

TWO NEW SPECIES OF *HETERANTHERA* (PONTEDERIACEAE)  
IN NORTH AMERICA

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ABSTRACT

Two new species are here described as segregates from *Heteranthera multiflora*. ***Heteranthera missouriensis*** sp. nov. has 5–13 flowers on an elongate floral axis, lavender to purplish flowers, a smaller perianth with the tube 3–5 mm long and lobes 3–4.5 mm long; it is common in the southern Great Plains of North America. ***Heteranthera pauciflora*** sp. nov. has 3–6 flowers on a shortened floral axis, commonly enclosed by the subtending spathe, white to light lavender flowers with the tube 8–10 mm long; it is known from the Atlantic coast from New Jersey to North Carolina. A taxonomic key to all species of the genus in North America, and a modified description of *Heteranthera multiflora*, are provided.

RESUMEN

Se describen dos especies nuevas segregadas de *Heteranthera multiflora*. ***Heteranthera missouriensis*** sp. nov. tiene 5–13 flores en un eje floral elongado, flores de lavanda a púrpura, perianto más pequeño con un tubo de 3–5 mm y lóbulos de 3–4.5 mm; es común al sur de las Grandes Llanuras de Norte América. ***Heteranthera pauciflora*** sp. nov. tiene 3–6 flores en un eje floral acortado, comúnmente encerrado por la espata inferior, flores de blanco a lavanda claro con un tubo de 8–10 mm; se conoce de la costa atlántica desde Nueva Jersey hasta Carolina del Norte. Se aporta una clave taxonómica de todas las especies del género en Norte América, y una descripción modificada de *Heteranthera multiflora*.

INTRODUCTION

The genus *Heteranthera* Ruiz & Pav. (mud plantains) has been historically recognized within the aquatic monocot family Pontederiaceae by having six perianth lobes, three dimorphic stamens and a many-seeded capsule (Horn 2002).

At the specific level, several new species of *Heteranthera* have been recently recognized in Brazil. Two species, *H. catharinensis* C.N. Horn & M. Pell. and *H. pumila* M. Pell. & C.N. Horn were described from southern Brazil as segregates from *H. reniformis* Ruiz & Pav. (Pellegrini & Horn 2017). Then, *Heteranthera longirachilla* D.J. Sousa & Giul. was described and is known from northeastern Brazil (Sousa et al. 2018). With these additions, a total of 19 species are now recognized within the genus.

Three closely related species have been known in North America, *Heteranthera reniformis* Ruiz & Pav., *H. peduncularis* Benth. and *H. multiflora* (Griseb.) C.N. Horn. *Heteranthera multiflora* was first described as a variety of *H. reniformis* and was documented in Argentina (Grisebach 1879). It was subsequently elevated to species level by Horn (1986).

*Heteranthera multiflora* s.l. has a wide geographical range, being found in North America from New Jersey west to Nebraska south to Texas, then in South America from Venezuela (one known population) east to northeastern Brazil and south to Argentina (Horn 1985). Horn (2002) recognized morphological variation in the species, with populations of the Great Plains of North America with blue flowers that extended well beyond the spathe, populations of the Atlantic coast of North America have white flowers, most of which are enclosed within the spathe. In addition, populations of Paraguay and Argentina in South America have white flowers with many of them exposed beyond the end of the spathe.

METHODS

Work for this revision was based on herbarium specimens and field trips from 1983 through 2016. Herbarium specimens of *Heteranthera reniformis*, *H. peduncularis*, and *H. multiflora* were used to collect quantitative

information on morphological features and to determine locations for potential field trips. In addition, online resources of SERNEC (<http://sernecportal.org/portal/>) were used to further establish geographic ranges. Details to solidify distinctions on newly proposed species included review of the following features: floral axis length, length of the floral axis beyond the spathe apex, number of flowers per inflorescence, perianth tube length, lateral anther length, and central anther length. From measurements on herbarium specimens, averages and ranges of morphological features were determined. Comparative graphs (not included) were generated from measuring at least three specimens for each character. Data averages and ranges for numerical features were calculated.

