AN INVESTIGATION OF CLIFFS AND CLIFF-NESTING BIRDS IN THE SOUTHERN APPALACHIANS WITH AN EMPHASIS ON THE PEREGRINE FALCON

CENTER FOR CONSERVATION BIOLOGY
COLLEGE OF WILLIAM AND MARY

AN INVESTIGATION OF CLIFFS AND CLIFF-NESTING BIRDS IN THE SOUTHERN APPALACHIANS WITH AN EMPHASIS ON THE PEREGRINE FALCON

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Front Cover: ***Morris Knob.   Photo by Shawn Padgett.***

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EXECUTIVE SUMMARY

The peregrine falcon was believed to be extinct in the southern Appalachians as a breeding species by the early 1960s. Despite extensive recovery efforts made over the past 30 years, the status of breeding Peregrines within this portion of the historic range remains virtually unknown. The primary objective of this study was to conduct a survey of cliffs within the southern Appalachians for bird species with an emphasis on the Peregrine Falcon.

A systematic aerial survey of cliffs and cliff use by birds was conducted throughout a significant portion of the southern Appalachian Mountains covering nearly all of the mountains of Virginia a small portion of Kentucky, and the spine of the Appalachians in West Virginia. During the course of helicopter flights, 242 exposed rock surfaces were mapped, characterized, and surveyed for bird use. Cliffs had a combined length of 122.4 km and a combined area of 470 ha. More than 25% (118 ha) of the collective rock surface that was mapped was occluded by vegetation. The surface area of 75 (31%) cliffs was estimated to be occluded by at least 50%. There was a relationship between cliff height and the level of occlusion. Cliffs that are greater than 30 m high are significantly less likely to be occluded by more than 30% corresponding to the maximum height of local tree species. A total of 97 (40%) of the surfaces mapped were estimated to be higher than 30 m with 13 (5.4%) exceeding 100 m.

Eleven bird species were observed using cliff faces during aerial surveys. Birds were either roosting/loafing (941, 92.6%) or nesting (75, 7.4%). Cliffs appear to represent prominent roosting sites within the landscape for several bird species. Vultures were observed roosting on 124 (51.2%) of the 242 cliffs surveyed with an additional 54 (22.3%) cliffs with characteristic whitewash. Nests of 5 species were detected on cliffs including Common Ravens (35), Turkey Vulture (2), Peregrine Falcon (1), Red-tailed Hawk (1), and Great Horned Owl (1). Common Ravens and Red-tailed Hawks built stick nests on the cliff surface or within overhangs while Turkey Vultures, Peregrine Falcons and Great Horned Owls were nesting within crevices or overhangs.

Given the distribution of historic breeding sites, the release of nearly 250 young falcons in the mountains, the growth of the population in coastal Virginia, and the recovery of breeding populations within the northern Appalachians, the near absence of Peregrines from the study area was surprising. Close examination of historic eyries suggests that the re-growth of vegetation around cliffs may have played a role in the lack of activity. Intense recreational use of the most prominent formations may have also played a role. It is also possible that the previous approach to hacking in the study area may have been inadequate to establish breeding pairs within this landscape.

One of the benefits of the systematic approach used in this survey is the documentation that exposed rock surfaces are not evenly or randomly distributed throughout the study area. The survey allowed for the delineation of 6 geographic areas that contain dominant rock formations that will not be degraded over time by vegetation and multiple surfaces that appear appropriate for nesting. Because of their qualities, these areas should represent priorities in the reintroduction, management, and monitoring of the Peregrine Falcon population. Over the next decade, efforts should be made to re-establish nesting pairs within all 6 of these sites so that they may serve as “nuclei” for re-colonization of this portion of the southern Appalachians.

BACKGROUND

Context

The Peregrine Falcon is essentially cosmopolitan in its distribution (Brown and Amadon 1968). Three races have been described in North America including *F. p. pealei, F. p. tundrius and F. p. anatum* (White 1968). *F. p. pealei* is a large, dark, sedentary form inhabiting the island chains of the Pacific Northwest. *F. p. tundrius* is a paler-colored, smaller, highly migratory form with a breeding distribution limited to the nearctic tundra region. *F. p. anatum* is a large, forest-inhabiting race that is variable in its migratory behavior. Its range spans the continent, intergrading with *tundrius* to the north and limited to north-central Mexico to the south (Palmer 1988).

The original population of peregrine falcons in the eastern United States was estimated to contain approximately 350 breeding pairs (Hickey 1942). Peregrines that nested in the southern Appalachians were an *F. p. anatum* subpopulation referred to as the Appalachian Peregrine, and the population was comprised of individuals larger and darker than the other subpopulations of the race. The historic status and distribution of Peregrine Falcons in this region is not completely known because no systematic survey of the species was completed prior to the loss of the population. From published records and accounts, there have been 24 historical Peregrine eyries documented in the Appalachians of Virginia (Gabler 1983) and a number of similar sites in West Virginia (Hall 1983). Mountain nest sites were open rock faces.

Throughout the 1950s and into the 1960s, Peregrine Falcon populations throughout parts of Europe and North America experienced a precipitous decline (Hickey 1969). A survey of 133 historic eyries east of the Mississippi River in 1964 failed to find any active sites (Berger et al. 1969). The Peregrine Falcon was believed to be extinct in the southern Appalachians as a breeding species by the early 1960's. Broad-scale declines resulted from reproductive rates that were insufficient to offset natural adult mortality. The cause of reproductive failure was the extensive use of chlorinated-hydrocarbon pesticides such as DDT. These compounds are persistent in the environment and bio-accumulate through the food chain. Breeding females with high levels of these compounds in their tissues produced eggs that had thin shells and were less viable (Cade et al. 1971, Peakall et al. 1975, Ratcliffe 1980).

Both *F. p. anatum* and *F. p. tundrius* were listed as endangered under the Endangered Species Conservation Act of 1969 (P.L. 91-135, 83, Stat. 275) and, subsequently, under the Endangered Species Act of 1973 (16 U.S.C. 1531 et seq). In 1975, the U.S. Fish and Wildlife Service appointed an Eastern Peregrine Falcon Recovery Team to develop and implement a Recovery Plan (Bollengier et al. 1979). Among other actions, the plan called for the establishment of a new Peregrine Falcon population within the vacant, eastern breeding range that would be self-sustaining and reach 50% of the estimated size of the original population in the 1940's.

In 1970, a captive breeding program was initiated at Cornell University to provide a source of birds for re-introduction of Peregrine Falcons into the eastern range (Cade 1974, Cade and Fyfe 1978). The breeding stock used for the captive program was of mixed heritage and contained individuals from non-indigenous subspecies (*F. p. cassini*, *F. p. brookei*, *F. p. pealei*, *F. p. peregrinus*, *F. p. tundries*, and *F. p. macropus*), as well as, native *F. p. anatums* (Barclay and Cade 1983). The first experimental releases were conducted in 1974 (Cade and Fyfe 1978). Since that time, approximately 6,000 falcons have been released into the historic North American range (Mesta 1999). Reintroduction efforts have been successful in establishing a new breeding population within the historic eastern range (Barclay 1988). The breeding population in eastern North America continues to increase at a rate of approximately 10%/year (Enderson et al. 1995).

Between 1978 and 1993, more than 300 captive-reared falcons were released in the states of Virginia and West Virginia. Following early releases on the coast of Virginia, 179 young falcons were released in the historic mountain breeding range between 1985 and 1993. In Virginia 126 falcons were released from 9 locations (http://ccb-wm.org/vafalcons/vacons/reintro.htm). In West Virginia 53 falcons were released from 4 locations (http://www.wvdnr.gov/wildlife/RETSpecies.asp) including 1 site in the New River Gorge and 3 sites in the North Fork Mountain area. In 2000, a new program designed to re-establish the mountain population in Virginia was initiated where young falcons hatched on the coast of Virginia in locations known to experience low fledging rates were translocated to mountain hack sites and released. Since 2000, 68 falcons have been released through this program (Watts et al. 2006).

F. p. tundrius was shown to be "recovered" and was removed from the federal list of threatened and endangered species on 5 October 1994 (Swem 1994). On 30 June 1995, the U.S. Fish and Wildlife Service published an Advance Notice of Intent to remove *F. p. anatum* from the list of threatened and endangered wildlife. This notice provoked considerable debate within the conservation community (Pagel et al. 1996, Cade et al. 1997, Pagel and Bell 1997, Millsap et al. 1998). On 25 August 1999, *F. p. anatum* was officially removed from the federal list of threatened and endangered species (Mesta 1999). Peregrine Falcons continue to be listed as threatened in the state of Virginia.

More than 20 years after the first releases of Peregrine Falcons in the southern Appalachians we still know very little about the success of this program and the status of the breeding population. Following the captive release program there have been several attempts to conduct targeted surveys for breeding peregrines. Among others these include aerial surveys of southwestern Virginia (Baker, unpublished memo) and other historic sites (Byrd, unpublished data) during the early 1990s, ground monitoring of Shenandoah National Park during the late 1980s and early 1990s (Watson, unpublished reports), and continuing in the late 1990s and 2000s (Gubler, pers. Comm.), aerial surveys of many sites across western Virginia in 2003 (Reynolds 2004), ongoing ground-based monitoring of various sites in West Virginia (Stihler, pers. Comm..), and volunteer-based monitoring over broad areas. These efforts have resulted in very little evidence of the broad re-colonization that was hoped to result from the reintroduction program. From 1992 through 1998 pairs were detected in various locations throughout Shenandoah National Park with some breeding attempts documented. Breeding was again documented in 2005 (Watts et al. 2005). In West Virginia, breeding was documented in 1991 and 1992 (Stihler 1991) and then again from 1999 through 2001 (http://www.wvdnr.gov/wildlife/RETSpecies.asp). The very low amount of breeding activity documented over the past 20 years begs the question of whether or not there are sites within this extensive landscape that are unknown. A systematic survey of available cliff sites is needed to address this question.

Objectives

The objectives of this project were 1) to survey, map and characterize exposed cliff surfaces within a significant portion of the southern Appalachians, 2) to survey cliffs detected for bird use with a particular emphasis on Peregrine Falcons. It is hoped that accomplishing these objectives will lead to new insight into the current status of the Appalachian Peregrine Falcon population and the development of new strategies for their recovery.

