

CONTRIBUTIONS TO AN ILLINOIS FLORA NO. 1. ORDER ALISMALES

ROBERT H. MOHLENBROCK and JAMES W. RICHARDSON
Southern Illinois University and University of Kansas

ABSTRACT.—A detailed study of the order Alismales in Illinois is presented. Included are descriptions, discussions, synonyms, and distribution of the taxa of *Echinodorus*, *Sagittaria*, *Alisma*, and *Butomus* in Illinois. Keys are also presented.

The Order Alismales in Illinois, as considered here, is composed of the families Alismaceae (Alismataceae by some authors) and Butomaceae. The group is thought now by many taxonomists to represent the most primitive of the monocotyledons, primarily because of the several ovaries and the more or less distinguishable series in the perianth. The Alismales seems to be paralleled in the dicotyledons by the Ranales.

Despite the fact that the Alismaceae shows a decided tendency toward unisexuality, most evidence indicates that this family is more primitive than the Butomaceae. In the Butomaceae, there is a more stabilized number of stamens and ovaries, in both cases the number tending to be reduced from that found in the Alismaceae. Furthermore, the ovaries in the Butomaceae are slightly connate basally, whereas they are free in the Alismaceae.

Within the Alismaceae, *Sagittaria* and *Echinodorus*, with their pistils borne in several rows on the convex receptacle, may be the primitive

genera, while *Alisma*, with the pistils borne in a single row on the flat receptacle and with a more stable stamen number, may be advanced.

The strong morphological resemblance between *Sagittaria* and *Echinodorus* suggests an extremely close relationship. *Sagittaria* would seem to be primitive on the one hand because of its large, indefinite number of stamens, and advanced on the other hand by its unisexual nature.

The Alismaceae in Illinois is comprised of eleven species in three genera. *Sagittaria*, with six species, is the largest genus. *Lophotocarpus*, maintained by several workers as a genus distinct from *Sagittaria*, is combined with that genus in this work. No additional species have been added to this family in Illinois for over 50 years, although the nomenclature of several of the species has been altered considerably.

As early as 1846, Mead had reported four species of Alismaceae in Illinois and by 1874, nine species had been reported. Only *Sagittaria engelmanniana* ssp. *brevirostra* (*S. brevirostra*) and *S. cuneata* have been added to the Illinois flora since that time.

Care should be taken when collecting specimens of this family since both flowers and fruits are generally needed for positive identification.

All members of the Alismaceae grow in or near water.

The leaves in the family are highly variable, particularly in *Sagittaria*, but generally show secondary veins at right angles to the major parallel veins. In some species of *Sagittaria*, the submerged leaves usually are reduced to sheaths (phyllodia).

The flowers are perfect in *Echinodorus* and *Alisma*, but unisexual in *Sagittaria* which usually has the staminate flowers positioned above the pistillate ones.

The perianth is 6-parted, the outer whorl of three being green, with the inner whorl of three usually whitish.

The stamens range from 6-9 in *Alisma* and *Echinodorus tenellus* var. *parvulus* to 12 or 21 in *Echinodorus berteroi* var. *lanceolatus* and *E. cordifolius*, and numerous and indefinite in *Sagittaria*.

The fruit of the Alismaceae is an achene in all three genera, winged in *Sagittaria* and beaked in both *Sagittaria* and *Echinodorus*.

The adventive *Butomus umbellatus* is the only Illinois representative of the Butomaceae, having been found in Illinois in 1957.

Related to the Alismales is the Juncaginales, an order differing by its scarcely distinguishable series of the perianth and by the constant stamen number.

ORDER ALISMALES

Herbaceous perennials of marshes with usually basal leaves; flowers perfect or unisexual, regular; perianth composed of two distinct series of three members each, at least the inner series petaloid; stamens 6-40, spirally arranged; ovaries 6 or more, free or united only at the base; fruit an achene or follicle.

Key to the Families of Alismales in Illinois

1. Ovaries 10 or more, free to base; inner series of perianth white; inflorescence racemose or paniculate Alismaceae
1. Ovaries 6, united near base; inner series of perianth pink; inflorescence umbellate Butomaceae

FAMILY ALISMACEAE—WATER PLANTAIN FAMILY

Flowers regular, perfect or unisexual; perianth composed of two distinct series, the inner white and petal-like; stamens 6-40; ovaries 10 or more, free from each other, each 1-celled; fruit an achene.

Key to the Genera of Alismaceae in Illinois

1. Receptacle convex, bearing several rows of pistils; stamens 12- numerous (6-9 in *E. tenellus* var. *parvulus*); flowers unisexual or perfect.
2. Achenes not winged; base of whorled inflorescence branches bearing 3 bracts and several bracteoles; flowers perfect; stamens never more than 21 1. *Echinodorus*
2. Achenes winged; base of whorled inflorescence branches bearing 3 bracts and 0 bracteoles; flowers unisexual; stamens usually more than 21 2. *Sagittaria*
1. Receptacle flat, bearing a single row of pistils; stamens 6-9; flowers perfect 3. *Alisma*

1. *Echinodorus* Rich.—Burhead

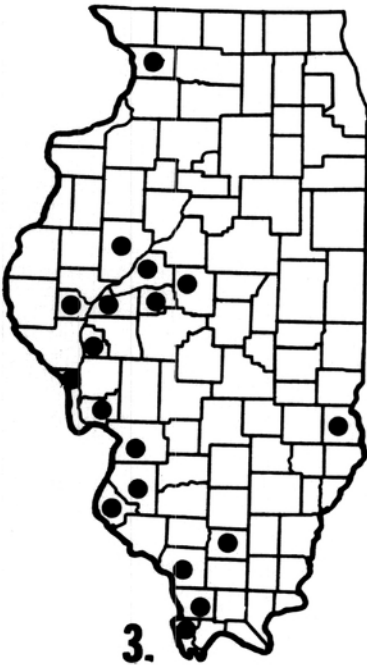
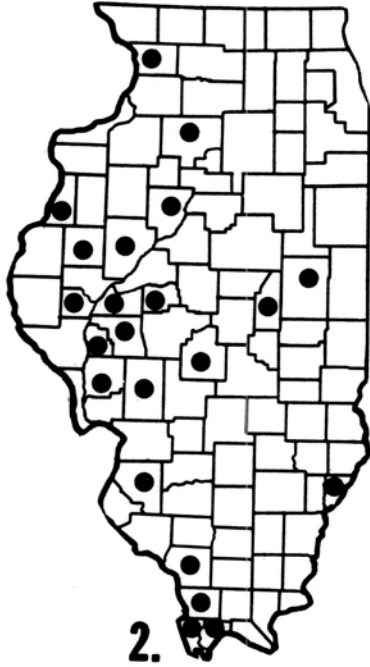
Flowers perfect; receptacle convex; sepals 3, green, persistent; petals 3, white, deciduous; stamens 6-21; ovaries more than 10, distinct, arranged in more than one series on the receptacle; achenes turgid, ribbed throughout.

