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## **Bachman's Sparrow management plan: Fort A. P. Hill, Virginia**

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Bachman's  
Sparrow  
Management  
Plan



Fort A.P. Hill, Virginia

**The Center for Conservation Biology  
Department of Biology  
College of William & Mary  
Williamsburg, Virginia**

**BACHMAN'S  
SPARROW  
MANAGEMENT  
PLAN**

**FORT A. P. HILL, VIRGINIA**

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The Center for Conservation Biology is an organization dedicated to discovering innovative solutions to environmental problems that are both scientifically sound and practical within today's social context. Our philosophy has been to use a general systems approach to locate critical information needs and to plot a deliberate course of action to reach what we believe are essential information endpoints.

## Table of Contents

Executive Summary.....	1
Species Description.....	2
Species Status.....	3
Geographic Distribution.....	4
History/Distribution in Virginia.....	5
Prior to 1969.....	5
After 1968.....	5
Bachman’s Sparrow on Fort A. P. Hill.....	8
Breeding Biology.....	10
Habitat Requirements.....	11
Management Recommendations.....	12
Population Evaluation.....	12
Population Monitoring.....	13
Site Management.....	13
Landscape Management.....	14
Literature Cited.....	14

## **Executive Summary**

The Bachman's Sparrow (*Aimophila aestivalis*) is endemic to southeastern North America. Following a dramatic northerly range expansion in the late 1800's and early 1900's, this species has been contracting back to the core of its historic range in the extreme southeast. Population declines along the northern fringe of the species range have likely been due to secondary succession within abandoned farmland and the increased use of sod-forming grasses. Declines within the core of the breeding range have been due to degradation and loss of the southeastern pine ecosystem and an effective fire suppression program.

The Bachman's Sparrow is a species of conservation concern throughout its current breeding range. In Virginia, where distribution has declined from 16 counties prior to 1969 to just 4 counties after 1969, the species is listed as threatened. Bachman's Sparrows were discovered on Fort A. P. Hill in 1993 during a natural history inventory conducted by the Virginia Department of Conservation and Recreation, Division of Natural Heritage. These birds represent the northern-most breeding population throughout the entire species range. The small population evidently persists because frequent fires resulting from artillery impacts have maintained the site in a savanna-like condition.

The Bachman's Sparrow is a disturbance-prone species that occupies a narrow disturbance/successional niche. The species requires pine or open savannas with a high density of grasses and forbs in the first meter layer above the ground and low densities of vegetation in the second to fourth meter layer above the ground. For most locations, habitat maintenance depends on a 3-5 year disturbance interval. In the absence of such disturbance, most habitat patches will become unusable within a short period of time as succession proceeds beyond where it is suitable for the species. Management recommendations include 1) an evaluation of the current breeding population, 2) establishment of an annual population monitoring program, and 3) maintaining a fire program that will perpetuate the savanna habitat.

### Species Description

The Bachman's Sparrow is the only member of the *Aimophila* genus found in southeastern North America. Characteristic of this genus, Bachman's have a relatively large head, large bill and long, rounded, dark tail. Plumage is generally plain and dull. The dorsum is gray-brown with rusty streaks. The ventrum is buffy above grading to white on the belly. Juveniles exhibit thin streaking on the breast. Crown is reddish brown. Bachman's have a dull superciliary line with a narrow, dark eyeline and dark malar streak. Mandible is bicolored with a dark upper and a pale lower. Sexes are similar in appearance. Total length is 12 – 15 cm. Weight is approximately 21 g.



*Adult Bachman's Sparrows (below and above left and right). Note large bill, long tail, and relatively unmarked plumage. Center photo depicts a 4-day old chick (photos by B. Watts).*



Due to its secretive and retiring nature, the Bachman's Sparrow is often detected and/or identified by song. As with most passerines, song is used to attract mates and for territorial defense. Three song types have been identified, including the primary song, whisper song, and excited song (Dunning 1993). The primary song includes 1-2 clear introductory notes followed by a clear or buzzy trill. The clear, pleasant quality of the song more than its cadence is diagnostic. The whisper song is structurally similar to the primary song but the quality is softer and often ventriloquial. The excited song includes the components of the primary song but has some added trills. The cadence and structure of these songs may be confused with the song of the Eastern Towhee (*Pipilo erythrophthalmus*). The trill may be confused with the Field Sparrow (*Spizella pusilla*). Both of these species co-occur with the Bachman's Sparrow throughout its breeding range.

## Species Status

Although no range-wide population estimates are available for the Bachman's Sparrow, apparent population declines from highs in the early 1900's have led to growing concerns about the conservation status of this species. Bachman's are classified as a Category 2 species by the United States Fish and Wildlife Service, indicating that classification as federally threatened or endangered may be warranted but further information is needed. This species has appeared on the National Audubon Society's Blue List every year that the list has been compiled (Tate 1986). Bachman's are considered among the highest priority species of management concern within the Southeast Region of the United States Fish and Wildlife Service (Hunter 1990). Within the mid-Atlantic Coastal Plain Physiographic Region, the Bachman's Sparrow has been placed in the highest tier of species of conservation concern by Partners-in-Flight (Watts 1999). The Virginia Natural Heritage Program ranks Bachman's as G3/S1, recognizing its rare to uncommon status throughout its range and its extremely rare status in Virginia. The Virginia Department of Game and Inland Fisheries lists the species as threatened in the state (Ridd 1991).