METHODS

Study Area

The study area included all mountainous areas west of the Piedmont in Virginia (with the exception of the lower Blue Ridge Mountains in Augusta, Nelson, Rockbridge, Amherst, and Bedford Counties), the ridgeline of Cumberland Mountain in Kentucky, and most of the eastern mountains of West Virginia (Figure 1).

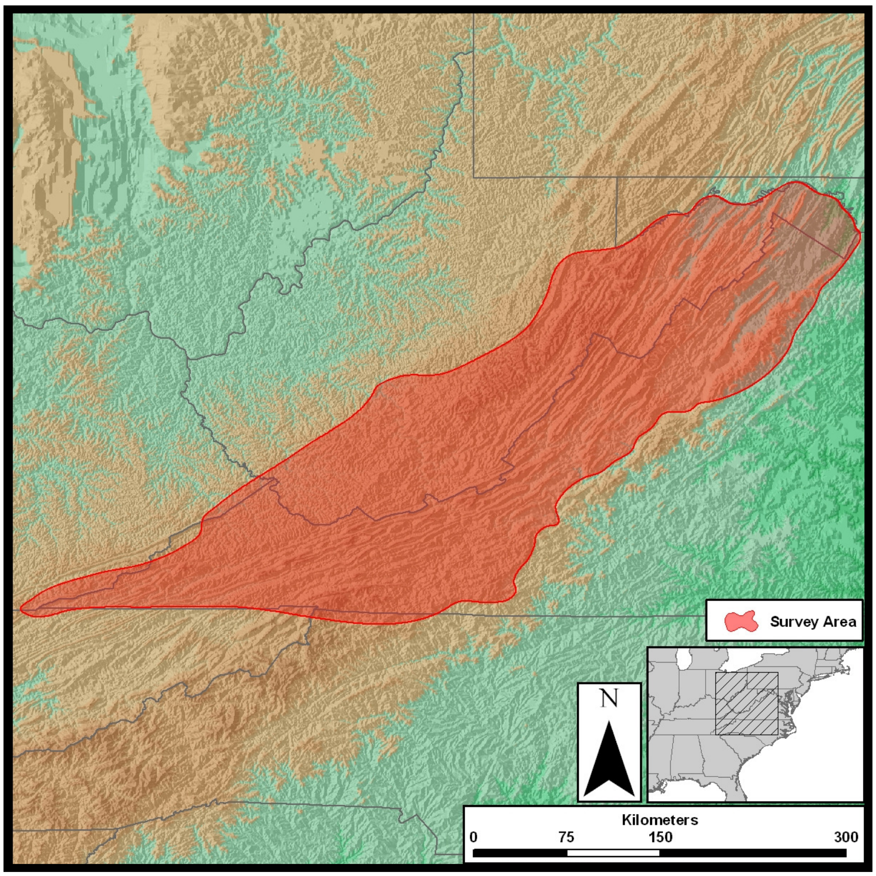

Figure 1. Map illustrating the extent of aerial surveys for exposed rock surfaces and birds.

Cliff Survey

Cliff surfaces were located by systematically flying a helicopter throughout the study area and searching for exposed rock surfaces. There is currently no remotely sensed database or map capable of identifying open rock surfaces. All surfaces were located during the course of the aerial survey. The entire land surface within the study area was over flown within 400 m to locate, map, and survey cliff surfaces.

Photo – Bryan Watts (l) and Shawn Padgett (r) with bell ranger used in surveys.

Only those cliffs that were 1) at least 10-m high, 2) had surfaces that were open and not completely occluded by vegetation, and 3) had some sections that were considered shear (estimated to have a no greater than 30° inclination from the vertical) were included in the survey. All rock surfaces that were included in the survey were mapped using a Garmin GPSMAP 76 global positioning system (GPS) and given a unique numeric code for each flight day. In the lab, GPS coordinates were overlaid on leaf-off, infrared or black and white, digital ortho quarter quads using ArcView 3.2 (Environmental Systems Research Institute, Inc.© 1992-2000). Aerial imagery was taken between 1995 and 2001 depending on the specific location and state of origin. Cliff positions were visually corrected by matching up to corresponding structures on aerial photographs and digitized by hand in ArcView 3.2. Large cliff formations were readily detected within aerial photographs. However, small cliff surfaces were often difficult to detect on photos such that locations should be considered approximate. All cliff locations were assigned unique, three part, alpha-numeric codes (state abbreviation – county abbreviation – number).

Cliff surfaces were examined at close range to evaluate size, occlusion, condition, and location within the landscape. The area of exposed cliff surface was estimated roughly by estimating length, height and degree of occlusion by vegetation. Cliff length (L) was estimated visually to within 10 m for cliff sections up to 200 m in length and measured from aerial photographs to within 10 m for cliffs beyond 200 m in length. Cliff height (H) was estimated visually to within 5 m. Cliff surfaces are occluded by vegetation growing directly on the surface or from trees growing up from the base. Degree of occlusion (O) was estimated visually in 10% intervals. Area of exposed cliff surface was estimated in ha as [L(m) X H(m) X (1- (O/100)]/10,000.

The condition and orientation of the strata forming the cliff surface determines, at least in part, the likelihood that a cliff will be used by nesting birds. The strata of the rock forming each cliff were examined for orientation. Orientation of strata examined included horizontal, vertical (upheaved surface), tilted (partially upheaved), and no apparent strata (large boulders). There were also mixed surfaces where the cliff was tilted longitudinally such that the angle of the strata changes along the length of the cliff. The type and degree of access into the rock surface was also examined. Access included, open horizontal seams, crevices and inpockets, overhangs, vertical fractures, horizontal fractures, closed seams, and no to poor access.

Small section of White Rocks with horizontal strata and a good overhang (TL), vertical fin formation near North Fork Mountain (TR), prominent position of Old Rag (LL, extensive occlusion by vegetation (LR). Photos by Shawn Padgett.

The distribution of exposed rock surfaces reflects both the distribution of the base material and the processes that lead to exposure. Although waterways may cut through vast areas leaving scattered exposed rock surfaces, surfaces may also be found on ridgelines or other settings. How a cliff is positioned on the landscape is relevant to the likelihood of bird use. Some surfaces are very prominent, tower over the surrounding landscape and may be seen easily for 40 km or more. Other surfaces are situated down in a canyon or narrow gorge and are hidden from most of the surrounding. The situation and general prominence of the cliff surface was noted.

Bird Survey

Exposed rock surfaces were approached to within 40 m in a helicopter to examine the surface and to flush all birds present. All birds detected on the surface or flushing from the surface were identified to species and recorded. Nest structures detected were examined for activity. Because many of the cliff surfaces appear to serve as communal roosts for vultures, whitewash on upper surfaces was noted.

Whitewash from roosting vultures (l), Nest of Common Raven positioned under overhang (r). Photos by Shawn Padgett.

RESULTS

Cliffs

A total of 242 exposed rock surfaces was mapped and surveyed for cliff-nesting birds throughout the study area. Surfaces were widely distributed throughout the area but relatively rare given the overall size of the area covered. The combined length of exposed cliffs was 122.4 km. Length of individual cliffs varied over three orders of magnitude from 20 to 4,170 m and estimated height varied from 10 to 150 m (Table 1).

The total estimated, vertical area included was 470 ha with nearly 352 ha of exposed rock surface. Individual cliffs varied in exposed surface area from 0.01 to 20.25 ha.

Table 1. Descriptive statistics on cliff surfaces mapped and surveyed within the study area.

Parameter	N	Minimum	Maximum	Mean	S. E.
Cliff Length (m)	242	20	4,170	506	39.7
Cliff Height (m)	242	10	150	35	1.6
Veg Occlusion (%)	242	0	90	32	1.7
Vertical Surface (ha)	242	0.02	20.41	1.9	0.21
Exposed Surface (ha)	242	0.01	20.25	1.4	0.19

Overall, more than 25% (118 ha) of the collective rock surface that was mapped was occluded by vegetation. However, individual rock surfaces varied considerably in the extent to which they were occluded by vegetation. Scores of rock surfaces were likely present within the study area but not mapped because they were completely occluded by vegetation. These surfaces may not have been detected from the aircraft or could not be assessed effectively. Of the 242 cliffs that were mapped and assessed, the surface area of 75 (31%) was estimated to be occluded by at least 50% (Figure 2, Appendix I). There is a relationship between cliff height and the level of occlusion. Cliffs that are greater than 30 m high are significantly less likely to be occluded by more than 30% compared to cliffs less than 30 m high ($X^2 = 16.72$, df = 1, $P < 0.01$) (Figure 3). Cliffs more than 30 m high exceed the maximum height of local tree species. A total of 97 (40%) of the surfaces mapped were estimated to be higher than 30 m with 13 (5.4%) exceeding 100 m.

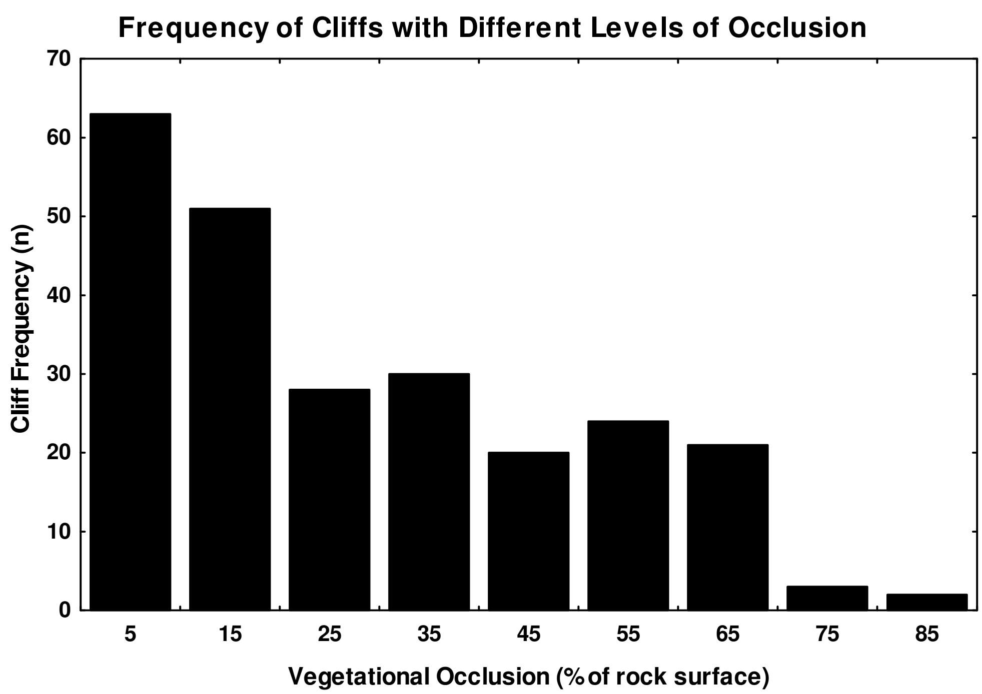

Figure 2. Frequency of cliffs with different levels of vegetational occlusion. Labels for occlusion categories represent midpoints of 10% ranges. Occlusion for most cliffs was less than 40%.