During field trips photographs were taken and specimens collected. Plants or seeds for some collections were subsequently germinated and grown outdoors in plastic aquatic pools in Newberry, South Carolina (34.29°N, 81.61°W) to review developmental patterns and observe flowering time.

## RESULTS

A total of 460 specimens were observed through a loan of herbarium specimens or photographs observed on the SERNEC portal. Additional specimens of *Heteranthera reniformis*, *H. peduncularis*, and *H. multiflora* s.l. were also observed through herbarium specimen loans. Variation in leaf shape, inflorescence length, and floral features were emphasized during the study.

Previous work (Horn 1985, 2002) confirmed that *Heteranthera reniformis* is easily separated from the other species in the study through observation of mature leaves that had a reniform shape, a cordate base, were wider than long, and had an obtuse apex. In addition, *H. reniformis* is unique in having a longer second internode of the cincinnus length, shorter spathe, a relatively short floral axis (Table 1), and white multicellular hairs on the filaments. Review of the Mexican species *Heteranthera peduncularis* confirmed several unique features, including a long floral axis, greater number of flowers and a mauve perianth lobe color (Table 1) along with the previous observation of glabrous filaments on both the central and lateral stamens (Horn 1985, 2002).

*Heteranthera multiflora* (of southern South America) has a white perianth with large flowers on a longer floral axis (Table 1, Horn 1987). *Heteranthera missouriensis* sp. nov. tends to have smaller flowers, including the perianth tube length, lateral anther length and central anther length (Table 1). *Heteranthera pauciflora* sp. nov. tends to have a shorter floral axis length and fewer flowers. However, overlap with other species is noted (Table 1). Elongation of the floral axis created some challenges in taxonomic distinction. In many cases young plants of those flowering in mid-summer tended to not have the floral axis elongate. However, later summer plants, especially when water levels were lower, provided for the greatest floral axis elongation and best flowering. Even then, the axis of *Heteranthera pauciflora* only had an elongation such that the terminal 1–2 flowers could fully open (Fig. 4). This feature was also seen in numerous herbarium specimens.

## SPECIES TREATMENTS

***Heteranthera missouriensis*** C.N. Horn, **sp. nov.** (Fig. 1). TYPE: U.S.A. KANSAS, Reno Co.: ¼ mi E, 3 mi S Medora, abundant in small pool in sandhill area, plants in shallow water or stranded, 17 Aug 1977, Brooks 13349 (HOLOTYPE: BRIT [399736]!; ISOTYPES: BRIT [399803]!, KANU!, MO!, NY!).

Inflorescencia cum 5–13 floribus pluribus exsertis supra spatium. Perianthium lavandulum usque ad purpureum. Perianthi tubus 3–5 mm longus, perianthi lobus 3–4.5 mm longus; antherae in staminiibus lateralibus 0.5–0.8 mm longae, antherae in stamine centrali 1–1.3 mm longae.

Leaf blade rounded, apex obtuse, 2.6–4.4 cm long, 2.9–5.2 cm wide. Spathe 3.6–8.5 cm long. Inflorescence 3.7–9.5 cm long with 5–13 flowers, 0–6 of which are within the spathe; floral axis elongating such that most flowers are beyond the spathe apex. Perianth tube 3–5 mm long; perianth lobes lavender to purple, 3–4.5 mm long; lateral stamens 1–1.8 mm long, the anthers 0.5–0.8 mm long; central stamen 2–3.1 mm long, the anther 1–1.3 mm long. Seeds 0.6–0.8 mm long, 0.3–0.4 mm wide, with 9–12 wings. Chromosome number  $2n = 32$ .

*Phenology.*—Flowering July to November. Inflorescences developing in one or two days. Individual flowers opening about two hours after dawn and wilting in early afternoon.

