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Management of Park Fields to Enhance the Natural Resources Value and Biodiversity of Colonial National Historical Park

The Center for Conservation Biology
Department of Biology
College of William and Mary

MANAGEMENT OF PARK FIELDS TO ENHANCE THE NATURAL RESOURCE VALUE AND BIODIVERSITY OF COLONIAL NATIONAL HISTORICAL PARK

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TABLE OF CONTENTS

EXECUTIVE SUMMARY

Maintaining threatened ecosystems in the face of an expanding human population is the greatest conservation challenge faced by land managers within the mid-Atlantic region. Due to their broad distribution and regional abundance, government-owned lands represent one of the most promising opportunities to preserve threatened communities. The Colonial National Historical Park contains a complex of historic lands that provide critical habitat to plant and animal populations of regional conservation concern. Open lands, in particular, have the potential to support populations of declining species. However, the current maintenance regimes used to manage these patches do not provide the habitat conditions required by target species.

An analysis of open lands within the Colonial National Historical Park was conducted to find a balance between wildlife benefits and programmatic objectives. Evaluation of 177 open patches with regard to biological and programmatic constraints revealed 21 patches that could be converted to native warm-season grasslands and 16 patches that could be converted to shrublands. A shift from the current land management regime to the recommended management regime would provide a sustainable source of habitat capable of supporting an estimated 1,450 breeding pairs of open-habitat bird species.

The recommended changes in management regime would require the conversion of some open patches from cool-season grasses to native warm-season grasses and shrublands. Collectively, this would require an estimated initial investment of $70,835. However, both warm-season grasslands and shrublands require less effort to maintain. Due to savings in maintenance costs, the initial investment to convert lands would be recouped in 3 years. Over the course of 10 years, savings in management costs are estimated to exceed $250,000. The estimated cost savings presented above do not include maintenance transition costs. The current maintenance program is not designed or outfitted to maintain warm-season grasslands or shrublands. This transition may require the purchase of new equipment, a reconfiguration of manpower, or a consideration of outsourcing options.

BACKGROUND

Context and Objectives

The mid-Atlantic Coastal Plain was the site of the first successful European settlement in North America. The natural landscape has been altered by European culture for nearly four centuries. By 1790, the region supported more than 600,000 people. In the intervening 200 years, the human population has grown to more than 10.5 million. Currently, the urban crescent from Baltimore south to Richmond and east to Norfolk is experiencing one of the fastest human growth rates in North America. The living space and infrastructure required by the expanding human population has had a pervasive impact on the natural landscape. The pattern of human settlement has caused a shift in the availability and distribution of habitats. Although the nature and extent of these impacts vary with habitat and location, every habitat type in the region has been affected to some extent.

Maintaining threatened ecosystems in the wake of a growing human population is the greatest conservation challenge faced by land managers within the mid-Atlantic region. Due to their broad distribution and regional abundance, government-owned lands represent one of the most promising opportunities to preserve threatened communities. However, finding the appropriate balance between resource conservation and ongoing operations is often a difficult task. The Colonial National Historic Park has extensive land holdings that are managed as open grasslands. With a shift in management approach, these grasslands have the potential to provide habitat for a diverse suite of species that are of conservation concern within the mid-Atlantic region. The objective of this investigation is to assess the benefits of various open-habitat management scenarios to declining species within the context of ongoing programmatic objectives.

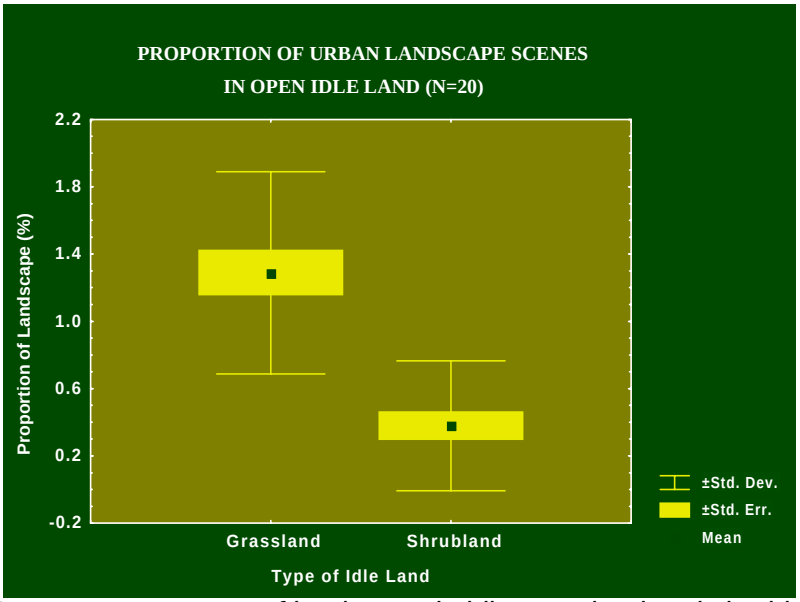
Grasslands and Shrublands within the mid-Atlantic region

Origins - Grasslands are open lands dominated primarily by grasses (*Gramineae*) and grass-like plants. Shrublands are open lands with a relatively high coverage of short, woody vegetation such as shrubs and saplings. In contrast to the mid-west, grasslands were not a significant component of the pre-European landscape in the mid-Atlantic region. Prior to European settlement, open grassland habitats were maintained as relatively small patches within a forested landscape by populations of native Americans. In the years following European settlement, open lands increased as forested lands were cleared for agriculture. Open lands reached their zenith in the nineteenth century when vast areas of forest were cleared throughout northeastern North America.

Today, prominent grassland and shrubland habitats within the mid-Atlantic region are primarily derived from agricultural fields and pasturelands. Additional grasslands occur as airport infields, transportation rights-of-way, industrial brown fields, municipal parks, and urban areas. Additional shrublands occur as maritime thickets, utility rights-of-way, and regenerating pine plantations. Some of the most extensive and significant open habitats within the region are located on public lands such as U.S. Department of Defense installations and national parks.

The structure and vegetational composition of grasslands varies considerably within the mid-Atlantic region depending on soil type, moisture, and land use history. Grasslands with a diverse plant community, such as this field (left) in Accomack County, Virginia provide the best habitat for breeding birds. Like grasslands, the structure and composition of shrublands also varies widely across the region. Shrublands with a minimum of 25% coverage of woody vegetation, such as this field (right) within the inner coastal plain of Virginia, provide ideal habitat for shrub-dependent birds.

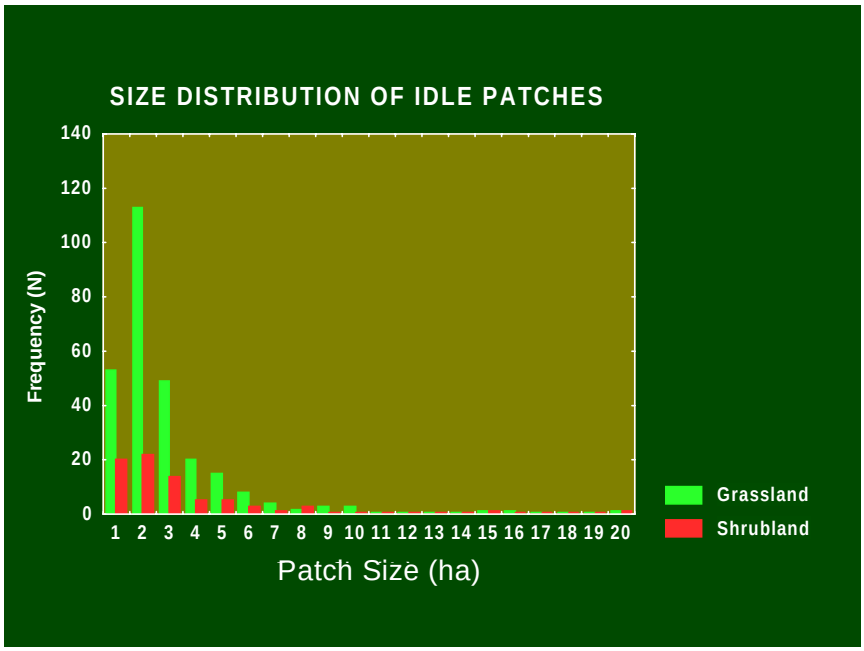
Trends - Throughout the twentieth century, the availability of open, idle lands has declined precipitously across northeastern North America. Initially, this decline was due to secondary succession on lands cleared during the previous century. More recently, urban sprawl has been responsible for the conversion of large tracts of open land to residential and industrial use. In Virginia, open, idle grasslands have been reduced by 55% since 1945. A recent investigation of idle grasslands and shrublands in coastal Virginia revealed that these two habitat types combined represent less than 2% of the current landscape.



