

Final Report
January 2007

Title of Project: An Evaluation of the Nonvascular Plants of Concern in Clark County

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PROJECT REVIEW

1. What measurable goals did you set for this project and what indicators did you use to measure your performance? To what extent has your project achieved these goals and levels of performance?

The major goal of this project was to find and assess populations of all eleven bryophyte (nonvascular) species of concern in Clark County, NV. These species are those classified as either "covered" or "evaluation" species based on listings in the Clark County Species Account Manual. Several of these species are notably rare on a global scale, whereas others are rare in the state of Nevada but relatively common outside of the state of Nevada. Assessment was to take the form of (i) estimating the number of populations present for each species, and (ii) estimating the health and projected future persistence of these populations based upon reproductive status of the species, life history attributes of the species, and land usage in the inhabited region. Secondary goals included revising the species on this list based on the findings in this project (i.e., some species may be suggested as not meriting formal listing, whereas others may be deserving of listing).

The methods employed included a search of the pertinent literature relevant to each listed species of bryophyte coupled to an inventory of the Wesley Niles (UNLV) herbarium. These two exercises served to produce precise localities of each species as known from historical collections dating back several decades, as well as recent collections deposited in the UNLV herbarium. Once the locations were established, an attempt was made to refind populations of each species using topographic maps and global positioning coordinates. The general area surrounding each known population was inspected for additional populations of the species in question.

Once found, critical samples of each species were examined using light microscopy for identification features associated with that species. Identifying features for bryophyte species normally involve the shape and ornamentation of leaf cells and cell walls, as well as attributes of the sexual condition and spore-bearing generation. Some species are difficult to identify and such specimens were sent to experts in a particular family for verification. The specimens were then curated and deposited in the UNLV herbarium. Classification issues were addressed with

species having uncertain taxonomic status by way of consulting the literature and also consulting with active experts for the genus in question.

Milestones for this project included the literature evaluation of each species, hiring a UNLV student assistant to assist with the project, and to relocate and assess the health and persistence prospects of populations of each listed species. These milestones were met excepting the hiring of a student assistant (I was able to receive competent help from two graduate students without compensation). The deliverables associated with this project included the submission of quarterly reports to the County, a report to the County Rare Plant Committee or working group, and the sharing of data with interested county and governmental agencies. These deliverables were met.

Additional accomplishments of this project included delineating the status of several species not listed by the county but deemed to be noteworthy by the investigator. These populations were encountered either during the normal course of species field evaluations, or, in three cases, deemed important enough (sufficiently rare in the county) to merit a separate line of investigation.

A brief synopsis of the eleven listed species is as follows. In six cases (*Anacolia menziesii*, *Crossidium seriatum*, *Dicranoweissia crispula*, *Didymodon nevadensis*, *Syntrichia princeps*, and *Targionia* sp. nov.), the number of existing populations was expanded significantly and/or judged not to be under immediate threat of extinction. In three cases (*Claopodium whippleanum*, *Pseudocrossidium crinitum*, and *Trichostomum sweetii*), the known distribution of populations was expanded but they are still known from just a handful of precariously small patches. In two cases (*Distichium inclinatum* and *Grimmia americana*), the original historic population could not be relocated despite searches, with the latter of these two species being a global rarity. Thus, six of the eleven species of bryophytes were found to be in fairly good shape insofar as their frequency and health, whereas five of the eleven species are viewed as precarious based upon their low population numbers or extreme rarity. In at least three cases (*Grimmia americana*, *Targionia* sp. nov., and *Trichostomum sweetii*), the listed species is a member of a complex of closely related species that complicates their correct identification.

Did the project encounter internal or external challenges? How were they addressed? Was there something Clark County could have done to assist you?

The only problem encountered was with the submission of the final report. I drafted it in March of 2006 and sought assistance with the required format, was directed to a web site, but was unable to access a completed report. Therefore there was a significant delay in the submission of this report.

What lessons did you learn from undertaking this project?

It was difficult to relocate populations of bryophytes in the field. If other individuals had collected the specimen, the difficulty arose because often the specimen was collected several decades ago and the label information was inexact. If I had collected the specimen (in two cases

the population was collected about 10 years ago), the difficulty arose because the landscape had changed due to flooding and/or human activities. Therefore, fieldwork can take longer than anticipated.

What impact to you think the project has had to date?

This project has contributed to three significant publications in plant biology journals, received local press coverage, and stimulated research on Nevada bryophytes by individuals both within and outside of the state of Nevada.

Is there additional research or efforts that would complement or add to your project that could be conducted?

I would suggest a more focused study of the most important and/or threatened bryophyte species in the county. In particular, the following three courses of action are suggested: First, *Grimmia americana* is one of the rarest plants in the world, known from only three populations, one of which was last found in the Newberry Mountains in the 1990s and not refound since. A concerted attempt should be made to (i) reassess existing collections in this genus, (ii) to explore potential likely habitats for its occurrence in the southern Newberry Mountains, and (iii) use a molecular approach to discern the relationships between it and its closely related species. Secondly, the species *Trichostomum sweetii* is rare and of sporadic occurrence in the western U.S. There are taxonomic questions surrounding its status, with one author suggesting it is part of a larger wide-ranging species and another group of scientists suggesting it is a separate evolutionary line (clade). Resolution of this problem is essential because the type locality (upon which the species is based) is in Clark County, one of only two species in this category. This endeavor will require a molecular systematics approach. Thirdly, the assessment of rare bryophyte species in Clark County needs to be an ongoing venture, or a project to be revisited every few years. The five species in need of periodic monitoring listed above, in combination with the two additional rare species found as a result of this project, have very small known distributions and need to be assessed regularly.

FORMAL REPORT

Executive Summary

Featured Project and Type. An evaluation of nonvascular plants of concern in Clark County, Nevada. This project seeks to assess the frequency, distribution, health, and persistence of populations of eleven bryophyte species categorized as "Evaluation" and "Covered" species.

Species Addressed. Eleven species of bryophytes were addressed in this project, as follows, noting that common names are not normally available: *Anacolia menziesii*, *Claopodium whippleanum*, *Crossidium seriatum*, *Dicranoweisia crispula*, *Didymodon nevadensis*, *Distichium inclinatum*, *Grimmia americana*, *Pseudocrossidium crinitum*, *Syntrichia princeps*, *Targionia* sp. nov. (an undescribed species), and *Trichostomum sweetii*.

Summary Project Description. This project investigated the status, health, and projected persistence of the 11 bryophyte (also known as nonvascular plants) species of concern (7 Evaluation species and 4 Covered species). For each species, (i) the literature was accessed for taxonomic treatments and historical collection data from southern Nevada, (ii) attempts were made to re-find critical specimens in Clark County including potential unexplored regions of similar habitat and recording precise GPS coordinates of such patches, (iii) specimens at hand in the UNLV herbarium were assessed for correct identification and location data, and (iv) collected specimens were curated and deposited into the UNLV herbarium (now known as the Wesley Niles Herbarium). Specific recommendations were drawn up for each species summarizing the status, health, and any persistence concerns.

Project Status/Accomplishments. Taking the results on a species-by-species basis, in six cases (*Anacolia menziesii*, *Crossidium seriatum*, *Dicranoweisia crispula*, *Didymodon nevadensis*, *Syntrichia princeps*, and *Targionia* sp. nov.), the number of existing populations was expanded significantly and/or judged not to be under immediate threat of extinction. The ranges of *Anacolia menziesii* and *Crossidium seriatum* were significantly expanded by exploration of immediately surrounding regions where the initial population was found. This was also true for *Dicranoweisia crispula* despite being unable to locate the original collection from the 1950s. In the case of the gypsophile *Didymodon nevadensis*, two gypsum-rich regions in the upper Las Vegas Wash were explored for potential new populations, but this species was not found. For *Syntrichia princeps*, one of two known populations was re-found, and additional populations are anticipated to exist in the county. Although the undescribed species of *Targionia* is relatively common in southern Nevada, one population is highlighted in this report because it is the largest population known in the county and also the only site in the county of another rare liverwort that has been recommended for listing, *Mannia californica*.

In three cases (*Claopodium whippleanum*, *Pseudocrossidium crinitum*, and *Trichostomum sweetii*), the known distribution of populations was expanded but they are still known from just a handful of precariously small patches. Previously known from only a single patch (a subunit of a population, taken here to be on the order of 10-20 cm wide and 10-20 cm long), *Claopodium whippleanum* is now known from two localities and several patches; nevertheless, these locations are subject to flooding and persistence is doubtful. Two populations of *Pseudocrossidium crinitum* exist in Clark county, and one of these was significantly expanded by exploration. This species is female-only in the county and the second population is subject to human impacts. The single known population of *Trichostomum sweetii*, while re-found as a fragment, is considered highly vulnerable and follow-up censuses are needed.

In two cases (*Distichium inclinatum* and *Grimmia americana*), the original historic population could not be relocated despite searches, with the latter of these two species being a global rarity. Searching for *Distichium inclinatum* in the Spring Mts failed to turn up the species at Deer Creek; however, there are concerns about the taxonomic status of this species. *Grimmia americana* remains one of the rarest plants in the world, and I was unable to relocate the single Clark County population collected in the 1990s. This locality (Newberry Mts) receives high

impacts from human visitation.

Thus, six of the eleven species of bryophytes were found to be in fairly good shape insofar as their frequency and health, whereas five of the eleven species are viewed as precarious based upon their low population numbers or extreme rarity. In at least three cases (*Grimmia americana*, *Targionia* sp. nov., and *Trichostomum sweetii*), the listed species is a member of a complex of closely related species that complicates their correct identification.

Partners. A contributing partner to this project was the National Geographic Society, which provided significant travel funds.

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Funding. \$30,340

Completion Date or Status. Project was completed as of June 30, 2006.

Documents/Information Produced. This project has contributed to the publication of the following articles.

Shevock, J. R., J. R. Spence, and L. R. Stark. 2005. Contributions toward a bryoflora of Nevada: bryophytes new for the Silver State. Madroño 52: 66-71.

Spence, J. R., L. R. Stark, and J. R. Shevock. 2006. Contributions toward a bryoflora of Nevada: bryophytes new for the Silver State. Part II. Madroño 53: 400-403.

Brinda, J. C., L. R. Stark, J. R. Shevock, and J. R. Spence. 2007. An annotated checklist of the bryophytes for Nevada, with notes on the collecting history of the state. Bryologist 110: in press.

Project Photos (2). Photographs of each of the eleven species studied are given toward the end of this report. My suggestion of two of the better photos would be Figures 15 and 19, which illustrate one of the mosses (*Pseudocrossidium*) and the liverwort (*Targionia*).

Introduction

Description of the Project. This project investigated the status, health, and projected persistence of the 11 bryophyte (also known as nonvascular plants) species of concern (7 Evaluation species and 4 Covered species). For each species, (i) the literature was accessed for taxonomic treatments and historical collection data from southern Nevada, (ii) attempts were made to refind critical specimens in Clark County including potential unexplored regions of similar habitat and recording precise GPS coordinates of such patches, (iii) specimens at hand in the UNLV herbarium were assessed for correct identification and location data, and (iv) collected specimens were curated and deposited into the UNLV herbarium (now known as the Wesley Niles Herbarium). Specific recommendations were drawn up for each species summarizing the status, health, and any persistence concerns.

Background and Need for the Project. Eleven bryophyte (mosses and liverworts) species of concern are known to occur within Clark County, Nevada. These species are listed as either Covered or Evaluation species as part of the Clark County Multiple Species Habitat Conservation Plan. Several of these species are rare on a global scale, with fewer than 10 known populations at the outset of this project. At the outset of this study, no follow-up assessments of the persistence of populations in Clark County had been carried out in some cases since the 1950s. This project aimed to assess each of these eleven species as well as a few others not listed by the county but regarded as deserving of attention by the investigator.

Management Actions Addressed (as identified in the MSHCP). To investigate plants listed as "Covered" and "Evaluation" species of concern for Clark County. Specifically, to assess the frequency of distribution of critical populations of each species and give recommendations to assist in the persistence of these populations.

Goals and Objectives of the Project. The principal goal of the project was to provide an account of each of the eleven listed species of bryophytes with respect to population frequency, health and/or reproductive capacity of the populations, and provide an estimate of the potential of the populations to persist in their respective habitats, including any perceived threats to the disturbance of these populations.

Methods and Materials

The methods employed included a search of the pertinent literature relevant to each listed species of bryophyte coupled to an inventory of the Wesley Niles (UNLV) herbarium. Library and interlibrary loan resources were accessed to assemble the available published information on each species. The UNLV herbarium contains about 1500 specimens, many collected in Clark County, and these were inventoried with each of the eleven species examined for correct determinations and locality data. These two exercises served to produce precise localities of each species as known from historical collections dating back several decades as well as recent collections deposited in the UNLV herbarium. Once the locations were established, an attempt was made to refind populations of each species using topographic maps and global positioning coordinates. The general area surrounding each known population was inspected for additional populations of the species in question. If found, the habitat was inspected for potential threats to the persistence of the populations. A small portion of the population (patch) was collected, curated, and deposited into the UNLV herbarium as a permanent record of this project.

Results and Evidence of the Results

Specific Accomplishments by Species.

1. *Anacolia menziesii* (Covered Species).

Species Description. *Anacolia* is a genus with robust plants having reddish root-like projections from their stems (called rhizoids). It inhabits shaded cliffed areas kept moist by seepage or

proximity to a stream (Figure 1). *Anacolia menziesii* is primarily a Pacific coast species present from Alaska to southern California, with inland stations in Idaho, Montana, Wyoming, and one spot in southwestern Utah (Washington Co.).

Distribution in Clark County. Going into this study, this species had last been verified from Clark County in Red Rock Canyon proper in 1999. In the spring of 2004, two visits to this region were conducted, and multiple patches of this species were found. The population occupying Red Rock Canyon was judged to be locally abundant. It occurs along the north-facing ridge of Red Rock Canyon proper (in the Spring Mts), after the canyon turns westward at Willow Spring. This species can be found intermittently for at least a mile beginning from Willow Spring and heading to the west. Patches of *Anacolia* are best developed on moist soil at the base of boulders, occupying heavily shaded sites. A specimen of *Anacolia menziesii* from these visits was deposited into the UNLV herbarium, bearing the following information.

Anacolia menziesii: Stark and Brinda s.n., 5-9-04. Clark County, Spring Mountains, Red Rock National Conservation Area, near mouth of Red Rock Canyon, N-facing bluffs near confluence with Red Rock Wash, elev. ~1450 m.

While carrying out the literature and specimen search for Nevada mosses, *Anacolia menziesii* was found to occur in a second locality in Clark County, based on a collection by Mr. James Shevock from the Virgin Mountains. This specimen is now deposited in the UNLV herbarium and carries the following information:

Anacolia menziesii: Shevock 23634, 11-2\15-2002. Clark County, Virgin Mountains, side tributary of Cabin Canyon, 11.7 miles S of Virgin River and community of Mesquite, elev. 4880 ft.

In June of 2005, an exploratory trip was made into Pine Creek Canyon with James Shevock and John Brinda, in an attempt to find additional sites for *Anacolia* and other rare species. We observed a few patches of *Anacolia*, thus expanding its known range in the Spring Mts to both Red Rock Canyon and Pine Creek Canyon. Specific locality data: BLM land, Red Rock Canyon National Conservation Area, Spring Mountains, North and South Fork of Pine Canyon, T21S, R58E, section 23 (estimated), Sandstone rock canyons, bluffs and terraces.

2. *Claopodium whippleanum* (Covered Species).

Species Description. This species is a pleurocarpous (prostrate) plant that has papillose leaves (cells on its leaves have tiny but regular cell wall projections on their surfaces), a very unusual feature for prostrate mosses. Plants prefer very mesic habitats well out of the direct sun (Figure 3). *Claopodium whippleanum* is a Pacific coast species ranging from southern British Columbia southward to southern California. Rarely found in deserts, recovering it from Clark County was indeed surprising, and represents the only known desert population of this species.

Distribution in Clark County. Going into this study, *Claopodium whippleanum* was known from a single locality in Clark County. This locality had not been verified since 1994, and was

thought to be represented only by a single patch in a single tributary canyon to Red Rock Canyon proper. In the spring of 2004, while looking for patches of another species (the *Syntrichia princeps* population), a population of several patches of *Claopodium* was found. Its presence was thought to be likely based on an unofficial finding in this area by James Shevock in 2003. Its habitat is in deep recesses of boulder overhangs along the north facing ridge of Red Rock Canyon proper. Access is difficult and the area has recently been washed out by heavy rains. This particular area is judged to be highly sensitive and conservation worthy, because it contains three species of concern for the county (*Claopodium whippleanum*, *Anacolia menziesii*, and *Syntrichia princeps*). Three patches of *Claopodium* were documented.

