

## ***Botrychium simplex***

<b>Family:</b>	Ophioglossaceae
<b>Genus:</b>	<i>Botrychium</i>
<b>Subgenus:</b>	<i>Botrychium</i> (syn. <i>Eubotrychium</i> )
<b>Species:</b>	<i>Botrychium simplex</i> E. Hitchcock
<b>Varieties:</b>	<i>simplex</i> , <i>tenebrosum</i> , <i>compositum</i> , <i>fontanum</i>
<b>Synonym:</b>	<i>B. tenebrosum</i> A. A. Eaton
<b>Common Name:</b>	Least Moonwort
<b>Ploidy:</b>	Diploid

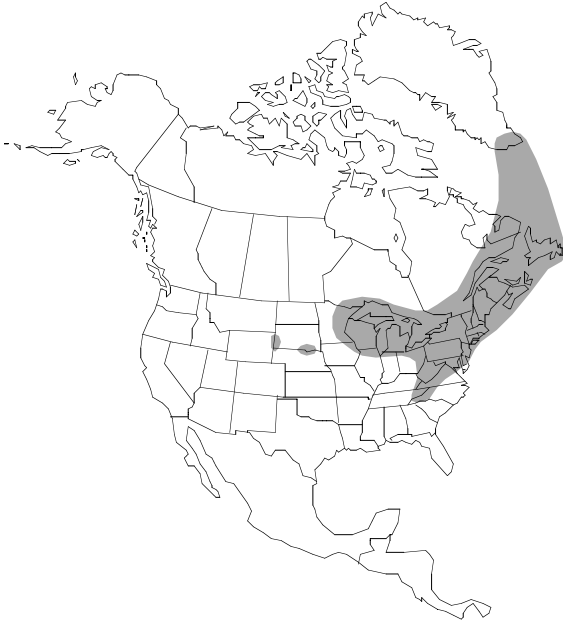
**Published description:** Trophophore stalk 0-3 cm, 0-1.5 times length of trophophore rachis; blade dull to bright green to whitish green, linear to ovate oblong to oblong to fully triangular with pinnae arranged ternately, simple to 2 (-3) pinnate, to 7 x 0.2 cm, fleshy to thin, papery or herbaceous. Pinnae or well-developed lobes to 7 pairs, spreading to ascending, approximate to widely separated, distance between 1<sup>st</sup> and 2<sup>nd</sup> pinnae frequently greater than between 2<sup>nd</sup> and 3<sup>rd</sup> pairs, basal pinna pair commonly much larger and more complex than adjacent pair, cuneate to fan-shaped, strongly asymmetric, undivided to divided to tip, basispic margins  $\pm$  perpendicular to rachis, acroscopic margins strongly ascending, basal pinnae often divided into 2 unequal parts, margins usually entire or shallowly sinuate, apex rounded, undivided and boat-shaped to strongly divided and plane, venation pinnate or like ribs of fan, with midrib. Sporophores mainly 1-pinnate, 1-8 times length of trophophores,  $2n = 90$ . (Wagner and Wagner 1993).

### **Identification**

Four varieties of *Botrychium simplex* were recognized by Clausen (1938). Three of these, var. *simplex*; var. *compositum*; and var. *tenebrosum* are currently recognized, and a fourth, var. *fontanum* is newly added in this treatment. These are illustrated on the following pages.



***B. simplex* var. *simplex*** includes plants with mostly undivided basal pinnae and trophophore stalk equal to or exceeding length of the common stalk. This is the common variety of the eastern United States, also found westward to the Black Hills and possibly in Colorado.

