

A NEW SPECIES OF *SYMPHYOTRICHUM* (ASTERACEAE:
ASTEREAE) FROM A SERPENTINE BARREN
IN WESTERN NORTH CAROLINA

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ABSTRACT

Symphyotrichum rhiannon Weakley & Govus, sp. nov., is described from the Buck Creek ultramafic barren (over serpentinitized dunite and olivine) in the Blue Ridge province of southwestern North Carolina. It is similar to *Symphyotrichum puniceum* but different in its smaller stature, thinner rhizomes, subspatulate cauline leaves, narrower and fewer-headed capitulescence, phyllaries with shorter, rhombic-lanceolate apical green zones, and shorter ray corollas. Its geographic range is imbedded within that of typical *S. puniceum* but morphological intergrades have not been observed, despite the co-occurrence of the two taxa within several meters of one another at the type locality. The Buck Creek site is within the Nantahala National Forest; 42 hectares of the site are managed by the United States Forest Service as a Special Interest Area and registered as a heritage area with the North Carolina Natural Heritage Program.

RESUMEN

Symphyotrichum rhiannon Weakley & Govus, sp. nov., se describe del Buck Creek ultrabásico (sobre dunita y olivino serpentinizados) en la provincia Blue Ridge del Suroeste de Carolina del Norte. Es similar a *Symphyotrichum puniceum* pero diferente por su talla más baja, rizomas más finos, hojas caulinares subespatuladas, capitulescencia más estrecha y con menos capítulos, filarias con zonas verdes apicales rómbico-lanceoladas más cortas, y radios de las corolas más cortos. Su rango geográfico está incluido en el de *S. puniceum* típico pero no se ha observado intergradación morfológica, a pesar de la co-ocurrencia de los dos taxa a unos pocos metros en la localidad tipo. El Buck Creek está en el Nantahala National Forest; 42 hectáreas están gestionadas por el Servicio Forestal de los Estados Unidos como un Área de Especial Interés y registrado como un área del Natural Heritage Program de Carolina del Norte.

INTRODUCTION

A new species of *Symphyotrichum* is described from the Buck Creek ultramafic barren in the Blue Ridge province of southwestern North Carolina (Clay County). The naming of this species ends more than twenty years of bewilderment regarding its identity, which has troubled researchers at the site since the late 1970's. Mansberg (1981) was apparently the first botanist to encounter this entity and collect it, a significant component of the ultramafic barren and adjoining woodlands. Despite consulting with experts at the time, she labeled this entity as "unidentifiable aster" and suggested that it might be a hybrid. Collections made during later studies of the vegetation at Buck Creek barren by the North Carolina Vegetation Survey in the 1990s yielded similar confusion, with specimens being identified as "*Aster laevis* var. *concinus*?", "*Aster surculosus*?", or "*Aster* # 1." Even more recently, U.S. Forest Service botanists involved in the management of Buck Creek barren have been troubled by the identity of this aster and have made additional guesses as to its affinity. Serendipitous circumstances have led to a revisiting of this persistent problem, and following additional study we now decisively describe this species as new.

A comparison of the putative new taxon to all other species of *Symphyotrichum* in eastern and central North America reveals that it has a unique set of characteristics. Furthermore, it does not appear to be a recent or stabilized F1 hybrid, intermediate between any other two species of *Symphyotrichum*, although it is possible (as noted below) that gene flow has been involved in its origin. In our assessment, it is a distinct taxon worthy of specific rank, possibly most closely related to *Symphyotrichum puniceum* (L.) A. & D. Löve.

Symphyotrichum rhiannon Weakley & Govus, sp. nov. (**Fig. 1**). TYPE: U.S.A. NORTH CAROLINA. Clay Co.: Buck Creek Ultramafic Barrens, Nantahala National Forest, 1.3 km N of US 64 on Buck Creek Rd, just NE from Glade Gap, below FS Rd 6269 (above bridge crossing Buck Creek), NW ca. 0.5 km from gate on steep slope above E side of Buck Creek; serpentine barrens, steep W aspect outcrop of dunite and olivine, open woodland dominated by pitch pine and prairie grasses, 3385 ft elev., UTM zone 17S, 261513mE, 3885663mN (WGS-84), 3 Nov 2003, T.E. Govus and G. Kauffman 1 (HOLOTYPE: NCU; ISOTYPES: BRIT, US, WAT).

