

**ARIZONA GAME AND FISH DEPARTMENT
HERITAGE DATA MANAGEMENT SYSTEM**

Plant Abstract

Element Code: PPOPH010L0

Data Sensitivity: No

CLASSIFICATION, NOMENCLATURE, DESCRIPTION, RANGE

NAME: *Botrychium crenulatum* W.H. Wagner
COMMON NAME: Crenulate moonwort, dainty moonwort, wavy moonwort, scalloped moonwort
SYNONYMS: *Botrychium dusenii* auct. non (Christ) Alston
FAMILY: Ophioglossaceae

AUTHOR, PLACE OF PUBLICATION: W.H. Wagner, American Fern Journal 71(1): 20-30. 1981.

TYPE LOCALITY: Mt. Baden-Powell Trail, Hamell Springs, San Gabriel Mountains, Los Angeles Co., California, 7745 ft.

TYPE SPECIMEN: HT: MICH. L.L. Kiefer 1488.

TAXONOMIC UNIQUENESS: Species *crenulatum* is 1 of 34 in the genus *Botrychium*. Ophioglossaceae contains four genera found worldwide. *Botrychium* further divided into three subgenera, one of which is *Botrychium* (moonworts). Taxonomy of this subgenus not well understood due to variability of species. Effect of habitat on plant form not known (Lellinger 1985). According to Wagner and Wagner (1981), *B. crenulatum* "is approximately equally distinct morphologically from *B. lunaria* and the endemic North American tetraploid species *B. minganense* Vict. (cf. Wagner & Lord, 1956)."

According to NatureServe (2005), "Kartesz 1999 indicates that *Botrychium crenulatum* occurs in Canada, in British Columbia and Alberta, while the Flora North America vol. 2 treatment report it only from western states in the United States. It is unclear if this is a difference due to taxonomic treatment or more complete information. Kartesz' Synthesis was published in 1999 and the Flora North America treatment vol. 2 was published in 1993."

DESCRIPTION: Perennial with a single aboveground frond (one per season); main roots mostly 0.5-1.0 mm in diameter. The frond is usually 10 cm or less tall, pale yellow-green, and divided into two segments that share a common stalk. Also reported 6 x 2 cm in measurement. The mostly sterile segment (trophophore stalk) is once pinnatifid with usually three or four well separated pairs of thin textured, broadly fan-shaped pinnae that have distinct veins and scalloped margins; midrib absent. The fertile segment (sporophore) is longer than the sterile segment (1.3-3 times the length), branched like a tiny Christmas tree, and bears grape-like sporangia. Pinnae on the sporophore to 5 pairs, spreading, and well separated.

Chromosome number is $2n=90$. (Lellinger 1985; FNA 1993+; Utah Native Plant Society 2003-2005; WDNR, WNHP 2003).

AIDS TO IDENTIFICATION: *Botrychium crenulatum* may be distinguished from *B. lunaria* (moonwort grape-fern) by its herbaceous (not fleshy) texture, yellow (not dark-green) color, higher placement of the sterile segment of the leaf, stalked rather than sessile sterile portion, an average of three pinna pairs (rather than five). Also *Botrychium crenulatum* superficially resembles *B. minganense* (Mingan's moonwort) however it differs in that it has a more delicate texture, a more abrupt reduction of the apex, with fewer, coarser and more angular rather than more numerous, smaller and rounder ultimate and penultimate segments, in the mostly crenulate rather than the mostly entire distal pinna margins. Also, the 2-3 (sometimes up to 5) pair of non-overlapping, fan-shaped pinnae is the key to recognizing this species.

ILLUSTRATIONS: Line drawing (Wagner 1981)
Color photo (Wagner 1981)
Color photo (In <http://www.denison.edu/biology/faculty/hauk/bcren.jpg>)
Color photos (Swartz in http://www2.state.id.us/fishgame/info/cdc/plants/plants_A-d/botcre.htm)
Line Drawing (David Wagner, in Utah Native Plant Society 2003-2005, <http://www.utahrareplants.org>)
Color photos of plant and habitat (T. Prendusi, in Utah Native Plant Society 2003-2005, <http://www.utahrareplants.org>)
Color photo (Kirk Larson (USFS), in WDNR, WNHP 2003)
Color photo (Steve Wirt, in WDNR, WNHP 2003)
Color photo (Steve Wirt, in MNHP 1997-2005 at <http://nhp.nris.state.mt.us/plants/plantguide.asp?species=14413>)
Color photo (Dennis Stevenson, in <http://www.plantsystematics.org>)

TOTAL RANGE: Western United States including Washington, Idaho, Montana, Wyoming, Utah, Oregon, Nevada, California and Arizona; western Canada.