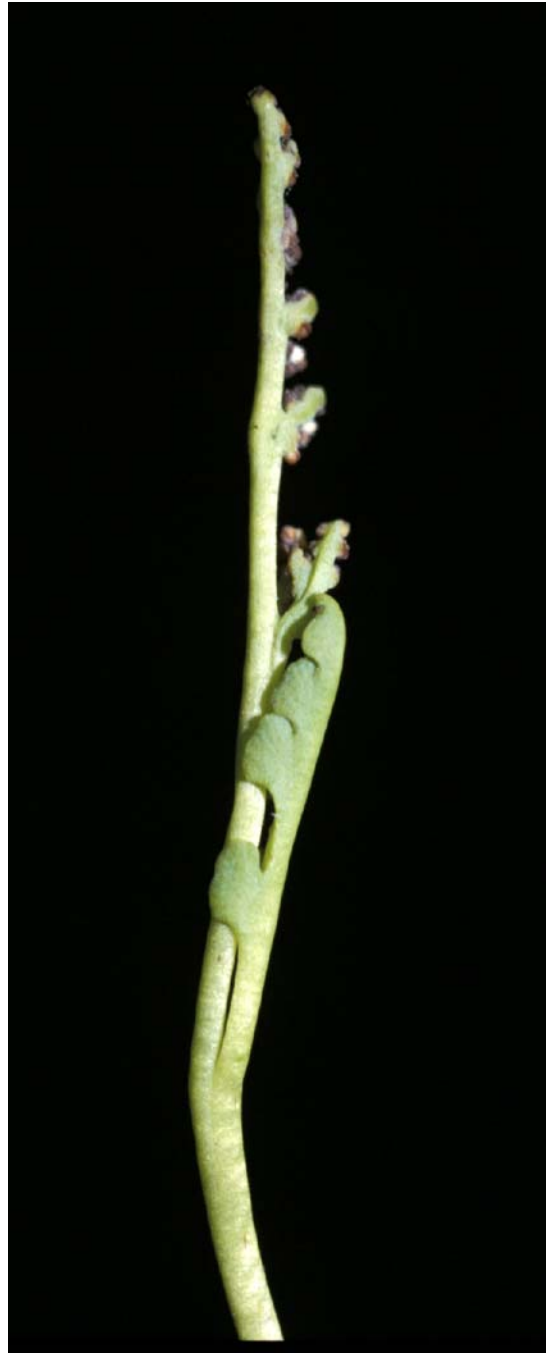
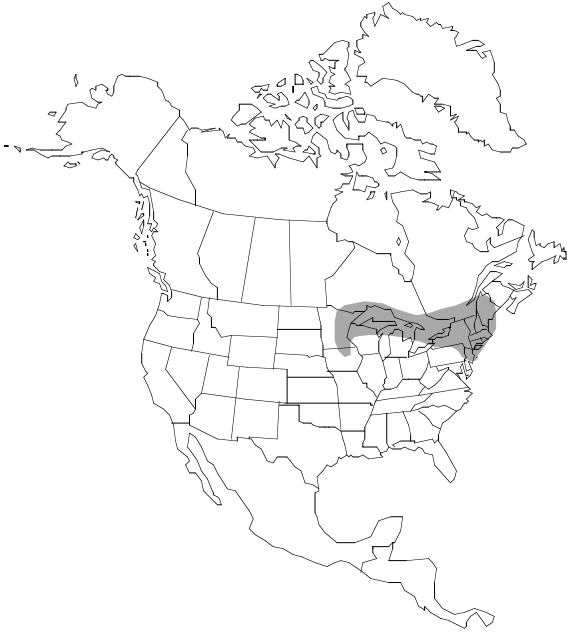


(above) a very "simple" plant

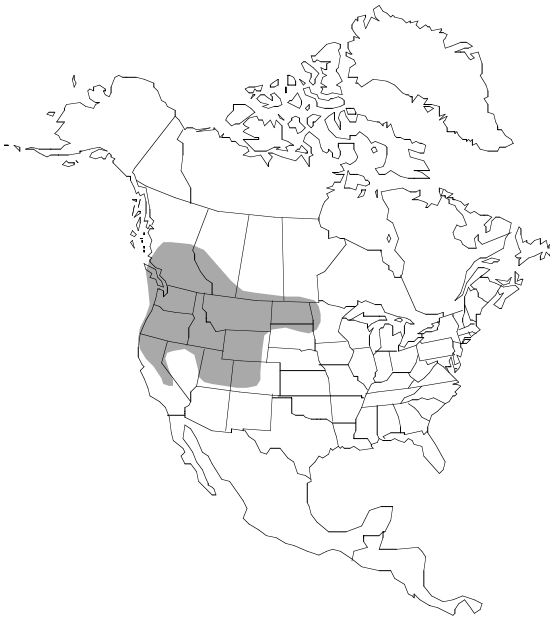


(left) larger plants get progressively more dissected with lower pinnae more elongated

***B. simplex* var. *tenebrosum*** includes slender plants with undivided basal pinnae and very short trophophore and sporophore stalks and relatively longer common stalks. Variety *tenebrosum* is the most distinct of the four varieties and most likely to be mistaken for another species. It was originally described as a distinct species, *B. tenebrosum* and may warrant recognition as such.



**B. simplex var. *compositum*** for plants with secondarily divided basal pinnae and trophophore stalk equal to or exceeding length of the common stalk



small plant with undivided basal pinnae



unusually large plant with second pair of pinnae pinnately divided

***B. simplex* var. *fontanum*** for robust plants of hardwater seeps, with basal pinnae divided or not, thick and fleshy with broad, bluish green pinnae and terminal pinnae with broadly rounded apices.



Large plant with pinnately divided lower pinnae.



Smaller plant with enlarged but not divided lower pinnae. Sporophore wilted.

