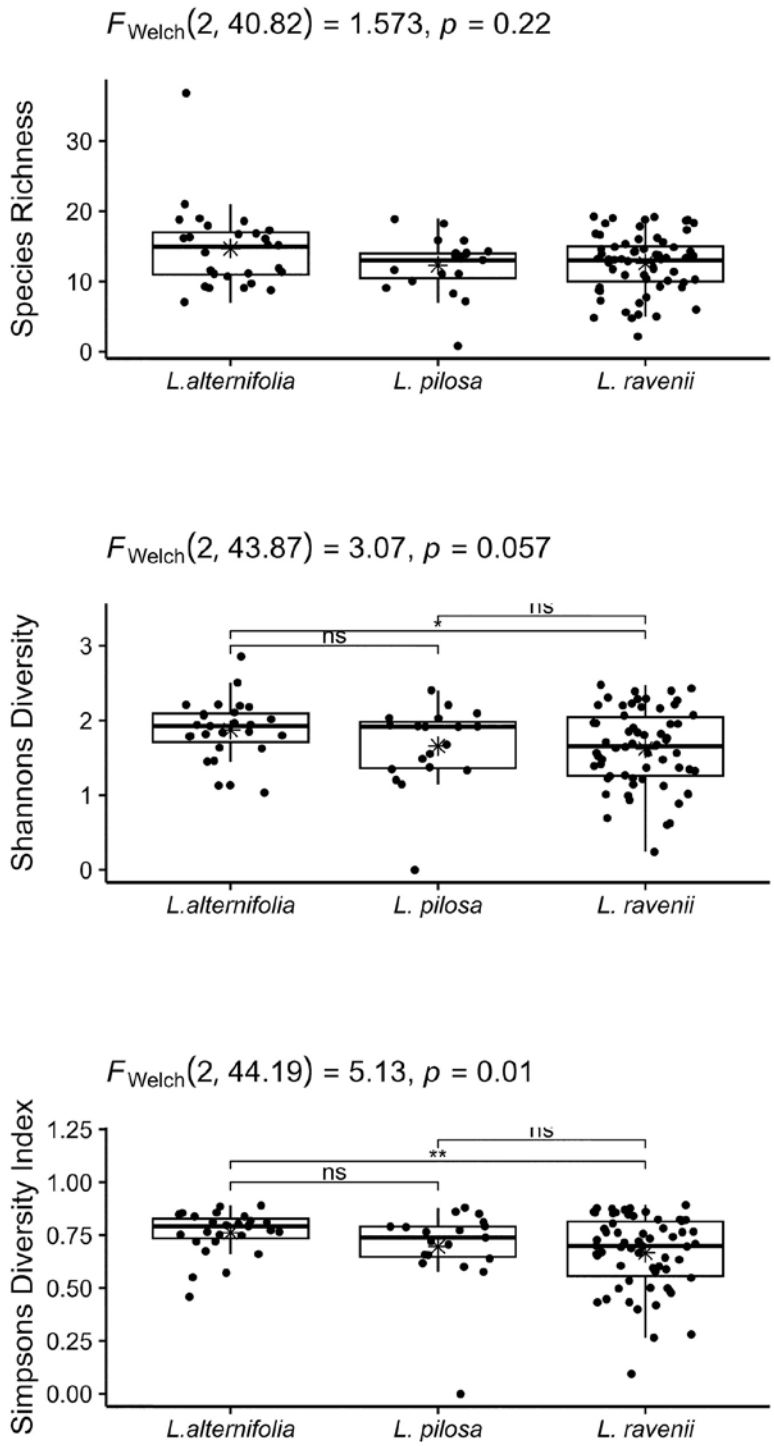
Supplemental Table 3. Wetland indicator status and definition as stated by Lichvar et al. (2012).

Indicator Status	Definition
Obligate (OBL)	Almost always occur in wetlands.
Facultative-Wetland (FACW)	Usually occur in wetlands, may occur in non–wetlands.
Facultative (FAC)	Occur in wetlands and non-wetlands.
Facultative–Upland (FACU)	Usually occur in non-wetlands but may occur in wetlands.
Upland (UPL)	Almost never occur in wetlands.

Supplemental Table 4. Data sources and resolutions for geographic information system (GIS) data collected at plot locations of target *Ludwigia* spp.

Name	Date Created	Data Source	Scale	Minimum mapping unit or pixel size
National Wetlands Inventory (NWI)	Various	See unredacted version of Conlin 2023, archived at NCNHP[1], SCNHP[1], and VADNHP[1] (USFWS 2019).	1:5,000–1:24,000	1 m
Soil Survey Geographic Database (SSURGO)	10/2021 Update (Various source dates)	See unredacted version of Conlin 2023, archived at NCNHP, SCNHP, and VADNHP.	1:12,000–1:63,360	1–30 m
Element Occurrence Records	2021	VADNH (2022), NCNHP (2021), SCNHP (2021)	1:5,000	1 m
Carolina Bay Survey	2/2022	USGS 1° LiDAR quadrangles	rendered at 120 cm horizontal grid	1–3 m

[1]NCNHP: North Carolina Natural Heritage Program; SCNHP: South Carolina Natural Heritage Program; VADNH: Virginia Division of Natural Heritage.



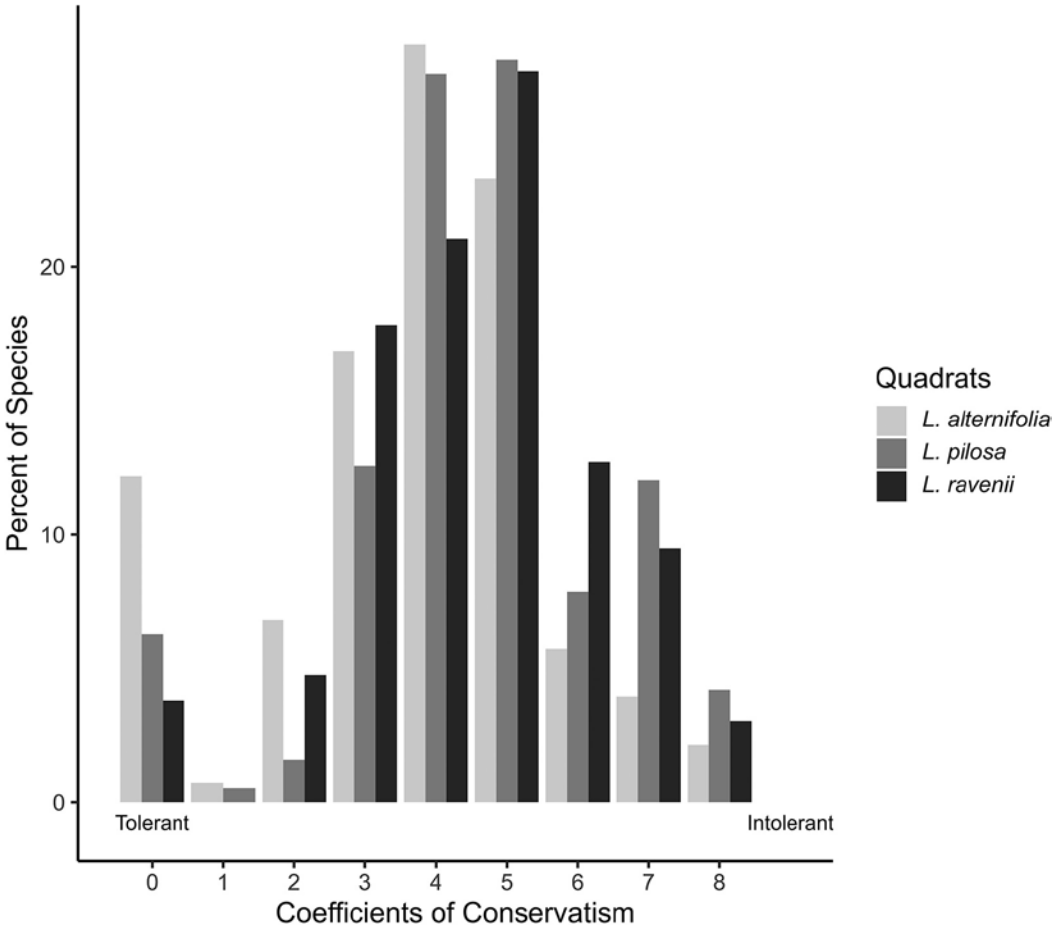
Supplemental Figure 3. Species diversity indices boxplots (A, C) and species richness (B) in 1 m^2 quadrats centered respectively on *Ludwigia alternifolia* (N_{plots}=27; N_{sites}=11), *L. pilosa* (N_{plots}=19; N_{sites}=4), and *L. ravenii* (N_{plots}=62; N_{sites}=18). Boxplots show mean (asterisk), median, and raw values. Post-hoc results from Games-Howell test (p<0.001=***, p<0.01=**, p<0.05=*, ns=Not Significant).

Supplemental Table 5. Mean±SE, minimum and maximum and one-way ANOVA results for derived vegetation variables and attributes measured at 1 m^2 quadrats centered on target species of *Ludwigia*. Statistically significant differences (p<0.05) are bolded, levels followed by a common letter are not significantly different by the Games-Howell test at 5% level of significance.

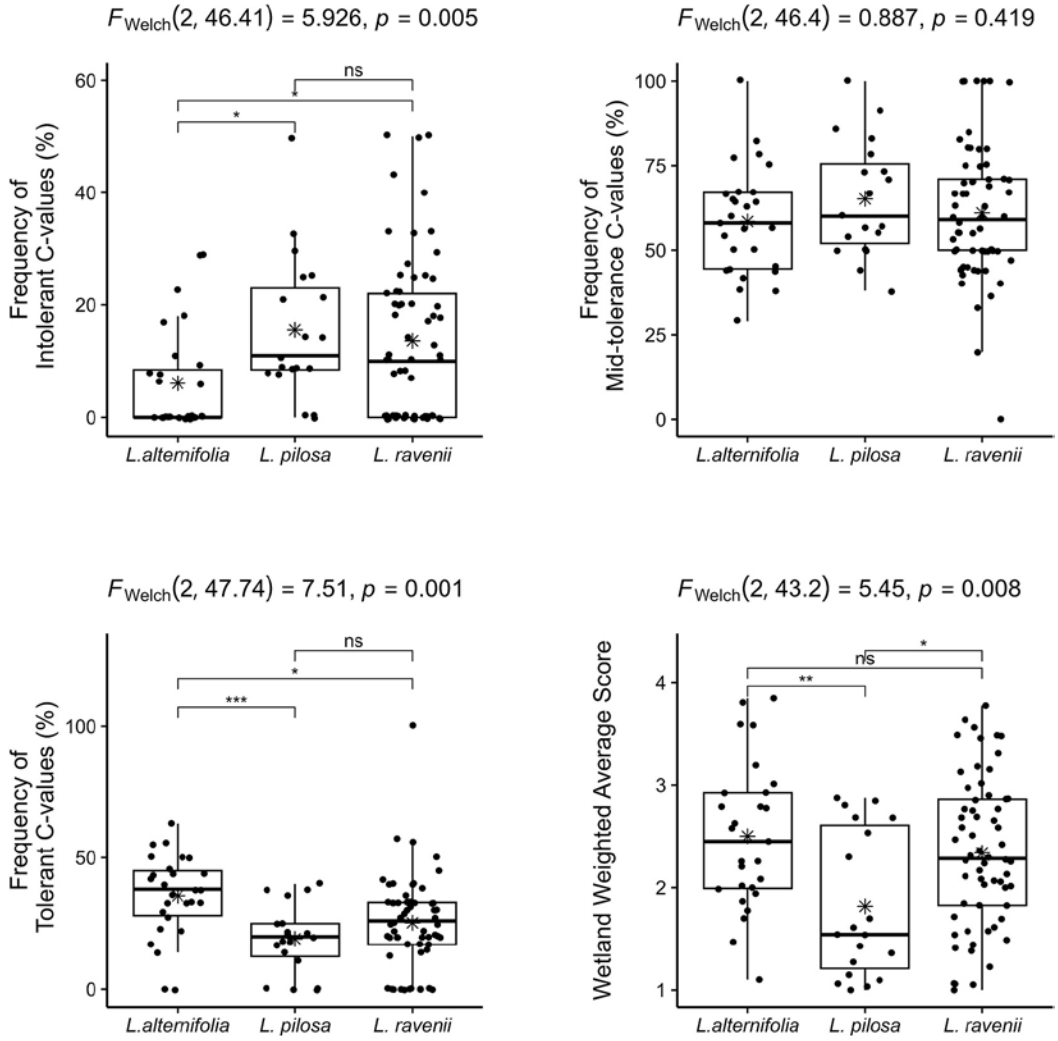
Variable	Level	N	Mean±SE	Min	Max	Test Statistic $F_{(Welch)}$	p-value
Shannons diversity index	*L. alternifolia*$_{a}$	27	1.87±0.08	1.04	2.86	3.07	0.057
	L. pilosa$_{ab}$	19	1.66±0.12	0	2.4		
	L. ravenii$_{b}$	62	1.62±0.07	0.24	2.48		
Simpsons diversity index	*L. alternifolia*$_{a}$	27	0.76±0.02	0.46	0.89	5.71	**0.01**
	L. pilosa$_{ab}$	19	0.7±0.04	0	0.88		
	L. ravenii$_{b}$	62	0.67±0.02	0.09	0.89		
Species richness	*L.alternifolia*	27	14.7±1.14	7	37	1.57	0.22
	L. pilosa	19	12.32±0.96	1	19		
	L. ravenii	62	12.6±0.54	2	19		
Frequency of intolerant C-values (%)	*L. alternifolia*$_{a}$	27	6.07±1.78	0	29	5.93	**0.005**
	L. pilosa$_{b}$	19	15.58±2.95	0	50		
	L. ravenii$_{b}$	62	13.63±1.84	0	50		
Frequency of mid-tolerance C-values (%)	*L.alternifolia*	27	58.44±3.06	43	100	0.89	0.419
	L. pilosa	19	65.11±3.91	50	100		
	L. ravenii	62	60.97±2.55	25	100		
Frequency of tolerant C-values (%)	*L. alternifolia*$_{a}$	27	35.52±3.01	0	36	7.51	**0.001**
	L. pilosa$_{b}$	19	19.16±3	0	25		
	L. ravenii$_{b}$	62	25.29±2.22	0	33		
Weighted wetland average score	*L. alternifolia*$_{a}$	27	2.51±0.14	1.10	3.85	5.45	**0.008**
	L. pilos$_{ab}$	19	1.82±0.16	1.00	2.88		
	L. raveni$_{i}$a	62	2.34±0.09	1.00	3.78		
Minimum distance to edge of Carolina Bay (km)*	*L.alternifolia*	27	2.24±0.72	0	11.9	0.95	0.40
	L. pilosa	19	2.65±0.77	0.09	8.09		
	L. ravenii	62	1.64±0.28	0	8.39		
Minimum distance to edge of wetland (km)*	*L. alternifolia*$_{ab}$	27	0.13±0.03	0	0.52	3.59	**0.037**
	L. pilosa$_{a}$	19	0.13±0.02	0	0.25		
	L. ravenii$_{b}$	62	0.09±0.01	0	0.23		

