

**An Investigation of Bryophyte Diversity and Distribution on the Grand Canyon-Parashant
National Monument**

Final annual report

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Summary

The primary focus of this project was a baseline assessment of the bryophyte diversity on the Grand Canyon-Parashant National Monument (GCPNM). To this end collecting locations were preselected in order to maximize the potential number of species collected at each site. Additional sites were added to this list in order to cover the monument geographically as well as include as many of the major vegetation types as possible. A total of 47 sites (Fig. 1, appendix C) were visited and 679 voucher specimens were collected. The species that have been identified from these collections are listed in appendix A of this report.

While the monument mostly lacks the wet and humid environments usually associated with bryophytes, it offers a diverse array of geological substrates set in a varied topography. These habitats promote a high diversity of xeric-adapted species especially in the Pottiaceae and Grimmiaceae families (Fig. 2). The monument's location also allows a mixing of the Mojave Desert and Rocky Mountain floras, enhancing its diversity. The new information provided by these collections shows that the bryophyte diversity on the GCPNM has been seriously underestimated in the past. This checklist of 110 species represents a dramatic increase from the most recent survey of the monument (Newberry & Stark 2004) as well as that previously reported for all of Mohave County (Haring 1961). In addition, 23 taxa are apparently newly reported for the State of Arizona and our investigations have yielded three taxa that are still undescribed or new to science.

Careful taxonomic work in this region will continue to yield range extensions for well-known species and probably also species new to science. Taxonomic notes on specific problems are presented in appendix B of this report.

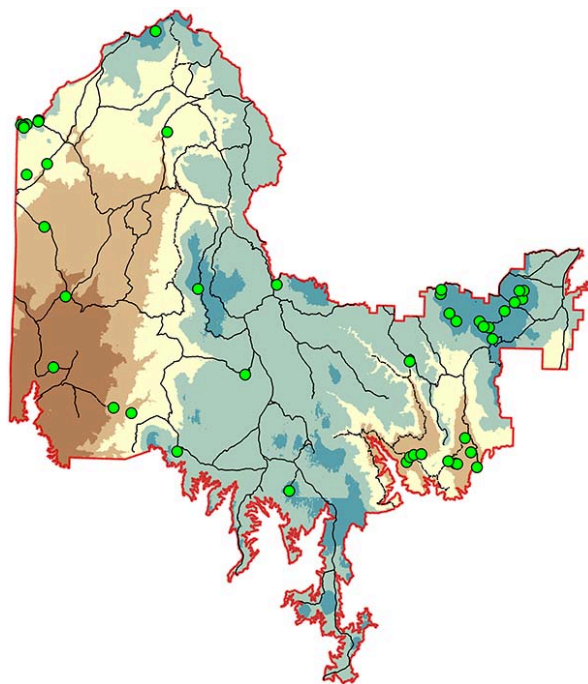


Figure 1. Map of bryophyte collecting sites on the Grand Canyon-Parashant National Monument.

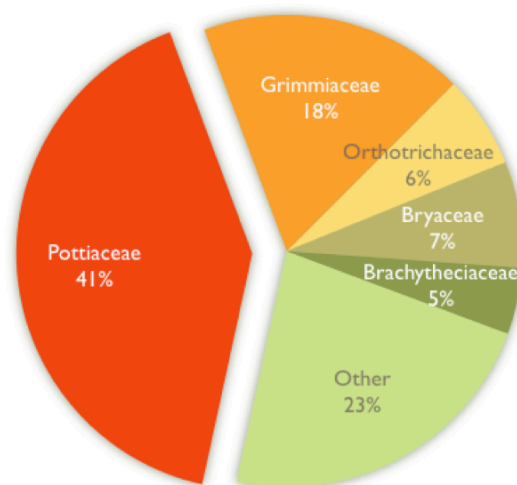


Figure 2. Distribution of the monument's bryophyte diversity among taxonomic families.

Previous Investigations

Past publications of bryophyte occurrences in the region have usually lacked the information necessary in order to pinpoint their location. Therefore prior to Newberry & Stark's (2004) report little was known regarding the bryophyte diversity on the monument. However, Haring (1961) reported 22 taxa for Mohave County:

Brachytheciastrum fendleri (Sull.) Ochyra & Żarnowiec [as *Brachythecium utahense* James]
Bryum argenteum Hedw.
Bryum lanatum (P. Beauv.) Brid. [as *Bryum argenteum* var. *lanatum* (P. Beauv.) Hampe]
Ceratodon purpureus (Hedw.) Brid. subsp. *purpureus*
Climacium americanum Brid.
Crossidium aberrans Holz. & E.B. Bartram
[as *Crossidium spatulaefolium* Holz. & E.B. Bartram]
Didymodon tophaceus (Brid.) Lisa
Dryptodon trichophyllus (Grev.) Brid. [as *Grimmia trichophylla* Grev.]
Eucladium verticillatum (Hedw.) Bruch & Schimp.
Funaria hygrometrica Hedw. var. *hygrometrica*
[also as *Funaria hygrometrica* var. *utahensis* Grout]
Grimmia calyptrata Drumm.
Grimmia decipiens (Schultz) Lindb.
Grimmia laevigata (Brid.) Brid.
Grimmia pulvinata (Hedw.) Sm.
Plagiomnium cuspidatum (Hedw.) T.J. Kop. [as *Mnium cuspidatum* Hedw.]
Platygyrium fuscoluteum Cardot
Pterygoneurum ovatum (Hedw.) Dixon
Rosulabryum capillare (Hedw.) J.R. Spence [as *Bryum capillare* Hedw.]
Schistidium apocarpum (Hedw.) Bruch & Schimp. [as *Grimmia apocarpa* Hedw.]
Syntrichia caninervis Mitt. var. *caninervis* [as *Tortula bistratosa* Flowers]
Syntrichia obtusissima (Müll. Hal.) R.H. Zander [as *Tortula obtusissima* (Müll. Hal.) Mitt.]
Syntrichia ruralis (Hedw.) F. Weber & D. Mohr var. *ruralis*
[as *Tortula ruralis* (Hedw.) P. Gaertn., B. Mey. & Scherb.]

To this list Newberry & Stark (2004) added the following 14 taxa* that they collected on the monument:

Brachytheciastrum collinum (Schleich. ex Müll. Hal.) Ignatov & Huttunen
[as *Brachythecium collinum* (Schleich. ex Müll. Hal.) Schimp.]
Eurhynchiastrum pulchellum (Hedw.) Ignatov & Huttunen var. *pulchellum*
[as *Eurhynchium pulchellum* (Hedw.) Jenn.]
Gemmabryum caespitium (Hedw.) J.R. Spence [as *Bryum caespitium* Hedw.]
Grimmia anodon Bruch & Schimp.
Grimmia montana Bruch & Schimp.
Grimmia orbicularis Bruch
Grimmia ovalis (Hedw.) Lindb.
Hedwigia nivalis (Müll. Hal.) Mitt.

Orthotrichum anomalum Hedw.
Orthotrichum hallii Sull. & Lesq.
Orthotrichum laevigatum J.E. Zetterst.
Orthotrichum rupestre Schleich. ex Schwägr.
Pseudoleskeella tectorum (Funck ex Brid.) Kindb. ex Broth.
Timmia bavarica Hessel.

*In addition *Amblystegium serpens*, *Desmatodon latifolius*, *Encalypta mutica*, *Grimmia tenerrima*, and *Orthotrichum tenellum* were reported in error (see excluded species, appendix A).

Current Research

After considering the two previous investigations cited above, the other 83 taxa reported in appendix A are apparently new for Mohave County. In addition, the following 23 taxa are apparently newly reported for the State of Arizona (Spence 2007, FNA 2007):

Anacolia menziesii (Turner) Paris var. *menziesii*
Anoetangium handelii Schiffner
Didymodon eckeliae R.H. Zander
Didymodon nevadensis R.H. Zander
Didymodon nicholsonii Culm.
Didymodon rigidulus var. *icmadophilus* (Schimp. ex Müll. Hal.) R.H. Zander
Dryptodon meridionalis (Müll. Hal.) Ochyra & Żarnowiec
Gemmabryum dichotomum (Hedw.) J.R. Spence & H.P. Ramsay
Gemmabryum kunzei (Hornsch.) J.R. Spence
Gemmabryum violaceum (Crumm. & Nyholm) J.R. Spence
Grimmia jamesii Austin
Gymnostomum viridulum Brid.
Homalothecium nevadense (Lesq.) Renauld & Cardot var. *nevadense*
Hymenoloma mulahaceni (Höhn.) Ochyra
Isothecium stoloniferum var. *cardotii* (Kindb.) Wijk & Margad.
Pottiopsis sweetii (E.B. Bartram) Ros & O. Werner
Pseudocrossidium obtusulum (Lindb.) H.A. Crum & L.E. Anderson
Rosulabryum flaccidum (Brid.) J.R. Spence
Schistidium cinclidodonteum (Müll. Hal.) B. Bremer
Schistidium lancifolium (Kindb.) H.H. Blom
Syntrichia calcicola J.J. Amann
Syntrichia laevipila Brid. var. *laevipila*
Syntrichia virescens (De Not.) Ochyra var. *virescens*

Finally, three undescribed species occur on the monument (see taxonomic notes in appendix B):

Targionia “*moj.*” A.T. Whittemore ined.
Schistidium “*squ.*” H.H. Blom ined.
Schistidium sp. nov. (Blom in litt.)