After laboratory examination, the species (*C. whippleanum*) was photographed, taxonomically confirmed, and a specimen curated and deposited into the UNLV herbarium bearing the following information:

Claopodium whippleanum (Sull.) Ren. & Card. Deeply shaded rock crevices. Clark County, Spring Mountains, Red Rock National Conservation Area, near mouth of Red Rock Canyon, N-facing bluffs near confluence with Red Rock Wash, elev. ~1450 m, L. Stark s.n., 3-31-2004. This finding thus confirms the location of the record, Stark NV-316, 6-4-1994, also deposited at UNLV.

This species confirmation means that the population is now known from more than just a single patch, but from several small patches within the canyon. It is, however, an extremely rare species for the county, and sexual reproduction was not observed in any of the patches.

An exploratory trip into Pine Creek Canyon revealed an additional patch of *Claopodium whippleanum*, discovered by James Shevock and verified in the laboratory. The patch of *Claopodium* was extremely small, less than a few inches across, and so only a small amount of material was removed in order to provide proper identification. Locality is as follows: BLM land. Red Rock Canyon National Conservation Area. Spring Mountains. North and South Fork of Pine Canyon, T21S, R58E. section 23 (estimated). Sandstone rock canyons, bluffs and terraces.

3. ***Crossidium seriatum*** (Evaluation Species; also on Nevada Heritage Program sensitive list and on Nevada Native Plant Society watch list).

Species Description. A low-elevation desert species normally restricted to sandstone and gypsum soils, this species is extremely small and difficult to identify in the field beyond genus, and there are four species in this genus in southern Nevada. The key features identifying this species are twofold. First, its leaves have very short cellular filaments extending from the leaf midvein (Figure 5). These filaments may be highly developed, as in the related *C. crassinerve*, or low and difficult to confirm without a microscope, as is the case with *C. seriatum* (a comparison of these two species is given in Figure 5). Second, the leaf cells of *C. seriatum* are multipapillose: each leaf cell has several protuberances extending upward from the cell wall surface. Confirmation of the identity of *C. seriatum* requires the use of a light microscope at a magnification of 400x. It grows in clumps on exposed soil or in the shadow on the north side of

shrubs like Mormon tea. *Crossidium* is bisexual, but does not normally produce fruit. *Crossidium seriatum* is globally known from fewer than fifteen populations, with perhaps the most numerous populations in Nevada occurring along the region north of Lake Mead (the north shore region). Other known localities include populations in the following areas: AZ (Mariposa Co., four localities), Baja California (type locality), British Columbia, Kansas (two localities), California (two localities), and Spain. Its main region of distribution appears to be southern Nevada, and it is a frequent co-associate of the Evaluation species *Didymodon nevadensis*.

Distribution in Clark County. Going into this study, based on specimens deposited in the UNLV herbarium collected as part of a survey of the North Shore region of the Lake Mead National Recreation Area during 1998-2000 (Stark 2000), *Crossidium seriatum* was known from these localities within Clark County:

North Shore region of Lake Mead:

- vicinity of Overton Beach (Stark NV-1960, 1961, 1969, 1984, 1986).
- southern Moapa Valley (Stark NV-872).
- Fire Bay (also known as Fire Cove) (Stark NV-1996).
- Blue Point Springs (Stark NV-2009, 2011, 2022).
- Echo Wash (Stark NV-2074, 2076, 2082, 2089).
- Black Mountains along Boathouse Cove Rd (Stark & Bonine NV-3038, 3045, 3058).
- Westend Wash North (Stark NV-1891a).
- southern Gale Hills, Lovell Wash (Stark NV-1956).

Muddy Mountains:

- southern end of White Basin (Stark & Bonine NV-3017, 3029).
- between Piute Point and Monocline Valley (Stark & Bonine NV-3105, 3108).

Newberry Mountains:

- Grapevine Canyon (Stark NV-34c).
- Needles Eye (Stark NV-81b).

Gold Butte region:

- northern foothills of Lime Ridge (Stark NV-232a).

As of February 2006, the range of *C. seriatum* was verified as occurring in the regions above, and also expanded to include the northern edge of the city of Las Vegas abutting the foothills of the Sheep Mountains, with the following collections:

- North of Corn Creek Springs Rd near junction with US 95 (Brinda 432, 435).
- North of new I215 in BLM buffer lands (Brinda 431).
- foothills of River Mountains near Henderson City limits (Stark, not curated).

Reproductive material. The winter rains of 2004-05 produced a banner year for sexually reproducing (“fruiting”) mosses at the lower elevations in Clark County. During mid-December 2004, fruiting material was extensively collected in the foothills of the River Mts over a two-day

period. This intensive collecting of fruiting material was carried out in part to recover the rare species *Crossidium seriatum* and gauge its frequency in the western foothills of the River Mts, near the NPS boundary with the Southern Nevada Water District and City of Henderson boundaries. Several species of *Crossidium* occur in this region, and *C. seriatum* was recovered in several patches bearing dense sporophytes.

Phylogenetic considerations. Some background phylogenetic information was assessed regarding the placement of *Crossidium*. A group of scientists based in Spain, where *Crossidium* occurs, recently published a phylogenetic analysis including *Crossidium* and its relatives (Werner et al. 2002). The latter is an interesting study that tackles a difficult group of genera, with insights offered in *Crossidium*, *Tortula*, and *Syntrichia*. Relevant to the present study (Clark County), the following points are noted from the Werner et al. paper:

a. *Crossidium* is found to be polyphyletic, with costal filaments having arisen more than once, and with ties to *Tortula*.

b. *Crossidium seriatum* and *Tortula brevissima* are difficult to distinguish, especially in Spain, and phylogenetic trees generated place these two species closer to one another than to members of their respective genera. Therefore, (i) the genera *Crossidium* and *Tortula* overlap here with the suggestion that these genera are not monophyletic (and are thus artificial constructs); and (ii) a need is present, for Clark Co., to assess the Spanish *T. brevissima* specimens in light of the variation present in Clark Co. specimens of *C. seriatum*. These two taxa may represent the same species.

4. *Dicranoweisia crispula* (Covered Species).

Species Description. This species occurs on fallen, often charred logs in the Spring Mountains of Clark County. When present it can be locally abundant on a given down log, in dense green clusters growing along the cracks in the bark, often fruiting. Dry plants of *Dicranoweisia* have crispate leaves (curved irregularly) that have a strong costa (midvein), erect capsules and a central strand (conducting tissue) in the shoots (Figure 7). The southern Nevada populations represent the southernmost known populations of this plant. This species occurs along the Pacific northwest corridor, and is common in the mountains of Utah.

Distribution in Clark County. This species was recorded from a collection in 1955 made by the late Dr. Elva Lawton from Lee Canyon in the Spring Mountains. Because the likelihood of encountering significant numbers of down trees was thought to be greater in the Deer Creek area, a relocation attempt focused on Deer Creek rather than Lee Canyon. Several potential patches were found on down and charred wood. My graduate student and I were able to successfully find a population, which was collected lightly, photographed, and a curated specimen deposited into the UNLV herbarium. To our knowledge this represents the first time this species has been refound since 1955.

Taxonomic considerations and specimen listing. A summary below is provided courtesy of Mr. John Brinda, UNLV Ph.D. student, who has assessed the variation in this species locally.

First, the Clark County collections of *Dicranoweisia crispula* (Hedw.) Milde var. *contermina*

(Ren. & Card.) Grout can be summarized as follows. There are still some outstanding questions concerning the taxonomy of *Dicranoweisia*. However, all Clark County specimens appear to be referable to the above variety (which is considered a distinct species by some). From the ten stations given below, *Dicranoweisia* can be found at elevations above ~7500 ft. on down wood in various conditions and stages of decay as well as occasionally on rock. The species is somewhat restricted in its range in Clark County, where it is confined to higher elevation forested sites. However, it can be locally common in its preferred habitats. So far the only known stations are in the Spring Mountains but the absence of collections from other areas (e.g., the Sheep Range and Virgin Mountains) may be due to a lack of collecting. In a checklist of bryophytes for the state of Nevada that will soon be published (Brinda, Stark, Shevock, and Spence 2007), the authors take the view that the plants from Clark County are referable to the species *Dicranoweisia contermina*, i.e., elevating the variety to species rank.

Second, here is a listing of historic collections (all from the Spring Mts) for *Dicranoweisia crispula* (Hedw.) Milde var. *contermina* (Ren. & Card.) Grout

Lee Canyon: Lawton 2942 (July 14, 1955); Lee Canyon along trail south of Lee Guard Station, elev. 8400 ft.

Deer Creek: Stark & Stark s.n. (June 26, 2004); Spring Mountains, Deer Creek watershed, vicinity of Deer Creek Spring, on charred wood, elev. ~10660 ft; Brinda 439 (October 22, 2005); Deer Creek Canyon above picnic area, mixed conifer forest, on wood, elev. ~8400 ft. [11S 0623405E 4019078N ∇12m].

Bonanza Peak Trail: Brinda 258 (July 4, 2005); Spring above Bonanza Peak Trailhead, on drier wood at head of spring, elev. 7700 ft. [11S 0612602E 4026999N ∇6.8m]; July 4, 2005; Bonanza Peak Trail, just below ridgeline, rocky slope in pine-fir forest, elev. 9769 ft. [11S 0611622E 4025735N ∇6.2m]. Brinda 266 (on charred wood), Brinda 267 (on wood), Brinda 268 (on rock), Brinda 277 (on rock a little bit lower down trail); July 4, 2005; Bonanza Peak Trail, rocky slope near bottom of avalanche runout, elev. 9375 ft. [11S 0611554E 4026069N ∇8m]. Brinda 286 (on moist, old wood in avalanche debris), Brinda 287 (on rock).

5. *Didymodon nevadensis* (Evaluation Species; also on Nevada Heritage Program sensitive list, on Nevada Native Plant Society watch list, and a U.S. Bureau of Land Management special status species).

Species Description. This is a recently described species from the Gold Butte area of Clark County that was unknown to science just eleven years ago. It was discovered by U.S. Bureau of Land Management botanist Gayle Marrs-Smith in 1994, and published in 1995 as new to science in consultation with the genus expert, Dr. Richard Zander (Zander et al. 1995). *Didymodon nevadensis* is one of only two bryophyte species described as new to science from the state of Nevada, and both are from Clark County (the other is *Trichostomum sweetii* from the Virgin Mts covered later in this report). This rare *Didymodon* can be recognized in the field by its gypsiferous habit, spirally twisted leaves when dry, and a light tan color to the population when

dry. When viewed through a light microscope, the leaves of *D. nevadensis* have a distinct leaf apex in which the surface of the leaf is channeled narrowly toward the apex, to the point of the leaf margins nearly obscuring the leaf apex region. The leaf margin toward the apex is at first incurved, then recurved, resulting in this unusual appearance. This feature, in combination with the strongly developed cushion of cells on the costa (midrib) surface serve to distinguish it from its nearest relative, which is not in the southern Nevada region (Figure 9). *Didymodon nevadensis* is a dioecious species that is known only from female plants; males have presumably become extinct and this has likely led to a more restricted range for the species (given the lack of sexual reproduction). The species proliferates asexually through gemma formation (small mitotically produced structures along the leaf bases).

Distribution in Clark County. This species is restricted to gypsiferous soils or gypsum/sandstone soils north of Lake Mead on both the east and west sides of the Overton arm of Lake Mead. It is most abundant in the Gold Butte region south of Mesquite, with large populations along Lime Ridge. Sites where *D. nevadensis* has been documented to occur within Clark County include the following (all specimens deposited at UNLV's Wesley Niles Herbarium):

North Shore of Lake Mead:

Bitter Springs (Marrs-Smith 29 Jan 1998).
Blue Point Springs (Stark NV-2017, 2023, 2024)
Boathouse Cove Rd (Stark & Bonine NV-3033, 3034, 3043, 3044, 3057).
Echo Wash (Stark NV-2069, 2075, 2077, 2085, 2086, 2092, 2093, 2095, 2097).
Fire Bay (Fire Cove) (Stark NV-2003, 2005).
Gale Hills south (Stark NV-1948).
Overton arm of L. Mead (Stark NV-1966, 1975, 1976, 1987, 1991).
Piute Point (Stark & Bonine NV-3104, 3111, 3113).
Westend Wash North (Stark NV-1881, 1882, 1883, 1886, 1887, 1894, 1900).

Muddy Mountains:

White Basin (Stark & Bonine NV-3022, 3027, 3028, 3030).

Gold Butte region:

Bitter Ridge (Stark NV-479).
Gold Butte (Marrs-Smith 22 Mar 1994: paratype).
Lime Ridge (Stark NV-440: paratype).
Red Bluff Spring (Stark NV-452: paratype).

Search for *Didymodon* in the NW Las Vegas Valley. In March of 2005, the U.S. Bureau of Land Management (BLM) was in the process of ruling on the suitability of land sales near the Sheep Range in Clark County, and its preliminary ruling was that more research needs to be carried out to determine if two rare species of flowering plants (including an *Eriogonum* and the Las Vegas poppy) occur in this buffer zone. Because the Evaluation species *Didymodon nevadensis* frequently co-occurs with the poppy on gypsum mounds both along the North Shore of Lake Mead and in the Gold Butte region, a field trip was conducted with the purpose of searching for potential sites of *Didymodon nevadensis*. This field trip was carried out with the assistance of

Mr. John Brinda, a Ph.D. graduate student in my lab. We stopped and investigated three sites in the general vicinity of these GPS coordinates: N36, 18.471, W115, 8.748. Although gypsum mounds were found at two of the sites, we were unable to locate *Didymodon nevadensis*. Similarly, a followup trip near Corn Creek Springs did not reveal any viable populations of this moss.

6. *Distichium inclinatum* (Evaluation Species).

Species description. *Distichium inclinatum* is known from eastern North America (Greenland and Labrador), the Pacific Northwest, and inland to Montana, Colorado, and Utah. In Nevada it is known from a single locality from a 1955 collection by Elva Lawton (then of the Univ. of Washington). This collection is from Deer Creek in the Spring Mountains. The genus *Distichium* is characterized by its shoots that appear plane (flat, two dimensional; Figure 11). Telling *D. inclinatum* from the closely related *D. capillaceum* can be difficult. The former species (*inclinatum*) has larger spores and more inclined and ovate capsules, whereas the latter species (*capillaceum*) has smaller spores and erect and cylindrical capsules. These differences are illustrated in Flowers (1973, page 99).

Taxonomic Notes. Two collecting trips were made in attempts to relocate this population at Deer Creek. The first trip revealed a sizeable population of its related species, *Distichium capillaceum*, which is known from three northern counties in Nevada, but had not been previously collected from Clark County. The second trip, conducted by my student John Brinda, located a specimen that may be referable to *D. inclinatum*. After study, Brinda determined the specimen from Deer Creek to be *D. inclinatum* based on capsule shape and degree of capsule inclination. However, a subsequent reexamination of this specimen (Brinda 436, Deer Creek Canyon above picnic area in mixed conifer forest on sandy soil at base of juniper) revealed that spore diameter is intermediate of the two species. Spore diameter was measured at a fairly constant 25 microns in the single capsules from Brinda 436; *D. capillaceum* is described as having spores 17-20 microns in diameter, whereas *D. inclinatum* is described as having spores 30-40 microns in diameter (in Lawton 1971, page 50). More recently, Dr. Rod Seppelt has completed his treatment of *Distichium* in North America for the Bryophyte Flora North America project (BFNA, posted on the web at: <http://www.mobot.org/plantscience/BFNA/>), and lists 25 microns as the minimum and maximum range of spore diameter for these two species. Seppelt distinguishes *D. inclinatum* from *D. capillaceum* on the basis of inclined capsules; capsules in Brinda 436 are either erect or inclined, so this feature is not definitively expressed in our population to date. Curiously, Flowers (1973), in his flora of Utah noted above, notes that hybrids between the two species may occur in Utah.

Status of *Distichium inclinatum* in Clark County. The present study definitely relocated a population in the genus *Distichium* from Deer Creek in the Spring Mountains, in the same vicinity as the original collection by Elva Lawton in 1955. This represents a noteworthy population in that it is the southernmost known locality for the species in the USA. Plants in this genus are discernable in the field with a hand lens, recognizable by the distichous habit of the shoots. Some of the patches in this population are referable to a very closely related species, *D. capillaceum*, which is known to occur more broadly in the state and North American continent.

One patch collected by John Brinda appears to be either *D. inclinatum* or a plant intermediate of *D. capillaceum* and *D. inclinatum*. While the capsules appear to be somewhat inclined, the diameter of the spores from this collection does not conform to known ranges for either species, rather falling in between published diameters. At this time, then, I am reluctant to state that *D. inclinatum* has been refound in Clark County.

7. *Grimmia americana* (Evaluation Species; also on Nevada Heritage Program sensitive list and on the Nevada Native Plant Society watch list).

Species Description. One of the rarest species of plants in the world, *Grimmia americana* is known from only three populations world-wide: one in west Texas, one in Arizona, and one from the Newberry Mts, Nevada (Clark County). Superficially in the field, this species resembles very closely one of the most common species of mosses in the state, *Grimmia anodon*. Both species occur on sandstone-derived boulders exposed to the sun and have asymmetrically attached capsules that are deeply immersed. In *G. americana*, capsules are peristomate and the upper leaf is bistratose (two cell layers thick); whereas in *G. anodon*, capsules are eperistomate and the leaves are only bistratose in lines (Figure 13).