Supplemental Table 5. continued

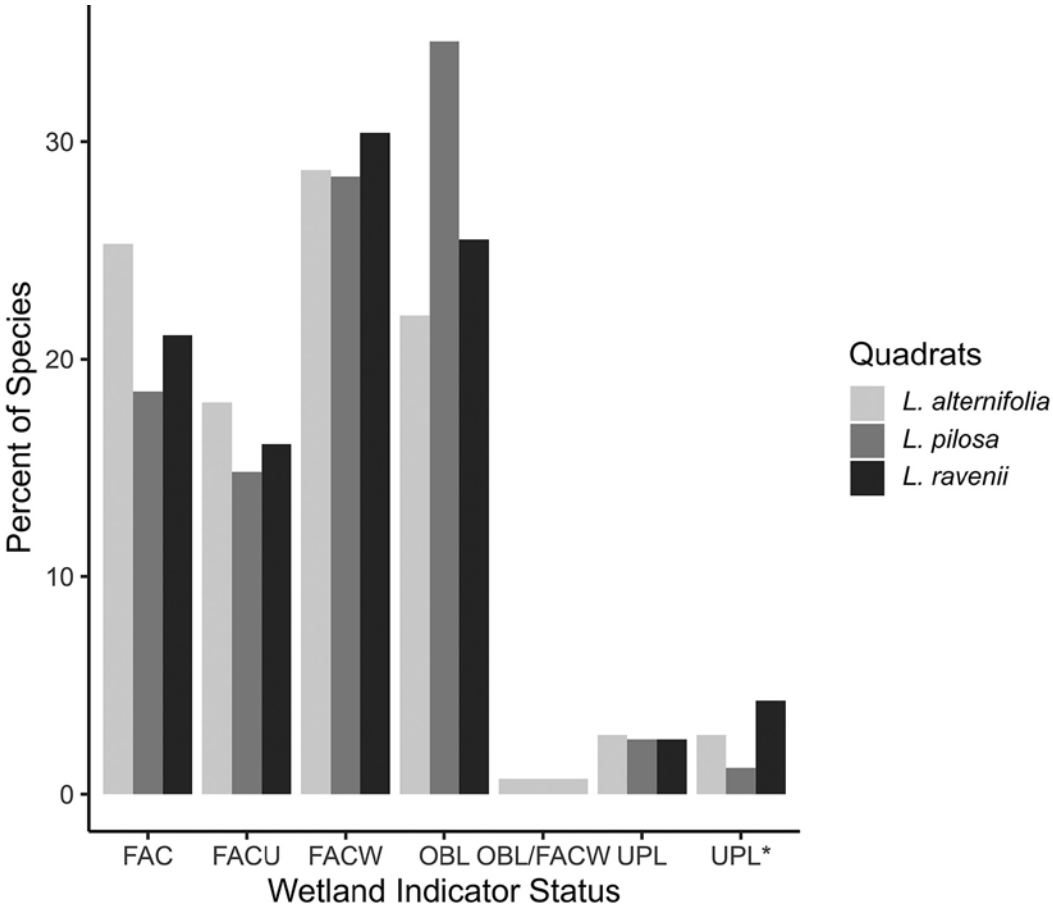
Variable	Level	N	Mean±SE	Min	Max	Test Statistic $F_{(Welch)}$	*p*-value
Minimum water table depth (April–June) in cm*	*L. alternifolia*$_a$	27	64.85±14.16	0	183	13.9	<**0.001**
	L. pilosa$_b$	19	6.32±2.19	0	20		
	L. ravenii$_a$	62	33.36±7.28	0	203		
Minimum water table depth (annual) in cm*	*L.alternifolia*	27	37.85±9.7	0	122	–	–
	L. pilosa	19	–	–	–		
	L. ravenii	62	17.58±5.08	0	192		
Available water storage (0–25cm depth)*	*L. alternifolia*	27	2.46±0.2	1.08	4.61	0.2	0.82
	L. pilosa	19	2.47±0.25	1.08	3.58		
	L. ravenii	62	2.35±0.1	0	3.25		



Supplemental Figure 4. Coefficients of Conservatism (C-value) for 174 taxa found in 1 m^2 quadrats centered respectively on *Ludwigia alternifolia* (n=27), *L. pilosa* (n=19), and *L. ravenii* (n=62). The C-value scale ranges from zero, representing species most tolerant of anthropogenic disturbance, to 10, representing species limited to high-quality natural environments as described by Gianopulos (2014). Species that were undefined or not referenced in the C-value process were not included.



Supplemental Figure 5. Frequencies of Coefficients of Conservatism (C-value) and weighted average of wetland taxa found in 1 m^2 quadrats centered respectively on *Ludwigia alternifolia* (N_{plots}=27; N_{sites}=11), *L. pilosa* (N_{plots}=19; N_{sites}=4), and *L. ravenii* (N_{plots}=62; N_{sites}=18). Boxplots showing mean (asterisk), median, and raw values. Post-hoc results from Games-Howell test (p<0.001=***, p<0.01=**, p<0.05=*, ns=Not Significant). The C-value categories range from: ≥7 Intolerant, 3>6 Mid–tolerant, ≤3 Tolerant, with the lowest range representing species most tolerant of anthropogenic disturbance as described by Gianopulos (2014). Species that were undefined or not referenced in the C-value process were not included. Weighted averages based on the wetland indicator categories and abundance described in Wentworth et al. (1988), ranging from 1=wetland obligate taxa to 5=upland taxa.



Supplemental Figure 6. Wetland indicator status (USACE 2020) for species found in 1 m^2 quadrats centered respectively on *Ludwigia alternifolia* (n=27), *L. pilosa* (n=19), and *L. ravenii* (n=62). Taxa not included in USACE (2020) were catergorized as UPL*. Quadrats with top-mowed *Juncus* were recorded as *J.effusus/coriaceus* and assigned OBL/FACW status.

Supplemental Table 6. Frequency (percent) and wetland status for taxa found at a frequency ≥15% in 1 m^2 quadrats of *L. ravenii* (n=total quadrats) and corresponding values for congener plots. Non-native species are indicated by a dot (•) preceding the name. Wetland indicator status from (USACE 2020).

Species	Wetland Indicator Status	*L. ravenii* (n=62)	*L. alternifolia* (n=27)	*L. pilosa* (n=19)
Acer rubrum	FAC	42	52	32
Kellochloa verrucosa	FACW	39	4	0
Ludwigia linearis	OBL	39	4	47
Coleataenia anceps	FAC	29	15	47
Diodia virginiana	FACW	27	7	26
Dichanthelium scoparium	FACW	23	19	26
Rhexia mariana var. *mariana*	FACW	21	0	0
Juncus effusus	OBL	21	15/22*	5
Lycopus virginicus	OBL	21	19	16
•*Paspalum notatum*	FACU	19	22	11
Euthamia caroliniana	FAC	18	7	0
Pinus taeda	FAC	18	15	5
Schizachyrium scoparium	FACU	18	15	0
Liquidambar styraciflua	FAC	16	22	5
Rubus hispidus	FACW	16	11	16
Coleataenia longifolia ssp. *longifolia*	FACU	15	0	0
Rhexia nashii	FACW	15	4	0
Juncus pelocarpus	OBL	15	0	0

*Two quadrats with top mowed *Juncus* and both taxa on site were recorded as *J.effusus/coriaceus* the treatment that includes those quadrats as *J.effusus* is on the right.

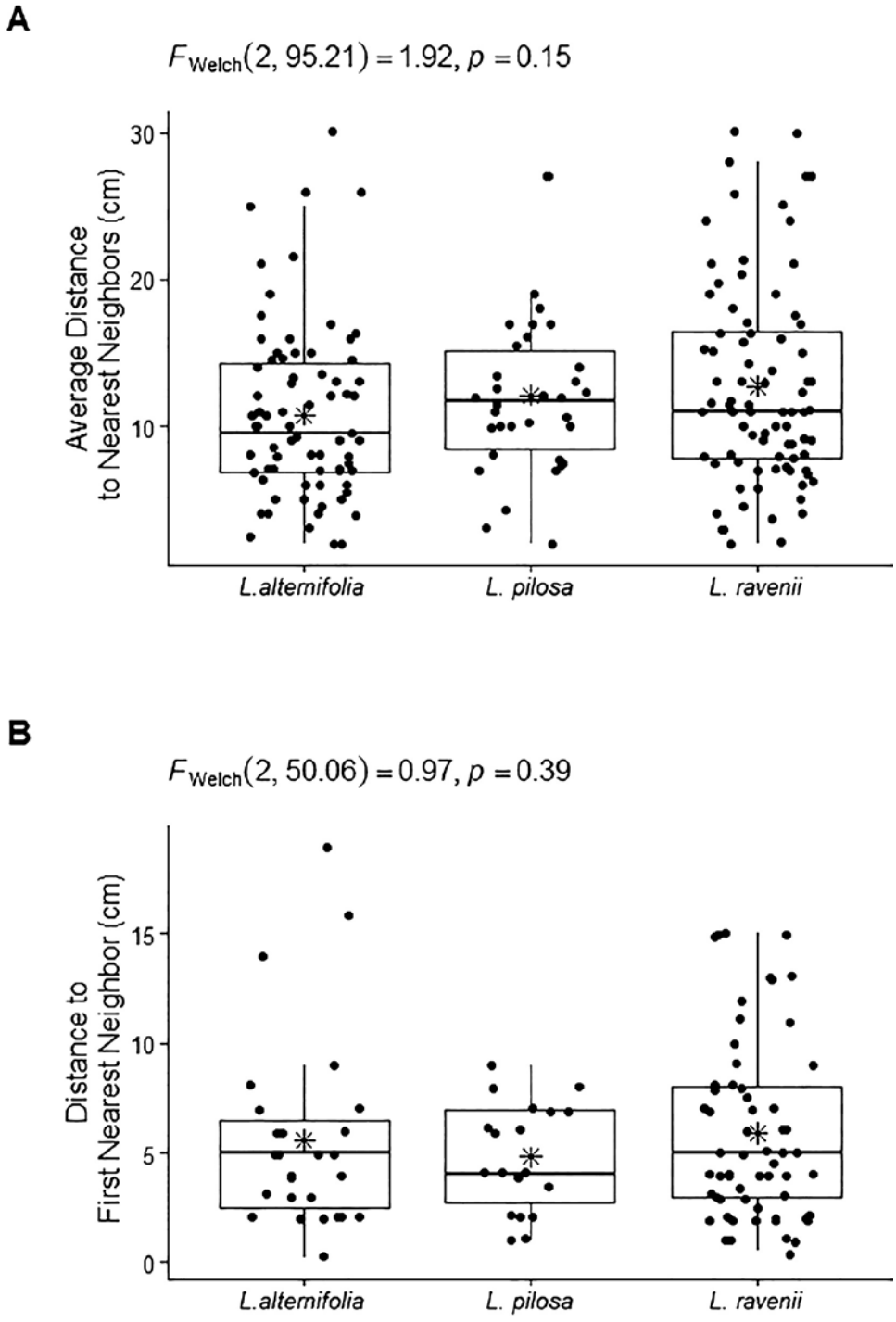
Supplemental Table 7. Observed maximum indicator values (IV_{max}) for each species found in 1 m^2 quadrats of *L. ravenii* (n=total quadrats), with IV_{max} >5 (following Dufrêne and Legendre 1997). Based on 4,999 randomizations. *P*-values provided for those species assigned as indicators to plots of *L. ravenii*. Significant species bolded (p<0.05). Non-native species are indicated by a dot (•) preceding the name. Wetland indicator status from USACE (2020). LUALT=*L. alternifolia*; LUPIL=*L. pilosa*; LURA=*L. ravenii*.

