

# GRASS AND HEATH BALDS

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## GRASS AND HEATH BALDS

**Concept:** Grass and Heath Balds are nonforested high elevation communities occurring on well-developed soils with only limited rock outcrops. They may be dominated by shrubs or herbs, with sparse or no trees.

**Distinguishing Features:** Grass and Heath Balds are distinguished by natural dominance by grasses, sedge, or shrubs with little or no tree cover, with little or no rock outcrop or shallow soil, and by at least fairly high elevation (3600 feet or above).

Heath Balds are distinguished by dense shrub layers dominated by *Rhododendron catawbiense*, *Rhododendron minus*, *Kalmia buxifolia*, or other Ericaceae, with the dominant shrubs distinguishing the subtypes. Most Grassy Balds are dense herbaceous vegetation dominated by grasses or sedges. The Alder Subtype has an open to dense shrub layer of *Alnus crispa* with a moderate to sparse herb layer beneath.

**Sites:** Grass and Heath Balds occur on high elevation ridges and upper slopes. Most examples are at high elevation, 4000 feet to over 6000 feet, but a few subtypes extend as low as 3600 feet.

Heath Balds often occur on sharp, narrow spur ridges or narrow ridge tops but may occur on broad domes or knobs or on convex slopes associated with rock outcrop communities. Grassy Balds usually occur on broader ridge tops, knobs, and saddles.

**Soils:** Grass and Heath Balds occur on a wide variety of high elevation soils, most Inceptisols. They may be rocky but, other than locally around embedded rock outcrops, are not unusually shallow or rocky. Heath Bald soils sometimes have a thick organic layer, almost resembling peat.

**Hydrology:** Sites for balds have good drainage but are mesic because of high rainfall, long periods bathed in fog, and low temperatures.

**Vegetation:** The Grass and Heath Balds theme encompasses two kinds of nonforest vegetation. Heath Balds are shrublands that usually have dense tall to short shrub canopies dominated by *Rhododendron catawbiense*, *Rhododendron minus*, or other evergreen Ericaceae. Some deciduous shrubs, such as *Vaccinium* spp., may also be present. Grassy Balds have dense herbaceous vegetation generally dominated by *Danthonia compressa* or *Carex* spp., with various other graminoids and forbs sometimes abundant. Grassy Bald (Alder Subtype) is intermediate in structure, with an open to dense shrub layer of *Alnus crispa* and varying herbaceous cover beneath. Some examples of Grassy Bald have developed sparse to dense stands of *Rubus alleghaniensis*, *Rubus canadensis*, or various shrubs in recent decades. Sparse trees, often stunted, may be present in either Grassy Balds or Heath Balds. Some balds show more recent substantial invasion by trees.

**Dynamics:** Dynamics appear to vary among different bald communities and may be particularly different between Grassy Bald and Heath Bald. Details are discussed for the individual communities. All of the balds occur in sites prone to severe weather and extreme conditions, but all are surrounded by forests in similar climate. The ecological processes or factors that keep them open under natural conditions are not always well known, and ideas are sometimes controversial.

**Comments:** There has been confusion caused by varying meanings of the term “bald” in both scientific and popular usage. Some known historic clearings are called balds by various authors. Many forested mountain peaks are named as balds (e.g. Cheoah Bald) and this has sometimes been used to argue that they should be cleared of their trees, though they may have old forest and offer no evidence that they ever were treeless. It should be noted that the word “bald” applied to people, though it now means hairless, once also meant white-headed. Given the tendency of snow and rime ice to form or persist only at higher elevations, it is possible we should be looking to the bald eagle rather than the turkey vulture as an avian analogue for these names.

**References:**

## KEY TO GRASS AND HEATH BALDS

1. Community dominated by grasses or sedges, or known to be formerly open and only recently invaded by woody vegetation. Local shrub patches or more extensive invading shrubs or young trees may be present in some examples.

2. Community dominated by grasses, generally *Danthonia spicata*, or of mixed herbaceous vegetation in which grasses predominate over sedges. .... **Grassy Bald (Grass Subtype)**

2. Community dominated by sedges, generally *Carex* spp., or of mixed herbaceous vegetation in which sedges predominate over grasses.

1. Community dominated by shrubs over the long term and apparently natural. Area not known to have formerly been naturally open. Grass or sedge cover is rarely present beneath the shrub layer.

3. Community dominated by *Alnus viridis* ssp. *crispa*, in a dense or open stand. Grasses or sedges sometimes with substantial cover. Rare community known only on Roan Mountains .....  
..... **Grassy Bald (Alder Subtype)**

3. Community not dominated by *Alnus viridis*. The species generally completely absent. Dominated by shrubs in the Ericaceae.

4. Community strongly dominated by *Kalmia buxifolia*. Larger shrubs, if present, a minor component. .... **Heath Bald (Sand Myrtle Subtype)**

4. Community not strongly dominated by *Kalmia buxifolia*, though the species may be present and occasionally abundant.

5. Community strongly dominated by *Rhododendron carolinianum*, occurring on quartzite substrate, often at lower elevation where *Kalmia latifolia* is present. Likely to occur only in Linville Gorge and possibly the Great Smoky Mountains. .... **Heath Bald (Carolina Rhododendron Subtype)**

5. Community not strongly dominated by *Rhododendron carolinianum*; the species codominant to absent. *Rhododendron catawbiense* dominant, codominant, or abundant.

6. Community strongly dominated by *Rhododendron catawbiense*, or mixed with *Vaccinium* spp., occurring at low to very high elevation. .... **Heath Bald (Catawba Rhododendron Subtype)**

6. *Rhododendron catawbiense* not strongly dominant, but mixed with *Kalmia latifolia*, *Pieris floribunda*, *Rhododendron carolinianum*, or other shrub species.

7. Community occurring at lower elevations, generally 5000 feet or lower. *Kalmia latifolia*, *Rhododendron maximum*, or other species of lower elevations abundant along with *Rhododendron catawbiense*. .... **Heath Bald (Low Elevation Subtype)**

7. Community generally occurring at higher elevations. *Kalmia latifolia*, *Rhododendron maximum*, and other species of lower elevations scarce or absent. Species of higher elevations, such as *Picea rubens* or *Sorbus americana*, often present in small numbers.

8. Community dominated by a mix of *Rhododendron catawbiense*, *Rhododendron carolinianum*, *Kalmia buxifolia*, and possibly *Rhododendron smokianum*, occurring on slate substrate. Known only in the Great Smoky Mountains. .... **Heath Bald (Slate Subtype)**

8. Community dominated by a mix of *Rhododendron catawbiense* with *Pieris floribunda*, *Vaccinium* spp., and other species, but without *Rhododendron carolinianum* or *Kalmia buxifolia*. Known only south of Asheville. Particularly abundant in the Balsam Mountains.

..... **Heath Bald (Southern Mixed Subtype)**

## GRASSY BALD (GRASS SUBTYPE)

**Concept:** Grassy Bald (Grass Subtype) is a natural high elevation meadow with a dense herb layer dominated by grasses, though patches of forbs and sedges are present and some examples now have extensive patches of shrubs or *Rubus*. Grassy Balds have well-developed soils that contrast with those of rock outcrop communities and glades. *Danthonia compressa* is typically the dominant grass, but pasture grasses such as *Phleum pratense* may become abundant in the more heavily grazed examples.

**Distinguishing Features:** Grassy Balds are distinguished from other natural communities by the natural dominance of dense herbaceous vegetation in high elevation upland sites that are not rock outcrops or glades. Small rock outcrops and shallow soil patches may be embedded but do not make up most of the area. High Elevation Rocky Summit communities, in contrast, contain substantial bare rock, though they may contain small patches of herbaceous vegetation with some of the same species. High Elevation Mafic Glades and Low Elevation Acidic or Basic Glades contain more grass but are clearly related to shallow soil.

True Grassy Balds can be difficult to distinguish from old high elevation pastures and burn scars. Some extensive grassy areas, e.g. Graveyard Fields and areas near Mount Mitchell, are known to have originated from logging and burning of spruce-fir forest in the 1900s and should not be regarded as Grassy Balds. The classification should be used only if there is reason to believe an area has been grassy from prehistoric times. Artificial grasslands may be dominated by *Danthonia compressa* but are less likely to contain rare plants and more often contain substantial weedy flora. However, heavily grazed natural Grassy Balds also may contain weedy flora, and many have been invaded by *Rubus* or various shrubs and are no longer herb dominated. Some examples may remain ambiguous.