This genus is related closely to *Sagittaria*, but is separated by its wingless achenes, its bracteoles subtending the inflorescence branches, and its always perfect flowers.

Fassett (1955) has studied the tropical American species, which include our three representatives. The stamen number alone is sufficient to distinguish the three taxa in Illinois.

Key to the Taxa of *Echinodorus* in Illinois

1. Plants erect, less than 10 cm tall;



MAPS 1-4.—Map 1. Illinois distribution of *Echinodorus tenellus* var. *parvulus*. Map 2. Illinois distribution of *Echinodorus berteroi* var. *lanceolatus*. Map 3. Illinois distribution of *Echinodorus cordifolius*. Map 4. Illinois distribution of *Sagittaria nontevadensis* ssp. *calycina*.

leaves linear to lanceolate; flowers at most only 6 mm broad; stamens 6-9; achenes 10-15, beakless or nearly so ... 1. *E. tenellus* var. *parvulus*

1. Plants erect*, usually more than 10 cm tall, or plants creeping or arching; leaves broadly ovate, rarely lanceolate; flowers at least 8 mm broad; stamens 12-21; achenes more than 40, beaked.
 2. Scape erect; stamens 12; style longer than the ovary; beak of achene straight 2. *E. berteroi* var. *lanceolatus*
 2. Scape creeping or arching; stamens 21; style shorter than the ovary; beak of achene incurved 3. *E. cordifolius*
1. **ECHINODOPUS TENELLUS** (Mart.) Buchenau var. **PARVULUS** (Engelm.) Fassett, *Rhodora* 27:185. 1955.
- Alisma tenellum* Mart. in Roem. & Schult. Syst. 7:1600. 1830.
- Echinodorus parvulus* Engelm. in Gray, Man. Bot. 438. 1856.
- Echinodorus tenellus* (Mart.) Buchenau, Abh. Naturw. Ver. Bremen 2:21. 1868.
- Helianthium parvulum* (Engelm.) Small, N. Am. Fl. 17:45. 1909.
- Erect, rooted perennial, with creeping shoots frequently present; leaves basal, the blade linear to lanceolate, acute, tapering to base, to 3 cm long, glabrous, the petiole longer than the blade; scape to 10 cm tall, bearing a single whorl of 2-8 flowers; bracts 1-3 mm long; flowers at most only 6 mm broad; sepals suborbiculate, subacute, green, persistent in fruit, 1-2 mm long; petals suborbiculate, subacute, white, deciduous, 1-3 mm long; stamens 6-9; styles shorter than the ovaries; achenes 1.0-1.5 mm long, ribbed, beakless or with a minute lateral beak 0.3 mm long, glabrous.
- The small burhead inhabits wet ditches in Illinois where it is extremely rare, with positive records from only three counties. Map 1. The overall range of this species is the eastern United States, Mexico, and Cuba.
- Typical var. *tenellus* has longer anthers and leaves concave toward the tip; it is restricted to South America.
- For an extensive discussion of this species, see Robinson (1903).
2. **ECHINODORUS BERTEROI** (Spreng.) Fassett var. **LANCEOLATUS** (Engelm.) Fassett, *Rhodora* 57:144. 1955.
- Alisma rostratum* Nutt. Trans. Am. Phil. Soc. 5:159. 1837.
- Echinodorus rostratus* (Nutt.) Engelm. in Gray, Man. 460. 1848.
- Echinodorus rostratus* var. *lanceolatus* Engelm. ex Wats. & Coult. in Gray, Man. 556. 1891.
- Echinodorus cordifolius* var. *lanceolatus* (Engelm.) Mack. & Bush, Man. Fl. Jackson Co. Mo. 10. 1902.
- Echinodorus cordifolius* f. *lanceolatus* (Engelm.) Fern. *Rhodora* 38: 73. 1936.
- Echinodorus rostratus* f. *lanceolatus* (Engelm.) Fern. *Rhodora* 49:108. 1947.
- Erect, rooted perennial; leaves basal, the blade broadly ovate, rarely lanceolate, obtuse, cordate or truncate at base, to 15 cm long, to 10 cm broad, glabrous, the petiole longer than the blade; scape usually more than 10 cm tall, with (1-) several clusters of 3-8 flowers; bracts 3-6 mm long; flowers 8-10 mm broad; sepals ovate, acute, green, persistent in fruit, 4-5 mm long; petals ovate to suborbiculate, acute, white, deciduous, 5-10 mm long, stamens 12; styles longer than the ovaries; achenes 2.5-3.5 mm long, with a straight beak about 1 mm long. 2n = 22 (Heiser & Whitaker, 1948).
- Echinodorus berteroi* var. *lanceolatus* ranges from Ohio to California, south to Texas and Florida. It has an outlying station in Delaware. It also extends into Mexico. In Illinois, where it occurs in wet ditches and along swamp borders, this taxon is scattered throughout the southern three-fourths of the state, as well as in Carroll County. Map 2.
- The nomenclature for this taxon has been confused. For awhile, this species was erroneously called *E. cordifolius*. Then it was called *E. rostratus*, until Fassett discovered the identity of *Alisma berteroi*, the basionym. Typical var. *berteroi*, from the southwestern United States, Central America, and the West Indies, has larger beaks on the nutlets and larger anthers.
3. **ECHINODORUS CORDIFOLIUS** (L.) Griseb. Abh. Ges. Wiss. Gott. 7:257. 1857.
- Alisma cordifolia* L. Sp. Pl. 343. 1753.