Species	Wetland Indicator Status	MaxGrp	LURA IV_{max} (n=62)	LUALT IV_{max} (n=27)	LUPIL IV_{max} (n=19)	*p*-value
Kellochloa verrucosa	FACW	LURA	27	1	0	**0.0292**
Rhexia mariana var. ***mariana***	FACW	LURA	21	0	0	**0.0166**
Juncus effusus	OBL	LURA	18	2	0	0.1298
Coleataenia longifolia ssp. ***longifolia***	FACU	LURA	15	0	0	**0.0506**
Diodia virginiana	FACW	LURA	15	0	11	0.3365
Juncus pelocarpus	OBL	LURA	15	0	0	0.0582
Pinus taeda	FAC	LURA	15	2	0	0.4161
Ludwigia linearis	OBL	LUPIL	15	0	31	–
Coleataenia anceps	FAC	LUPIL	12	1	23	–
Rhynchospora chalarocephala	OBL	LURA	13	0	0	**0.0544**
Schizachyrium scoparium	FACU	LURA	13	4	0	0.1908
Euthamia caroliniana	FAC	LURA	12	3	0	0.1932
Rhexia nashii	FACW	LURA	12	1	0	0.1056
•*Digitaria sanguinalis*	FACU	LURA	11	0	0	0.1518
Dichanthelium scabriusculum	OBL	LURA	11	0	0	0.101
Dichanthelium sp. 4	NA	LURA	10	0	0	0.0954
Axonopus fissifolius	FACW	LURA	10	2	0	0.2671
Smilax rotundifolia	FAC	LURA	9	2	0	0.5353
•*Paspalum notatum*	FACU	LUALT	8	13	0	–
Acer rubrum	FAC	LUALT	9	18	15	–
Carex glaucescens	OBL	LURA	8	0	4	0.4497
Dichanthelium sp. 2	NA	LURA	8	0	0	0.2026
Eleocharis tuberculosa	OBL	LURA	8	1	2	0.4485
Eragrostis elliottii	FACW	LURA	8	0	0	0.1926
Juncus acuminatus	OBL	LURA	8	0	1	0.2597
Juncus validus	FACW	LURA	8	0	0	0.3065
Paspalum laeve var. *laeve*	FACW	LURA	8	0	0	0.2114
Pinus sp.	NA	LURA	8	0	0	0.1892
Cyperaceae sp.	NA	LURA	7	0	2	0.3635
Fimbristylis autumnalis	OBL	LURA	7	0	0	0.3159
Lycopus virginicus	OBL	LUALT	7	7	5	–
Rubus hispidus	FACW	LURA	8	2	6	0.7592
Andropogon glomeratus	FACW	LURA	6	0	0	0.2581
Andropogon virginicus s.l.	FAC	LURA	6	0	0	0.2747
Centella erecta	FACW	LUPIL	6	0	12	–
Persicaria longiseta	NA	LURA	6	2	0	0.5437
Liquidambar styraciflua	FAC	LUALT	6	11	1	–
Sacciolepis striata	OBL	LURA	6	0	0	0.3745

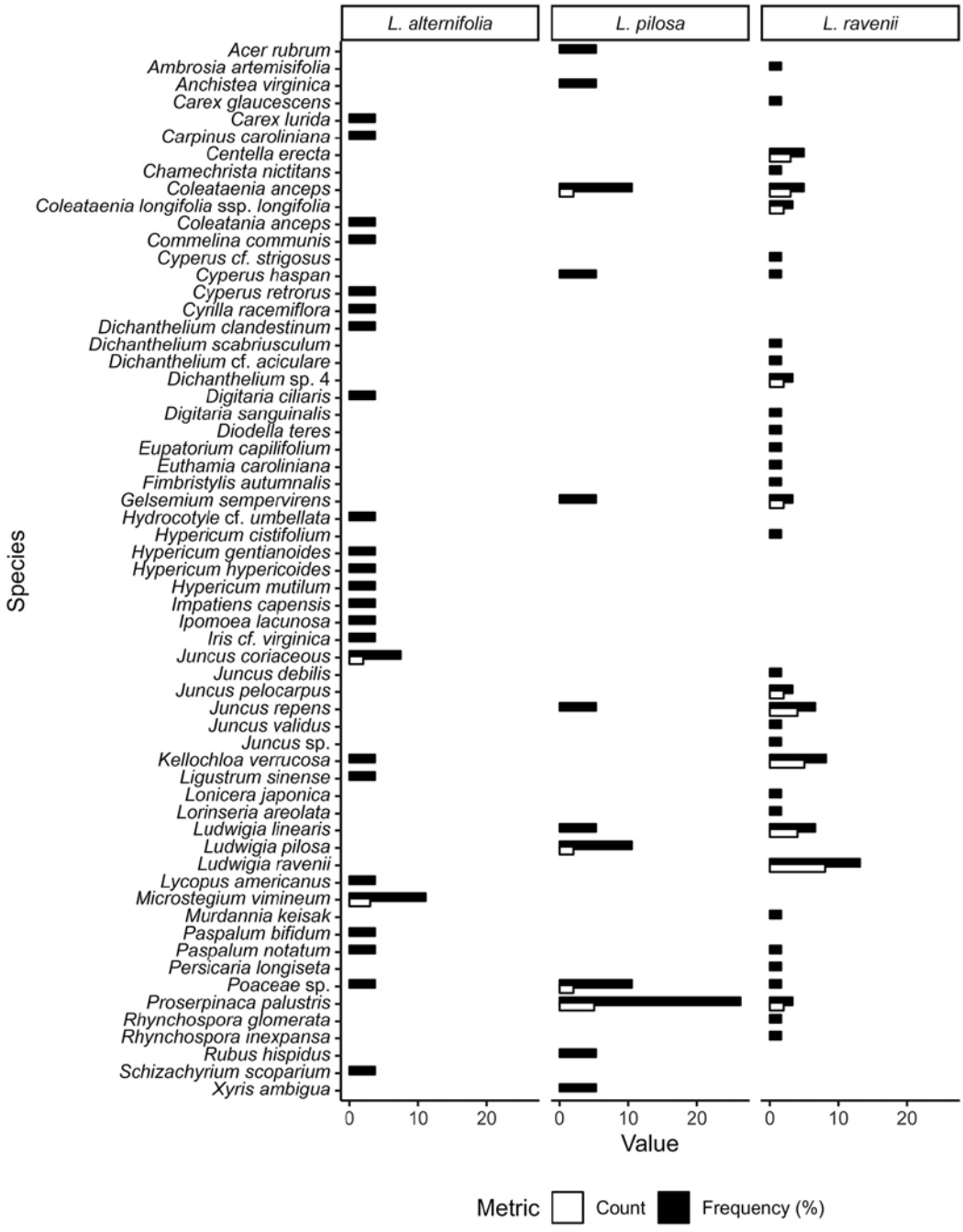
Supplemental Table 8. Average percent vegetative cover and wetland status for taxa found at an average cover ≥10% in 1m² quadrats of *Ludwigia ravenii* (n=total quadrats) and corresponding values for *Ludwigia* congener plots. Those species found at high frequency (≥15%) are underlined. Non-native species are indicated by a dot (•) preceding the name. Wetland indicator status from USACE (2020).

Species	Wetland Indicator Status	*L. ravenii* (n=62)	*L. alternifolia* (n=27)	*L. pilosa* (n=19)
•*Murdannia keisak*	OBL	63	26	0
Juncus repens	OBL	46	0	36
Sesbania herbacea	FACW	38	0	0
Centella erecta	FACW	31	4	6
Gordonia lasianthus	FACW	28	0	0
Eleocharis olivacea	OBL	23	0	0
Coleataenia longifolia ssp. *longifolia*	FACU	20	0	0
Diospyros virginiana	FAC	18	0	0
Leersia virginica	FACW	18	2	0
Juncus effusus	OBL	15	1/4*	4
Dichanthelium sp. 2	–	14	0	0
Coleataenia anceps	FAC	12	4	7
Aristida stricta	FAC	12	0	0
Dichanthelium scabriusculum	OBL	10	0	0

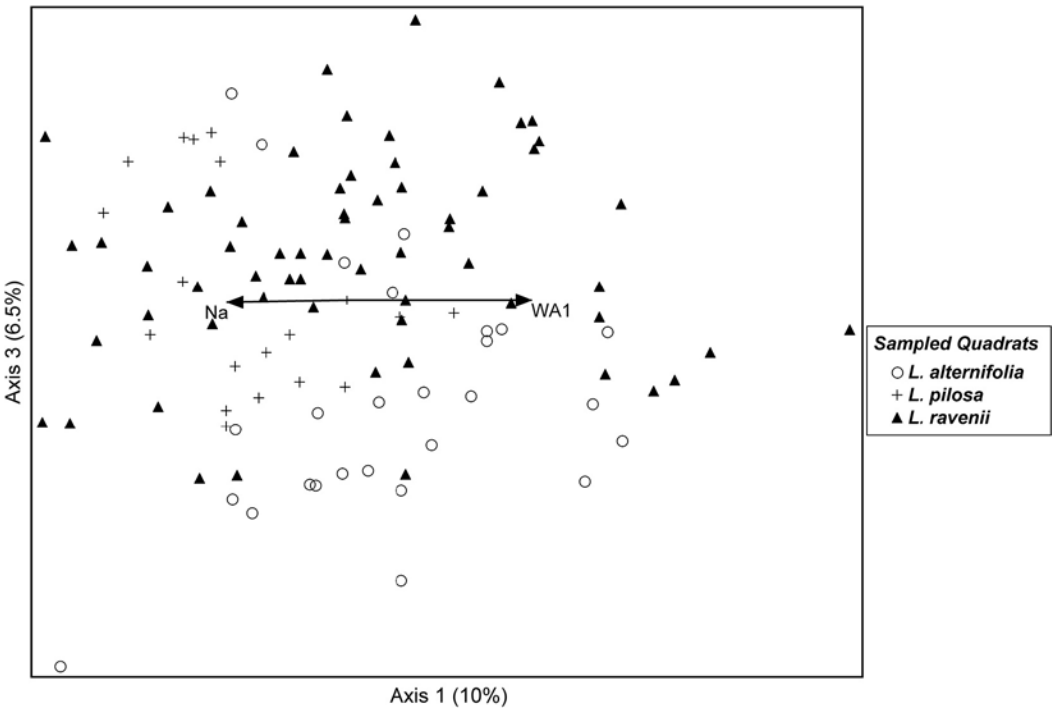
*Two quadrats with top mowed *Juncus* and both taxa on site were recorded as *J.effusus/coriaceus*; the treatment that includes those quadrats as simply *J.effusus* is on the right of the forward slash.



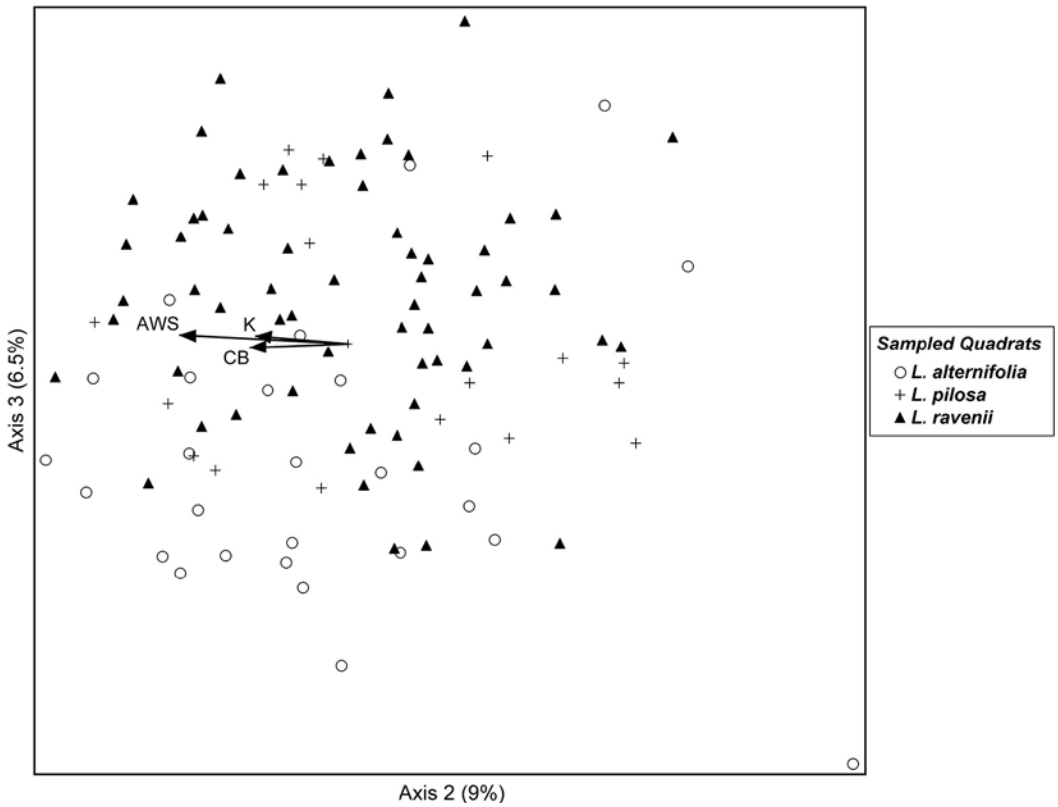
Supplemental Figure 7. Results of basally nearest-neighbor distance to target stems of *Ludwigia* sp. measured in 1 m^2 quadrats centered respectively on *L. alternifolia* (N_{plots}=27; N_{sites}=11), *L. pilosa* (N_{plots}=19; N_{sites}=4), and *L. ravenii* (N_{plots}=61; N_{sites}=18). One plot of *L. ravenii* was excluded due to unavailable data. Boxplots showing mean (asterisk), median, and raw values of the average distances of the 5 nearest-neighbors (A) and distances of the first nearest-neighbor (B).