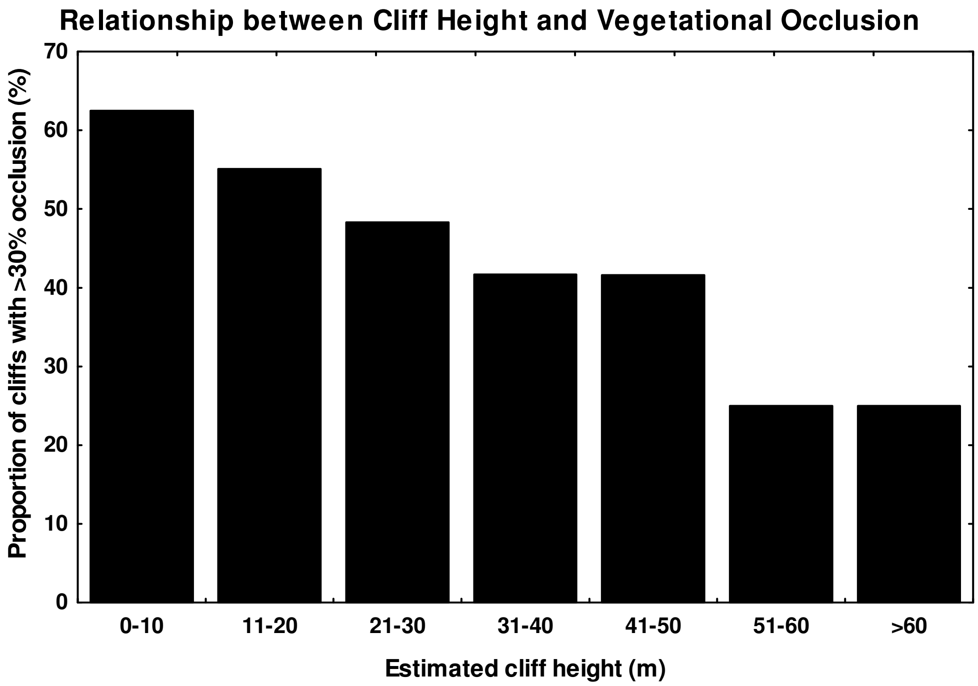

Figure 3. Relationship between estimated cliff height and the proportion of cliffs that had >30% vegetational occlusion.

The condition and orientation of rock surfaces varied throughout the study area. Four configurations of strata were recorded during surveys including 1) horizontal, 2) vertical, 3) tilted, and 4) none (Appendix I). Strata that was oriented along a horizontal plane was most common (179, 74.4%). These cliff surfaces often provided access into the rock surface in the form of in-pockets and overhangs. Cliffs formed from rock that had been heaved up such that the strata approached the vertical plane were much less common (39, 16.1%). Access into these surfaces was typically limited to fractures that were open enough to permit access. An even less common configuration was cliffs that presented horizontal strata along the surface but were tilted backwards such that rain could flow into the crevice (20, 8.3%). Fairly rare were large bolder fields where the rock surfaces had no apparent strata (4, 1.6%).

The level of access into cliff surfaces was influenced by the orientation of strata (Figure 4, Appendix I). Cliffs that had horizontal or tilted strata were significantly more likely to have good to very good access into the rock surface compared to cliffs that had vertical or no strata ($X^2 = 31.67$, df = 3, $P < 0.01$). Throughout the study area, cliffs with horizontal strata often had many open seams that had deep crevices, in-pockets, and overhangs. Cliffs with vertical strata typically had some fractures but seams were often tight with relatively few in-pockets or overhangs.

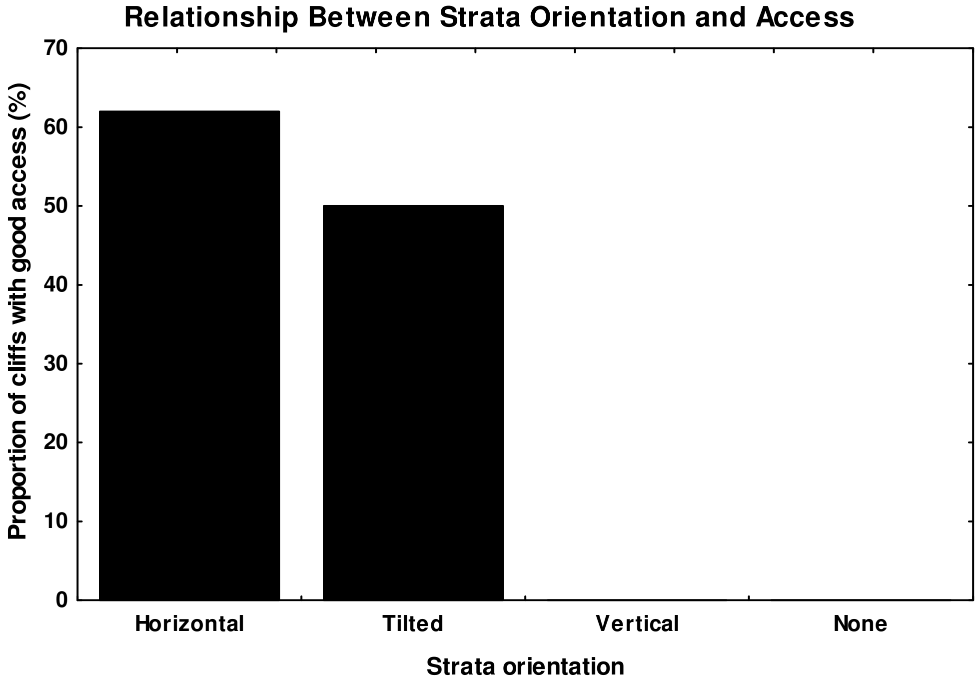

Figure 4. Relationship between strata orientation and access into the cliff surface. Cliffs with horizontal or tilted strata tended to have significantly greater access into the surface when compared to cliffs with vertical strata or boulders/monoliths.

Birds

Relatively few bird species were observed using cliff faces during aerial surveys. Eleven species were observed either roosting or nesting on cliffs (Appendix II). These included the Turkey Vulture (*Cathartes aura*), Black Vulture (*Coragyps atratus*), Common Raven (*Corvus corax*), Peregrine Falcon, Red-tailed Hawk (*Buteo jamaicensis*), Bald Eagle (*Haliaeetus leucocephalus*), Red-shouldered Hawk (*Buteo lineatus*), Sharp-shinned Hawk (*Accipiter striatus*), Broad-winged Hawk (*Buteo platypterus*), Great Horned Owl (*Bubo virginianus*), and Rock Dove (*Columba livia*). Observations were numerically dominated by only 4 species that accounted for 97.6% of all individuals recorded. Turkey Vultures dominated observations accounting for 81.0% of individuals followed by Common Ravens (7.7%), Black Vultures (5.9%), and Rock Doves (3.0%).

Birds observed on cliff faces were either roosting/loafing (941, 92.6%) or nesting (75, 7.4%). Cliffs appear to represent prominent roosting sites within the landscape for several bird species. Vultures were observed roosting on 124 (51.2%) of the 242 cliffs surveyed. In addition, whitewash from vultures was recorded on an additional 54 cliffs suggesting that the majority (73.6%) of the rock surfaces receive regular use by vultures. Many of the cliffs appeared to have one to several rock surfaces that were "preferred" roost sites for vultures. Nearly all of the other species were observed as individuals perched on top of the cliff surface, on rocks within the cliff or on vegetation growing on the cliff surface. Rock Doves were flushed from a few cliffs in small flocks. Nests of 5 species were detected on cliffs including Common Ravens (35), Turkey Vulture (2), Peregrine Falcon (1), Red-tailed Hawk (1), and Great Horned Owl (1). Common Ravens and Red-tailed Hawks built stick nests on the cliff surface or within overhangs while Turkey Vultures, Peregrine Falcons and Great Horned Owls were nesting within crevices or overhangs.

<u>Turkey Vulture</u> – Turkey Vultures were abundant and widely distributed throughout the study area. This was one of the most common birds seen on the wing during aerial surveys. Birds in small to large groups were flushed from cliff surfaces throughout the day. However, it is likely that cliff use by this species was greatly underestimated since many birds were likely on the wing while cliffs were being surveyed. This suspicion is supported by the large number of cliffs with whitewash that did not have birds roosting on them when they were surveyed. Cliffs that seemed to receive regular usage were typically prominent on the landscape with good surrounding views and likely good updrafts for soaring. Cliffs embedded deep within enclosed ravines received less use. Most of the birds observed roosting on cliffs did not appear to be in breeding condition. These birds had dull brown plumage and dull-colored heads. A small portion (<5%) of the birds observed on cliffs appeared to be in breeding condition with clean, deep black plumage and red heads. Only 2 cliffs were observed to be used by nesting birds during the aerial surveys. This includes 1 pair in a crevice on Paintlick Mountain in Tazewell County and one in a crevice on White Rocks in Lee County.

<u>Black Vulture</u> – Like Turkey Vultures, Black Vultures were common within the study area and were seen on the wing regularly during aerial surveys. However, this species was much less common than the Turkey Vulture and the ratio of 10-15:1 observed in cliff use is comparable to that observed within the area. The majority of individuals observed were in mixed groups with Turkey Vultures. No birds were observed nesting on cliff surfaces.

<u>Common Raven</u> – Common Ravens were not detected during aerial surveys with the same frequency as vultures but were the most common species detected nesting on cliff surfaces. Active nests were detected on 30 (12.4%) of 242 cliff surfaces surveyed. This was believed to represent a fairly accurate assessment of cliff use since nests were relatively easy to detect from the air. Although this species breeds very early in the year, most nests detected had attending adults, young in the nest or were covered with heavy whitewash indicating that they had been active during the survey year. Nests were bulky, made of sticks, and were placed either on ledges or within crevices. Nests were widely distributed throughout the study area (Figure 5) and were located within 15 counties.