Taxonomic Notes. In early 2006, Dr. Claudio Delgadillo examined the type of this species and made the following comments, from which I conclude that *G. americana* is indeed a good species. Because it might be expected to occur in northern Mexico, Dr. Delgadillo provided comments on discriminating between the Mexican *G. involucrata* and the American *G. americana*.

Quoting Dr. Delgadillo from an email correspondence:

“I have had the opportunity to examine the type of *Grimmia americana* and compare it against that of *G. involucrata*. Although these are very closely related species, there are some basic differences that indicate that they are taxonomically distinct. Essentially, in *G. americana* the distal two thirds of the peristome teeth are strongly perforated, the urn is distinctly ventricose, and the seta is sigmoid; the perichaetial leaves are differentiated and, although hyaline, are not as strongly so as in *G. involucrata*. The latter has peristome teeth that are hardly perforated (and perhaps not as broad as those of *G. americana*), the urn may be symmetric to slightly ventricose, and the seta varies from straight to slightly curved (not sigmoid). Because of the urn shape in *G. involucrata*, the seta insertion may be central or excentric; the perichaetial leaves are distinctly hyaline and differentiated.” --C. Delgadillo, UNAM, Mexico City.

In addition to Dr. Delgadillo, Dr. Jesús Muñoz, an expert on the genus in Europe, examined the Clark County specimen (Stark NV-16) and annotated it as *Grimmia americana*.

Attempts to relocate *Grimmia americana*. This species is known from a single site in southernmost Nevada, in Grapevine Canyon near the native American petroglyphs, Lake Mead National Recreation Area. Another collection series was made in this vicinity, and to date no collections of *G. americana* have been found. However, I have not had the opportunity to examine the entire collection series. Dr. Roxanne Hastings, a North American *Grimmia* specialist at the University of Edmonton (Alberta, Canada), examined a series of *Grimmia*

specimens from Clark County and he did not recover any collections of *G. americana*.

8. *Pseudocrossidium crinitum* (Evaluation Species).

Species description. This species was originally collected in Nevada in 1955, from the south end of Valley of Fire State Park (VFSP), on sandstone soil. This population was revisited in 1999 and appeared healthy at that time. In March 2006, the population was again revisited to assess its distribution and health. We found the population to be larger than originally thought, finding additional patches in the vicinity of "Mouse's Tank." These patches are more than likely part of the original population found in 1955 by Dr. Elva Lawton. Although still representing a fairly small population, it is clear that this population occurs over a greater area than the series of patches delineated in 1999 (~100 m²). We can state with confidence that this population at Valley of Fire State Park probably occurs in most ravines in the vicinity of Mouse's Tank, in southern VFSP. In addition, recent uncurated collections from the southern Newberry Mountains revealed a second population of *Pseudocrossidium crinitum* in Clark County. This species can occur on both rock and shaded soil surfaces, at times forming extensive mats. It resembles *Didymodon nevadensis* in its twisted leaf appearance and coloration (Figure 15). Like *D. nevadensis*, it is comprised of female-only plants, with males unknown in North America. Distinguishing features of *Pseudocrossidium* include highly revolute leaf margins and the presence of a distinct awn on the leaves. A rarity in the Mojave Desert, *Pseudocrossidium* becomes more common in the Chihuahuan Desert of southern New Mexico and west Texas, with a few scattered localities from southern California and one population in southern Utah.

Distribution in Clark County. Two populations are known, with details as follows for the specimens in the UNLV herbarium:

Valley of Fire State Park, 0.3 mi S of Mouse's Tank, sandstone bluffs within a mile of the visitor center, elev. 2296 ft (Stark & Bonine NV-3076, 3084, 3099).

Newberry Mountains, vicinity of Hiko Springs, elev. 1800 ft (Stark NV-3324, 3330, 3327, 3328, 3345, 3358).

From field observations, the population at Hiko Springs extends just inside the Lake Mead NRA border. I will need to process and identify this series of specimens in order to ascertain the presence of *P. crinitum* within the park; Hiko Springs is on U.S. Bureau of Land Management (BLM) land.

9. *Syntrichia princeps* (Covered Species).

Species description. This species is fairly common along the coast of California, Oregon, and Washington. However, in Nevada it is known from only three populations: one in Carson City Co. and two in Clark County. The most extensive population occurs near the mouth of Red Rock Canyon proper in the Red Rock National Conservation Area (RRNCA). A secondary population occurs in the Virgin Mountains and has not been refound since its discovery by Dr. Wesley Niles in 1996. In the field, the species resembles the related and common *Syntrichia*

ruralis (Figure 17). However, *S. princeps* is bisexual, whereas *S. ruralis* is unisexual (dioecious), and therefore our plants of *S. princeps* nearly always are productive of abundant sporophytes (presumably owing to self-fertilization). Plants can occur on boulders or soil above ~4000 ft in elevation. The diagnostic technical feature for the species is an inflorescence containing both sexual structures, termed synoicous.

Status and distribution of the populations. Attempts to relocate the only known population of *Syntrichia princeps* in the Spring Mts (and one of only two localities in Clark Co.) were unsuccessful in the Spring of 2004, despite many hours of searching. The area is rugged and steep. This single population was observed several times between 1994-1999, and last observed (and sampled by James Shevock of the Calif. Academy of Sciences) in 1999. I suspect that local flooding has covered the patch and that it has disappeared from this locality.

On a positive note, one new patch of *S. princeps* was found during a followup trip in May 2004 to the upper reaches of Red Rock Canyon. While searching intensively along north-facing sandstone bluffs in two sites, the following patch was identified and coordinates logged with a GPS given below.

N36E 9' 13.2", W115E 31' 11.1", elev. 5250 ft \pm 20 ft.

A very small section was collected in order to confirm its identity in the laboratory; identity was confirmed by detecting its synoicous inflorescence condition. This patch was curated and deposited into the UNLV bryophyte herbarium. This represents only the second known population (patch) of the species in the Spring Mts, but given that the other patch could not be refound, may be the only extant patch in the Spring Mts.

In the Spring of 2005, an exploratory collecting trip was conducted into the north fork of Pine Creek, with Jim Shevock and John Brinda, targeting evaluation and covered species in the Spring Mountains. No definitive patches of this species were recovered.

Known locations of *S. princeps* in Clark Co. based on specimens deposited in the UNLV herbarium:

Spring Mountains, Red Rock National Conservation Area, confluence of Red Rock Canyon and Red Rock Wash, elev. 4750 ft (Shevock 19081; Stark & Brinda 9May2004; Stark NV-291).

Virgin Mountains, E base of South Virgin Peak Ridge, Lime Spring Canyon (Niles 22Mar1996).

10. *Targionia* sp. nov. (Evaluation Species).

Species description. A liverwort, this species will be described as new to science by Dr. Alan Whittemore of the U.S. National Arboretum, probably in an upcoming volume of the in-progress multivolume set, Flora North America. *Targionia* sp. nov. seems to be a Mojave Desert endemic, distinguished from the related *T. hypophylla* by spore ornamentation features (Whittemore 1996). It is bisexual, and occurs in deeply shaded habitats where ferns are found, at

elevations above 4000 ft. Large, healthy populations of *Targionia* have been found in Red Rock Natural Conservation Area, near White Rock Spring, in the Newberry Mountains near Christmas Tree Pass, and in the Eldorado Mountains near the mouth of Keyhole Canyon. In the field, it looks like green (if wet) or black (if dry) ribbons along the north side of boulders or in deeply recessed cliff overhangs. This genus is apt to be confused with the genus *Mannia* if sporulating plants are absent from the population (Figure 19).

Assessment of Clark County populations of *Targionia*. Three investigations were carried out relating to the evaluation species *Targionia sp. nov.*, an undescribed Mojave Desert endemic species of liverwort. First, in March 2005, I assessed the largest known population of *Targionia* in Clark County, at White Rock Spring within the Red Rock NCA. This population is under the rock overhangs just above White Rock Spring, and spans about 100 meters, with GPS coordinates as follows: N36, 10.448, W115, 28.718 (UTM coordinates, with an error of 24 feet). Photographs and a sample collection were taken at this time. A closer look in the field revealed that the plants were in full sporophyte (“fruit”), with the extension of the sporophyte above the thallus exceedingly long for this genus. Therefore, I collected a portion for further analysis. In the lab, Mr. John Brinda identified the collection, surprisingly, as *Mannia californica*, and this determination has been confirmed by Dr. Alan Whittemore of the U.S. National Arboretum. It is possible that the constitution of the population has changed and been partially taken over by *Mannia*, or, that the population represents a mixture of these two species, and because of difficulties discerning the two genera when not in fruit, has remained a mixture for the last 11 years following discovery.

Secondly, another Spring 2005 trip was conducted to White Rock Spring to confirm that both *Targionia* and *Mannia* were present in this population, with John Brinda. We found both species (Brinda was instrumental in locating the *Targionia*), and in one patch they were growing adjacent to one another. Most of this population, which sprawls from near the parking area for White Rock Spring to beyond the spring itself (~100 m), is composed of the only locality in the state for *Mannia californica*. A search of online web resources revealed a Lavin specimen at NYBG from NW Nevada. GPS coordinates as UTM coordinates were retaken: Zone 11, East 0636824, North 4004129, √23 ft, elevation 4818 ft. Both species were in abundant fruit (liberating spores), no doubt resulting from the abundant rains this region has had during the previous months. A few specimens were collected for deposition at UNLV and also to send duplicates to Mr. Shevock and Dr. Whittemore.

Thirdly, I reviewed the UNLV holdings of *Targionia* in light of the *Mannia californica* finding at White Rock Spring, and inquired to Dr. Alan Whittemore of his private herbarium holdings to see if he retained a specimen from the mid-1990s of this population. He replied that he did not have such a specimen. UNLV herbarium specimens were examined to see which specimens were definitively referable to *Targionia* by the presence of spores:

- Eldorado Mts, base of Keyhole Canyon (Stark NV-201).
- Newberry Mts, LMNRA, Pipe Spring (Stark NV-98A, 102, 104A).
- Newberry Mts, LMNRA, Grapevine Canyon (Stark NV-28, 153)
- LMNRA, 3 mi S of Rogers Spring (Stark NV-2052).

Spring Mts, Red Rock NCA, White Rock Spring (Stark and Brinda s.n., 25 Mar 2005).

11. *Trichostomum sweetii* (Evaluation Species).

Species description. This moss is known globally from seven populations, and is one of only two bryophyte species to be originally described from the state of Nevada (*Didymodon nevadensis* is the other). The type locality is from Yant Pit Canyon in the Virgin Mountains. Recent attempts to relocate the type population of this species in the Virgin Mountains proved unsuccessful (Stark 1996). One large population was located on the ancient sand dune formations at the Red Stone Picnic Area within the Lake Mead NRA. Another population was recently found near Zzyzx Rd. in the Eastern Mojave of California. The plants occur in sandstone rock crevices sheltered from direct sunlight. Wet or dry, the plants appear green. Distinguishing features of *Trichostomum* relative to the related genus *Weissia* include the very slight incurvature (or erect) of the leaf apex in the former, as opposed to the highly incurved leaf margins in *Weissia* (Figure 21).

Taxonomic considerations. As the editor of the family Pottiaceae for the Bryophyte Flora North America (BFNA) project originating from the Missouri Botanical Garden, I reviewed Richard Zander's proposed manuscripts on *Weissia* and *Trichostomum* for the upcoming publication of BFNA. I suggested to Richard that *W. perligulata* and *W. sweetii* are synonymous and should be called *T. sweetii*, as put forth in Stark (1996). He agreed with this (rather than place *W. perligulata* into *W. ligulaefolia*), but still maintained that *T. sweetii* is synonymous with the east Asian *T. planifolium* (Dixon) R.H. Zander. As such, *T. planifolium* is known from Japan and China, then disjunct to the southwestern USA from only a few localities. In light of the fact that the type locality of *T. sweetii* is in Clark County (Virgin Mts) and could not be refound, this species, however broadened in concept, should be maintained on local conservation lists.

My graduate student, John Brinda, took an interest in this rare species and attempted to refind the type locality by reconstructing historical events surrounding the type collection of Nathan Sweet in 1941. John spent several days and visited the Rancho Santa Ana Botanical Garden in Pomona, CA, attempting to find clues to the location of Yant Pit Canyon. He then reviewed the relevant literature on *Weissia/Trichostomum*, and examined a set of southern Nevada specimens; here are the notes of his investigations:

For the Nevada checklist of mosses in preparation by Brinda and co-workers (Brinda et al. 2007), it was necessary to determine whether the type of *Trichostomum sweetii* (E. B. Bartram) L. R. Stark was actually collected in Clark County and if possible to revisit the type locality. Doubt had been expressed in the past and there was reason to believe that the real type locality was possibly in California instead. The difficulty lies in the fact that the locality description of "Yant Pit Canyon, Virgin Mountains, Clark Co." from Bartram's type description is of little help. This is because the name "Yant Pit Canyon" is not on any map of the general area surrounding the Virgin Mountains that was examined, including historic maps. It is also not found on any list of place names for the state. The name was probably in vernacular use in the area and has since been lost. Local historians were consulted but they had no specific knowledge of the locality. They

could confirm however, that “Yant” is the Paiute word for *Agave* and that a yant pit is a pit constructed by native americans for roasting *Agave* (E. Warren, personal communication). These pits are of interest to archeologists and doubtless the name was given to the canyon by archeologists working in the area. While other scientists would certainly have had the opportunity pick up this name, it apparently never came into use by the local residents. Fortunately this piece of information did allow us to narrow the search somewhat to canyons with abundant *Agave* populations.

The next approach was to investigate the collector of the type, N. C. Sweet, in order to find out what brought him to Nevada on June 5, 1941. An internet search revealed a handful of collections in the 1940’s but all were from California, which again raised doubts about the type really being from Nevada. His collections were mostly at the herbarium of Pomona College (now at Rancho Santa Ana Botanic Garden), so the next logical question was, why? His collections only covered a short period and he seemed to have stopped collecting and gone on to other things. On the hunch that he was a student, I searched the Pomona College library for anything he may have authored. Much to my surprise, it turned out he had actually written a Master’s thesis on the mosses of southern California (Sweet 1943). This still did not explain why he was in Nevada collecting mosses until I noticed that his thesis advisor was P. A. Munz, an important vascular plant collector. Munz collected plants in Clark County in 1941, probably for his treatment of the Onagraceae of Nevada, number 32 in the Contributions to a Flora of Nevada series. By cross-referencing some of Munz’s collections with Sweet’s it was possible to determine that Sweet accompanied Munz on his trip to Nevada in 1941, probably as an assistant.

Munz’s field notes reside at the Rancho Santa Ana Botanic Garden (RSA), where he worked for many years. Irene Holiman, the librarian at RSA, was very helpful in obtaining both Sweet’s thesis and the appropriate pages from Munz’s field notes for June 5, 1941. Naomi Fraga, also at RSA, was also kind enough to help my cross-referencing efforts by looking up Munz’s collections in the RSA herbarium. Munz’s field notes are very brief and do not include a detailed itinerary, however his collection numbers 16747-16759 were made at “east fork of Yant Pit C 4600.” The 4600 matches the elevation (in feet) at which the type of *T. sweetii* was collected.

The list of plants is as follows:

- 16747 *Spiraea caespitosa*
- 16478 *Cryptantha flava* Pays
- 16479 *Cercis occid.* Torr
- 16750 *Tragia ramosa* Torr
- 16751 fungus on *Symphoricarpos longiflorum*
- 16752 *Notholaena jonesii* Maxon
- 16753 *Encelia frutescens virginensis* Blake
- 16754 *Oryzopsis hymenoides* Ricker
- 16755 *Forsellesia nevadensis*

16756 *Gaura coccinea* var. *glabra*
16757 *Eriodictyon angustifolium* Nutt
16758 *Arenaria macradenia* Wats.
16759 *Galium stellatum* Kell.

The next plant on the list is 16760 *Agave utahensis* Engelm. collected at the slightly lower elevation of 4300 feet so we can be fairly certain of the source of the name “Yant Pit Canyon.” This prompted the idea of cross-referencing the plants collected by Munz with localities published in a Master’s thesis on the vegetation of the Virgin Mountains by Armstrong in 1969 provided to me by Dr. W. Niles and K. Birgy. While many of the species are common, quite a few are listed by Armstrong as restricted to the southern canyons in the Virgin Mountains. With the inclusion of this information, the search area was narrowed enough to permit a relatively efficient search effort.