Sagittaria radicans Nutt. Trans. Am. Phil. Soc. 5:159. 1837.

Echinodorus radicans (Nutt.) Engelm. in Gray, Man. 460. 1848.

Creeping or arching perennial; leaves upright, broadly ovate, obtuse, cordate, to 20 cm long, to 17 cm broad, glabrous, conspicuously cross-veined on the lower surface; scape prostrate, creeping, over 50 cm long, bearing many whorls of flowers; bracts 10-25 mm long; flowers more than 12 mm broad; sepals ovate to suborbiculate, obtuse, green, persistent in fruit, 5-7 mm long; petals obovate, obtuse, white, deciduous, 6-12 mm long; stamens 21; styles shorter than the ovaries; achenes 1.8-2.2 mm long, ribbed, with an incurved beak about 0.5 mm long. $2n = 22$ (Baldwin & Speese, 1955).

The creeping burhead occupies similar habitats as *E. berteroi* var. *lanceolatus*. It is not common in Illinois, apparently restricted to the western side of the state, except for Crawford County. Map 3. This species ranges from Maryland to Kansas, south to Texas and Florida, extending into Mexico.

This taxon resembles *E. berteroi* var. *lanceolatus*, but differs by its arching growth habit, its 21 stamens, and the curved beak of its achenes.

During the period that *E. rostratus* (= *E. berteroi*) erroneously was called *E. cordifolius*, this species (the true *E. cordifolius*) was known as *E. radicans*.

2. *Sagittaria* L. — Arrow-Leaf

Mostly aquatic perennial herbs, with milky sap; leaves emersed, floating, or submerged, with sheathing petioles, the submerged leaves sometimes reduced to phyllodia; flowers whorled, bracteate, mostly unisexual, with the staminate flowers above the pistillate; sepals 3, greenish, persistent, those of the staminate flowers reflexed, those of the pistillate flowers appressed, spreading, or reflexed; petals 3, white or pinkish, deciduous; stamens whorled, mostly numerous; carpels numerous, distinct, 1-celled, spirally arranged on a dome-shaped receptacle; achenes flat, winged, beaked.

Lophotocarpus T. Dur. is included within *Sagittaria* since Mason (1952) and Bogin (1955) have pointed out that the usual distinguishing characters of *Lophotocarpus* of annuals with staminate flowers above and pistillate flowers below do not hold up.

Sagittaria is distinguished from *Echinodorus* by its flattened achenes and

usual presence of separate staminate and pistillate flowers.

A recent revision of the genus is by Bogin (1955).

Key to the Taxa of *Sagittaria* in Illinois

1. Filaments roughened with minute scales.
2. Peduncle and pedicel inflated; sepals tightly appressed to fruiting head . . . 1. *S. montevidensis* ssp. *calycina*
2. Peduncle and pedicel slender; sepals usually reflexed.
3. Pistillate flowers and fruiting heads sessile or subsessile . . . 2. *S. rigida*
3. Pistillate flowers and fruiting heads long-pedunculate . . . 3. *S. graminea*
1. Filaments glabrous.
4. Mature achene with 1-3 facial wings; beak of achene inserted apically.
5. Beak of achene less than 0.5 mm long, straight, with 1 small, narrow facial wing; bracts usually less than 2 cm long . . . 4. *S. cuneata*
5. Beak of achene more than 0.5 mm long, usually reflexed at apex, usually with 2-3 facial wings with 1 well developed; bracts usually more than 2 cm long . . . 5. *S. engelmanniana* ssp. *brevirostra*
4. Mature achene with marginal wings only; beak of achene inserted laterally . . . 6. *S. latifolia*

1. *SAGITTARIA MONTEVIDENSIS* ssp. *CALYCINA* (Engelm.) Bogin, Mem. N. Y. Bot. Gard. 9:197. 1955.

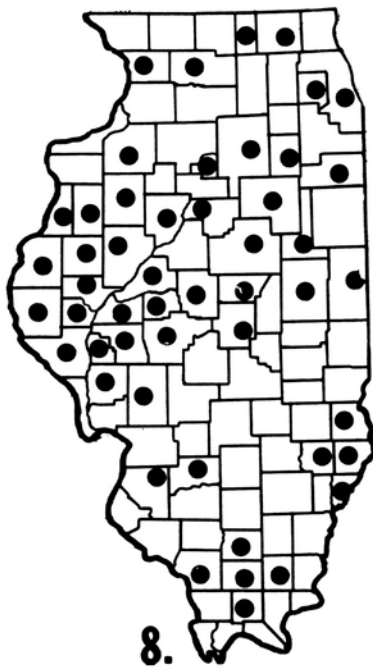
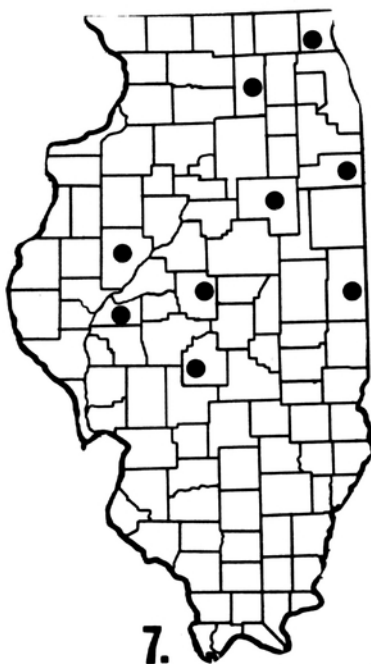
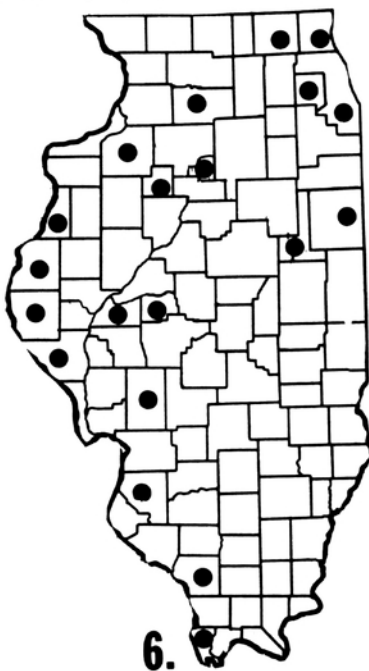
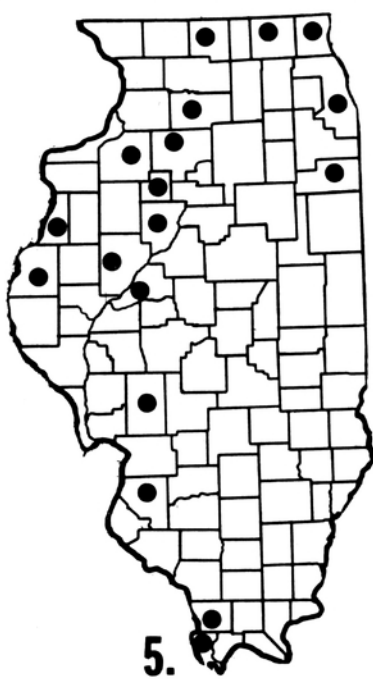
Sagittaria calycina Engelm. in Torrey, Bot. Mex. Bound. Surv. 212. 1859.

