

***Botrychium lineare* Population Status in Colorado:  
Clarifications and Suggested *Species Assessment* Update and Erratum  
April 12, 2004**

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**Summary**

This report clarifies current status of all known and suspected sites of *Botrychium lineare* W. H. Wagner (slender or narrowleaf moonwort or grapefern) (Ophioglossaceae) in the State of Colorado. It also updates and corrects an erroneous statement made in the most current U. S. Forest Service (USFS) *Species Assessment* report for the taxon, full citation:

Beatty, Brenda L., William F. Jennings, and Rebecca C. Rawlinson. November 12, 2003. *Botrychium ascendens* (trianglelobe moonwort) *Botrychium crenulatum* (scalloped moonwort) *Botrychium lineare* (narrowleaf moonwort): A Technical Conservation Assessment. Prepared for the USDA, Forest Service, Rocky Mountain Region, Species Conservation Project by CDM, Denver, Colorado. 64pp. Report posted at: <http://www.fs.fed.us/r2/projects/scp/assessments/botrychiums.pdf>.

There is general consensus among *Botrychium lineare* authorities and botanists in Colorado that, based upon our current, limited knowledge of above-ground presence and observations, *Botrychium lineare* is among the most rare vascular plants in the State. However, it is unclear how above-ground expression relates to below-ground presence or abundance. There is a paucity of reliable surveys for this plant in Colorado as well as range-wide, as it is quite difficult to survey and stems do not always appear above ground in a given year. It is possible that additional sites exist, and that the plant may be more common than currently perceived. It is appropriate to remember that “Moonworts, in their elusive way, have a habit of turning up...as apparently sporadic populations, but often, once recognized, field workers find that a given moonwort is more common and widespread than previously believed. Remember the situation with *Botrychium pallidum*, which is now being found over an enormous range” (Wagner and Wagner, 1998).

There are **between 1 and 4 extant sites in Colorado**, depending upon the reader’s preferences in considering if certain sites (California Gulch and Crater Creek) should be considered “historic” or extant, and if the Pikes Peak site(s) should be considered as a single site with two “subpopulations” or as 2 separate sites. Similarly, there are **between 1 and 4 historic sites**, most of which are deemed “historic” because no one has recently re-visited the sites and each site could, in fact, still be extant. Exact number of above-ground stems (“plants”) is unknown. Total number of estimated above-ground stems across all known sites in Colorado, based upon maximum observed expression or upper estimate at each site at that site’s peak year, is **about 60 stems**, 53 (88%) of which were observed in 1996 at the Pikes Peak monitoring site, by far the State’s largest (i.e., greatest number of stems) known site. The remaining number of estimated plants is derived from the collection sheets from the remaining other sites, and no estimates of the number of

plants *in situ* are stated. At most, only a few stems have been observed at each of these sites.

Some type and level of threat has been identified at each known site, but degree of realized threat is known only at the Pikes Peak monitoring site. This is possibly the most intensively monitored site for the species (Farrar, pers. comm., on site at Black Hills National Forest, May 2003). The Pikes Peak monitoring site (and possibly its nearby site) is being actively invaded by the aggressive Colorado noxious weed *Linaria vulgaris* (yellow toadflax), and monitoring efforts at the site sometimes crush *B. lineare* stems (see references under the site information). Although the monitored site has exhibited a decrease in stems over time, the site does not seem to be in imminent danger of extirpation (based upon monitoring data and general consensus among Steve Popovich, Steve Olson, and Steve Tapia). Nonetheless, these impacts to the site and the observed decrease in stem number are serious cause for concern, and efforts to address the concern are underway by the Pike-San Isabel National Forests' Botanist. Plants have not been observed recently at the nearby site (in part because no one has recently looked), and the habitat there seems to be maintained, except for possible but unconfirmed *Linaria* weed invasion. It is unknown if all other sites are in imminent danger of extirpation. Most are *perhaps* secure, but this is speculation in the absence of confirmation visits, and plants may have been harmed or habitat adversely altered for at least one site (California Gulch).

There are 3 possible additional unconfirmed sites, 2 of which (Mt. Evans Road Tollbooth and Colorado Highway 91 near Copper Mountain) seem to be fairly highly probable as to correct identification. There are collections from those 2 sites, but they have not been conclusively verified as *B. lineare*. Root and Hauk have not recently observed plants at these sites, despite repeated efforts.

It is obvious that revisits to all extant, historic, and unconfirmed sites should be attempted if possible to ascertain current status and threats.

I recommend that this report be referenced in conjunction with the recent USFS *Species Assessment* for arriving at determinations of current status of *B. lineare* in Colorado.

### **Information Gathering Efforts**

I reviewed the entire hard-copy *Botrychium* species' files and electronic data and all reports available at the Colorado Natural Heritage Program (CNHP) Office in Fort Collins on Feb. 9 and 10, and March 23, 2004. I also reviewed the United States Fish and Wildlife Service (USFWS) document entitled *Candidate and Listing Priority Assignment Form for B. lineare*, current as of Jan. 31, 2002 (USFWS 2002a). In January, February, and March, 2004, I contacted by phone or email (or both) the following 26 individuals regarding their knowledge of *B. lineare* population occurrences in Colorado. They are grouped into the following order: taxon authority and Colorado field experience, *Species Assessment* author, USFWS staff, USFS staff, NPS staff, Colorado Natural Heritage Program staff, herbaria staff, Denver Botanic Garden staff, and other knowledgeable individuals.

#### Individuals contacted:

Donald Farrar, Iowa State University, Ames, Iowa  
Peter Root, Denver, Colorado  
Warren Hauk, Denison University, Granville, Ohio  
Toby Spribille, University of Goettingen, Goettingen, Germany  
Rebecca Rawlinson, CDM, Denver; co-author of the species assessment cited above  
Gina Glenne, USFWS, Lead Field Office Contact, Snake River Basin Office, Boise, ID  
Ellen Mayo, USFWS, Botanist/Plant Ecologist, Grand Junction, Colorado  
Andy Kratz, USFS, R2 Regional Botanist, RO, Denver, Colorado  
Barry Johnston, USFS, Botanist, GMUG NFS, Gunnison, Colorado  
Steve Olson, USFS, Forest Botanist, PSI NFS and CC NGS, Pueblo, Colorado  
John Proctor, USFS, Forest Botanist, MBR NFS and TB NG, Walden, Colorado  
Jeff Redders, USFS, Ecologist, SJ NF, Durango, Colorado  
Kathy Roche, USFS, Ecologist, MBR NFS and TB NG, Laramie, Wyoming  
Deanna Reyher, USFS, Forest Soil Scientist/Ecologist/Botanist, BLKH NF, Custer, South Dakota  
Steve Tapia, USFS, Wildlife Biologist, Pike NF and Manitou Resident Manager, RMRS, Manitou Experimental Forest, Woodland Park, Colorado  
Bev Baker, USFS, Wildlife Biologist, AR NFS and P NG, Boulder, Colorado  
Nancy Redner, USFS, Seasonal Employee, WR NF, Dillon, Colorado  
Jeff Connor, USDI-NPS, Natural Resources Specialist, Rocky Mountain National Park, Estes Park, Colorado  
Dave Anderson, Botany Team Leader/Botanist, Colorado Natural Heritage Program, Fort Collins, Colorado (visited in person)  
Jill Handwerk, Botany Information Manager, Colorado Natural Heritage Program, Fort Collins, Colorado (visited in person)  
Tim Hogan, Collections Manager, University of Colorado Museum Herbarium (COLO), University of Colorado, Boulder, Colorado  
B.E. Nelson, Herbarium Manager, Rocky Mountain Herbarium (RM), University of Wyoming, Laramie, Wyoming  
Jennifer Ackerfield, Collections Manager, Colorado State University Herbarium (CS), Colorado State University, Fort Collins, Colorado  
Tom Grant, Manager, Conservation/Research, Denver Botanic Gardens, Denver, Colorado  
George Cameron, Pikes Peak Community College, Colorado Springs, Colorado  
Kit Buell, Habitat Concepts, Inc., Yampa, Colorado

#### **Results**

The following are my conclusions based upon the best available data I reviewed. I have only reviewed plant collections available at CU (Herbarium COLO) (Table 1). I plan on reviewing all other available plant collections in fall, 2004, and updating this report as appropriate; their label data likely would yield additional useful information. Neither the herbaria at Colorado State University (Herbarium CS) nor the University of Wyoming (Herbarium RM) contained any *B. lineare* collections from Colorado (Jennifer Ackerfield and B.E. Nelson, respectively, pers. comms., 3/25/2004). The people listed in the

*Information Gathering Efforts* section above were given the opportunity to review this report and all comments have been incorporated. Time formally tracked associated with this report's information gathering and write-up was approximately 68 hours.

One important update for the species relative to its ally *B. campestre* across Colorado and beyond is that Donald Farrar now feels that (Farrar email dated 3/4/2004):

Given 1) the morphological variability among the *B. lineare* plants I have examined, including the new finds in the Black Hills, the Yukon, and Alaska, and 2) the fact that I still have not genetically confirmed a *B. campestre* within the Rocky Mountains, **I am inclined to treat all Rocky Mountain plants as *B. lineare* unless proven otherwise.** With the range and variability of *B. lineare* now exceeding that of *B. campestre*, I am thinking that *B. lineare* may be the ancestral and *B. campestre* the derived species in this close species relationship, *B. campestre* having differentiated in the plains with the retreat of Pleistocene glaciers and adaptation to the prairie habitat and climate. This is wild speculation, but it does place a different perspective on the situation.