Average percentage of land cover in idle grassland and shrubland in coastal Virginia. Data taken from twenty 2,500 ha landscape scenes (Watts 1999)

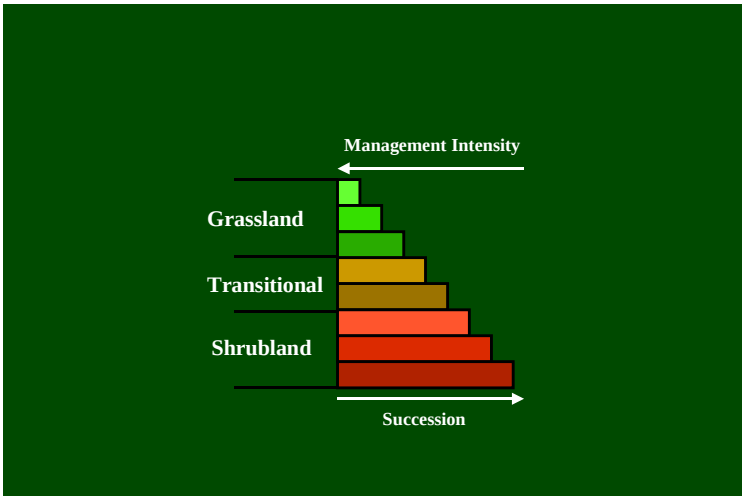
As the quantity of open land continues to decline, an increasing proportion of the remaining area is being fragmented into small, isolated patches. The result of fragmentation is that the majority of open habitats within the region exist as small, ephemeral patches. Large open patches that are maintained for long periods of time are relatively rare within the landscape. An investigation conducted within coastal Virginia has shown that 95% of grassland and shrubland patches are less than 10 ha in area.

Distribution of patch sizes for idle grassland/ shrublands in Coastal Virginia (Watts 1999).



Maintenance of Open Lands - Across eastern North America, the majority of open lands that are left fallow will naturally proceed through secondary succession from grasslands to shrublands and eventually back to forests. The primary agents of change within this habitat gradient are succession that changes habitats from grasslands to shrublands and disturbances such as fire or mechanical maintenance that set back succession and return the land to an open condition. The regularity with which these open fields are managed largely determines the availability of fields in different stages of succession. Management of habitats on a relatively short rotation schedule (less than 2 years) will result in the production of open grasslands and will provide habitat for species that specialize on early successional habitats. A longer management rotation will allow fields to proceed to the shrub stage and provide habitats for species requiring later successional habitats.

Within the mid-Atlantic, management intensity or frequency determines habitat conditions within open lands. However, management frequency that is too low will allow lands to proceed to forest and management frequency that is too high will disrupt the breeding season.



Grassland and Shrubland Bird Populations

Within the mid-Atlantic region, the complex of grassland and shrubland habitats support a diverse assemblage of breeding birds. This assemblage includes species that are resident throughout the year, as well as, species that migrate long distances to the tropics and species that migrate shorter distances within North America. Open habitats also support a diverse community of species that spend the winter months in the region and other species that stopover during spring and fall migration.

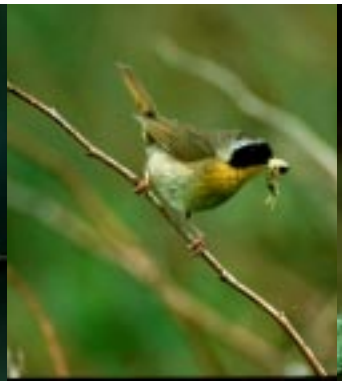
Selected breeding species of open grasslands and shrublands within the mid-Atlantic region.

Grassland Species	Shrubland Species	
Northern Harrier	Yellow-billed Cuckoo	Gray Catbird
American Kestrel	Brown Thrasher	White-eyed Vireo
Northern Bobwhite	Yellow Warbler	Common Yellowthroat
Killdeer	Yellow-breasted Chat	Northern Cardinal
Barn Owl	Blue Grosbeak	Indigo Bunting
Eastern Kingbird	Dickcissel	Eastern Towhee
Horned Lark	Field Sparrow	Song Sparrow
Eastern Bluebird	Orchard Oriole	American Goldfinch
Grasshopper Sparrow		
Henslow's Sparrow		
Eastern Meadowlark		