The Grass Subtype is distinguished from the Sedge Subtype by dominance of grasses, usually *Danthonia compressa*, rather than *Carex* spp. It is distinguished from the Alder Subtype by the absence of substantial cover of *Alnus crispa*.

**Synonyms:** *Danthonia compressa* - (*Sibbaldiopsis tridentata*) Herbaceous Vegetation (CEGL004242).

Ecological Systems: Southern Appalachian Grass and Shrub Bald (CES202.294).

**Sites:** Grassy Balds occur on gentle to moderate slopes, ridgetops, and broad domes at high elevation. Examples range from around 5000 feet to over 6000 feet in elevation.

**Soils:** Grassy Balds occur on relatively deep soils, where tree presence apparently is not precluded by soil depth. Most are mapped as the Burton series (Typic Haplumbrept). Cain (1931) found that Grassy Bald soils in the Smokies were less acidic than other soils at similar elevations, although it is unclear that this causes the distinctive vegetation rather than results from it.

**Hydrology:** Grassy Balds generally occur on high convex slopes and are well drained, though seeps may be embedded in them. They are mesic due to high rainfall, frequent fog, and low temperatures, but are exposed to drying winds.

**Vegetation:** Grassy Balds are characteristically dominated by dense herbaceous vegetation, with *Danthonia compressa* the dominant species. Patches may be dominated by *Sibbaldia retusa* (*Sibbaldiopsis tridentata*), *Packera schweinitziana*, or *Rumex acetosella*. Other frequent herbs in CVS plot data include *Carex pensylvanica*, *Pilosella* (*Deschampsia*) *caespitosa*, *Potentilla simplex*, *Poa compressa*, *Achillea borealis*, *Carex brunnescens* var. *sphaerostachya*, and *Athyrium asplenioides*. *Phleum pratense*, *Poa compressa*, and *Poa pratensis* are also fairly frequent, presumably because of a history of grazing. Other species less frequent in plots but often prominent in observations include *Houstonia serpyllifolia*, *Fragaria virginiana*, *Lilium grayi*, *Athyrium angustum*, *Athyrium asplenioides*, *Gentiana austromontana*, and the moss *Polytrichum commune*. Balds may be purely herbaceous or may have shrubs and trees of varying density. *Rubus canadensis* or *Rubus alleghaniensis* have invaded many balds that were grazed and then removed from grazing and may be dominant over large patches where not kept in check by deliberate management. *Vaccinium altomontanum*, *Rhododendron calendulaceum*, *Rhododendron catawbiense*, *Vaccinium simulatum*, *Kalmia latifolia*, *Menziesia pilosa*, *Abies fraseri*, *Picea rubens*, *Fagus grandifolia*, and *Quercus rubra* may be present in sparse-to-moderate density. These species too are considered invaders and may eventually shade out the herb layer.

**Range and Abundance:** Ranked G1. Only a few examples are known, scattered throughout the higher mountains from the Great Smoky Mountains northward. The overall abundance and range is confused by the presence of ambiguously natural grassy areas in several places and the widespread use of the term bald for artificial grasslands. This community is nearly endemic to North Carolina, but a few examples occur in adjacent Tennessee and Virginia.

**Associations and Patterns:** The Grass Subtype may be associated with the Sedge Subtype and on Roan Mountain, the Alder Subtype. Grassy Balds are sometimes associated with Heath Balds, High Elevation Red Oak Forest, or Northern Hardwood Forest. High Elevation Rocky Summit or High Elevation Boggy Seep patches may be embedded. Transitions to adjacent forests sometimes seem gradual, sometimes abrupt. Because of recent management and unknown past management, it is impossible to know the nature of natural ecotones. Even examples of natural origin were grazed and may have been expanded by clearing at their edges. Encroachment of shrubs and trees into Grassy Bald often appears to progress from the edges.

**Variation:** Balds vary widely in dominant plants from site to site and within sites. Sites vary with grazing history, exposure, and unknown factors.

**Dynamics:** The factors that produced and maintained Grassy Balds have been the subject of intense scientific interest over the years, and much has been written about them, but consensus has not been reached (see Smathers 1980, summary by Peterson 1980, and views expressed in Billings and Mark 1957, Bratton and White 1980, Brown 1941, Cain 1931, Gersmehl 1973, Lindsay and Bratton 1976a, 1976b, Lindsay and Bratton 1980, Mark 1958, Smathers 1980, Stratton and White 1982, and Wells 1937, 1956). Hypotheses of origin include human action such as clearing and grazing of cattle by early settlers; clearing and burning by Native Americans; presettlement grazing and trampling by native large mammals; natural disturbances such as fire, windthrow, or insects; and changing climatic conditions. New Grassy Balds are not being created from forests at present, and existing examples do not seem to be maintaining themselves. Johnson (1995) documented the

loss of grassy area in the Craggy Mountains, and a management team has tracked the changes in Grassy Balds at Roan Mountain for decades. The question of the origin of Grassy Balds is given urgency by their ecological instability at present. All examples appear to be experiencing invasion by shrubs or trees, though trees are much slower to establish and spread than in disturbed forests. Balds that are not actively being managed to remove woody vegetation are losing their open grassy character.

The question of recent human creation is confused by the existence of grassy areas that clearly are recently created, either by logging and burning of spruce-fir forests or by clearing and grazing by early settlers. Some of these areas have place names of “bald” and are treated as grassy balds by some authors. However, there is evidence that other grassy areas were present when settlers arrived, and these are the focus of the Grassy Bald community defined here. Though Grassy Balds are not floristically similar to northern alpine tundra (Stratton and White 1982), and many of their species are present in other open natural communities, they likely developed from Pleistocene alpine tundra that is generally believed to have existed in the Southern Appalachians. The balds contain some shade-intolerant species, such as *Packera schweinitziana* and *Sibbaldiopsis tridentata*, which are not in surrounding forests. Such species are not observed spreading into new sites, and their presence suggests great antiquity for balds such as those on Roan Mountain. The potential for creation by Native Americans is more difficult to rule out, given their longer tenancy and the range of possible human behavior. However, the sites of Grassy Balds are not suited for agriculture or long-term settlement and were not particularly close to Native American settlements. Prehistoric people hunted throughout the region and ignited fires throughout the region, but there is no reason to expect them to have focused such activities on particular ridge tops sufficiently to replace forest with grassland. With the exception of spruce-fir forests, even severely burned forest areas quickly begin returning to tree cover. Only frequent burning, more frequent than either the natural or anthropogenic background rate, or ongoing cattle grazing, will prevent tree establishment. More plausibly, the previous existence of grassy meadows led to a focus on such places for cattle grazing and, probably in earlier times, for hunting. Weigl and Knowles (2013) discuss several such lines of evidence against human creation of Grassy Balds.

Known natural disturbances do not seem sufficient to explain the origin or persistence of Grassy Balds. Where forests have been disturbed by wind storms, ice storms, or natural fire at high elevations, they quickly grow back in trees. With the more catastrophic disturbance caused by logging and slash fires or by introduction of the balsam woolly adelgid, spruce-fir forests developed open successional vegetation that can be distinguished from Grassy Bald vegetation. While the grassy vegetation can burn, especially outside of the growing season, fire seems unlikely to ever have occurred frequently enough to maintain balds. The moist foggy climate limits flammable periods. The spruce-fir and northern hardwood communities that surround most Grassy Balds are not very flammable, nor do they contain species favored by frequent fire. Only High Elevation Red Oak Forests, less frequent neighbors, are likely to have burned very often.

Weigl and Knowles (2013) advanced an argument for grazing by native animals as a means of creating Grassy Balds and maintaining them. A diverse fauna of large grazing mammals existed in the Pleistocene and they presumably grazed in open tundra created by the Pleistocene climate, perhaps helping to exclude trees from it. The more crucial question, however, is why any open areas created or maintained by climate or these animals would have persisted for the 13,000 years

since those species became extinct. The native herd-forming grazing animals in the region since that time have been elk and bison. If these species gravitated to previously existing open grasslands, they may have contributed to excluding trees as the climate became more favorable. This needs further investigation. With their populations extirpated early by European settlers, the behavior of these species in North Carolina landscapes is not well known. There is no reason to expect it, or their ecological effects, to be very similar to those of domesticated cattle.