These findings are being prepared for publications in peer-reviewed journals and a forthcoming photographic field guide.

Appendix A: Bryophytes of the Grand Canyon-Parashant National Monument (110 taxa)

MARCHANTIOPHYTA Stotler & Crand.-Stotl. [4 Liverworts]

MARCHANTIALES Limpr. [2]

AYTONIACEAE Cavers [1]

Asterella californica (Hampe) Underw.

TARGIONIACEAE Dumort. [1]

Targionia hypophylla L. [see note #1]

RADULALES Stotler & Crand.-Stotl. [1]

RADULACEAE Müll. Frib. [1]

Radula complanata (L.) Dumort. subsp. *complanata*

JUBULALES W. Frey & M. Stech [1]

FRULLANIACEAE Lorch in G. Lindau [1]

Frullania inflata Gottsche

BRYOPHYTA Schimp. [106 Mosses]

TIMMIALES Ochyra [1]

TIMMIACEAE Schimp. [1]

Timmia bavarica Hessel.

ENCALYPTALES Dixon [2]

ENCALYPTACEAE Schimp. [2]

Encalypta intermedia Jur.

Encalypta vulgaris Hedw. var. *vulgaris*

FUNARIALES M. Fleisch. [2]

FUNARIACEAE Schwägr. [2]

Funaria hygrometrica Hedw. var. *hygrometrica*

Funaria muhlenbergii var. *lineata* Grout [see note #2]

GRIMMIALES M. Fleisch. [22]

PTYCHOMITRIACEAE Schimp. [2]

Jaffuelobryum raui (Austin) Thér.

Jaffuelobryum wrightii (Sull.) Thér.

GRIMMIACEAE Arn. [20]

Dryptodon meridionalis (Müll. Hal.) Ochyra & Żarnowiec [see note #3]

Dryptodon torquatus (Drumm.) Brid. [= *Grimmia torquata* Drumm.]

Grimmia alpestris (F. Weber & D. Mohr) Schleich.

Grimmia anodon Bruch & Schimp.

Grimmia calyptrata Drumm. [= *Coscinodon calyptratus* (Drumm.) C.E.O. Jensen]

Grimmia jamesii Austin [see note #4]

Grimmia laevigata (Brid.) Brid.

Grimmia longirostris Hook.

Grimmia montana Bruch & Schimp.

Grimmia moxleyi R.S. Williams

Grimmia orbicularis Bruch

Grimmia ovalis (Hedw.) Lindb.

Grimmia plagiopodia Hedw.

Grimmia poecilostoma Cardot & Sebillé

[*Grimmia crinitoleucophaea* Cardot, fide FNA 2007]

Grimmia pulvinata (Hedw.) Sm.
Schistidium ambiguum Sull.
Schistidium cinclidodonteum (Müll. Hal.) B. Bremer
Schistidium lancifolium (Kindb.) H.H. Blom
Schistidium “*squ.*” H.H. Blom ined. [see note #5]
Schistidium sp. nov. [see note #5]
 DICRANALES H. Philib. ex M. Fleisch. [50]
 FISSIDENTACEAE Schimp. [3]
Fissidens bryoides var. *pusillus* (Wilson) Pursell
Fissidens exiguus Sull. [see note #6]
Fissidens sublimbatus Grout
 RHABDOWEISACEAE Limpr. [1]
Hymenoloma mulahacenii (Höhn.) Ochyra [see note #7]
 CERATODONTACEAE Schimp. [1]
Ceratodon purpureus (Hedw.) Brid. subsp. *purpureus*
 POTTIACEAE Schimp. [45]
 TRICHOSTOMOIDEAE (Schimp.) Broth. [9]
Anoetangium handelii Schiffner
Gymnostomum aeruginosum Sm. var. *aeruginosum*
Gymnostomum calcareum Nees & Hornsch. var. *calcareum*
Gymnostomum viridulum Brid.
Pleurochaete luteola (Besch.) Thér.
Pottiopsis sweetii (E.B. Bartram) Ros & O. Werner
 [= *Trichostomum sweetii* (E.B. Bartram) L.R. Stark, see note #8]
Tortella alpicola Dixon
Weissia andrewsii E.B. Bartram [see note #9]
Weissia ligulaefolia (E.B. Bartram) Grout
 BARBULOIDEAE (Herzog) Hilp. [13]
Aloina ambigua (Bruch & Schimp.) Limpr.
 [= *Aloina aloides* var. *ambigua* (Bruch & Schimp.) E.J. Craig]
Aloina bifrons (De Not.) Delgad.
Barbula unguiculata Hedw.
Bryoerythrophyllum recurvirostrum (Hedw.) P.C. Chen var. *recurvirostrum*
Didymodon australasiae (Hook. & Grev.) R.H. Zander var. *australasiae*
Didymodon brachyphyllus (Sull.) R.H. Zander
Didymodon eckeliae R.H. Zander
Didymodon nevadensis R.H. Zander
Didymodon nicholsonii Culm.
Didymodon rigidulus var. *icmadophilus* (Schimp. ex Müll. Hal.) R.H. Zander
Didymodon tophaceus (Brid.) Lisa
Didymodon vinealis (Brid.) R.H. Zander var. *vinealis*
Pseudocrossidium obtusulum (Lindb.) H.A. Crum & L.E. Anderson
 POTTIOIDEAE Broth. [23]
Crossidium aberrans Holz. & E.B. Bartram
Crossidium crassinerve (De Not.) Jur. var. *crassinerve*
Crossidium seriatum H.A. Crum & Steere