Supplemental Figure 8. Count and frequency of basally nearest-neighbor to target stems of *Ludwigia* sp. measured in 1 m^2 quadrats centered respectively on *Ludwigia alternifolia* (N_{plots}=27; N_{sites}=11), *L. pilosa* (N_{plots}=19; N_{sites}=4), and *L. ravenii* (N_{plots}=61; N_{sites}=18). One plot of *L. ravenii* was excluded due to unavailable data. Count values provided for species occurring >1 time.



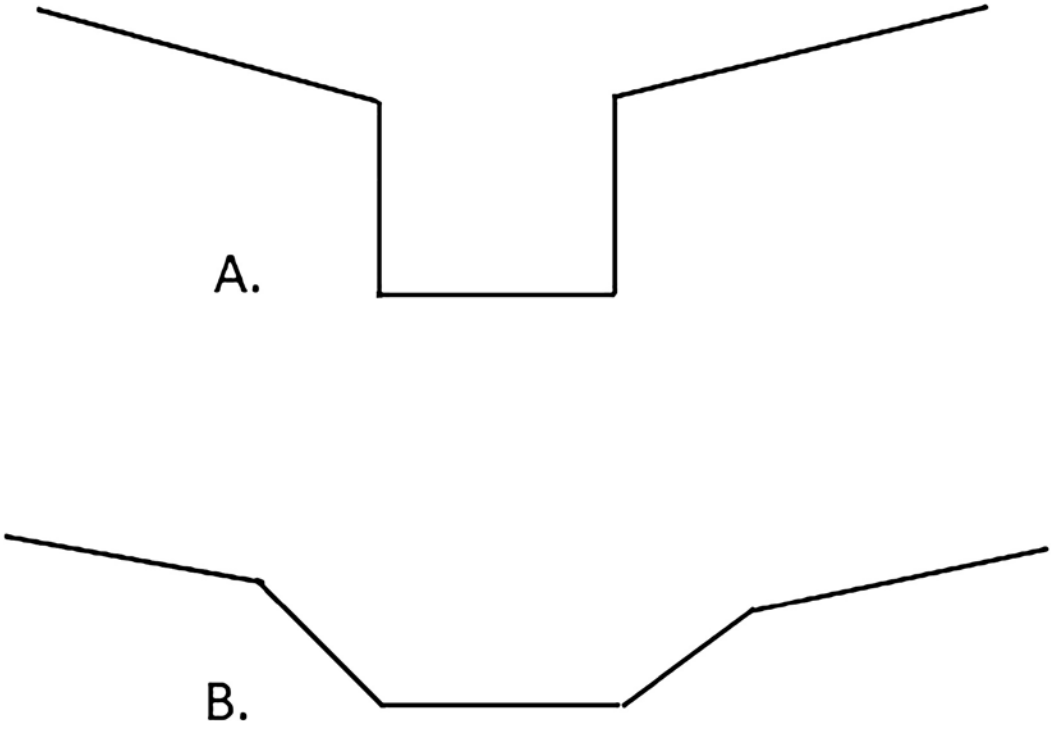
Supplemental Figure 9. Axes 1 and 3 of nonmetric multidimensional scaling (NMS) ordination of vegetation cover in 1 m^2 quadrats centered respectively on *Ludwigia alternifolia* (N_{plots}=27; N_{sites}=11), *L. pilosa* (N_{plots}=18; N_{sites}=4), and *L. ravenii* (N_{plots}=62; N_{sites}=18). Target species of *Ludwigia* themselves were removed from the analysis. Biplot vectors represent the most influential habitat variables (r^2 cutoff=0.2) and are found in the direction of increasing abundance and association with ordination axes. Habitat variables from left to right are: soil sodium (Na) values, and weighted wetland average plot score (WA1).



Supplemental Figure 10. Axes 2 and 3 of nonmetric multidimensional scaling (NMS) ordination of vegetation cover in 1 m^2 quadrats centered respectively on *Ludwigia alternifolia* (N_{plots}=27; N_{sites}=11), *L. pilosa* (N_{plots}=18; N_{sites}=4), and *L. ravenii* (N_{plots}=62; N_{sites}=18). Target species of *Ludwigia* themselves were removed from the analysis. Biplot vectors represent the most influential habitat variables (r^2 cutoff=0.2) and are found in the direction of increasing abundance and association with ordination axes. Habitat variables from left to right are: available water storage for plants at 0–25 cm depth (AWS) as estimated from soil survey interpolation (Soil Survey Staff 2022), soil potassium (K), and distance (km) to closest Carolina Bay (CB).

Supplemental Table 9. Mean±SE, minimum and maximum, and one-way ANOVA results for environmental habitat variables measured in 1 m^2 quadrats centered on target species of Ludwigia.

Variable	Level	N	Mean±SE	Min	Max	$F_{(Welch)}$	p-value
Quadrat canopy openness (%)	*L. alternifolia*	27	46.58±4.17	2.6	92.6	17.13	<0.0001
	L. pilosa	19	83.38±4.67	34.6	99.8		
	L. ravenii	62	64.88±3.19	13.8	99.8		
Bryophyte cover (%)	*L. alternifolia*	27	0.82±0.34	0	7.5		
	L. pilosa	19	0.61±0.43	0	7.5		
	L. ravenii	62	12.83±2.99	0	97.5		
Bare soil cover (%)	*L. alternifolia*	27	5.2±1.7	0	37.5		
	L. pilosa	19	8.42±2.15	0	37.5		
	L. ravenii	62	9.1±2.22	0	85		
Leaf litter cover (%)	*L. alternifolia*	27	40.48±5.01	0.505	85		
	L. pilosa	19	14.63±5.28	0	62.5		
	L. ravenii	62	27.77±3.46	0	85		
Rock cover (%)	*L. alternifolia*	27	0.13±0.13	0	3.5		
	L. pilosa	19	0.03±0.03	0	0.505		
	L. ravenii	62	0.05±0.02	0	0.505		
Woody debris cover (%)	*L. alternifolia*	27	4.72±2.61	0	62.5		
	L. pilosa	19	0.5±0.26	0	3.5		
	L. ravenii	62	0.37±0.11	0	3.5		
Lichen-fungi cover (%)	*L. alternifolia*	27	0.02±0.02	0	0.505		
	L. pilosa	19	0±0	0	0		
	L. ravenii	62	0±0	0	0.05		
Other cover: trash, bones, carcasses (%)	*L. alternifolia*	27	2.45±1.52	0	37.5		
	L. pilosa	19	2.82±1.98	0	37.5		
	L. ravenii	62	0.45±0.1	0	3.5		
Water cover (%)	*L. alternifolia*	27	5.78±3.84	0	97.5		
	L. pilosa	19	38.08±8.55	0	97.5		
	L. ravenii	62	5.35±2.4	0	97.5		



Supplemental Figure 11. Side view of typical ditch shapes observed among *Ludwigia* plots: (**A**) Box-like, incised ditches, (**B**) broad, inverted trapezoid ditches.

Supplemental Table 10. Mean±SE, minimum and maximum, and one-way ANOVA results for habitat variables measured at Ludwigia sp. roadside ditch plots (elevation, and water depth variables include non–roadside plots). The slope 1 variable always recorded as the slope closest to the road. Statistically significant differences ($p<0.05$) are bolded, levels followed by a common letter are not significantly different by the Games-Howell test at 5% level of significance.

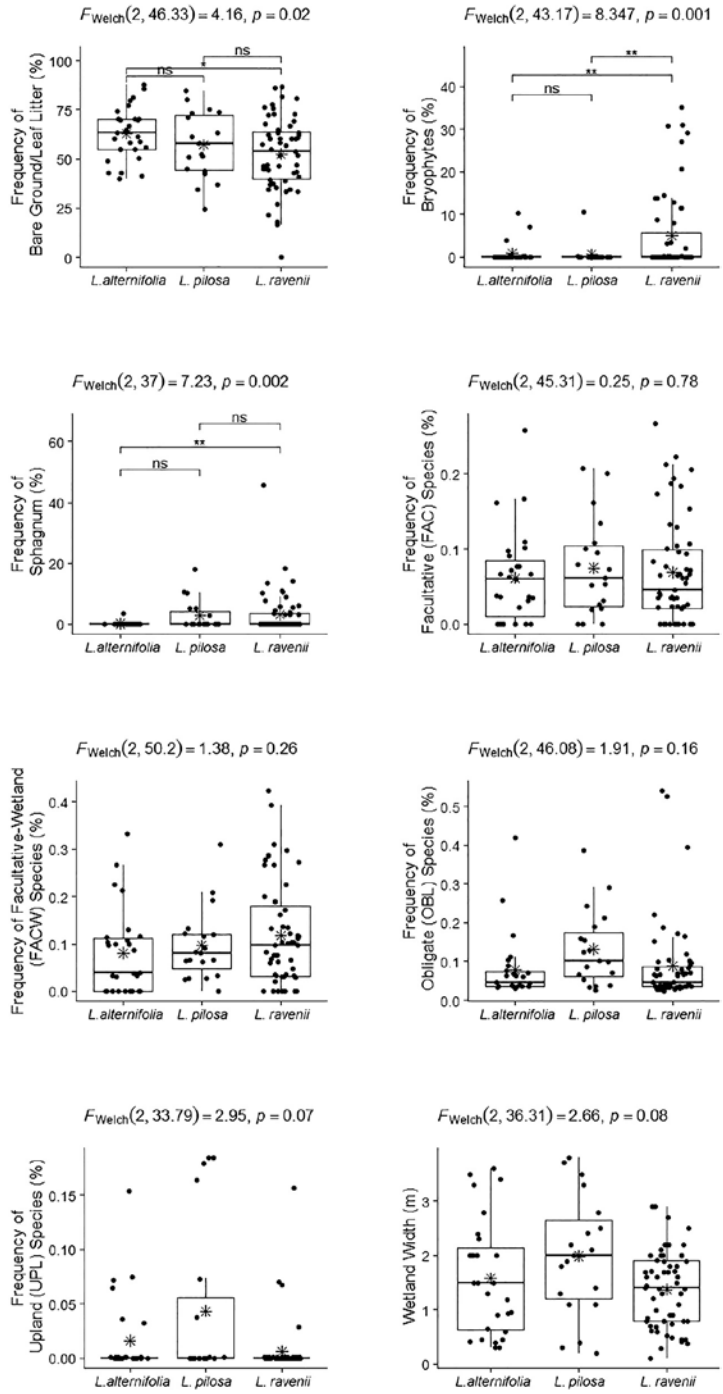
Variable	Level	N	Mean±SE	Min	Max	Test Statistic $F_{(Welch)}$	*p*-value
Ditch depth (cm)	*L. alternifolia*$_{ab}$	27	45.26±4.3	13.0	100.0	5.36	**0.009**
	L. pilosa$_{a}$	19	57.05±4.9	26.0	103.0		
	L. ravenii$_{b}$	55	39.84±2.1	12.5	90.0		
Ditch width (m)	*L. alternifolia*$_{ab}$	27	1.35±0.14	0.6	3.0	3.54	**0.038**
	L. pilosa$_{a}$	19	1.77±0.18	0.8	3.4		
	L. ravenii$_{b}$	55	1.24±0.09	0.5	3.0		
Slope 1 (degrees)	*L. alternifolia*	27	31.11±3.84	5.0	90.0	0.12	0.889
	L. pilosa	19	32.11±4.19	5.0	70.0		
	L. ravenii	55	30±1.9	15.0	90.0		
Slope 2 (degrees)	*L. alternifolia*$_{a}$	27	27.63±2.93	0.0	65.0	3.54	**0.037**
	L. pilosa$_{ab}$	19	31.58±5.38	10.0	80.0		
	L. ravenii$_{b}$	55	38.44±2.81	5.0	90.0		
Elevation (meters)	*L. alternifolia*$_{ab}$	27	24.06±2.77	3.9	50.2	10.23	**<0.0001**
	L. pilosa$_{a}$	19	17.47±1.09	10.4	22.7		
	L. ravenii$_{b}$	62	25.68±1.54	11.6	51.1		
Water depth (cm)	*L. alternifolia*$_{a}$	27	1.78±1.11	0.0	25.0	6.21	**0.005**
	L. pilosa$_{b}$	19	9.47±2.16	0.0	37.0		
	L. ravenii$_{a}$	62	1.5±0.63	0.0	22.0		
Aspect in degrees from North	*L. alternifolia*	27	91.7±9.05	10	170	2.9	0.066
	L. pilosa	19	66.16±11.13	16	170		
	L. ravenii	55	96.33±5.54	5	170		

Supplemental Figure 12. Ditch aspect class for roadside plots centered respectively on *Ludwigia alternifolia* (N_{plots}=27; N_{sites}=11), *L. pilosa* (N_{plots}=19; N_{sites}=4), and *L. ravenii* (N_{plots}=55; N_{sites}=16). Raw aspect values were divided into cardinal + intercardinal categories (**A**) and collapsed into cardinal categories in terms of degrees from north (**B**); see text.

Supplemental Table 11. Mean±SE, minimum and maximum, and one-way ANOVA results for variable length transects measured at *Ludwigia* sp. roadside ditch plots. Seven plots of *L. ravenii* that did not occur in roadside ditches were not included. Transect readings were taken every 10 centimeters, frequency is assessed out of total transect readings by plot. Statistically significant differences ($p<0.05$) are bolded, levels followed by a common letter are not significantly different by the Games-Howell test at 5% level of significance.