## Identification

Because of the substantial differences among and even within the varieties of *B. simplex*, it is difficult to specify morphological traits separating all its forms from all other moonworts. *B. simplex* plants, especially of var. *compositum*, are the only moonworts with a sporophore-trophophore junction near ground level, but eastern plants of var. *simplex* may have the junction midway along the combined length of the sporophore + common stalk, and plants of var. *tenebrosum* have the junction higher still. The sporophore in all varieties tends to be long and lax with uncrowded branches, and the sporophore stalk commonly exceeds the length of the entire trophophore (except in var. *tenebrosum*). The trophophore stalk is also prominent, its length usually exceeding the length between the first two pairs of pinnae which, in turn, is much greater than the distance between the second and third pinna pairs. Undivided pinnae are strongly ascending with a decurrent attachment to the rachis. Outer pinna margins are rounded as are their junctions with side margins, giving the pinnae a more rounded appearance than in other moonwort species. Spores of *B. simplex* are significantly larger than those of other diploid species, averaging more than 40 microns.

Shade grown plants of *B. simplex* (especially var. *tenebrosum*) without divided or elongated basal pinnae resemble plants of *B. mormo* and its western relative *B. montanum* in some characteristics, but these species have a stiffer and stouter, more succulent appearance than *B. simplex* and their pinnae have straight outer margins that are more or less toothed. More robust plants of *B. simplex* with undivided, un-elongated basal pinnae can be distinguished from *B. lunaria* and similar species by their broad and decurrently attached pinnae, non-angular junction of outer and side margins, and strongly stalked trophophore.

Plants of *B. simplex* with divided or elongated basal pinnae can be distinguished from *B. pumicola* by the much shorter trophophore and sporophore stalk of the latter. Such plants can be differentiated from other twice dissected moonworts by their un-elongated pinnae above the first pair.

A major problem in identifying and studying the relationships among varieties of *B. simplex* is their tendency to persist in "juvenile" forms. These are not truly juvenile plants, but especially in drier habitats, plants remain very small (often less than 2cm tall) with undivided trophophores or with only a single pair of pinnae below the undivided apical portion. All of the varieties, at this size, have more or less the same appearance. Morphologies typical of the variety develop only on larger plants. Thus varietal identification of "juvenile" forms is dependent on presence of some larger plants in the population or use of chemical/molecular methods. However, even "juvenile" forms of *B. simplex* can be distinguished from other species by their relatively undivided, often boat-shaped terminal segments.

## Distribution

*Botrychium simplex*, together with *B. lunaria* and *B. lanceolatum*, is one of the three most widely distributed of moonwort species. It has much the same distribution

as *B. lunaria* and *B. lanceolatum*, occurring southward at high elevations in the Appalachian Mountains to North Carolina, westward across the northern plains to the Rocky Mountains where it extends southward at high elevations to New Mexico and southern California. In the Midwest, it extends further southward (to Iowa and Nebraska) than any other species except *B. campestre*. From southeastern Canada it extends northward to Newfoundland and occurs in southern Greenland, Iceland and Europe. In northwestern North America it occurs in the southern parts of the Canadian provinces.

*Botrychium simplex* var. *simplex* is the most common and widespread variety in eastern North America, occurring from the mountains of North Carolina to New England and westward across the Great Lakes region to Nebraska and the Black Hills.

*Botrychium simplex* var. *tenebrosum* occurs sporadically in New England and the Great Lakes Area, extending northward and eastward to Iceland and Scandinavia.

*Botrychium simplex* var. *compositum* is often the most common and frequently the only species of moonwort present in mountain meadow sites throughout the western mountains from southern California, Utah and Colorado north to the southern portions of the Canadian provinces. It may become especially common in alluvial meadows developed on granitic substrates.

*Botrychium simplex* var. *fontanum* occurs locally from southeastern Washington to southern California in sites influenced by hardwater seeps. It is the most common variety in southern third of California, especially in the San Gabriel and San Bernadino Mountains.

## **Habitat**

*Botrychium simplex* is primarily a plant of open habitats, occurring in pastures, meadows, orchards, prairies, wetlands, fens, sand dunes and in lake and stream edge vegetation. Most of these habitats are at least temporarily wet and some (fens) are permanently saturated. Varietal segregation exists, with variety *tenebrosum* in northeastern North America being the taxon most commonly present in permanently wet, often deeply shaded habitats. Most plants in permanently wet fen and hardwater seep habitats in western North America are var. *fontanum*. Within these habitats, plants of *B. simplex* may be among sparse vegetation and fully exposed to the sun, or they among tall dense herbaceous vegetation, receiving only very low light. Plants in the latter can be detected only by parting the vegetation in diligent search on hands and knees. *B. simplex* is a frequent companion of *B. multifidum*.

Additional photographs of *Botrychium simplex*:



variety simplex



variety compositum



variety tenebrosum



variety fontanum