Crossidium squamiferum var. *pottioideum* (De Not.) Mönk.
Crossidium squamiferum (Viv.) Jur. var. *squamiferum*
Desmatodon guepinii Bruch & Schimp. [= *Tortula guepinii* (Bruch & Schimp.) Broth.]
Microbryum starckeanum var. *brachyodus* (Bruch & Schimp.) R.H. Zander
Pachyneurum atrovirens (Sm.) J.J. Amann [= *Tortula atrovirens* (Sm.) Lindb.]
Phascum cuspidatum Hedw. var. *cuspidatum* [= *Tortula acaulon* (With.) R.H. Zander]
Pterygoneurum ovatum (Hedw.) Dixon
Pterygoneurum subsessile (Brid.) Jur. var. *subsessile*
Syntrichia calcicola J.J. Amann [see note #10]
Syntrichia caninervis Mitt. var. *caninervis*
Syntrichia laevipila Brid. var. *laevipila*
Syntrichia pagorum (Milde) J.J. Amann
Syntrichia papillosissima (Copp.) Loeske
Syntrichia princeps (De Not.) Mitt. var. *princeps*
Syntrichia ruralis (Hedw.) F. Weber & D. Mohr var. *ruralis*
Syntrichia virescens (De Not.) Ochyra var. *virescens* [see note #10]
Tortula brevipes (Lesq.) Broth.
Tortula inermis (Brid.) Mont.
Tortula mucronifolia Schwägr.
Tortula muralis Hedw. var. *muralis*
HEDWIGIALES Ochyra [1]
HEDWIGIACEAE Schimp. [1]
Hedwigia nivalis (Müll. Hal.) Mitt. [see note #11]
BARTRAMIALES D. Quandt, N.E. Bell & M. Stech [1]
BARTRAMIACEAE Schwägr. [1]
Anacolia menziesii (Turner) Paris var. *menziesii*
BRYALES Limpr. [8]
BRYACEAE Schwägr. [8, see note #12]
Bryum argenteum Hedw.
Bryum lanatum (P. Beauv.) Brid. [= *Bryum argenteum* var. *lanatum* (P. Beauv.) Hampe]
Gemmabryum dichotomum (Hedw.) J.R. Spence & H.P. Ramsay
[= *Bryum dichotomum* Hedw.]
Gemmabryum kunzei (Hornsch.) J.R. Spence [= *Bryum kunzei* Hornsch.]
Gemmabryum violaceum (Crundw. & Nyholm) J.R. Spence
[= *Bryum violaceum* Crundw. & Nyholm]
Imbriobryum gemmiparum (De Not.) J.R. Spence [= *Bryum gemmiparum* De Not.]
Rosulabryum capillare (Hedw.) J.R. Spence [= *Bryum capillare* Hedw.]
Rosulabryum flaccidum (Brid.) J.R. Spence [= *Bryum flaccidum* Brid.]
ORTHOTRICHIALES Dixon [7]
ORTHOTRICHACEAE Arn. [7]
Orthotrichum anomalum Hedw.
Orthotrichum cupulatum Hoffm. ex Brid.
Orthotrichum diaphanum Schrad. ex Brid.
Orthotrichum hallii Sull. & Lesq.
Orthotrichum laevigatum fo. *macounii* (Austin) E. Lawton & Vitt [see note #13]
Orthotrichum pumilum Sw.