TABLE 1. Comparison of *Heteranthera* species in this study. Numbers are a range of observed values. Data for *H. peduncularis* and *H. reniformis* from Horn (1985).

Characteristic	<i>multiflora</i>	<i>missouriensis</i>	<i>pauciflora</i>	<i>peduncularis</i>	<i>reniformis</i>
Leaf blade apex	acute to obtuse	obtuse	acute to obtuse	acuminate to acute	obtuse
Spathe length (cm)	2.5–5.5	3.6–8.5	3.0–5.7	3.6–5.9	1.1–2.6
Lower cincinnus length (cm)	< 0.5	< 0.5	< 0.5	< 0.5	0.5–3.5
Floral axis length (cm)	4.1–9.5	3.7–8.0	2.9–5.5	8–12	0.4–3.5
Number flowers	5–12	5–13	3–7	7–17	2–8
Perianth lobe color	white	lavender to purple	pale lavender	mauve	white
Perianth tube length (mm)	6–10	3–5 mm	8–10	2–3.5	5–10
Lateral anther length (mm)	0.7–1.1	0.5–0.8	0.6–1.0	0.5–0.9	0.2–0.8
Central anther length (mm)	1.2–1.7	1.0–1.3	1.3–1.9	0.8–1.2	0.8–1.8

*Distribution* (Figs. 2, 3).—Roadside ditches, rice fields, and pond edges, 10–470 m; USA, Iowa and Nebraska south to Louisiana and Texas. Introductions have been recorded in Alabama, North Carolina and California.

Representative specimens. **U.S.A. ALABAMA. Jackson Co.:** wet depression in access road, *Barger & Taylor HC#619* (ALNHS, AUA, UWAL, AMAL). **ARKANSAS. Ashley Co.:** jet two roads 1.8 mi W of jet US 165, *Thomas 97132* (MO, NLU, NY, TENN, UARK). **St. Francis Co.:** N of Cypress Creek, *Denke 1207* (MEM, MSU). **CALIFORNIA. Glenn Co.:** W of I-5 rice field of organic grower, *J. Lundberg s.n.* (DAV). **ILLINOIS. St. Clair Co.:** lakes, *Eggert s.n.* (GH, MO, WTU). **Union Co.:** IL 3, 2.3 mi S jct AL 146, *Hill & Koontz 34266* (ILLS, NY, USF). **KANSAS. Douglas Co.:** 2 mi NE of Lawrence, *McGregor 715* (KANU). **Harvey Co.:** 2 mi N of Burrton on Co. road then 3 mi E on dirt road, *Horn 549* (AAU, EA, MO, NY, UNA). **Jefferson Co.:** 10 mi S of McLouth, Kansas Rockerfeller Tract, *Brooks & Seiler 5250* (KANU). **Lyon Co.:** McKinney Marsh, 1 mi W and 2 mi S of Neosho Rapids, *Hauser 3157* (KANU). **Pottawatomie Co.:** Plum Creek, *Gates 17560* (MO). **LOUISIANA. Ouachita Par.:** Ouachita Wildlife Management Area near Bayou Lafourche, *Thomas 101069* (MO, NLU). **MISSISSIPPI. Madison Co.:** Barnett Reservoir, W of Safe Harbor Marina at Pearl River Waterfowl Refuge, *Rogers 8784* (GH, MO, NCU, NY, SMU, USF). **MISSOURI. Bates Co.:** 1.5 mi W of Papinsville, *Steyermark 21282* (F, MO). **Boone Co.:** Mo. Dairy farm pond, ca. 8 mi W of Columbia on Hwy 40, *Christian s.n.* (MO). **Butler Co.:** rice field on N side of US 60 between rt Z and rt 581, *Horn 8804* (GH, MEXU, MICH, NASC, NBYC, NY). **Christian Co.:** 1.5 mi NE of Lindenlure, *Palmer 64386* (MO, NLU, UMO). **Jackson Co.:** Atherton, common in Gaffner's Lake, *Bush 443* (MO, US), Sheffield, *Bush 863* (BR, US). **Newton Co.:** 2 mi SW of Joplin, *Palmer 53019* (F, MO, UMO). **St. Charles Co.:** 5 mi N of St. Peters, *Steyermark 8914* (MO, UMO). **NORTH CAROLINA. Wake Co.:** lake at William B. Umstead State Park, *Horn 21352* (NBYC). **TENNESSEE. Shelby Co.:** Meemen-Shelby Forest State Park, *Bates 410* (MEM, MSU). **TEXAS. Cameron Co.:** Unit 1, Laguna Atascosa National Wildlife Refuge, *Fleetwood 7052* (TEX, US).