American Kestrel

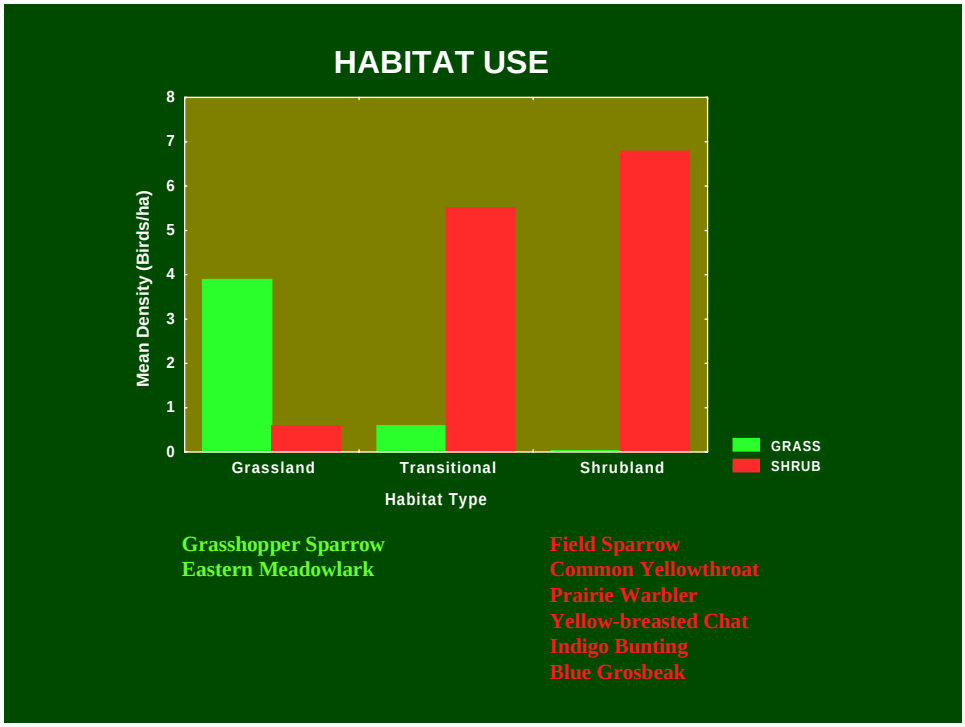
Grasshopper Sparrow

Common Yellowthroat



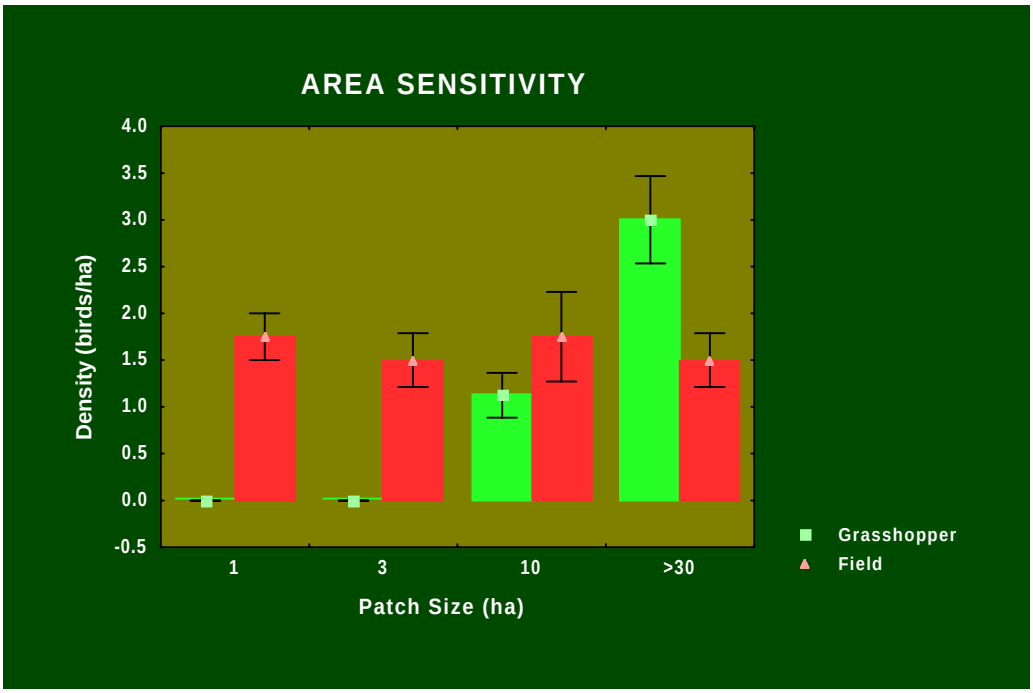
White-eyed Vireo

Habitat Requirement - Avian species that inhabit idle, open lands exist within specific disturbance/successional niches. Because of this, communities that occupy grasslands are markedly different from those that occupy shrublands. The complex of birds that breed in grasslands often require dense stands of bunch grasses and forbs with relatively little intrusion by woody vegetation. As woody cover increases, most grassland birds will abandon breeding sites. The complex of birds that breed in shrublands require later stages of oldfield succession with moderate to substantial intrusion by woody shrubs and saplings. Within the mid-Atlantic region, all of these species show a positive response to the density of shrub cover but differ somewhat in the specific successional stage preferred. Most of these species will utilize a wide range of alternate habitats including hedgerows, recent clearcuts, and maritime shrublands. Most will also utilize dense, understory vegetation within forest patches.



Influence of habitat type (and related management regime) on common breeding bird species. Species composition changes with successional stage. Grassland specialists avoid dense woody vegetation while shrubland specialists require it (data from Watts et al. 1997).

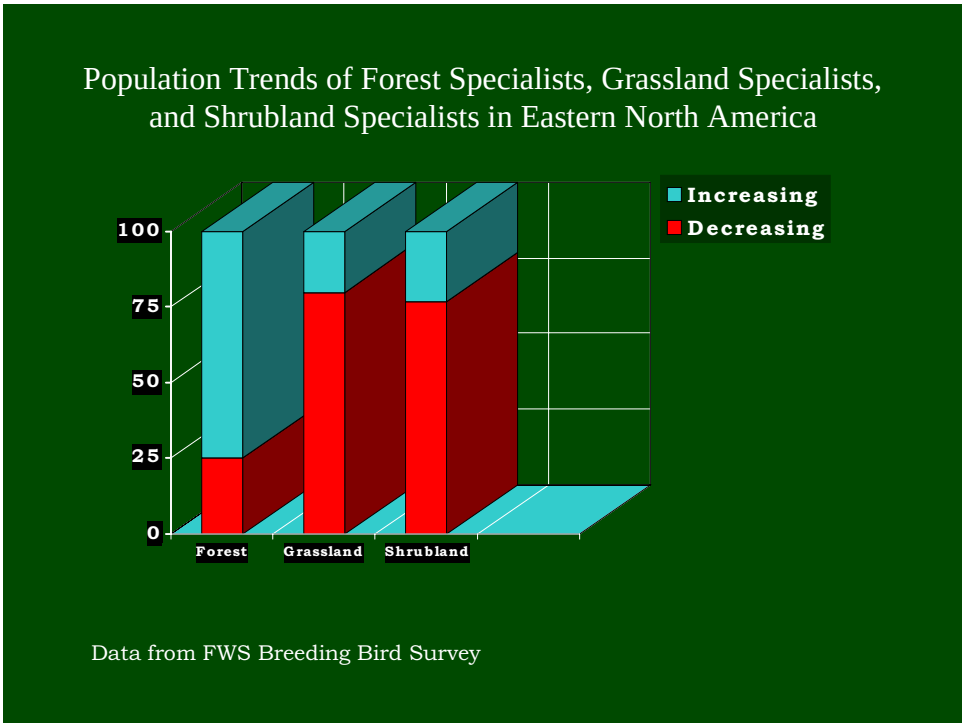
Patch Size Requirements - For many bird species patch area is an important habitat requirement for breeding. These, so called, "area-sensitive" species will not utilize habitat patches below a threshold size regardless of habitat condition. Within the mid-Atlantic region, grassland and shrubland species differ in area-sensitivity. Most grassland species are highly area-sensitive and require patches that are 10 ha or larger. In contrast, most shrubland species do not appear to respond to patch area.



Influence of patch area on habitat use in the Grasshopper Sparrow (grassland specialist) and the Field Sparrow (shrubland specialist). These two species illustrate the general difference in area-sensitivity between the two bird communities.

Status - Many bird species that depend on open grassland or shrubland habitats for breeding have declined significantly over the past 30 years. Results from the annual, breeding bird survey coordinated by the U.S. Fish and Wildlife Service suggest that species associated with open habitats have experienced some of the highest rates of population decline of any species group within the mid-Atlantic region. Declining species represent a comparatively high proportion of the overall community within these habitat types. In Virginia, five of twelve bird species listed as endangered

depend on open lands for breeding. In recognition of continuing population declines, the National Partners-in-Flight program has listed grassland/shrubland as one of the top priority habitats for conservation action.



Grassland and shrubland bird communities have experienced some of the highest decline rates of all bird groups in the mid-Atlantic region. Declining species represent a very high proportion of the overall communities.

Causes for Population Declines - Several factors have likely contributed to recent declines in open habitat species. One obvious factor has been the dramatic loss and fragmentation of open habitats within the mid-Atlantic region. In addition to a decline in total area, the character of remaining open lands has also changed. Since the 1960's, the intensification of agricultural practices has altered the character of active farmland to the extent that it is no longer suitable for many species. The use of high frequency maintenance programs has made successful breeding impossible within many open lands. The practice of mowing grasslands during the breeding season directly impacts grassland bird populations by destroying nests, eggs, and young. Finally, the conversion of warm-season grass habitats to monocultures of cool season grasses has had a devastating impact on grassland birds. Cool season grasses such as fescue that form dense sod mats do not provide for the microhabitat and food requirements of most grassland birds.