Symphyotricho puniceo similis sed differt statura minore, rhizomatibus tenuioribus, foliis caulinis subspatulatis, capitulescentiis angustioribus paucicapitatis, phyllariis zonis apicalibus viridibus rhombi-lanceolatis brevioribus, et corollis radii brevioribus.

Plants perennial herbs, apparently without a distinct caudex, arising from a system of slender, scale-leaved rhizomes 0.5–1 mm wide and up to 10 cm long, older rhizomes woody or lignescent, thickened to 2–4 mm wide. **Stems** 15–40 cm tall, erect from the base, hirsute to hispid-hirsute with spreading to spreading-ascending, uniseriate trichomes 0.2–0.6 mm long (Type A, sensu Nesom 1976), evenly distributed or concentrated in vertical lines, lines especially evident immediately below nodes, hirsutulous below heads, also with closely ap-



FIG. 1. *Symphyotrichum rhiannon*: A. Holotype; B. Closeup of capitulum (isotype).

pressed, uniseriate trichomes 0.1–0.2 mm long [Type B, sensu Nesom 1976], eglandular. **Leaves:** basal and lower cauline usually not persistent at flowering, subspatulate when present, 3–7 cm long, blades oblanceolate-elliptic, 10–15 mm wide, shallowly crenate to serrate-crenate, prominent midvein and reticulate secondary venation, gradually narrowed to a petiolar region 4–6 mm wide, clasping to subclasping and shallowly auriculate, midcauline usually longer than lower, 5–11 cm long, 8–22 mm wide, with petiolar region remaining evident but becoming shorter and relatively broader or the upper leaves oblong-lanceolate, upper cauline (of capitulescence) 1–3 cm long, 4–6(–8) mm wide, all adaxially scabrous with stiff, thick-based, ascending hairs 0.1–0.2 mm long (foreshortened Type A), abaxially inconspicuously strigose (use lens) with thin, closely appressed trichomes 0.05–0.2 mm long (Type B). **Heads** in a sparsely leafy-bracteate, broadly cylindric-paniculate to subcorymbose arrangement, clustered near branch tips on ultimate peduncles 5–15(–30) mm long; involucre turbinate-campanulate, 6–11 mm wide (pressed); phyllaries in 3–4 weakly graduate series, mostly narrowly oblong-lanceolate, inner 6–7 mm long, outer 1/2–3/4 the length of the inner, outer white-indurate on the basal 1/2–2/3, upper 1/2–1/3 with a rhombic-lanceolate green zone 1.8–2.5(–3.0) mm long from widest point to tip, glabrous or the upper part of the green zone minutely strigose-puberulent, margins usually irregularly ciliate, eglandular. **Ray florets** 18–32, corollas 6–9 mm long, laminae 0.8–1.4 mm wide, blue to lavender, tightly coiling with wilting or maturity, tube and lower lamina sparsely appressed-puberulent with minute biseriate trichomes (Type C, sensu Nesom 1976). **Disc florets:** corollas (4.0–)4.5–5.5 mm long, yellow but at least the lobes usually turning purple, sparsely appressed-puberulent with biseriate trichomes (Type C), tube 1.5–2.1 mm long, throat and limb cylindric, lobes 0.8–1.0 mm long, erect; style branches with narrowly triangular collecting appendages 0.3–0.5 mm long. **Achenes** oblong to narrowly obovate in outline, slightly compressed, 2.6–3.0 mm long, 0.7–0.9 mm wide, 4–6-nerved (with 1 nerve on each edge and 1–2 on each face), sparsely short-strigose, tan or often purplish at maturity; pappus 1-seriate, of 36–46 barbellate bristles.