Two main canyons enter the Virgin Mountains on the south side; both are unnamed on any official map. One of these is the obvious entry point for Munz’s group since it has a road most of its length and was the site of the “Nay Summer Camp.” This area is called “Nay Canyon” in Armstrong’s thesis and has many of the plants collected by Munz on his trip as well as good bryophyte habitat on the north-facing slopes. It is a bit puzzling though, because it does not have an obvious “east fork” at the elevations listed by Munz. Another canyon with no name parallels “Nay Canyon” just to the west. This other canyon is also promising because it has a more obvious “east fork” and while it remains roadless it is still relatively accessible. Also, according to W. Niles (personal communication) “Yant Pit Canyon” may be one of the lower canyons in that area and is probably not the same as “Nay Canyon.” Both of these canyons were searched in early 2006 for populations of *T. sweetii* and collections made of plants that looked promising.

Examination of the collected specimens proved difficult because, despite fairly good treatments of the group for our area by Ann Stoneburner and Richard Zander, problems remain. Recent molecular work by the Werner lab in Spain has clarified some things but has also generated additional questions (Zander, personal communication). It was necessary to not only study the collections of putative *T. sweetii* but all of the closely related species in the group that occur in our area. Besides discovering two species not yet reported for Clark County, *Weissia ligulifolia* (E. B. Bartram) Grout and *Trichostomum planifolium* (Dixon) R. H. Zander, this work has possibly uncovered some of the sources of these taxonomic problems. The following statements are necessarily provisional since they follow from the study of specimens from a very small area.

Stoneburner (1985) synonymized *Weissia sweetii* and *W. perligulata* with *Trichostomum crispulum* Bruch. Zander (1993), in his book on the family Pottiaceae, recognized both species as distinct and transferred *W. perligulata* to *Trichostomum*. Stark (1996) synonymized *W. sweetii* with *T. perligulatum*, generating the new combination *Trichostomum sweetii* (because *W. sweetii* is the older name). Zander, in his recent web-based treatment of the genus as part of the Bryophyte Flora North America (<http://www.mobot.org/plantscience/BFNA/>), synonymized *T. sweetii* with an even older

name, *W. planifolia*, as *Trichostomum planifolium*. One wonders though, if he considered the two species separately or simply followed the opinion in Stark's 1996 paper. My own investigations suggest that *T. sweetii* and *T. planifolium* represent two different entities, based in part on differences in leaf width, with leaf width in *T. sweetii* much less than that allowed for *T. planifolium* by Zander's web-based treatment.

While it is perhaps easier to accept *T. perligulatum* and *T. planifolium* as synonymous, *T. sweetii* seems closer to *W. ligulifolia*. In the area examined, the degree of inrolling of the leaf margin is sometimes less constant than leaf shape. Therefore the long-ligulate leaf of *W. ligulifolia* when unrolled approaches *T. sweetii*. Specimens from the Virgin Mountains appear to exhibit such variation. Flowers (1973) may have included plants with narrower leaves as in *W. sweetii* in his concept of *W. perligulata*, prompting his statements regarding a possible connection between *W. perligulata* and *W. ligulifolia*. These statements were discounted by Stoneburner but perhaps too quickly. Flowers' experience of mixed collections containing *W. ligulifolia* and the more plane margined species is very common in southern Nevada. In fact because of the difficulty in identifying these species in the field one will often only collect the more common *Weissias*. It is only by reaching far back into the deep shade of recesses that one will find typical *Trichostomum*; here it is often associated with *Fissidens* spp. That the plane leaf margins may be a plastic response to low light levels cannot be wholly discounted without the appropriate growth experiments. Though their study is not without problems, the Werner lab of Spain suggested in 2005 that the elements of *Trichostomum* may not form a natural group and this mirrors the comments of Zander. In Werner et al.'s phylogram *W. ligulifolia* falls in with species that are variously *Weissia* or *Trichostomum*. Determining whether *W. sweetii* and *W. perligulata* together bridge the gap between *W. ligulifolia* and *T. planifolium* is beyond the scope of this project. In addition, further study of the type specimen *T. sweetii* appears to be called for. Therefore *T. sweetii* should be retained on the Nevada checklist until these problems can be resolved. --contributed by John Brinda, UNLV.

Assessment of the health and numbers of populations. In November 2004, a collecting trip to Red Stone Picnic Area, LMNRA, with John Brinda was carried out in an attempt to assess the health and distribution of *Trichostomum sweetii*. Unfortunately, we could not refind the original series of patches upon which the Stark (1996) paper was based. At present it is unknown if the population was destroyed or simply that we were unable to refind it. However, we were able to find a new patch at the base of one of the ancient sandstone dunes, not far from the turnoff from Northshore Road into the Redstone Picnic area. GPS coordinates of this small population (a patch with dimensions no more than 10 x 10 cm): N36, 14.488 W114, 31.108, ∇16 feet, elevation 2250 ft. This specimen represents the 3rd locality (from two populations) in Clark County of this endemic western species.

Other Noteworthy Species not on the official Clark County list

The following species were encountered during the course of this project, and while not on the official Clark County list as evaluation/covered species, I list below some of the more significant

species about which we should be aware.

Aloina rigida

During the unsuccessful attempt to find new populations of *Didymodon nevadensis* in the NW Las Vegas Valley, another rare gypsophilous bryophyte of interest was recovered and found to be a mucous (no leaf hairpoint present) species in the genus *Aloina*. Using Dr. Delgadillo's *Flora North America* key of *Aloina* posted on the web (<http://www.mobot.org/plantscience/BFNA/>) and the California key of Norris and Shevock (2004a), the specimen was identified preliminarily as *Aloina rigida*. It will have to be confirmed by the world expert in the genus, Dr. Claudio Delgadillo (UNAM University, Mexico City), because the diagnostic feature (a well defined basal leaf marginal limbidium) is demonstrated on only a few leaves. Fruiting material is necessary for Delgadillo's confirmatory identification, and at this point fruiting material has not been encountered. *Aloina rigida* is present in California and in New Mexico, but otherwise disjunct, so this locality in southern Nevada, if confirmed, represents a new state record for Nevada according to its distribution map posted on the web in Delgadillo's *Flora North America* treatment, used in conjunction with the data in the bryoflora of California by Norris and Shevock (2004b). The specimen of this putative species was curated and deposited it into the UNLV herbarium, and Mr. Shevock was notified of the existence of this species. GPS coordinates for this state record were forwarded to BLM personnel as information pertinent to their pending decisions on the status of these lands.

Anthoceros carolineanus

During the Pine Creek collecting trip with James Shevock and John Brinda, we found the first recorded hornwort for Clark County. Brinda tentatively identified it as *Anthoceros carolineanus*, sent a duplicate specimen to Dr. William Doyle of UC Santa Barbara for confirmation, and the confirmation was received (despite the absence of sporophytes) from Dr. Doyle. The Pine Creek watershed is thus considered highly diverse and worthy of followup investigations for potential bryophyte disjuncts.

Barbula convoluta

While exploring for *Trichostomum sweetii* in LMNRA, Red Stone Picnic area, also found was another locality of *Barbula convoluta*, a rare species in Clark Co. This species awaits laboratory confirmation, and would represent only the second known locality in the county.

Cratoneuron filicinum

A specimen from Deer Creek was originally thought to be *Amblystegium noterophilum*, as identified by Mr. Clayton Newberry, and to represent its first appearance in southern Nevada. However, Mr. James Shevock and Dr. Daniel Norris (USFS and UC Berkeley, respectively) named the plants as *Cratoneuron filicinum*. Although common in Nevada along streamlets and springs with carbonate ions in the water, the species remains rare in Clark County, and this specimen represents only the second locality. The other known location is also in the Spring Mts (Cold Creek); Elva Lawton found *C. filicinum* both at Deer Creek and Cold Creek (Lawton 1958).

Entosthodon planoconvexus

This species is known from just outside the northern border of Clark County, in Nye County, and thus is expected to occur within Clark County. It is a significant species geographically because there are only three known localities in the world (one in southern Utah, one in Arizona, and the Nye County population). Access to the UNLV herbarium collection of this species was requested and granted to Dr. David Anderson of Bechtel Nevada, Nevada Test Site Operations. This species occurs just over the Clark County border in Nye County at the southern edge of the Nevada Test Site. Dr. Anderson subsequently revisited the population in the Spectre Range and sent me photos documenting the population location and a duplicate specimen that awaits analysis.

Eurynchium pulchellum

A specimen collected from Red Rock NCA was determined by Mr. Newberry as *Eurynchium pulchellum* (Hedw.) Jennings. There are no specimens of this species currently in the UNLV herbarium, and none are listed in Stark and Whittemore (2000) from southern Nevada. It is reported from California as fairly common (Norris and Shevock 2004b), who also cite Harthill et al. (1979), so I assume it is found in southern California, which would make it expected in southern NV. I sent this specimen to Shevock for confirmatory identification, since it looks to be a NV state record. In the words of Shevock: "The other plant labelled as *Eurhynchium pulchellum* is not that species. Dan and I think it probably is a *Eurynchium*, but we are not sure what species it is at this time. The sample is a bit small, so it's hard to tell if it is just depauperate for that location site. We will probably have to wait until we have other *Eurhynchium* material to study to figure out what it most likely should be." Therefore I shall keep an eye out for this plant and collect more material as it becomes available.

Fabronia pusilla

Two patches of *Fabronia ciliata* were found at:

N36E 9' 12.4", W115E 31' 10.0", elev. 5300 ft ∇ 20 ft.

N36E 9' 50.4", W115E 30' 35.5", elev. 5100 ft ∇ 50 ft.

Apparently this species is new to the Mojave Desert, even though I had previously collected *Fabronia* from Red Rock Canyon (uncurated in personal herbarium, L. Stark). This species appears to be common in California but rare from Nevada or Utah. One specimen is in the UNLV herbarium from Douglas Co., NV.

Homalothecium nevadense

While identifying the series of collections from Red Rock Canyon, I came across only the second known population from Clark County of the pleurocarpous moss, *Homalothecium nevadense*, in the uppermost reaches of the canyon in a north-facing region seldom receiving direct sunlight and close to (i) the *Syntrichia princeps* original population and (ii) the *Claopodium whippleanum* series of populations recently discovered. The collection was verified by Mr. Clayton Newberry. The only other known location of this species in Clark County is in Wood Canyon of the northern Spring Mts.

Specimens of *H. nevadense* were recently deposited into the UNLV herbarium by Mr. James

Shevock (USFS and Calif. Academy of Sciences) from several northern Nevada counties (Washoe, Elko, Carson City, Douglas). This species is listed in Flowers (1973) as occurring from British Columbia to California, and in Montana, Colorado, and northern Arizona. Clark County populations (2) appear to be disjunct from northern Arizona, Utah (no county distributions are given in Flowers 1973 for this species, so we can probably assume it is widespread in Utah), and northern NV.

Mannia californica

A routine inspection of the *Targionia* sp. nov. population at White Rock Spring (Red Rock NCA) revealed a reproducing population of the liverwort *Mannia californica*, the first time this species has been found in Nevada. Its identity was confirmed by Dr. Alan Whittimore of the U.S. National Arboretum (Washington, D.C.).

Porotrichum bigelovii

A single patch of *Porotrichum bigelovii* was collected at the base of Lost Creek Trail in Red Rock NCA, near the waterfall. This species should be added to the list of species of concern for the county. This population represents the only known locality of this species in the state of Nevada. Originally discovered at Lost Creek (RRNCA) in 1999, by Dr. John Spence (U.S. Nat. Park Service, Page, Arizona), and later reassessed with a followup collection made in 2003 by Stark and Shevock, the specimen is curated as follows: Shevock & Stark 23975, shaded seep of rock wall (CAS, UC, UNLV).

Pterygoneurum lamellatum

A specimen of *Pterygoneurum lamellatum* from Henderson, NV was curated; it represents a state record that was found as part of a study of the reproductive biology of this species. Sporophytes were cultured to maturity and the identity confirmed. I consider this species to be fairly common in the county, although at the moment only a single population has been documented.

***Syntrichia cainii* or sp. nov.**

My graduate student, John Brinda, while collecting near the boundary of North Las Vegas and Lake Mead NRA (in BLM lands), found one of the rarest plants in the world, known previously from three populations (two in Ontario, Canada, and one in Colorado). According to the genus expert (Dr. Brent Mishler, Univ. Calif. Berkeley), the Colorado population is referable to another species, leaving only the type locality in Ontario as the only known specimens. *Syntrichia cainii* had not been found in many years, and is known only from asexual plants. This is a remarkable find and this species, once its taxonomic relationships are clear, deserves listing as an evaluation species for the county. The location is near a high impact area, where graffiti is common and littering evident, not far from the “great unconformity” of Frenchman Mountain. In the spring of 2006, Dr. Mishler examined the specimen and agreed it was either *S. cainii* or an undescribed species. Brinda has the specimen in culture and this work is in progress.

Tortula guepinii

A pair of specimens from the Eldorado and Newberry Mountains was determined by Dr. Richard Zander (Missouri Botanical Garden) as *Tortula guepinii*. In the words of Dr. Zander, “both are *Tortula guepinii* (B.&S.) Broth. The peristome is short, the awn is brown and short, the leaves

are latifolia-ish.” A check of the distribution of *Tortula guepinii* using web sources reveals that it occurs in these countries/states: Spain, Netherlands, Sweden, British Columbia, Baja California, Alberta, Pima County Arizona, and in California (Norris & Shevock 2004b). This species therefore appears to be a state record for Nevada. Presently there are 9 collections from two populations of *Tortula guepinii* in the UNLV herbarium, all from either the Eldorado or the Newberry Mts, and all collected in 1994, a very wet winter (1993/94). A duplicate specimen (NV-205) was shipped to James Shevock (California Academy of Sciences) to be deposited at the UC Berkeley herbarium and which will serve as a reference collection to facilitate publication of this species as a new Nevada record in the next article on Nevada mosses led by Mr. Shevock (to be published in the journal Madrono).

Tortula muralis

Dr. Richard Zander identified a specimen collected on the outskirts of east Henderson (foothills of River Mts) as *Tortula muralis* Hedw. This specimen (Stark 12 Dec 2004) was curated and deposited into the UNLV herbarium. According to James Shevock (Cal Academy), the specimen from Clark County of this species represents a new Nevada state record, and was deposited in the UNLV herbarium. This particular species is fairly common outside of Nevada, often in urban settings (James Shevock, personal communication, 2005).

Additional Activities/Accomplishments

Designing a web-based herbarium record system for UNLV. In order to better organize both the rare and common species of interest in Clark County, John Brinda and I are designing a software system that is web based and which will house and organize all of the UNLV bryophyte records on a computer housed in my lab and purchased through this grant. This will enable approved individuals to have access to geographical location data for species of concern. To date we entered data from ~100 herbarium specimens into the database (it is not completed).

Fields we are incorporating into the web-based system include all of the information normally found on herbarium specimens, namely:

- species name and author
- collector and collector number and/or date
- location of the population
- reproductive status of the population
- GPS coordinates
- elevation
- person who identified the species
- images of the specimen

Detailed location data for the rare species will be protected through a password approval system, and access to the system will be limited to approved professional biologists and other appropriate individuals. Once the system is completed, Clark County personnel and UNLV personnel will have access.

Manuscripts/Publications/Presentations produced

Four manuscripts, one local press article, and a powerpoint presentation given to the Nevada Rare Plant Group have been produced as a result of this contract, as follows (these are attached to this report as hardcopies excepting the presentation, which is sent on a CD as a powerpoint file along with this report):

Shevock, J. R., J. R. Spence, and L. R. Stark. 2005. *Contributions toward a bryoflora of Nevada: bryophytes new for the Silver State*. Madroño 52: 66-71.

Spence, J. R., L. R. Stark, and J. R. Shevock. 2006. *Contributions toward a bryoflora of Nevada: Bryophytes new for the Silver State. Part II*. Madroño 53: 400-403.

Brinda, J. C., L. R. Stark, J. R. Shevock, and J. R. Spence. 2007. *An annotated checklist of the bryophytes of Nevada, with notes on collecting history in the state*. Bryologist 110: in press. (a copy of the accepted manuscript is printed accompanying this report)

Stark, L. R., J. Spence, J. R. Shevock, and J. Brinda. *Contributions toward a bryoflora of Nevada: Bryophytes new for the Silver State. Part III*. Madroño, in manuscript (not yet available).

Local press coverage: Las Vegas Sun, Feb 27, 2006, "*For moss, it's not all that easy to find love*", by Abigail Goldman.

Stark, L. R. 2006. An Evaluation of Non-vascular Plants of Concern in Clark County, final report. presented to the Nevada Rare Plant Working Committee, March 2006. [powerpoint file]

Evaluation/Discussion of Results

Summary and Recommendations for *Anacolia menziesii*. This study expands the known distribution of *Anacolia menziesii* from one to three populations (Figure 2). Presently this species is known from both the Spring Mts and the Virgin Mts. The population from the Spring Mts (Red Rock Canyon proper) appears to be in good health and established in many patches along the north-facing base of Red Rock Canyon in a rugged, cliffed area that is not in any immediate danger of impacts. The population from Pine Creek Canyon is substantially more limited in distribution, confined to specific areas along the canyon wall. The Virgin Mountain population appears to be substantially smaller, limited to a single locality near Cabin Creek. I anticipate finding additional patches of *Anacolia menziesii* in the Red Rock general area, most likely in Icebox and Oak Creek Canyons. Nevertheless, I have yet to observe sexually reproducing patches of *Anacolia*, which likely means that our populations consist entirely of female plants. Recommendations are for the BLM Red Rock managers to be made aware of the extraordinarily rich (in biodiversity) region along Red Rock Canyon, where several rare species of bryophytes can be found, to be used in their park planning/inventory processes.