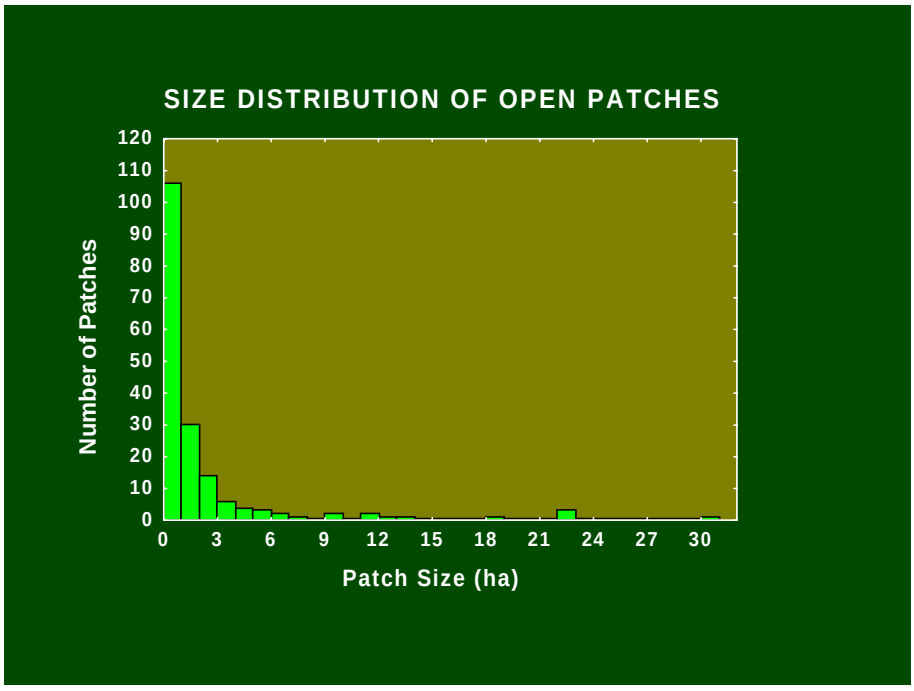
One of the most important parcels of land owned by the Colonial National Historical Park, Jamestown Island contains extensive areas of brackish marsh intermixed with pine forest.

COLONIAL NATIONAL HISTORICAL PARK

The Colonial National Historical Park contains a complex of historic lands that extend from Jamestown Island to Yorktown. In addition to their historic value, lands within the park support ecosystems that provide critical habitat to plant and animal populations of regional conservation concern. Open lands are distributed throughout the park and collectively represent some of the most extensive open lands in coastal Virginia.

Open Lands

The Colonial National Historical Park currently supports 177 patches of open habitat that cover 378.9 hectares (935.9 acres) of land. These patches vary in size from very small fragments that cover less than one tenth of 1 hectare to larger patches more than 30 hectares (74 acres) in area. The majority (76.8%) of patches are less than 2 hectares (5 acres) in size. Most of these smaller patches are positioned along roadways and have a very linear shape.



Frequency distribution of patch sizes for open lands found on the Colonial National Historical Park. See Appendix I for complete accounting of patch sizes.

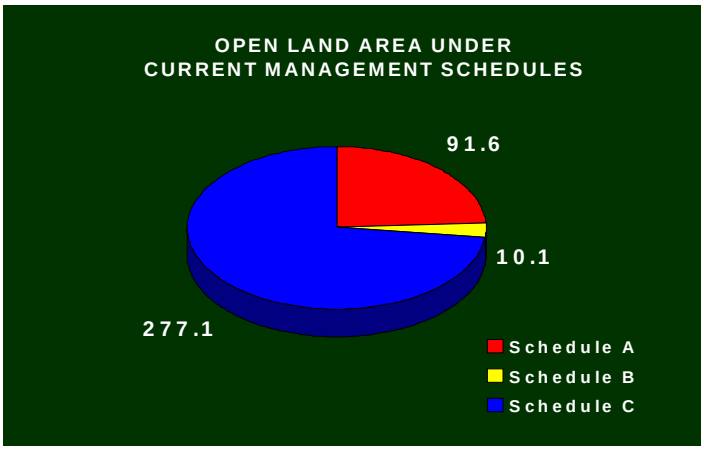
Current Conditions - All open habitat patches within the park currently support dense stands of sod-forming grasses. Ground cover is dominated by exotic grass species that are capable of excluding most native grasses and forbs. These species form a continuous mat of sod where the availability of interstitial bare ground is too low to permit colonization by native plants. As a result, species and structural diversity is low.

Table of common grass species found within the Colonial National Historical Park. List is based on data collected by the Virginia Department of Conservation and Recreation, Division of Natural Heritage.

Common Name	Scientific Name	Status
Small Carpgrass	Antraxon hispidus	Alien
Sugarcane Plumegrass	Erianthus giganteus	Alien
Bermuda Grass	Cynodon dactylon	Alien
Orchard Grass	Dactylis glomerata	Alien
Nepalese Browntop	Eulalia viminea	Alien
Meadow Fescue	Festuca elatior	Alien
Rice Cutgrass	Leersia oryzoides	Alien
Redtop Pancium	Pancium agrostoides	Alien
Fall Panicgrass	Pancium dichotomiflorum	Alien
Switchgrass	Pancim virgatum	Alien
Field Paspalum	Paspalum Laeve	Alien
Canada Bluegrass	Poa compressa	Alien
Johnsongrass	Sorghum halpense	Alien
Broomsedge Bluestem	Andropogon virginicus	Native

Current Management - Open lands on the Colonial National Historical Park are maintained mechanically by regular mowing. However, the mowing regime employed by park staff varies from patch to patch depending on programmatic objectives. Three different mowing regimes are currently in use for field management. These regimes differ primarily in the frequency of maintenance activities. See table below for description of maintenance schedules (page 17).

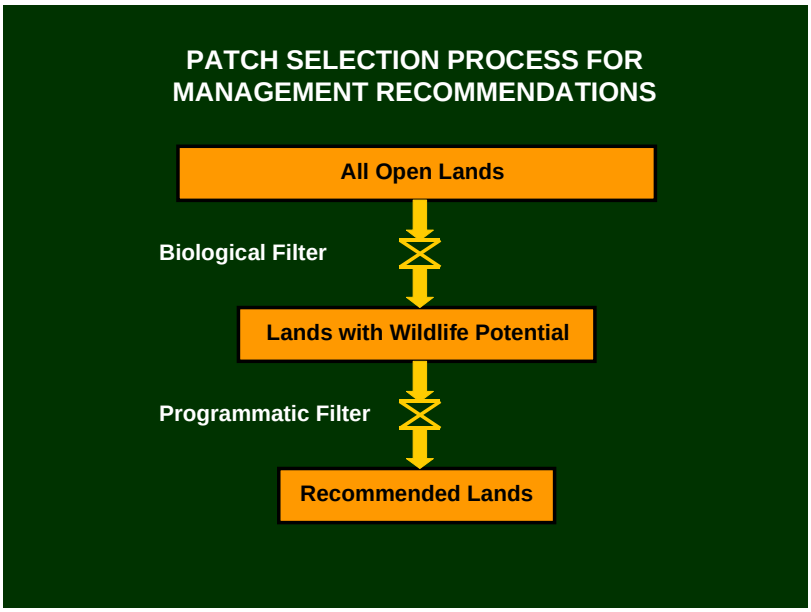
Land area (presented in hectares) within the Colonial National Historical Park falling under different maintenance schedules. Information on individual patches (see Appendix I) provided by park staff.



Management Analysis

A portion of the open-habitat patches found within the Colonial National Historic Park have the potential to support populations of species that are of conservation concern within the mid-Atlantic region. However, the current maintenance regimes used to manage these patches do not provide the habitat conditions required by these species. Improving habitat conditions to the point where they will support target species will require a change in management regime.

Two criteria or "filters" were used to select open patches for a change in management regime. A biological filter was used that was designed to screen candidate patches according to the basic requirements of grassland and shrubland bird species. A programmatic filter was used to exclude candidate patches where a change in management regime would not be appropriate due to conflicts with planned or ongoing land-use patterns.