The climate in Grassy Bald sites is harsh. Forests that are destroyed at high elevations are slower to recover compared to those at lower elevations, but balds are surrounded by forests that persist in similarly harsh climates. Cogbill, et al. (1997) estimated that the elevation of the hypothetical timberline in the Southern Appalachians in the current climate would be around 8000 feet, considerably higher than any existing balds. Nevertheless, harsh climate may amplify the effects of other processes and contribute to keeping balds open.

Understanding of the natural dynamics of Grassy Balds and their current instability is hampered by the universal history of cattle grazing after European settlement. The current invasion of woody plants into balds often is associated with the end of cattle grazing as lands were brought into conservation status in the mid-to-late 1900s, and the removal of cattle is often blamed for the encroachment. However, the relationship between grazing and grasslands here, as more widely, is complex. Cases in other regions include not only maintenance by grazers but also cases of grazing increasing woody encroachment (e.g., Briggs et al. 2002 in tallgrass prairie). Crawford and Kennedy (2009), looking at ages of trees that had invaded Grassy and Heath Balds at Craggy Gardens, found rapid canopy closure after cattle were removed in 1925; however, they also found that tree patches had established in four separate episodes from 1760-1925, though cattle grazing did not start until the late 1800s. Thus, encroachment apparently was happening both before cattle arrived and during their presence. Stratton and White (1982) noted that most of the prominent invading shrubs in Great Smoky Mountains Grassy Balds had been present in the 1930s while grazing was still occurring, though they became more extensive after release from grazing. Brown (1941) noted the disappearance of Grassy Bald on the western part of Roan Mountain by invasion of spruce. He also noted that the upper 50 meters of spruce forest on western Roan Mountain had few trees more than 150 years old, though trees 300-350 years old occurred farther into the forest interior. He also noted open-grown forms of trees near the edge. He took this as evidence of ongoing shrinkage of balds. This would suggest a slow invasion dating back to at least the late 1700s, either early in the period of grazing or perhaps predating it and extending throughout its duration. Given the history of the Cloudland Hotel on this side of the mountain, we cannot rule out the possibility either that older trees were cut near the edge, nor that the open area he saw disappearing beneath spruce invasion in the 1930s had been cleared forest rather than Grassy Bald.

Cattle trample woody plants and at sufficient grazing intensity can prevent succession to forest as long as they are present. They have numerous other effects, including soil disturbance, selective increase or decrease of different species of plants, and if grazing is heavy, creation of conditions favorable to ruderal plants rather than long-lived competitive plants of grasslands. Such effects reduce the competitiveness of the native grasses, possibly making them more susceptible to invasion than they were before cattle were introduced. The rapid spread of woody vegetation immediately after grazing ended, compared to the slower establishment of trees and shrubs at



present, and the slower encroachment in the rare cases documenting pregrazing dynamics, suggest this.

Most remaining Grassy Balds have some Eurasian pasture species that became established during grazing, and some have substantial exotic plant cover. Balds that are still actively grazed often have low plant cover and an increased component of unpalatable herbs. Some of the most prolific native plants invading Grassy Balds, such as *Rubus*, are species associated with severe disturbance and are species that can continue to spread vegetatively once established. Weigl and Knowles (2013) and others before them have argued that the cattle have replaced the role of native grazers in a natural process to maintain balds. However, given the distant taxonomic relationship of cattle to bison and elk, the alteration of their behavior by domestication, and their absence in the natural evolution of bald communities, they are better regarded as an exotic species that may be a means of artificial maintenance comparable to mowing, with its own suite of side effects. The abundance of exotic plants in remote mountaintop locations is an indication of the alteration caused by cattle grazing. Maintenance by cattle grazing can be expected to maintain the state of alteration produced by European settlement. At present, the appropriate natural means of maintaining Grassy Balds is not known, and management techniques must be selected for their ecological effects without benefit of this knowledge.

**Comments:** The previous distinction between a Northern Grass Subtype (*Danthonia compressa* - *Sibbaldiopsis tridentata* Herbaceous Vegetation [CEGL004258]) and Southern Grass Subtype has been dropped. The distinction with the Sedge Subtype has been retained but needs further investigation into whether it is justified given the uncertainties caused by grazing history.

Grassy Bald is a rare and very threatened community type. The debate about Grassy Bald origins raises questions regarding their naturalness, and some scientists regard them as an artificial vegetation type. Because of their distinctive vegetational character, however, and because their origin is not known, they are best regarded as natural communities worthy of protection. While active artificial maintenance is required, such management should be oriented toward imitating natural processes to the extent that they are understood, eliminating exotic species, allowing natural vegetation to recover, and minimizing disturbance to the site.

**Rare species:**

Vascular plants: *Agrostis mertensii*, *Alnus crispa*, *Sceptridium multifidum*, *Calamagrostis canadensis* var. *canadensis*, *Carex cristatella*, *Delphinium exaltatum*, *Dendrolycopodium dendroideum*, *Dendrolycopodium hickeyi*, *Geum geniculatum*, *Houstonia montana*, *Lilium grayi*, *Lilium philadelphicum*, *Mononeuria groenlandica*, *Monarda media*, *Packera schweinitziana*, *Phlox subulata*, *Platanthera grandiflora*, *Poa palustris*, *Rhododendron cumberlandense*, *Rhododendron vaseyi*, *Spiranthes ochroleuca*, and *Trisetum spicatum*.

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## GRASSY BALD (SEDGE SUBTYPE)

**Concept:** Grassy Bald (Sedge Subtype) is a natural high elevation meadow with dense herb cover dominated by species of *Carex*, though patches with grasses and forbs are also present and some examples now have extensive patches of shrubs or *Rubus*. The Sedge Subtype often occurs in a mosaic with other Grassy Bald subtypes. Sedge-dominated wetlands and areas resulting from recent forest clearing should not be included.

**Distinguishing Features:** Grassy Balds are distinguished from other natural communities by the natural dominance of dense herbaceous vegetation in high elevation upland sites that are not rock outcrops or glades. The Sedge Subtype is distinguished from the Grass Subtype by the dominance of *Carex* spp. It is distinguished from the Alder Subtype by the absence or only sparse presence of *Alnus crispa*. High Elevation Rocky Summit communities may contain some of the same species but have limited herbaceous vegetation and extensive bare rock. Northern Hardwood Forest (Beech Gap Subtype) has similar *Carex* dominated herbaceous cover but has a well-developed tree canopy.

**Synonyms:** *Carex pensylvanica* Herbaceous Vegetation (CEGL004094).  
Ecological Systems: Southern Appalachian Grass and Shrub Bald (CES202.294).

**Sites:** The Sedge Subtype occurs in settings similar to the other subtypes, on gentle to moderate slopes, ridgetops, and broad domes at high elevation.

**Soils:** Most soils are mapped as the Burton series (Typic Haplumbrept).

**Hydrology:** Sites are high convex slopes and are well drained, though seeps may be embedded in them. They are mesic due to high rainfall, frequent fog, and low temperatures but are exposed to drying winds.

**Vegetation:** The Sedge Subtype has dense herbaceous vegetation dominated by species of *Carex*. *Carex pensylvanica* usually is the dominant species, and *Carex flexuosa* and *Carex brunnescens* var. *sphaerostachya* are frequent. *Danthonia compressa* and other grasses are often intermixed. Other high constancy species in CVS plot data include *Dennstaedtia punctilobula*, *Angelica triquinata*, *Rumex acetosella*, and *Anemone quinquefolia*. *Rubus canadensis* also is present in most plots. Species that are fairly frequent include *Houstonia serpyllifolia*, and *Erythronium americanum* ssp. *americanum*. Additional species in CVS plots include *Luzula echinata*, *Lysimachia ciliata*, *Nabalus* sp., and *Lilium grayi*. Additional species are noted in the NVC description, including *Carex debilis*, *Sibbaldia retusa*, *Fragaria virginiana*, *Ageratina altissima* var. *roanensis*, and *Bromus pubescens*. Some areas are invaded by woody species, which may include *Vaccinium* spp., *Rhododendron catawbiense*, *Fagus grandifolia*, *Aesculus flava*, *Abies fraseri*, and others, as well as *Rubus*.