Orthotrichum rupestre Schleich. ex Schwägr. [see note #14]
 HYPNALES (M. Fleisch.) W.R. Buck & Vitt [12]
 PSEUDOLESKEACEAE Schimp. [2]
Claopodium whippleanum (Sull.) Renauld & Cardot
Conardia compacta (Müll. Hal.) H. Rob.
 BRACHYTHECIACEAE G. Roth [5]
Brachytheciastrum collinum (Schleich. ex Müll. Hal.) Ignatov & Huttunen
 [= *Brachythecium collinum* (Schleich. ex Müll. Hal.) Schimp. var. *collinum*]
Brachytheciastrum fendleri (Sull.) Ochyra & Żarnowiec
 [= *Brachythecium fendleri* (Sull.) A. Jaeger, = *Brachythecium utahense* James]
Brachytheciastrum olympicum (Jur.) Vanderpoorten, Ignatov, Huttunen & Goffinet
 [= *Brachythecium venustum* De Not., = *Brachythecium suberythrorrhizon* Ren. & Card.]
Eurhynchiastrum pulchellum (Hedw.) Ignatov & Huttunen var. *pulchellum*
 [= *Eurhynchium pulchellum* (Hedw.) Jenn.]
Homalothecium nevadense (Lesq.) Renauld & Cardot var. *nevadense*
 LEMBOPHYLLACEAE Broth. [1]
Isothecium stoloniferum var. *cardotii* (Kindb.) Wijk & Margad.
 NECKERACEAE Schimp. [1]
Neckera pennata Hedw.
 PSEUDOLESKEELLACEAE Ignatov & Ignatova [1]
Pseudoleskeella tectorum (Funck ex Brid.) Kindb. ex Broth.
 PYLAISACEAE Schimp. [2]
Stereodon revolutus Mitt. var. *revolutus* [= *Hypnum revolutum* (Mitt.) Lindb.]
Stereodon vaucheri (Lesq.) Lindb. ex Broth. [= *Hypnum vaucheri* Lesq.]

EXCLUDED SPECIES

Amblystegium serpens (Hedw.) Schimp. [reported in Newberry & Stark 2004], *Newberry*, 23 May 2003 (!UNLV) misidentified
Encalypta mutica I. Hagen [reported in Newberry & Stark 2004], *Newberry*, 20, 21, 24 & 26 May 2003 (!UNLV) misidentified
Grimmia tenerrima Renauld & Cardot [reported in Newberry & Stark 2004], *Newberry*, 20 May 2003 (!UNLV) misidentified
Orthotrichum tenellum Bruch ex Brid. [reported in Newberry & Stark 2004], *Newberry*, 23 May 2003 (!UNLV) misidentified
Tortula hoppeana (Schultz) Ochyra [reported in Newberry & Stark 2004 as *Desmatodon latifolius*], no voucher found & unlikely

SPECIES ALSO LIKELY TO OCCUR ON THE MONUMENT

**Mannia californica* (Gottsche) L.C. Wheeler [occurs at Pipe Spring NM, *Flowers* 2729 (NY)]
 **Pseudocrossidium crinitum* (Schultz) R.H. Zander [occurs along Hwy 93, *Brinda* 1149 (UNLV)]

Voucher specimens collected for this project will be deposited at the Herbarium of the University of Nevada, Las Vegas (UNLV). When enough material for duplicates exists these will be sent to the monument for their reference collection as well as other major North American herbaria.

Appendix B: Taxonomic Notes

Note #1: All collections of *Targionia* on the monument actually represent an as yet undescribed species (Whittemore 2009). In the past most bryologists have lumped all collections of *Targionia* from North America into *Targionia hypophylla*. However, there appear to be cryptic species in this complex that will require more detailed work in order to understand them (Bączkiewicz et al. 2005, Boisselier-Dubayle & Bischler 1999).

Note #2: This taxon is actually a variety of *Entosthodon pulchellus* (H. Philib.) Brugués, but the correct combination has not yet been published (Brugués 2000, Crundwell & Nyholm 1974, Fife 1985).

Note #3: *Dryptodon* is a segregate genus of *Grimmia* with strong molecular support (Hernández-Maqueda et al. 2008a, 2008b). *Dryptodon meridionalis* is closely related to *Dryptodon trichophyllus* (Grev.) Brid. but differs in its costal anatomy (Maier 2002, 2009).

Note #4: *Grimmia jamesii* is used here to refer to plants in the *Grimmia montana* complex with basal cells that are more or less uniform in length, are dioicous or cladautoicous, have mamillate opercula, and variously reduced peristomes. These plants were referred to *Grimmia ungeri* Jur. by Muñoz (1998), however Greven (2003) illustrates *G. ungeri* as gonioautoicous and claims it is endemic to Cyprus. *Grimmia jamesii* would appear to be the name with priority if *G. ungeri* is excluded from North America (Muñoz & Pando 2000).

Note #5: Hans Blom (in litt.), an authority on the genus *Schistidium*, has identified specimens from the monument as belonging to what are probably two undescribed species. The plants bear some resemblance to *Schistidium crassipilum* H.H. Blom and more study is required in order to understand their taxonomic status.

Note #6: This taxon may only be a form of *Fissidens bryoides* var. *pusillus* (Pursell 1997). It shares with that species the clear, non-bulging laminal cells but is smaller and striking in its complete lack of a marginal border. *Fissidens sublimbatus* on the other hand has obscure, bulging cells and has a narrow marginal border on most leaves.