A number of factors have likely contributed to Bachman's Sparrow population declines over the past several decades. One dominant factor is that the species is contracting back to its historic breeding range following a dramatic northerly range expansion that occurred from the late 1800's through the early 1900's. Broad-scale land clearing occurred throughout the northeastern United States during the 1800's. During the late 1800's, Bachman's Sparrows were recorded for the first time in several states across northeastern North America as they colonized abandoned farmlands and pasturelands. As these recently cleared lands were abandoned and allowed to proceed through secondary succession, habitat availability declined and Bachman's Sparrows began to disappear from the northern fringe of their new breeding range. This process is continuing today.

*Field proceeding through secondary succession. Bachman's Sparrows will abandon breeding areas when woody vegetation becomes dense. Secondary succession has been one of the leading causes of habitat loss throughout the northern portion of the breeding range.*

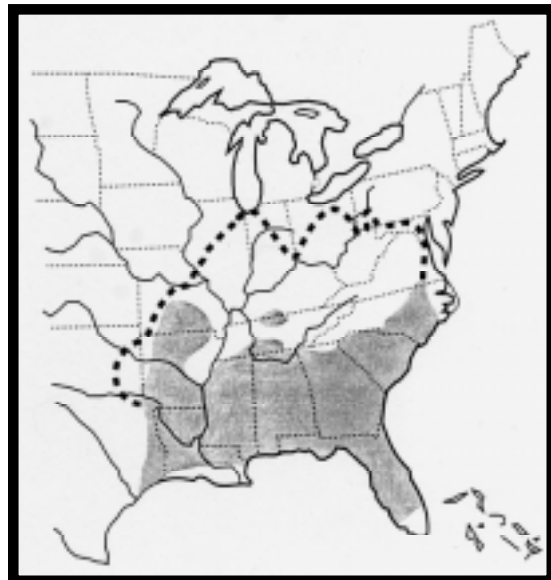


A second factor that has likely played a significant role in population declines is the loss and degradation of the southeastern pine ecosystem. Prior to European settlement, the Southeastern Coastal Plain was characterized by old-growth pine forests that covered more than 24 million ha (Crocker 1979). This ecosystem was maintained by low-intensity ground fires caused by lightning strikes (Komarek 1964, 1974) and indigenous people (Bartram 1791, Ware et al. 1993). Fires occurred over vast areas on approximately 3-5 year intervals (Chapman 1932, Krusac et al. 1995) and maintained forests with an open midstory and dense cover of forbs and grasses (Platt et al. 1991). Land clearing for agriculture, exploitation of mature pines for the naval stores industry, and suppression of wild-fires lead to severe declines in the abundance and distribution of inland pine savannas by the early 1800's (Ashe 1894, 1915, Pinchot and Ashe 1897). Three centuries of fragmentation and fire suppression have led to the development of dense hardwood midstories and replacement of open pine forests with closed-canopy pine and pine-hardwood forests. Currently, pine savannas occur on only about 1% of their former range (Ware et al. 1993).

### **Geographic Distribution**

The Bachman's Sparrow is endemic to southeastern North America (Figure 1). The core of its historic breeding range coincides with the southeastern pine ecosystem. Its current breeding range extends within the coastal plain and piedmont from Virginia south to central Florida and west to east Texas (Dunning 1993). Occasional extralimital observations are reported to the north from central Missouri, Kentucky, and Tennessee. The northern limit of known breeding is currently on Fort A.P. Hill in Virginia. Throughout much of its range, Bachman's are locally distributed with many patches of seemingly suitable habitat not occupied.

**Figure 1:** *Geographic range of the Bachman's Sparrow. Northern populations are at least partly migratory, but because winter status is poorly known in this species, the edge between migrant and resident populations cannot be defined. Dotted line indicates maximum range reached by breeders during the population expansion of 1890-1920s. Map taken from Dunning 1993.*





Winter range for the Bachman's Sparrow is believed to include the core of the breeding range north to North Carolina. Southern breeding populations are presumed to be year-round resident but northern populations are presumed to migrate south. However, migratory status and winter distribution is uncertain for northern populations due to the secretive nature of this species during the winter months. Currently, there are no winter records for Bachman's Sparrows over much of the breeding range.