Peter Root also agrees that material in the mountains of Colorado should probably best be referred to as *B. lineare* unless evidence proves otherwise, and that *B. campestre* appears in Colorado to be restricted to the lower-elevation prairies (Root, pers. com., Feb. 2004). This concept revises or at least brings into question the identification of one Colorado site, Mt. Evans Road Tollbooth, currently identified as *B. campestre*, possibly revising the identification to *B. lineare*. For this report, therefore, I refer to the Mt. Evans Road Tollbooth site as an "unconfirmed possible" *B. lineare* site (page 8).

## **Extant *Botrychium lineare* sites in Colorado**

**Pikes Peak monitoring site, El Paso County, ownership: Pike National Forest.** CNHP Element Occurrence (EO) 003. 3.1 road-miles up toll road from toll booth. First observation: July 1987 (not 1988 as cited in CNHP EO 003 and in Root, undated), by Warren Hauk (Hauk emails dated 3/24/2004 and 3/25/2004). Most recent observation and plant monitoring: summer 2003 (Cameron, 2003), by G. Cameron, S. Olson, S. Tapia, S. Popovich, K. Carsey (AR NFS) and others. Plant numbers at site: 1988 – 45 above-ground stems (hereafter referred to as "plants"), from "intensive search in entire area"; 1989 – 1 plant, from "casual observation"; 1990 – no data; 1991 – 12 plants, from "casual observation"; 1992 through 1994 – no data; 1995 – 24 plants, "plants tagged and monitoring plot boundaries established, but entire plot not surveyed"; 1996 monitoring – 53 plants, first year of consistent, repeatable monitoring via census in fixed-area plot (Carpenter, 1996a,b); 1997 monitoring – no data?; it is unclear if data were recorded (Cameron 2003 report states plants were counted "every year from 1995 to 2001," but see Cameron email dated 2/20/2004); 1998 monitoring – 40 plants; 1999 monitoring – 44 plants; 2000 monitoring – 30 plants; 2001 monitoring – 36 plants; 2002 – no data (not monitored); 2003 monitoring – 20 plants. Habitat: relatively undisturbed grassy meadow streamside corridor near pine and into aspen. Elevation: Ca. 9,000 feet. Specimens: Peter Root 89-9 (no longer at COLO); Warren Hauk 507 (apparently collected in 1987,

not 1988 or 1989, see Hauk email dated 3/24/2004); “45 individuals of *B. lineare*” cited as collected by Warren Hauk in 1988 (Carpenter, 1996a) apparently refers (?) to the 1987 collection; “mid-July 1989 Warren D. Hauk s.n. (MICH)” referenced in Wagner and Wagner (1994) is perhaps an erroneous citation, as Hauk does not know of this collection or collection year, see Hauk email dated 3/24/2004. Hauk has made trips to this Pikes Peak site in 1987, 1993, 1998, and 2003; he does not recall visiting Colorado in 1989 (Hauk email dated 3/24/2004).

Threats: possible destructive impacts (trampling and crushing) from monitoring; realized recent invasion of noxious weed *Linaria vulgaris* (yellow toadflax). Two *B. lineare* individuals were observed by Popovich to be crushed by trampling during 2003 monitoring; sporophore and trophophore of one such plant was cut by Popovich at ground level and forwarded while fresh to Donald Farrar for line drawings and possible DNA testing. Warren Hauk (Hauk email 3/2/2004) also observed some trampling from 2003 monitoring efforts in his visit in summer 2003. Steve Tapia planned but did not initiate weed treatment. Revision of the monitoring technique planned for summer 2004 to avoid impacts to plants is being discussed. A nearby wooden utility (telephone) pole used as a permanent witness post for the monitoring plot (referenced in Carpenter, 1996a; Cameron, 1995) has been mysteriously recently removed, indicating possible disturbance could have occurred near but probably not within the occupied site (Steve Tapia, pers. comm. on site during inspection of occupied site and utility pole location, July 2003).

Note: Largest (i.e., greatest number of plants) site in Colorado and among the larger extant sites for the species; possibly the only site intensively monitored for the species (Donald Farrar, pers. comm. on BLKH NF during field trip, May 2003). Relatively less-disturbed site compared to other sites across species' range.

**Pikes Peak site adjacent to above monitored site, El Paso County, ownership: Pike National Forest.** CNHP EO 004. 2.1 road-miles up toll road from toll booth, about 1 road-mile away from (below) the above site. First observation: June 29, 1996, (possibly 1995?) by ?. Most recent observation: July 7, 1998, by Warren Hauk and Kim Fayette. Number of plants in 1998 – 2, “more plants expected but did not find any in an intensive search of area.” No prior record of number of plants. Habitat: small clearing in ponderosa pine stand, base of grassy slope, with much litter and pine needles, forb cover 50%, litter/moss cover 50%. Elevation: ca. 8,700 feet (label data), ca. 8,560 feet (CNHP EO 001). Specimens: Peter Root 95-1 (June 29, 1996) (COLO) (Table 1).

Threats: none perceived, although *Linaria* (species not indicated) has been reported to occur nearby along the roadway.

Note: The above two sites are “sub-EO’s” 003 and 004 lumped as one Element Occurrence (EO 001) with Colorado Natural Heritage Program (i.e., CNHP EO 001 is lumped occurrence of sub EO’s 003 and 004). Steve Tapia feels the sites may best be treated as separate due to distance and difference in site attributes (Tapia email dated 3/25/2004).

**California Gulch, Lake County, ownership: private.** CNHP EO 005. 1.6 miles SE of Leadville, south side of upper California Gulch. Only observation: August 11, 1992, by Laurel H. Pye. Failed to detect plants when re-surveyed in summer of 2000 (USFWS 2002a). Number of plants: Known from a single annotated (8/2000 by Kolb and Spribille) collection, Pye 09 (August 11, 1992) (COLO), containing 2 plants (Kolb and Spribille 2000 *in* USFWS 2002a). “Believed to have not been observed since 1992, and **could be considered historic** in that sense” (Peter Root, pers. comm., Feb. 2004, and Root email dated 2/4/2004). Habitat: disturbed sagebrush steppe. Elevation: ca. 10,460 feet.

Threats: “Someone, perhaps Andy Kratz, told me the Leadville site had been destroyed. I think that a bicycle trail was built up California Gulch. I think that the moonwort may still be there and whoever has looked for it wasn't aware of its short growing season” (Peter Root, pers. comm., Feb. 2004). “I think someone told me once that the site may be near a disturbance site or bicycle path and may have been impacted, but I can't remember” (Andy Kratz, pers. comm., Feb. 2004). “The *B. lineare* site in Lake County, Colorado (near Leadville) is apparently located within a Superfund site. This site is **currently threatened** [emphasis added] by activities and associated disturbance related to the construction of a concrete conduit. An asphalt bike path constructed through the upper portion of the site was completed in July 2000, and major construction and excavation to install the concrete conduit was observed in August 2000. Although other *Botrychium* species, including *B. lunaria* and *B. minganense*, were found at this site, no *B. lineare* plants were observed despite intensive surveys conducted in August 2000 (T. Spribille, in litt. 2000)” (USFWS 2002a). Redner thinks “the population is no longer viable” (Redner email dated 3/27/2004).

**Crater Creek, Grand County, ownership: Rocky Mountain National Park.** CNHP EO: no data on file. “Crater Creek, 0.5 mile below rim of Crater, 13 mi. north of Grand Lake [from label data].” “This is on the west side of Specimen Mountain. It isn't very far from the Colorado River trailhead” (Peter Root, pers. comm., Feb. 2004). Only observation: July 27, 1961, by John and Margaret Douglass. Known only from John and Margaret Douglass annotated collection 61-384 (July 27, 1961) (COLO) (Table 1). “Site has probably not been visited since original documentation and **could be considered historic** in that sense” (Peter Root and Jeff Connor, pers. comms., Feb. 2004, and Root email dated 2/4/2004). Number of plants: no data. Habitat: no data. Elevation: “The Crater is a cirque on the west side of Specimen Mountain and if by the rim they meant the top edge of the cirque the elevation is about 10,400 feet” (Root email 2/22/2004).

Threats: possibly trampling from hikers (Jeff Connor, pers. comm., Feb. 2004).

Note: Peter Root (pers. comm., Feb. 2004) feels specimens at this site as well as the California Gulch site above **could possibly be interpreted morphologically as “skinny” *B. minganense*** in the absence of DNA testing /electrophoresis.