**Range and Abundance:** Ranked G1. The Sedge Subtype is reported only from the Roan Mountain highlands of North Carolina and adjacent Tennessee and possibly from one additional site in Watauga County. Since it can occur in association with the Grass Subtype, a few more examples may be overlooked.

**Associations and Patterns:** The Sedge Subtype occurs in a mosaic with the Grass Subtype and Alder Subtype and may be bordered by Northern Hardwood Forest.

**Variation:** Variation is not well known, other than local variation with the transition to adjacent communities and the variation in the degree of woody species encroachment.

**Dynamics:** The uncertainties and controversies discussed for the dynamics of the Grass Subtype of Grassy Bald also apply to the Sedge Subtype.

**Comments:** The relationship between the Sedge Subtype and Grass Subtype is particularly poorly known. It may be related to subtle site differences but may equally easily be related to differences in successional state or to differences in degree of alteration by grazing. The subtypes are recognized based on the NVC, but they may be only marginally distinct. The widespread alteration of Grassy Bald communities by grazing, woody plant invasion, and later management make the distinguishing of appropriate herbaceous dominance problematic.

**Rare species:** *Agrostis mertensii*, *Alnus crispa*, *Sceptridium multifidum*, *Calamagrostis canadensis* var. *canadensis*, *Carex cristatella*, *Delphinium exaltatum*, *Dendrolycopodium dendroideum*, *Dendrolycopodium hickeyi*, *Geum geniculatum*, *Houstonia montana*, *Lilium grayi*, *Lilium philadelphicum*, *Mononeuria groenlandica*, *Monarda media*, *Packera schweinitziana*, *Phlox subulata*, *Platanthera grandiflora*, *Poa palustris*, *Spiranthes ochroleuca*, *Trisetum spicatum*.

**References:**

## GRASSY BALD (ALDER SUBTYPE)

**Concept:** Grassy Bald (Alder Subtype) is a high elevation shrubland dominated by *Alnus crispa*, often with a grass or sedge herb layer beneath. This subtype is confined to the Roan Mountain highlands.

**Distinguishing Features:** The Alder Subtype is distinguished from all other communities in North Carolina by the dominance of *Alnus crispa*.

**Synonyms:** *Alnus viridis* ssp. *crispa* / *Carex pensylvanica* Shrubland (CEGL003891).  
Ecological Systems: Southern Appalachian Grass and Shrub Bald (CES202.294).

**Sites:** The Alder Subtype occurs in settings similar to the other subtypes, on gentle to moderate slopes, ridgetops, and broad domes at high elevation.

**Soils:** Mapped as the Burton series (Typic Haplumbrept). Donaldson, et al. (2014) found soils in the Alder Subtype to have pH of 4-5, more acidic than either other Grassy Bald or Heath Bald soils. The nitrogen fixation carried on by *Alnus* acidifies the soil, so this likely is a result of the vegetation. The Alder Subtype also have higher cation exchange capacity and organic matter than other Grassy Balds or than Heath Balds.

**Hydrology:** Sites are high convex slopes and are well drained, though seeps may be embedded in them. They are mesic due to high rainfall, frequent fog, and low temperatures, but are exposed to drying winds.

**Vegetation:** The Alder Subtype is a shrubland dominated by *Alnus crispa*, which may range from dense to open. *Rhododendron calendulacum*, *Vaccinium altomontanum*, or *Vaccinium corymbosum* may be present in small numbers. In some areas, *Rubus canadensis* is present, and it may be dense. The herb layer varies in cover, but usually is extensive where *Rubus* is not abundant. *Carex pensylvanica* dominates, and *Carex flexuosa*, *Poa compressa*, *Houstonia serphillifolia*, *Erythronium americanum* ssp. *americanum* are often present. Other herbs may include *Avenella flexuosa*, *Danthonia compressa*, *Dennstaedtia punctilobula*, *Carex brunnescens* var. *sphaerostachya*, and *Rumex acetosella*. *Abies fraseri*, *Fagus grandifolia*, *Aesculus flava*, or other trees may be established in some areas.

**Range and Abundance:** Ranked G1. This community is known only in a small portion of the Roan Mountain highlands on the North Carolina-Tennessee border. Its entire global range is less than 200 acres. The population of *Alnus crispa* represents a long distance disjunction; the nearest native population is in Pennsylvania, where it too is a disjunct from a widespread population in New England, Canada, the upper Midwest, and Greenland.

**Associations and Patterns:** Grassy Bald (Alder Subtype) occurs in association with the Grass Subtype and Sedge Subtype. It also may border Northern Hardwood Forest and High Elevation Rocky Summit.

**Variation:** Examples vary in shrub density and herbaceous composition.

**Dynamics:** Most of the uncertainties and controversies discussed for the dynamics of the Grass Subtype of Grassy Bald also apply to the Alder Subtype, with the addition of uncertainty about its relationship to the other subtypes. *Alnus crispa* has sometimes been regarded as a woody invader of the Grass and Sedge subtypes, spreading vegetatively since the cessation of cattle grazing and representing a threat to them similar to *Rhododendron* and *Rubus*. Brown (1941) briefly indicated he thought vigorous alder growth was slowly invading open Grassy Bald. He included it as an alternative successional pathway from grass to spruce forest. However, historical information is not detailed enough about the boundaries between these adjacent communities to be certain that alder has expanded. The turnover of stems makes it impossible to age the shrubs.

However, the *Alnus* is a long-distance disjunct population, apparently persisting at this location since the Pleistocene. It does not occur in adjacent forests, and its presence is one of the indicators of great antiquity of open balds on Roan Mountain. It has shown no tendency to spread even into the separate Grassy Bald patches near its occurrence, neither the heavily grazed balds of Little Hump Mountain or Big Yellow Mountain nor the less grazed Round Bald. Donaldson, et al. (2014) noted that the species was reported on Roan Mountain before 1850 and that its cover seems to have declined rather than increased, though the loss appears to be due to tree encroachment rather than spread of other Grassy Bald subtypes. It thus seems appropriate to regard it as a natural community and to not manage for open grassland at its expense. At the same time, the Alder Subtype, just as the other subtypes, is at risk of losing its distinctive character due to invasion by other woody species, with the herbaceous layer especially threatened. Areas that have been invaded by *Rubus* have greatly reduced herb cover and diversity. The mowing and hand cutting that have kept reversed the increase of *Rubus* cover in the nearby balds, is not possible amid the shrubs.

Donaldson, et al. (2014) noted that alder in other regions plays a role in primary succession, adding nitrogen to the soil through its ability to fix atmospheric nitrogen, and that it can account for a significant portion of the nitrogen in and even near its populations. It is not clear that it plays a similar role in Grassy Balds. Unlike in northern glaciated areas, the Grassy Bald soils likely have been present for a very long time, and there is no obvious reason to regard the Alder Subtype areas as later in primary succession than the other Grassy Bald subtype. They also found nitrogen levels to be extremely variable in the Alder Subtype, and not consistently higher than in other balds.

The interaction of the Alder Subtype with grazing is unclear. Cattle are widely regarded as preventing the establishment or spread of woody plants, but the population of *Alnus* survived the era of cattle grazing, and it is not clear if it decreased or increased during it. No records suggest that *Alnus* was present in the more heavily grazed balds nearby, though it is conceivable that heavy grazing eliminated an unrecorded population. Interactions with long lost native grazers is even less clear.

**Comments:** This community was treated as a subtype of Heath Bald in early drafts of the 4<sup>th</sup> approximation, and was included with Heath Bald in the 3<sup>rd</sup> approximation. However, unlike Heath Balds, it contains substantial herb cover beneath the shrub canopy, primarily consisting of

the same species found in Grassy Bald. It appears to be more closely related to the Sedge Subtype than to the Grass Subtype. It is unclear if the locations of the Alder Subtype are determined by subtle site differences, by successional dynamics, or simply result from the chance persistence of the defining species in particular places.