Sagittaria calycina var. *maxima* Engelm. in Torrey, Bot. Mex. Bound. Surv. 212. 1859.

Lophotocarpus calycinus (Engelm.) J. G. Sm. Mem. Torrey Club 5:25. 1894.

Lophotocarpus depauperatus J. G. Sm. Ann. Rep. Missouri Bot. Gard. 11:148. 1899.

Lophotocarpus calycinus f. *maximus* (Engelm.) Fern. Rhodora 38: 73. 1936.



MAPS 5-8.—Map 5. Illinois distribution of *Sagittaria rigida*. Map 6. Illinois distribution of *Sagittaria graminea*. Map 7. Illinois distribution of *Sagittaria cuneata*. Map 8. Illinois distribution of *Sagittaria engelmanniana* ssp. *brevirostra*.

Annual or perennial, monoecious or dioecious, erect or lax and sprawling, the scape 5 cm to 2 m tall, the flower stalk equalling or shorter than the leaves, drooping; emerged leaves sagittate, the floating leaves ovate, the submerged leaves reduced to linear phyllodia; petiole long, usually rather smooth with expanded base; emerged blade sagittate, prominently nerved, deltoid or deltoid-orbicular with acute apex, 1-10 cm long, 1-16 cm broad, basal lobes ovate-lanceolate, acute or acuminate, shorter than length of blade, 1-12 cm long, 1.0-7.5 cm broad; floating blades ovate, to 2.5 cm long, the submerged leaves reduced to phyllodia; scape with 3-12 whorls of flowers; peduncle inflated, smooth, with few flowers; flowers in whorls of 3, the upper either staminate or pistillate, the lower usually pistillate; bracts 3, fused basally to form a sheath around stem, not prominently veined, small and hyaline, ovate, acute, to 1 cm long, about 0.5 cm broad; pedicels long, inflated, terete, to 6 cm long; sepals free, short, persistent, erect and closed, appressed to fruiting head, ovate to ovate-elliptic with obtuse apex, to 1.3 cm long, to 1.7 cm broad; petals free, equalling or slightly shorter than sepals, ovate, obtuse, 0.7-1.5 cm long, 0.5-1.5 cm broad; stamens numerous, to 3 mm long, the filaments narrowly winged at margin, pubescent, equalling anther; fruiting head globoid, 2-4 cm in diameter when mature, very smooth in appearance to horizontal beak of achene; achene narrowly cuneate-ovoid, to 3 mm long, to 2.5 mm broad, narrowly winged on both margins, with a well-developed resin duct at apex of embryo and at the base of horizontal, straight beak; beak about 1 mm long.

This taxon occurs in marshes or shallow water or along pond margins or shorelines from Ohio to South Dakota, south to New Mexico, Louisiana, and Tennessee. It also occurs in California and Mexico. In Illinois, it is local throughout the central and southern counties, but is apparently absent from the northern counties. Map 4.

This plant is identified rather easily by the greatly enlarged peduncle and pedicels, the erect sepals which are tightly appressed to the fruiting head, and the leaves which have a wrinkled appearance. As in most of the *Sagittarias*, the achene is an important characteristic in identification, and should be mature. If immature, the achene can readily be confused with that of *S. latifolia*, but

S. calycina may be separated by its bracts, peduncle, and pedicel. The pubescent filaments, hyaline bracts, straight long beak of achene, and well developed resin ducts of the achene readily identify this species.

Both gigantic (to 2 m tall) and dwarfed (5 cm tall) specimens occur.

The typical subspecies of *S. montevidensis* occurs naturally in South America.

2. *SAGITTARIA RIGIDA* Pursh, Fl. Am. Sept. 397. 1814.

Plants monoecious or dioecious, erect, 1.5-8.0 dm tall, the flower stalk equalling or slightly shorter than the leaves, rather slender; petiole long, weak, slightly ridged, with expanded base; blades ovate-elliptic, lanceolate, or hastate, prominently nerved, acute at apex, 2-16 cm long, 3-9 cm broad, or blade lanceolate with acute apex, 8-18 cm long, 1-4 cm broad, or blade hastate with acute apex, 5-15 cm long, 3-9 cm broad, the lobes either 1 or 2, if 2, poorly developed, unequal in length and width, 3-8 cm long, 0.5-1.5 cm broad; peduncle weak, slightly ridged, few-flowered; flowers in whorls of 3, the upper either staminate or pistillate, the lower pistillate; bracts opposite the pedicels, fused about $\frac{3}{4}$ entire length, weak, prominently nerved with a hyaline margin, rather inconspicuous, ovate, obtuse, 2-6 mm long, including the lobes up to 2 mm long, to 5 mm broad; pedicels of staminate flower long, slender, terete; pistillate flowers sessile; sepals free, short, with hyaline margin, persistent and reflexed after flowering, ovate-lanceolate with rounded or obtuse apex, 0.4-1.0 cm long, to 0.5 cm broad; stamens numerous, to 4 mm long, filaments inflated, densely pubescent or scaly, exceeding length of broad anther; fruiting head globoid, 2-3 cm in diameter when mature, prickly in appearance due to erect curved beak of achene; achene oblongoid, 2.5-7.0 mm long, 2.5-4.0 mm broad, with a well-developed crested dorsal wing, a small narrow ventral wing, usually 1 small facial keel, with resin ducts well-developed at apex of embryo; beak of achene usually terminal, erect, recurved, 1.0-1.5 mm long. 2n = 22 (Oleson, 1941).