Variable	Level	N	Mean±SE	Min	Max	Test Statistic $F_{(Welch)}$	*p*-value
Frequency bare ground/litter (%)	*L. alternifolia*$_a$	27	62.88±2.6	40.0	87.5	4.16	**0.022**
	L. pilosa$_{ab}$	19	57.06±3.85	24.5	84.6		
	L. ravenii$_b$	55	52.41±2.51	0.0	86.4		
Frequency of bryophytes* (%)	*L. alternifolia*$_a$	27	0.79±0.47	0.0	10.3	8.35	**0.008**
	L. pilosa$_a$	19	0.55±0.55	0.0	17.9		
	L. ravenii$_b$	55	5.02±1.29	0.0	54.3		
Frequency of FAC (%)	*L. alternifolia*	27	0.18±0.03	0.0	0.6	0.25	0.781
	L. pilosa	19	0.2±0.04	0.0	0.5		
	L. ravenii	55	0.16±0.02	0.0	0.7		
Frequency of FACW (%)	*L. alternifolia*	27	0.21±0.05	0.0	0.9	1.38	0.26
	L. pilosa	19	0.26±0.04	0.0	0.8		
	L. ravenii	55	0.31±0.03	0.0	0.9		
Frequency of OBL (%)	*L. alternifolia*	27	0.23±0.04	0.1	0.7	1.91	0.159
	L. pilosa	19	0.32±0.04	0.1	0.6		
	L. ravenii	55	0.22±0.03	0.1	1.0		
Frequency of UPL (%)	*L.alternifolia*	27	0.04±0.02	0.0	0.3	2.95	0.066
	L. pilosa	19	0.09±0.04	0.0	0.5		
	L. ravenii	55	0.01±0.01	0.0	0.3		
Frequency of *Sphagnum* (%)	*L. alternifolia*$_a$	27	0.13±0.13	0.0	3.6	7.23	**0.002**
	L. pilosa$_{ab}$	19	2.76±1.16	0.0	17.9		
	L. ravenii$_b$	55	3.26±0.99	0.0	45.7		
Wetland width (m)	*L. alternifolia*	27	1.58±0.21	0.3	3.6	2.66	0.084
	L. pilosa	19	1.99±0.26	0.2	3.8		
	L. ravenii	55	1.38±0.09	0.1	2.9		
Transect length (m)	*L. alternifolia*$_{ab}$	27	3.38±0.15	2.6	5.0	4.25	**0.021**
	L. pilosa$_a$	19	3.82±0.18	2.9	5.3		
	L. ravenii$_b$	55	3.24±0.09	2.4	5.0		

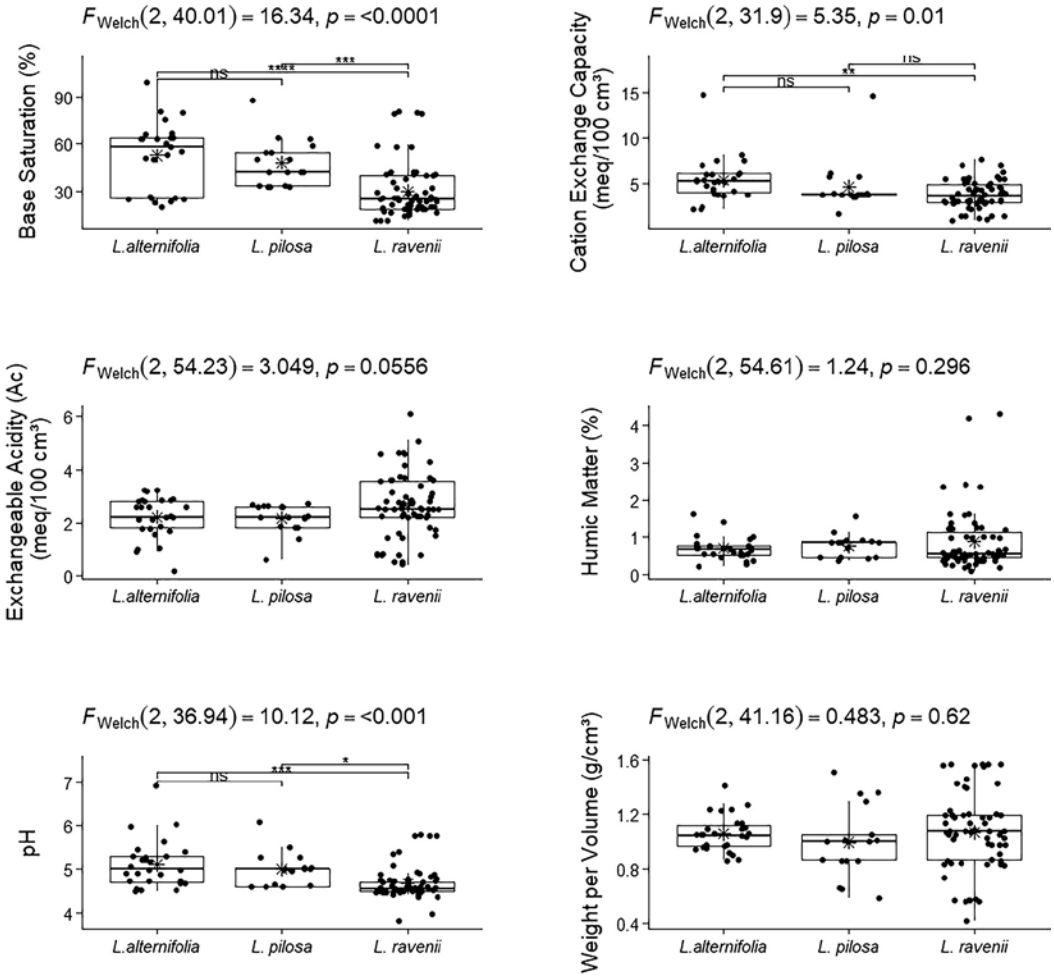
*Bryophytes does not include *Sphagnum* sp.



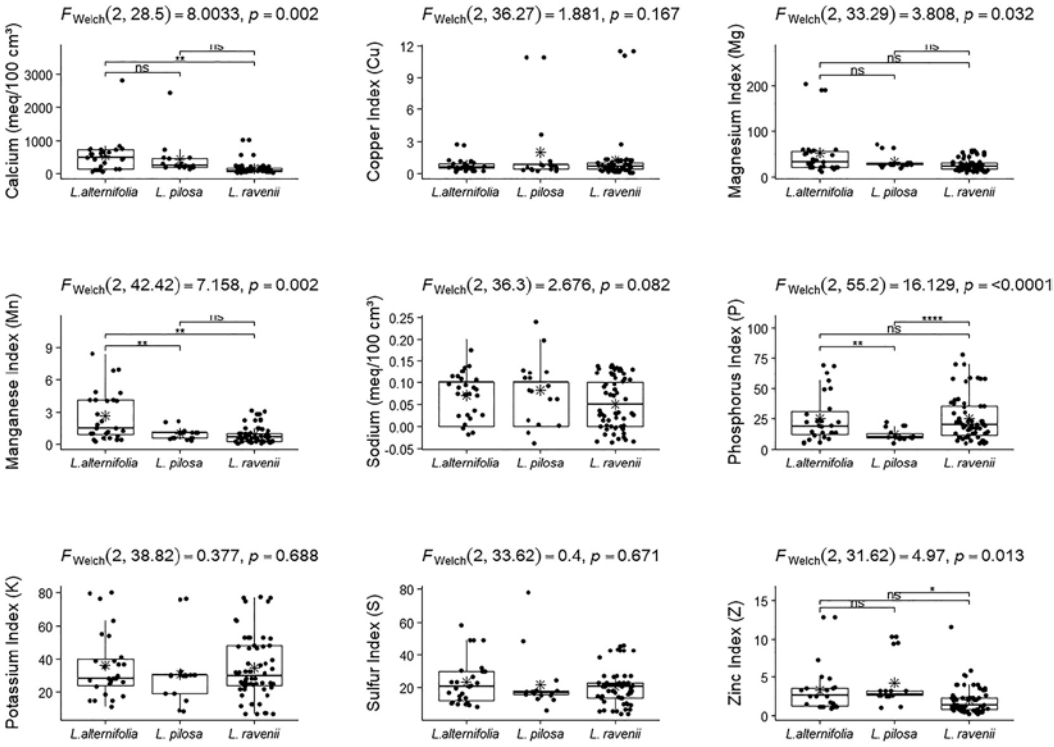
Supplemental Figure 13. Composition frequencies and width of roadside ditch wetlands for variable length transects crossing respectively *Ludwigia alternifolia* (N_{plots}=27; N_{sites}=11), *L. pilosa* (N_{plots}=19; N_{sites}=4), and *L. ravenii* (N_{plots}=55; N_{sites}=16). Seven *L. ravenii* plots excluded as non–roadside plots. Boxplots showing mean (asterisk), median, and raw values. Post-hoc results from Games-Howell test (p<0.001=***, p<0.01=**, p<0.05=*, ns=Not Significant). For detailed values refer to Supplemental Table 11. Wetland indicator status from USACE (2020). Bryophytes figure excludes *Sphagnum* sp. (shown separately).

Supplemental Table 12. Mean±SE, minimum and maximum, and one-way ANOVA results for soil variables measured in *Ludwigia* sp. sites, soil tests completed by NCDA & CS Agronomic Services (2021). Two plots excluded due to unavailable data. Statistically significant differences (p<0.05) are bolded, levels followed by a common letter are not significantly different by the Games-Howell test at 5% level of significance.

Variable	Group	N	Mean±SE	Min	Max	$F_{(Welch)}$	p-value
Weight/volume	*L. alternifolia*	27	1.05±0.03	0.9	1.41	0.48	0.62
(g/cm^3)	*L. pilosa*	17	0.99±0.06	0.6	1.5		
	L. ravenii	62	1.06±0.04	0.4	1.56		
Exchangeable	*L. alternifolia*	27	2.2±0.15	0.2	3.2	3.05	0.056
Acidity (Ac)	*L. pilosa*	17	2.17±0.14	0.6	2.7		
(meq/100 cm^3)	*L. ravenii*	62	2.65±0.16	0.4	6.1		
Base Saturation (%)	*L. alternifolia*$_a$	27	52.48±4.12	20	99	16.34	<**0.0001**
	L. pilosa$_a$	17	47.94±3.61	33	88		
	L. ravenii$_b$	62	29.98±2.2	11	80		
Calcium (Ca)	*L. alternifolia*$_a$	27	2.69±0.51	0.3	14.1	8.01	**0.002**
(meq/100 cm^3)	*L. pilosa*$_{ab}$	17	2.16±0.65	0.8	12.1		
	L. ravenii$_b$	62	0.83±0.12	0.18	5.09		
Cation Exchange	*L. alternifolia*$_a$	27	5.4±0.47	2.1	14.8	5.35	**0.01**
Capacity	*L. pilosa*$_{ab}$	17	4.65±0.67	1.6	14.6		
(meq/100 cm^3)	*L. ravenii*$_b$	62	3.78±0.2	0.9	7.7		
Humic Matter (%)	*L. alternifolia*	27	0.69±0.06	0.2	1.61	1.24	0.296
	L. pilosa	17	0.77±0.07	0.4	1.55		
	L. ravenii	62	0.88±0.1	0.09	4.32		
Potassium Index (K)	*L. alternifolia*	27	35.93±3.83	11	80	0.38	0.688
	L. pilosa	17	30.82±4.54	8	76		
	L. ravenii	62	34.47±2.39	7	77		
Copper Index (Cu)	*L. alternifolia*	27	0.77±0.12	0.2	2.7	1.88	0.167
	L. pilosa	17	2.01±0.83	0.3	10.9		
	L. ravenii	62	1.22±0.3	0.1	11.5		
Magnesium Index (Mg)	*L. alternifolia*	27	52.44±10.29	12	204	3.81	**0.032**
	L. pilosa	17	33.29±3.79	20	70		
	L. ravenii	62	26.97±1.75	10	57		
Manganese Index (Mn)	*L. alternifolia*$_a$	27	2.63±0.44	0.3	8.4	7.16	**0.002**
	L. pilosa$_b$	17	0.99±0.12	0.4	2.1		
	L. ravenii$_b$	62	0.89±0.1	0.1	3.1		
Phosphorus Index (P)	*L. alternifolia*$_a$	27	25.52±3.85	5	69	16.13	<**0.0001**
	L. pilosa$_b$	17	11.94±1.15	5	22		
	L. ravenii$_a$	62	25.03±2.35	5	78		
pH	*L. alternifolia*$_a$	27	5.12±0.11	4.5	6.9		
	L. pilosa$_a$	17	5.01±0.1	4.6	6.1	10.12	<**0.001**
	L. ravenii$_b$	62	4.68±0.05	3.8	5.8		
Sulfur Index (S)	*L. alternifolia*	27	23.41±2.67	9	58		
	L. pilosa	17	21.71±4.1	6	78	0.4	0.671
	L. ravenii	62	20.71±1.36	4	46		
Zinc Index (Z)	*L. alternifolia*$_{ab}$	27	3.27±0.6	1	12.8		
	L. pilosa$_a$	17	4.28±0.79	1.1	10.3	4.97	**0.013**
	L. ravenii$_b$	62	2.03±0.23	0.2	11.6		
Sodium (meq/100 cm^3)	*L. alternifolia*	27	0.07±0.01	0	0.2		
	L. pilosa	17	0.08±0.02	0	0.2	2.68	0.082
	L. ravenii	62	0.05±0.01	0	0.1		



Supplemental Figure 14. Soil variables one-way ANOVA results from sampled plots centered respectively on *Ludwigia alternifolia* (N_{plots}=27; N_{sites}=11), *L. pilosa* (N_{plots}=17; N_{sites}=3), and *L. ravenii* (N_{plots}=62; N_{sites}=18). Two plots excluded due to unavailable data. tests completed by NCDA & CS Agronomic Services (2021). Boxplots showing mean (asterisk), median, and raw values. Post-hoc results from Games-Howell test (p<0.001=***, p<0.01=**, p<0.05=*, ns=Not Significant). For detailed values refer to Table 11.