Note #7: Flowers (1956) noted the distinctness of this species but failed to recognize it as anything more than a form of *Hymenoloma crispulum* (Hedw.) Ochyra [as *Dicranoweisia crispula* (Hedw.) Milde]. This has been followed by most workers up until the present (Schofield 2007). However Ochyra et al. (2003) recognized the segregate genus *Hymenoloma* and later transferred *Oreoweisia mulahacenii* Höhn. to it (Ochyra et al. 2008b). Ochyra et al. (2008a) also noted that plants with bistratose lamina referred to *D. crispula* by North American authors actually represent *Hymenoloma mulahacenii*. The following is a key to the three species of this complex in North America:

- 1a. Leaf cells smooth; leaf margins recurved; capsule with annulus. *Dicranoweisia cirrata*
- 1b. Leaf cells with cuticular striations, appearing papillose in cross-section; leaf margins plane or slightly incurved; annulus lacking. 2
- 2a. Leaves distinctly bistratose distally, especially on the margins. *Hymenoloma mulahacenii*
- 2b. Leaves ± unistratose throughout. *Hymenoloma crispulum*

Note #8: Zander (2007) synonymized this species with *Trichostomum planifolium* (Dixon) R.H. Zander. However Ros & Werner (2007) showed the species to be distinct from both *Trichostomum* and *Weissia* and transferred it to the segregate genus *Pottiopsis*.

Note #9: This taxon is probably only a variety of *Weissia controversa* Hedw., but that combination has not yet been published. However it differs enough from the typical expression of *W. controversa* to deserve some sort of taxonomic recognition. The thick costa and broader leaves have probably resulted in misidentification as *Weissia condensa* (Voit) Lindb. in the past but it is probably more closely related to *Weissia controversa* var. *crispata* (Nees & Hornsch.) Nyholm (Bartram 1927, Nyholm 1956, Zander 1994).

Note #10: Kramer (1988) reported both *Syntrichia calcicola* and *S. virescens* from North America [as *Tortula calcicolens* W.A. Kramer and *Tortula virescens* (De Not.) De Not.] but this has unfortunately been mostly ignored by North American authors (Mishler 2007).

Note #11: Allen (2010) explains the differences between this species and *Hedwigia ciliata* (Hedw.) P. Beauv.

Note #12: The treatment of the family Bryaceae follows Spence's (2007, 2009a, 2009b, 2010) recent work for the Flora of North America.

Note #13: Vitt (2009) synonymized *Orthotrichum macounii* Austin with *O. laevigatum*. The plants examined from the monument have the leaf characters of *O. macounii* and may be better recognized as a variety of *O. laevigatum*. However that combination has not yet been published.

Note #14: Vitt (2009) synonymized *Orthotrichum texanum* Sull. & Lesq. with *O. rupestre*. The plants examined from the monument have the peristome characters of *O. texanum* and may best be recognized as a variety of *O. rupestre*. However that combination has not yet been published.

Appendix C: List of Collection Sites

- 14-May-2007; South Ridge of Lime Kiln Mountain, Virgin Mountains (Sandstone hoodoos east of monument boundary sign on county 242); UTM: 11S 0767216E 4058950N (NAD83, ± 0.8 m); Elev: 1491.6 m; Habitat: Pinyon-Juniper-Apache Plume
- 14-May-2007; South Ridge of Lime Kiln Mountain, Virgin Mountains (Draw below sandstone hoodoos east of monument boundary sign on county 242); UTM: 11S 0767217E 4058918N (NAD83, ± 3.4 m); Elev: 1483.7 m; Habitat: Pinyon-Juniper-Apache Plume-Manzanita
- 14-May-2007; East Virgin Peak Ridge, Virgin Mountains (Sandstone-limestone junction on hillside west of monument boundary sign); UTM: 11S 0767156E 4058729N (NAD83, ± 6 m); Elev: 1519 m; Habitat: Pinyon-Juniper-Manzanita
- 15-May-2007; East Virgin Peak Ridge, Virgin Mountains (Quartzite boulder on ridge south of Lime Kiln Canyon); UTM: 11S 0765248E 4058178N (NAD83, ± 3 m); Elev: 1729.5 m; Habitat: Pinyon-Juniper-Ceanothus
- 15-May-2007; East Virgin Peak Ridge, Virgin Mountains (North-facing limestone cliffs on ridge south of Lime Kiln canyon); UTM: 11S 0765342E 4058120N (NAD83, ± 4 m); Elev: 1768.7 m; Habitat: Pinyon-Rock Spirea
- 15-May-2007; Springs Above Hecs Hole, Virgin Mountains (Old guzzler and cottonwood at stream junction); UTM: 11S 0764410E 4058021N (NAD83, ± 3 m); Elev: 1655 m; Habitat: Chaparral-Riparian
- 15-May-2007; Springs Above Hecs Hole, Virgin Mountains (Fin of metamorphic rock); UTM: 11S 0764816E 4057852N (NAD83, ± 4 m); Elev: 1594 m; Habitat: Pinyon-Juniper-Riparian
- 15-May-2007; Springs Above Hecs Hole, Virgin Mountains; UTM: 11S 0764892E 4057592N (NAD83, ± 3 m); Elev: 1528.6 m; Habitat: Chaparral-Riparian
- 16-May-2007; Gypsum Outcrop Along County Road 101, Hungry Valley; UTM: 12S 0232119E 4051945N (NAD83, ± 2 m); Elev: 1172.4 m; Habitat: Joshua Tree-Blackbrush
- 16-May-2007; N of the Cockscomb Along County Road 111, Hungry Valley; UTM: 12S 0231675E 4041763N (NAD83, ± 3 m); Elev: 988.6 m; Habitat: Joshua Tree-Creosote Bush
- 16-May-2007; Cutbank along Road to Tassi Spring, Grand Wash Valley; UTM: 12S 0233130E 4019024N (NAD83, ± 3 m); Elev: 538 m; Habitat: Creosote Bush
- 17-May-2007; North-facing Side Canyon to Snap Canyon, Grand Wash Cliffs; UTM: 12S 0245653E 4011943N (NAD83); 995 m; Habitat: Acacia-Riparian-Selaginella
- 17-May-2007; N-facing Cliffs at Mouth of Snap Canyon, Grand Wash Cliffs; UTM: 12S 0242858E 4012485N (NAD83, ± 9 m); Elev: 771.8 m; Habitat: Creosote-Acacia