Etymology.—*Symphyotrichum rhiannon* is named in honor of Rhiannon Weakley, whose desire to rest during a field excursion led the authors to further investigate and finally resolve this decades-old taxonomic conundrum, and also in honor of the original Rhiannon, a Welsh goddess figure associated with the underworld, and therefore particularly appropriate for a plant endemic to a serpentine substrate.

Additional collections examined. **NORTH CAROLINA.** **Clay Co.:** Buck Creek Ultramafic Barrens, Nantahala National Forest, 1.6 km N of US 64 on Buck Creek Rd, NE from Glade Gap, 0.5 km below bridge over Buck Creek and W upslope along old road to powerline ROW, E aspect slope of dunite and olivine, pitch pine woodland with abundant prairie grasses, 3280 ft elev., UTM zone 17S, 261347mE, 3885588mN (WGS-84), 3 Nov 2003, *Govus* and *Kauffman* 2 (NCU); Buck Creek Serpen-

tine Pine Barrens; in grassy understory; west-facing slope, midslope; pH 6.5, 20 Sep 1981, *Mansberg* 421 (NCU 575098); Buck Creek Serpentine Pine Barrens; in grassy understory; west-facing slope, lower slope; pH 6.0, 20 Sep 1981, *Mansberg* 422 (NCU 575100); Buck Creek Serpentine Pine Barrens; in grassy understory; west-facing slope, midslope; pH 7.0, 20 Sep 1981, *Mansberg* 423 (NCU 575099).

DISCUSSION

Symphyotrichum rhiannon is closest in morphology to *S. puniceum* and *S. prenanthoides*. These three taxa share a set of features: plants eglandular, stoloniferous; leaves with serrate margins, scabrous upper surfaces, the basal petioled but not cordate, cauline clasping, those of capitulescence reduced in size and relatively few; phyllaries long-acuminate to attenuate, subequal to weakly graduate in length. The leaves of *S. prenanthoides* are distinctly spatulate with dilate-auriculate bases, which contrast with both of the other species, and the new species keys to *S. puniceum* (Radford et al. 1968; Gleason & Cronquist 1991; Cronquist 1980) because of the leaf shape. Of features noted here as characteristic of *S. rhiannon*, only its subspatulate leaf shape apparently is not found in at least a few populations of *S. puniceum*. Thus, *S. rhiannon* might be considered intermediate between *S. puniceum* and *S. prenanthoides*, either from common ancestry or perhaps a result of hybridization. Contrasts between these three taxa are summarized in the following couplet.

1. Basal and cauline leaves distinctly spatulate, abruptly constricted to a petiolar region, auriculate-clasping, the auricles dilated from the petiole base and completely enveloping stem; lower 1/2–1/3 of stem generally glabrous _____ ***Symphyotrichum prenanthoides***
1. Cauline leaves subspatulate or oblong to oblong-ob lanceolate or lanceolate, gradually narrowed or not toward the base, base clasping to subclasping but not dilated-auriculate and not completely enveloping the stem; lower 1/2–1/3 of stem generally hairy.
 2. Plants 1.5–4 dm tall; young rhizomes thin, 0.5–1.0 mm wide; midcauline leaves subspatulate, slightly narrowed toward the base to a petiolar region; green area of phyllary apices rhombic-lanceolate, 1.8–2.5(–3.0) mm long from widest point to apex; ray corollas 6–9 mm long _____ ***Symphyotrichum rhiannon***
 2. Plants mostly 4–20 dm tall; young rhizomes thickened, 2–4 mm wide; midcauline leaves mostly oblong to oblong-ob lanceolate, not narrowed to a petiolar region; green area of phyllary apices narrowly lanceolate, 2.5–4.0 mm long from widest point to apex; ray corollas 10–15(–20) mm long _____ ***Symphyotrichum puniceum***

Apart from the distinction in leaf shape, differences between *Symphyotrichum rhiannon* and *S. puniceum* are largely quantitative and are primarily reductions in size. Stems of the new species are relatively short and the capitulescence tends to be narrower with fewer heads. Phyllaries with short green regions are not generally characteristic of *S. puniceum* but do occasionally occur in the species, but the rhombic-lanceolate green zones and more graduate phyllaries of *S. rhiannon* give the heads a distinctive appearance. The cumulative effect of these and the more quantitative differences, however, coupled with the unique

habitat and restricted distribution of *S. rhiannon*, is that the latter can be recognized as sharply distinct. Typical *S. puniceum* occurs in most if not all of the counties in the mountains and piedmont of North Carolina (Radford et al. 1968), where it characteristically grows in wet habitats, especially fens, seepages, swamp forests, wet meadows, and in altered wetlands such as ditches and other drainages.