**Rare species:** *Empidonax alnorum*

**References:**

Brown, D.M. 1941. Vegetation of Roan Mountain: a phytogeographical and successional study. Ecol. Monogr. 11: 61-97.

Donaldson, J.T., Z.C. Dinkins, F. Levy, and A. Nardis. 2014. Surface-soil properties of alder balds with respect to grassy and Rhododendron balds on Roan Mountain, North Carolina and Tennessee. Southeastern Naturalist 13: 377-395.



## HEATH BALD (CATAWBA RHODODENDRON SUBTYPE)

**Concept:** Heath Balds are persistent natural high elevation shrublands, dominated by various evergreen Ericaceous shrubs. The Catawba Rhododendron Subtype is the most abundant subtype, dominated by *Rhododendron catawbiense*, with or without abundant *Kalmia latifolia* or *Vaccinium* spp., occurring on high elevation narrow ridgetops, broad high elevation domes, or in smaller patches bordering rock outcrops.

**Distinguishing Features:** Heath Balds are distinguished from all other community types by natural dominance or occasional codominance of dense evergreen Ericaceous shrubs, with few or no trees, over a substantial area (one acre or more). Examples generally range from 4000 to over 6000 feet. Several other communities may have dense evergreen shrub layers but have a well-developed closed or open tree canopy under normal natural conditions. Examples that have suffered canopy mortality may be difficult to tell from Heath Balds, but most will show evidence of having had trees in the recent past. The shrubby subtypes of Red Spruce–Fraser Fir Forest and High Elevation Red Oak Forest may have similar shrub layers, but the more abundant Pine–Oak/Heath and Swamp Forest–Bog Complex communities occur at lower elevations and are more likely to have shrub layers dominated by *Rhododendron maximum*, *Kalmia latifolia*, or species not characteristic of Heath Balds.

Small patches that closely resemble Heath Bald vegetation may occur as part of the complex of vegetation in rock outcrop communities such as High Elevation Granitic Dome or High Elevation Rocky Summit. Classification as Heath Bald should be reserved for shrub communities not associated with substantial rock outcrops and for exceptionally large patches associated with rock outcrops (comparable to the open rock in extent).

The Catawba Rhododendron Subtype is distinguished from all other subtypes of Heath Bald by the dominance of *Rhododendron catawbiense* with little cover of the shrub species that distinguish other subtypes.

**Synonyms:** *Rhododendron catawbiense* Shrubland (CEGL003818).

Ecological Systems: Southern Appalachian Grass and Shrub Bald (CES202.294).

**Sites:** Heath Bald (Catawba Rhododendron Subtype) occurs in three different kinds of sites. One is narrow, often steeply plunging spur ridges on the flanks of higher ridges. The second is on broad knobs or domes at higher elevations, where it may occupy substantial area. A few examples occur on less distinctive ridge tops or upper slopes on the edges of rock outcrop communities. Examples generally range from 4000 feet to over 6000 feet in elevation.

**Soils:** Heath Bald soils often are shallow and rocky and may have a thick organic layer built up because of the slow decomposition of the litter from the evergreen shrubs. The examples on spur ridges and around rock outcrops generally are inclusions in soil map units. Large examples are mapped as Wayah (Typic Haplumbrept), Burton (Typic Humadept), Craggey (Lithic Haplumbrept), or Clingman (Lithic Udifolist). More of the smaller patches may be Lithic Udifolists. Cain (1930) found that Heath Bald soils were more acidic than soils in forest communities at the same elevations, though Donaldson et al. (2014) found that Grassy Bald (Alder

Subtype) soils were even more acidic. Conkle and Young (2004) noted high aluminum levels as well. These soil chemistry differences probably are the result of the vegetation rather than the cause of it.

**Hydrology:** Despite occurrence on steep and often sharply convex topography, the Catawba Rhododendron Subtype generally is mesic because of high rainfall, frequent fog, and low temperatures. Where the soil has a thick organic layer, it may hold substantial water, but the shallow soil in many examples may lead to drought stress in drier weather.

**Vegetation:** The Catawba Rhododendron Subtype is dominated by *Rhododendron catawbiense*, sometimes overwhelmingly so, sometimes with codominant *Kalmia latifolia* or *Vaccinium corymbosum*. Other shrub species with high constancy but usually with limited cover in CVS and NatureServe plot data are *Sorbus americana* and *Aronia melanocarpa*. Fairly frequent species include *Vaccinium erythrocarpum*, *Ilex montana*, and *Viburnum cassinoides*, and other shrub species include *Rhododendron (Menziesia) pilosum*, *Clethra acuminata*, and *Eubotrys recurva*. *Galax urceolata* is the only high constancy species in the herb layer, and it may have large cover. Other herbs that are frequent in plots are *Angelica triquinata* and *Maianthemum canadense*, and other species such as *Athyrium asplenoides*, *Medeola virginiana*, *Lysimachia quadrifolia*, *Dennstaedtia punctilobula*, and *Oclemena acuminata* may less frequently occur. Other herbs often mentioned in reports and included on site lists include species associated with small openings or small rock outcrops, such as *Hydatica petiolaris*, *Danthonia compressa*, *Krigia montana*, and *Sibbaldia retusa*.

**Range and Abundance:** Ranked G2. Examples are scattered throughout the higher mountains, though most are north of Asheville. The equivalent NVC association ranges into adjacent Virginia, Tennessee, and possibly Georgia, but most of its global range is in North Carolina.

**Associations and Patterns:** Heath Balds generally are surrounded by high elevation forests of the Spruce–Fir Forests or Northern Hardwood Forests themes. Some may occur in association with rock outcrop communities such as High Elevation Rocky Summit or High Elevation Granitic Dome or with Grassy Bald. The Catawba Rhododendron Subtype does not generally occur with other subtypes.

**Variation:** Examples vary in the amount of shrubs other than *Rhododendron catawbiense*. Examples codominated by *Kalmia latifolia* or by *Vaccinium* spp. may warrant recognition as variants. McLeod (1988) emphasized the occurrence of both dense thickets and open “garden” Heath Balds.

**Dynamics:** The dynamics of Heath Balds in general have been the subject of much discussion, though such discussion often can’t be attributed to particular subtypes. Cain (1930) found evidence that all of the Heath Balds he sampled in the Smokies (probably a combination of Catawba Rhododendron, Slate, and Carolina Rhododendron subtype) had burned multiple times in the past. He suggested that a variety of disturbances, including fire, landslides, and windthrows, and also extreme environmental conditions, were responsible for their occurrence. Whittaker (1956) suggested that Heath Balds were successional in part, but that they seemed to be able to maintain

themselves under present conditions. White et al. (2001) indicated a similar view, rejecting the idea that Heath Balds represented primary succession or were maintained by ongoing erosion. They suggested these communities were created by existing heath shrub layers taking over after fire destroyed a previous tree canopy, with the shrubs then inhibiting tree recovery. Terrain modeling they conducted showed that most sites topographically comparable to Heath Bald sites supported forests, and they interpreted this as suggesting that Heath Balds result from disturbance. At the same time, though they emphasized that the two watersheds with the largest and most numerous Heath Balds had experienced severe fires after logging in the early 1900, they also found that Heath Balds are much more abundant on the northern Tennessee side of the Smokies in general. They suggested several possible environmental reasons rather than disturbance history for this pattern. And they described several cases where fires or other disturbances have not led to formation of Heath Balds. It should be noted that many models for particular communities or species greatly overpredict their occurrence. Such errors are likely if important independent determining variables are not included in the model.

In contrast to the Smokies, some open Heath Balds on Roan Mountain and the Craggy Mountains are being invaded by trees (Brown 1941, Crawford and Kennedy (2009). McLeod (1988) regarded Heath Balds as secondary successional communities after disturbances in extreme sites.

It may be that all viewpoints are true about at least some Heath Balds. Some are clearly primary successional communities, occurring on landslide scars and the edges of rock outcrops. Others are not obviously so but show evidence of fire. They may represent secondary succession or maintenance by chronic natural disturbance. The location of most Heath Balds on the driest, most exposed microsites in their vicinity presumably makes them more susceptible to lightning fires and makes natural fires more severe than in surrounding forests. Severe site conditions and the competitiveness of dense shrub cover at least contribute to Heath Balds resisting tree growth and may be sufficient to maintain some in the long run. Conkle and Young (2004) and Conkle, et al (2003) found radiocarbon dated organic soils in Heath Balds to range from 100-3000 years old, with clusters of ages at 2900, 1100, and 120 years. Though they appeared to regard these dates at the bottom of the organic deposit as being the origin of the Heath Bald, it is also plausible that it represents a severe fire in what was already a Heath Bald. Conkle and Young (2004) also noted that organic deposits, protected from decomposition by extreme acidity and aluminum saturation, appeared to be spreading into adjacent forests, suggesting the possibility that some balds were expanding.