## Historic *Botrychium lineare* sites in Colorado

**Arapaho Moraine, Boulder County, ownership: presumed Roosevelt National Forest.** CNHP EO 002. East slope of Arapaho Moraine, 1 mile south of University [CU] Camp. Only observation: August 15, 1947, by W.A. Weber. Number of plants: A few individuals, known only from annotations of certain duplicate sheets of mixed collections by Weber (W.A. Weber 3431 at KANU) collected August 15, 1947 (Peter Root, pers. comm., Feb. 2004). Exploration of potential habitat in nearby areas in cursory survey by Popovich and Baker, summer 2003, failed to detect plants. Exact location of Weber site(s) is unknown and no attempt was made to relocate sites. Habitat: Based on field inspection by Popovich and Baker in summer 2003, presumed to be meadows or forest edges near aspen and conifer. “Gravelly, poor drained soil [label data].” Area exhibits very similar habitats to known Pikes Peak sites. Elevation: ca. 2900m (9,500 feet).

Threats: no data. Field inspection in summer 2003 by Popovich and Baker revealed that various localized disturbances from human use (e.g., roadway re-routes, new power corridors and telephone poles, new outbuildings) have occurred in area since 1947. No noxious weeds cursorily observed in areas of greatest potential habitats.

Note: this site has two collections by Weber that are located in the same general area (exact distance between collections is unknown), so this site has **sometimes been treated as two separate sites** by previous authors. The ARP NFG and CNHP consider this one site.

Also, as previously discussed, in addition to the Arapaho moraine site(s) above, **readers could consider the California Gulch and Crater Creek presumed extant sites as historic** due to the fact that they have not been relocated in numerous years (either failed to relocate in revisit or re-visitation has not been attempted).

## Unconfirmed possible *Botrychium lineare* sites in Colorado

**Colorado Highway 91 near Copper Mountain, Summit County, ownership: presumed White River National Forest.** CNHP EO: no data on file. 1.9 road-miles south of Interstate 70, on CO HWY 91. Only observation: July 9, 1987, by Warren Hauk. Failed to relocate more plants in his visits in summers ca. 1993 and 1998 (Hauk email dated 3/2/2004). “I think that I told Rick Thompson about this [site] and he went to look without results” (Root email dated 2/22/2004). Number of plants: 1, known from a single collection Hauk made July 9, 1987, Hauk 512a (Denison University Herbarium, Grangeville, Ohio). The specimen has not been reviewed by Wagner or Farrar (Hauk email dated 3/2/2004) or Root (Root, pers. comm., Feb. 2004), but Hauk feels confident that the identification is valid (Hauk email dated 3/2/2004) and Root alludes to it being an additional site of *B. lineare* (Root email dated 2/22/2004). Farrar feels it is better to spend time looking for more plants than to subject the specimen to DNA testing (Farrar email dated 3/4/2004). Habitat: Gentle slope underneath large power lines, soil rocky and moist with grasses and herbs, with other species of *Botrychium* (*B. lanceolatum*, *B.*

*echo*, *B. hesperium*, *B. minganense*?) (Hauk email dated 3/2/2004). Hauk has a digitized image of the site. B. Johnston (pers. comm., March 2004) believes the power line may date to the 1940's. Elevation: no data (9,000-10,000 feet?).

Threats at time of observation: not assessed.

**Mt. Evans Road Tollbooth, Clear Creek County, ownership: City of Denver.** CNHP EO: no EO as *B. lineare*, but the site data is captured in an EO of a possible misidentification as another *Botrychium*, the EO for the "Echo Lake" location of *B. campestre*. The *B. campestre* EO should be revised to reflect updated identification information (see Peter Root's comment below and Donald Farrar's email dated 3/4/2004). "Ca. 10 to 150 meters up road from the Mt. Evans USFS tollbooth, along road shoulder ditch along north side of road, before the sharp road bend" (Peter Root, pers. comm., Feb. 2004). Note: This road corridor area, from the USFS tollbooth uphill along the road to past the first sharp bend, is technically City of Denver property. The ownership becomes USFS after the first bend in the road, at an East-West property line. Only observation: summer ca. 1990, by Peter Root. Failed to re-locate in summer 2003 during USFS/Peter Root training site visit using intensive survey. Number of plants: 1. Peter Root identified this plant as *B. campestre*, but recently decided it should be considered "Most likely to be *B. lineare*, based upon elevation. *Botrychium campestre* appears restricted to the prairie in our area. There may be a difference in thickness of midrib between *B. campestre* and *B. lineare*, but I cannot reliably make this distinction for the Echo Lake plant" (Peter Root, pers. comm., Feb. 2004). A leaf fragment collected by Ron Abbott (CNHP temporary employee) has been retained by Peter but has not been subjected to electrophoresis: perhaps this should be done (but Farrar feels it is better to spend time looking for more plants; Farrar email dated 3/4/2004). Farrar also states in the 3/4/2004 email that "**I am inclined to treat all Rocky Mountain plants as *B. lineare* unless proven otherwise.**" Habitat: disturbed roadside ditch, open, at forest edge, with various understory species, willows nearby. Elevation: Ca. 10,700-10,750 feet.

Threats: "The drainageway appears changed hydrologically somehow this last summer as compared to my observation in 1990, perhaps water has been diverted uphill of the site?" (Peter Root, pers. comm., Feb. 2004).

**Nolan Lake Trailhead, Eagle County, ownership: White River National Forest.** CNHP EO: no data on file. At the Nolan Lake Trailhead (trail no. 646) on the White River NF, southeast of Eagle, near town site of Fulford, T06S, R83W, Sec24. Only observation: summer 1995, by Kathy Roche. Number of plants: 1. Kathy Roche (Roche email dated 1/29/2004) observed a single stem in 1995 that she could not identify at the time (the species may not have appeared in keys yet) and material was not collected. She believes it had the appearance of *B. lineare* and feels "60-70% confident" that it could be the species (Kathy Roche, pers. comm., Feb. 2004). She feels she may have a paper trail of this information or could re-locate the general area. It may be worth surveying this area. This information was mentioned to Andy Kratz in 1995 in passing, but was not raised since then and was NOT considered in the recent *Species Assessment* report, so it is not a source of that report's error (Kathy Roche, pers. comm., Feb. 2004). Habitat:

spruce-fir forest, in disturbed roadside bank next to mine site, with grasses, sedges, and strawberry or *Sibbaldia*. Elevation: ca. 9,900 feet.

Threats at time of observation: recreational use, potential mine rehabilitation, soil slipping.

### **Summary of known Colorado *Botrychium lineare* sites (excluding the three unconfirmed possible sites)**

**Number of total extant sites in Colorado:** 4 if considering the Pikes Peak sites as separate sites and the California Gulch and Crater Creek sites as still extant; 3 if considering the Pikes Peak sites as one site with 2 subpopulations and the California Gulch and Crater Creek sites as still extant; only 1 extant site if considering the Pikes Peak sites as one site with two subpopulations and the California Gulch and Crater Creek sites as historic.

**Number of total historic sites in Colorado:** 1, if considering the Arapaho Moraine site as one site with two subpopulations and the California Gulch and Crater Creek sites as extant; 2 if considering the Arapaho Moraine site as 2 sites and the California Gulch and Crater Creek sites as extant sites; 3 if considering the Arapaho Moraine site as one site and the California Gulch and Crater Creek sites as historic rather than extant; 4 if considering the Arapaho Moraine site as 2 sites and the California Gulch and Crater Creek sites as historic.

Note: The USFS' *Species Assessment* report (Beatty et al, 2003) treats the Pikes Peak site as two separate sites (not two subpopulations of one site) and the historic Arapaho Moraine site as two separate sites as well. It also treats both the California Gulch site and Crater Creek site as historic, not extant.

The USFWS' *Candidate and Listing Priority Assessment Form* of Jan 21, 2002 (USFWS, 2002a) treats Colorado as having 3 extant sites: the two at Pikes Peak and the one at California Gulch. The Boulder site(s) is considered historic, and the Rocky Mountain National Park site at Crater Creek is not discussed.

**Hence, there is a need for authors to clarify their assumptions when arriving at number of extant and historic sites!**

### **Correction to an error of fact in the USFS *Species Assessment* report, and updated information for *B. lineare* in Region 2**

The USFWS' *Candidate and Listing Priority Assessment Form* of Jan 21, 2002 (USFWS, 2002a) seems correct in its statements relating to Colorado populations, except that it fails to mention the Rocky Mountain National Park Crater Creek site (error of omission).

However, there is an error of fact in the USFS' *Species Assessment* report entitled *Botrychium ascendens* (trianglelobe moonwort) *Botrychium crenulatum* (scalloped moonwort) *Botrychium lineare* (narrowleaf moonwort): *A Technical Conservation*

*Assessment* (Beatty et al, 2003). The error of fact has been confirmed by the contractor (Robbert-Paul Smit email dated 2/19/2004).

The erroneous statement appearing on page 32 is tracked throughout the report, and is as follows:

**“*Botrychium lineare* occurs...at one occurrence near Leadville in White River National Forest (Lake County) [Colorado]....”**

Currently, there are no known sites on the White River National Forest. This was probably simply an erroneous reference to the California Gulch site near Leadville on private property (Rebecca Rawlinson, pers. comm., Feb. 2004).

Both Hauk and Roche have, however, provided information of other possible unconfirmed sites for *B. lineare* that occur or potentially occur within the White River National Forest (the CO HWY 91 site near Copper Mountain and the Nolan Lake Trailhead site, discussed above). It is possible, therefore, that there are indeed extant sites on the White River National Forest.