Individual plants have rounded leaves with an obtuse to slightly acute apex, a floral axis commonly almost twice as long as the spathe with 5–15 flowers such that most flowers extend beyond the spathe tip. The perianth is a dark purplish color.

***Heteranthera pauciflora* C.N. Horn, sp. nov. (Fig. 4).** TYPE: VIRGINIA. CHARLES CITY Co.: shallow roadside pool NW of Harrison Point, 17 Aug 1938, *Fernald & Long 9015* (HOLOTYPE: GH!; ISOTYPES: FI, LP, PH!).

Inflorescentia cum 3–6 floribus pluribus intra spathum. Perianthium pallidum lavandulum. Perianthi tubus 8–10 mm longus; perianthi lobus 5.5–7.3 mm longus; antherae in stamine laterali 0.6–1 mm longae, anthera in stamine centrali 1.3–1.9 mm longa.

Leaf blade rounded, acute to obtuse at apex, 3.5–5.2 cm long, 4.2–6.5 cm wide. Spathe 3.0–5.7 cm long. Inflorescence 2.2–4.3 cm long with 3–7 flowers, 3–5 of which are within the spathe. Perianth tube 8–10 mm long; perianth lobes pale lavender to white, 5.5–7.3 mm long; lateral stamens 2–2.9 mm long, the anthers 0.6–1 mm long; central stamen 4.2–4.8 mm long, the anther 1.3–1.9 mm long. Seeds 0.8–1 mm long, 0.4–0.5 mm wide, with 9–11 wings. Chromosome number unknown.

*Phenology.*—Flowering July to November. Inflorescences developing in one day. Individual flowers open about three hours after dawn and wilt in early afternoon. Most commonly flowers do not elongate out of the spathe and are thus self-pollinated.

*Distribution* (Fig. 3).—Freshwater marshes and river margins typically under tidal influence, sea level to 20 m; USA, New Jersey to North Carolina.

Representative specimens. **U.S.A. DELAWARE. [New Castle Co.]:** near Wilmington, *Canby 8491* (KANU). **MARYLAND. Cecil Co.:** White Swan Lake, ca. 2 mi SE of Chesapeake City, *Long 41098* (PH). **NEW JERSEY. Burlington Co.:** South Branch of Pensaulan Creek, 0.25 mi S of



FIG. 1. *Heteranthera missouriensis*. (A) habit showing dense clump of plants, (B) plant with flowering stem, (C) inflorescence showing arrangement of flowers on axis, (D) detail of flowers including several not open. (A–C from Clay Co., NB, Aug 2012 by P. Marcum; D from Jackson Co., AL, Jul 2015 by W. Barger.