18-May-2007; North-facing Cliffs Along BLM Road 1007, Grand Wash Valley; UTM: 12S 0235116E 4030469N (NAD83, ± 4 m); Elev: 631 m; Habitat: Creosote-Ambrosia

18-May-2007; Narrow Side Canyon Along BLM Road 1007, Black Canyon; UTM: 12S 0251020E 4057146N (NAD83); 1195 m; Habitat: Riparian-Cliff

29-May-2007; Draw Southeast of Summit of Mt. Trumbull, Uinkaret Mountains; UTM: 12S 0308847E 4030078N (NAD83, ± 3 m); Elev: 2286.1 m; Habitat: Ponderosa Pine-Oak

29-May-2007; N-facing Cliffs Along Summit of Mt. Trumbull, Uinkaret Mountains; UTM: 12S 0309099E 4031424N (NAD83, ± 6 m); Elev: 2350.8 m; Habitat: Oak-Cliff

29-May-2007; Upper Section of Mount Trumbull Trail, Uinkaret Mountains; UTM: 12S 0308393E 4031405N (NAD83, ± 10 m); Elev: 2412.3 m; Habitat: Ponderosa Pine Forest

29-May-2007; Lower Section of Mount Trumbull Trail, Uinkaret Mountains; UTM: 12S 0307619E 4029530N (NAD83, ± 10 m); Elev: 2065.7 m; Habitat: Pinyon-Juniper Forest

30-May-2007; Southeast Slopes of Mount Logan, Uinkaret Mountains; UTM: 12S 0303480E 4025455N (NAD83, ± 3 m); Elev: 2208.7 m; Habitat: Pine-Oak Forest

30-May-2007; East-facing Cliffs of Mount Logan, Uinkaret Mountains; UTM: 12S 0302468E 4025764N (NAD83, ± 5 m); Elev: 2286.8 m; Habitat: Oak-Cliff

31-May-2007; N-facing Cliffs Along Summit of Mt. Logan, Uinkaret Mountains; UTM: 12S 0301963E 4026449N (NAD83, ± 8 m); Elev: 2324.6 m; Habitat: Oak-Cliff

31-May-2007; Campsite Southeast of Mount Logan, Uinkaret Mountains; UTM: 12S 0302615E 4025599N (NAD83, ± 7 m); Elev: 2269.5 m; Habitat: Ponderosa Pine Forest

1-Jun-2007; Draw East of Petty Knoll, Uinkaret Mountains; UTM: 12S 0304055E 4023606N (NAD83, ± 7 m); Elev: 2086.9 m; Habitat: Pinyon-Juniper Forest

1-Jun-2007; North End of Little Spring Lava Flow, Uinkaret Mountains; UTM: 12S 0305997E 4028116N (NAD83, ± 2 m); Elev: 2013.6 m; Habitat: Lava Bed

24-Jun-2007; Death Valley Lake, Sawmill Mountains; UTM: 12S 0298209E 4026466N (NAD83, ± 4 m); Elev: 2087.9 m; Habitat: Pine-Oak Forest