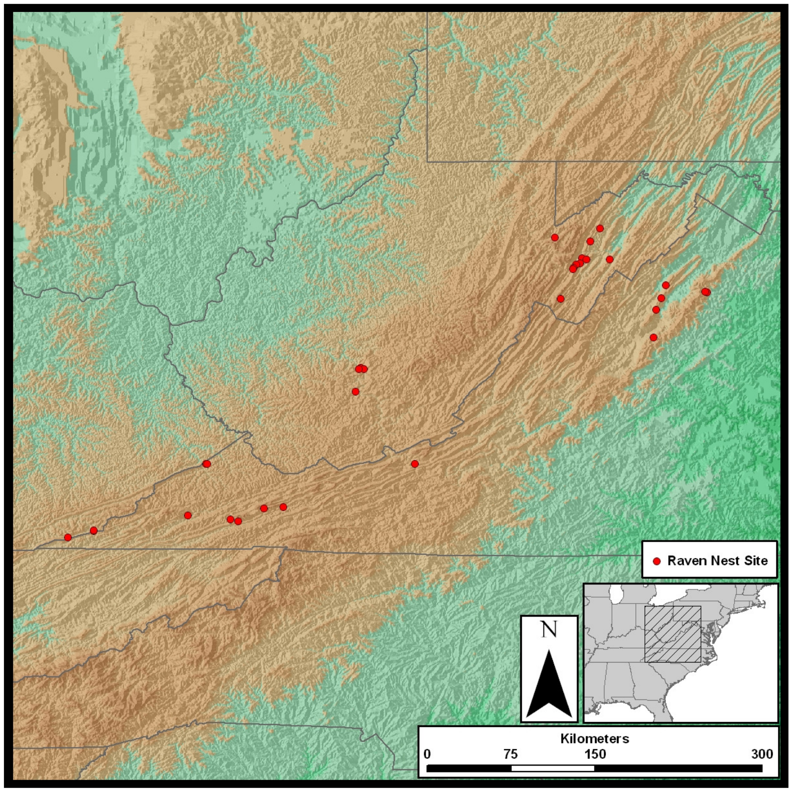

Figure 5. Map of Common Raven nests detected during aerial surveys. Note that due to the large scale, some of the nest locations overlap.

Peregrine Falcon – Peregrine Falcons were surprisingly rare within the study area. Individuals were detected within only 4 locations during aerial surveys. An adult male was observed stooping on a kettle of vultures in Amherst County (VA) just north of Route 130 near Three Sisters Knobs. This bird appeared to be defending a territory. This section of the Blue Ridge is the only mountainous portion of Virginia not systematically covered in the survey. An adult female was observed on the wing in Albemarle County (VA) just north of Middle Mountain and west of Pasture Fence Mountain near the boundary of Shenandoah National Park. This bird could have been the female of the pair nesting on Stony Man on the other side of the ridge. An adult female was flushed from the cliff formation Chimney Top in Grant County (WV) just south of North Fork Gap. This bird emerged from a crevice, flew out and circled back to perch on the ridge top just above the point of emergence. This bird was flushed 4 times and circled back to this location to perch each time suggesting an attachment to the site. A follow-up ground visit to this location by WV DNR suggests that this may have been an unmated female. The site should receive targeted annual monitoring. A single nesting pair was located on the formation Stony Man in Page County (VA) within Shenandoah National Park. This pair was known to have nested in this location for the past 2 years.

Others – The 7 other bird species observed on cliffs occurred in very low numbers. Bald Eagles were observed scattered throughout the study area but only 2 individuals were observed perched on cliffs. This included a full adult bird and a 4-year old bird.

Both of these individuals were perched on formations along North Fork Mountain in Grand and Pendleton Counties (WV). Red-tailed Hawks were common throughout the study area and were frequently observed on the wing. Birds were typically observed perched on the top of cliffs or on trees growing on the cliff surface. A single stick nest was observed on a cliff formation along North Fork Mountain in Pendleton County (WV). Red-shouldered Hawks, Sharp-shinned Hawks, and Broad-winged Hawks were observed on the wing throughout the study area. Red-shouldered Hawks were particularly common throughout the New River drainage and appeared to be the most common raptor throughout this system. These species were only observed perched or loafing around the cliff faces. Great Horned Owls are common throughout the study area but were not observed due to their nocturnal habits. A single nest was detected within a deep crevice in a cliff near Pearisburg in Giles County (VA). Rock Doves were flushed from cliffs in small flocks typically in sites where cliffs were surrounded by open farmland. No evidence of nesting was detected though it is possible and would have been very difficult to detect from the air.

Geographic Areas

Exposed rock surfaces were widely distributed throughout the study area (Figure 6) and were mapped within 35 counties (Table 2). However, cliffs were not evenly distributed throughout the area. Six geographic areas stand out as having high concentrations of rock surfaces. All of these areas support significant rock formations that contain multiple sites that could support cliff-dependent species such as the Peregrine Falcon (Table 3, Figure 7).

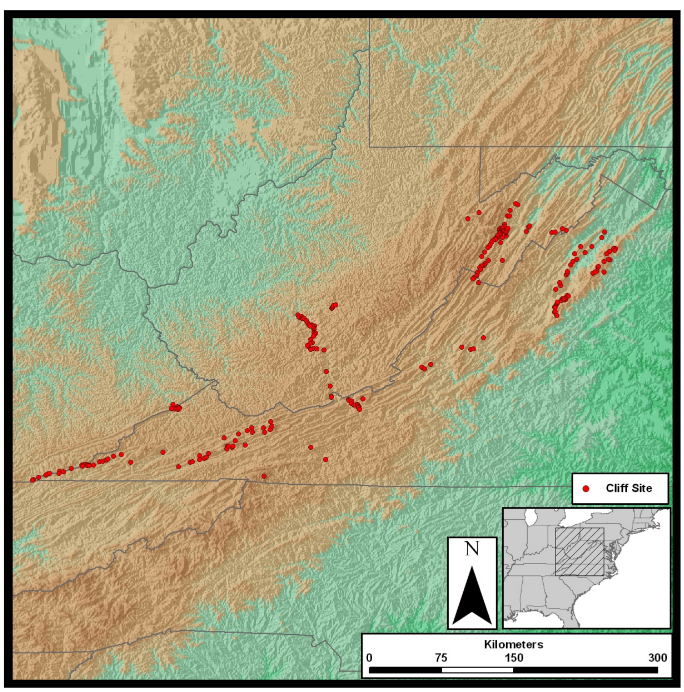

Figure 6. Distribution of cliffs surveyed. Note that due to the large scale, some points overlap.

Table 2. Summary of cliff and most common bird observations by county. Alpha codes are TUVA – Turkey Vulture, BLVU – Black Vulture, CORA – Common Raven, PEFA – Peregrine Falcon, RTHA – Red-tailed Hawk, BAEA – Bald Eagle. Numbers refer to individuals observed on cliffs. A number with an "n" refers to 1 or more active nests. Parenthetic values refer to the number of cliffs occupied by that species. Cliff length is expressed in km and area is expressed in ha.

State	County	N	Cliff Length	Cliff Area	TUVU	BLVU	CORA	PEFA	RTHA	BAEA
KY	Bell	1	0.12	0.11						
	Harlan	9	8.58	12.44	27(6)		3n(3)			
	Pike	3	0.53	1.30						
VA	Albemarle	1	0.10	0.15						
	Alleghany	2	0.80	0.56	3(2)					
	Augusta	4	0.69	0.50	4(1)					
	Botetourt	2	0.63	0.78	4(1)					
	Carroll	1	0.10	0.13	2(1)					
	Dickenson	9	4.88	30.26	14(4)		2n(2)			
	Giles	15	4.73	26.67	27(7)		1n(1)		1(1)	
	Grayson	1	0.75	1.20	3(1)					
	Highland	3	1.28	2.22	8(2)					
	Lee	15	13.34	30.44	33(6)					
	Madison	3	1.39	3.04						
	Page	10	4.37	7.26	45(6)		1n(1)			
	Rappahannock	8	1.62	2.69	45(6)		2n(2)			
	Rockbridge	3	0.70	1.21	9(3)	3(2)				
	Rockingham	20	3.67	6.14	96(13)	28(1)	1n(1)			
	Russell	4	1.91	2.91	9(2)				1(1)	
	Scott	2	1.08	2.40	4(1)		1n(1)			
	Shenandoah	3	1.58	2.86	30(3)		2n(2)			
	Smyth	3	0.90	0.90			1n(1)			
	Tazewell	10	8.58	17.35	103(7)	20(1)				
	Warren	3	0.57	1.54	3(1)					
	Washington	8	0.79	1.16	23(2)		3n(3)			
	Wise	1	0.84	0.13						
	Wythe	1	0.09	0.18						
WV	Fayette	25	15.14	24.10	124(16)		5n(3)			
	Grant	25	16.90	72.20	71(8)	7(3)	5n(5)	1(1)	2(2)	1(1)
	Hardy	6	2.44	6.37	19(4)				1(1)	
	Nicholas	5	5.42	8.16						
	Pendleton	29	16.10	79.75	103(18)		6n(5)		5(5)	1(1)
	Raleigh	2	0.41	0.48			1n(1)			
	Summers	3	1.05	0.49		2(1)			1(1)	
	Tucker	2	0.32	0.26	14(1)		1n(1)			

Table 3. Summary of cliffs and most common bird species by geographic area. Alpha codes are TUVA – Turkey Vulture, BLVU – Black Vulture, CORA – Common Raven, PEFA – Peregrine Falcon, RTHA – Red-tailed Hawk, BAEA – Bald Eagle. Numbers refer to individuals observed on cliffs. A number with an "n" refers to 1 or more active nests. Parenthetic values refer to the number of cliffs occupied by that species. Cliff length is expressed in km and area is expressed in ha.