Supplemental Figure 15. Soil nutrient variables one-way ANOVA results from sampled plots centered respectively on *Ludwigia alternifolia* (N_{plots}=27; N_{sites}=11), *L. pilosa* (N_{plots}=17; N_{sites}=3), and *L. ravenii* (N_{plots}=62; N_{sites}=18). Two plots excluded due to unavailable data. Soil tests completed by NCDA & CS Agronomic Services (2021). Nutrient status index values are categorized as follows: 0–10 Very low, 11–25 Low, 26–50 Medium, 51–100 High, 100+ Very high (Hardy et al. 2013). Boxplots showing mean (asterisk), median, and raw values. Post-hoc results from Games-Howell test (p<0.001=***, p<0.01=**, p<0.05=*, ns=Not Significant). For detailed values refer to Table 11.

Supplemental Table 13. Dominant soil series for plots as mapped in Soil Survey Database (Soil Survey Staff 2022) for plots centered respectively on *L. alternifolia* (N_{plots}=27; N_{sites}=11), *L. pilosa* (N_{plots}=19; N_{sites}=4), and *L. ravenii* (N_{plots}=62; N_{sites}=18). Percent calculated as occurrence of each series out of total plots per species of *Ludwigia*.

Taxon	Order	Series	Drainage plots per species	Percent
L. alternifolia	Entisols	Levy silty clay loam	Very poorly drained	4%
L. alternifolia	Spodosols	Centenary fine sand	Well drained	4%
L. alternifolia	Spodosols	Leon fine sand	Poorly drained	15%
L. alternifolia	Spodosols	Lynn Haven sand	Poorly drained	7%
L. alternifolia	Ultisols	Autryville loamy fine sand, 0 to 6 percent slopes	Well drained	11%
L. alternifolia	Ultisols	Autryville loamy sand, 0 to 6 percent slopes	Well drained	11%
L. alternifolia	Ultisols	Dragston fine sandy loam	Somewhat poorly drained	4%
L. alternifolia	Ultisols	Foreston loamy fine sand, 0 to 2 percent slopes	Moderately well drained	11%
L. alternifolia	Ultisols	Foreston loamy sand	Moderately well drained	4%
L. alternifolia	Ultisols	Myatt fine sandy loam	Poorly drained	11%
L. alternifolia	Ultisols	Rains fine sandy loam, 0 to 2 percent slopes, Atlantic Coast Flatwoods	Poorly drained	7%
L. alternifolia	Ultisols	Tomotley fine sandy loam	Poorly drained	11%
L. pilosa	Spodosols	Echaw sand	Moderately well drained	16%
L. pilosa	Spodosols	Leon fine sand	Poorly drained	26%
L. pilosa	Ultisols	Rains fine sandy loam	Poorly drained	26%
L. pilosa	Ultisols	Rains sandy loam, 0 to 2 percent slopes	Poorly drained	32%
L. ravenii	Inceptisols	Torhunta fine sandy loam	Poorly drained	5%
L. ravenii	Spodosols	Centenary fine sand	Well drained	5%
L. ravenii	Spodosols	Echaw sand	Moderately well drained	2%
L. ravenii	Spodosols	Leon fine sand	Poorly drained	5%
L. ravenii	Spodosols	Leon sand, 0 to 2 percent slopes	Poorly drained	3%
L. ravenii	Spodosols	Lynn Haven sand	Poorly drained	5%
L. ravenii	Spodosols	Witherbee sand	Somewhat poorly drained	5%
L. ravenii	Ultisols	Autryville loamy sand, 0 to 6 percent slopes	Well drained	6%
L. ravenii	Ultisols	Dragston fine sandy loam	Somewhat poorly drained	2%
L. ravenii	Ultisols	Foreston loamy sand	Moderately well drained	8%
L. ravenii	Ultisols	Lynchburg fine sandy loam	Somewhat poorly drained	5%
L. ravenii	Ultisols	Nansemond fine sandy loam, 0 to 2 percent slope	Moderately well drained	10%
L. ravenii	Ultisols	Rains fine sandy loam	Poorly drained	27%
L. ravenii	Ultisols	Wagram loamy sand, 0 to 6 percent slopes	Well drained	2%
L. ravenii	Ultisols	Woodington loamy sand	Poorly drained	8%
L. ravenii	–	Water	–	3%

Supplemental Table 14. Historical specimens (N=194) and species (N=170) sharing the same strict locality or broader vicinity and collector as historical specimens of *Ludwigia ravenii*. Bolded specimens represent *strict* co-collections of *L. ravenii* sharing the same collection date, collector, and locality. Plain text is used for specimens with a higher level of spatiotemporal uncertainty in their association with a collection of *L. ravenii* (including for example, being collected on a different date or from a spatially broader vicinity). However, although spatially broader than for strict co-collections, this latter specimen category is also constrained in that no specimens from localities farther than 0.8 km (0.5 mi) from a *L. ravenii* collection are included. Specimens of *L. ravenii* lacking clear locality information are not included in these data. Species with asterisks (*) were recorded as associates of *L. ravenii* in the present research. Species with lines (|) were collected by multiple collectors. Co-collected specimens representing species observed in this research from non-roadside habitats are treated with a superscript. Data were compiled by J. Crawford and M. Conlin from SERNEC (2023). Species nomenclature represents the unmodified output from SERNEC (2023).

Scientific Name	Co-occurring Voucher (Collector Number [Date])	Associated *Ludwigia ravenii* Voucher (Collector Number [Date])
*Acalypha gracilens**	McCrary 438 [1963-06-29]	McCrary 1071 [1963-09-15]
Agrimonia parviflora	Fernald & Long 3968 [1934-08-04]	Fernald & Long 4074 [1934-08-04]
Amaranthus cannabinus	**Fernald & Long 11026 [1939-08-20]**	Fernald & Long 11091 [1939-08-20]
Amelanchier canadensis	**Fernald & Long 3958 [1934-08-04]**	Fernald & Long 4074 [1934-08-04]
Anthaenantia rufa	Godfrey 48475 [1948-09-02]	Godfrey 48407 [1948-08-20]
Apocynum cannabinum	**Fernald & Long 4137 [1934-08-04]**	Fernald & Long 4074 [1934-08-04]
Aristida virgata	Fernald 15178 [1946-09-08]	Fernald, Long & Clement 15316 [1946-09-12]
*Arundinaria gigantea subsp. tecta**	Ahles 48424 [1958-08-01][3]	Ahles 51539 [1958-10-16]
Asclepias lanceolata	**Fernald & Long 4143 [1934-08-04]**	Fernald & Long 4074 [1934-08-04]
Aster spectabilis var. *suffultus*	**Fernald 15375 [1946-09-12]**	Fernald, Long & Clement 15316 [1946-09-12]
Baptisia tinctoria	McCrary 549 [1963-06-29]	McCrary 1071 [1963-09-15]
Betula nigra	**Fernald & Long 3895 [1934-08-04]**	Fernald & Long 4074 [1934-08-04]
Bigelowia nudata	McCrary 1770 [1963-11-16]	McCrary 1071 [1963-09-15]
*Boehmeria cylindrica**	Godfrey 4682 [1938-06-22]	Godfrey 6240 [1938-08-28]
Bulbostylis coarctata	Godfrey 4670 [1938-06-18]	Godfrey 6240 [1938-08-28]
Burmannia capitata	**Ahles 56483 [1957-09-28]**	Ahles 35485 [1957-09-28]
Burmannia capitata	**McCrary 1080 [1963-09-15]**	McCrary 1071 [1963-09-15]

[1]"exsiccated pool" (SERNEC 2023)
[2]"low woods border"/"sandy woods" (SERNEC 2023)
[3]"pocosin in sand ridge" (SERNEC 2023)
[4]"savanna" (SERNEC 2023)
[5]"sphagnous and peaty bog" (SERNEC 2023)
[6]"border of moist thicket by sandy and gravelly railroad embankment" (SERNEC 2023) 7 "stream margin" (SERNEC 2023)
[8]"swamp forest border" (SERNEC 2023)
[9]"swampy pineland" (SERNEC 2023)
[10]"wet, peaty clearings in woods of Pinus serotina" (SERNEC 2023)

Supplemental Table 14. continued

Scientific Name	Co-occurring Voucher (Collector Number [Date])	Associated *Ludwigia ravenii* Voucher (Collector Number [Date])
Cakile harperi	Godfrey & Buell 3545 [1938-04-18]	Godfrey 6240 [1938-08-28]
Carex austrodeflexa	Ahles (NCU00080625) [1958-05-09]	Ahles 51539 [1958-10-16]
Carex comosa	Godfrey 4683 [1938-06-22]	Godfrey 6240 [1938-08-28]
*Carex glaucescens**	**Ahles 51546 [1958-10-16]**[3]	Ahles 51539 [1958-10-16]
*Carex lurida**	**Fernald & Long 3809 [1934-08-04]**[10]	Fernald & Long 4074 [1934-08-04]
Carex venusta	**Fernald & Long 3806 [1934-08-04]**	Fernald & Long 4074 [1934-08-04]
Carphephorus tomentosus	Fernald, Long & Clement 15366 [1946-09-08]	Fernald, Long & Clement 15316 [1946-09-12]
Carphephorus tomentosus	**Fernald, Long & Clement 15367 [1946-09-12]**	Fernald, Long & Clement 15316 [1946-09-12]
Cephalanthus occidentalis	Godfrey 4693 [1938-06-22]	Godfrey 6240 [1938-08-28]
Chamaecyparis thyoides	Ahles 40383 [1958-05-09]	Ahles 51539 [1958-10-16]
Chamaedaphne calyculata	**Ahles 47985 [1958-07-30]**	Ahles 47982 [1958-07-30]
Chrysopsis nervosa	Ahles 48428 [1958-08-01]	Ahles 51539 [1958-10-16]
Cicuta maculata	McCrary 1034 [1963-09-15]	McCrary 1071 [1963-09-15]
Cleistes divaricata	Ahles 26482 [1957-05-27]	Ahles 35485 [1957-09-28]
*Coleataenia anceps**	**Peng 4410 [1982-09-09]**	Peng 4402 [1982-09-09]
*Coleataenia longifolia**	**Peng 4434 [1982-09-09]**	Peng 4402 [1982-09-09]
Crataegus phaenopyrum	**Fernald & Long 3960 [1934-08-04]**	Fernald & Long 4074 [1934-08-04]
Crotalaria purshii var. *bracteolifera*	Fernald, Long & Clement 15273 [1946-09-08]	Fernald, Long & Clement 15316 [1946-09-12]
Ctenium aromaticum	Fernald 15177 [1946-09-08]	Fernald, Long & Clement 15316 [1946-09-12]
Cyperus esculentus var. *macrostachyus*	**Ahles 48422 [1958-08-01]**	Ahles 48407 [1958-08-01]
Cyperus filiculmis	Ahles & Duke 44708 [1958-06-26]	Ahles 51539 [1958-10-16]
Cyperus filiculmis	Ahles 44709 [1958-06-26]	Ahles 51539 [1958-10-16]
Decodon verticillatus	**Beal 2637 [1956-09-00]**	Beal 2631 [1956-09]
*Desmodium paniculatum**	Fernald, Long & Clement 15278 [1946-09-08][6]	Fernald, Long & Clement 15316 [1946-09-12]