Additionally, there is an **important update** to the *Species Assessment*. There is a recently verified site of *B. lineare* occurring on the Black Hills National Forest, in Wyoming (USFS, 2003c). The site contains 3 plants, first observed on June 19, 2003, and is located in “An old vegetative native surface roadbed beside the drainage bottom. *Symphoricarpus* shrubs are starting to become established in the road. The actual roadbed is very open and sunny. The lower slopes above the bottom are dominated by *Betula papyrifera* and *Quercus macrocarpa* with occasional *Pinus ponderosa*, with a thick shrub layer of *Corylus cornuta*. Weedy species such as *Trifolium* and *Taraxacum* are present at the site” (USFS, 2003c). The fairly intensive survey failed to locate more plants. There may be other *Botrychium* species at the site. Elevation: 4880-4920 feet. Slope: 0-10% Aspect: N. Threats: Grazing and weeds? One- to two-year-old cattle feces and faint cow paths were found on-site, and “grazing occurs in the area but not at the time of the survey.” Weeds of concern were found nearby but not in the site. There was no recent vehicle use on the old roadbed.

Plant material from this site was not confirmed by Donald Farrar as *B. lineare* until December 11, 2003 (USFS, 2003c), which is one month after the *Species Assessment* final report date of November 12, 2003. No mention of the site as a possible unconfirmed *B. lineare* site appears in the report. To my knowledge, this is the only confirmed site of *B. lineare* occurring on land administered by the U.S. Forest Service in Region 2 that is not in Colorado.

I recommend an **erratum** be generated for the *Species Assessment* report to correct the erroneous statement regarding reference to a site on the White River National Forest, as well as generating an **update** to the report to reflect the recent *B. lineare* Black Hills, Wyoming site in Region 2.

### **Other *Botrychium* species sites in Rocky Mountain National Park**

This section is added as additional useful information to document other *Botrychium* sites in the Park and is based upon recent conversations with Jeff Connor, Rocky Mountain National Park. The species present include *B. lunaria*, *B. lanceolatum*, *B. hesperium*, *B. echo*, and possibly other species. Peter Root may or may not know of additional sites in the Park. I will research this in full this fall.

#### **Lulu City, Grand County, ownership: Rocky Mountain National Park, NPS.**

CNHP EO: not assessed. Species: not assessed. The following information is from Jeff Connor (pers. comm., Feb. 2004). “On trail above Lulu City [town site].” Only observation: known from a single plant collection from 1962, Margaret Douglass 62-43, deposited at COLO or in the Park Herbarium. Site has not been revisited, **and could be considered historic**. Number of plants: no data. Habitat: no data, possibly historically disturbed. Elevation: no data, at least as high as Lulu City (ca. 9,350 feet).

Threats: no data, possibly trampling from hikers.

#### **Sundance Burn, Larimer County, ownership: Rocky Mountain National Park, NPS.**

CNHP EO: not assessed. Species: not assessed. The following information is from Jeff Connor (pers. comm., Feb. 2004). “Sundance burn, below Trail Ridge Road.” “Incomplete UTM: 4430 44723.” Only observation: known from a single plant collection from 1972, Robert Peet 2488 (COLO) (Table 1). Site has not been revisited, **and could be considered historic**. Number of plants: no data. Habitat: presumed to be historically disturbed, in old (ca. 1920’s?) Sundance Burn, in probably what is referred to as “Hanging Valley,” which is downhill from where the fire crossed Trail Ridge. Elevation: ca. 11,000 feet.

Threats: low visitor use in area, but perhaps some elk trampling?

#### **Old Hidden Valley Ski Area, Larimer County, ownership: Rocky Mountain**

**National Park, NPS.** CNHP EO: not assessed. Species: not assessed. The following information is from Jeff Connor (pers. comm., Feb. 2004) and Tom Grant email dated 3/28/2004. “On previously-disturbed shoulder edge, south side of old paved parking lot, decommissioned Hidden Valley Ski Area.” First observation: 1987 by Peter Root. Last observation: summer, 2003 by Peter Root and Jeff Connor. There is a collection in the Park Herbarium, park catalog number 07485. Number of plants: 3 or 4 total plants observed in 2003; mixed species at site (*B. lanceolatum*, *B. hesperium*, *B. echo*, each verified by Root), not recorded how many were each species. Habitat: historically disturbed soil, shoulder edge of old parking lot, with (“probably”) *Bromus inermis*, native re-vegetation. Elevation: ca. 9,400 feet.

Threats: on-going Park Service decommissioning work to restore parking area to vegetation; occupied site is flagged off and avoided during construction; possible trampling from hikers.

## Recommended Full Citation for this Report

Popovich, Steve J. 2004. *Botrychium lineare* Population Status in Colorado: Clarifications and Suggested Species Assessment Update and Erratum. Unsolicited report prepared for the Arapaho-Roosevelt National Forests and Pawnee National Grassland, Supervisor's Office, Fort Collins, Colorado. 45pp. Report dated April 12, 2004. Original on file with Forest Botanist, Arapaho-Roosevelt National Forests and Pawnee National Grassland, Supervisor's Office, Fort Collins, with copy on file with Colorado Natural Heritage Program, Fort Collins, Colorado.

## Literature Cited (\*\*) and Selected Materials Reviewed for this Report

Many (ca. 50) *Botrychium* reports and references on file at CNHP were reviewed which do not appear below, either because they did not contain references to *B. lineare* or the references were not relevant to this report. The below references were most helpful in determining *B. lineare* status in Colorado or are listed to indicate that they have been reviewed.

Associated Press. Undated. *Rare Plant [B. lineare] Wont Get Protection by Wildlife Service* [USFWS]. News release.

\*\*Beatty, Brenda L., William F. Jennings, and Rebecca C. Rawlinson. 2003. *Botrychium ascendens* (trainglelobe moonwort) *Botrychium crenulatum* (scalloped moonwort) *Botrychium lineare* (narrowleaf moonwort): A Technical Conservation Assessment. Prepared for the USDA, Forest Service, Rocky Mountain Region, Species Conservation Project by CDM, Denver, Colorado. Report on file with Colorado Natural Heritage Program, Fort Collins, and with Forest Botanist, Arapaho-Roosevelt National Forest and Pawnee National Grassland, Supervisor's Office; posted at: <http://www.fs.fed.us/r2/projects/scp/assessments/botrychiums.pdf>.

\*\*Cameron, George. 1995. *Field Notes, Botrychium Lineare Monitoring, July 10, 1995*. Report prepared for Alan Carpenter, The Nature Conservancy.

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\*\*Carpenter, Alan. 1996a. *Monitoring Plan for the Rare Fern, Botrychium Lineare, on the Pikes Peak Ranger District, Pike-San Isabel National Forest, El Paso County, Colorado*, and attached Memorandum. Report prepared by The Nature Conservancy, Boulder, Colorado. Dated May 24.

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**Table 1. Collections of *B. lineare* at CU (COLO).**

**All *Botrychium lineare* W. H. Wagner collections at CU Boulder (Herbarium COLO), current as of March 25, 2004.**

**Verified current by Popovich personal communication with Tim Hogan, Collections Manager, March 25, 2004.**

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**OPHIOGLOSSACEAE (OPH)**

***Botrychium lineare* W. H. Wagner**

**Accession No:** 459562    **Elevation:** 8700 ft.

**Location:** El Paso County, Colorado, USA. Base of grassy slope, Pikes Peak Highway ca. 2 mi W of Cascade.

**Habitat:** Base of grassy slope.

**Collector:** Peter Root #95-1.

**Date:** 29 June 1996.

**Miscellaneous:** Reproductive Status: Spore.

**Annotations:**

---

**OPHIOGLOSSACEAE (OPH)**

***Botrychium lineare* W. H. Wagner**

**Accession No:** 386891    **Elevation:** 10720 ft.

**Location:** Grand County, Colorado, USA. Crater Creek, ½ mi. below rim of "Crater", 13 mi. N of Grand Lake.

**Habitat:** Mud slope below talus of bare surface exposed to sun.

**Collector:** John & Margaret Douglass #61-384.

**Date:** 27 July 1961.

**Miscellaneous:** Original ID: *Botrychium matricariaefolium hesperium* Max. & Claus. Reproductive Status: Spore.

**Annotations:** *Botrychium echo* W.H. Wagner det. by W.A. Weber, 1985. *Botrychium lineare* W. H. Wagner det. by A. Kolb & T. Spribille, 2000.

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**OPHIOGLOSSACEAE (OPH)**

***Botrychium lineare* W. H. Wagner**

**Accession No:** 451170    **Elevation:** 10640 ft.

**Location:** Lake County, Colorado, USA. 1.6 miles southeast of Leadville, on south side of upper California Gulch.

**Habitat:** Disturbed sagebrush.

**Collector:** Laurel H. Pye #9.

**Date:** 11 August 1992.

**Miscellaneous:** Original ID: *Botrychium minganense*. Reproductive Status: Spore.

**Annotations:** *Botrychium lineare* W. H. Wagner det. by A. Kolb & T. Spribille, 2000.

## **Tracking of Popovich Email Correspondences to Support Clarifications and Erratum.**

Phone calls were not tracked but are referenced as “pers. comm.” in the report if their information is not supported by the below emails. Correspondences are in order by date, most recent dates first.