Fernald (1950) treated *Symphyotrichum puniceum* (as *Aster puniceus* L.) with a number of varietal taxa, but all of these are now recognized as populational variants or intergrading populations except one — Warners and Laughlin (1999) have provided a convincing case for treatment of *S. firmum* (Nees) Nesom as a distinct species, in contrast to many earlier treatments of it as *Aster puniceus* var. *firmus* (Nees) Torr. & Gray or *A. puniceus* var. *lucidulus* Gray. Evidence has been presented for recognition of *S. puniceum* var. *scabriculaule* (Shinners) Nesom (Nesom 1997), the only infraspecific taxon currently recognized within the species. It might be argued that *S. rhiannon* would be more appropriately treated at varietal rank, especially in view of its largely quantitative difference, but we infer that the new species is reproductively isolated because its geographic range is imbedded within that of typical *S. puniceum* and morphological intergrades have not been observed, despite the co-occurrence of the two taxa within several meters of one another at the type locality.

It is possible and likely that adaptation to the relatively drier habitat of the serpentine barren play a significant part in the observed size reductions of *Symphyotrichum rhiannon*. Common garden experiments would be of interest to determine what component, if any, of the differences are phenotypic. The differences in leaf shape, however, suggest that other genomes might have been involved in the evolution of *S. rhiannon*. *Symphyotrichum prenanthoides*, which apparently is closely related and which is sympatric with *S. puniceum* over much of its range, has cauline leaf blades distinctly narrowed to a petiolar region and Semple (pers. comm.) hypothesizes that *S. rhiannon* is most closely related to *S. prenanthoides*, apparently weighting the tendency in *S. rhiannon* to produce subspatulate leaves. *Symphyotrichum rhiannon*, *S. prenanthoides*, *S. puniceum*, and *S. firmum* have been treated as members of *Symphyotrichum* sect. *Symphyotrichum* (sensu Nesom 1994), but because hybrids in many parental combinations have been observed in *Symphyotrichum*, hypotheses regarding evolutionary ancestry could justifiably include species of putatively more distant relationship. It is perhaps notable that the stem leaves of *S. rhiannon* are less strongly clasping than those of either *S. puniceum* or *S. prenanthoides*.

Symphyotrichum rhiannon has only been documented within a serpentine plant community endemic to a 120 ha area surrounding Buck Creek in the southern Nantahala Mountains of Clay County, North Carolina (Fig. 2). Serpentine soils in the Southern Appalachian Mountains are very rare, and only a

