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Population dynamics of endangered *Iresine rhizomatosa* (Juda's bush)

By

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Submitted 3/20/14

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Time-frame of this report: 2012 - 2013

Introduction:

The goal of this project was to assess potential population changes of *Iresine rhizomatosa* Standl. (Juda's bush, bloodleaf: Amaranthaceae) a State listed (Endangered in Illinois and Maryland, Rare in Indiana) perennial bush of floodplain forests. This listed plant is at the northern edge of its range in southeastern Illinois and is limited to a very few sites in Crawford, Lawrence, Massac, Pulaski, and Wabash counties. While some observational data have been collected on this plant, quantitative records of population size and dynamics are unknown. Two high quality sites that it occurs in are the 133 ha Beall Woods Nature Preserve and 56.5 ha Robeson Hills Nature Preserve. Beall Woods is an excellent remaining example of floodplain forest that once occurred along the Wabash River and contains several state champion trees in the upland and bottomland forests. Robeson Hills is a remnant of mesic upland forest of the Southern Upland Section on the Wabash Border Natural Division consisting of narrow flat-topped ridges, steep slopes, and deep ravines. The most significant feature of the preserve is a beech-maple forest on dissected, deep loess deposits overlooking the Wabash River. *Iresine rhizomatosa* populations have been known at both sites for many years (at least 1962 for Beall Woods), and qualitatively surveyed since 1988 (Beall Woods) and 1999 (Robeson Hills). However, apart from anecdotal observations about population size and health (e.g., Beall Woods population 1995 "population is increasing", 2009 "community stable", Element Occurrence Records notes), quantitative data have not been recorded. Indeed, *I. rhizomatosa* is essentially unstudied throughout its range with its records in the literature being limited to reports in floristic surveys. There is a clear need to know more about the basic biology of this listed plant, and in Illinois to obtain better information on population changes to enable effective stewardship.

Objectives:

Project objectives were to determine the potential for *I. rhizomatosa* populations to increase or decrease in size in the near future. This is an important objective as the findings will allow site managers to plan appropriate conservation measures for this state listed plant. Ideally, long-term survey work would be undertaken to monitor population size through time. However, there is not a baseline for such a study for *I. rhizomatosa* and it is unlikely that such a program can be initiated in the near future. We proposed an alternative approach to essentially gauge the reproductive health of plants in two key populations.

Specifically, we monitored the size/stage class distribution of *I. rhizomatosa* plants in Beall Woods and Robeson Hills to determine the proportional representation of individuals of different sizes, and monitor fecundity (= seed production). These measurements will be part of a larger project on the comparative population dynamics of members of the Amaranthaceae plant family in Illinois, that includes *I. rhizomatosa*, the invasive exotic *Achyranthes japonica*, and the agricultural weeds, *Amaranthus rudis* and *A. palmeri* being undertaken by one of the project PIs (Lauren Schwartz) for her doctoral dissertation research at SIUC.

Objective 1: Determine the distribution of size classes of individuals in two populations of *I. rhizomatosa.*

Objective 2: Determine the recruitment success from seed of new individuals and survivorship of juvenile individuals in two populations of *I. rhizomatosa.*

Objective 3: Determine the fecundity of flowering individuals in two populations of *I. rhizomatosa.*

Methods:

Objective 1: One hundred randomly located individuals were tagged in each population in March 2012. Individuals were tagged at the seedling stage and observed over the season and as the plants grew they were assigned to one of four size/stage classes (seedling (1-3 nodes), juvenile (4-7 nodes), non-flowering adult (7+ nodes), flowering adult [male or female]). The populations were revisited in late spring and late summer 2013 to assess survivorship and transition to larger size-classes of each individual. In addition, 100 randomly located flowering adult individuals were tagged in October 2012 (64 female and 36 male plants at Beall Woods State Park and 48 female and 52 male plants at Robeson Hills).

Objective 2: One thousand seeds collected in early fall 2012 were sown (November 2012) into 7 of 10 $1m^2$ plots in each population (three of the 10 plots remained as controls). The plots were revisited and monitored monthly through spring 2013 to assess seedling emergence and recruitment. Emerging seedlings were to be tagged and monitored to assess recruitment to the juvenile stage class.

Objective 3: The number of flowering spikes was counted on 20 randomly chosen adult flowering plants per population in fall 2012 (10 male, 10 female) to quantify fecundity. The number of seed was counted on subsamples of flowering spikes to allow total plant fecundity to be determined. Seed was tested for viability and germination. Viability was determined in the lab using tetrazolium tests. Germination testing was done by placing 100 seeds (in two groups of 50 seeds), per site, onto moist filter paper in a Petri dish and placed underneath a light bank (24 hour continuous illumination) with a temperature range of 28.9°C to 29.8°C. Emergence of the radicle was considered to represent successful germination.