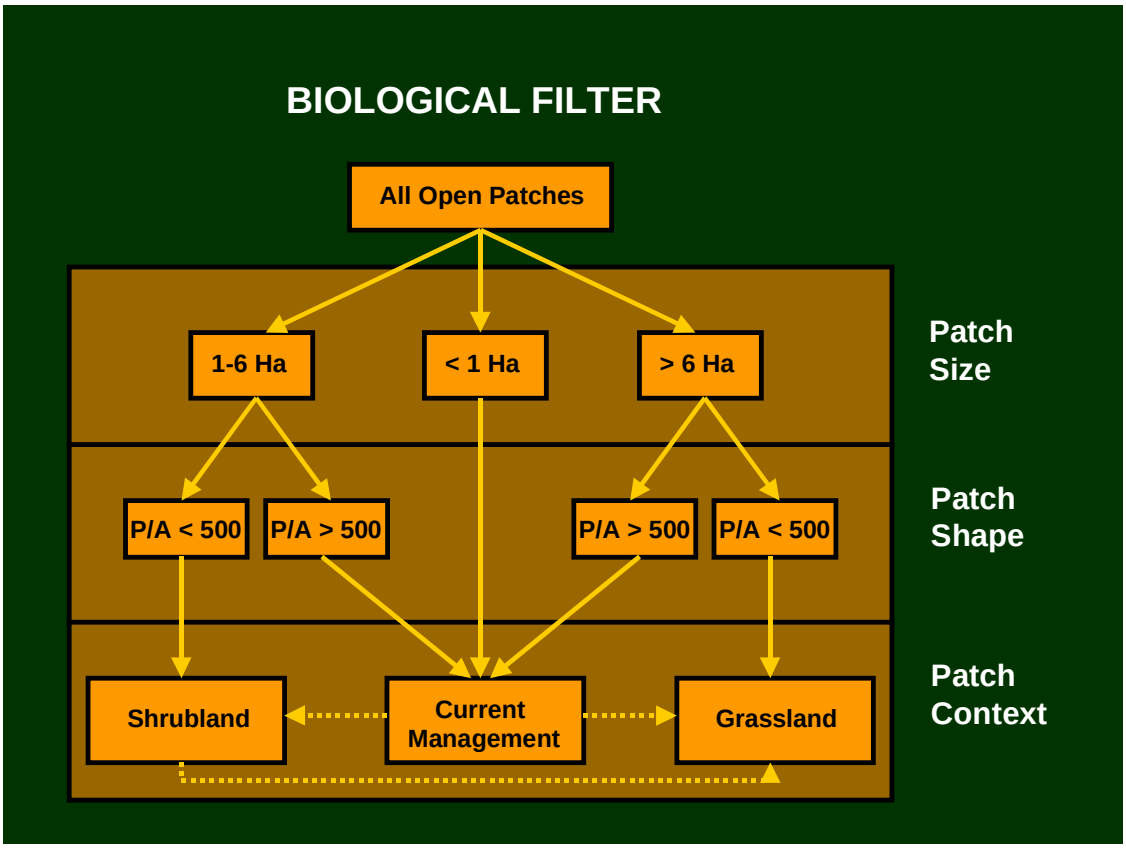


Biological Filter - Three characteristics were assessed when evaluating the potential of open patches to support grassland or shrubland species. Patch characteristics included patch size, patch shape, and patch context.

Patch Size – Due to their requirement for large patches and the general lack of such patches in the region, grassland birds were given first priority in patch management decisions. Based on the area requirements of these species, patches larger than 6 hectares (14.8 acres) in area were reserved for grassland management. Patches between 1 and 6 hectares (2.47 to 14.8 acres) were reserved for shrubland management. Finally, open patches that were smaller than 1 hectare (2.47 acres) were considered to have little value for either bird community.

Patch Shape – In general, species that are sensitive to habitat area prefer patches with block shapes rather than patches that are long and thin. Such patches provide more habitat that is distant from edges. Open-habitat patches within the Colonial National Historic Park that had a perimeter to area ration (P/A) greater than 500 meters/hectare were considered to have poor habitat potential and were excluded from the candidate pool.

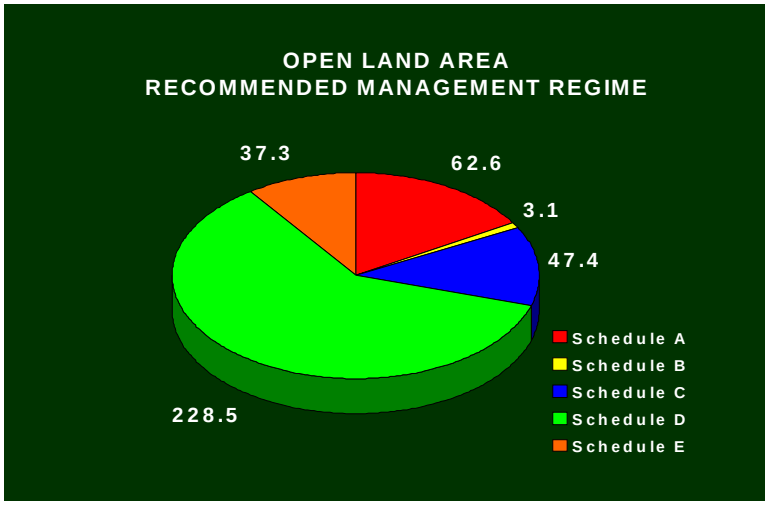
Patch Context – Under certain conditions, clusters of open patches may collectively provide adequate habitat for area-sensitive species when managed in a similar way. For this reason, the characteristics of the surrounding landscape were also examined when evaluating the benefits of potential changes in management regime. Patches that were not large enough by themselves but were associated with other open patches were considered for alternate management along with adjacent patches.



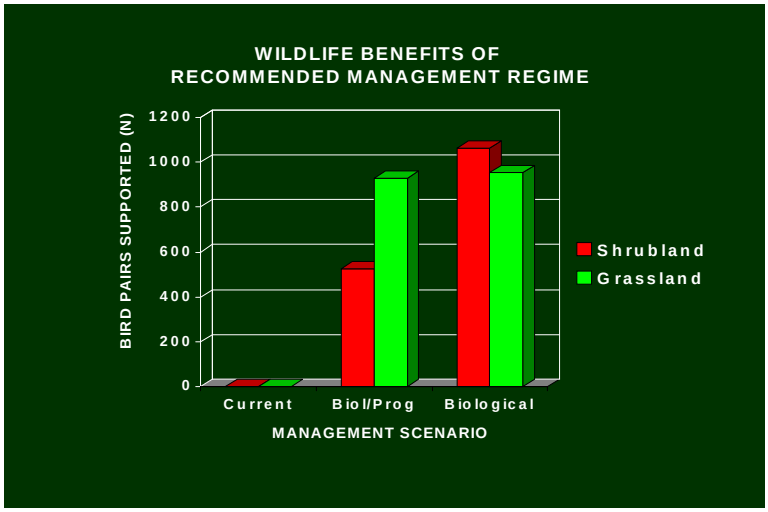
Programmatic Filter – One of the highest priorities for land management within the Colonial National Historic Park is public access to historic areas. Open lands that are designed to receive a high volume of visitor use, are generally not candidates for management alternatives designed to enhance wildlife potential. For this reason, such areas were not considered for conversion to either grassland or shrubland habitat. These areas included open lands around buildings, parking areas, beaches and monuments