#### History/Distribution in Virginia

##### *Prior to 1969 (account adapted from Dalmas 1995)*

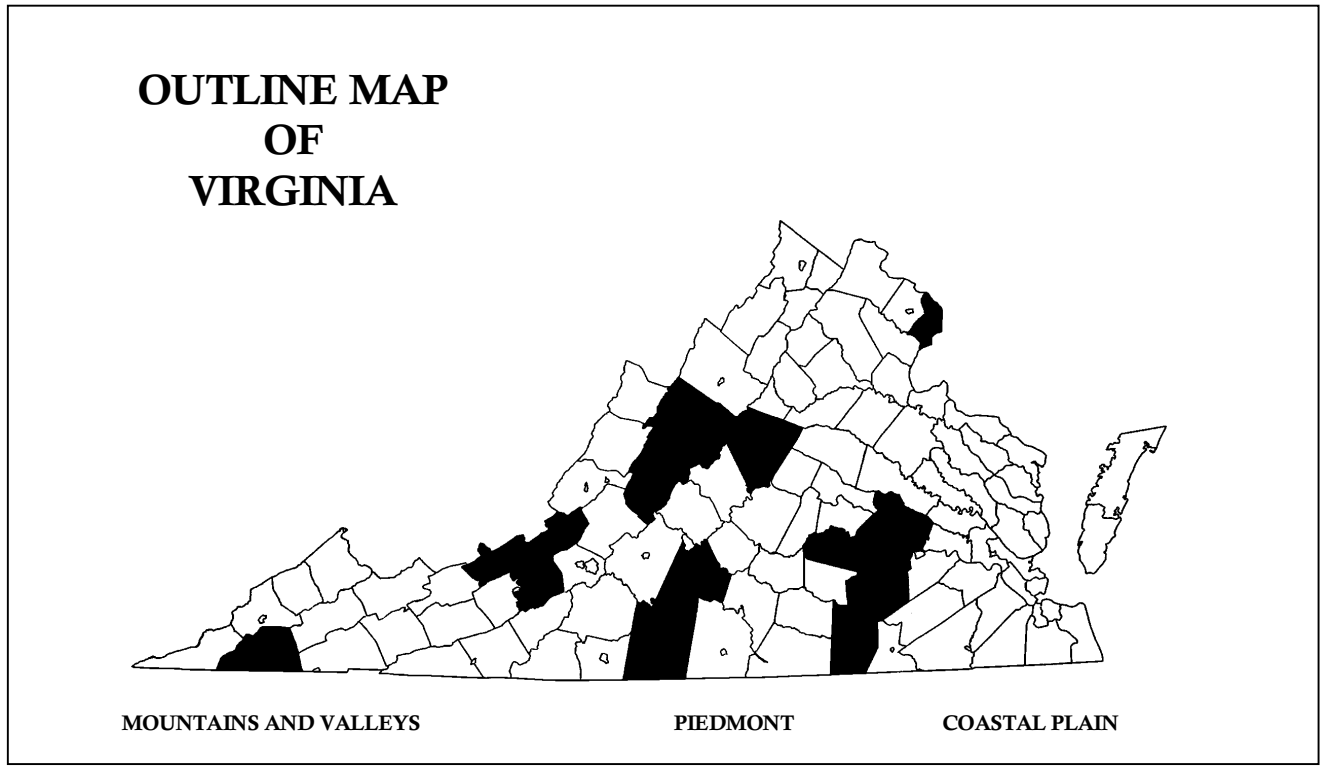
The Bachman's Sparrow was first documented in Virginia on 12 May 1897 (Murray 1933) when John W. Daniel, Jr. collected a pair, plus a nest and five eggs, near Blackwater Creek in Lynchburg (Freer 1939). Although not listed by Rives (1890) in *A Catalogue of the Birds of the Virginias*, the Bachman's Sparrow was included in Bailey's (1913) *The Birds of Virginia*. Although egg dates are given from 5 to 15 May, no comment was given on the general abundance status of the species (Bailey 1913). Fred M. Jones reported finding "a dozen or more nests" in the 1940's in Scott County (Dalmas 1995).

By 1952, Murray lists this species as "a summer resident in the Piedmont and in Southwest Virginia, uncommon; scarce transient and occasional summer visitor in the mountains; no records east of Richmond. It is a rare and irregular summer resident in Amelia County and in central and southern Chesterfield County, and is regular in summer in Petersburg. Probably less common than twenty years ago." A summary of confirmed summer records for the period between 1897 and 1969, by county, is presented in Figure 1a. Table 1 gives a list of documented records during this same time period.