Results:

Of the 100 seedlings that were tagged in October 2012, the *Iresine rhizomatosa* plants located in Beall Woods, had only 38% of the seedlings survive and flower (Figure 1), with adult fecundity of 702 ± 139 seeds per female plant (Figure 2). Of the 62% that did not survive, 48% died at the seedling stage and the other 14% died during the juvenile stage. Robeson Hills showed a similar survivorship rate of 43%, with adult fecundity of 783 ± 152 seeds per female plant. The 57% that did not

survive to flowering all died during the seedling stage except for 3% of the plants, which died during the juvenile stage. Of the additional 20 randomly chosen adult plants, fecundity was lower in 2013 than 2012 at both sites (Figure 2). Mean seed viability at Beall Woods was 8%, while seed viability Robeson Hills was slightly greater at 12%. Seed germination rates were < 1% for both sites.

The following year, 21 female plants and 17 male plants at Beall Woods came back following winter dieback whereas at Robeson Hills 29 female and 14 male plants grew back (data collected from the 100 adult plants tagged in October 2012). The plots that were sown in the fall of 2012 had zero plants emerge at both sites.

On average, male or female plants smaller than 50 cm in height produced 1 – 3 spikes; plants 50-100 cm produced 3-7 spikes for females and 2-5 for males; 100+ cm plants produced 5+ spikes for females and 3+ spikes for males (Table 1). Across sites, females produced more flowering spikes than male plants (female: 9 ± 2 per plant; male: 5 ± 3).

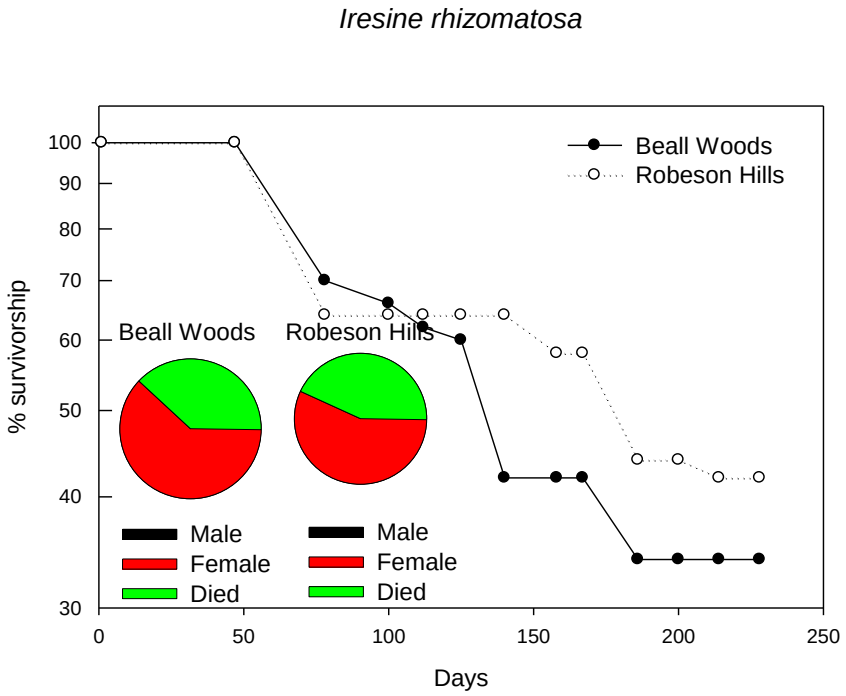


Figure 1. Survivorship of *Iresine rhizomatosa* seedlings emerging in 2012 through 230 days.

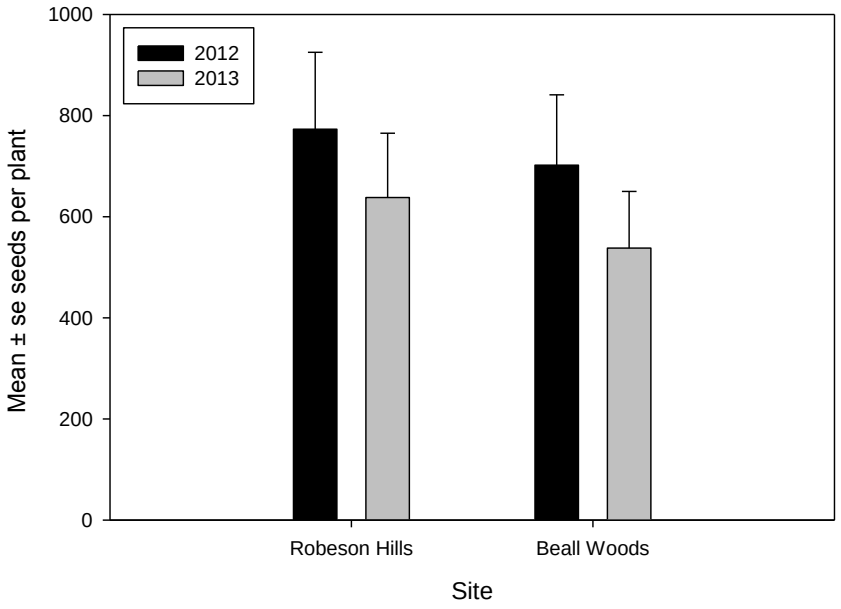


Figure 2. Average fecundity (mean ± se seeds per plant) at Robeson Hills and Beall Woods in 2012 and 2013 (n=20 plants in each year).