Management Recommendations

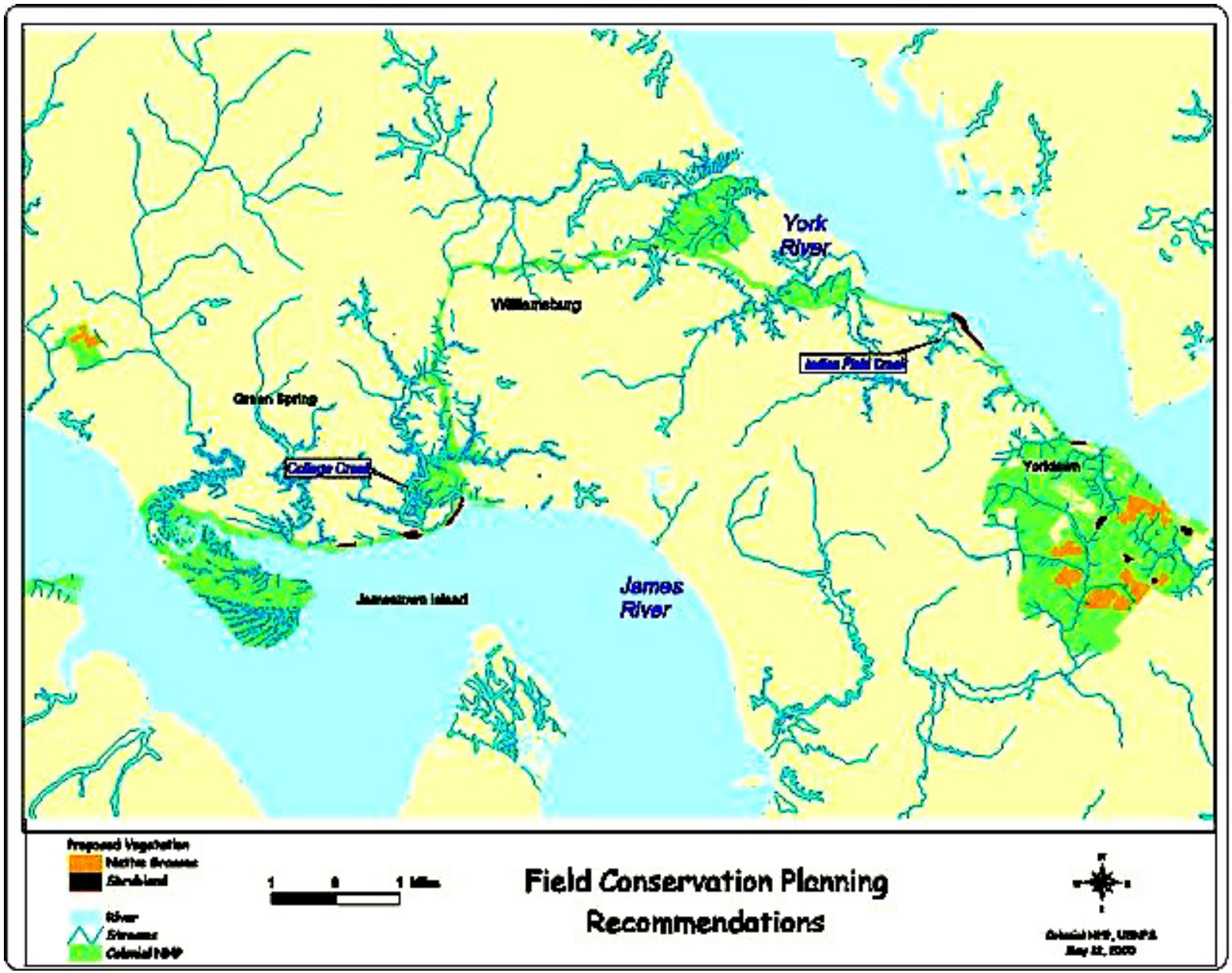
From a total of 177 patches of open land, 37 patches fit within both biological and programmatic requirements (see Appendix I for a complete evaluation of all patches). This subset represents 21 patches that are recommended for management as warm-season grasslands and 16 patches that are recommended for management as shrublands. Conversion of recommended patches from current conditions to grasslands and shrublands will require an initial period of habitat establishment (See Appendices II and III for discussion of establishment and maintenance of grasslands and shrublands respectively). After habitats are established, management will require the adoption of two new maintenance schedules (see table below).



Recommended management regime for open habitat patches within the Colonial National Historical park. Land areas falling under different maintenance schedules are presented in hectares. Recommendations for individual patches are given in Appendix I.



Projected estimates of the number of shrubland and grassland birds that would be supported under recommended management regimes. The total number of breeding pairs supported within patches (if converted) that meet biological constraints is 2,015. The total number of breeding pairs supported within patches that meet both biological and programmatic constraints is 1,453. Bird density values used to estimate benefits were taken from Watts et al. 1997.


York River
Williamsburg
Green Spring
College Creek
Jamestown Island
James River
Yorktown
Proposed Vegetation
River
Streams
Colonial NHP
1 0 1 Miles
Field Conservation Planning Recommendations

Economic Analysis

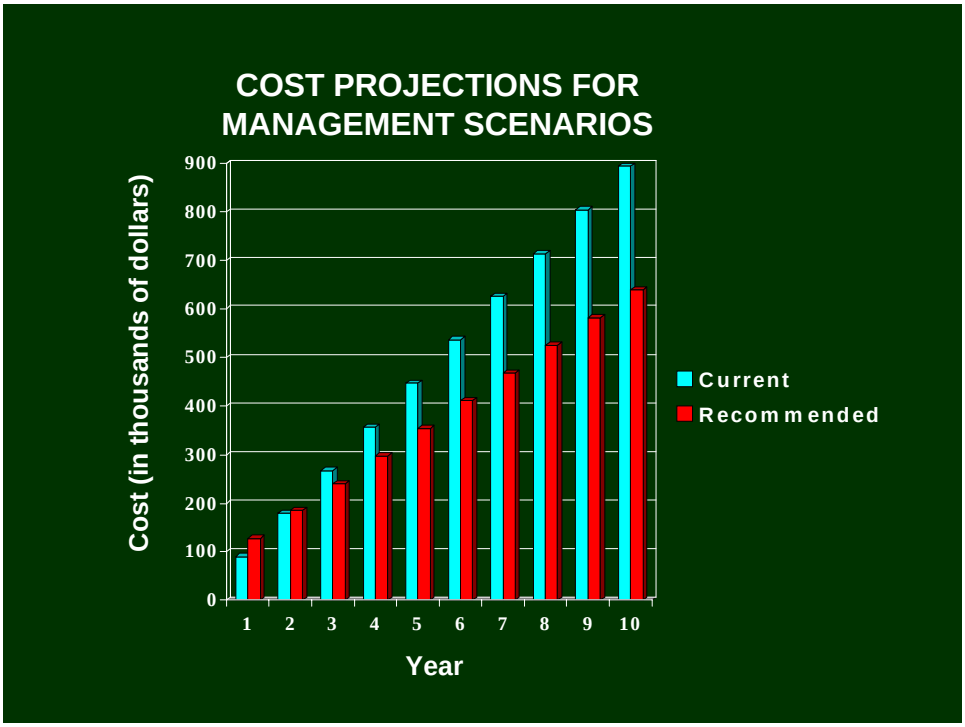
Under the current management regime, the primary cost of maintaining open lands on the Colonial National Historical Park is regular mowing. The estimated cost of mowing a single hectare of land one time is $66.69 ($27/acre) (cost estimate provided by park staff). The estimated annual cost of maintaining open patches varies considerably because fields are managed under different maintenance schedules (see table above). The collective annual cost of maintaining open park lands under the current management regime (pie chart on page 13) and cost schedules is estimated to be $89,381.

Maintenance	Patch Condition	Mowings/Year	Annual Cost
Schedule A[1]	Short Cool-Season Grass	8	$535.52/ha
Schedule B[2]	Medium Cool-Season Grass	5	$333.45/ha
Schedule C[3]	Taller Cool-Season Grass	2	$133.38/ha
Schedule D[4]	Native Warm-Season Grass	1	$66.69/ha
Schedule E[5]	Shrubland	1/4	$16.67/ha

[1] Patch is mowed bi-weekly during the growing season (May – August). Grass height < 4 inches.
[2] Patch is mowed approximately 5 times during the growing season. Grass height < 8 inches.
[3] Patch is mowed 2 times per year.
[4] See Appendix II.
[5] See Appendix III.