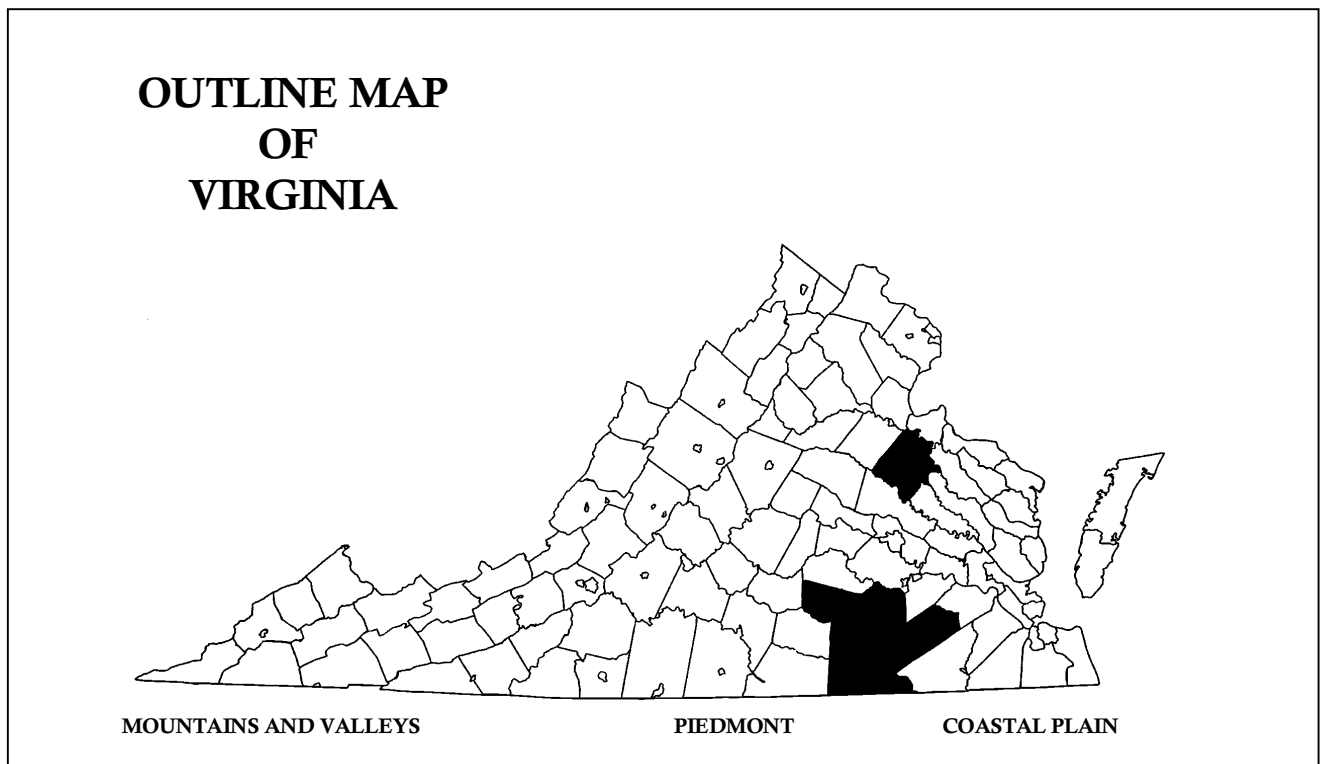
##### *After 1968 (account adapted from Dalmas 1995)*

The 19 June 1968 sighting of a singing male in Dinwiddie County by F. R. Scott proved to be the last documented summer record of Bachman's Sparrow in Virginia prior to its rediscovery in 1986 (Kain 1987). The only other Virginia records during this time period were from the Eastern Shore. One individual was observed on the Cape Charles Christmas Count on 28 December, 1975. The other observation was a presumed migrant photographed on 12 October, 1980 on the Chesapeake Bay Bridge Tunnel (Kain 1987).

**Figure 2 - Bachman's Sparrow Summer Records, by county, 1897-1968**



**Figure 3 - Bachman's Sparrow Summer Records, by county, 1969-1999**



**Table 1.** Historical records of the Bachman's Sparrow in Virginia (1897-1969).

Location	Dates	Literature Source
Albemarle County	1899, 1947-1953	Murray 1933 Grey and Stevens 1949 Murray 1952, Scott 1952
Amelia County	1930-1935, rare and irregular	Lewis 1938
Arlington County	1914	Cooke 1929
Augusta County	1933	Freer 1939
Brunswick County	1930-1935	Lewis 1938
Campbell County	1927, 1929, 1933	Freer 1939
Chesterfield County	1937, rare and irregular	Murray 1952
Craig County	1948	Murray 1952
Dinwiddie County	1968	Kain 1987
Fairfax County	1913, 1922, 1964	Cooke 1929, Kain 1987
Giles County	1938	Murray 1952
Henrico County	1949	Murray 1952
Lynchburg	1897	Murray 1952
Montgomery County	1906, rare, 4 records	Smyth 1912, Murray 1959
Petersburg	Regular in summer	Murray 1952
Pittsylvania County	Uncommon summer resident	Eggleston and Lyle 1952
Rockbridge County	1939, 1948	Murray 1957
Scott County	1940-1943	Jones 1943
Shenandoah Nat. Park	1945	Wetmore 1950

The Bachman's Sparrow was rediscovered in Virginia during the summer of 1986 when A. Bryan observed three singing males at two adjacent sites in Brunswick County (Virginia Department of Game and Inland Fisheries unpublished record). The birds were in a large clearcut area with broomsedge (*Andropogon virginicus*), young pines, and some hardwood saplings. This report was investigated by numerous other observers during the same breeding season. Adults were observed carrying nest material on 9 July. Immature birds were found on 6, 10, and 19 August. A recently fledged young and three singing birds were reported on 10 August. Bachman's Sparrows were still being reported from this site in 1988. By the summer of 1991, this site had become overgrown with young pines, and birds were no longer observed (Dalmas 1992).