Geographic Area	N	Cliff Length	Cliff Area	TUVU	BLVU	CORA	PEFA	RTHA	BAEA
Breaks Interstate Park	12	5.41	31.56	14(4)		2n(2)			
Morris Knob	11	10.24	19.84	108(8)	20(1)				
New River Valley	45	21.33	51.74	151(23)	2(1)	7n(5)		2(2)	
North Fork Mountain	55	31.81	150.80	165(26)	7(3)	10n(9)	1(1)	7(7)	2(2)
Shenandoah	52	13.99	24.18	223(30)	28(1)	6n(6)	1n(1)		
White Rocks	26	22.88	43.01	60(13)		3n(3)			
Others	41	16.74	40.51	102(19)	3(2)	7n(7)		2(2)	
Total	242	122.40	351.85	823(124)	60(8)	35n(32)	2(2)	11(11)	2(2)

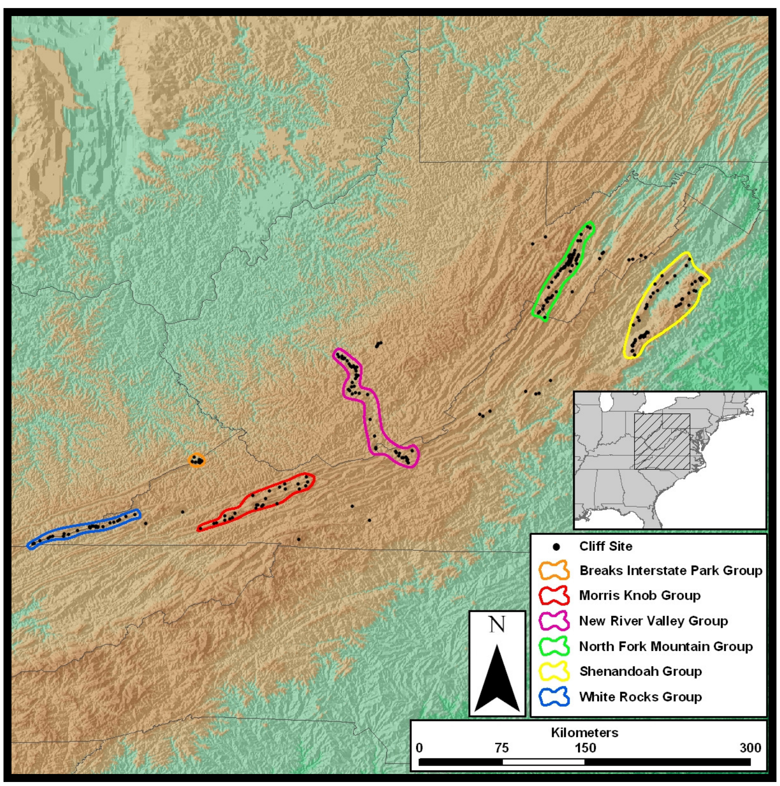

Figure 7. Map of areas with high concentrations of exposed rock surfaces.

<u>North Fork Mountain</u> – The North Fork Mountain area has the highest density of exposed rock surfaces within the study area and the greatest diversity of use by birds. The area is composed of a north to south escarpment. Most of the exposed rock

surfaces are thin plates of rock that have been heaved up vertically and emerge from the ground through valleys that run east to west. This gives the formations a fin-like configuration. The seam of rock that forms these surfaces runs for miles and overlooks a valley to the west. Because the rocks are oriented vertically, many of them have limited crevices or access into the rock surface. Several of the more prominent formations such as Seneca Rocks are favorite climbing areas and so experience considerable recreational disturbance. The formation Chimney Top in the northern portion of the area is a spectacular ridgeline cliff complex that runs for several miles. This formation is easily a class A peregrine site that has multiple nest sites, is prominent on the landscape, and overlooks a broad valley. The site may be viewed from a good road (Route 28) and should be monitored for peregrine nesting activity annually.

New River Valley – The New River Valley is formed by an ancient river that runs east to west through a mountain range that runs north to south. Because of this, the valley cuts a deep gorge that contains extensive sections of exposed rock. This area is easily a class A peregrine site. The most impressive section of this system extends from Gauley Bridge to Bluestone Lake. Exposed seams of rock run for tens of miles along this stretch on both sides of the gorge. Stratification is horizontal and the cliffs have very good access with perfect crevices and overhangs for nesting. However, the benches below rock surfaces have undergone secondary succession and many of the cliff surfaces are now occluded by standing trees. Although there is considerable climbing interest in this area, recreational climbing is somewhat limited by access. Further up river near the town of Pearisburg the river cuts through Peters Mountain and then Walker Mountain. This area supports several isolated, large rock surfaces that have many crevices for nesting peregrines. Both of these upper and lower sections of the river should be focal areas for peregrine recovery.

White Rocks – The White Rocks complex is one of the most spectacular series of cliffs in the southeast. The exposed rock runs along the east-facing edge of Cumberland Mountain at the Virginia-Kentucky border. The cliffs run for tens of miles to the northeast and are prominent on the landscape overlooking a broad valley to the east. The cliffs may be seen for 40-50 miles away and clearly represent a class A peregrine site. The surfaces themselves have extensive horizontal stratification, good crevices and provide multiple nesting areas for peregrines. Although some sections are now occluded by tree regrowth from below, many of the sections are high enough that they will never be overtaken by trees. A dirt road along the ridge above the cliffs appears to receive regular use and may be a disturbance concern for sections of the site. To the west of the main cliff line is a series of exposed rock surfaces that are formed by tilted plates of rocks. The surfaces are east-facing with horizontal stratification but many of the available crevices are vulnerable to rain. These surfaces are also not prominent on the landscape but are enclosed in horseshoe canyons. The primary section of White Rocks may be viewed from Route 58 and should be monitored annually for peregrine activity.

Breaks Interstate Park – The Breaks Interstate Park area includes a gorge formed by Russell Fork at the northeastern end of Pine Mountain. The gorge has extensive cliff formations including a central pinnacle which was a historic nesting site for Peregrine Falcons. Similar to the New River Gorge this site has extensive wall cliffs on both sides of the main gorge. These formations have horizontal stratification and many crevices and overhangs for nesting. The main cliff is part of the state park with overlooks and trails along the ridge. However, the height and situation of this cliff suggests that it may accommodate both nesting birds and human use. This site is isolated from other concentrations of cliffs but should play a role in peregrine recovery efforts.

Morris Knob – The area surrounding Morris Knob contains a substantial number of prominent cliffs that provide multiple crevices that could be used as alternate nesting sites for Peregrine Falcons surrounded by farmland foraging areas. Exposed rock surfaces exist in a concentrated area but are located in a complex if ridgelines including Paint Lick Mountain, Rich Mountain, Buckhorn Mountain, and Brushy Mountain. A few of these cliffs are very prominent on the landscape and represent class A peregrine sites. This area should be monitored annually for colonization by Peregrine Falcons and should play a role in the recovery in Virginia.

Shenandoah National Park – Shenandoah National Park and surrounding formations such as Old Rag and Massanutten Mountains contain a diversity of exposed rock surfaces including rock canyons, bluffs, gap formations, ridgeline cliffs, boulder fields, etc. The number and diversity of potential nesting sites within this concentrated area makes the overall site attractive. However, many of the rock surfaces are old and have a sloughed off appearance with extensive talus slopes below them. Except for a very few formations, the quality of these sites are marginal. Most of the cliff faces are small enough to be overtaken by trees growing up from the base. Old Rag Mountain is an exception to that and represents a class A site for peregrines. This site dominates the surrounding landscape and may be seen from many miles away. As with Old Rag, many of the prominent sites in both Shenandoah and Massanutten have fairly good access and receive a great deal of recreational use. The area around Brown Mountain is an exception to this. This area is remote and contains a couple of high-quality rock surfaces. The area around Shenandoah has historically played an important role for the Peregrine Falcon population. Prominent sites should be monitored annually for breeding activity.

DISCUSSION

Exposed rock surfaces were found to be rare relative to the landscape within the study area. The vast majority of steep slopes, ridgelines, and ravines within this portion of the southern Appalachians were covered by forest habitats. Many of the areas where rock protruded from the land surface were covered by trees and so the cliffs that might be available for use by birds were not exposed. Rock formations that were large and prominent on the landscape represent a relatively small portion of the overall cliff surfaces. Areas that contain multiple surfaces with the potential to be used by birds were even less common on the landscape and represented by only 6 areas.

Use of cliff faces by birds was surprisingly low during aerial surveys. Only 11 of the more than 100 species breeding throughout the study area were detected using cliff surfaces. The vast majority of individuals using cliffs were observed roosting or loafing. Of the 147 cliffs where birds were detected, nests were found on only 36. Virtually all of the species found loafing or nesting on the cliffs are facultative users. Red-tailed Hawks primarily build nests in trees and use cliffs or other structures such as buildings occasionally or when trees are not available (Preston and Beane 1993). Turkey Vultures nest in a diversity of structures including in abandoned buildings, within tree cavities, within logs, or on the ground in thickets or boulders (Kirk and Mossman 1998). Although they often utilize deep crevices or caves within rocks it seems that they are more likely to use cliffs and boulder fields that are embedded within forests compared to exposed cliff faces. Common Ravens were detected nesting on cliff surfaces more than any other species. This species is well known to nest on cliff faces within the region (Clark and Forbes 1934, Jones 1935, Hooper 1977) but also nests frequently in trees and on man-made structures such as transmission towers and bridges (Shedd and Shedd 2004). Given the small number (35) of nests detected on cliff sites during the study and the substantial population within the area, it seems likely that the majority of pairs are nesting on trees or other structures. This pattern is consistent with selected other populations. For example, only 2 of 35 nests in Wyoming were found to be on cliffs (Avery et al. 1991) and only 17 of 305 nests located in Idaho were on cliffs (Kockert et al. 1984). Aside from rare examples of pairs using other raptor nests or tree cavities (Jones 1946) Peregrine Falcons in the southern Appalachians were obligate cliff users. Since the first nesting in the modern era in 1982, the known Virginia population has primarily nested on artificial structures including nesting towers, bridges, abandoned buildings, ships, and city office buildings (Watts 2006). Although pairs within the historic mountain range of the southern Appalachians may nest on bridges or buildings, this has never been documented and the population is expected to require cliff faces for breeding.