Fork Landing, *Trudell s.n.* (PH). **CAMDEN Co.:** along Delaware River off of NJ 543 in Pennsauken, *Horn 8614* (GH, MEXU, MICH, MO, NASC, NY, UNA). **GLOUCESTER Co.:** Mathews Brook, West Woodbury, *Long 26588* (PH). **SALEM Co.:** 2 mi NW of Pedricktown, *Fogg 7915* (GH, PH). **NORTH CAROLINA. Bertie Co.:** US 17 at Connie Creek, Roanoke River Swamp, *Radford 5968* (NCU, SMU). **Martin Co.:** shallow pool edge of cypress-gum swamp near Welch Creek on US 64 at Washington Co. line, *Radford 4586* (NCU, NY). **Pasquotank Co.:** 4.4 mi S of Weeksville, *Ahles 48126* (FLAS, NCU, UC). **Perquimans Co.:** 1.6 mi NE of Bethal, then 1.2 mi E on dirt road, *Ahles 48024* (NCU, SMU). **PENNSYLVANIA. Philadelphia Co.:** League Island Park, *Hass s.n.* (PH). **VIRGINIA. Gloucester Co.:** Beaverdam Lake off rt 606, *Horn 12489* (GMUF, NY, UNA, WILLI); Newport News City, 200 ft from Mulberry Island Rd., Fort Eustis, *Appler 828* (NCU, WILLI).