The changes in management regime recommended above will require the conversion of some open patches from cool-season grasses to native warm-season grasses and shrublands. Although conversion of patches to shrublands does not entail an added cost, the conversion of cool-season grasses to native warm-season grasslands will require an estimated initial investment of $310/hectare ($125/acre) (information provided by the Virginia Department of Game and Inland Fisheries). These costs include the application of herbicide, site preparation, and the purchase and planting of seed. Collectively, this would require an estimated initial investment of $70,835. However, both warm-season grasslands and shrublands require less effort to maintain. The collective annual cost of maintaining open lands under the recommended management regime (pie chart on page 16) is estimated to be $56,740. Due to savings in maintenance costs, the initial investment to convert lands would be recouped in 3 years (see below). Over the course of 10 years, savings in management costs are estimated to exceed $250,000.

The estimated cost savings presented above do not include maintenance transition costs. The current maintenance program is not designed or outfitted to maintain warm-season grasslands or shrublands. In the event that habitat conversions are approved, an analysis should be conducted to determine the most appropriate strategy for tailoring the existing maintenance program to accomplish new objectives. This transition may require the purchase of new equipment, a reconfiguration of manpower, or a consideration of outsourcing options. The cost of transition is not known at this time.



Ten-year accumulated cost estimates for open land management under current and recommended management regimes. Initial cost of conversion to native warm-season grasses is recouped in the first 3 years due to savings in maintenance costs. Over the ten-year period, estimated savings exceed $250,000. Cost estimates do not include purchase of new equipment.

CONCLUSIONS

· The Colonial National Historical Park contains significant open lands that have the potential to support natural communities of conservation concern within the mid-Atlantic Region.

· Under the current management regime, open lands do not provide the habitat conditions required by species of conservation concern.

· Evaluation of 177 open patches with regard to biological and programmatic constraints revealed 21 patches (228.5 hectares) that could be converted to native warm-season grasslands and 16 patches (37.3 hectares) that could be converted to shrublands.

· A shift from current to recommended management regime would provide a sustainable source of habitat capable of supporting an estimated 1,453 breeding pairs of open-habitat bird species.

· A shift from current to recommended management regime would result in estimated savings in maintenance costs of more than $250,000 over a ten-year period.

Appendix I: Complete list of patch codes, characteristics, and management.

Patch Code	Perimeter (m)	Area (ha)	Current Manag.[1]	Biolog. Recom.[1]	Biol/Prog. Recom.[1]
1A	1509.0	4.63	C	D	D
1B	675.2	1.99	C	D	D
2A1	404.0	0.78	C	E	E
2A2	644.1	1.90	C	E	E
2B	855.6	1.99	C	E	E
2D	299.4	0.60	C	C	C
3A	1399.4	7.76	C	D	D
3B	555.4	0.98	C	C	C
3C	828.8	4.05	C	D	D
3D	1309.7	4.34	C	D	D
3E	481.1	1.57	C	D	D
5A2	775.2	2.54	C	E	E
5B1	1053.5	1.75	C	C	C
5B2	775.3	1.78	C	C	C
6A	1014.6	6.05	C	D	D
6B	581.4	2.09	C	E	E
6D	252.3	0.19	C	C	C
6E	414.1	0.24	C	C	C
7A	828.1	3.11	C	D	D
7B	1299.9	9.70	C	D	D
7C	216.9	0.30	C	C	C
8	1860.7	12.92	C	D	D
9	1303.6	11.44	C	D	D
10A	2645.5	22.42	C	D	D
10B	1011.0	5.39	C	D	D
14	3504.6	30.19	C	D	D
15	2815.4	22.47	C	D	D
16A	276.6	0.45	C	C	C
16B	325.6	0.71	C	C	C
16C	343.8	0.73	C	C	C
17	1743.3	18.14	C	D	D
18A	1170.4	6.09	C	D	C
18B	1014.2	5.56	C	D	D
18C	1930.0	11.80	C	D	D
19	916.3	3.64	C	E	C
20	1061.5	3.51	C	E	C
21A	2669.1	22.19	C	D	D
21B	542.3	0.97	C	C	C
21C	886.2	2.79	C	E	C
21D	553.2	0.76	C	C	C
21E1	483.1	1.81	C	C	C
21E1	408.0	0.38	C	C	C
21F1	812.4	2.09	C	E	C

1 Letter codes refer to management schedules (see table on page 17).

Appendix I: continued

Patch Code	Perimeter (m)	Area (ha)	Current Manag.[1]	Biolog. Recom.[1]	Biol/Prog. Recom.[1]
21F2	250.1	0.28	C	C	C
21G	796.7	1.35	C	C	C
21H	418.5	0.76	A	A	A
21I1	589.5	1.28	C	E	C
21I2	239.7	0.35	A	A	A
22	1653.1	13.22	A	D	D
23A	1800.8	9.58	C	D	D
23B	244.9	0.25	C	C	C
23C	508.6	0.83	C	C	C
23D	206.3	0.19	C	C	C
24A	625.6	2.09	C	E	E
24B	600.9	1.72	C	E	E
25A	645.6	1.79	C	E	C
25B	307.4	0.63	C	C	C
25C	1028.8	2.87	C	E	C
25D	585.7	1.31	C	E	C
25E	417.9	0.65	C	C	C
26A	472.0	1.49	C	E	C
26B	341.5	0.48	C	C	C
26C	314.6	0.45	C	C	C
28	772.3	1.94	A	E	C
29	396.6	0.20	A	A	A
38	3106.2	1.37	C	C	C
39	2643.0	1.28	A	A	A
40A	359.0	0.47	C	C	C
40B	1209.9	3.22	C	E	E
42	374.1	0.48	A	A	A
44A	2550.0	4.63	B	E	E
44B	478.5	0.51	B	B	B
45A	1341.7	2.42	B	E	E
45B	320.9	0.38	B	B	B
46	2746.7	1.90	A	A	A
47	389.8	0.62	A	A	A
48	475.9	0.81	A	A	A
49	481.8	0.64	A	A	A
51	710.3	0.92	A	A	A
52A	715.4	1.12	B	B	B
53	379.4	0.67	B	B	B
54	348.2	0.21	B	B	B
55	241.8	0.30	A	A	A
61A	102.3	0.03	A	A	A
61B	119.8	0.06	A	A	A
61C	41.4	0.01	A	A	A
61D	367.5	0.50	A	A	A
61E	285.9	0.27	A	A	A

1 Letter codes refer to management schedules (see table on page 17).

Appendix I: continued

Patch Code	Perimeter (m)	Area (ha)	Current Manag.[1]	Biolog. Recom.[1]	Biol/Prog. Recom.[1]
62A	204.9	0.26	A	A	A
62B	287.8	0.60	A	A	A
63A	778.1	0.40	A	A	A
63B	137.2	0.09	A	E	E
63C	484.0	1.25	A	A	A
64	341.9	0.44	A	A	A
67	1445.6	1.05	A	A	A
68	725.5	0.49	A	A	A
69A	265.3	0.44	A	A	A
69B	183.1	0.08	A	A	A
69C	170.6	0.13	A	A	A
69D	24.8	0.01	A	A	A
69E	171.5	0.11	A	A	A
69F	361.7	0.56	A	A	A
70A	262.5	0.16	A	A	A
70B	75.3	0.02	A	A	A
70C	196.4	0.10	A	A	A
71A	547.3	0.23	A	A	A
71B	602.7	0.85	A	A	A
71C	247.1	0.31	A	A	A
71D	134.4	0.05	A	A	A
72	350.1	0.63	A	A	A
73A	1377.7	0.85	A	A	A
73B	364.2	0.28	A	A	A
73C	222.3	0.15	A	A	A
73D	205.8	0.20	A	A	A
73E	602.2	0.49	A	A	A
74A	245.5	0.13	A	A	A
74B	260.1	0.17	A	A	A
74C	68.0	0.02	A	A	A
75A	218.8	0.09	A	A	A
75B	197.0	0.08	A	A	A
75C	196.3	0.21	A	A	A
75D	66.0	0.02	A	A	A
75E	95.6	0.05	A	A	A
76A	68.8	0.01	A	A	A
76B	78.8	0.02	A	A	A
77A	235.4	0.24	A	A	A
77B	1017.6	0.60	A	A	A
77C	82.4	0.04	A	A	A
78A	325.7	0.44	A	A	A
78B	208.5	0.13	A	A	A
78C	248.2	0.06	A	A	A
78D	262.6	0.22	A	A	A
79A	1547.6	2.47	A	A	A