In 1989, two singing Bachman's Sparrows were found in Brunswick County on land later referred to as the "Hobbs Chapel site". On 3 July 1989, R. Hilton located a breeding site in Sussex County that would later be referred to as the "Jerusalem Church site". This site was described as a clearcut that had recently been burned. The vegetation consisted primarily of sweet gum, oak, loblolly pine, and various grasses. In 1990, J. and T. Dalmas found two singing Bachman's Sparrows within this site. In June of 1989, B.

Watts and D. Bradshaw conducted a short roadside survey for Bachman's Sparrows in Sussex County. Singing males were detected within 7 clearcuts (including the Jerusalem Church site). Occupied sites were 2-3 year old clearcuts with stands of bunch grasses and scattered saplings.

In June of 1991, the Virginia Society of Ornithology held a Breeding Bird Foray in southeastern Virginia. The foray listed the Bachman's Sparrow as "locally common but found in only two previously known areas in Sussex County (Jerusalem Church site) and Brunswick County (Hobbs Chapel site)". R. Hilton had five singing males at the Brunswick County site, along with two presumed females and one juvenile (Dalmas 1992). Sightings of Bachman's Sparrows continued at the Jerusalem Church site and Hobbs Chapel site through 1992. Sporadic sightings have also been made in Greenville County. All recent records (excluding those on military installations) have been made within the three counties of Sussex, Greenville, and Brunswick (see Figure 3 for distribution of records since 1968).

In the summer of 1996, a systematic survey was conducted along every clearcut within a one degree block encompassing all areas where the Bachman's Sparrow had been observed since 1986 (with the exception of military impact areas) (Watts et al. 1998). The study block included portions of Brunswick, Dinwiddie, Greenville, Sussex, and Southampton Counties. A total of 280 different clearcuts were surveyed. Bachman's Sparrows were detected within only 4 (1.4%) clearcuts. All occupied clearcuts were greater than 5 ha in area and 2 were greater than 50 ha in area. All occupied sites were 2-3 year old clearcuts that were wet in winter through spring and contained dense stands of bunch grasses such as broomsedge and a low density of young saplings.

#### Bachman's Sparrow on Fort A.P. Hill

Bachman's Sparrows were discovered on Fort A.P. Hill in 1993 during a natural history inventory conducted by the Virginia Department of Conservation and Recreation, Division of Natural Heritage (Fleming and Alstine 1994). The site of detection is referred to as the "Carters Corner Macrosite" and is located on the western portion of the base's controlled access area (Figure 4). This area has been used for decades for ballistics training. The upland area supporting Bachman's Sparrows burns very frequently due to fires that spread from the Upper Zion Impact Area. These regular fires have led to the formation of a botanically diverse open savanna that provides ideal breeding habitat for the Bachman's Sparrow.

Fort A.P. Hill, Virginia  
Bowling Green Quadrangle  
Carters Corner Macrosite (Sub-area 1)



Figure 2.



*Habitat within Carters Corner  
Macrosite on Fort A.P. Hill. Area is  
burned over frequently due to  
ordnance impacts (Photo by B.*

The section of land occupied by Bachman's Sparrows is described as sandy uplands dissected by several tributaries of Maracossic Creek. The site is characterized as having acidic, nutrient-poor soils with a significant pine-grassland savanna classified as oligotrophic woodland. This community type is rare in Virginia, likely due to effective fire suppression programs. The community in this region is characterized by widely spaced loblolly pines, scattered shrubs, and a profusion of light-demanding grasses and late-flowering herbs. Grasses are primarily native, warm-season species including little bluestem (*Schizachyrium scoparium*), poverty grass (*Danthonia spicata*), splitbeard bluestem (*Andropogon ternarius*), beardgrass (*Gymnopogon ambiguus*), and silver plumegrass (*Erianthus alopecuroides*).

### **Breeding Biology**

Breeding biology of the Bachman's Sparrow is typical of a temperate passerine. Very little is known about pair formation, but one function of the advertisement song is presumed to be female attraction. Breeding territory is established early in the season and appears to be maintained, at least in part, by countersinging between males. Average territory size varies between 0.6 and 6.7 ha depending on geographic location, habitat, and population density (Dunning 1993). The date of breeding season initiation varies with latitude. Northern populations initiate breeding later. Although no definitive information is available from Virginia, breeding is likely to begin in early to mid May.

The nest of the Bachman's Sparrow is nearly always placed on the ground at the base of overhanging grass clump, forb, sapling, or small shrub. Throughout breeding range, broomsedge and wiregrass seem to be common host for nests. Most nests are domed and incorporate overhanging vegetation that serves to hide the nest entrance. Females build nest from grasses, forbs, and small roots while males guard the territory, acting as lookouts. Nests are often lined with fine grass or hair. Pair behavior around nest is very secretive, making nests very difficult to find.