Summary and Recommendations for *Claopodium whippleanum*. This study expands the known distribution of *Claopodium whippleanum* within Clark County from a single, potentially extinct patch in Red Rock Canyon, to several healthy patches in Red Rock Canyon and a single patch in Pine Creek Canyon (Figure 4). No sexual reproduction has been observed, and therefore it is likely that our patches consist entirely of female plants. The two populations in Clark County are precarious because of the absence of male plants and sexual reproduction, and because of the small patch size that presently exists in these two canyons. The single patch in Pine Creek Canyon is only a few centimeters across and subject to flooding by Pine Creek. Recommendations include followup visits to the Pine Creek population to note presence or movement of this patch, and to search for additional patches. The Red Rock Canyon patches occur on rugged slopes and are not endangered by human impacts. This population should be assessed every few years.

Summary and Recommendations for *Crossidium seriatum*. Questions remain about the taxonomic position of *Crossidium seriatum* in relation to a closely related Spanish species oddly enough in another genus, *Tortula brevissima*. Nevertheless, *C. seriatum* is quite distinct morphologically in the USA, clearly set off from other representatives in the genus. Over the last two years, the range of *C. seriatum* within Clark County has been significantly expanded to include areas to the north and to the southeast of the cities of Las Vegas and Henderson. These localities add to the more remote localities on gypsum and sandstone where *C. seriatum* is known along the north shore of Lake Mead. At this time it can be stated that *C. seriatum* is known within Clark County from healthy populations along the North Shore of Lake Mead (a series of populations), from the Muddy Mountains, from the Newberry Mountains, from the Gold Butte region, and from the northwest and southeast portions of the Las Vegas Valley (Figure 6). Those plants in the BLM buffer zone in the northwest portion of the valley are most likely subject to impact from the high rate of development in the area, but should be assisted by the land recently set aside for the Las Vegas poppy. Preservation of this population will depend on the restriction of foot, vehicle, and horse traffic, because simply stepping on the population will destroy the plants by compacting the gypsum soils and modifying the microhabitat.

Summary and Recommendations for *Dicranoweisia crispula*. The distribution of this species has been expanded to include not only the original Lee Canyon locality (still not refound), but also two additional populations in the Spring Mts: Deer Creek and the Bonanza Peak Trail (Figure 8). These populations appear to be in good health and with additional exploration the prospects of finding more populations is promising in areas of down or charred wood. The next step in the management of this species is to investigate new probable localities for additional populations.

Summary and Recommendations for *Didymodon nevadensis*. The type locality of this species is near Gold Butte, NV, and in this region the species is well populated. It is most likely that the species evolved here, since nowhere in the world is it more abundant; in fact, the Gold Butte region represents the only significant “population” of the species in the world, with other localities restricted to single or a few patches. A second smaller “population” occurs along the North Shore of Lake Mead in gypsum/sandstone habitats, particularly near Blue Point Spring and

the White Basin region (Figure 10). During the course of this study, I was not able to adequately assess the health of these two populations. Each needs to be revisited in light of the recent drought cycle affecting Clark County.

Summary and Recommendations for *Distichium inclinatum*. Despite two trips to the Deer Creek area and searching the vicinity, plants unequivocally determined as *Distichium inclinatum* have not been recovered (Figure 12). The Deer Creek Picnic Area of the Spring Mts is rich in habitats for mosses, and is also very accessible to the public. Therefore some concern exists for potential human impacts upon the available habitat. I recommend that the Forest Service be apprised of how to recognize *Distichium* patches in the field in order that they are able to recognize potential habitat for this rare species. The taxonomic problem associated with this closely related species pair is clearly impeding a clear-cut species determination. The species needs to be relocated with abundant sporophytes, and the capsules and spores reexamined in order to ensure proper species identification.

Summary and Recommendations for *Grimmia americana*. Attempts to relocate the specimen of *Grimmia americana* in Clark County, collected by the author in 1994 (Stark NV-16), have been unsuccessful. Despite a variety of collection efforts in other parts of the county, this species has not been found. The Clark County population at Grapevine Canyon is only one of three known sites in the world (Figure 14), and represents the last known definitive collection that has been made (the Texas and Arizona populations have not been refound). Therefore, this species is probably highly sensitive to any perturbations to its habitat and may have a difficult time establishing new patches. Given the high public access to this site, and the presence of the population at the very point of public visitation (the mouth of the canyon at the petroglyphs is where public activity and the *Grimmia* population co-occur), an acute concern is present for potential habitat damage to occur from humans climbing about the boulders and/or vandalizing the rock art (which occurred a few years ago).

Summary and Recommendations for *Pseudocrossidium crinitum*. Clark County populations of this species (Figure 16) are considered vulnerable because of (i) the absence of male plants at both sites, and (ii) the relatively small size of each population. At Hiko Spring, the population of *Pseudocrossidium crinitum* is less than 100 m², while at Valley of Fire State Park (VFSP) the population is larger. In terms of potential impacts, the population at Hiko Spring is subjected to higher human impacts than the population at VFSP. However, the VFSP population is one of the most highly visited regions in the park, Mouse's Tank. Mitigating this is the recent finding that the population is not restricted to the immediate vicinity of Mouse's Tank, but occurs on both sides of the access road to the park, with much of the population not exposed to park visitors and in fairly rugged sandstone formations. The Hiko Spring canyon in which *P. crinitum* grows was the site of a planned burn to eradicate tamarisk growth along the stream in the late 1990s, charring the canyon and in some instances the canyon sides. Nevertheless, the *P. crinitum* population at Hiko Spring survived this burn. BLM personnel should be apprised of the precise location of the plants at Hiko Spring so that this can be considered in any further plans to develop this site. There is fairly heavy off-road use in the Hiko Spring area, and it would be optimal if this spring can be better protected in the future. I am happy to assist BLM and NPS personnel in the field recognition of *Pseudocrossidium*; it is one of the bryophyte species of

concern that can fairly easily recognized in the field.

Summary and Recommendations for *Syntrichia princeps*. In Clark County, two (and potentially three) populations of *S. princeps* have been verified, one in the Spring Mts and one in the Virgin Mts (Figure 18). The population in the Spring Mts is within the Red Rock NCA and in the same vicinity as three other county evaluation/covered species: *Anacolia menziesii*, *Claopodium whippleanum*, and *Targionia* sp. nov. This particular locality, near the mouth of Red Rock Canyon proper, represents an amazingly diverse site and a refugium for rare species. Also in this area are species of concern that are not part of the official listing for the county: *Porotrichum bigelovii* (this is its only known locality in the state of Nevada), and *Scleropodium* sp. (one of the few known localities in the state of Nevada). It therefore stands to reason that Red Rock/U.S. BLM personnel should be alerted to the refugial value of this area and to limit further development of the Willow Springs and Lost Creek picnic/trail areas. These two areas are perhaps the most commonly used facilities in the park, and are within a half-mile of the refugial region. Fortunately, the refugial region is in a rugged area and part of a steep north-facing canyon wall not very accessible to hikers or large animals.

Summary and Recommendations for *Targionia* sp. nov.. In Clark County, five sporulating populations of *Targionia* sp. nov. are known (listed above), with four of the five within or closely adjacent to the Lake Mead NRA. The largest population resides at White Rock Spring in the Red Rock NCA. Non-sporulating populations tentatively identified as *Targionia* sp. nov. are known from five additional sites (Figure 20). This undescribed species is not uncommon within the county, and ranges throughout the Mojave Desert, from Joshua Tree National Park into southern Utah. The White Rock Spring population is unique in its size and composition. It is clearly the largest known population of *Targionia* sp. nov. in the state of Nevada, and has not only the *Targionia* plants but also plants of *Mannia californica*. This species of *Mannia* is known from the state of Nevada only from White Rock Spring. White Rock Spring includes a parking area and hiking trails easily accessible to the public. The population itself is directly above the pond fed by the spring, and people can frequently be seen climbing among the boulders along the face of the outcrop, precisely where these two liverworts are growing. The Red Rock NCA staff should be made aware of this population and consider its presence in any expansion/management of the White Rock Spring trailhead.

Summary and Recommendations for *Trichostomum sweetii*. This rare species is found on sandstone formations in Clark County. However, despite the presence of a single patch in the River Mts (which was collected), the only known population occurs on the ancient sand dunes of Red Stone Picnic Area in Lake Mead NRA (Figure 22). These dunes are a common point of public use, including hiking, horseback riding, and picnicking. The sandstone is soft and easily disturbed by climbing about the formations. I was unable to relocate a previously large segment of the population on one of the sand dune formations, and the status of this population consisted of a single patch as of the fall of 2004. My recommendation is to show the Lake Mead NRA botanist what the plant looks like and the kind of habitat it prefers (shaded sandstone rock crevices), and to keep track of its status on a yearly or biennial basis. Given the history of the type location presented above under Brinda's notes, it is wise to continue to track down the type population in Yant Pit Canyon. Given the difficulty of the taxonomy of this species, it is

suggested that at some point a separate molecular study be conducted of the related species in this group in order to ascertain which element is represented in Clark County.

Conclusion (taken mostly from Executive Summary)

This project investigated the status, health, and projected persistence of the 11 bryophyte (also known as nonvascular plants) species of concern (7 Evaluation species and 4 Covered species).

Taking the results on a species-by-species basis, in six cases (*Anacolia menziesii*, *Crossidium seriatum*, *Dicranoweisia crispula*, *Didymodon nevadensis*, *Syntrichia princeps*, and *Targionia* sp. nov.), the number of existing populations was expanded significantly and/or judged not to be under immediate threat of extinction. The ranges of *Anacolia menziesii* and *Crossidium seriatum* were significantly expanded by exploration of immediately surrounding regions where the initial population was found. This was also true for *Dicranoweisia crispula* despite being unable to locate the original collection from the 1950s. In the case of the gypsumophile *Didymodon nevadensis*, two gypsum-rich regions in the upper Las Vegas Wash were explored for potential new populations, but this species was not found. For *Syntrichia princeps*, one of two known populations was refound, and additional populations are anticipated to exist in the county. Although the undescribed species of *Targionia* is relatively common in southern Nevada, one population is highlighted in this report because it is the largest population known in the county and also the only site in the county of another rare liverwort that has been recommended for listing, *Mannia californica*.

In three cases (*Claopodium whippleanum*, *Pseudocrossidium crinitum*, and *Trichostomum sweetii*), the known distribution of populations was expanded but they are still known from just a handful of precariously small patches. Previously known from only a single patch (a subunit of a population, taken here to be on the order of 10-20 cm wide and 10-20 cm long), *Claopodium whippleanum* is now known from two localities and several patches; nevertheless, these locations are subject to flooding and persistence is doubtful. Two populations of *Pseudocrossidium crinitum* exist in Clark county, and one of these was significantly expanded by exploration. This species is female-only in the county and the second population is subject to human impacts. The single known population of *Trichostomum sweetii*, while refound as a fragment, is considered highly vulnerable and followup censuses are needed.

In two cases (*Distichium inclinatum* and *Grimmia americana*), the original historic population could not be relocated despite searches, with the latter of these two species being a global rarity. Searching for *Distichium inclinatum* in the Spring Mts failed to turn up the species at Deer Creek; however, there are concerns about the taxonomic status of this species. *Grimmia americana* remains one of the rarest plants in the world, and I was unable to relocate the single Clark County population collected in the 1990s. This locality (Newberry Mts) receives high impacts from human visitation.

Thus, six of the eleven species of bryophytes were found to be in fairly good shape insofar as their frequency and health, whereas five of the eleven species are viewed as precarious based upon their low population numbers or extreme rarity. In at least three cases (*Grimmia*

americana, *Targionia* sp. nov., and *Trichostomum sweetii*), the listed species is a member of a complex of closely related species that complicates their correct identification.

Finally, two species, *Porotrichum bigelovii* and *Manni californica*, are suggested to be added to the County list of bryophytes of concern, based on the presence of a single population of each species found in Clark County (and nowhere else in the state).

Recommendations

Recommendations for each species are given above in the section Evaluation/Discussion of Results.

Literature Cited

Brinda, J. C., L. R. Stark, J. R. Shevock, and J. R. Spence. 2007. An annotated checklist of the bryophytes of Nevada, with notes on collecting history in the state. *Bryologist* 110: in press.

Flowers, S. 1973. *Mosses: Utah and the West*. Brigham Young University Press, Provo, UT. 567p.

Harthill, M. P., D. M. Long, and B. D. Mishler. 1979. Preliminary list of southern California mosses. *Bryologist* 82: 260-267.

Lawton, E. 1958. Mosses of Nevada. *Bryologist* 61: 314-334.

Lawton, E. 1971. *Moss Flora of the Pacific Northwest*. The Hattori Botanical Laboratory Supplement No. 1, Nichinan. 362p.

Norris, D. H. and J. R. Shevock. 2004a. Contributions toward a bryoflora of California I. A specimen-based catalogue of mosses. *Madroño* 51: 1-131.

Norris, D. H. and J. R. Shevock. 2004b. Contributions toward a bryoflora of California: II. A key to the mosses. *Madroño* 51: 133-269.

Stark, L. R. 1996. The status of *Weissia sweetii*, a species endemic to the southwestern United States. *Bryologist* 99: 345-348.

Stark, L. R. 2000. Bryophyte inventory of the North Shore region of Lake Mead in Clark County, Nevada, Oct. 15, 2000, joint report to U.S. Bureau of Land Management and Lake Mead NRA, 49 pp.

Stark, L. R. and A. T. Whittemore. 2000. Bryophytes from the northern Mojave Desert. *Southwestern Naturalist* 45: 226-232.

Stoneburner, A. 1985. Variation and taxonomy of *Weissia* in the southwestern United States. II.

Taxonomic treatment. *Bryologist* 88: 293-314.

Werner, O., R. M. Ros, M. J. Cano, and J. Guerra. 2002. *Tortula* and some related genera (Pottiaceae, Musci): phylogenetic relationships based on chloroplast *rps4* sequences. *Plant Systematics and Evolution* 235: 197-207.

Whittemore, A. T. 1996. The taxonomy of *Targionia* (Targioniaceae) in North America (abstract). *American Journal of Botany* 83 (6 suppl.) 22-23.

Zander, R. H. 1993. Genera of the Pottiaceae: Mosses of Harsh Environments. *Bulletin of the Buffalo Society of Natural Sciences* Vol. 32. Buffalo, NY. 378p.

Zander, R. H., L. R. Stark, and G. Marrs-Smith. 1995. *Didymodon nevadensis*, a new species for North America, with comments on phenology. *Bryologist* 98: 590-595.

Figure 1. *Anacolia menziesii* (mm scale).