Given the distribution of historic breeding sites, the release of nearly 250 young falcons in the mountains, the growth of the population in coastal Virginia, and the recovery of breeding populations within the northern Appalachians, the near absence of Peregrines from the study area was surprising. Peregrines were observed on only 2 of 242 cliff surfaces surveyed with only a single breeding pair documented. This finding is consistent with a recent aerial survey of more than 20 historic peregrine eyries and high-quality sites in Virginia (Reynolds 2004). In 2003, Reynolds (2004) detected no birds on cliffs but located 3 sites that contained ledges or crevices with characteristic whitewash. Peregrines were not detected within any of these sites during this survey and the site located in the White Rocks complex was observed to have nesting Turkey Vultures. The lack of re-colonization within the historic range continues to be perplexing.

Close examination of sites where breeding falcons were documented during the 1920s and 1930s was informative. Many of these sites were in poor condition and did not meet general requirements for nesting. This observation is consistent with Gabler's (1983) analysis of historic sites in the early 1980s and Reynold's (2004) more recent observations. Many of these sites have been degraded by the encroachment of vegetation through secondary succession. Since the earlier part of the twentieth century, much of the study area and remaining southern Appalachians has experienced extensive secondary succession that followed broad-scale logging in the late 1800s and early 1900s. Regrowth of vegetation both on and below these sites has increasingly occluded the surfaces reducing their quality for nesting. This may help to explain the absence of birds at least for a portion of the historic eyries.

Beyond the historic eyries, rock surfaces located during the survey varied considerably in the extent to which they were occluded by vegetation. Scores of rock surfaces are likely present within the study area that were not mapped because they were completely occluded by vegetation. These surfaces may not have been detected from the aircraft or could not be assessed effectively. Vegetation occludes cliff surfaces in two ways including from plants growing on the surface or from the base. Surface occlusion is caused by either shrubs or herbaceous plants growing directly on the surface of the cliff. This form of occlusion is typically patchy leaving interspersed, open rock surfaces. When cliffs are shear this form of occlusion typically does not exceed 30% of the surface area. When cliffs are not completely shear or terraced, occlusion may be higher. Occlusion from the base occurs when trees grow up from the toe of the cliff high enough to screen the surface of the cliff. Occlusion from the base may be 100% for cliffs below 30 m in height because the common tree species within the area may grow to this height. However, occlusion is frequently less due to the young age of the trees or the stability of the cliff toe that supports the trees. Cliffs that are higher than 30 m are less and less influenced by vegetation because they exceed the maximum height of local tree species. A total of 97 (40%) of the surfaces mapped were estimated to be higher than 30 m with 13 (5.4%) exceeding 100 m. These larger rock surfaces will be stable through time since they will not be overtaken by vegetation. Many of these sites are prominent on the landscape and continue to provide the physical characteristics believed to be attractive to falcons.

Following his examination of historic eyries, Gabler (1983) concluded that human disturbance was the greatest factor causing sites to be unsuitable for nesting and eliminated nearly 40% of the sites from consideration as potential release sites on that basis. Although the assessment of human disturbance as a limitation on cliff use is beyond the scope of this investigation, it is clear that many of the most prominent rock formations within the study area are focal sites for recreational activities. During the short survey of Seneca Rocks within the North Fork Mountain area 158 individuals were distributed throughout the surface. While circling Old Rag Mountain 26 people were sitting on the summit alone. While flying past the best portion of White Rocks 4 rock climbers were repelling over the surface and a 4-wheel vehicle was driving along the crest. While flying along the endless wall portion of the New River Gorge, 8 people were repelling down from the crest. While flying around Massanutten Mountain 12 people were standing near Buzzard Rock. It remains unclear what if any impact this level of human use has on colonization of cliff sites by Peregrines within the study area. However, disturbance is a factor that should be considered in future management strategies.

Reintroduction efforts between 1985 and 1993 used a “shotgun” approach in an attempt to re-establish the historic population. Several locations were chosen for release sites based on access, elevation, and site characteristics and young falcons were released over a short period of time. The hope was that falcons would explore the region and establish territories in appropriate locations. However, many of the locations were isolated and not part of areas supporting concentrations of rock surfaces. In addition, most of the sites were used for only short periods of time. For example, of the 9 sites used in Virginia, 4 sites were only used for a single year, 2 sites were used for 2 years, 2 sites were used for 3 years, and 1 site was used for 5 years. Recent experience suggests that a more targeted hacking program may be more successful. The single known nesting pair in the mountains of Virginia is resident on Stony Man Mountain in Shenandoah National Park. This pair was established after the release of 41 birds over a 5-year period. This more focused approach of releasing falcons into a location specifically to establish a breeding pair in that location may be more viable within the southern Appalachians where suitable substrate is limited.

One of the benefits of the systematic approach used in this survey is the documentation that exposed rock surfaces are not evenly or randomly distributed throughout the study area. The survey allowed for the delineation of 6 geographic areas that have high concentrations of exposed rock surfaces. Each of these areas contains dominant rock formations that will not be degraded over time by vegetation and multiple surfaces that appear appropriate for nesting. Because of their qualities, these areas should represent priorities in the reintroduction, management, and monitoring of the Peregrine Falcon population. A new strategy of targeted management should be implemented in these areas. One of these areas, Shenandoah National Park has been the focus of ongoing management. In the spring of 2006, a new targeted hacking program was initiated in a second of the areas, the New River Gorge. Over the next decade, efforts should be made to re-establish nesting pairs within all 6 of these sites so that they may serve as “nuclear” areas for other areas within the southern Appalachians.

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Appendix I: Descriptions of cliff sites surveyed in 2005. Strata refers to the orientation of the strata forming the cliff face. Access refers to the availability of in-pockets and crevices that allow birds to have access into the cliff face for nesting.

Code	County	Topographic Quad	Length (m)	Height (m)	Occlusion (%)	Strata	Access
KY-BE-01	Bell County	Varilla	120	15	40	Horizontal	Poor
KY-HA-01	Harlan County	Ewing	990	30	25	Tilted	Good
KY-HA-02	Harlan County	Rose Hill	1640	20	40	Horizontal	Good
KY-HA-03	Harlan County	Hubbard Springs	1250	15	50	Vertical	Limited
KY-HA-04	Harlan County	Hubbard Springs	430	20	5	Horizontal	Good
KY-HA-05	Harlan County	Hubbard Springs/Evarts	360	15	20	Horizontal	Very Good
KY-HA-06	Harlan County	Hubbard Springs/Evarts	1710	15	5	Horizontal	Very Good
KY-HA-07	Harlan County	Hubbard Springs/Evarts	920	20	20	Horizontal	Very Good
KY-HA-08	Harlan County	Hubbard Springs	550	5	80	Horizontal	Good
KY-HA-09	Harlan County	Hubbard Springs	730	30	10	Horizontal	Good
KY-PI-01	Pike County	Elkhorn City	260	40	20	Horizontal	Limited
KY-PI-02	Pike County	Elkhorn City	90	20	40	Horizontal	Poor
KY-PI-03	Pike County	Elkhorn City	180	40	50	Horizontal	Very Good
VA-AG-01	Alleghany County	Jordan Mines	130	20	40	Tilted	Limited
VA-AG-02	Alleghany County	Longdale Furnace	670	10	40	Vertical	Poor
VA-AL-01	Albemarle County	Crimora	100	15	0	Horizontal	Poor
VA-AU-01	Augusta County	Crimora	120	15	70	Vertical	Limited
VA-AU-02	Augusta County	Crimora	100	15	65	Vertical	Poor
VA-AU-03	Augusta County	Crimora	80	15	25	Horizontal	Limited
VA-AU-04	Augusta County	Crimora	390	10	20	Horizontal	Good
VA-BO-01	Botetourt County	Strom	260	30	25	Horizontal	Limited
VA-BO-02	Botetourt County	Strom	370	20	75	Tilted	Limited
VA-CA-01	Carroll County	Austinville	100	20	35	None	Limited
VA-DI-01	Dickenson County	Elkhorn City	380	15	80	Horizontal	Very Good
VA-DI-02	Dickenson County	Elkhorn City	490	25	0	Horizontal	Limited
VA-DI-03	Dickenson County	Elkhorn City	450	50	70	Horizontal	Poor
VA-DI-04	Dickenson County	Elkhorn City	60	40	5	Horizontal	Poor
VA-DI-05	Dickenson County	Elkhorn City	60	20	0	Horizontal	Good
VA-DI-06	Dickenson County	Elkhorn City	1570	130	15	Horizontal	Very Good

Appendix I: -continued-

Code	County	Topographic Quad	Length (m)	Height (m)	Occlusion (%)	Strata	Access
VA-DI-07	Dickenson County	Elkhorn City	460	100	30	Horizontal	Good
VA-DI-08	Dickenson County	Elkhorn City	420	100	20	Horizontal	Very Good
VA-DI-09	Dickenson County	Elkhorn City	990	80	50	Horizontal	Good
VA-GI-01	Giles County	Peterstown	310	20	60	Horizontal	Very Good
VA-GI-02	Giles County	Peterstown	240	20	60	Horizontal	Good
VA-GI-03	Giles County	Pearisburg	160	50	50	Horizontal	Very Good
VA-GI-04	Giles County	Pearisburg	160	60	15	Horizontal	Very Good
VA-GI-05	Giles County	Pearisburg	1270	100	5	Horizontal	Good
VA-GI-06	Giles County	Pearisburg	320	35	75	Horizontal	Good
VA-GI-07	Giles County	Pearisburg	690	40	0	Horizontal	Limited
VA-GI-08	Giles County	Pearisburg	270	80	10	Horizontal	Very Good
VA-GI-09	Giles County	Pearisburg/Eggleston	420	80	10	Horizontal	Very Good
VA-GI-10	Giles County	Eggleston	200	80	10	Horizontal	Very Good
VA-GI-11	Giles County	Eggleston	370	70	10	Horizontal	Good
VA-GI-12	Giles County	Eggleston	50	40	20	Horizontal	Good
VA-GI-13	Giles County	Eggleston	70	50	40	Horizontal	Good
VA-GI-14	Giles County	Eggleston	90	30	50	Horizontal	Good
VA-GI-15	Giles County	Eggleston	110	100	40	Horizontal	Good
VA-GR-01	Grayson County	Whitetop Mountain	750	20	20	Vertical	Poor
VA-HI-01	Highland County	Snowy Mountain/Monterey	530	20	10	Tilted	Good
VA-HI-02	Highland County	Monterey	640	20	10	Tilted	Good
VA-HI-03	Highland County	Doe Hill	110	15	30	Horizontal	Limited
VA-LE-01	Lee County	Middlesboro South	40	15	80	Horizontal	Limited
VA-LE-02	Lee County	Varilla	1690	20	40	Horizontal	Very Good
VA-LE-03	Lee County	Varilla	1430	15	40	Tilted	Limited
VA-LE-04	Lee County	Varilla	1670	15	40	Tilted	Limited
VA-LE-05	Lee County	Ewing	4170	45	5	Horizontal	Very Good
VA-LE-06	Lee County	Ewing	680	45	0	Tilted	Good
VA-LE-07	Lee County	Hubbard Springs	1040	25	70	Horizontal	Limited
VA-LE-08	Lee County	Hubbard Springs	830	30	85	Horizontal	Limited
VA-LE-09	Lee County	Ben Hur	80	15	0	None	Poor
VA-LE-10	Lee County	Pennington Gap	420	25	5	Vertical	Poor