*Typical Bachman's Sparrow nest. Nests are frequently built in grass clumps with a dome and overhanging vegetation concealing the entrance (photos by B. Watts).*

In Arkansas, clutch size for the Bachman's Sparrow ranges from 2-5 with a mean of 3.90 eggs (Haggerty 1988). Clutch size is similar in South Carolina and Georgia (Watts, unpub. data). Average breeding cycle was 48 days per clutch from first egg laid to fledgling independence. Pairs produce at least 2 clutches per season and many are double brooded. In transition between broods, male will often take over brood rearing while female builds second nest and initiates second clutch. In Arkansas, females produced an average of 2.99 young per year (Haggerty 1988). Fledged young disperse from natal territory within 25 days.

### Habitat Requirements

The Bachman's Sparrow appears to have evolved in association with the fire regime that shaped the southeastern pine ecosystem. In the southern portions of the breeding range, Bachman's are associated with mature pine stands where wiregrass (*Aristida sp.*) or broomsedge (*Andropogon sp.*) dominates ground cover. Populations often reach high densities in pine stands managed for the Red-cockaded Woodpecker (*Picoides borealis*). Frequent burning of pine forests maintains habitat suitability by eliminating understory shrubs. Sparrow populations have been shown to disappear approximately 4-5 years after burning in forest stands in Florida, South Carolina, and Georgia (Engstrom et al. 1984, Gobris 1992).



*Understory after recent burn      Understory 1-2 years after burn      Understory 5-7 years after burn*

*Three images illustrating habitat changes after prescribed burn. Bachman's Sparrows will recolonize burned areas 2-3 years after burn when vegetation recovers. Breeding birds will occupy areas for 2-4 years until woody vegetation becomes too dense as in photo to far right (Photos by B. Watts)*

In addition to using mature pine forests, Bachman's Sparrows also breed within a variety of early successional habitats where shrub intrusion is limited by poor soils, fire, or disturbance. Such habitats include young clearcuts, abandoned farmland, utility rights-of-way, and orchards. The species requires dense stands of grasses and forbs in the first meter layer above the ground and low densities of vegetation in the second to fourth meter above the ground (Dunning and Watts 1990). Clearcuts provide habitat 1-7 years after replanting until pine seedlings form a dense understory.

The habitat used by Bachman's Sparrows on Fort A.P. Hill (described in Fleming and Alstine 1994) is similar in structure to other breeding sites described in Virginia over the past few years (e.g. Hilton 1990, Dalmás 1995, Watts et al. 1998) and with sites elsewhere within the species range (e.g. Hardin et al. 1982, Kadir 1987, Haggerty 1988, Dunning and Watts 1990). The small population evidently persists because frequent fires resulting from artillery impacts have maintained the site in a savanna-like condition. In the absence of regular fires, these sites would become unusable within a short period of time as succession proceeds beyond where it is suitable for the species.

### **Management Recommendations**

The Bachman's Sparrows discovered on Fort A. P. Hill represent the northernmost extant breeding population throughout the entire species range. In addition, the population appears to be one of only two apparently stable breeding areas in the state of Virginia. Both the conservation and general significance of these birds extends well beyond the boundaries of Fort A. P. Hill. Efforts should be made to evaluate and monitor the population and, to the extent possible, provide for habitat needs.

### Population Evaluation

Due to unsafe conditions related to unexploded munitions, the Carters Corner Macrosite (delineated by Natural Heritage) was not systematically surveyed for Bachman's Sparrows in 1993. For this reason, population size has never been accurately determined. Likewise, no monitoring data is available from the time the birds were detected in 1993 to the present. The natural dynamics of this habitat type along with the description of the vegetational conditions within the focal area and the surrounding uplands (Fleming and Alstine 1994) suggest the potential for a much larger population.

A survey is needed to determine the size and distribution of the Bachman's Sparrow population. A dedicated survey should include the active impact area, as well as, all patches of potential habitat within a 10-km radius of the site. Surveys should be conducted using standardized point counts (Ralph et al. 1995). Territorial, male Bachman's Sparrows readily respond to broadcast songs by singing and approaching tape players (Dunning and Watts 1990). Point counts should utilize playbacks of the primary advertising song of the Bachman's Sparrow interspersed with silent listening periods. A cassette tape consisting of alternating one-minute segments of the male advertising song (2 segments) and one minute silent periods (3 segments) has proven to be an effective survey tool (Watts et al. 1998). Tapes may be broadcast using portable tape players.



Surveys may be conducted from roadways or within habitat patches where accessible. Singing males may generally be detected over a distance of approximately 200-300 m (Pers. Obs.). Placing point counts at 250 m intervals along roadways will insure that the maximum amount of available habitat is covered. Singing males should be mapped on 7.5 min. topographic maps. Surveys should be conducted within the first 4 hr after dawn. Three surveys should be conducted between mid-May and the end of June. Surveys should not be conducted during heavy wind or rain.