Vegetation resembling Heath Bald can also result from logging and severe burns in spruce-fir forests in historical times, but such examples are better regarded as altered vegetation. Other heath areas have resulted from invasion of Grassy Balds by shrubs.

**Comments:** Heath Balds occupy a relatively small area in the mountains as a whole. In general they are in inaccessible, well protected sites, but some, particularly the open, garden-like examples, may be threatened by trampling and by natural succession. Exclusion of fire may be a long-term threat to all Heath Balds, but the proper management is not known.

**Rare species:** *Rubus idaeus* ssp. *strigosus*, *Rhododendron vaseyi*, *Stenanthium leimanthoides*.

**References:**

- Brown, D.M. 1941. Vegetation of Roan Mountain: a phytogeographical and successional study. *Ecological Monographs* 11: 61-97.
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- Conkle, L., Young, R.S., Bochicchio, C.J., Khiel, A. 2003. Why go Bald? Understanding the age and origin of southern Appalachian heath balds in Great Smoky Mountains National Park. *GSA Abstracts with Programs*, 35:6:330.
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- White, P.S., S.P. Wilds, and D.A. Stratton. 2001. The distribution of heath balds in the Great Smoky Mountains, North Carolina and Tennessee. *Journal of Vegetation Science* 12: 453-466.
- Whittaker, R.H. 1956. Vegetation of the Great Smoky Mountains. *Ecological Monographs* 26: 1-80.

## HEATH BALD (CAROLINA RHODODENDRON SUBTYPE)

**Concept:** Heath Balds are persistent natural high elevation shrublands, dominated by various evergreen Ericaceous shrubs. The Carolina Rhododendron Subtype is a rare subtype that is strongly dominated by *Rhododendron carolinianum*, occurring on quartzite or potentially on other rocks but not on slate. It is known only in the area of Linville Gorge.

**Distinguishing Features:** The Carolina Rhododendron Subtype is distinguished from most other subtypes by the strong dominance of *Rhododendron carolinianum*. It occurs at somewhat lower elevation, associated with pine communities rather than spruce-fir or northern hardwood forests. The Slate Subtype of the Great Smoky Mountains also has *Rhododendron carolinianum* dominant but in combination with other species and usually in more open stands.

**Synonyms:** *Rhododendron carolinianum* Shrubland (CEGL003816).

Ecological Systems: Southern Appalachian Grass and Shrub Bald (CES202.294).

**Sites:** The Carolina Rhododendron Subtype occurs on both steep slopes and spur ridges and on ridge tops near rock outcrops of quartzite or related rocks.

**Soils:** Soils are generally fairly shallow, with bedrock near the surface. The quartzite substrate creates extremely acidic conditions.

**Hydrology:** The relatively low elevation setting of the Carolina Rhododendron Subtype, combined with the steep convex slopes and shallow soils, makes for dry conditions, perhaps much drier than the mesic higher elevation subtypes.

**Vegetation:** The Carolina Rhododendron Subtype is a tall or short shrubland dominated or codominated by *Rhododendron carolinianum*. The shrub canopy may be very dense or fairly open. *Kalmia buxifolia* is usually present and often abundant. Other shrubs with high constancy in the few CVS plots include *Vaccinium corymbosum*, *Clethra acuminata*, *Ilex montana*, *Kalmia latifolia*, *Eubotrys recurves*, *Aronia arbutifolia*, *Gaylussacia baccata*, and *Fothergilla major*. *Xerophyllum asphodeloides* and *Galax urceolata* are present in all plots. Almost all other herbs are associated with open rock inclusions: *Bryodesma tortipilum*, *Trichophorum cespitosum*, *Liatris helleri*, and *Carex umbellata*, though *Lysimachia quadrifolia* is also present.

**Range and Abundance:** Ranked G2, but possibly better treated as G1. All North Carolina examples are in a small area on the rim of Linville Gorge, but the NVC also reports the association as occurring in Tennessee in the area around Mount LeConte in the Great Smoky Mountains.

**Associations and Patterns:** The Carolina Rhododendron Subtype is closely associated with High Elevation Rocky Summit (Quartzite Subtype) communities. It may also grade to Pine–Oak/Heath and potentially to various dry acidic forest communities.

**Variation:** Examples vary in density of the shrub layer, with the transition to adjacent communities.

**Dynamics:** This subtype is related to the extreme site conditions of relatively shallow soil, excessive drainage, and extreme soil acidity. However, within those conditions, fire appears to be an important factor in driving its presence. Some areas may depend on periodic fire to remain as more open rock outcrop communities, and Heath Bald may encroach on them in the absence of fire. Similarly, Pine–Oak/Heath may encroach on the Heath Bald with insufficient fire.

**Comments:** The concept of this subtype has been narrowed by the creation of the Slate Subtype. *Rhododendron carolinianum* has a very patchy distribution and is not even present in most Heath Balds. Communities where it dominates are rare. This subtype may exist only at Linville Gorge but may be found in a few other places.

The subtypes of Heath Bald are more finely divided than most natural communities, following the lead of the NVC. Given the different geologic settings and dominant vegetation, the distinctions appear justified.

**Rare species:** *Fothergilla major*, *Liatris helleri*, *Stenanthium leimanthoides*.

**References:**

Newell, C.L. and R.K. Peet. 1995. Vegetation of Linville Gorge Wilderness, North Carolina. Unpublished report to USDA Forest Service. University of North Carolina, Department of Biology, Chapel Hill.

Newell, C.L. 1997. Local and regional variation in the vegetation of the Southern Appalachian Mountains. PhD dissertation, University of North Carolina, Chapel Hill.

## HEATH BALD (SOUTHERN MIXED SUBTYPE)

**Concept:** Heath Balds are persistent natural high elevation shrublands, dominated by various evergreen Ericaceous shrubs. The Southern Mixed Subtype encompasses high elevation examples containing *Pieris floribunda* as well as other shrubs, usually codominant with *Rhododendron catawbiense*. This subtype is confined to south of the Asheville Basin.

**Distinguishing Features:** The Southern Mixed Subtype is distinguished from all other subtypes by the substantial presence of *Pieris floribunda*, though it may not dominate. Other Heath Balds at high elevations south of Asheville and codominated by other evergreen shrub species not typical of the Catawba Rhododendron Subtype may also be classified here. The distinction with the Low Elevation Subtype may be particularly difficult.

**Synonyms:** *Rhododendron catawbiense* - *Pieris floribunda* Shrubland (CEGL004516).  
Ecological Systems: Southern Appalachian Grass and Shrub Bald (CES202.294).

**Sites:** The Southern Mixed Subtype may occur in sites similar to the Catawba Rhododendron Subtype: steeply plunging spur ridges, broad knobs or domes at higher elevations, or small patches associated with rock outcrops. Elevations range from 4000-6000 feet.

**Soils:** The range of soils is not well known, but presumably is similar to those for the Catawba Rhododendron Subtype.

**Hydrology:** Despite occurrence on steep and often sharply convex topography, the Southern Mixed Subtype probably is mesic because of high rainfall, frequent fog, and low temperatures. Where the soil has a thick organic layer, it may hold substantial water, but the shallow soil in many examples may lead to drought stress in drier weather.