This species ranges from Quebec to Minnesota, south to Nebraska, Missouri, Tennessee, and Virginia, where it is found in shallow water, in swamps, in muddy sand, and along the margins of ponds and waterways. It is relatively uncommon in Illinois. Map 5.

Sagittaria rigida is recognized readily by the sessile fruiting heads, inconspicuous bracts, and long recurved beak of the achene. The three basic types of leaves—ovate-elliptic, lanceolate, and hastate—may all be borne on the same plant. Frequently, however, only one of the leaf forms may be present. Usually, if the plant is submerged for any length of time, the unlobed forms develop; if emersed, the lobed leaves develop.

Several authors state that phyllodia are present in this species. Of the specimens examined, no trace of phyllodia was noted in the Illinois specimens.

Bogin (1955) reports that *S. rigida* apparently hybridizes with *S. graminea*.

3. **SAGITTARIA GRAMINEA** Michx. Fl. Bor. Am. 2:190. 1803. var. **GRAMINEA**

Sagittaria acutifolia Pursh, Fl. Am. Sept. 2:397. 1814.

Plants monoecious or dioecious, erect, 0.5-5.0 dm tall, the flower stalk equalling or slightly shorter than leaves, rather slender in appearance; petiole long, slender, minutely ridged, with expanded base; blade either entire, hastate, or represented by bladeless phyllodia, prominently nerved, the unlobed blade linear-lanceolate, tapering to acute apex, 2-17 cm long, 3-5 cm broad, the hastate blade with lobes usually unequal in both length and width, up to 2.5 cm long, 2 mm broad, the phyllodia linear-lanceolate, tapering to acuminate tip, to 19 cm long, to 2 cm broad; peduncle slender, minutely ridged, sparsely flowered, the flowers in whorls of 3, upper flowers either staminate or pistillate, lower flowers pistillate; bracts 3, opposite the pedicel, basally connate to fused $\frac{1}{2}$ their entire length, weak, prominently nerved, hyaline in appearance, inconspicuous, ovate, obtuse, 2 mm long, 1-2 mm broad; pedicels long, slender, terete, with staminate and pistillate being same length, 1-3 cm long; sepals basally connate, short, with a hyaline margin, persistent, reflexed in fruit, ovate-lanceolate with obtuse apex, 3-6 mm long, 1-3 mm broad; petals free, greatly exceeding sepals, ovate, narrowing to slender claw at base, obtuse, 1-2 cm long, 1-2 cm broad; stamens numerous, to 3 mm long, the filaments inflated, scaly, shorter than anther; fruiting head globoid, small, 4-8 mm in diameter when mature, smooth in appearance; achene narrowly ovoid, 2 mm long, 1 mm broad, with both ventral

and dorsal wings well-developed, 1-3 facial wings with one well-developed, with a well-developed resin duct along one side of embryo, the beak usually oblique to horizontal and borne below summit of achene, short, less than 0.3 mm long. $2n = 22$ (Brown, 1946).

This species occurs in mud, sand, or shallow water, often in swamps, from Labrador to South Dakota, south to Texas and Florida, as well as Cuba. It is relatively uncommon in Illinois, where it is found primarily in the central and northern counties. Map 6.

Sagittaria graminea is most often confused with *S. rigida*, but can easily be separated by the fruiting heads with long pedicels in *S. graminea*. The very short horizontal beak of the achene with 1-3 facial wings, the small, fused, hyaline bracts, and presence of phyllodia all help to separate *S. graminea* from *S. rigida* and the other members of this genus in Illinois.

Two additional varieties of *S. graminea* approach Illinois, but have not as yet been found in Illinois. Variety *platyphylla*, with recurved pedicels of the pistillate heads and an achene beak longer than 3 mm, is a southwestern United States taxon which reaches north to the "boot-heel" of Missouri. Variety *cristata*, with the filaments as long as the anthers, is a taxon of the Great Lakes region, which extends southward to the southeastern corner of Wisconsin.

4. **SAGITTARIA CUNEATA** Sheld. Bull. Torrey Club 20:283. 1893.

Sagittaria arifolia Nutt. ex J. G. Sm. Missouri Bot. Gard. Rep. 6:6. 1894.

Plants monoecious or dioecious, erect, to 7 dm tall, the flower stalk usually exceeding the leaves, slender; petiole long, slender, generally smooth, with a slightly expanded base; blade sagittate, prominently nerved, broadly rounded or slightly tapering to acute, bristle-tipped apex, with median constrictions along each margin opposite the attachment of petiole, 6-10 cm long, 1.0-4.5 cm broad, basal lobes broadly lanceolate, tapering to acuminate apex, equalling or slightly exceeding the blade in length; peduncle slender, smooth; inflorescence sparsely flowered, the flowers in whorls of 3, unbranched, the upper predominantly staminate, the lower predominantly pistillate, occasionally both staminate and pistillate at the same node; bracts 3, opposite the pedicel, basally connate, firm, promi-

nently nerved with a subhyaline margin, usually shorter than immature flower head, erect, narrowly lanceolate, acute to acuminate at apex, to 2 cm long, to 5 mm wide; pedicels long, slender, terete, with the staminate slightly longer than pistillate, the staminate up to 2 cm long, the pistillate up to 1 cm long; sepals free, short, persistent and usually reflexed after flowering, ovate with obtuse apex, 8 mm long, 5 mm broad; petals free, equalling or exceeding the sepals, ovate and tapering to a slender claw, obtuse at apex, 8-10 mm long, 5-8 mm broad; stamens numerous, to 5 mm long, the filaments slender, glabrous, 1 mm longer than the anther; fruiting head globoid, to 1.5 cm in diameter when mature; achene ovoid, up to 2.8 mm long, to 2 mm broad, with small ventral and lateral wings, with a small facial wing, with resin ducts undeveloped, the erect, terminal beak up to 0.4 mm long. $2n = 22$ (Brown, 1946, as *S. arifolia*).