Appendix I: -continued-

Code	County	Topographic Quad	Length (m)	Height (m)	Occlusion (%)	Strata	Access
VA-LE-11	Lee County	Pennington Gap	320	25	5	Vertical	Poor
VA-LE-12	Lee County	Keokee	50	10	20	Vertical	Poor
VA-LE-13	Lee County	Keokee	260	25	35	Horizontal	Good
VA-LE-14	Lee County	Keokee	180	20	40	Horizontal	Limited
VA-LE-15	Lee County	Middlesboro South	480	30	30	Horizontal	Limited
VA-MD-01	Madison County	Old Rag Mountain	790	30	30	Horizontal	Limited
VA-MD-02	Madison County	Big Meadows	130	20	5	Horizontal	Limited
VA-MD-03	Madison County	Big Meadows	470	30	20	Horizontal	Limited
VA-PA-01	Page County	Old Rag Mountain	380	50	15	Horizontal	Good
VA-PA-02	Page County	Old Rag Mountain	330	40	20	Horizontal	Good
VA-PA-03	Page County	Big Meadows	310	50	50	Horizontal	Limited
VA-PA-04	Page County	Tenth Legion	280	60	50	Horizontal	Very Good
VA-PA-05	Page County	Tenth Legion	90	40	50	Horizontal	Good
VA-PA-06	Page County	Tenth Legion	100	30	80	Horizontal	Good
VA-PA-07	Page County	Hamburg	940	20	50	Horizontal	Good
VA-PA-08	Page County	Hamburg	1670	40	80	Horizontal	Very Good
VA-PA-09	Page County	Luray	210	50	80	Vertical	Limited
VA-PA-10	Page County	Rileyville	60	40	5	Vertical	Poor
VA-RB-01	Rockbridge County	Collierstown	330	15	80	Horizontal	Very Good
VA-RB-02	Rockbridge County	Collierstown	210	30	20	Horizontal	Very Good
VA-RB-03	Rockbridge County	Goshen	160	45	15	Horizontal	Very Good
VA-RH-01	Rockingham County	Harrisonburg	490	40	30	Horizontal	Very Good
VA-RH-02	Rockingham County	Elkton West	60	25	15	Vertical	Limited
VA-RH-03	Rockingham County	Elkton West	100	20	50	Vertical	Poor
VA-RH-04	Rockingham County	McGaheysville	120	20	10	Vertical	Limited
VA-RH-05	Rockingham County	McGaheysville	120	20	20	Vertical	Poor
VA-RH-06	Rockingham County	McGaheysville	80	40	40	Vertical	Poor
VA-RH-07	Rockingham County	McGaheysville	460	10	70	Vertical	Limited
VA-RH-08	Rockingham County	McGaheysville	150	30	5	Horizontal	Good
VA-RH-09	Rockingham County	McGaheysville	180	20	40	Horizontal	Very Good
VA-RH-10	Rockingham County	McGaheysville	70	20	15	Horizontal	Very Good
VA-RH-11	Rockingham County	McGaheysville	110	20	15	Horizontal	Very Good

Appendix I: -continued-

Code	County	Topographic Quad	Length (m)	Height (m)	Occlusion (%)	Strata	Access
VA-RH-12	Rockingham County	McGaheysville	100	20	30	Horizontal	Very Good
VA-RH-13	Rockingham County	McGaheysville	220	50	50	Vertical	Limited
VA-RH-14	Rockingham County	McGaheysville	110	15	30	Horizontal	Good
VA-RH-15	Rockingham County	McGaheysville	100	25	15	Horizontal	Good
VA-RH-16	Rockingham County	McGaheysville	80	40	15	Horizontal	Good
VA-RH-17	Rockingham County	Grottoes	120	15	30	Vertical	Limited
VA-RH-18	Rockingham County	Crimora	140	15	20	Vertical	Limited
VA-RH-19	Rockingham County	Grottoes	800	20	30	Vertical	Limited
VA-RH-20	Rockingham County	Crimora	60	30	30	Vertical	Limited
VA-RP-01	Rappahannock County	Thornton Gap	180	15	15	Vertical	Limited
VA-RP-02	Rappahannock County	Thornton Gap	100	10	50	Horizontal	Limited
VA-RP-03	Rappahannock County	Thornton Gap	460	10	75	Horizontal	Poor
VA-RP-04	Rappahannock County	Thornton Gap	100	35	0	Horizontal	Poor
VA-RP-05	Rappahannock County	Thornton Gap	380	35	15	Horizontal	Good
VA-RP-06	Rappahannock County	Chester Gap	200	40	40	Horizontal	Limited
VA-RP-07	Rappahannock County	Chester Gap	120	20	25	Horizontal	Good
VA-RP-08	Rappahannock County	Chester Gap	80	29	35	Horizontal	Good
VA-RU-01	Russell County	Hansonville	50	20	10	Horizontal	Poor
VA-RU-02	Russell County	Hansonville	50	20	5	Horizontal	Limited
VA-RU-03	Russell County	Saltville	150	20	25	Horizontal	Very Good
VA-RU-04	Russell County	Richlands/Honaker/Elk Gd	1660	25	40	Tilted	Good
VA-SC-01	Scott County	Dungannon	810	30	30	Horizontal	Limited
VA-SC-02	Scott County	East Stone Gap	270	40	35	Horizontal	Good
VA-SH-01	Shenandoah County	Tenth Legion	460	30	30	Horizontal	Good
VA-SH-02	Shenandoah County	Edinburg	320	20	30	Tilted	Good
VA-SH-03	Shenandoah County	Hamburg	800	30	40	Horizontal	Good
VA-SM-01	Smyth County	Saltville	230	30	0	Horizontal	Very Good
VA-SM-02	Smyth County	Saltville	210	20	75	Horizontal	Limited
VA-SM-03	Smyth County	Broadford	460	25	75	Horizontal	Limited
VA-TA-01	Tazewell County	Tiptop	1070	30	25	Horizontal	Good
VA-TA-02	Tazewell County	Hutchinson Rock	440	15	70	Tilted	Limited
VA-TA-03	Tazewell County	Hutchinson Rock	40	30	15	Horizontal	Poor

Appendix I: -continued-

Code	County	Topographic Quad	Length (m)	Height (m)	Occlusion (%)	Strata	Access
VA-TA-04	Tazewell County	Hutchinson Rock	110	15	5	Horizontal	Poor
VA-TA-05	Tazewell County	Saltville	1220	25	35	Horizontal	Good
VA-TA-06	Tazewell County	Pounding Mill	700	40	20	Tilted	Good
VA-TA-07	Tazewell County	Tazewell South	3040	30	0	Horizontal	Good
VA-TA-08	Tazewell County	Pounding Mill	1380	30	20	Horizontal	Good
VA-TA-09	Tazewell County	Tazewell South	280	10	45	Horizontal	Limited
VA-TA-10	Tazewell County	Tazewell South	300	30	25	Horizontal	Limited
VA-WA-01	Washington County	Mendota	40	10	20	Horizontal	Poor
VA-WA-02	Washington County	Brumley	120	25	30	Horizontal	Good
VA-WA-03	Washington County	Brumley	180	20	15	Horizontal	Very Good
VA-WA-04	Washington County	Brumley	60	20	0	Horizontal	Very Good
VA-WA-05	Washington County	Brumley	110	20	40	Horizontal	Very Good
VA-WA-06	Washington County	Brumley	150	30	50	Horizontal	Good
VA-WA-07	Washington County	Saltville	20	10	0	Horizontal	Good
VA-WA-08	Washington County	Saltville	110	20	50	Horizontal	Good
VA-WI-01	Wise County	Big Stone Gap	840	15	90	Horizontal	Limited
VA-WR-01	Warren County	Chester Gap	90	30	25	Horizontal	Good
VA-WR-02	Warren County	Strasburg	280	40	30	Tilted	Limited
VA-WR-03	Warren County	Strasburg	200	40	30	Horizontal	Limited
VA-WY-01	Wythe County	Wytheville	90	100	80	Vertical	Poor
WV-FA-01	Fayette County	Gauley Bridge	440	40	70	Horizontal	Very Good
WV-FA-02	Fayette County	Gauley Bridge	90	30	0	Horizontal	Limited
WV-FA-03	Fayette County	Gauley Bridge	130	40	50	Horizontal	Very Good
WV-FA-04	Fayette County	Beckwith	200	30	60	Horizontal	Very Good
WV-FA-05	Fayette County	Beckwith	360	30	70	Horizontal	Very Good
WV-FA-06	Fayette County	Beckwith	100	40	20	Horizontal	Very Good
WV-FA-07	Fayette County	Fayetteville	160	50	50	Horizontal	Good
WV-FA-08	Fayette County	Fayetteville	210	20	80	Horizontal	Limited
WV-FA-09	Fayette County	Fayetteville	110	25	50	Horizontal	Poor
WV-FA-10	Fayette County	Fayetteville	2970	30	40	Horizontal	Limited
WV-FA-11	Fayette County	Fayetteville	1480	40	40	Horizontal	Good
WV-FA-12	Fayette County	Fayetteville	2440	20	80	Horizontal	Limited