**Vegetation:** The Southern Mixed Subtype is codominated by *Rhododendron catawbiense*, usually in combination with *Pieris floribunda*. The shrub canopy may be very dense or somewhat open. Other shrubs frequent in the limited CVS plots data include *Diervilla sessilifolia*, *Vaccinium simulatum*, *Ilex montana*, *Kalmia latifolia*, *Vaccinium erythrocarpum*, *Vaccinium corymbosum*, *Viburnum cassinoides*, and *Vaccinium stamineum*. The herb layer may be sparse where shrub cover is high but may be extensive in more open areas. High constancy species in plots are *Dennstaedtia punctilobula*, *Carex pensylvanica*, *Oclemena acuminata*, *Avenella flexuosa*, and *Angelica triquinata*. Other frequent species include *Danthonia compressa*, *Solidago curtissii*, *Diphasiastrum digitatum*, *Athyrium asplenioides*, *Trillium undulatum*, *Houstonia serpyllifolia*, *Eurybia macrophylla*, and *Hieracium paniculatum*. Trees are found in many plots, and include *Picea rubens*, *Betula alleghaniensis*, *Sorbus americana*, *Prunus pensylvanica*, *Amelanchier laevis*, and *Quercus rubra*.

**Range and Abundance:** Ranked G1. It may be better treated as G2, but several occurrences of uncertain classification, as well as the difficulty in distinguishing it from successional disturbed forests, confuse the understanding of its abundance. The Southern Mixed Subtype is most abundant in the Balsam Mountains, but other occurrences scattered in the area farther southwest have been attributed to it. The equivalent association is also attributed to Tennessee.

**Associations and Patterns:** The Southern Mixed Subtype is generally surrounded by high elevation forests of the Spruce-Fir Forests or Northern Hardwood Forests themes, or by High Elevation Red Oak Forest. Some may occur in association with rock outcrop communities such as High Elevation Rocky Summit or High Elevation Granitic Dome.

**Variation:** Variation is not well known and is confused by examples being of uncertain classification.

**Dynamics:** The dynamics of the Southern Mixed Subtype are presumably similar to those in the Catawba Rhododendron Subtype, but this is not fully certain. The best documented examples are in the Balsam Mountains, an area that had particularly heavy impacts of logging and slash fires in the early 1900s. Although natural Heath Bald presumably was present before these disturbances, some of the examples may represent secondary succession in degraded spruce-fir forests. The abundance of trees in plots attributed to this subtype suggests secondary succession.

**Comments:** This subtype, originally intended to cover several southern variations, was narrowed by the creation of the Slate Subtype. This subtype reportedly does not occur in the Great Smoky Mountains. Nevertheless, the appropriate classification for several occurrences attributed to it outside of the Great Balsam Mountains area remains uncertain.

**Rare species:** *Rhododendron vaseyi*.

**References:**



## HEATH BALD (SLATE SUBTYPE)

**Concept:** Heath Balds are persistent natural high elevation shrublands, dominated by various evergreen Ericaceous shrubs. The Slate Subtype encompasses examples occurring on slate substrate, known on in the Great Smoky Mountains. The vegetation is somewhat more mixed and more open than most other subtypes.

**Distinguishing Features:** The Slate Subtype is distinguished by the combination of *Rhododendron carolinianum*, *Rhododendron catawbiense*, and *Kalmia buxifolia* on a slate substrate. The Carolina Rhododendron Subtype may have the same dominant species but occurs on quartzite and has a different overall flora. Other subtypes may be dominated by *Rhododendron catawbiense* in combination with other shrub species. The Heath Subtype of Red Spruce–Fraser Fir Forest, Fraser Fir Forest, and High Elevation Red Oak Forest also has a shrub layer dominated by *Rhododendron catawbiense* but has a well-developed tree canopy.

**Synonyms:** *Rhododendron carolinianum* - *Rhododendron catawbiense* - *Leiophyllum buxifolium* Shrubland (CEGL007876).

Ecological Systems: Southern Appalachian Grass and Shrub Bald (CES202.294).

**Sites:** The Slate Subtype occurs on steep spur ridges and steep high elevation steep slopes with slate substrate, often with thin soils. Examples range from 5500 feet to over 6000 feet. Some sites are clearly old landslide scars.

**Soils:** Soils are shallow and may or may not have thick organic layers. Most, if not all, are smaller than the minimum map unit for soil mapping.

**Hydrology:** The Slate Subtype is well drained and has shallow soil but is generally mesic because of cool temperatures, high rainfall, and frequent fog. It may become dry during dry weather.

**Vegetation:** The Slate Subtype is a dense to open shrubland dominated by a combination of *Rhododendron catawbiense*, *Rhododendron carolinianum*, and *Kalmia buxifolia*. There is some confusion whether *Rhododendron minus* may also be present. The only other shrub present with fairly high frequency in NatureServe plots was *Vaccinium corymbosum*, but *Aronia melanocarpa*, *Rhododendron (Menziesia) pilosum*, *Vaccinium erythrocarpum*, *Viburnum cassinoides*, *Kalmia latifolia*, *Ilex montana*, *Pieris floribunda*, and a variety of other species may occur occasionally. Stunted *Picea rubens* and *Sorbus americana* also are fairly frequent. Because the shrubland is often open and contains small rock outcrops, a variety of herbaceous species are shared with high Elevation Rocky Summits as well as the surrounding Red Spruce–Fraser Fir Forests. These include *Hydatica petiolaris*, *Carex misera*, *Dryopteris campyloptera*, *Solidago glomerate*, *Oxalis montana*, *Dennstaedtia punctilobula*, *Galax urceolata*, *Cinna latifolia*, *Angelica triquinata*, *Carex pensylvanica*, and even *Calamagrostis cainii*, as well as mosses and *Cladonia* lichens.

**Range and Abundance:** Ranked G1. This subtype is known only in the Great Smoky Mountains, primarily in Tennessee but with some patches believed to occur in North Carolina.

**Associations and Patterns:** The Slate Subtype occurs surrounded by Red Spruce–Fraser Fir Forest. It may possibly be associated with High Elevation Rocky Summit.

**Variation:** Examples vary in density and stature of shrubs and in amount of rock outcrop.

**Dynamics:** As with other Heath Balds, the dynamics of the Slate Subtype are not well known. The slate is prone to slippage, making landslides more likely, and this may be an important factor in the occurrence of this subtype. Most examples may be primary successional communities developed on the bare rock of landslide tracks. Given their typical high elevation and context of spruce-fir forest, fire may not be a major influence. Yet, the sharply convex, highly exposed position of many patches may make them prone to lightning and to local fires. Given their occurrence in the Great Smoky Mountains, they presumably are among the Heath Balds Cain (1930) reported as universally showing evidence of fire, and that White, et al. (2001) discussed potential causes for occurrence. It is possible that in the absence of further landslides or small patch fires these Heath Balds may succeed to Red Spruce–Fraser Fir Forest; however, they may occur in their distinctive environment because this setting is prone to these natural disturbances.

**Comments:** This association was created by NatureServe to cover examples in the Great Smoky Mountains. It may be narrowly defined. It is somewhat unclear how distinct it is from the Carolina Rhododendron Subtype. Both quartzite and the sulfidic slate of the Great Smoky Mountains form extremely acidic soils. The slate is also prone to landslides and is less stable. Both characteristics may make for distinctive vegetation.

**Rare species:** *Calamagrostis cainii*.

**References:**

Cain, S.A. 1930. An ecological study of the heath balds of the Great Smoky Mountains. Butler University Botanical Studies 1: 177-208.

## HEATH BALD (SAND MYRTLE SUBTYPE)

**Concept:** Heath Balds are persistent natural high elevation shrublands, dominated by various evergreen Ericaceous shrubs. The Sand Myrtle Subtype encompasses examples dominated by *Kalmia (Leiophyllum) buxifolia*, known primarily at Grandfather Mountain and the Great Smoky Mountains.

**Distinguishing Features:** The Sand Myrtle Subtype is distinguished by the dominance of *Kalmia buxifolia* over the whole community. It is distinguished from rock outcrop communities, which may contain moderate sized patches of *Kalmia buxifolia* by covering a larger area and having the area of the community dominated by shrub cover rather than rock or herbs.

**Synonyms:** *Leiophyllum buxifolium* Dwarf-shrubland (CEGL003951).

Ecological Systems: Southern Appalachian Grass and Shrub Bald (CES202.294).

**Sites:** The Sand Myrtle Subtype occurs on sharp spur ridges, steep slopes, and shallow soils near rock outcrops, perhaps associated with quartzite or other very acidic metasedimentary rocks. Most examples are above 5000 feet in elevation.