**To: Steve Popovich**  
**From: George Cameron**  
**4/8/2004**

Reply from Steve Popovich 4/8/2004:

Hi George,

Thanks for the comments. I'll make the edits. -Steve

-----  
Original message follows:

Steve,

Sorry for the delay in answering.

I have some comments on the *Botrychium* report of 3/31/04. On page 3, my affiliation is with Pikes Peak Community College, not Colorado College. Page 5 refers to a report with my name for 1995. Should that be Alan Carpenter? I counted that year, but turned my data over to Alan. Page 12 refers to the utility pole originally designated as a landmark, with my July 10, 1995 field notes as a reference. On that day I took Judy Sellers to the site to photograph plants found in the June 29 survey. We found a few more; I marked them and sent a report to Alan. The utility pole had already been chosen as a landmark for the June 29 survey. I don't recall being involved in the choice of landmarks.

Thank you for the information about the *Cypripedium* monitoring workshops. The level 2 session sounds worthwhile, although the dates might be a problem. The unit of counting is critical to clarify before the next monitoring in Emerald Valley (scheduled for June 24).

George

**To: Steve Popovich**  
**From: Donald Farrar**  
**4/1/2004**

Steve,

I looked it over quickly and saw no problems. I'll try to read it in detail this weekend. If you don't hear from me soon, assume it is ok with me.

Don

At 04:36 PM 3/31/2004, Steve Popovich wrote:

>Hi Don,

>

>I've received and incorporated comments from Root, Spribille, and Hauk on this report and wanted to forward it one last time to you for your review as you are referenced several times. This report is done if you have no comments. I'll assume it looks OK to you if I don't hear back by April 12.

>

>-Steve

>

>(See attached file: Botrychium\_lineare\_Colo\_update3-2004.doc)

**To: Steve Popovich**  
**From: Tom Grant**  
**3/28/2004**

Hello Steve,

I read the first 10 pages of the report. It does an excellent job summarizing and clarifying the information available for *B. lineare*. I have a little more information concerning the ROMO sites. In ROMO's working herbarium (separate from the Museum's archival collection), we have submitted three collections from Hidden Valley Ski Area (*B. lanceolatum*, *B. hesperium*, *B. echo*). These three collections were all identified/verified by Peter Root in late 1999 or early 2000. Please contact me if you need any additional information or clarification.

See ya later and thanks again for all the help with the cheatgrass/fire study in Boulder,

Thomas A. Grant III  
Manager of Research Programs  
Denver Botanic Gardens  
720 865-3562  
720 865-3683 fax  
[grantt@botanicgardens.org](mailto:grantt@botanicgardens.org)

>>> From Steve J Popovich <sjpopovich@fs.fed.us> 3/26/2004 12:12:11 PM >>>

As your name appears in the list of people I contacted, and as the report states they all had an opportunity to review (primarily intended for the taxon authorities consulted as part of this effort), I am forwarding this on to you in case you choose to peruse and comment. If so, I'll need comments by next Thursday, April 1.

Thanks to all of you for your herbarium and DBG database help with this the other day.

-Steve

**To: Steve Popovich**  
**From: Nancy Redner**  
**3/27/2004**

Steve,

I was with Toby and Annette the day we searched for the *Botrychium lineare*, in Leadville. At this site they have put a bike path through the area, and we never found *Botrychium lineare* that day. The record was down at CU in the Herbarium. So I don't know if we were at the site at the wrong time of the growing season. I thought I had found *Botrychium* up Peru Creek in Summit County, but since there was only one plant at the time I never got a specimen and that was the summer of 2001. I only knew of the Pike's Peak site and Leadville site, [the latter site at] which I think the population is no longer viable.

This could be a plant that should be considered at least threatened by federal guidelines. I've looked at over 25,000 individual *Botrychium* plants of about 8 species, I have yet to find *B. lineare* and confirm a population. It is a very puzzling plant. It is far more illusive than *Eutrema penlandii*. Hope this helps.

Kit Buell could live in Walden and that's all I have. Rick Thompson of Western Ecosystems, Inc. at 303 442-6144 in Boulder probably keeps in contact with him.

-----Original Message-----

From: Steve J Popovich [mailto:sjpopovich@fs.fed.us]  
Sent: Thursday, March 25, 2004 3:48 PM  
To: redners@colorado.net  
Subject: Botrychium lineare Colo. status report

Nancy,

Here is there report I'd like you to look over if you can. This all stemmed from an error in a recent USFS species assessment for *B. lineare* and I took it on to review all Colorado sites. You're the last one to review along with Kit Buell. By the way, do you have his email or phone? I called him once but lost his Yampa, CO contact info.

Thanks,

Steve

(See attached file: Botrychium\_lineare\_at\_COLO\_3-2004.doc)

**To: Steve Popovich**  
**From: Peter Root**  
**3/25/2004**

Yes Peter, regarding the Twin Sisters RMNP *Botrychium* (non-lineare) sp. site in my report page 9, you were right, it is not *Botrychium*. Tom Grant (DBG) today told me Jeff Connor may have simply called up the wrong species record, it is indeed *Aquilegia saximontana*, not *Botrychium*. He clarified that there were no *Botrychium* species of any kind observed anywhere near the site. I will take it out of the report. The other 3 sites in RMNP for other *Botrychium* species seem correct. Thanks for the important edit!

-Steve

\*\*\*\*\*

Steve J. Popovich, Botanist  
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Arapaho-Roosevelt National Forests & Pawnee National Grassland  
240 W. Prospect  
Fort Collins, CO 80526 USA

Phone 970.498.2732 FAX 970.498.1212  
email <sjpopovich@fs.fed.us>

\*\*\*\*\*

Steve,

The only information I have seen on Kit Buell is in the Breckenridge report you handed out last July. I haven't met him.

I would be glad to do a training day at Echo Lake in July. I hope we will have some rain by then and I would like to look at some of the wetter sites for *B. crenulatum*. If we train enough people some of them will go out and make new moonwort discoveries.

I was interested to see you mention the Twin Sisters area in RMNP as a moonwort site. Today I spoke with Tom Grant at DBG and he checked his field notes. The only thing in his notes with 100-200 plants was *Aquilegia saximontana*. He doesn't remember seeing moonworts there and his notes don't mention them. Lulu City is not far from Crater Creek and as a mining town site should have moonworts. I have my field notes from 1987 when I found several moonwort sites in the park.

I think that some day we will find *B. crenulatum*, *B. ascendens*, and *B. montanum* in Colorado.

Peter Root

**To: Steve Popovich**  
**From: Steve Tapia**  
**3/25/2004**

It all makes sense Steve, a HUGE thank you on the Pikes Peak site, it was something I've been meaning to do for a long time now. I personally think the EO003 and E004 sites should be listed separately. They are far enough apart (3.1 road- miles and 2.1 road-miles respectively), and in slightly different habitat types (aspen-grassy toeslope and ponderosa pine-grassy slope respectively) that I think merits separate citations and tracking. On your Pikes Peak extant site write-up (page 3), do you have the actual survey datasheets for 1995 through 2003? I would sure like to get copies for our District records. Did you get the count numbers from George Cameron?  
ST

Original message from Steve Popovich:

Please review what you can and let me know if you want edits. Roche and Tapia, your names appear a couple times for the Pikes Peak site and Nolan Lake site, make sure it makes sense to you.

-Steve

**To: Steve Popovich**  
**From: Warren Hauk**  
**3/25/2004**

Steve,

Yes, the year I found the population was 1987. And one small detail in the draft you sent. My school is located in Granville, OH, not Grangeville.

cheers,

Warren

On Thursday, March 25, 2004, at 11:47 AM, Steve J Popovich wrote:

> Warren,

>

> Your helpful email reply dated 3/24/2004 has raised another question. I hope this will be the last one! In that email you state that your first visit to the Pikes Peak B. lineare site was July 1987. Peter Root (*A Survey of Possible Additional Populations of the Narrow Leaf Moonwort on Pikes Peak, Order Number 43-82BH-8-0096*, undated) and Colo Heritage Program list the visit date as July, 1988, not 1987. Root states "In July 1988 Warren Hauk who was then at the University of Kansas stopped on the Pikes Peak Highway to look for moonworts in a sloping meadow about four miles west of Cascade."

>

> I assume your indication as July, 1987 is correct and we should adjust the Heritage database to reflect the year as 1987?

>

> -Steve

**To: Steve Popovich**  
**From: Kathy Roche**  
**3/24/2004**

I read this through and think its great! I have no problems with what you did with the info I provided. I'm impressed with the time and effort you put in on it and am glad to see that it is done. We really struggled with this species in our forest plan effort because there was a lot of confusion.

I think the report needs a spell check and capitalization check before going public. KR

Kathy Roche, Ecologist  
R2 Medicine Bow Routt NFs - Thunder Basin NG  
2468 Jackson Street, Laramie, WY 82070  
(307) 745-2419 FAX (307) 745-2398

Kathy Roche/R2/USDAFS@FSNotes or  
kroche@fs.fed.us

Original message from Steve Popovich:

Please review what you can and let me know if you want edits. Roche and Tapia, your names appear a couple times for the Pikes Peak site and Nolan Lake site, make sure it makes sense to you.