25-Jun-2007; Death Valley Spring, Sawmill Mountains; UTM: 12S 0297086E 4027733N (NAD83, ± 5 m); Elev: 1979.5 m; Habitat: Pine-Oak-Riparian

25-Jun-2007; Wash at South End of Hurricane Cliffs, Sawmill Mountains; UTM: 12S 0295662E 4030867N (NAD83, ± 3 m); Elev: 1885.5 m; Habitat: Pinyon Pine-Oak

25-Jun-2007; South End of Hurricane Cliffs; UTM: 12S 0295770E 4031572N (NAD83, ± 9 m); Elev: 1892 m; Habitat: Pinyon-Juniper

26-Jun-2007; Whitmore Trail Near Monument Boundary, Whitmore Canyon; UTM: 12S 0301526E 4002839N (NAD83, ± 8 m); Elev: 771.6 m; Habitat: Creosote-Ocotillo-Ferrocactus

26-Jun-2007; Cane Spring Canyon, West Fork; UTM: 12S 0298033E 4003456N (NAD83, ± 4 m); Elev: 894.4 m; Habitat: Creosote-Acacia

26-Jun-2007; Cane Spring, Cane Spring Canyon; UTM: 12S 0298349E 4003369N (NAD83, ± 8 m); Elev: 895.6 m; Habitat: Springhead

27-Jun-2007; Whitmore Canyon Narrows, Whitmore Canyon; UTM: 12S 0300559E 4005268N (NAD83, ± 10 m); Elev: 864.8 m; Habitat: Acacia-Cliff

29-Jun-2007; Parashant Canyon Narrows, Parashant Canyon; UTM: 12S 0290183E 4003707N (NAD83, ± 6 m); Elev: 774 m; Habitat: Acacia-Sandbar

30-Jun-2007; Parashant Canyon Narrows at Copper Mountain Mine Tributary; UTM: 12S 0290722E 4004501N (NAD83, ± 15 m) m; Habitat: Elev: 822.8; Acacia-Sandbar

30-Jun-2007; Parashant Canyon Narrows below Frog Spring; UTM: 12S 0291348E 4004835N (NAD83, ± 16 m); Elev: 847 m; Habitat: Sandbar with Beargrass

30-Jun-2007; Frog Spring, Parashant Canyon; UTM: 12S 0292554E 4004970N (NAD83, ± 4 m); Elev: 962.6 m; Habitat: Mixed Shrub

30-Jun-2007; Stock Tank Along Road to Frog Spring above Cane Spring Canyon; UTM: 12S 0296895E 4003814N (NAD83, ± 3 m); Elev: 1152 m; Habitat: Leaky Stock Tank Wall

1-Jul-2007; Basalt Outcrop near Bundy Cabin, Whitmore Canyon; UTM: 12S 0299614E 4007563N (NAD83, ± 6 m); Elev: 1038.8 m; Habitat: Creosote-Ephedra

1-Jul-2007; Upper Trail Canyon, Shivwits Plateau; UTM: 12S 0290664E 4019979N (NAD83, ± 10 m); Elev: 1503.4 m; Habitat: Pinyon-Juniper

24-Aug-2007; Rocks near Summit of Mt. Dellenbaugh, Shivwits Plateau; UTM: 12S 0271222E 3999018N (NAD83, ± 6 m); Elev: 2132.6 m; Habitat: Pinyon-Juniper

25-Aug-2007; Upper Snap Canyon, Shivwits Plateau; UTM: 12S 0253117E 4005388N (NAD83, ± 7 m); Elev: 1725 m; Habitat: Pinyon-Oak-Juniper

25-Aug-2007; Upper Pigeon Canyon, Shivwitz Plateau; UTM: 12S 0264100E 4017836N (NAD83, ± 6 m); Elev: 1719.2 m; Habitat: Pinyon-Oak-Juniper

26-Aug-2007; Last Chance Knoll, Hidden Hills; UTM: 12S 0256480E 4031705N (NAD83, ± 6 m); Elev: 2055.2 m; Habitat: Pinyon-Juniper

26-Aug-2007; Upper Hidden Canyon, Shivwitz Plateau; UTM: 12S 0269206E 4032388N (NAD83, ± 3 m); Elev: 1805 m; Habitat: Pinyon-Juniper

27-Aug-2007; Sandstone Bluffs near Red Rock Spring, Hungry Valley; UTM: 11S 0765808E 4050029N (NAD83, ± 4 m); Elev: 1218.3 m; Habitat: Pinyon-Juniper

28-Aug-2007; Rocks near Summit of Black Rock Mountain, Virgin Mountains; UTM: 12S 0249636E 4073428N (NAD83, ± 9 m); Elev: 2210.9 m; Habitat: Ponderosa Pine-Oak-Pinyon-Juniper Ecotone

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