Table 1. Range (minimum/maximum) of flowering spikes on *I. rhizomatosa* plants in relationship to plant height class (n=20).

Gender	Plant Height Class		
	< 50 cm	**50-100 cm**	**> 100 cm**
Male	1-3	2-5	3 +
Female	1-3	3-7	5 +

Discussion and management implications:

The poor re-growth of the plants, the low viability and germination rate of the seeds, and the zero emergence of seedlings in experimentally sown plots likely reflects the drought that occurred during the 2012 field season. This observation could indicate that previous season precipitation acts as a driving force on the current year population vitality. Future research is needed to assess long-term survival and change of *I. rhizomatosa* populations. It appears that new plant recruitment from seed is a critical phase in the population dynamics of this rare species. As a perennial shrub, *I. rhizomatosa* populations are buffered to a certain extent against years of zero recruitment. However, these populations would be at risk if zero recruitment coincided with a period of higher than normal adult plant mortality. This project acts as a baseline that allow site managers to assess and plan appropriate conservation measures for populations. Ideally, long-term survey work

would be undertaken to monitor population size through time. Also, helping site managers and private land owners be able to correctly identify mature or new populations is critical.

Promotion:

SIU Media Services released a Press Release on February 22nd, 2013 announcing the funding of this project that is available at:

http://news.siu.edu/2013/02/022213amh13011.html

The Southern Illinoisan carried the SIU Press Release on February 25th, 2013:

http://thesouthern.com/news/local/siu/idnr-funds-research-projects-at-siu/article_807376a8-82c7-11e2-b79c-001a4bcf887a.html

Photographs:

The following digital images are included with this report:

1. Flowering population of *Iresine rhizomatosa* at Beall Woods Nature Preserve. July 24, 2012.
2. Lauren Schwartz and Travis Neal tagging and measuring *Iresine rhizomatosa* at Beall Woods Nature Preserve. July 24, 2012.
3. Tagged seedling of *Iresine rhizomatosa* at Beall Woods Nature Preserve. July 24, 2012.
4. Composite figure showing a) a seedling, b) a juvenile, c) a flowering adult female, and d) population view of *Iresine rhizomatosa* at Beall Woods State Park

Photo 1. Flowering population of *Iresine rhizomatosa* at Beall Woods Nature Preserve. July 24, 2012.

Photo 2. Lauren Schwartz and Travis Neal tagging and measuring *Iresine rhizomatosa* at Beall Woods Nature Preserve. July 24, 2012.

Photo 3. Tagged seedling of *Iresine rhizomatosa* at Beall Woods Nature Preserve. July 24, 2012.

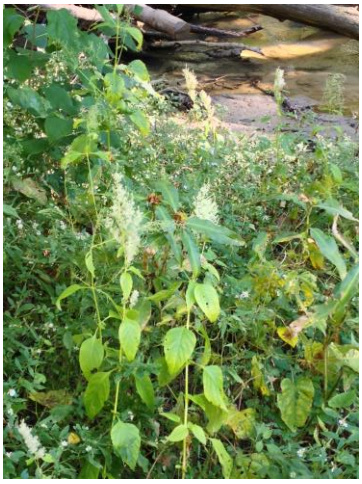
Seedling (1-3 nodes) at .. 	Juvenile (4-6 nodes) at … 
Flowering female (7 + nodes) at ….. 	Flowering population at … 

Photo 4: Composite figure showing a) a seedling, b) a juvenile, c) a flowering adult female, and d) population view of *Iresine rhizomatosa* at Beall Woods State Park

Expenditures:

Undergraduate Field Assistant: $8.50/hour for 28.6 hours = $243

Travel: 11 trips at ~$100/vehicle rental = $1,023.00

Commodities:

Field Supplies: Purchased 6/6/2013
Forestry Suppliers Inc.
205 West Rankin St.
P.O. Box 8397
Jackson, MS 39284-8397

Item #	Quantity	Description	Price (Unit/Total)
79500	1	TAGS, ALUM 3/4X3", PK 1000	$94.50
33768	10	FLAGS,4 X 5 X 36W,ORANGE GLO	$8.65/$86.50
33566	10	FLAGS, 4 X 5 X 18W, PINK GLO	$6.40/$64.00
33560	3	FLAGS, 4 X 5 X 18W, RED	$7/$21

Total: $266.00 (without shipping); $304.26 (with shipping)

Hummert International: 2/4/13: $68.87

Clear vinyl saucers, 6 @ $9.00 = $54 + shipping @ $14.87 = $68.87

Greenhouse megastore: 2/4/13: $25.16

Kord Regal Standard pots, 1 case @99.00 + shipping and tax @ $16.42 = $116.42 less $91.26 charged to another account = $25.16.

Total Commodities: $304.26 + $68.87 + $25.16 = $398.29

Facilities and Administrative Costs (@20% rate): = 333.00

Total Expenditure: $243 + $1023 + $398 + $333 = $1997