#### Population Monitoring

Due to the significance of the Bachman's Sparrow population on Fort A. P. Hill, a methodology should be adopted and implemented for long-term population monitoring. Permanent point count locations should be established along accessible roadways. A survey protocol similar to that described above should be adopted. Surveys should be conducted 3 times/year during the peak of the breeding season. This survey will require a relatively small time commitment from a single observer. Adequate surveys could be performed during 3-5 mornings per year.

#### Site Management

The Bachman's Sparrow is a disturbance-prone species that occupies a narrow disturbance/successional niche. Without regular disturbance from fires, most habitat patches suitable for this species will rapidly proceed through secondary succession and become unusable. Maintenance of any local population requires the implementation of an appropriate disturbance regime.

Vegetational conditions described by the natural heritage inventory of 1993 (Fleming and Alstine 1994) suggest that fire disturbance within the Carters Corner Macrosite has occurred with an adequate frequency to maintain habitat conditions. However, fire frequency should be monitored in association with habitat condition in order to insure that most areas are burned on an approximate 3-year rotation. When woody vegetation begins to dominate the site, prescribed burns should be used to improve habitat quality. For proactive management purposes, a burn interval of 3-5 years is recommended. A burn interval longer than 5 years will often result in a deterioration of site quality due to intrusion by woody vegetation. However, Bachman's will often not recolonize a burned area until 2-3 years post burn because the recovery of herbaceous vegetation is inadequate. For this reason, a burn interval shorter than 3 years will drastically reduce the "useable" portion of the burn cycle. In order to insure a "sustainable" source of

breeding habitat, the management area should be subdivided into quarters with one quarter burned each year. Late winter/early spring burns are desired to allow for the most rapid regeneration of herbaceous vegetation. However, burning any time outside the breeding season is acceptable.

To the extent possible, sites with active Bachman's Sparrow pairs should be protected from physical disturbance. The area should be closed to timber harvest except for that needed to maintain habitat. Heavy equipment should be confined to existing roadways. Further construction should be avoided.

### Landscape Management

Bachman's Sparrows respond to the landscape-level distribution of habitat patches (Dunning et al. 1995). Landscapes with isolated habitat patches tend to support very few birds. In contrast, landscapes with numerous habitat patches in close association promote population persistence. To the extent possible and when consistent with operational objectives, habitat patches within a 5 km radius of the Carters Corner Macrosite (Sub-area 1) should be enhanced with the objective of increasing the local Bachman's Sparrow breeding population. Enhancement activities should focus on two areas, including 1) pine stand improvement, and 2) fire regime. Existing pine stands should be managed toward an open-canopy, savanna-like profile by reducing stem density within closed-canopy stands. Open-canopy pine stands and open lands should be placed on an approximately 3-year burn cycle to promote pyrogenic vegetation.

### **Literature Cited**

- Ashe, W. W. 1884. The forests, forest lands, and forest products of eastern North Carolina. North Carolina Geologic Survey 5:1-128.
- Ashe, W. W. 1915. Loblolly or North Carolina pine. North Carolina Geologic Survey 24:1-176.
- Bailey, H. H. 1913. The Birds of Virginia. J. P. Bell Company. Lynchburg, VA.
- Bartram, W. 1791 (1955). Travels through North and South Carolina, Georgia, East and West Florida. Dover Publications, New York, New York.
- Chapman, H. H. 1932. Is the longleaf type a climax? Ecology 13:328-334.
- Cooke, M. T. 1929. Birds of the Washington D. C. Region. Proc. Biol. Soc. Wash. 42:1-80.
- Crocker, T. C., Jr. 1979. Longleaf pine. Journal of Forest History 23:32-43.
- Dalmas, J. H. 1992. The Greenville County Foray of 1991. Raven 63:21-33.