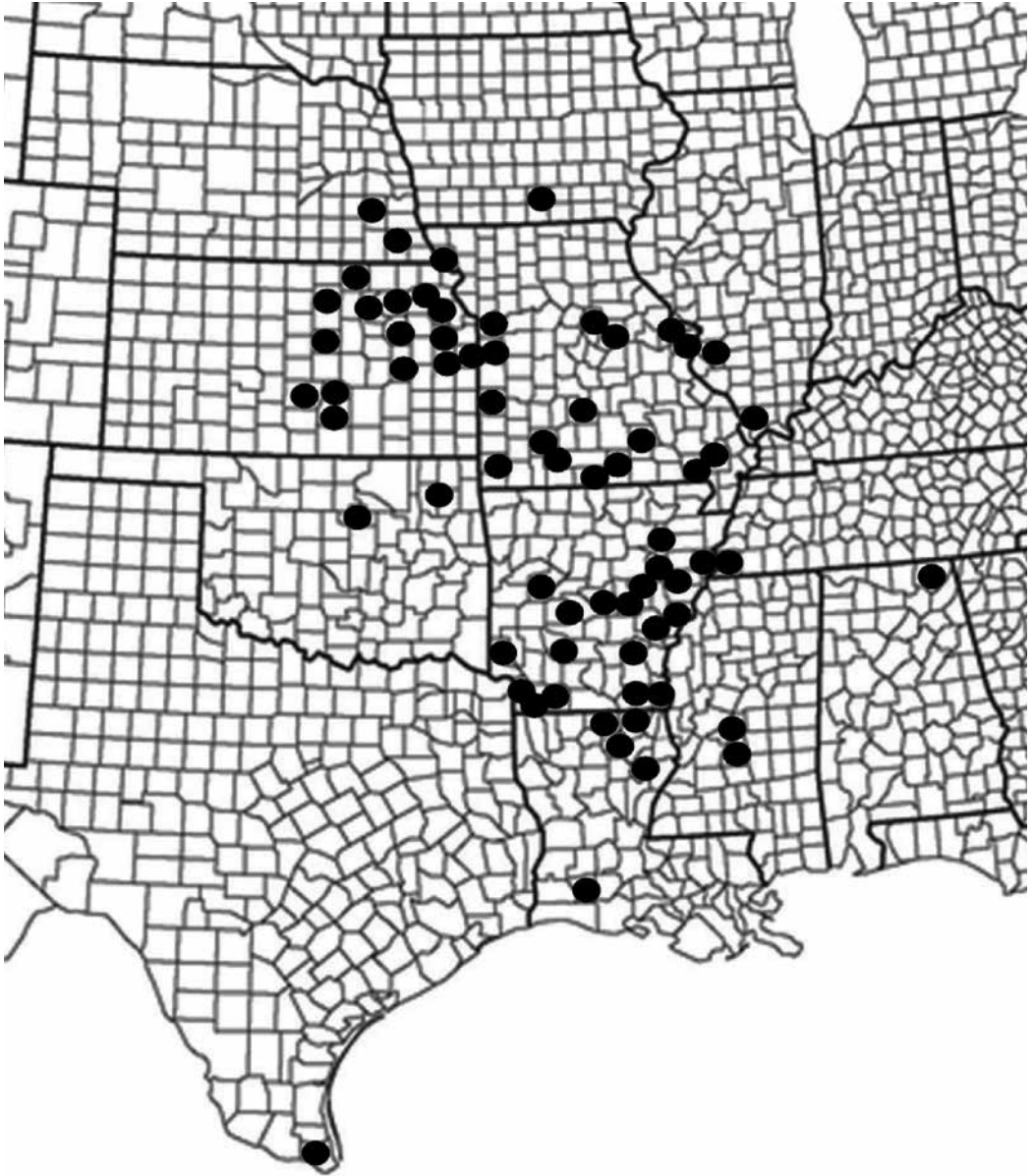


FIG. 2. Distribution of *Heteranthera missouriensis* in the central U.S.A. (dots).

These plants have rounded leaves with an obtuse to slightly acute apex and the flowering axis is only about as long as the spathe and the perianth is a pale lavender color. The inflorescence has 3–6 flowers and typically only the terminal flower projects beyond the terminus of the spathe, so it may open (Fig. 1d).

KEY TO SPECIES OF *HETERANTHERA* IN NORTH AMERICA (NORTH OF MEXICO)

1. Inflorescences monoflorous, stamens of similar size.
  2. Leaves all linear, perianth yellow, anthers curling after anthesis \_\_\_\_\_ **H. dubia**
  2. leaves linear (on seedlings) or with distinct petiole and blade, anthers remaining straight to slightly falcate.