The usual habitat for *S. cuneata* is in mud or water in sloughs or along waterways. This species ranges all across northern North America south to California, Texas, Illinois, and New York. Thus far it is known in Illinois only from the central and northern counties. Map 7.

Sagittaria cuneata can easily be distinguished, when mature, by the slender appearance of the plant and the very short, erect, terminal beak of the ovoid achene. The immature specimens are very difficult to separate from *S. engelmanniana* ssp. *brevirostra*.

5. **SAGITTARIA ENGELMANNIANA** J. G. Sm. ssp. **BREVIROSTRA** (Mack. & Bush) Bogin, Mem. N. Y. Bot. Gard. 9(2):224. 1955.

Sagittaria brevirostra Mack. & Bush, Missouri Bot. Gard. Rep. 16:102. 1905.

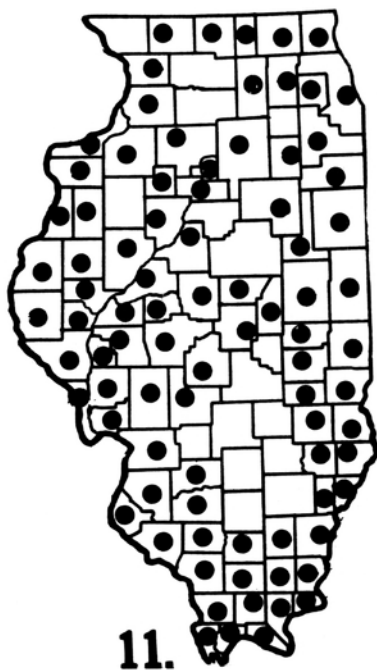
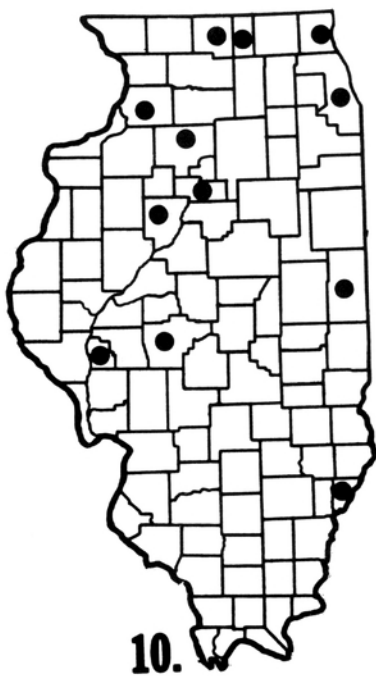
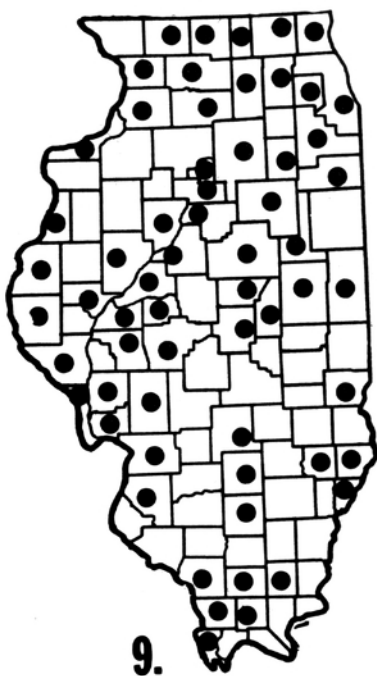
Plants monoecious or dioecious, erect, 4-7 dm tall, the flower stalk equalling or slightly exceeding leaves, robust in appearance; petiole long, stout, ridged, with expanded base; blade sagittate, hastate, or very rarely entire, prominently nerved, the blade usually tapering to the narrowly obtuse apex, with median constrictions along each margin opposite the attachment of the petiole, 10-22 cm long, 3-12 cm broad, basal lobes lanceolate to ovate-lanceolate tapering to the acute, bristle-tipped apex, equalling or slightly exceeding the blade in length, 9.5-22.0 cm long, 2.5-7.5 cm broad; pedun-

cle stout, ridged, densely flowered, the flowers in whorls of 3 or 4, the lower whorls occasionally replaced by branches, the upper flowers either staminate or pistillate, the lower flowers entirely pistillate; bracts as many as and opposite the pedicels, free or slightly connate basally, firm, prominently nerved with a hyaline margin, equalling or exceeding the immature flower head, arched-ascending with reflexed tips, lanceolate to ovate-lanceolate, long-attenuate or acute, 1.5-4.0 cm long, 0.5-1.0 cm broad; pedicels long, slender, terete, those of the staminate flowers being slightly longer than those of the pistillate, staminate 1.5-3.0 cm long, pistillate 1-2 cm long; sepals free, short, with hyaline margin, persistent and usually reflexed after flowering, ovate-lanceolate with acute or obtuse apex, 0.6-1.5 cm long, 0.6-1.5 cm broad; petals free, exceeding the sepals, orbicular with a short claw, obtuse, 1-2 cm long, 1.0-1.5 cm broad; stamens numerous, to 5 mm long, filaments slender, glabrous, equalling the anther; fruiting head globoid, 2-3 cm in diameter when mature; achene cuneate-ovoid, 2.5-3.0 mm long, 1-2 mm broad, with a ventral narrow wing and a broad, crested dorsal wing, with 1-3 facial wings with one usually well developed, with resin ducts not developed at apex of embryo, the broad-based beak usually oblique, rarely erect, recurved at apex, 0.5-1.5 mm long.

This is one of the more common species of *Sagittaria* in Illinois. Map 8. Its overall range is Michigan to South Dakota, south to Texas, Mississippi, and Georgia, where it occurs in sloughs, in shallow water, and along shorelines.