Figure 2. *Anacolia menziesii* distribution in Clark County

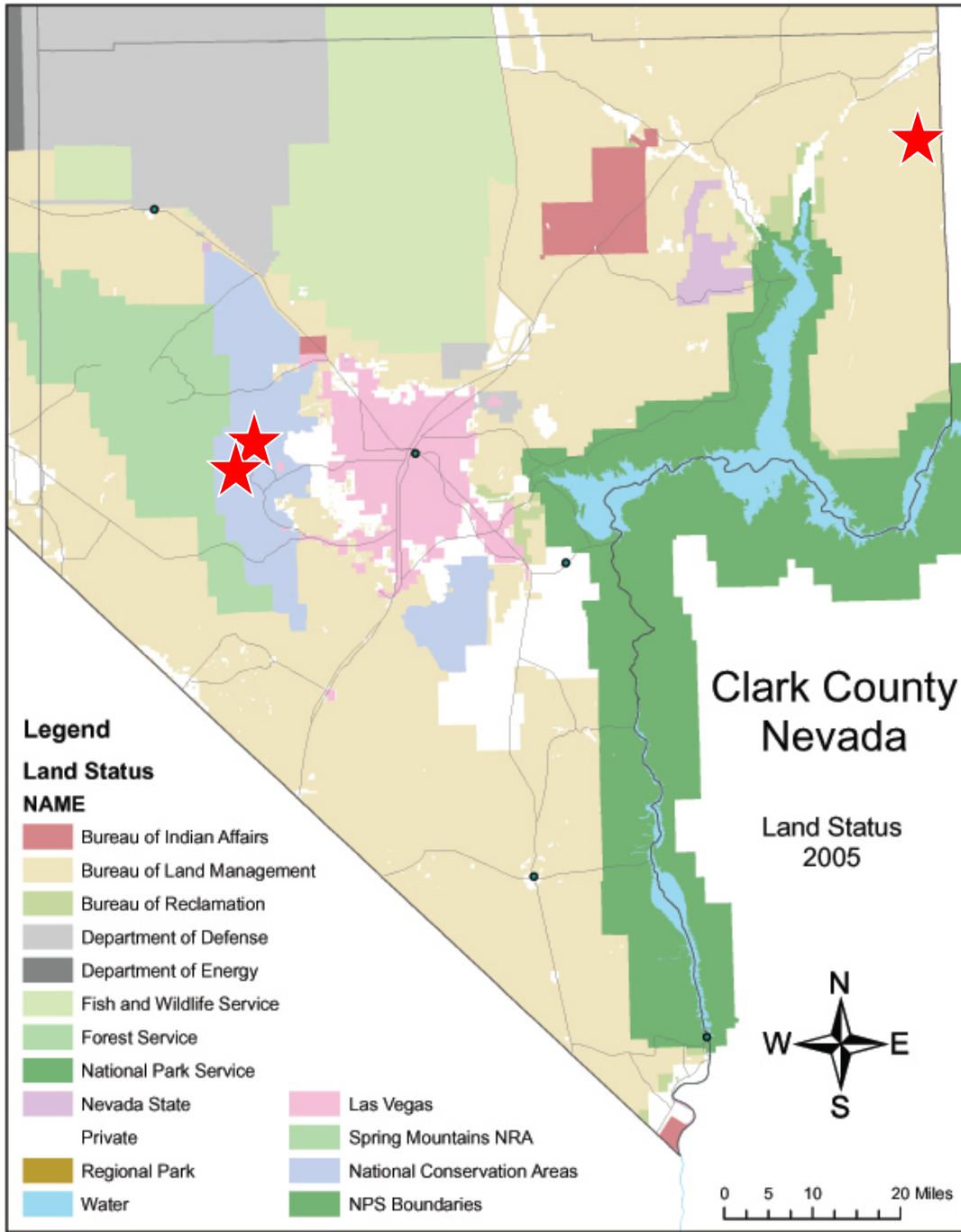


Figure 3. *Claopodium whippleanum* (mm scale).



Figure 4. *Claopodium whippleanum* distribution in Clark County.

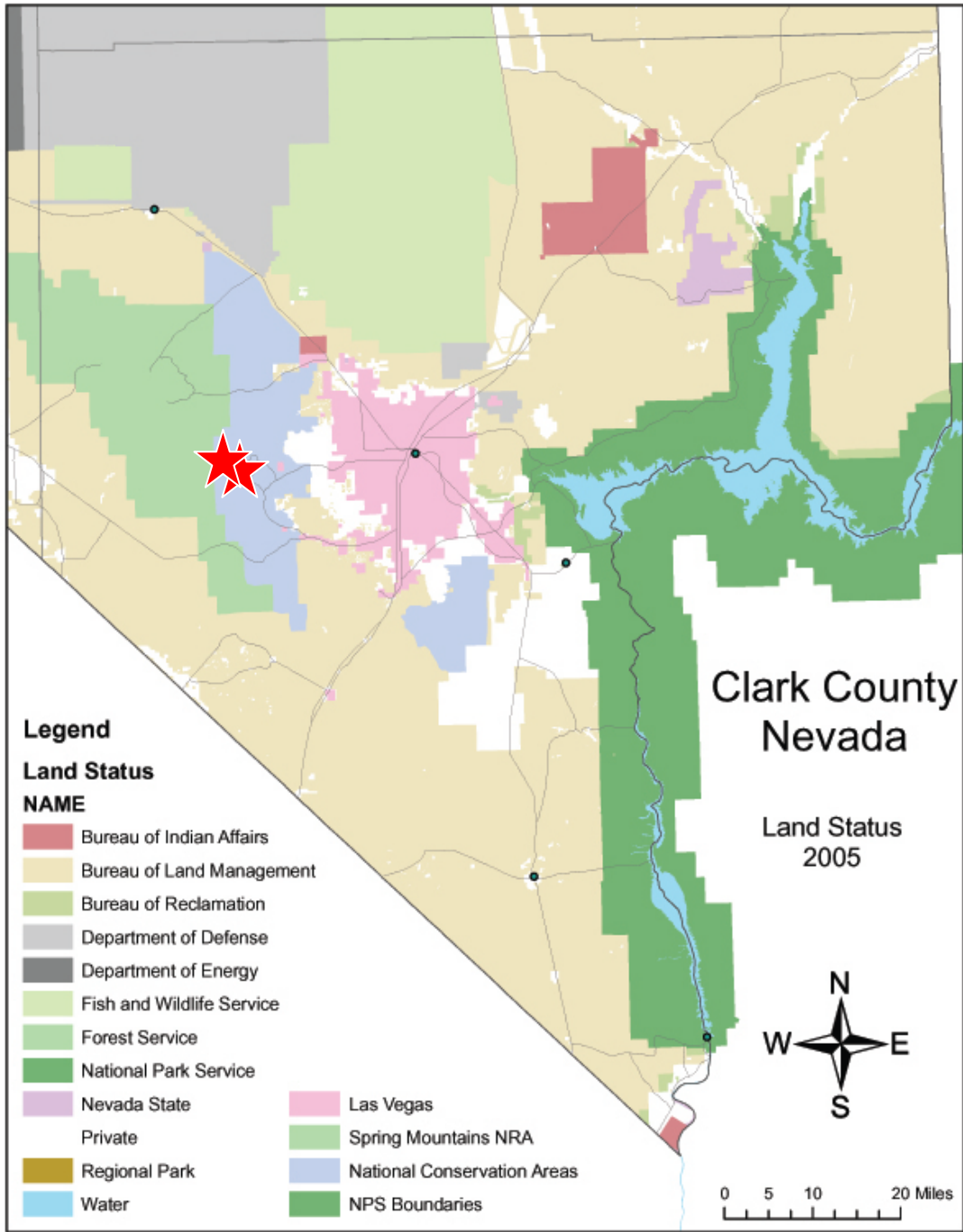


Figure 5. *Crossidium seriatum*. A: Leaves of *C. seriatum* (upper right) contrasted with those of *C. crassinerve* (lower left). B. Closeup of leaf of *C. seriatum*.



Figure 6. *Crossidium seriatum* distribution in Clark County.

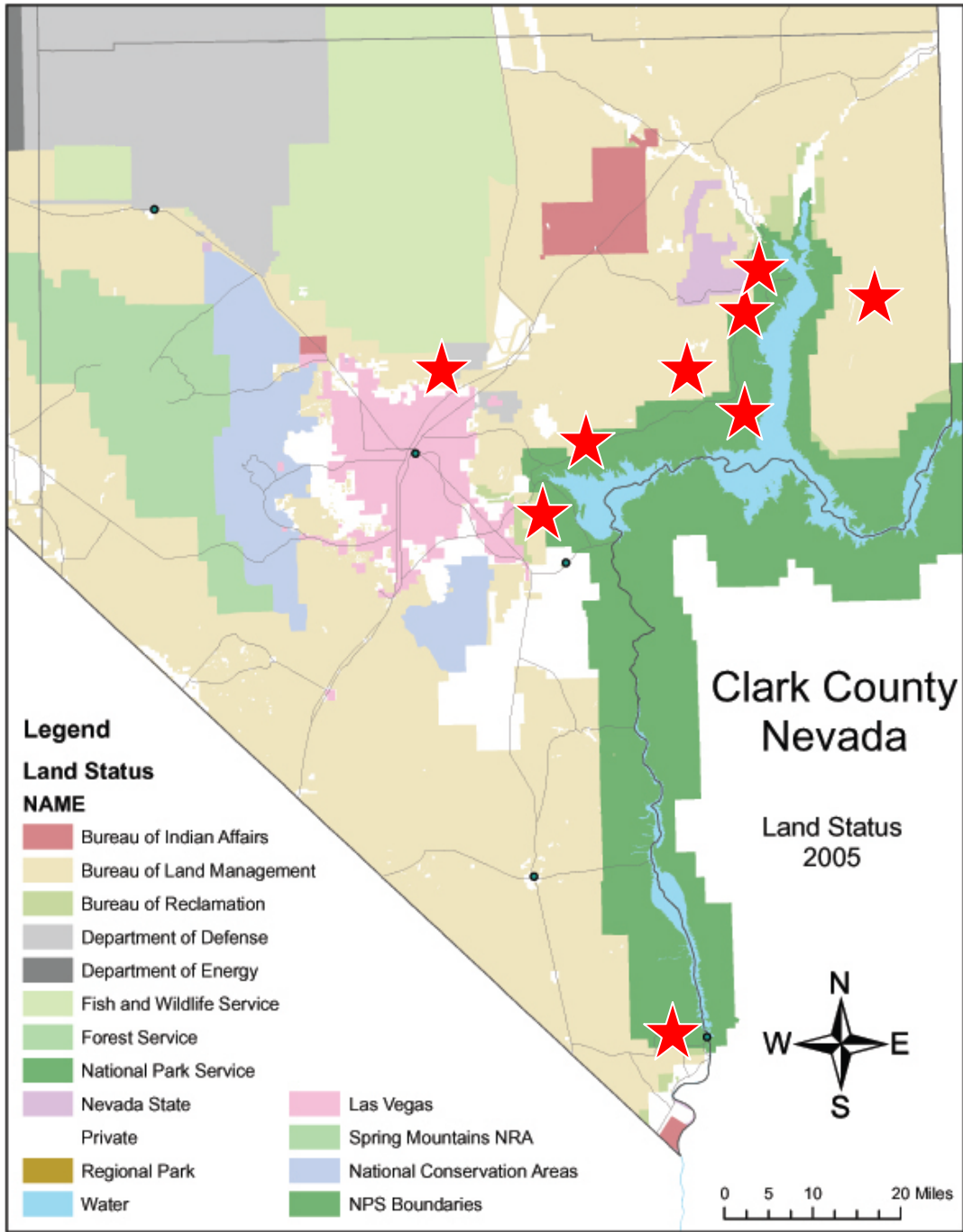


Figure 7. *Dicranoweisia crispula* (mm scale).



Figure 8. *Dicranoweisia crispula* distribution in Clark County.

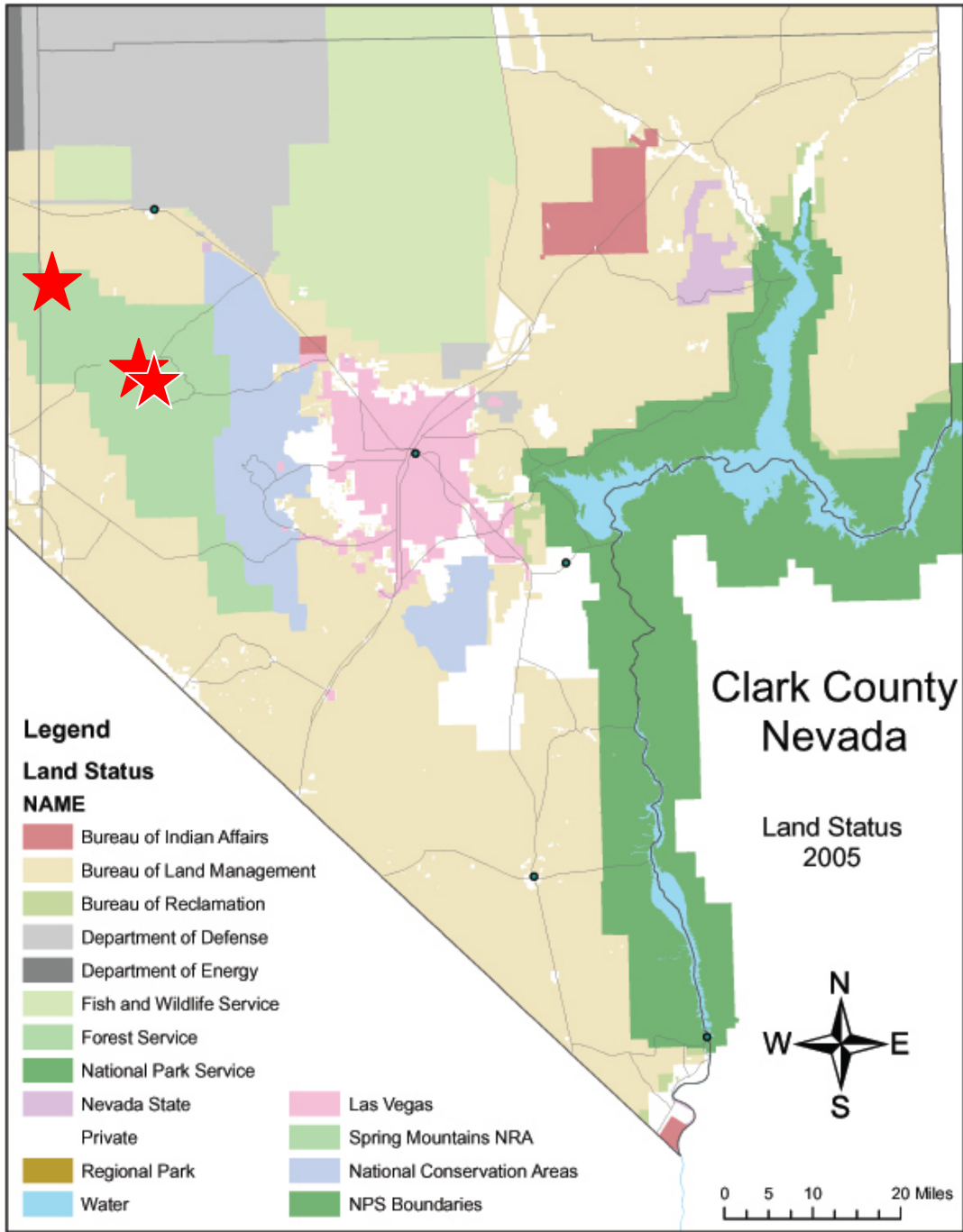


Figure 9. *Didymodon nevadensis*. Left: dry shoots (mm scale). Right: closup of leaves (mm scale).

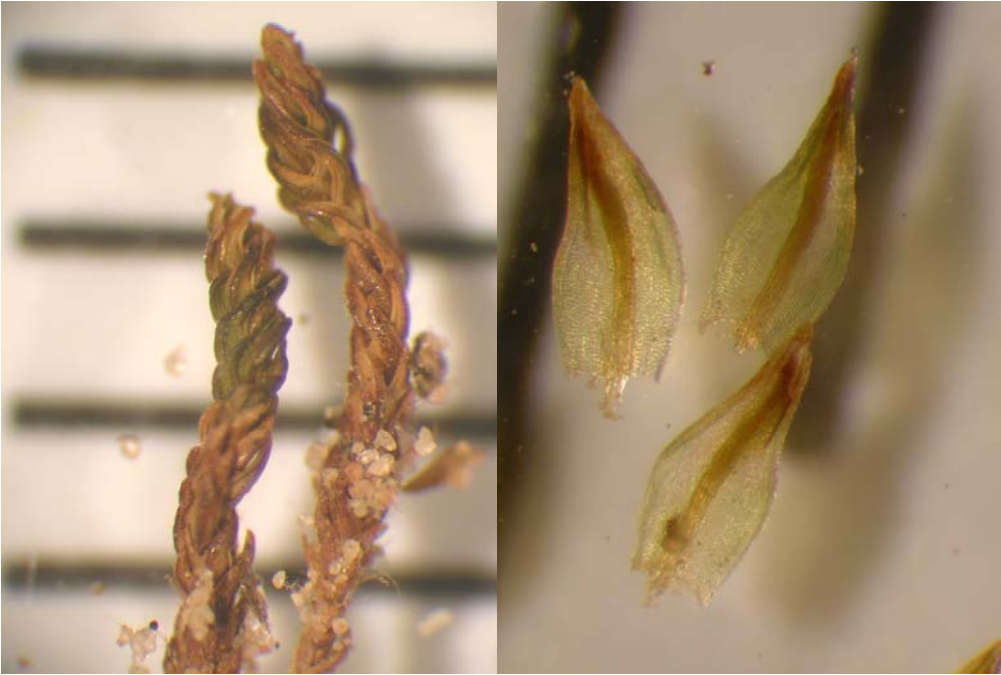


Figure 10. *Didymodon nevadensis* distribution in Clark County.