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Scientific Name	Co-occurring Voucher (Collector Number [Date])	Associated *Ludwigia ravenii* Voucher (Collector Number [Date])
Desmodium tenuifolium	**Fernald, Long & Clement 15283 [1946-09-12]**	Fernald, Long & Clement 15316 [1946-09-12]
Desmodium tenuifolium	Fernald, Long & Clement 15284 [1946-09-08]	Fernald, Long & Clement 15316 [1946-09-12]
Dichanthelium	**Peng 4421 [1982-09-09]**	Peng 4402 [1982-09-09]
Dichanthelium	**Peng 4437 [1982-09-09]**	Peng 4402 [1982-09-09]
Dichanthelium commutatum var. *ashei*	Ahles 40389 [1958-05-09]	Ahles 51539 [1958-10-16]
*Dichanthelium scabriusculum**	**Fernald & Long 3687 [1934-08-04][10]**	Fernald & Long 4074 [1934-08-04]
*Digitaria ischaemum**	**Radford 37592 [1958-07-19][4]**	Radford 37586 [1958-07-19]
*Drosera intermedia**	**Godfrey 48405 [1948-08-20][1]**	Godfrey 48407 [1948-08-20]
Dulichium arundinaceum	**Beal 2625 [1956-09-00]**	Beal 2631 [1956-09]
Dulichium arundinaceum	**Beal 2705 [1956-09-00]**	Beal 2631 [1956-09]
Echium vulgare	Fernald, Long & Clement 15344 [1946-09-08]	Fernald, Long & Clement 15316 [1946-09-12]
Eleocharis microcarpa	**Ahles 48413 [1958-08-01]**	Ahles 48407 [1958-08-01]
Eleocharis microcarpa	**Boufford 18896 [1976-09-10]**	Boufford 18898 [1976-09-10]
Eleocharis microcarpa	**Radford 34584 [1958-07-19]**	Radford 37586 [1958-07-19]
*Eleocharis tuberculosa**	McCrary 564 [1963-06-30]	McCrary 1071 [1963-09-15]
Eriocaulon compressum	Godfrey & Buell 3550 [1938-00-00]	Godfrey 6240 [1938-08-28]
Eryngium aquaticum	**Peng 4416 [1982-09-09]**	Peng 4402 [1982-09-09]
*Eubotrys racemosa**	**Fernald & Long 4113 [1934-08-04][10]**	Fernald & Long 4074 [1934-08-04]
Eupatorium album	**Godfrey 6238 [1938-08-28]**	Godfrey 6240 [1938-08-28]
Eupatorium mohrii	**Fernald & Long 4223 [1934-08-04]**	Fernald & Long 4074 [1934-08-04]
Eupatorium perfoliatum	**Fernald & Long 4225 [1934-08-04]**	Fernald & Long 4074 [1934-08-04]
Eupatorium pubescens	**Ahles 51543 [1958-10-16]**	Ahles 51539 [1958-10-16]
*Eupatorium rotundifolium**	**Fernald & Long 4219 [1934-08-04][10]**	Fernald & Long 4074 [1934-08-04]
Euphorbia humistrata	Fernald 15299 [1946-09-08]	Fernald, Long & Clement 15316 [1946-09-12]

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Eurybia spectabilis	Fernald 15375 [1946-09-08]	Fernald, Long & Clement 15316 [1946-09-12]
Eutrochium dubium	**Godfrey 6237 [1938-08-28]**	Godfrey 6240 [1938-08-28]
Fothergilla gardenii	McCrary 607 [1963-06-29]	McCrary 1071 [1963-09-15]
Gentiana autumnalis	Fernald, Long & Clement 15341 [1946-09-08]	Fernald, Long & Clement 15316 [1946-09-12]
| *Gentiana catesbaei*	**Fernald, Long & Clement 15342 [1946-09-12]**	Fernald, Long & Clement 15316 [1946-09-12]
| *Gentiana catesbaei*	McCrary 1763 [1963-11-16]	McCrary 1071 [1963-09-15]
Hamamelis virginiana	**Ahles 51545 [1958-10-16]**	Ahles 51539 [1958-10-16]
| *Helianthus angustifolius*	**Ahles 51130 [1958-10-14]**	Ahles 51133 [1958-10-14]
| *Helianthus angustifolius*	McCrary 1037 [1963-09-15]	McCrary 1071 [1963-09-15]
Hypericum	**Ahles 48291 [1958-08-01]**	Ahles 48303 [1958-08-01]
Hypericum canadense	**McCrary 1072 [1963-09-15]**	McCrary 1071 [1963-09-15]
Hypericum canadense	McCrary 553 [1963-06-29]	McCrary 1071 [1963-09-15]
*Hypericum cistifolium**	McCrary 875 [1963-08-17]	McCrary 1071 [1963-09-15]
Hypericum denticulatum var. *denticulatum*	**Ahles 48292 [1958-08-01]**	Ahles 48303 [1958-08-01]
*Hypericum mutilum**	McCrary 439 [1963-06-29]	McCrary 1071 [1963-09-15]
Hypericum reductum	Godfrey s.n. (MISSA008249) [1939-06-18]	Godfrey 6240 [1938-08-28]
Hypericum reductum	Godfrey s.n. (NCU00417037) [1939-06-18]	Godfrey 6240 [1938-08-28]
Ilex laevigata	**Ahles 51544 [1958-10-16]**	Ahles 51539 [1958-10-16]
Juncus biflorus	Godfrey 48210 [1948-06-20]	Godfrey 48407 [1948-08-20]
*Juncus canadensis**	**Beal 2627 [1956-00-00]**[7]	Beal 2631 [1956-09]
*Juncus debilis**	**Fernald & Long 3838 [1934-08-04]**[10]	Fernald & Long 4074 [1934-08-04]
*Juncus dichotomus**	Godfrey 48213 [1948-06-20]	Godfrey 48407 [1948-08-20]
*Juncus effusus**	**Beal 2640 [1956-00-00]**[7]	Beal 2631 [1956-09]

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*Juncus repens**	**Beal 2644 [1956-09-00]**	Beal 2631 [1956-09]
*Juncus repens**	**Boufford 18897 [1976-09-10]**	Boufford 18898 [1976-09-10]
*Juncus scirpoides**	**Godfrey 6242 [1938-08-28]**	Godfrey 6240 [1938-08-28]
Kyllinga odorata	McCrary 1026 [1963-09-15]	McCrary 1071 [1963-09-15]
*Lachnanthes caroliniana**	McCrary 665 [1963-07-13]	McCrary 1071 [1963-09-15]
Lachnocaulon anceps	Godfrey 926 [1939-06-18]	Godfrey 6240 [1938-08-28]
Lachnocaulon beyrichianum	Godfrey 4680 [1938-06-22]	Godfrey 6240 [1938-08-28]
Lachnocaulon beyrichianum	Godfrey s.n. (NCU00054615) [1939-06-18]	Godfrey 6240 [1938-08-28]
Lachnocaulon minus	Godfrey s.n. (MISSA011420) [1939-06-18]	Godfrey 6240 [1938-08-28]
Lilium catesbaei var. *longii*	**Ahles 33209 [1957-08-02]**	Ahles 33210 [1957-08-02]
Linum striatum	**Fernald & Long 3993 [1934-08-04]**	Fernald & Long 4074 [1934-08-04]
Lobelia canbyi	**McCrary 1007 [1963-09-15]**	McCrary 1071 [1963-09-15]
*Ludwigia alternifolia**	**Fernald & Long 4072 [1934-08-04]** [10]	Fernald & Long 4074 [1934-08-04]
*Ludwigia alternifolia**	**Fernald & Long 4073 [1934-08-04]**[10]	Fernald & Long 4074 [1934-08-04]
*Ludwigia alternifolia**	**Fleming & Ludwig 9962 [1994-09-27]**	Fleming & Ludwig 9961 [1994-09-27]
*Ludwigia alternifolia**	**Radford 37588 [1958-07-19]**[4]	Radford 37586 [1958-07-19]
Ludwigia hirtella	Fernald, Long & Clement 15314 [1946-09-08]	Fernald, Long & Clement 15316 [1946-09-12]
*Ludwigia linearis**	**Beal 2633 [1956-09-00]**[7]	Beal 2631 [1956-09]
*Ludwigia linearis**	**Boufford 18899 [1976-09-10]**	Boufford 18898 [1976-09-10]
*Ludwigia linearis**	**Fernald & Long 4075 [1934-08-04]**[10]	Fernald & Long 4074 [1934-08-04]
Ludwigia linifolia	Godfrey 48480 [1948-09-02]	Godfrey 48407 [1948-08-20]
*Ludwigia pilosa**	**McCrary 1071 [1963-09-15]**	McCrary 1071 [1963-09-15]
Lupinus diffusus	Godfrey 7081 [1939-04-06]	Godfrey 6240 [1938-08-28]
*Lycopodiella alopecuroides**	McCrary 916 [1963-06-29]	McCrary 1071 [1963-09-15]

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Lycopodiella appressa	**Ahles 35488 [1957-09-28]**	Ahles 35485 [1957-09-28]
Lycopodiella appressa	McCrary 444 [1963-06-29]	McCrary 1071 [1963-09-15]
Lycopodiella prostrata	**Ahles 35489 [1957-09-28]**	Ahles 35485 [1957-09-28]
Lycopus amplectens	**Ahles 35486 [1957-09-28]**	Ahles 35485 [1957-09-28]
*Lycopus virginicus**	**Peng 4423 [1982-09-09]**	Peng 4402 [1982-09-09]
*Lyonia ligustrina f. nanella**	Fernald 15331 [1946-09-08][5]	Fernald, Long & Clement 15316 [1946-09-12]
*Lyonia lucida**	**Fernald & Long 4114 [1934-08-04][10]**	Fernald & Long 4074 [1934-08-04]
Marshallia graminifolia	**Peng 4418 [1982-09-09]**	Peng 4402 [1982-09-09]
*Mikania scandens**	Godfrey 4652 [1938-06-18]	McCrary 1071 [1963-09-15]
*Mikania scandens**	McCrary 440 [1963-06-29]	McCrary 1071 [1963-09-15]
Nasturtium officinale	Godfrey 3542 [1938-04-18]	Godfrey 6240 [1938-08-28]
Panicum	**Peng 4428 [1982-09-09]**	Peng 4402 [1982-09-09]
Panicum glutinoscabrum	Fernald 15186 [1946-09-08]	Fernald, Long & Clement 15316 [1946-09-12]
*Panicum verrucosum**	**Ahles 48415 [1958-08-01][3]**	Ahles 48407 [1958-08-01]
Panicum virgatum var. *cubense*	Godfrey 4696 [1938-06-23]	Godfrey 6240 [1938-08-28]
*Paspalum dilatatum**	McCrary 447 [1963-06-29]	McCrary 1071 [1963-09-15]
Paspalum dissectum	Fernald 15190 [1946-09-08]	Fernald, Long & Clement 15316 [1946-09-12]
Paspalum praecox	Fernald 15193 [1946-09-08]	Fernald, Long & Clement 15316 [1946-09-12]
Paspalum setaceum var. *muhlenbergii*	Fernald 15191 [1946-09-08]	Fernald, Long & Clement 15316 [1946-09-12]
*Paspalum urvillei**	**Peng 4409 [1982-09-09]**	Peng 4402 [1982-09-09]
Persea borbonia	McCrary 795 [1963-06-29]	McCrary 1071 [1963-09-15]
Persea palustris	Godfrey 4657 [1938-06-18]	Godfrey 6240 [1938-08-28]
*Persicaria sagittata**	**Peng 4429 [1982-09-09]**	Peng 4402 [1982-09-09]
Pinus serotina	**Fernald & Long 3618 [1934-08-04]**	Fernald & Long 4074 [1934-08-04]

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*Pityopsis graminifolia**	**Ahles 48297 [1958-08-01][2]**	Ahles 48303 [1958-08-01]
Platanthera conspicua	**Ahles 33213 [1957-08-02]**	Ahles 33210 [1957-08-02]
|*Platanthera cristata*	**Ahles 33216 [1957-08-02]**	Ahles 33210 [1957-08-02]
|*Platanthera cristata*	**Fernald & Long 3881 [1934-08-04]**	Fernald & Long 4074 [1934-08-04]
Platanthera X *bicolor*	**Ahles 33214 [1957-08-02]**	Ahles 33210 [1957-08-02]
Polygala brevifolia	**Godfrey 6239 [1938-08-28]**	Godfrey 6240 [1938-08-28]
Polygala cruciata	**Fernald, Long & Clement 15297 [1946-09-12]**	Fernald, Long & Clement 15316 [1946-09-12]
*Polygala lutea**	**Fernald, Long & Clement 15298 [1946-09-14][9]**	Fernald, Long & Clement 15319 [1946-09-14]
Polygala nuttallii	**Ahles 48294 [1958-08-01]**	Ahles 48303 [1958-08-01]
Pteridium aquilinum var. *pseudocaudatum**	**Ahles 51541 [1958-10-16][3]**	Ahles 51539 [1958-10-16]
Rhexia aristosa	**Godfrey 48411 [1948-08-20]**	Godfrey 48407 [1948-08-20]
Rhexia cubensis	Godfrey 48476 [1948-09-02]	Godfrey 48407 [1948-08-20]
Rhus copallinum	**Fernald & Long 4019 [1934-08-04]**	Fernald & Long 4074 [1934-08-04]
Rhus toxicodendron	Ahles 40388 [1958-05-09]	Ahles 51539 [1958-10-16]
Rhynchospora baldwinii	Godfrey 48208 [1948-06-20]	Godfrey 48407 [1948-08-20]
Rhynchospora filifolia	**Godfrey 48410 [1948-08-20]**	Godfrey 48407 [1948-08-20]
*Rhynchospora glomerata**	**Ahles 48295 [1958-08-01][2]**	Ahles 48303 [1958-08-01]
Rhynchospora gracilenta	**Fernald & Long 3792 [1934-08-04]**	Fernald & Long 4074 [1934-08-04]
|*Rhynchospora microcephala**	**Fernald & Long 3785 [1934-08-04][10]**	Fernald & Long 4074 [1934-08-04]
|*Rhynchospora microcephala**	**Radford 37593 [1958-07-19][4]**	Radford 37586 [1958-07-19]
Robinia nana	Ahles 40382 [1958-05-09]	Ahles 51539 [1958-10-16]
Rosa virginiana	Godfrey 48477 [1948-09-02]	Godfrey 48407 [1948-08-20]
Rumex hastatulus	Godfrey & White 7079 [1939-04-06]	Godfrey 6240 [1938-08-28]
Ruppia maritima	Godfrey & Wells 4785 [1938-06-28]	Godfrey 6240 [1938-08-28]