1 Letter codes refer to management schedules (see table on page 17).

Appendix I: continued

Patch Code	Perimeter (m)	Area (ha)	Current Manag.[1]	Biolog. Recom.[1]	Biol/Prog. Recom.[1]
79B	307.7	0.24	A	A	A
80	1830.8	3.81	A	E	E
81	419.2	0.70	A	A	A
82	708.1	1.54	A	E	E
83	885.9	2.54	A	E	E
84	2431.6	2.47	A	A	A
85	1776.1	3.70	A	E	A
86	1453.5	2.68	A	A	A
87	676.4	1.24	A	A	A
88	524.9	0.70	A	A	A
89	255.9	0.24	A	A	A
91	969.9	2.10	A	E	E
92	1645.3	1.51	A	A	A
94	246.5	0.29	A	A	A
95	523.6	0.21	B	B	B
97B	67.9	0.01	A	A	A
98	1065.6	0.87	A	A	A
99	845.4	1.09	A	A	A
99B	246.3	0.22	A	A	A
100A	172.8	0.09	A	A	A
100B	583.1	0.87	A	A	A
100C	573.3	0.63	A	A	A
100D	390.8	0.84	A	A	A
100E	1177.1	1.28	A	A	A
101A	251.1	0.30	A	A	A
101B	483.2	0.49	A	A	A
102	325.5	0.44	A	A	A
103	297.3	0.30	A	A	A
108	784.8	0.75	A	A	A
109	310.7	0.25	A	A	A
110	1063.2	1.44	A	A	A
111	439.4	0.75	A	A	A
112	477.5	0.50	A	A	A
118A	505.3	1.01	A	A	A
118B	536.3	1.52	A	E	A
118C	426.6	1.09	A	E	A
118D	376.8	0.53	A	A	A
118E	468.1	0.67	A	A	A
118F	667.7	2.62	A	E	A
APVA	342.1	0.45	A	A	A
APVA	261.8	0.40	A	A	A
AVPA	1143.5	5.30	A	E	A
APVA	481.6	1.06	A	E	A
MEM	854.5	2.58	A	E	E

1 Letter codes refer to management schedules (see table on page 17).

APPENDIX II: Establishment and maintenance of native warm-season grasses.

Description

Native warm-season grass is a collective name for a group of native grasses that once dominated open lands in eastern North America. The role of these grasses in the regional landscape has been greatly reduced over the past 2 centuries due to conversion to agriculture, overgrazing, the widespread use of sod-forming grasses, and fire suppression. These grasses include big and little bluestem, indiangrass, switchgrass, sideoats grama, eastern gamagrass, and several other species.

Native warm-season grasses provide superior habitat value to early successional wildlife species when compared to sod-forming cool-season grasses. Stands of warm-season grasses provide greater species and structural diversity. Such stands provide protective cover, significant amounts of seed and insect biomass for consumers, and interstitial patches of bare ground required by many species for foraging. Warm-season grasses are also cheaper and easier to maintain when compared to their cool-season counterparts.

Establishment

Establishment of native warm-season grasslands is more difficult than establishing stands of cool-season grasses. Several procedures help to increase probability of success. Care must be given to control competition with other grasses. Stands of cool-season grasses must be eliminated typically with one or more applications of herbicide. Obtaining good quality seed that is appropriate for the local area will increase germination rates. A firm seed bed should be established with minimal surface trash. Seed should be planted shallow preferably using no till techniques. Because establishment procedures are region-specific and evolving continually, government agents should be consulted that have experience in the local area before attempting to plant warm-season grasses (e.g. Stephen Capel, Virginia Department of Game and Inland Fisheries, (804) 598-3706).

Cost – Conversion of open lands dominated by cool-season grasses to native warm-season grasslands is currently estimated to cost $310/hectare ($125/acre) (cost information provided by the Virginia Department of Game and Inland Fisheries). This figure includes 1) the cost of herbicide and initial application ($74.10/hectare), 2) the cost of seed ($207.48/hectare), and 3) the cost of site preparation and seed planting.

Maintenance

Maintaining a healthy stand of warm-season grass requires the regular removal of plant biomass. This may be accomplished by burning the entire patch on a 3-year rotation or mowing annually. Mowing operations should include haying to prevent the buildup of plant biomass over time. In order to provide the maximum wildlife benefit, maintenance activities should be scheduled between early march and mid May. This allows wildlife to utilize cover throughout the winter period and allows for plant renewal prior to the summer breeding season.

APPENDIX III: Establishment and maintenance of shrublands.

Description

Shrublands are open lands with a relatively high coverage of short, woody vegetation such as shrubs and saplings. Within the mid-Atlantic region shrublands typically represent a transitional stage between open grasslands and young forests. Typical native shrubs include a number of blackberry species, wax myrtle, and saltbush. Non-native shrubs that have become naturalized within the region include autumnn olive, silverberry, privet, and multifloral rose. A number of early successional tree species such as black cherry, hackberry, sumac, and black locust also provide woody vegetation within shrublands.

Shrublands provide superior habitat for wildlife when compared to cool-season grasses. Shrublands provide the protective cover required by many species during both the breeding and winter season. Shrublands also provide a diversity of important food resources for wildlife communities. Maintenance requirements are less for shrublands than for any other open habitat within the region.

Establishment

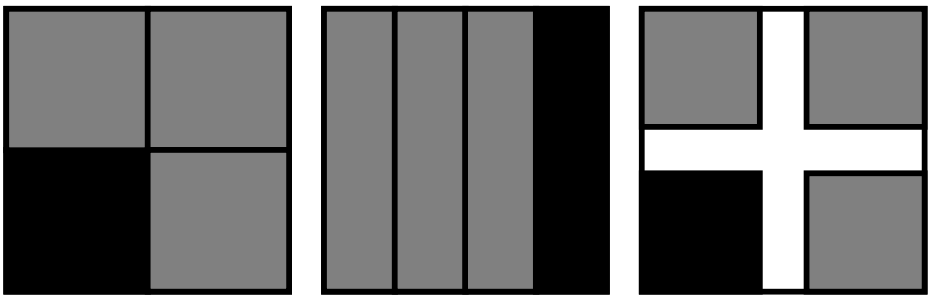
Establishment of shrublands within the mid-Atlantic region requires very little effort. Shrubs and small saplings will naturally invade virtually any open, idle land over a 3-5 year period. The planting of shrubs and small saplings is not required. When converting cool-season grasses to shrublands, an initial application of herbicides will improve habitat conditions.

Maintenance

Whenever possible, shrubland patches should be actively managed so as to provide a "sustained yield" of early successional, shrubby vegetation while preventing succesion from reaching a forest stage. Within the mid-Atlantic region, 4 years typically allows enough time from regrowth of woody vegetation but is not enough time for saplings to get so large that they are difficult to manage. For relatively large shrubland patches, the surface area should be subdivided and managed on a four-year rotation where a different portioin of the patch is managed each year (see figure below for rotational scenarios for different size patches).

Whenever feasible, management activities should be conducted during the spring between early April and mid May. Within the mid-Atlantic region, most shrubland birds appear within breeding areas in mid to late May. Breeding activities often extend between late May and mid August. Management activities such as mowing that occur within this time window may destroy nests and/or young. Similarly, vegetation that is removed after the growing season will not be available as cover to species during the winter months.

Shrubland Management Scenarios For Patches of Different Size



>4 ha **2-4 ha** **<2 ha**