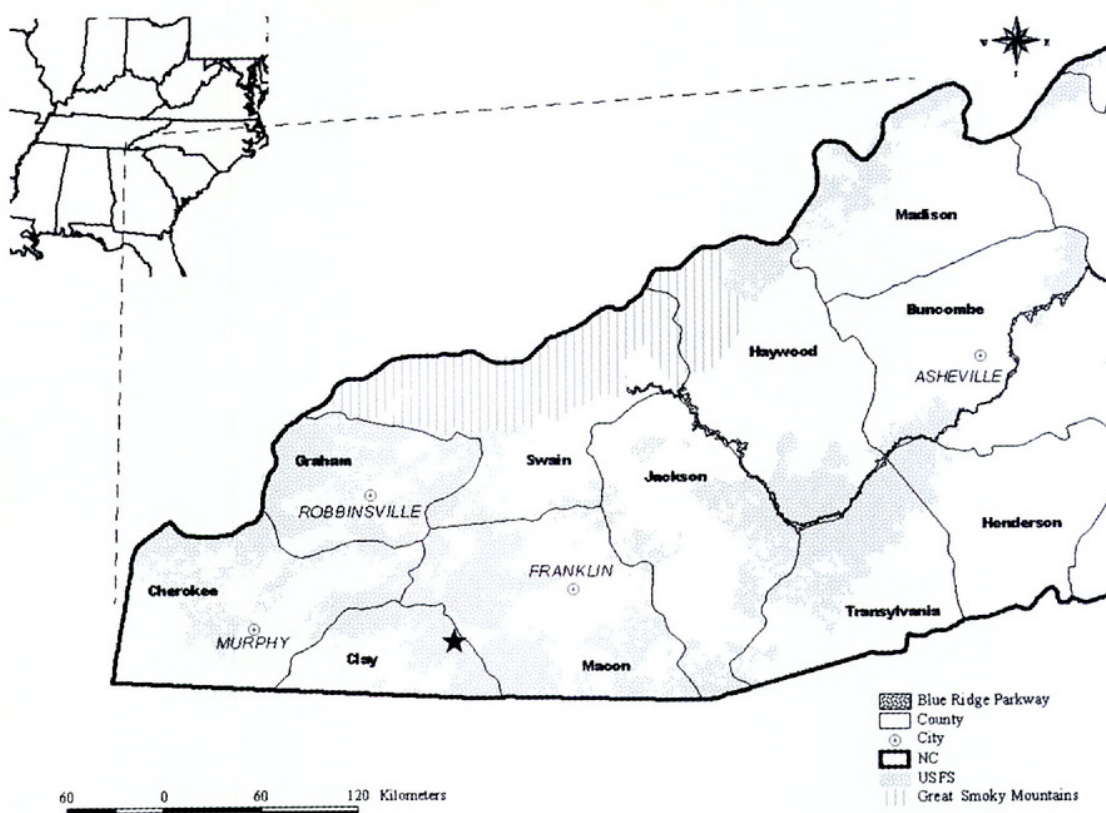


FIG. 2. Location of Buck Creek serpentine site (denoted by star) in Clay County, western North Carolina.

few serpentine barrens have been located and studied, beginning with a pioneering study by Albert E. Radford (1948). The Buck Creek Serpentine Barren was discovered in 1951, following Radford's dissertation, by the late Robert K. Godfrey, then at N.C. State University, and has been periodically studied by botanists and ecologists ever since, as it is the largest and floristically and vegetationally most distinctive of the Southern Appalachian serpentine barrens. In the late 1970s and early 1980s, Laura Mansberg (now Cotterman) conducted the most detailed study of this unique plant community, describing it as a Pine-Savanna (Mansberg 1981; Mansberg & Wentworth 1984). The unusual aster here described as *Symphyotrichum rhiannon* was initially noted during this study by Mansberg, and was referred to in her thesis and subsequent paper as "an undescribed *Aster*." Schafale and Weakley (1990) classified the Buck Creek site as an Ultramafic Outcrop Barren, and considered it to be the best-developed and largest example of this critically imperiled natural community type. The hierarchical United States National Vegetation Classification classifies the community association type as a *Quercus alba*-*Pinus rigida* / *Sporobolus heterolepis*-*Andropogon gerardii* Woodland and assigns it a conservation rank of G1 (Critically Imperiled) (NatureServe 2004).

A physiognomic patchwork of forest, dense grass patches and partially

open woodland occurs across the Buck Creek site (Fig. 3). The dominant rock types, serpentized dunite and olivine, influence the striking vegetation present on this site (Hadley 1949; Pratt & Lewis 1905). Soil depth is variable, ranging from 0 to 60 cm, although rock outcrops represent between 5 and 10% of the local landscape. Soil characteristics reveal higher base saturation, cation exchange capacity, pH, and magnesium relative to surrounding sites in the Nantahala Mountains (Mansberg & Wentworth 1984). The serpentine plant communities occupy both east and west-facing slopes extending from 975 meters elevation along Buck Creek to over 1220 meters elevation atop Corundum Knob. *Symphyotrichum rhiannon* occurs within the woodland and grass-dominated areas.