RANGE WITHIN ARIZONA: Inner Basin, San Francisco Peaks, Coconino County, and Mount Baldy, White Mountains, Apache County. The FNA (1993+) range map shows it in the extreme northwest part of the state.

SPECIES BIOLOGY AND POPULATION TRENDS

GROWTH FORM: Herbaceous

PHENOLOGY: Sporophores are present July – September. Leaves appear in mid to late spring, maturing June – July, and dying late summer; in extremely dry years, there is a shorter duration of leaf appearance or they do not appear at all.

BIOLOGY: *Botrychium crenulatum* is among the most primitive of living ferns. Spores germinate underground and develop into minute, subterranean, non-photosynthetic gametophytes which depend on an endophytic fungus for nourishment.

HABITAT: Local in marshy or springy areas. In the San Francisco Peaks (ASU-90357, in SEINet), usually in patches of bare gravelly soil in rocky terrain, among scattered spruce and fallen logs. Drier areas of damp locations, preferring partial shade although may occur in either shady or sunny areas (in California).

ELEVATION: 10,000 - 11,000 ft. (3050-3355 m). 8,000 feet (2440 m) in Utah (Utah Native Plant Society 2003-2005). FNA (1993+) reports elevation from 1200-2500 m (3,935-8,197 ft). In Washington State, elevation ranges from 2,000-5,500 feet (610-1678 m) (WDNR, WNHP 2003).

EXPOSURE: Collected in full sun on the San Francisco Peaks.

SUBSTRATE: Collected from bare gravelly soil in the San Francisco Peaks.

PLANT COMMUNITY: In the San Francisco Peaks of Arizona, associated species include *Arenaria* (sandwort), *Castilleja* (Indian-paintbrush), *Cystopteris*, *Lonicera* (honeysuckle), and *Potentilla* (cinquefoil). (SEINet accessed 2005). According to Wagner and Wagner (1981), associated genera that have been recorded include woody plants *Pinus* (pine) and *Salix* (willow), and herbs *Dodecatheon* (shooting-star), *Hypericum* (St. John's-wort), *Liparis* (twayblade), *Mimulus* (monkey-flower), *Maianthemum* (= *Smilacina*, Solomon's-plume), and *Veratrum* (false-helleborne). Associated species of grapeferns include commonly *B. simplex* (least grape-fern) and rarely *B. multifidum* (leathery grape-fern). FNA (1993+) reports that *Botrychium crenulatum* is commonly associated with *B. simplex* in California, and in the Wallowa Mountains of Oregon, it occurs with *B. ascendens* (upward-lobed moonwort), *B. lunaria*, and *B. minganense*.

POPULATION TRENDS: Unknown.

SPECIES PROTECTION AND CONSERVATION

ENDANGERED SPECIES ACT STATUS: None (USDI, FWS 1996)
[Category 2 USDI, FWS 1993]
[Category 2 USDI, FWS 1990]
[Category 2 USDI, FWS 1985]

STATE STATUS: None

OTHER STATUS: Forest Service Sensitive (USDA, FS Region 3 1999)

MANAGEMENT FACTORS: Threats include timber harvest and associated road building and erosion, and changes in soil moisture levels. They may tolerate low intensity fire if the fire occurs after sporulation in late summer or early fall, however, spring and summer burning would likely have adverse impacts. (WDNR, WNHP 2003). Threatened by grazing and trampling in California (CNPS 2001, in NatureServe 2005).

CONSERVATION MEASURES TAKEN:

SUGGESTED PROJECTS: Surveys are needed throughout the species' range in order to better assess its distribution and abundance.

LAND MANAGEMENT/OWNERSHIP: USFS – Apache-Sitgreaves and Coconino National Forests.

SOURCES OF FURTHER INFORMATION

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MAJOR KNOWLEDGEABLE INDIVIDUALS:

ADDITIONAL INFORMATION:

J.G. Lemon collected Mount Agassiz specimen in August 1884.

Revised: 1993-09-20 (BKP)
1995-04-25 (DBI)
2003-08-29 (AMS)
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