**Soils:** Soils are generally shallow over bedrock.

**Hydrology:** As with most other Heath Balds, the Sand Myrtle Subtype is well drained and has shallow soil but is generally mesic because of cool temperatures, high rainfall, and frequent fog. However, drought stress may occur during dry periods.

**Vegetation:** The Sand Myrtle Subtype is a short shrubland dominated by *Kalmia buxifolia*. The shrubs may be only 0.5 meter tall, and the shrub layer may be patchy, with significant areas of bare rock interspersed. *Rhododendron catawbiense*, *Vaccinium pallidum*, *Rhododendron (Menziesia) pilosum*, and *Vaccinium erythrocarpum* are frequent species in plot data, along with stunted *Picea rubens*, *Betula alleghaniensis*, and *Sorbus americana*. *Rhododendron carolinianum* may also occur. Most herbs are in open areas or associated with embedded rock outcrops. Species at high frequency in plot data include *Hydatica petiolaris*, *Galax urceolata*, *Carex misera*, *Oclemena acuminata*, and *Trichophorum cespitosum*. The NVC description also notes *Vaccinium corymbosum*, *Avenella flexuosa*, *Bryodesma tortipilum*, *Carex umbellata*, and *Stenanthium leimanthoides*.

**Range and Abundance:** Ranked G1. Examples are known at Grandfather Mountain and in the Great Smoky Mountains, with a reported occurrence at Linville Gorge. The NVC also questionably attributes the equivalent association to South Carolina and Georgia, but this seems unlikely.

**Associations and Patterns:** The Sand Myrtle Subtype often occurs associated with High Elevation Rocky Summit and may occur with other subtypes of Heath Bald. Examples grade to various spruce-fir forest communities or high elevation hardwood forest communities.

**Variation:** Examples are somewhat heterogeneous at fine scales and vary with the gradation to adjacent communities.

**Dynamics:** Dynamics of the Sand Myrtle Subtype likely are similar to the Slate Subtype. The extreme environment of high elevations and shallow soils prevents not only trees but other shrubs from becoming dominant. This subtype probably is best regarded as a primary successional community, developing slowly on landslide scars or on bedrock and perhaps eventually succeeding to taller Heath Bald subtypes. Natural fire is unlikely in the spruce-fir forests that surround most examples of the Sand Myrtle Subtype, but the exposed topographic position may promote occasional lightning strikes and local fires.

**Comments:** The Sand Myrtle Subtype is more closely related to rock outcrop communities than are other Heath Balds. The distinction between well-developed occurrences of this Heath Bald subtype and *Kalmia buxifolia* patches in High Elevation Rocky Summit communities can be subtle. The CVS plots used in the description of vegetation here were all collected by Susan Wiser in the course of her study on high elevation rock outcrops (Wiser et al. 1996).

**Rare species:** *Calamagrostis cainii*, *Liatris helleri*, *Solidago spithamaea*, *Stenanthium leimanthoides*, *Trichophorum cespitosum*.

**References:**

Wiser, S.K., R.K. Peet, and P.S. White. 1996. High-elevation rock outcrop vegetation of the Southern Appalachian Mountains. *Journal of Vegetation Science* 7: 703-722.

## HEATH BALD (LOW ELEVATION SUBTYPE)

**Concept:** Heath Balds are persistent natural high elevation shrublands, dominated by various evergreen Ericaceous shrubs. The Low Elevation Subtype covers warmer, lower elevation examples, dominated by *Kalmia latifolia* and generally with a greater diversity of shrub species.

**Distinguishing Features:** The Low Elevation Subtype is distinguished from the Catawba Rhododendron Subtype by having a larger amount of *Kalmia latifolia*, making up more than 50 percent of cover, along with the presence of associated lower elevation species such as *Rhododendron maximum*, *Quercus rubra*, and *Quercus montana*, rather than high elevation species such as *Picea rubens*, *Abies fraseri*, and *Sorbus americana*. It lacks significant amounts of *Pieris floribunda* or *Kalmia (Leiophyllum) buxifolia* though they may be present in small numbers. While some trees may be present, this community should be classified only where shrub-dominated vegetation appears to be persisting in association with severe site conditions. Shrub-dominated areas that were forested in the recent past and are succeeding back to forest should not be included. Pine–Oak/Heath occurrences that have lost their canopy due to southern pine beetles and exclusion of fire should not be treated here.

**Synonyms:** *Kalmia latifolia* - *Rhododendron catawbiense* - (*Gaylussacia baccata*, *Pieris floribunda*, *Vaccinium corymbosum*) Shrubland (CEGL003814).

Ecological Systems: Southern Appalachian Grass and Shrub Bald (CES202.294).

**Sites:** The Low Elevation Subtype occurs on shrub spur ridges, steep slopes, and large areas of shallow soil near rock outcrops, on a variety of kinds of substrates but at lower elevations or in warmer settings than other Heath Bald subtypes, generally below 5000 feet.

**Soils:** Soils are shallow and may or may not have thick organic layers.

**Hydrology:** The Low Elevation Subtype is well drained and may become dry. It presumably is less mesic than the other subtypes, which occur at higher elevations.

**Vegetation:** The Low Elevation Subtype is a dense tall shrubland, generally dominated by *Kalmia latifolia* and *Rhododendron catawbiense*. Other shrubs with high constancy in CVS and NatureServe plot data are *Gaylussacia baccata*, *Vaccinium corymbosum*, *Ilex montana*, *Clethra acuminata*, *Aronia arbutifolia*, *Kalmia buxifolia*, *Viburnum cassinoides*, and *Eubotrys recurves*. *Acer rubrum*, *Picea rubens*, and *Quercus rubra* also are highly constant. The NatureServe description also notes *Rhododendron carolinianum*, *Vaccinium stamineum*, and *Pieris floribunda*, as well as several additional tree species. Herbs are generally sparse beneath the dense shrubs, with *Galax urceolata* the only species with high constancy. Fairly frequent herbs include *Gaultheria procumbens*, *Pteridium latiusculum*, *Melampyrum lineare*, *Xerophyllum asphodeloides*, *Solidago* spp., *Iris verna* var. *smalliana*, and *Coreopsis major*.

**Range and Abundance:** Ranked G2G3. Examples are scattered throughout the mountains of North Carolina and occur in adjacent Tennessee, Georgia, and Virginia. The equivalent NVC association is also reported in Kentucky. This subtype may be overlooked in some site descriptions, making its abundance less clear than for other subtypes. Its lower elevation range

and possible habitat is much more extensive than for other subtypes, but microsites capable of supporting long term Heath Bald at lower elevation may be scarcer.

**Associations and Patterns:** Associations are not well known. Examples may be associated with rock outcrop communities. They may be surrounded by a wide variety of forest communities, perhaps usually High Elevation Red Oak Forest and Northern Hardwood Forest but potentially including other oak forests.

**Variation:** Variation is not known.

**Dynamics:** The Low Elevation Subtype presumably is more dependent on fire than the other subtypes, because the lower elevation climate is more favorable to tree growth and to soil formation. Examples may be less persistent than other subtypes, though this subtype is intended for communities that persist at least for decades. Persistence must depend on severe site conditions as well as fire. The prevailing natural fire regime clearly was consistent with occurrence of forest over most of the landscape. Forest community patches with catastrophic natural or artificial disturbance show fairly rapid secondary succession back to forest and do not persist as Heath Balds. As with other subtypes, the occurrence of the Low Elevation Subtype on highly exposed topography may make it particularly prone to lightning strikes and to local fires at a rate greater than the landscape as a whole.

**Comments:** The description of the equivalent association in the NVC is problematic in suggesting lumping of short-term successional vegetation created by logging with more persistent natural shrublands.

*Photinia melanocarpa* - *Gaylussacia baccata* / *Carex pensylvanica* Shrubland (CEGL008508) is a G1? association defined in Virginia and stated to potentially occur in North Carolina. It is described as a mosaic of shrub, herbs, and bare rock, so it would not be considered a Heath Bald. *Menziesia pilosa* - *Vaccinium (erythrocarpum, simulatum, corymbosum)* - *Sorbus americana* Shrubland [Provisional] (CEGL004819) has been defined for Mount Rogers. Communities like it may occur in North Carolina and may represent a distinctive subtype most closely related to this subtype.

**Rare species:** None known.

**References:**