Within the woodland the forest canopy varies from 20-60% cover depending on the intensity and frequency of recent prescribed burns. The woodland is dominated in the tree canopy by older stunted *Quercus alba* and smaller denser *Pinus rigida* stems. *Tsuga canadensis*, *Sassafras albidum*, *Acer rubrum*, *Oxydendrum arboreum*, and *Amelanchier laevis* also occur within the canopy and subcanopy. Shrub cover is meager, typically occurring in clumps and providing no more than 10% cover. Diagnostic shrub species include *Rhododendron viscosum*, *Physocarpus opulifolius*, *Viburnum cassinoides*, *Kalmia latifolia*, *Lyonia ligustrina* var. *ligustrina*, *Vaccinium stamineum*, and *V. corymbosum*.

The grass dominance within the herb stratum is reminiscent of prairie vegetation and presents a striking contrast to the regionally typical herbaceous layer consisting of mesophytic, broad-leaved forbs. *Andropogon gerardii*, *Schizachyrium scoparium* var. *scoparium*, and *Sporobolus heterolepis* are the most important grasses. Characteristic forb species include *Hexastylis arifolia* var. *ruthii*, *Thalictrum macrostylum*, *Packera plattensis*, *Castilleja coccinea*, *Phlox ovata*, *Oxypolis rigidior*, *Sanguisorba canadensis*, *Polygala paucifolia*, *Asplenium platyneuron*, *Solidago nemoralis*, *Symphyotrichum undulatum* and *S. phlogifolium*. A striking contrast within the herb layer is the juxtaposition of both mesophytic and xerophytic species. It is not unusual to observe *Sanguisorba canadensis* and *Oxypolis rigidior* emerging from a grassy thicket of *Sporobolus heterolepis* and *Schizachyrium scoparium*. Mansberg noted a perched water table while surveying the site and suggested that there is a complex soil moisture gradient within the serpentine site (Mansberg & Wentworth 1984). Many of the minerals predominant in mafic and ultramafic rocks chemically weather to clays, and the soils at Buck Creek have a substantial clay component, providing a perched water table and abundant seepage after rains, but drying to highly xeric conditions during droughts.

In response to periodic mining threats, 42 hectares of the serpentine site at Buck Creek are now managed by the USFS as a Special Interest Area and registered as a Natural Heritage Area with the North Carolina Natural Heritage Program. In 1995, the U.S. Forest Service initiated active conservation management



FIG. 3. Buck Creek serpentine woodland in mid August. The dominant grass is *Andropogon gerardii*.



FIG. 4. Emerging grasses at Buck Creek serpentine woodland 3 weeks following a prescribed burn designed to reduce the canopy layer. Prescribed fire was conducted in April of 1995.

TABLE 1. Status of North Carolina rare plant species documented at Buck Creek serpentine site.

Species	G-rank ^a	S-rank ^b	Relative Rarity within North Carolina
<i>Sporobolus heterolepis</i>	G5	S1	1 of 2 occurrences documented in NC; disjunct eastwards from a primary distribution in the Great Plains
<i>Deschampsia cespitosa</i> ssp. <i>glauca</i>	G5	S1	Only known occurrence in NC; disjunct from further west
<i>Elymus trachycaulus</i> ssp. <i>trachycaulus</i>	G5T5	S1	Only known occurrence in NC; disjunct from further west
<i>Calamagrostis porteri</i> ssp. <i>porteri</i>	G4T4	S1	1 of 8 extant occurrences within NC
<i>Poa saltuensis</i>	G5	S1	1 of 2 occurrences documented in NC; disjunct from further west
<i>Muhlenbergia glomerata</i>	G5	S1	1 of 2 occurrences documented in NC; disjunct from further west
<i>Carex woodii</i>	G4	S2	Dense in forested area within and surrounding serpentine site; northern species near its southern range extent
<i>Calystegia catesbiana</i> var. <i>sericata</i>	G3T3	S3	Locally common in Southwestern NC Mts; broad Southern Appalachian endemic
<i>Liparis loeselii</i>	G5	S1	Locally restricted to only a few individuals; circumpolar, near its southern range extent
<i>Gentianopsis crinita</i>	G5	S1	1 of 2 high quality occurrences in NC
<i>Oenothera perennis</i>	G5	S2	1 of 3 high quality occurrences in NC
<i>Ranunculus fascicularis</i>	G5	S1	1 of 2 occurrences documented in NC
<i>Pedicularis lanceolata</i>	G5	S1	1 of 2 drainages with extant populations in NC
<i>Parnassia grandifolia</i>	G3	S2	1 of 3 high quality occurrences in NC
<i>Viola appalachiensis</i>	G3	S2	Largest population documented in NC; Central and Southern Appalachian endemic
<i>Brachyelytrum aristosum</i> (= <i>B. septentrionale</i>)	G4G5	S3?	Locally common in higher elevations in the southwestern Mountains of NC; northern species near its southern range extent
<i>Drepanolejuenea appalachiensis</i>	G2?	S2	Remarkable occurrence for tiny liverwort that more typically occurs in mesic hardwood forest; Southern Appalachian endemic; with one disjunct occurrence in West Indies