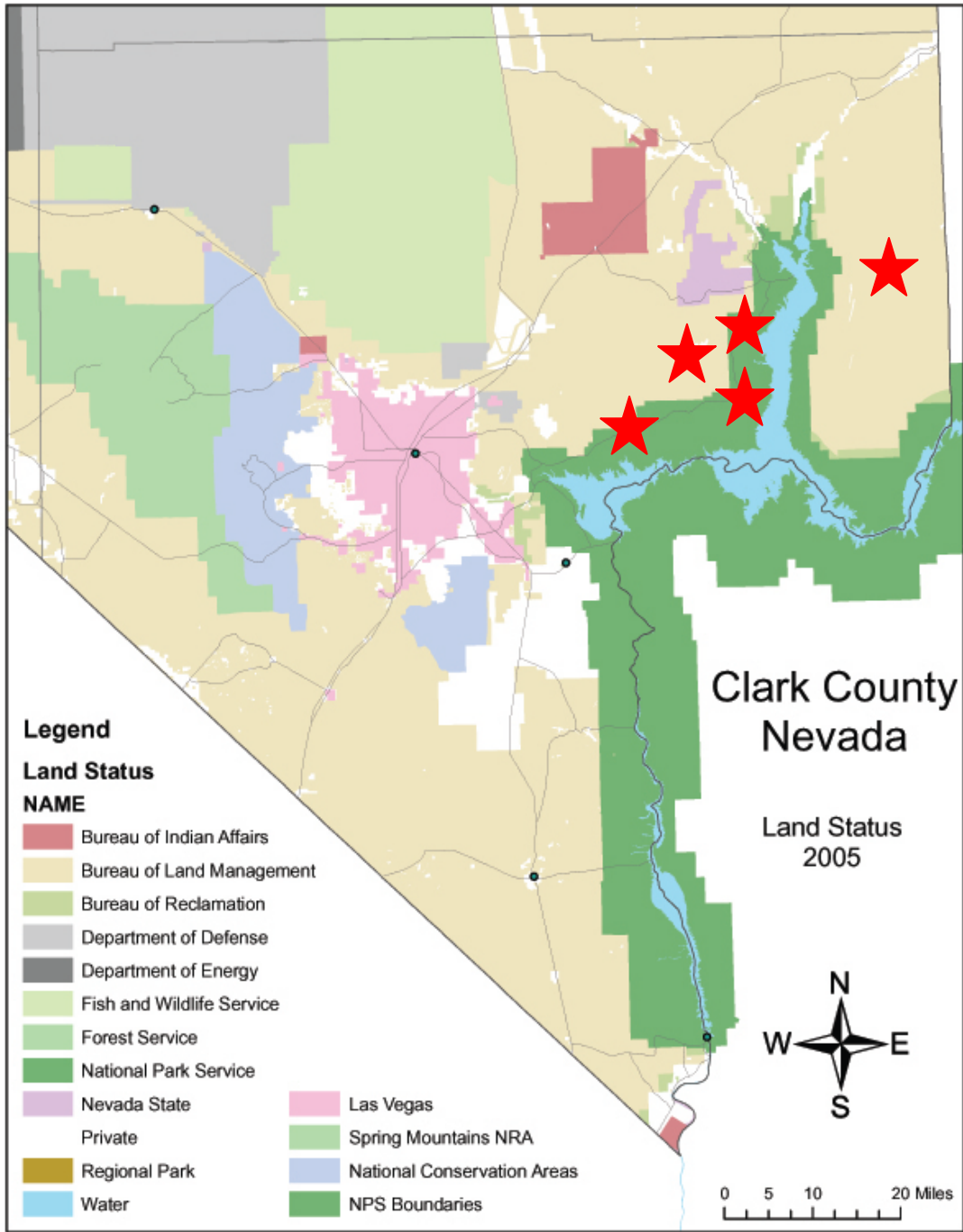


Figure 11. *Distichium inclinatum* (mm scale).

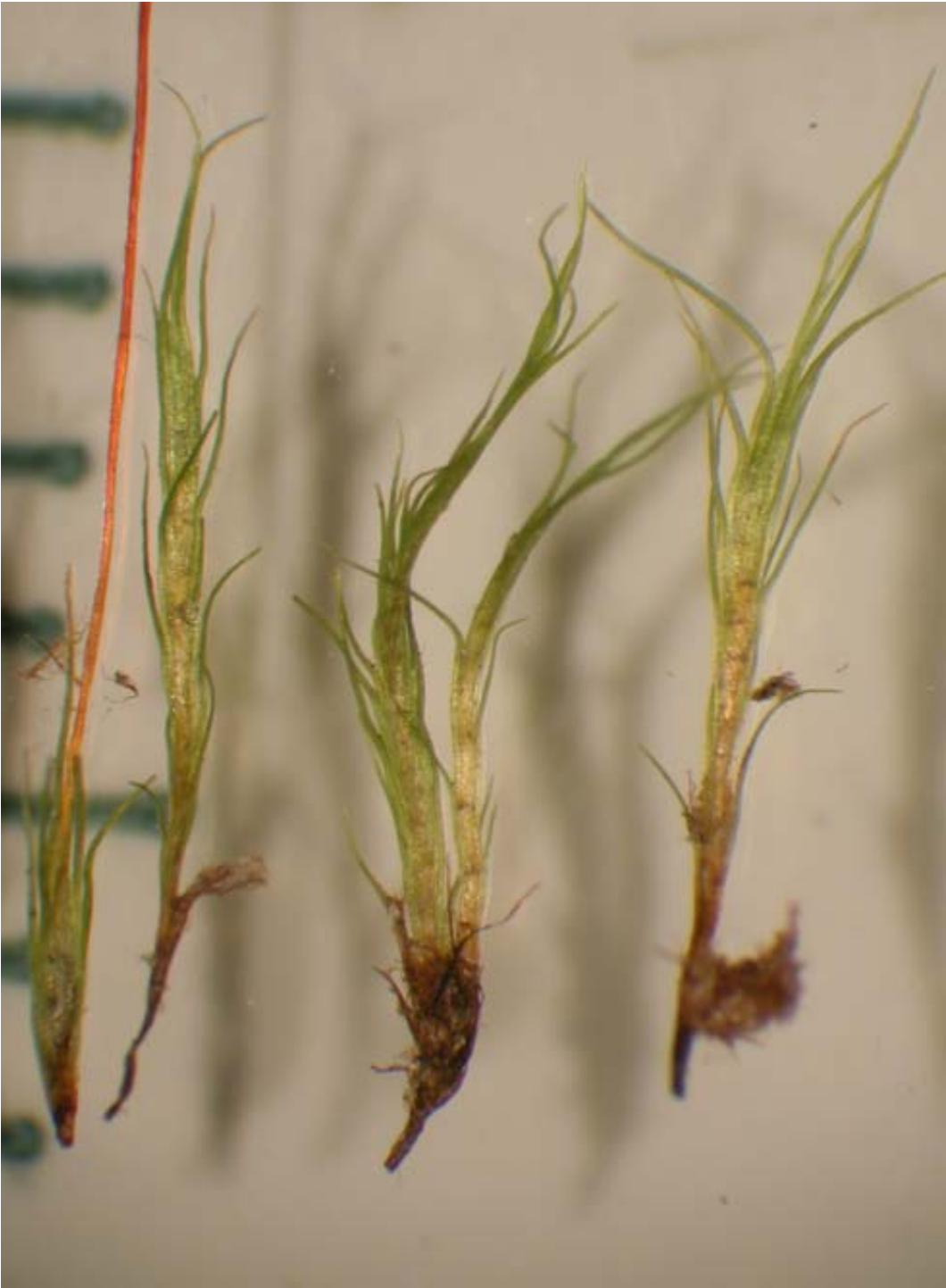


Figure 12. *Distichium inclinatum* distribution in Clark County.

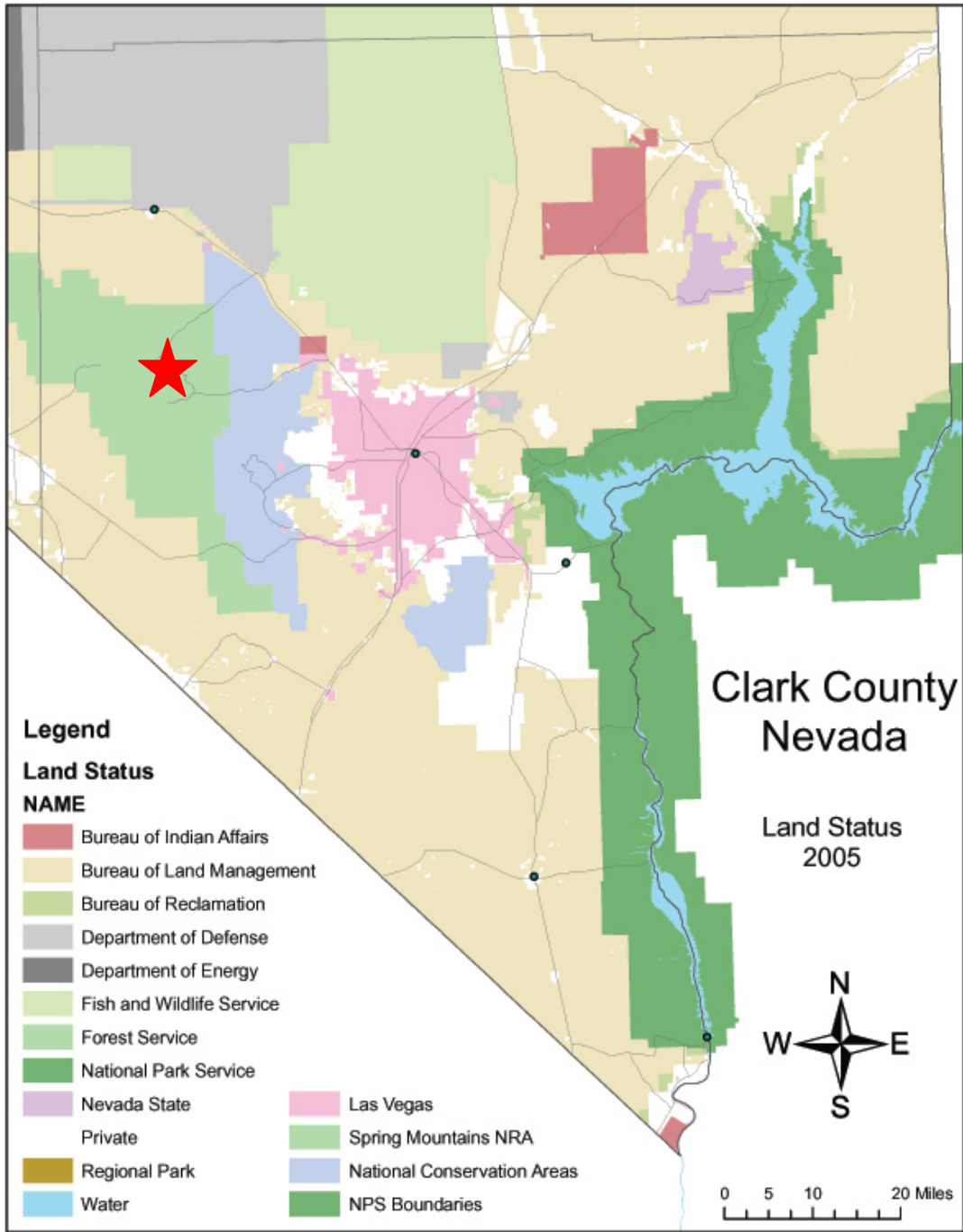


Figure 13. *Grimmia americana* (mm scale). Two plants at the right have sporophytes.

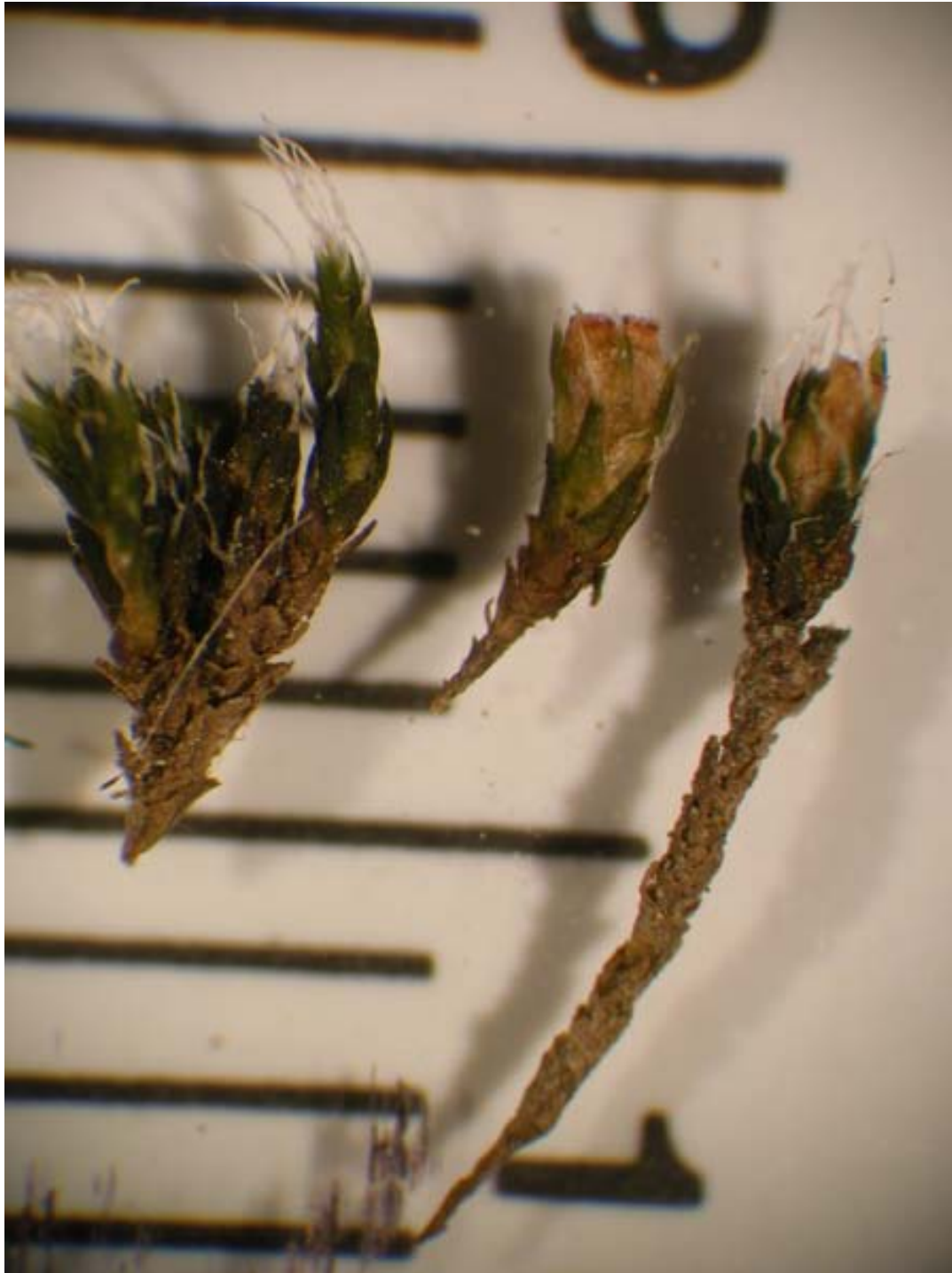


Figure 14. *Grimmia americana* distribution in Clark County.

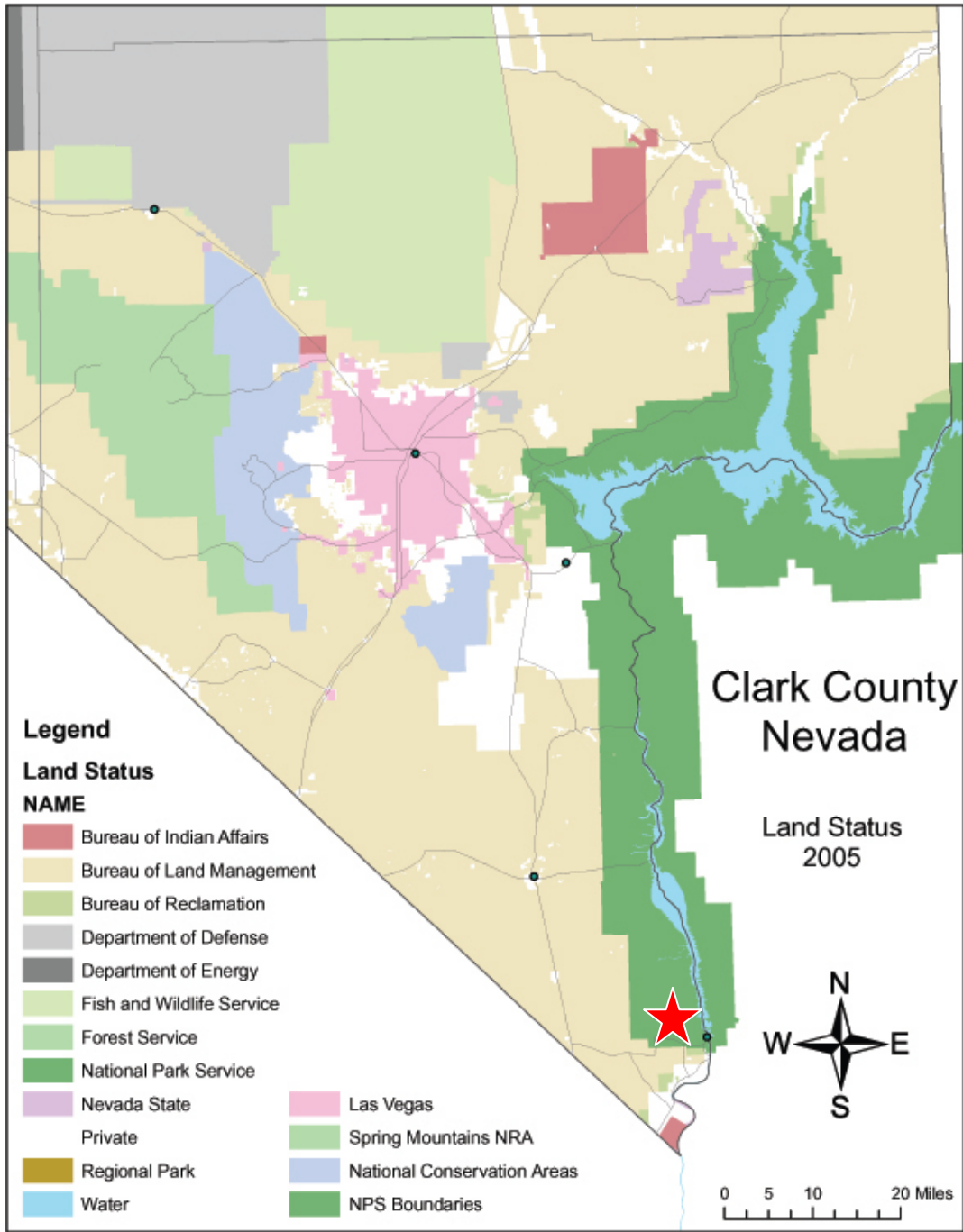


Figure 15. *Pseudocrossidium crinitum*. Right: dry shoots (mmm scale). Left: closeup of leaves.