Sagittaria engelmanniana ssp. *brevirostra* is most often confused with *S. latifolia*, but can easily be distinguished by the long attenuate bracts, the presence of facial wings on the achene, and the beak of the achene with recurved apex. Much confusion can occur when examining immature specimens of *S. brevirostra*, *S. cuneata*, and *S. latifolia*. Even though achenes are not fully developed, the relative position and length of the beak and size and shape of the bracts separate the species adequately.

Subspecies *engelmanniana* is restricted to the states along the Atlantic seaboard. Subspecies *longirostra*, with more recurved, longer beaks of the achenes, is a southeastern United States species which ranges to Fulton County, Kentucky, just across from the southern tip of Illinois.



MAPS 9-12.—Map 9. Illinois distribution of *Sagittaria latifolia*. Map 10. Illinois distribution of *Alisma plantago-aquatica* var. *americanum*. Map 11. Illinois distribution of *Alisma subcordatum*. Map 12. Illinois distribution of *Butomus umbellatus*.

Bogin (1955) reports hybridization between *S. engelmanniana* and *S. latifolia*, and possibly between *S. engelmanniana* and *S. cuneata*.

6. **SAGITTARIA LATIFOLIA** Willd. Sp. Pl. 4:409. 1805. var. **LATIFOLIA**.

Sagittaria simplex Pursh, Fl. Am. Sept. 2:397. 1814.

Sagittaria variabilis Engelm. in A. Gray, Man. Bot. 461. 1848.

Sagittaria variabilis var. *diversifolia* Engelm. in A. Gray, Man. Bot. 439. 1856.

Sagittaria latifolia f. *diversifolia* (Engelm.) B. L. Robins. Rhodora 10:31. 1908.

Plants monoecious or dioecious, erect, 4.0-8.3 dm tall, the flower stalk equalling or slightly exceeding the leaves, robust in appearance; petiole long, stout, ridged, with expanded base; blade hastate or sagittate, prominently nerved, usually broadly rounded to the acute apex, with median constrictions along each margin opposite the attachment of the petiole, 6-20 cm long, 5-19 cm broad, basal lobes broadly lanceolate, tapering to the acute or obtuse, bristle-tipped apex, usually equalling or rarely exceeding the blade in length, 5-23 cm long, 2-11 cm broad; peduncle stout, smooth, sparsely flowered, the flowers in whorls of 3, rarely branched at first node, the entire stalk staminate, pistillate, or both; bracts 3, opposite the pedicels, free or slightly connate basally, thin, prominently nerved with hyaline margin, much shorter than the flower head, erect, ovate-lanceolate, obtuse, 1 cm or less long, 1 cm or less broad; pedicels long, slender, terete, with those of the staminate and pistillate flowers about equal in length, to 5 cm long; sepals free, short, with hyaline margin, persistent and reflexed after flowering, ovate, the apex obtuse or shallowly bilobed, 0.5-1.5 cm long, 0.5-1.0 cm broad; petals free, exceeding the sepals, orbicular with short claw, obtuse, 1-2 cm long, 1-2 cm broad; stamens numerous, to 5 mm long; filaments slightly inflated, glabrous, longer than the anther; fruiting head globoid, 2-3 cm in diameter when mature; achene obvoid, 2.5-3.0 mm long, 3-4 mm broad, with a narrow ventral wing and a broad dorsal wing forming a low crest at apex of achene, without facial wings, with usually one well de-

veloped resin duct on facial surface over center of embryo, with the beak of the achene horizontal and straight, to 2 mm long.

This species has the broadest range of any taxon of *Sagittaria* which occurs in Illinois. It occurs throughout most of North America, extending into Ecuador; it also is known from Hawaii. It is found in most aquatic or semi-aquatic habitats. It seemingly occurs more frequently in the northern and central counties of Illinois. Map 9.

In Illinois, *S. latifolia* is not as common as reported by earlier authors, primarily due to the confusion with *S. engelmanniana* ssp. *brevirostra*. (See discussion of *S. engelmanniana* ssp. *brevirostra*.)

The leaf outline of *S. latifolia* is extremely variable and, therefore, not a good identification character. The thin, short, obtuse bracts, mature achene with no facial wings, and the horizontal, straight beak easily distinguish this species.

3. *Alisma* L. — Water Plantain

Flowers perfect; receptacle flat; sepals 3, green; petals 3, white; stamens 6 or 9; ovaries 10-25, distinct, arranged in a single series; achenes flattened, ribbed only on the back.

This genus is distinguished readily from *Sagittaria* and *Echinodorus* by its ovaries arranged in a single series on the flat receptacle.

A monograph of the genus, prepared by Hendricks (1957), does not seem to depict adequately our species.

Key to the Species of *Alisma* in Illinois

1. Petals 3.5-6.0 mm long; flowers at least 7 mm broad; styles at anthesis as long as the ovaries; achenes at least 2.5 mm long 1. *A. plantago-aquatica*
1. Petals 1.0-2.5 mm long; flowers at most 3.5 mm broad; styles at anthesis less than one-half as long as the ovaries; achenes less than 2.5 mm long 2. *A. subcordatum*

1. **ALISMA PLANTAGO-AQUATICA** L. var. **AMERICANUM** Roem. & Schultes, Syst. 7:1598. 1830.

Alisma triviale Pursh, Fl. Am. Sept. 1: 252. 1814.

Alisma plantago L. var. *triviale* (Pursh) BSP. Prel. Cat. N. Y. Pl. 58. 1888.

Alisma plantago-aquatica L. var. *triviale* (Pursh) Farwell, Ann. Rep. Comm. Parks & Boulev. Det. 11:44. 1900.

Rooted perennial; leaves basal, the blade elliptic to ovate, membranous, to 15 cm long, to 8 cm broad, subacute at apex, rounded to cordate at base, glabrous, the petioles much longer than the blades; scape (primary stalk of inflorescence) erect, bearing a panicle with the secondary branches borne in whorls of 3-10; bracts of inflorescence ovate or narrowly ovate; flowers at least 7 mm broad; sepals obtuse, 3-4 mm long; petals white, 3.5-6.0 mm long; stamens 6-9, at least twice as long as the ovaries; styles at anthesis as long as the 10-25 ovaries; fruiting heads 5-7 mm in diameter; achenes broadly rounded on back, 2.5-3.0 mm long. $2n = 14$ (Brown, 1946; Gadella & Kliphuis, 1963; Sokolovskaya, 1963).