-Steve

**To: Steve Popovich**  
**From: Warren Hauk**  
**3/24/2004**

Hey Steve,

That is an error. He is referring to the Pike's Peak monitoring site. I did find moonworts at the Independence Pass site, but none of *B. lineare*. I'm certain there was *B. manganense*, and likely *B. lunaria*, perhaps *B. lanceolatum*. Hmm, as for the s.n. collection from 1989, wow that is a tough one. I really don't recall going to Colorado in 1989, but I'm not certain about that. I did check my voucher list and I have no collections from CO in 1989. He may be referring to the original 1987 collection which should have the number 507. Let me just tell you the story of how all of this happened.

In spring of 1987 I went to MI to meet with Herb and Florence and learn about moonworts. We collected in Grand Sable Dunes and I learned the MI species. In July of that year I went out to Colorado to collect specimens for my research with a grad school friend. The first site I headed for was an old old collection site that simply listed "on the road to Pike's Peak". Once we got there I found out that the road to Pike's Peak is about 40 miles long, so we had no idea where to look. Based on the MI fieldwork with Herb and Florence, we just drove along the road and I spotted that grassy site. We looked, found some moonworts, but I had no idea what species they were. I collected them, took them back to the lab and ran isozymes on them hoping I would figure out what they were. Two years later as I was writing my thesis, I was even more perplexed by the Pike's Peak population and spoke with Herb about it. He was astounded and said that they sounded like dead ringers for a new species he was describing from Oregon or someplace out west. When I returned to school I mailed the specimens to Herb, but the package was destroyed by the postal service.

What I can't recall is whether I got back to Colorado that summer of 1989 or whether it was my 1993 collections that Herb verified as *B. lineare*. Perhaps the best thing to do would be to contact Florence at MI and see if she can find the s.n. collection. Sorry about this, but I can only clearly recall trips to the Pike's Peak site in 1987, 1993, 1998, and 2003.

I hope this helps at least a little bit,

Warren

On Tuesday, March 23, 2004, at 05:28 PM, Steve J Popovich wrote:

> Warren,  
>  
> In trying to finish up the status report for *B. lineare* in Colorado, I ran into a confusing narrative in Wagner and Wagner 1994, Another widely disjunct..... (American Fern Journal 84(1). Top of page 8 states that a site is located at : "El Paso Co., road to Independence Pass, Route 82 W from Twin Peaks, Pikes Peak, difficult to see in knee-high grass, 2700m, mid-July 1989 Warren D. Hauk s.n. (MICH)"  
>

> My question is, where is this site? Were they referring to the Pikes  
> Peak monitoring site? Did you collect at the Pikes Peak site in 1989  
with an s.n. collection? Is it still at MICH? That all seems to fit  
the site description.

>

> But then, my question is, what is this "**road to Independence Pass,**  
> **Route 82 W from Twin Peaks**" phrase referring to? Is this a different  
site no-one seems to know about? The site at Pikes Peak is on a  
private toll road, no where near the cited Route 82 W or Twin Peaks,  
and in El Paso county, while Route 82 is in Lake County, pretty far  
away from Pikes Peak. Is this phrase just an error? No-one at  
Heritage Program here knows what that phrase was referring to.

>

> I hope to get this report done soon so we can all use it; this is the  
> last remaining loose end before I send it out for people to review.

>

> -Steve

>

>

> \*\*\*\*\*

> Steve J. Popovich, Botanist

> U.S. Forest Service

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> 240 W. Prospect

>

> Fort Collins, CO 80526 USA

>

> Phone 970.498.2732 FAX 970.498.1212

> email <sjpopovich@fs.fed.us>

> \*\*\*\*\*

>

**To: Steve Popovich**  
**From: Toby Spribille**  
**3/23/2004**

Hi Steve,

My affiliation is the University of Goettingen (Germany). The report looks like it is thorough.

Best, Toby

-----  
>  
> All,  
>  
> Please review what you have time for, especially related to your  
> email citations, attached Hauk, Root and Farrar emails are cited  
> several times. I will make edits based on any comments you provide and  
> redistribute. I hope this will be helpful for our local Forest Service  
> botanists trying to assess Colorado sites; there has been confusion for  
> them in the past.  
>  
> -Steve  
>  
> Toby, what is your current location and affiliation?  
>

**To: Steve Popovich**  
**From: Donald Farrar**  
**3/4/2004**

Steve

Given 1) the morphological variability among the *B. lineare* plants I have examined, including the new finds in the Black Hills, the Yukon, and Alaska, and 2) the fact that I still have not genetically confirmed a *B. campestre* within the Rocky Mountains, I am inclined to treat all Rocky Mountain plants as *B. lineare* unless proven otherwise. With the range and variability of *B. lineare* now exceeding that of *B. campestre*, I am thinking that *B. lineare* may be the ancestral and *B. campestre* the derived species in this close species relationship, *B. campestre* having differentiated in the plains with the retreat of Pleistocene glaciers and adaptation to the prairie habitat and climate. This is wild speculation, but it does place a different perspective on the situation.

This is Warren's call, but I doubt that DNA sequencing would convincingly differentiate the species even if you could get good material from the dried plants. I would rather see the effort spent in trying to relocate these populations.

Don

At 05:23 PM 3/2/2004, Steve J Popovich wrote:

>Hi Guys,

>

>Well Warren Hauk has just confirmed with me that he does have a collection from 1987 (Hauk 512a) of a single specimen of what he is convinced is *B. lineare* from near Copper Mountain on HWY 91, tried twice since then to relocate more but failed. He said you two have not seen the specimen which he has retained. Also, Jeff Conner in Rocky Mtn Nat. Park just told me he has 5 verified *lineare* sites in the Park, so the total verified sites in Colorado is now around 10, counting the historic Weber site out of Boulder.

>

>As I'm wrapping up the status report for Colorado sites, a question to you >two is: What shall we call the "*B. campestre*?" sites at Cameron Pass west of Ft Collins and at Echo Lake? Peter has already indicated that the specimen from Echo Lake should perhaps best be regarded as *B. lineare* based upon elevation and that no electrophoresis has been done on a fragment he still has. Don, what do you think, consider it *B. lineare*, or is it worth it to try DNA on it? What about the Cameron Pass site? Perhaps the same thing, or do you two feel confident that that site should be retained as *B. campestre* for now?

>

>-Steve

**To: Steve Popovich**  
**From: Peter Root**  
**3/3/2004**

Steve,

I think that Jeff Connor meant that he knew of five moonwort sites in the park. As far as I know there are no known occurrences of lineare in the park. Cameron Pass is a B. pallidum site and it was first found there by Jim Montgomery in 1984. Since then the parking lot has been enlarged and some of the plants are under pavement. Pallidum comes up late there in early August. I last saw it there in August of 1990. In 1999 Don Farrar, Angelique, and I went there but didn't find any pallidum.

The RMNP herbarium has been put away as a museum item like a holy relic. They have a working collection which was put together by people from DBG. They collected only trophophores from moonworts. I remember seeing an unusual one but it was not lineare. If anyone has found lineare in the park I would like to see specimens and have location data.

Peter Root

**To: Steve Popovich**  
**From: Warren Hauk**  
**3/2/2004**

Steve,

The collection number is Hauk #512a. The specimen is not yet deposited in an herbarium collection, but just say it is in the Denison University Herbarium, Granville, OH 43023. One sheet only, with a single specimen. Neither Wagner nor Farrar have seen this specimen. I didn't even know I had it until a few years ago when I was looking over my CO collections and saw it among some B. echos I had from that site.

As for the mileage, it was a ways away from the intersection and I tried to fastidiously measure the distance (as well as you can with a Honda). The site was directly underneath the power lines, I don't recall where they crossed the road. There is a fairly steep climb up to the site from the road, maybe 10-15 feet up. This was clearly a site with significant disturbance in the past. I attributed the decline in the population over the 10 years after the original collection to encroachment by woody and other plants. Almost every site I have seen moonworts at in CO has had a history of fairly recent disturbance (except the Pike's Peak site, but that habitat has remained remarkably constant over the last 15 years - it looks virtually identical to how it looked when I first found the site).

I have renamed the file and attached it below.

This next year I will be on sabbatical, and I had hoped to get out to CO to do more fieldwork both summer of 2004 and 2005. I would love to get out and look for more moonworts, so let me know if there are any possibilities. I have never met Peter Root, and coordinating with him or Farrar would also be great.

I'll take a pic of the specimen and send it along soon. I hope you can open the habitat pic file.

Glad to be of help.

Warren



48.jpg

**To: Steve Popovich**  
**From: Warren Hauk**  
**3/2/2004**

Steve,

I apologize, I did get the earlier email, but have been sidetracked by a million things. Thanks for the reminder. I have the specimen in question, and I did collect it from the Copper Mountain site on highway 91. I am certain it was *B. lineare*. I actually have a digitized image of the site that I will attach to this email. I found one plant there on July 9, 1987. Site info is:

Summit Co., 1.9 miles S of I-70 on CO 91, gentle slope underneath large power lines, soil rocky and moist with grasses, herbs

I have been back to this site twice since then (in ca. 1993 and 1998), and have located no more specimens of *B. lineare*. I think it was a fluke actually. The other species I found at that site (*B. lanceolatum*, *B. echo*, *B. hesperium*, *B. manganense*?) have also declined in numbers over the years, so I think the possibility of this being a viable site for *B. lineare* is very, very slim.