TABLE 1. Continued

Species	G-rank ^a	S-rank ^b	Relative Rarity within North Carolina
<i>Celastrina nigra</i>	G4	S2?	1 or 6 occurrences documented in NC, near eastern range limit
<i>Speyeria aphrodite cullasaja</i>	G5T1	S1?	Only known occurrence in NC; southern Appalachian endemic
<i>Chlosyne gorgone</i>	G5	S1?	Only known occurrence in NC; primarily Midwestern and western species near eastern range limit
<i>Phyciodes batesii maconensis</i>	G5	S2	Largest population documented in NC; southern Appalachian endemic

^aG-rank indicates global rarity and threat status. See NatureServe (2004) for definitions.

^bS-rank indicates state rarity and threat status. See NatureServe (2004) for definitions.

of the site, using prescribed fire as the primary tool, resulting in reduction of woody growth encroaching on the site and an increase in herbaceous cover, particularly the grasses once dominant at the site (Fig. 4). Within the last 10 years monitoring plots were established both by both the North Carolina Vegetation Survey and the U.S. Forest Service to document current vegetation and provide a baseline for detecting change. A review of this plot data shows that *S. rhiannon* prefers more open conditions, occurring exclusively within plots ($n = 27$) with less than 50% tree cover and primarily in plots with less than 33% canopy cover. *S. rhiannon* grows sparsely; cover estimates in plots have not exceeded 2% cover. *S. rhiannon* has either maintained its coverage or slightly increased its density within fire-maintained areas at the Buck Creek Serpentine Barren.

In addition to the presence of the unusual plant community, the presence of rare species adds to the conservation importance of the Buck Creek Serpentine Barren. Seventeen state-listed rare plant species and four state-listed butterfly species occur within the site (Franklin & Finnegan 2004; LeGrand et al. 2004; Gatreille 1998; Table 1). Most of these species are primarily wide-ranging and globally secure (G4 or G5 rank), yet rare in NC; a few are restricted to only this site within the state. Although serpentine is well known for its tendency to generate locally endemic species (Brooks 1987), relatively few endemics have been described from the serpentine areas in eastern North America. A number of endemics have been described from the well known serpentine barrens of Maryland and Pennsylvania, including *Symphyotrichum depauperatum* (Fernald) Nesom, though the taxonomic distinctiveness of many remains controversial. The less well known serpentine areas in Virginia, North Carolina, and Georgia have not heretofore yielded endemic taxa described. However, a number of odd putative taxa (*Carex*, *Hexastylis*, *Rhododendron*, *Symphyotrichum*,

Thalictrum) from serpentines in Virginia and North Carolina are currently the subject of taxonomic investigation and may add to a growing list of eastern North American serpentine endemics.

Current information suggests that *S. rhiannon* is a serpentine endemic restricted to the G1-ranked woodland community at the Buck Creek Serpentine Barren. We hope that publication of this species will result in the discovery of other populations, at the few other Southern Appalachian serpentine barrens, though the potential for locating other undocumented occurrences within ultramafic rock influenced woodlands or barrens within the region is probably limited given the overall scarcity of this habitat.

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