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Sabatia difformis	Godfrey s.n. [1939-06-18]	Godfrey 6240 [1938-08-28]
*Sacciolepis striata**	Godfrey 4648 [1938-06-18]	Godfrey 6240 [1938-08-28]
Sagittaria latifolia var. *obtusa*	**Beal 2648 [1956-09-00]**	Beal 2631 [1956-09]
Sarracenia flava	**Ahles 47984 [1958-07-30]**	Ahles 47982 [1958-07-30]
Sarracenia minor	**Peng 4439 [1982-09-09]**	Peng 4402 [1982-09-09]
Sarracenia purpurea	Ahles 48426 [1958-08-01]	Ahles 51539 [1958-10-16]
Scleria brittonii	Godfrey 48482 [1948-09-02]	Godfrey 48407 [1948-08-20]
Scleria georgiana	**Godfrey 48409 [1948-08-20]**	Godfrey 48407 [1948-08-20]
Scleria triglomerata	Ahles & Duke 48431 [1958-08-01]	Ahles 51539 [1958-10-16]
Scleria triglomerata	**Ahles 33217 [1957-08-02]**	Ahles 33210 [1957-08-02]
Scleria triglomerata	Godfrey 4636 [1938-06-15]	Godfrey 6240 [1938-08-28]
Sida rhombifolia	McCrary 1794 [1963-11-16]	McCrary 1071 [1963-09-15]
Silphium compositum	**McCrary 1981 [1963-09-15]**	McCrary 1071 [1963-09-15]
Sisyrinchium atlanticum	Godfrey & Buell 3539 [1938-04-18]	Godfrey 6240 [1938-08-28]
*Solidago fistulosa**	**Fernald, Long & Clement 15372 [1946-09-12][5]**	Fernald, Long & Clement 15316 [1946-09-12]
Solidago nemoralis var. *nemoralis*	Fernald 15374 [1946-09-08]	Fernald, Long & Clement 15316 [1946-09-12]
Solidago rugosa var. *aspera*	McCrary 1765 [1963-11-16]	McCrary 1071 [1963-09-15]
Solidago virgata	Ahles 26484 [1957-05-27]	Ahles 35485 [1957-09-28]
Sophronanthe pilosa	McCrary 443 [1963-06-29]	McCrary 1071 [1963-09-15]
Stylisma humistrata	Ahles 44704 [1958-06-26]	Ahles 51539 [1958-10-16]
Stylosanthes biflora	McCrary 437 [1963-06-29]	McCrary 1071 [1963-09-15]
Symphyotrichum novi-belgii	**Fernald 15376 [1946-09-12]**	Fernald, Long & Clement 15316 [1946-09-12]
Teesdalia nudicaulis	Ahles 44703 [1958-06-26]	Ahles 51539 [1958-10-16]
Triantha racemosa	McCrary 749 [1963-07-31]	McCrary 1071 [1963-09-15]

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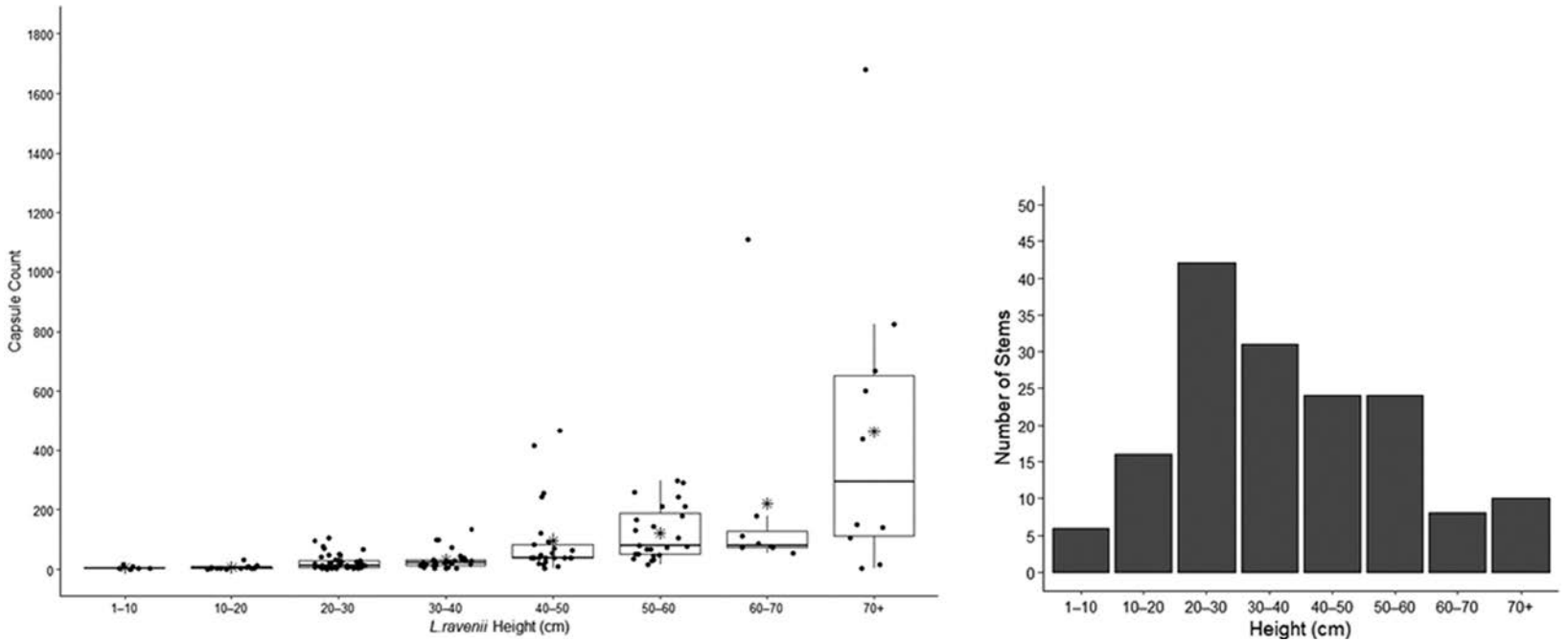
Trichostema dichotomum	Ahles 44702 [1958-06-26]	Ahles 51539 [1958-10-16]
Utricularia gibba	**Ahles 33212 [1957-08-02]**	Ahles 33210 [1957-08-02]
Utricularia subulata	**Ahles & Duke 51540 [1958-10-16]**	Ahles 51539 [1958-10-16]
*Woodwardia virginica**	**Fernald 3601 [1934-08-04][10]**	Fernald & Long 4074 [1934-08-04]
*Xyris ambigua**	Godfrey 4629 [1938-06-15]	Godfrey 6240 [1938-08-28]
Xyris baldwiniana	**Godfrey 48406 [1948-08-20]**	Godfrey 48407 [1948-08-20]
Xyris conocephala	Godfrey 4645 [1938-06-15]	Godfrey 6240 [1938-08-28]
Xyris laxifolia var. *iridifolia*	**Boufford 18895 [1976-09-10]**	Boufford 18898 [1976-09-10]
*Zenobia pulverulenta**	**Ahles 47986 [1958-07-30][8]**	Ahles 47982 [1958-07-30]

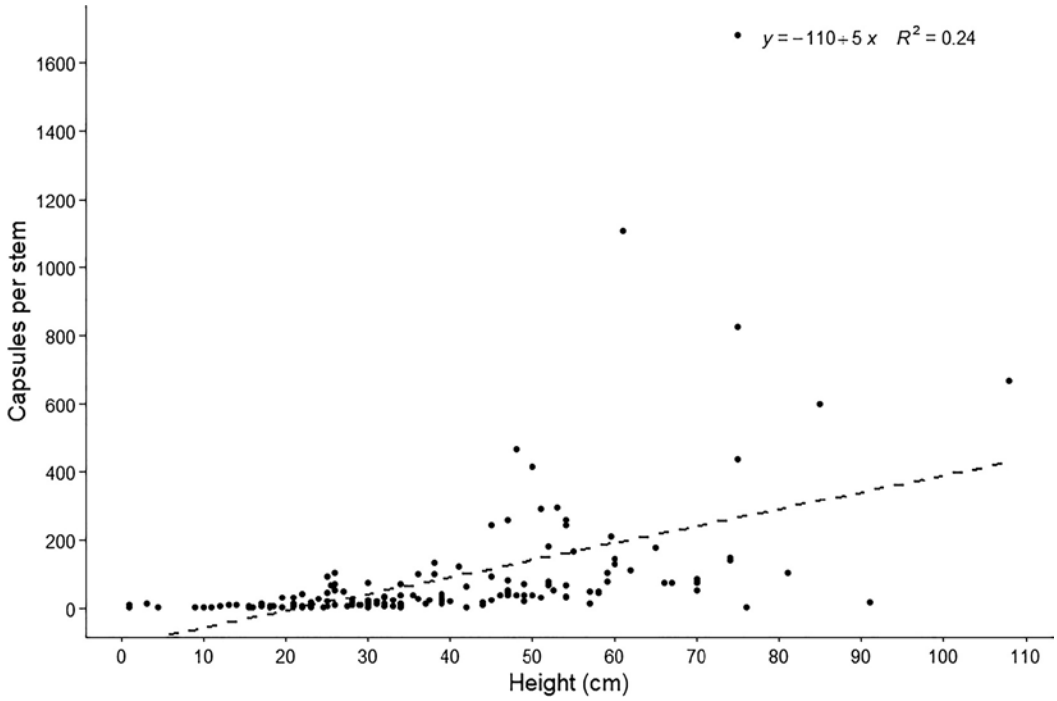
[1]"exsiccated pool" (SERNEC 2023)
[2]"low woods border"/"sandy woods" (SERNEC 2023)
[3]"pocosin in sand ridge" (SERNEC 2023)
[4]"savanna" (SERNEC 2023)
[5]"sphagnous and peaty bog" (SERNEC 2023)
[6]"border of moist thicket by sandy and gravelly railroad embankment" (SERNEC 2023) 7 "stream margin" (SERNEC 2023)
[8]"swamp forest border" (SERNEC 2023)
[9]"swampy pineland" (SERNEC 2023)
[10]"wet, peaty clearings in woods of Pinus serotina" (SERNEC 2023)

Supplemental Table 15. Summary statistics for sampled stems of *Ludwigia ravenii* found in 62 plots, each comprising of a 1 m^2 quadrat and a variable length transect. Individual stem metrics were assessed for 162 total stems; stem average includes two outlier plots containing the maximum observed densities of 17 and 19.

Variable	Mean±SE	Min	Max
Average quadrat cover (%)	3.5±1.2	0.5	62.5
Stems per quadrat	2.0±0.37	1	19
Stems per transect	1.2±0.06	1	3
Stem height (cm)	39.0±1.5	1	108
Average number of capsules per stem	127±44	1	6731



Supplemental Figure 16. Height and counted or estimated capsule totals for individual stems of *Ludwigia ravenii* (N=161) excluding one outlier stem with over 6,700 estimated total capsules and height of 55 cm. Boxplots showing mean (asterisk), median, and raw values.



Supplemental Figure 17. Scatterplot of *Ludwigia ravenii* capsules per stem by height (n=161) excluding one outlier stem with over 6,700 estimated total capsules.

SUPPLEMENTAL NOTE 1.

R scripts for univariate ANOVA, and Games-Howell post-hoc tests.

```
################### Univariate Analysis of Plot Variables##########
library(tidyverse)

library(rstatix)

AllABIOvars <- read.csv("data/BasePlotData_Conlinetal_2024.csv", header =
TRUE, skip = 1, na.strings = c(".", "NA"))
# Verify data file of 108 observations of 102 variables, skipping the first row
and treating cells with period as NA

AllABIOvars$Taxon = as.factor(AllABIOvars$Taxon)

# Subset data to only include relevant quantitative variables for analysis
PlotVarsCont <-  (subset(AllABIOvars,select= -c(Date,Plot_Num, Full._SiteName,
State, County.Locality,verbatimLocality, Coordinates, Coor_Accuracy,
Site,Type, Lrstems_Plot,Brdr1, Rd_Direction, Brdr2,Ditch.Face.Cate.,
Aspect_combined,NNTreeDist.1,NNTreeDist.2, NNTreeHt1, NNTreeHt2,
Border_SPP_Comments, Data_Comments,Habitat.Comments, CBFID, NEAR_CB_X,
NEAR_CB_Y,WET_FID,NEAR_WI_X, NEAR_WI_Y, WETLAND_TY, musym, muname_series,
series_code,taxclname,drclassdcd, drclassCode, hydgrpdcd, hydgrpCode,
taxclname,taxclCode, taxorder, taxorCode)))
       # Verify data frame of 108 observations of 61 variables with only nu-
meric or integer variables

# Transform data from wide to long
plotVars_long <- pivot_longer(data = PlotVarsCont, cols = c(Ele_m:D_Simpsons),
#exclude SiteCode, Taxon variables#
         names_to = "Vars", values_to = "Value")
# Retrieve summary statistics
Stats <- plotVars_long %>% group_by(Taxon, Vars) %>% get_summary_stats(.,
type = "common")

# Perform ANOVA for unequal variance (WELCH)
plot.welch.anova <- plotVars_long %>%
  group_by(Vars) %>%
  welch_anova_test(Value ~ Taxon) %>%
  add_significance()
plot.welch.anova

write.csv(plot.welch.anova, "data_output/AllPlotVariablesANOVA-bySpp.csv",
row.names = FALSE)

# Perform Post-hoc tests #
GH_post <- plotVars_long%>%
  group_by(Vars) %>%
  games_howell_test (Value ~ Taxon, detailed=TRUE)

write.csv(GH_post, "data_output/AllPlotVariablesGHPostHoc-bySpp.csv", row.
names = FALSE)
```

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