Just last summer I visited the El Paso Co.(?) site for *B. lineare* outside of Colorado Springs (they looked great and I noticed that someone is monitoring the population - and in the process trampled a few plants!). I collected *B. lineare* at both El Paso and Summit Co sites in 1987 and had no idea what they were at that time. It wasn't until a couple of years later when I showed them to Herb Wagner that I found out they represented a new species he was in the process of describing.

Does this information help? If not, please let me know if I can help further.

Warren



#48.jpg

On Tuesday, March 2, 2004, at 10:34 AM, Steve J Popovich wrote:

> Not sure if you got this message first time around....  
> ----- Forwarded by Steve J Popovich/R2/USDAFS on 03/02/2004 08:33 AM  
>  
> Steve J Popovich  
>To: [Hauk@cc.denison.edu](mailto:Hauk@cc.denison.edu) 02/23/2004 10:11  
> cc: Beth A Burkhart/R2/USDAFS@FSNOTES  
> Subject: Another Colorado Botrychium lineare site?  
>  
>  
> Dear Warren,  
>

> I am preparing a short report attempting to give a current overview of B. lineare sites in Colorado. Can you substantiate the below info > regarding your possible find of Botrychium lineare near Copper Mountain? Is there a collection? Has it been verified? Is there a reference report? I have reviewed the Nov 2001 tech report for Copper Mountain Resort in which the B. lineare discussion states you may have found a plant on HWY 91 but a latter survey failed to detect its presence. Is that still the current situation? Should I reference that site as a "possible unconfirmed site" or how do you feel? If you feel this should be maintained as a "possible" site, what are the general site attributes -- county, disturbance, forest type, number of plants seen and when, perceived threats? Colo Heritage Program has no info on this.

> I would greatly appreciate any clarifying info you have, this is the > last site not yet reviewed.

>  
> -Steve  
>  
> \*\*\*\*\*

> Steve J. Popovich, Botanist  
> U.S. Forest Service  
> Arapaho-Roosevelt National Forests & Pawnee National Grassland  
> 240 W. Prospect  
>  
> Fort Collins, CO 80526 USA  
>  
> Phone 970.498.2732 FAX 970.498.1212  
> email <sjpopovich@fs.fed.us>  
> \*\*\*\*\*

> ----- Forwarded by Steve J Popovich/R2/USDAFS on 02/23/2004 09:55 AM  
> -----

>  
> From: Rootp75930@aol.com  
> To: [sjpopovich@fs.fed.us](mailto:sjpopovich@fs.fed.us) 02/22/2004 02:10 PM  
> Subject: Another B. lineare site

>  
> Steve,  
>  
> The information I have on the specimen from Grand County is Grand Co:  
> Crater Creek, 1/2 mile below rim of Crater, 13 mi north of Grand Lake.  
> 27 July 1961, John and Margaret Douglass 61- 394 The Crater is a cirque  
> on the west side of Specimen Mountain and if by the rim they meant the  
> top edge of the cirque the elevation is about 10,400 feet. To reach  
> Jeff Connor at RMNP try (970) 586- 1296.

>  
> When I went through your lineare update I realized that there is one  
> more lineare site in Colorado. After I did some work at Copper  
> Mountain in 2000 I went to the botanical meetings in Portland OR. I met  
> Warren Hauk and he told me that he had found one plant of lineare down  
> the road from Copper Mountain where a power line crosses the highway. I  
> think that I told Rick Thompson about this and he went to look without  
> results. My maps show Copper Mountain on the Arapaho NF but I have  
> noticed that when Channel 4 turns on their camera there they say it is  
> in the White River NF. Warren Hauk's e-mail is Hauk@cc.denison.edu

>  
> Peter Root

**To: Steve Popovich**  
**From: Peter Root**  
**2/22/2004**

Steve,

The information I have on the specimen from Grand County is Grand Co: Crater Creek, 1/2 mile below rim of Crater, 13 mi north of Grand Lake. 27 July 1961, John and Margaret Douglass 61-394

The Crater is a cirque on the west side of Specimen Mountain and if by the rim they meant the top edge of the cirque the elevation is about 10,400 feet. To reach Jeff Connor at RMNP try (970) 586- 1296.

When I went through your lineare update I realized that there is one more lineare site in Colorado. After I did some work at Copper Mountain in 2000 I went to the botanical meetings in Portland OR. I met Warren Hauk and he told me that he had found one plant of lineare down the road from Copper Mountain where a power line crosses the highway. I think that I told Rick Thompson about this and he went to look without results. My maps show Copper Mountain in the Arapaho NF but I have noticed that when Channel 4 turns on their camera there they say it is in the White River NF. Warren Hauk's e-mal is [Hauk@cc.denison.edu](mailto:Hauk@cc.denison.edu)

Peter Root

**To: Steve Popovich**  
**From: George Cameron**  
**2/20/2004**

Steve,

I'm pleased to know that the *Cypripedium* and *Botrychium* reports are useful.

I have no data on *Botrychium* before 1999. I thought we did annual surveys after 1995, but my personal records show no mention of a survey in 1997. Unless other data surfaces, I will edit the report to show no survey that year.

I've attached an edited version of the *Cypripedium* report. One item I left alone was about the unit of counting. I need clarification about the meanings of stem and cluster.



George *Cypripedium* project, 2003.d

**To: Beth Burkhart**  
**From: Robbert-Paul Smit**  
**2/19/2004**

Beth

Steve Popovich with the USFS has pointed out an erroneous statement we had in the *Botrychium lineare* assessment report. We had stated on pg.23 that a population of *Botrychium lineare* existed on White River National Forest. This was erroneous, there is no *Botrychium lineare* population on White River National Forest, and no new population was found (as some people may interpret). There is a population near Leadville, and the sentence should have read "one population near Leadville on private land".

Our information source regarding this population near Leadville was forwarded to us by Andy Kratz, and it was misinterpreted. Steve Popovich is pressing for an errata letter from us; however I believe that if this is needed, the direction should come from you or Joy. Hopefully you could make this change to the *Botrychium lineare* publications, with the final report having been accepted by the USFS.

Thanks

Please let me know if you have any concerns or questions.

**CDM**

Robbert-Paul Smit  
Project Manager and Environmental Chemist  
Tel: 720 264-1108 Fax: 303 295-1895



**To: Steve Popovich**  
**From: Toby Spribille**  
**2/12/2004**

Hi Steve,

I also have no information on a White River site; the only site I am aware of in that area is just south of Leadville, and we were unable to locate the plants there in 2000. You may also be interested to know that there is a potential *B. ascendens* site in Rocky Mtn. National Park, on the west site. I examined the specimen at COLO and like with many *B. ascendens* specimens, it is not unambiguous, but very likely. Thought you might want to know, since this is +- your territory. I may have the label data in my files.

All the best,  
Toby

-----  
> Mr. Spribille,  
>  
> Can you provide any insight to this?  
>  
> -Steve  
>  
> \*\*\*\*\*  
> Steve J. Popovich, Botanist  
> U.S. Forest Service  
> Arapaho-Roosevelt National Forests & Pawnee National Grassland  
> 240 W. Prospect  
>  
> Fort Collins, CO 80526 USA  
>  
> Phone 970.498.2732 FAX 970.498.1212  
> email <sjpopovich@fs.fed.us>  
> \*\*\*\*\*  
  
> ----- Forwarded by Steve J Popovich/R2/USDAFS on 02/11/2004 04:59 PM  
> From: Don Farrar  
> -----  
  
> Steve  
>  
> No, I do not have any information on a White River location. If you  
> want to check out the Leadville site, Toby Spribille's e-mail is  
> <tspribi@gwdg.de>.  
>  
> There is also a Boulder Co. Arapahoe moraine (1947) collection cited  
> by Wagner and Wagner in 1994 that has not been relocated.  
>  
> You might also check with Edna Rey-Visgirdas who first compiled the  
> *B. lineare* occurrence data.  
>  
> Don

**To: Steve Popovich**  
**From: Donald Farrar**  
**2/11/2004**

Steve

No, I do not have any information on a White River location. If you want to check out the Leadville site, Toby Spribille's e-mail is <tspribi@gwdg.de>.

There is also a Boulder Co. Arapahoe moraine (1947) collection cited by Wagner and Wagner in 1994 that has not been relocated.

You might also check with Edna Rey-Visgirdas who first compiled the B. lineare occurrence data.

Don

At 01:41 PM 2/11/2004, Steve Popovich wrote:

>Don,  
>  
>Are you aware of a historic or extant site of B. lineare on the White River Nat. Forest in Colorado? This is cited in the Nov 2003 species assessment by Beatty et al. No one here knows anything about it, including Peter Root. and the Heritage Program Perhaps the report meant the site near Leadville which has a collection from ca. 1992 and is on private? Or perhaps you have been annotating material on that Forest?  
>  
>If you also do not know, I will then contact the authors and ask them, but I told them I would ask you first.  
>  
>-Steve  
>  
>  
>\*\*\*\*\*  
>Steve J. Popovich, Botanist  
>U.S. Forest Service  
>Arapaho-Roosevelt National Forests & Pawnee National Grassland  
>240 W. Prospect  
>  
>Fort Collins, CO 80526 USA  
>  
>Phone 970.498.2732 FAX 970.498.1212  
>email <sjpopovich@fs.fed.us>  
>\*\*\*\*\*

**To: Steve Popovich**  
**From: Jeff Redders**  
**2/5/2004**

Hi Steve, I don't have any info on this. The site is not on the San Juan.