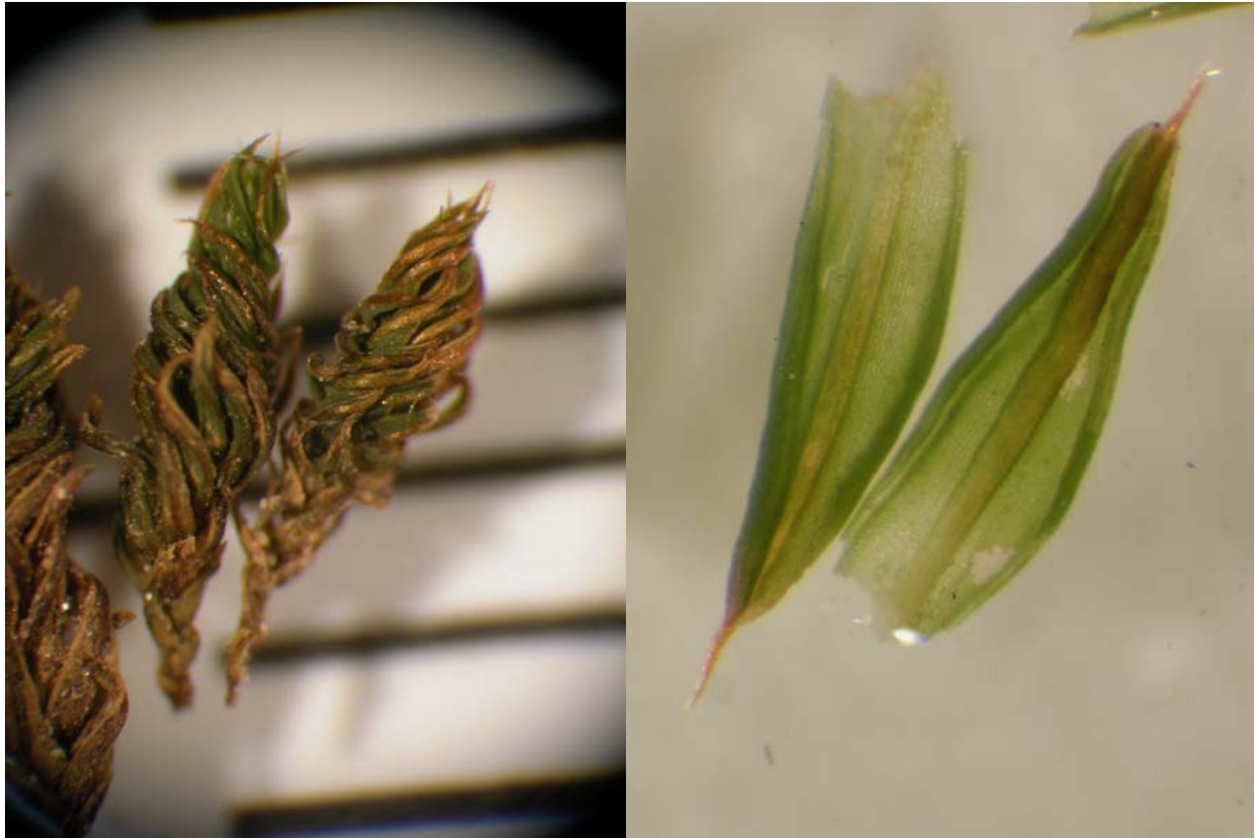


Figure 16. *Pseudocrossidium crinitum* distribution in Clark County.

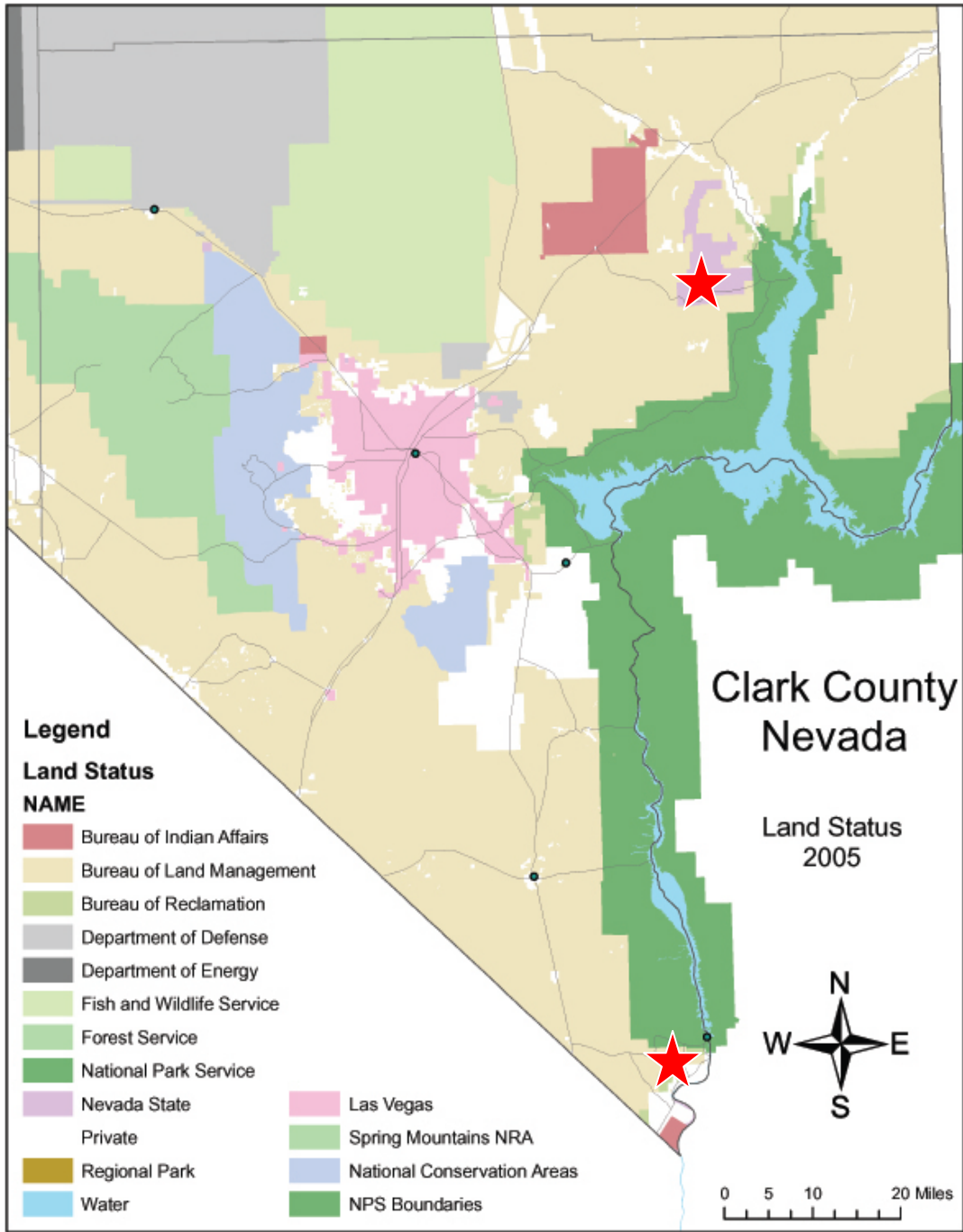


Figure 17. *Syntrichia princeps*. Comparison of dry and wet shoots (mm scale).



Figure 18. *Syntrichia princeps* distribution in Clark County (hollow star indicates the population could not be refound).

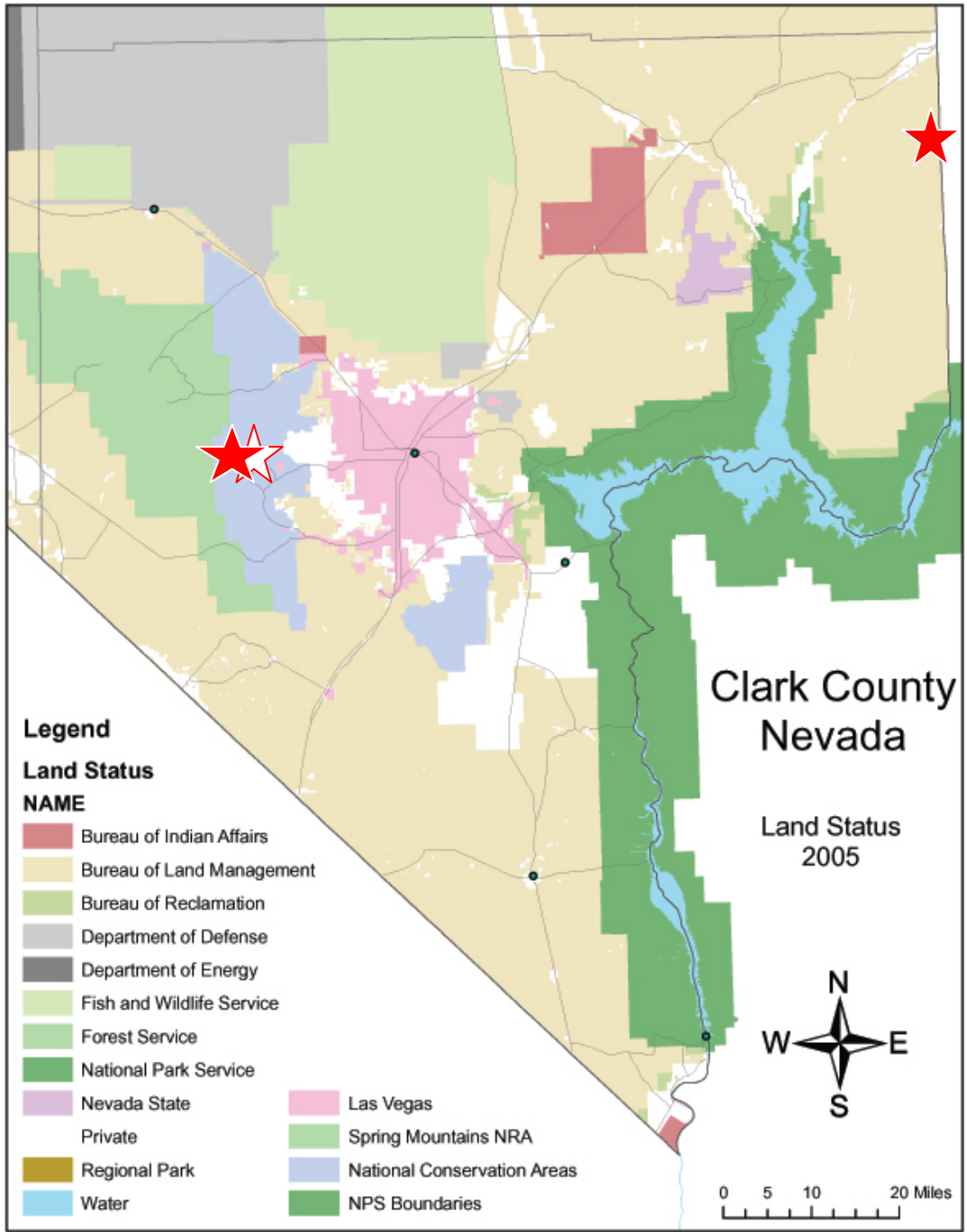


Figure 19. *Targionia* sp. nov. (mm ruler).



single patch

Figure 20. *Targionia* sp. nov. distribution in Clark County.

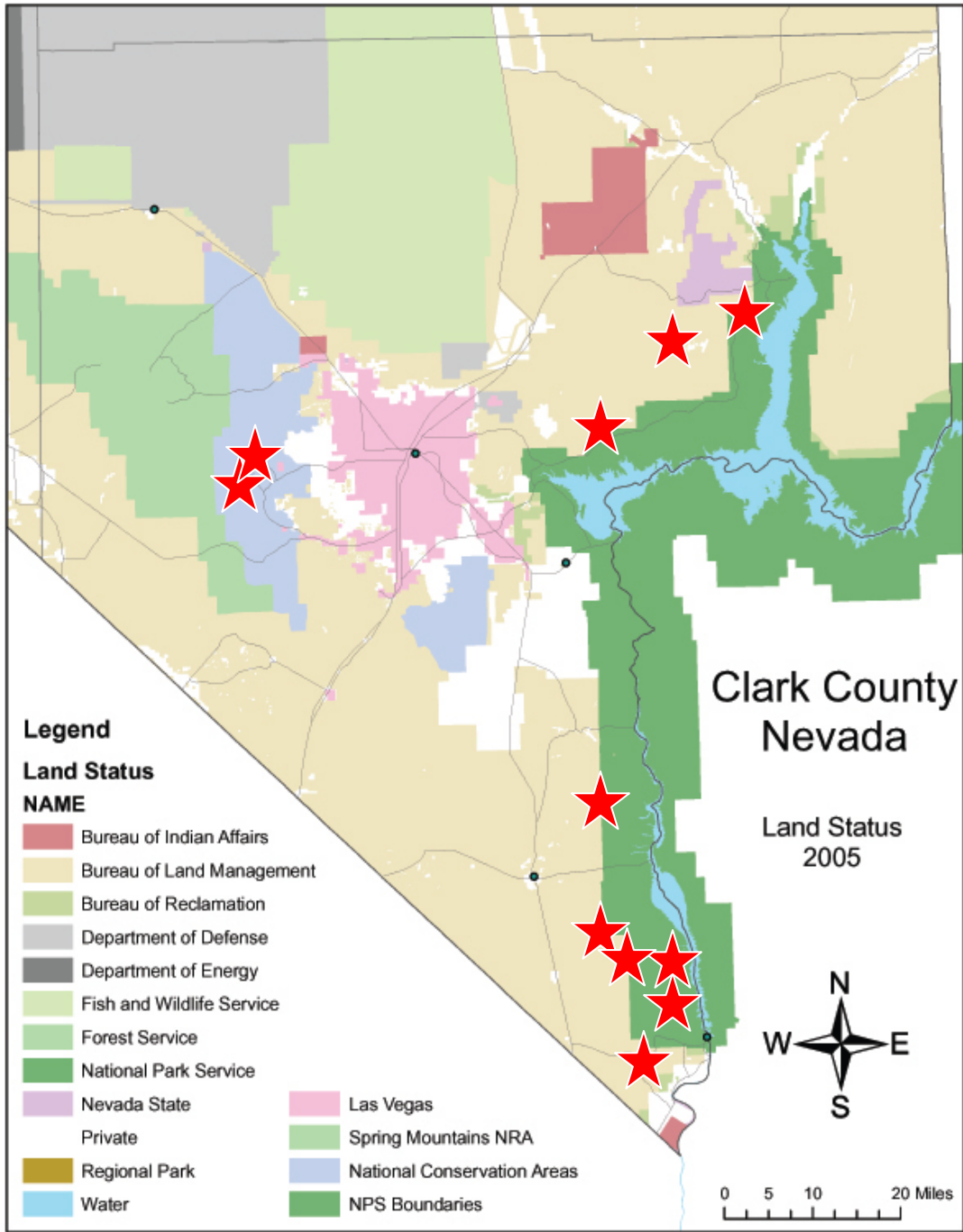


Figure 21. *Trichostomum sweetii*. Above: dry shoots (mm scale). Below: closeup of single leaf.



Figure 22. *Trichostomum sweetii* distribution in Clark County (hollow star indicates plants have not been refound since the original collection in the 1940s).