The range of this taxon is from Nova Scotia to Oregon, south to California, New Mexico, Illinois, and Maryland. In Illinois, it is much rarer than *A. subcordatum*, occurring in a few northern counties and in Wabash County. Map 10. It grows in shallow water, marshes, and ditches.

Typical var. *plantago-aquatica*, from Europe, has mostly lilac petals, longer anthers, and longer styles.

For a discussion of *Alisma plantago-aquatica*, see Fernald (1946).

This species is distinguished readily from *A. subcordatum* by its larger flower parts, elongated stamens, and larger achenes.

Pogan (1963) reports $2n = 28$ for *Alisma triviale*, here considered synonymous with *A. plantago-aquatica* var. *americanum*.

2. **ALISMA SUBCORDATUM** Raf. Med. Rep. N. Y. II. 5:362. 1808.

Alisma plantago Bigel, Fl. Bost. 87. 1814.

Alisma parviflorum Pursh, N. Am. Sept. 1:252. 1814.

Alisma plantago var. *parviflorum* (Pursh) Torr. Fl. N. & Mid. U. S. 1: 382. 1824.

Alisma plantago-aquatica L. var. *parviflorum* (Pursh) Farwell, Ann. Rep. Comm. Parks & Boulev. Det. 11:44. 1900.

Rooted perennial; leaves basal, the blade elliptic to ovate, membranous, to 12 cm long, to 6.5 cm broad, subacute at

apex, rounded to cordate at base, glabrous, the petioles much longer than the blades; scape erect, bearing a panicle with much-branched secondary branches borne in whorls of 3-10; bracts of inflorescence lanceolate; flowers at most 3.5 mm broad; sepals obtuse, 1-3 mm long; petals white, 1.0-2.5 mm long; stamens 6-9, slightly longer than the ovaries; styles at anthesis less than one-half as long as the 10-25 ovaries; fruiting heads 3-4 mm in diameter; achenes 1.5-2.5 mm long. $2n = 14$ (Pogan, 1963).

The smaller-flowered water plantain is confined to the eastern half of the United States and to Mexico. In Illinois, it probably exists in every county. Map 11. It occupies similar habitats like the preceding.

The smaller flowers and achenes distinguish this species from *A. plantago-aquatica* var. *americanum*.

The flowers appear from mid-July until the end of August.

FAMILY BUTOMACEAE — FLOWERING RUSH FAMILY

Only the following genus comprises this family.

1. *Butomus* L. — Flowering Rush

Flowers perfect; perianth composed of two distinct series of 3 members each; stamens 9; ovaries 6, united at the base; follicles many-seeded; leaves grass-like.

Only the following naturalized species occurs in Illinois.

1. **BUTOMUS UMBELLATUS** L. Sp. Pl. 372. 1753.

Perennial from a stocky rhizome; leaves basal, to 1 m long, 5-10 mm broad, glabrous; scape usually 1 m long, bearing a terminal umbel; umbel many-flowered; bracts 3, broadly lanceolate, acute, purplish; flowers pinkish, at least 18 mm broad; pedicels arched-ascending, to 10 mm long; sepals 3, pinkish or greenish, persistent; petals 3, pinkish, persistent; stamens 9; follicles to 1 cm long, long-beaked. $2n = 28, 40$ (Lohammar, 1931), 39 (Gadella & Kliphuis, 1963).

This species, known as the flowering rush, is native to Europe but has become naturalized along the St. Lawrence River and around the Great Lakes. In Illinois, it is known from a single locality in Cook County: small pond south of 87th Street, east of Kean Avenue, near Buffalo Woods Forest. Map 12.

Illinois is one of several states where this species has been introduced in recent years.

LITERATURE CITED

- BALDWIN, J. T., and B. M. SPEESE. 1955. Chromosomes of taxa of the Alismataceae in the range of Gray's Manual. Amer. J. of Bot. 42:406-411.
- BOGIN, C. 1955. Revision of the genus *Sagittaria* (Alismataceae). Mem. New York Botanical Garden 9(2):179-233.
- BROWN, W. V. 1946. Cytological studies in the Alismaceae. Bot. Gazette 108: 262-267.
- FASSETT, N. C. 1955. *Echinodorus* in the American tropics. Rhodora 57:133-156; 174-188; 202-212.
- FERNALD, M. L. 1946. North American representatives of *Alisma plantago-aquatica*. Rhodora 48:86-87.
- GADELLA, T. W. J., and K. KLIPHUIS. 1963. Chromosome numbers of flowering plants in the Netherlands. Acta. Bot. Neerl. 12:17-39.
- HEISER, C. B., and T. W. WHITAKER. 1948. Chromosome number, polyploidy, and growth habit in California weeds. Amer. J. of Bot. 35:179-186.
- HENDRICKS, A. J. 1957. A revision of the genus *Alisma* (Dill.) L. Amer. Midland Naturalist 58:470-493.
- LOHAMMAR, G. 1931. The chromosome numbers of *Sagittaria natans* Pallas and *S. sagittifolius* L. Svensk. Bot. Tideskr. 25:32-35.
- MASON, C. T. 1952. The status of *Lophotocarpus* in western North America. Madroño 11:263-270.
- MEAD, S. B. 1846. Catalogue of plants growing spontaneously in the state of Illinois, the principal part near Augusta, Hancock County. Prairie Farmer 6:35-36; 60; 93; 119-122.
- OLESON, E. M. 1941. Chromosomes of some Alismaceae. Bot. Gazette 103: 198-202.
- PATTERSON, H. N. 1876. Catalogue of the phaenogamous and vascular cryptogamous plants of Illinois. 54 pp. Oquawka, Illinois
- POGAN, E. 1963. Taxonomical value of *Alisma triviale* Pursh and *Alisma subcordatum* Rafin. Canadian J. of Bot. 41:1011-1013.
- ROBINSON, B. L. 1903. The generic position of *Echinodorus parvulus*. Rhodora 5:85-89.
- SOKOLOVSKAYA, A. P. 1963. Geographical distribution of polyploidy in plants. Vest. Leningrad. Univ. 15:38-52.

Manuscript received January 18, 1967.