

The Flowering of *Lemna minor* and the Establishment of *Centaurium pulchellum* in Northwestern Indiana

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The flowering of *Lemna minor* is considered to be an infrequent occurrence (4, 5, 6). This rarity of flowering has imposed serious restrictions on studies which contribute to an understanding of the life cycle of the Lemnaceae (7). It has been recommended that, when such phenomena occur, flowering material be collected for critical study (6).

Such an occasion did present itself this summer while a routine microscopic examination was made of a Schererville pond. The first indication of a serendipitous find was an almost transparent bubble-like structure adjacent to several thalli of *Lemna minor*. A more critical observation revealed this to be the cup-shaped stigma attached to an equally semi-transparent style protruding from the reproductive pouch of a parent duckweed.

Although in no way related to the ferns, the term frond is commonly employed in describing the thallus of the duckweeds. While there seems to be considerable controversy in interpreting the inflorescence of this group, little disagreement exists in the belief that the Lemnaceae is a degenerate offshoot of the Araceae.

Maheshwari and Kapil have described the frond of *Lemna paucicostata* as being composed of three indistinct regions: 1. The distal end which is primarily photosynthetic in function; 2. A nodal sector flanked by the reproductive pouches, and from which arise the root, the daughter fronds and the flowers; 3. A basal axial region from which arises a pedicel and is partly modified to form the pouches. The frond is asymmetric, largely undifferentiated and somewhat broader at the distal end (7).

With the exception of the pedicel, this description may be cautiously applied to *Lemna minor*. Environmental conditions often lead to such variation that species are not readily distinguished (3, 8).

The primordium of the foot arises from a subepidermal layer which is overarched by a protective sheath of epidermis. This sheath is soon pierced by a root cap which becomes winged in *L. paucicostata* but not *L. minor*. The epidermis is without root hairs. The anatomy of the root reveals four layers of cells. While the outer two are chlorophyllous, the inner two are devoid of pigment and may be compared to the endodermis and the xylem respectively. The vascular strand in the frond is simple. In *L. paucicostata*, it is composed of a narrow strip of elongated cells. In *Lemna minor*, these cells may become lignified (7).

The question of the floral assemblage is more difficult to assess. It commonly has been interpreted as several flowers (usually one female, two males) in a common membranous spathe (1, 4, 5). Pool describes the family as bearing extremely simple flowers consisting of one stamen and one pistil (9). In *L. paucicostata* the pistil is lateral with respect

to the stamens, but in *L. minor* the carpel lies between two stamens. The latter arrangement lends support to the view that what is usually considered an inflorescence is in reality a flower (7).

If this assumption is true, it may be appropriate to consider this species as near polygamomonecious since what seem to be perfect flowers and staminate flowers may be borne on the same individual. It has been the practice to regard this entire group as monecious (1, 10).

As earlier stated, the first indication of the flowering process was the appearance of style and stigma. Closer scrutiny revealed that the pistil was flanked on either side by immature stamens. This discovery prompted a quantitative study. Of six hundred plants examined on June 19, 95 or 15.8% bore this type of "flower." At this point it suddenly became apparent that a second type of "flower" was present, this being entirely staminate, composed of two stamens only. The next four hundred plants examined on this same day produced 113 "flowers" of either the perfect or staminate type. This represented about 28% of the total population.

On June 23 a duckweed sampling was taken from a small lake near St. John. Only five, or less than 2% of three hundred plants examined, yielded flowering individuals. On the same day the original Schererville pond yielded 28 flowering plants of one hundred studied. On June 25, a ditch connected to the Kankakee River near Schneider was explored for flowering specimens. None of the one hundred plants examined exhibited "flowers." The Schererville pond produced 117 flowering plants of two hundred examined on July 9. This represented approximately 58% of the population. By August 29, this percentage dropped to 31%, and by September 17 it was estimated that this percentage had declined to about 15%.

Statistical errors are easily introduced because of the sampling techniques used. Chief among these is properly identifying one plant. As in other duckweeds, *L. minor* reproduces asexually by buds or daughter fronds in the same reproductive pouches where flowering occurs. In most cases the daughter, granddaughter and great granddaughter fronds remain attached to the parent frond forming a chain of thalli. Even gentle manipulation produces fragmentation so that the pure definition of a plant is at best obscure. A lesser obstacle was the immaturity of the stamens. Few seemed to reach anthesis. Many remained subepidermal and had to be gently pressed out with a teasing needle to prove their existence. Of the hundreds of flowers observed, only a few anthers exhibited dehiscence. The anthers are tetralocular, but all four microsporangia do not develop synchronously. One cell may be metaphase while others in early prophase (7).

The stigma and style appear to be but one cell thick. There is but one ovule in an ovary and this may be removed with little difficulty. The membranous sac (spathe) which invests the "perfect flowers" is curiously but sparingly pigmented with red spots.

With a great amount of disappointment, no fruiting has been observed.

In the *Flora of Indiana*, Deam listed *Centaurium pulchellum* as an excluded species (2). He had received a report of a specimen from the Dunes area without a specific locality and had seen a plant collected in South Chicago. He cautiously preferred to "wait and see" if this species would establish itself in Indiana.

Centaurium pulchellum is a member of the Gentianaceae. It produces a handsome flower with a salverform corolla and is pleasingly pink. Three or four specimens were found cringing from periodic onslaughts of a power mower in a Schererville lawn in midsummer of 1968. Since that time abundant stands have been found near the hangars and on runways of the Griffith airport at the eastern edge of that community. These plants seemed stunted and judging from other plants, this could be explained on the basis of soil. A smaller but more luxuriant population was found on the extreme southern edge of Griffith in late summer.

Literature Cited

1. BENSON, LYMAN. 1957. *Plant Classification*. D. C. Heath and Co.
2. DEAM, CHARLES C. 1940. *Flora of Indiana*. Department of Conservation, State of Indiana.
3. FASSETT, NORMAN C. 1957. *A manual of Aquatic Plants*. University of Wisconsin Press.
4. FERNALD, MERRITT L. 1950. *Gray's Manual of Botany*, 8th Ed. American Book Co.
5. GLEASON, HENRY A. and CRONQUIST, ARTHUR. 1963. *Manual of Vascular Plants of Northeastern United States and Adjacent Canada*. D. Van Nostrand and Co.
6. LAWRENCE, GEORGE. 1964. *Taxonomy of Vascular Plants*. The Macmillan Co.
7. MAHESHWARI, SATISH and KAPIL, R. 1963. Morphological and Embryological Studies on the Lemnaceae. I. The Floral Structure and Gametocytes of *Lemna paucicostata*. *Amer. J. Bot.* 50:677-686.
8. MCCLURE, JERRY and ALSTON, RALPH. 1966. A Chemotaxonomic Study of Lemnaceae. *Amer. J. Bot.* 53:849-860.
9. POOL, WILLIAM H. 1941. *Flowers and Flowering Plants*. McGraw Hill.
10. PORTER, C. L. 1967. *Taxonomy of Flowering Plants*. W. H. Freeman Co.