\*\*\*\*\*

Jeff Redders, San Juan Forest, 15 Burnett Ct, Durango, CO 81301  
jredders@fs.fed.us, 970-247-4874

Hi Jeff and Steve,

I'm trying to clarify info on the B. lineare sites in Colo. Are you the "familiar ones" with the history of the site near Leadville? If not, which USFS person is? I am seeking clarification on:

1) Is the site on San Isabel or White River NF? Page 23 of the current species assessment says "One occurrence near Leadville in White River National Forest" -- is that correct? Could you give me a rough legal or direction from a town?

2) What is the status of the plants on the site? I have heard "historic, not seen in recent years" as well as "extant." If historic, is it because we can't find the exact site or because we know where the plants were but they have not been observed recently. When was the last time they were observed and how many plants.

I would appreciate any clarification you can provide to compare to other sources.

-Steve

\*\*\*\*\*

Steve J. Popovich, Botanist  
U.S. Forest Service  
Arapaho-Roosevelt National Forests & Pawnee National Grassland  
240 W. Prospect  
Fort Collins, CO 80526 USA

Phone 970.498.2732 FAX 970.498.1212  
email <sjpopovich@fs.fed.us>

\*\*\*\*\*

**To: Steve Popovich**  
**From: Peter Root**  
**2/4/2004**

Steve:

The Leadville and RMNP sites are probably considered historic because noone has found the moonwort there again. Someone-perhaps Andy Kratz told me the Leadville site had been destroyed. I think that a bicycle trail was built up California Gulch. I think that the moonwort may still be there and whoever has looked for it wasn't aware of its short growing season. The RMNP site is on Crater Creek on the west side of Specimen Mountain. It isn't very far from the Colorado River trailhead. I don't know if anyone at the park knows about it. Jeff Connor would be a good person to contact at the park. I think that I have his phone number and will look for it.

Peter Root

**To: Steve Popovich**  
**From: Steve Olson**  
**2/4/2004**

It's about a mile from the Forest boundary on non-USA land, and therefore didn't appear on the state heritage database for the Forest. It's one of those records that we are "aware" of, but hasn't been a priority. There is, however (with further digging through the files), a map highlighting areas to look for this species. Among the recommendations are a few areas 3-6 miles north of Leadville on the Forest. I'll need to talk to Barb M. about how some of the other areas to search were selected.

Steve Olson  
Botanist  
Pike and San Isabel National Forests  
Comanche and Cimarron National Grasslands  
2840 Kachina Drive  
Pueblo, CO 81008  
719-553-1519  
solson01@fs.fed.us

-----  
To: Steve Olson  
From: Steve Popovich

Well, 1.6 miles SE of leadville isnt even on Forest Service land is it? Are you considering this site on your forest?

-Steve

\*\*\*\*\*

Steve J. Popovich, Botanist  
U.S. Forest Service  
Arapaho-Roosevelt National Forests & Pawnee National Grassland  
240 W. Prospect  
Fort Collins, CO 80526 USA

Phone 970.498.2732 FAX 970.498.1212  
email <sjpopovich@fs.fed.us>

-----  
**To: Steve Popovich**  
**From: Steve Olson**  
**2/4/2004**

Here is the available information that I have concerning the Leadville Botrychium lineare site: In a March 20, 2002, phone call between Barb Masinton (PSICC botanist, at that time) and Tim Hogan, herbarium curator, University of Colorado, Tim provided the following label information -

"Lake County; 1.6 miles southeast Leadville; on south side of Upper California Gulch; 10,460 feet; disturbed [sic] sagebrush; August 11, 1992; annotated by T. Spribille and A. Colb August 2000."

Steve Olson  
Botanist  
Pike and San Isabel National Forests

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2840 Kachina Drive  
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719-553-1519  
[solson01@fs.fed.us](mailto:solson01@fs.fed.us)

---

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I would appreciate any clarification you can provide to compare to other sources.

-Steve

\*\*\*\*\*

Steve J. Popovich, Botanist  
U.S. Forest Service  
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Phone 970.498.2732 FAX 970.498.1212  
email <[sjpopovich@fs.fed.us](mailto:sjpopovich@fs.fed.us)>

\*\*\*\*\*

**To: Steve Popovich**  
**From: Steve Olson**  
**2/4/2004**

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Steve Olson  
Botanist  
Pike and San Isabel National Forests  
Comanche and Cimarron National Grasslands  
2840 Kachina Drive  
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719-553-1519  
solson01@fs.fed.us

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I would appreciate any clarification you can provide to compare to other sources.

-Steve

\*\*\*\*\*

Steve J. Popovich, Botanist  
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240 W. Prospect  
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Phone 970.498.2732 FAX 970.498.1212  
email <sjpopovich@fs.fed.us>

\*\*\*\*\*

**To: Steve Popovich**  
**From: Steve Olson**  
**1/29/2004**

To add to the information, here is this years' monitoring results from the larger Pikes Peak toll road population. It appears that this is the only population that has a history of regular monitoring. As far as I know the smaller population from a mile or so down hill from this site has not been observed since 1998. I haven't heard if anybody has looked, but I will be there this season. Anybody care to join the fun?

steve



Botrychium lineare 2003.d

Steve Olson  
Botanist  
Pike and San Isabel National Forests  
Comanche and Cimarron National Grasslands  
2840 Kachina Drive  
Pueblo, CO 81008  
719-553-1519  
solson01@fs.fed.us

-----  
**Forwarded from: Kathy Roche**  
**To: Steve Olson**  
**1/29/2004**

This is what I have in my records:

From: Botrychium ascendens (trianglelobe moonwort)  
Botrychium crenulatum (scalloped moonwort)  
Botrychium lineare (narrowleaf grapefern):  
A Technical Conservation Assessment

Prepared for the USDA, Forest Service,  
Rocky Mountain Region,  
Species Conservation Project  
November 12, 2003  
Brenda L. Beatty, William F. Jennings, and Rebecca C. Rawlinson  
CDM, 1331 17th Street, Suite 1100, Denver, Colorado 80202

There are only six documented occurrences of Botrychium lineare in Region 2. While the two populations on Pikes Peak (Pike-San Isabel National Forest) have been observed in the last five years, the other populations of B. lineare (i.e., Arapahoe-Roosevelt National Forest, White River National Forest, and Rocky Mountain National Park) have not been re-observed in recent years (P. Root personal communication 2002).

Just as an aside, I think I may have seen it at the Nolan Lake Trailhead on the WRNF in August 1995 -- one single stem, small (<2cm total height) one leaf blade, one sporophore blade. It was on a cut bank next to an old mine site. I tried to key it out at the time but it didn't fit any of the keys I had at the time. I described it at the time as a much reduced *B. simplex*. (Since this species was first described in 1994, it is no surprise that it wouldn't have been in any keys yet in 1995.) I have a couple of e-mail messages that document this description. I had just moved to the WRNF from the Umatilla NF in WA/OR where we had about 5 different botrychiums that we were tracking --so was fairly familiar w/ botrychiums and keying them out at the time.

Kathy Roche, Ecologist  
R2 Medicine Bow Routt NFs - Thunder Basin NG  
2468 Jackson Street, Laramie, WY 82070  
(307) 745-2419 FAX (307) 745-2398

Kathy Roche/R2/USDAFS@FSNotes or  
kroche@fs.fed.us

**Forwarded from Deanna Reyher to Kathy Roche**

**To: Deanna Reyher**  
**From: Steve Popovich**  
**1/29/2004**

Deanna,

I have reviewed the R2 species assessment for *B. lineare*. I will call Peter Root to verify, but my take on the *B. lineare* discussion on page 23 is that the 2 occurrences mapped on ARP in Boulder County in Fig. 6 are 1) both historic, and we have looked cursorily and failed to relocate them, and 2) actually the 2 collections are from within a few thousand feet of each other, so we consider this as "one site" for management concerns. Also, I believe the Grand County Rocky Mtn Nat. Park site is historic as well. To my knowledge, there are only 3 EXTANT sites in Colorado: 2 very close together at Pikes Peak, PSICC, El Paso County, and one near Leadville, White River NF, Lake County).

I will double check all of this and let the botany contacts know for sure so everyone is clear on status of this plant in Colorado.

-Steve

\*\*\*\*\*

Steve J. Popovich, Botanist  
U.S. Forest Service  
Arapaho-Roosevelt National Forests & Pawnee National Grassland  
240 W. Prospect  
Fort Collins, CO 80526 USA

Phone 970.498.2732 FAX 970.498.1212  
email <sjpopovich@fs.fed.us>

.....  
**--END STEVE POPOVICH BOTRYCHIMUM LINEARE APRIL 2004 REPORT--**