- Dalmas, T. H. 1995. Bachman's Sparrow in Virginia. Unpublished prospectus 12pp.
- Dunning, J. B., Jr. 1993. Bachman's Sparrow. In *The Birds of North America*, No. 38 (A. Poole, P. Settenheim, and F. Gill, Eds.). Philadelphia: The Academy of Natural Sciences; Washington, D. C.: The American Ornithologists' Union.
- Dunning, J. B., Jr. and B. D. Watts. 1990. Regional differences in habitat occupancy by Bachman's Sparrow. *Auk* 107:463-472.
- Dunning, J. B., Jr., R. Borgella, Jr., K. Clements and G. K. Meffe. 1995. Patch isolation, corridor effects, and colonization by a resident sparrow in a managed pine woodland. *Conservation Biology* 9:542-550.
- Eggleston, R. B. and R. Lyle, Jr. 1952. The birds of Pittsylvania County, Virginia. *Raven* 23:54.
- Engstrom, R. T., R. L. Crawford, and W. W. Baker. 1984. Breeding bird populations in relation to changing forest structure following fire exclusion: a 15-year study. *Wilson Bulletin* 96:437-450.
- Fleming, G. P. and N. E. Alstine. 1994. A natural heritage inventory of Fort A. P. Hill, Virginia. Natural Heritage Technical Report 94-1. Virginia Department of Conservation and Recreation, Division of Natural Heritage, Richmond, Virginia. Unpubl. Report to U.S. Army. 165 pp..
- Freer, R. S. 1939. The birds of Lynchburg, Virginia and vicinity. *Bulletin of Lynchburg College*, Volume 7, No. 1.
- Gobris, N. M. 1992. Habitat occupancy during the breeding season by Bachman's Sparrow at Piedmont National Wildlife Refuge in central Georgia. M.S. Thesis, University of Georgia, Athens, GA.
- Grey, J. H. and C. E. Stevens. 1949. The birds of Albermarle County. *Raven* 20:109.
- Haggerty, T. M. 1988. Aspects of the breeding biology and productivity of Bachman's Sparrow in central Arkansas. *Wilson Bulletin* 100:247-255.
- Hardin, K. I., T. S. Baskett, and K. E. Evans. 1982. Habitat of Bachman's Sparrow breeding on Missouri glades. *Wilson Bulletin* 94:208-212.
- Hilton, R. 1990. Bachman's Sparrow in Sussex County. *Raven* 61:10-12.
- Hunter, W. C. 1990. Handbook for nongame bird management and monitoring in the Southeast Region. U.S. Fish and Wildlife Service., Atlanta, Georgia.
- Kadir, W. R. 1987. Vegetational characteristics of early successional sites utilized for breeding by the Bachman's Sparrow (*Aimophila aestivalis*) in eastern Texas. M.S. Thesis, Stephen F. Austin University, Nacogdoches, Texas.

- Kain, T. 1987. Virginia's Birdlife: An annotated checklist. Virginia Society of Ornithology. Virginia Avifauna Number 2.
- Komarek, E. V., Sr. 1964. The natural history of lightning. Proceedings of the Tall Timbers Fire Ecology Conference 3:139-183.
- Komarek, E. V., Sr. 1974. Effects of fire on temperate forests and related ecosystems: southeastern United States. In Fire and Ecosystems (T.T. Kowalski and C. E. Ahlgren, Eds.). Academic Press, New York, New York.
- Krusac, D. L., J. M. Dabney, and J. J. Petrick. 1995. An ecological approach to recovering the red-cockaded woodpecker on southern National Forests. In Red-cockaded Woodpecker: recovery, ecology and management (D. L. Kulhavy, R. G. Hooper, and R. Costa, eds.). Center for Applied Studies in Forestry, College of Forestry, Stephen F. Austin State University, Nacogdoches, Texas.
- Lewis, J. B. 1938. An annotated list of birds observed in Amelia and Brunswick Counties. Raven 19:66-84.
- Murray, J. J. 1933. Additions to the Virginia Avifauna since 1890. Auk 50:198.
- Murray, J. J. 1952. A checklist of the birds of Virginia. Virginia Society of Ornithology.
- Pinchot, G. and W. W. Ashe. 1897. Timber trees and forests of North Carolina. North Carolina Geological Survey 6:1-227.
- Platt, W. J., J. S. Glitzenstein, and D. R. Streng. 1991. Evaluating pyrogenicity and its effects on vegetation in longleaf pine savannahs. Proceedings of the Tall Timbers fire Ecology Conference 17:143-161.
- Ralph, C. J., J. R. Sauer, and S. Droege. (Eds.) 1995. Monitoring bird populations by point counts. Gen. Tech. Rep. PSW-GTR-149. Albany, CA; Pacific Southwest Research Station, Forest Service, U.S. Department of Agriculture.
- Ridd, S. 1991. Bachman's Sparrow. In Virginia's Endangered Species (K. Terwilliger, Ed.). Proc. Symp. Endangered and Threatened Plants and Animals of Virginia. MacDonald and Woodward, Blacksburg, Virginia.
- Rives, W. C. 1890. A Catalogue of the Birds of the Virginias. Proceedings of the Newport Natural History Society. Newport, Rhode Island.
- Scott, F. R. 1952. The nesting season in Virginia, 1951. Raven 23:65-67.
- Smyth, E. A. 1912. Birds observed in Montgomery County, Virginia. Auk 29:521.
- Tate, J. 1986. The Blue List for 1986. American Birds 40:227-236.

- Ware, S., C. Frost, and P. D. Doerr. 1993. Southern mixed hardwood forest: the former longleaf pine forest. In *Biodiversity of the Southeastern United States* (W. H. Martin, S. G. Boyce, and A. C. Echternacht, eds.). John Wiley and Sons, Inc., New York, New York.
- Watts, B. D., M. D. Wilson, D. S. Bradshaw, and A. S. Allen. 1998. A survey of the Bachman's Sparrow in southeastern Virginia. *The Raven* 69:9-14.
- Watts, B. D. 1999. *Partners-in-Flight: Mid-Atlantic Coastal Plain Bird Conservation Plan* (Physiographic Area #44). 81pp.
- Wetmore, A. 1950. The list of birds of the Shenandoah National Park (Third Revision), Shenandoah Natural History Association, Bulletin Number 1, p 24.