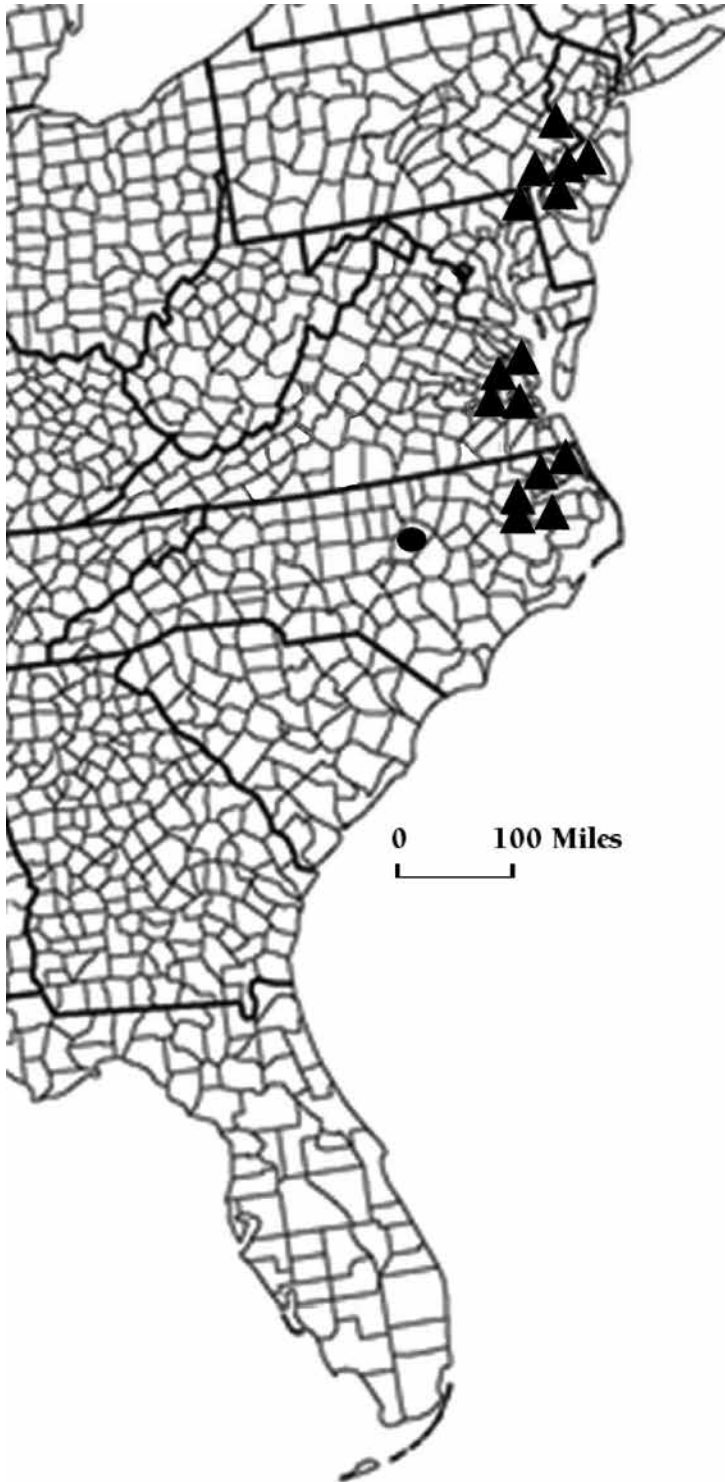


FIG. 3. Distribution of *Heteranthera missouriensis* (dots) and *H. pauciflora* (triangles) in the southeastern U.S.A.





FIG. 4. *Heteranthera pauciflora*. (A) plant in shallow water, (B) plant on mudflat, (C) leaves and pair of flowers, (D) single open flower extending out of spathe. (A & B from Mercer Co., NJ, Sep 2014 by B. Cunningham; C from Monmouth Co., NJ, Oct 2010 by B. Keim; D from Mercer Co., NJ, Aug 2017, by B. Cunningham).

3. Leaves oblong to ovate, blade base truncate to cuneate; perianth arrangement actinomorphic, upper lobe without lateral flanges \_\_\_\_\_ **H. limosa**
3. Leaves rounded to oblong, blade base cordate to truncate; perianth arrangement zygomorphic, upper lobe with paired flanges \_\_\_\_\_ **H. rotundifolia**
1. Inflorescences 2-many flowered; stamens of two distinct sizes.
4. Leaves lanceolate to linear, no petiolate leaves produced; inflorescences elongating over several days, filaments obliquely swollen \_\_\_\_\_ **H. mexicana**
4. Leaves with linear seedling leaves only, petiolate leaves abundant as seedlings, filaments linear.
5. Leaves on flowering plants distinctly cordate (length to width ratio 1–2); perianth mauve with darker blotches on upper central perianth lobe; filaments of lateral (smaller) stamens glabrous \_\_\_\_\_ **H. peduncularis**

5. Leaves on flowering plants reniform to slightly cordate (length to width ratio 0.5–1); perianth white or lavender to purple with bilobed blotches green or brown to purple; filaments of lateral (smaller) stamens pubescent with long hairs.
6. Inflorescences with 5–15 flowers; the flowering stalk elongating well beyond the spathe apex on emerged inflorescences such that the apical flowers extend well beyond the spathe apex, perianth lobes lavender to purple  
**H. missouriensis**
6. Inflorescences with 3–8 flowers; the flowering stalk elongating such that the terminal 1–2 flowers might extend beyond the spathe apex and some to most flowers are enclosed within spathe, perianth lobes white to pale lavender.
7. Leaves mostly rounded; apex obtuse to slightly acute; second internode of cincinnus less than 0.5 cm; hairs on lateral filaments purple  
**H. pauciflora**
7. Leaves distinctly reniform, apex obtuse; second inter node of cincinnus more than 0.5 cm long; hairs on lateral filaments white  
**H. reniformis**

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