Appendix I: -continued-

Code	County	Topographic Quad	Length (m)	Height (m)	Occlusion (%)	Strata	Access
WV-FA-13	Fayette County	Fayetteville	2020	30	70	Horizontal	Good
WV-FA-14	Fayette County	Fayetteville	190	50	40	Horizontal	Limited
WV-FA-15	Fayette County	Fayetteville	2540	50	40	Horizontal	Very Good
WV-FA-16	Fayette County	Thurmond	30	25	70	Horizontal	Good
WV-FA-17	Fayette County	Thurmond	110	25	80	Horizontal	Good
WV-FA-18	Fayette County	Thurmond	340	35	90	Horizontal	Limited
WV-FA-19	Fayette County	Thurmond	70	15	0	Horizontal	Limited
WV-FA-20	Fayette County	Thurmond	30	60	25	Horizontal	Poor
WV-FA-21	Fayette County	Thurmond	40	30	20	Horizontal	Good
WV-FA-22	Fayette County	Thurmond	180	20	75	Horizontal	Good
WV-FA-23	Fayette County	Prince	480	30	75	Horizontal	Limited
WV-FA-24	Fayette County	Prince	150	35	70	Horizontal	Good
WV-FA-25	Fayette County	Prince	270	30	40	Horizontal	Limited
WV-GR-01	Grant County	Hopeville	80	50	20	Vertical	Poor
WV-GR-02	Grant County	Hopeville	180	50	70	Vertical	Poor
WV-GR-03	Grant County	Hopeville	200	30	20	Vertical	Poor
WV-GR-04	Grant County	Hopeville	340	100	10	Horizontal	Poor
WV-GR-05	Grant County	Hopeville	70	30	15	Horizontal	Limited
WV-GR-06	Grant County	Hopeville	80	30	0	Vertical	Limited
WV-GR-07	Grant County	Hopeville	510	50	60	Vertical	Limited
WV-GR-08	Grant County	Maysville	930	30	10	Horizontal	Limited
WV-GR-09	Grant County	Maysville	110	10	50	Horizontal	Good
WV-GR-10	Grant County	Greenland Gap	1670	40	15	Horizontal	Limited
WV-GR-11	Grant County	Greenland Gap	1110	40	15	Vertical	Limited
WV-GR-12	Grant County	Medley	280	15	0	Horizontal	Good
WV-GR-13	Grant County	Petersburg West	1100	80	0	Horizontal	Limited
WV-GR-14	Grant County	Hopeville/Petersburg West	2520	50	10	Horizontal	Limited
WV-GR-15	Grant County	Hopeville	150	10	30	Tilted	Limited
WV-GR-16	Grant County	Hopeville	430	20	40	Horizontal	Poor
WV-GR-17	Grant County	Hopeville	670	50	10	Horizontal	Good
WV-GR-18	Grant County	Hopeville	2280	70	10	Horizontal	Very Good
WV-GR-19	Grant County	Petersburg West	610	40	5	Vertical	Limited

Appendix I: -continued-

Code	County	Topographic Quad	Length (m)	Height (m)	Occlusion (%)	Strata	Access
WV-GR-20	Grant County	Petersburg West	70	30	15	Tilted	Good
WV-GR-21	Grant County	Petersburg West	70	100	0	Horizontal	Poor
WV-GR-22	Grant County	Petersburg West	60	70	10	Horizontal	Good
WV-GR-23	Grant County	Petersburg West	1040	70	10	Horizontal	Poor
WV-GR-24	Grant County	Petersburg West	290	20	70	Horizontal	Good
WV-GR-25	Grant County	Petersburg East	2050	35	20	Horizontal	Good
WV-HA-01	Hardy County	Petersburg East	210	35	15	Horizontal	Good
WV-HA-02	Hardy County	Petersburg East	670	65	15	Horizontal	Good
WV-HA-03	Hardy County	Wolf Gap	470	30	40	Horizontal	Very Good
WV-HA-04	Hardy County	Wolf Gap	410	25	25	Tilted	Good
WV-HA-05	Hardy County	Lost City	500	25	85	Tilted	Limited
WV-HA-06	Hardy County	Lost City	180	15	10	Horizontal	Poor
WV-NI-01	Nicholas County	Mount Nebo	1970	15	5	Horizontal	Good
WV-NI-02	Nicholas County	Mount Nebo	1500	15	0	Horizontal	Good
WV-NI-03	Nicholas County	Mount Nebo	1310	15	0	Horizontal	Good
WV-NI-04	Nicholas County	Mount Nebo	380	20	0	Horizontal	Good
WV-NI-05	Nicholas County	Mount Nebo	260	15	5	Horizontal	Good
WV-PE-01	Pendleton County	Circleville	1750	100	0	Vertical	Poor
WV-PE-02	Pendleton County	Circleville	1190	100	0	Vertical	Poor
WV-PE-03	Pendleton County	Onego	660	100	70	Vertical	Poor
WV-PE-04	Pendleton County	Onego	220	50	10	Vertical	Limited
WV-PE-05	Pendleton County	Onego	310	50	80	Vertical	Poor
WV-PE-06	Pendleton County	Upper Tract	370	259	10	Vertical	Poor
WV-PE-07	Pendleton County	Upper Tract	150	90	70	Vertical	Poor
WV-PE-08	Pendleton County	Upper Tract	880	40	0	Horizontal	Limited
WV-PE-09	Pendleton County	Upper Tract	230	20	0	Horizontal	Good
WV-PE-10	Pendleton County	Upper Tract	190	30	20	Horizontal	Good
WV-PE-11	Pendleton County	Hopeville	1350	150	0	Vertical	Limited
WV-PE-12	Pendleton County	Hopeville	150	50	20	Vertical	Poor
WV-PE-13	Pendleton County	Hopeville	420	30	50	Horizontal	Limited
WV-PE-14	Pendleton County	Hopeville	90	10	20	Horizontal	Limited
WV-PE-15	Pendleton County	Hopeville	1070	20	65	Tilted	Limited

Appendix I: -continued-

Code	County	Topographic Quad	Length (m)	Height (m)	Occlusion (%)	Strata	Access
WV-PE-16	Pendleton County	Upper Tract	340	50	20	Horizontal	Limited
WV-PE-17	Pendleton County	Upper Tract	240	70	10	Horizontal	Limited
WV-PE-18	Pendleton County	Upper Tract	180	40	0	Horizontal	Very Good
WV-PE-19	Pendleton County	Upper Tract	650	30	15	Horizontal	Very Good
WV-PE-20	Pendleton County	Franklin	420	35	15	Horizontal	Good
WV-PE-21	Pendleton County	Moatstown	170	10	70	Tilted	Limited
WV-PE-22	Pendleton County	Moatstown	30	20	5	Horizontal	Poor
WV-PE-23	Pendleton County	Moatstown	260	30	20	Horizontal	Limited
WV-PE-24	Pendleton County	Moatstown	290	30	20	Horizontal	Limited
WV-PE-25	Pendleton County	Moatstown	740	35	15	Horizontal	Good
WV-PE-26	Pendleton County	Circleville	790	30	15	Horizontal	Good
WV-PE-27	Pendleton County	Circleville	400	20	65	Tilted	Good
WV-PE-28	Pendleton County	Snowy Mountain	580	35	25	Horizontal	Poor
WV-PE-29	Pendleton County	Snowy Mountain/Moatstown	1980	15	70	Horizontal	Poor
WV-RA-01	Raleigh County	Prince	360	50	85	Horizontal	Good
WV-RA-02	Raleigh County	Prince	50	50	15	Horizontal	Good
WV-SU-01	Summers County	Meadow Creek	60	15	80	Horizontal	Limited
WV-SU-02	Summers County	Pipestem	350	20	70	Horizontal	Very Good
WV-SU-03	Summers County	Lerona	640	20	80	Horizontal	Very Good
WV-TU-01	Tucker County	Mozark Mountain	140	10	40	None	Poor
WV-TU-02	Tucker County	Blackwater Falls	180	10	0	None	Poor

Appendix II: Summary of bird observations during cliff surveys. Alpha codes are TUVA – Turkey Vulture, BLVU – Black Vulture, CORA – Common Raven, PEFA – Peregrine Falcon, RTHA – Red-tailed Hawk, BAEA – Bald Eagle, RSHA – Red-shouldered Hawk, SSHA – Sharp-shinned Hawk, BWHA – Broad-winged Hawk, GHOW – Great Horned Owl, and RODO – Rock Dove. Numbers refer to individuals observed on cliffs. A number with an "n" refers to 1 or more active nests.

Code	County	TUVU	BLVU	CORA	PEFA	RTHA	BAEA	RSHA	SSHA	BWHA	GHOW	RODO
WV-GR-12	Grant County	4		1n								
WV-GR-09	Grant County			1n								
WV-GR-17	Grant County											
WV-GR-22	Grant County			1n								
WV-GR-24	Grant County											
WV-GR-25	Grant County	15		5, 1n								
WV-HA-02	Hardy County											
WV-HA-01	Hardy County	8										
VA-SH-01	Shenandoah County	3		1n								
VA-SH-03	Shenandoah County	12		1n								
VA-WR-01	Warren County	3										
WV-PE-10	Pendleton County					1						
WV-PE-09	Pendleton County			1n								
WV-PE-26	Pendleton County											
WV-PE-25	Pendleton County			1n								
WV-PE-20	Pendleton County	2										
VA-RP-07	Rappahannock County	3										
VA-RP-08	Rappahannock County											
VA-RP-05	Rappahannock County	8										
VA-RH-16	Rockingham County	3										
VA-RH-15	Rockingham County											
VA-RH-14	Rockingham County	10										
VA-RH-08	Rockingham County			1n								
VA-PA-05	Page County	3										
VA-PA-06	Page County	4										
VA-PA-07	Page County	12										
VA-PA-01	Page County											
VA-PA-02	Page County											

Appendix II: -continued-

Code	County	TUVU	BLVU	CORA	PEFA	RTHA	BAEA	RSHA	SSHA	BWHA	GHOW	RODO
WV-NI-03	Nicholas County											
WV-NI-02	Nicholas County											
WV-NI-01	Nicholas County											
WV-NI-04	Nicholas County											
WV-NI-05	Nicholas County											
VA-AU-04	Augusta County											
WV-FA-07	Fayette County											
WV-FA-11	Fayette County	5		2n								
WV-FA-13	Fayette County	4										
WV-FA-16	Fayette County											
WV-FA-17	Fayette County											
WV-FA-21	Fayette County	1										
WV-FA-22	Fayette County	4										
WV-FA-24	Fayette County	2										
WV-RA-01	Raleigh County			1n								
WV-RA-02	Raleigh County							2				
VA-GI-02	Giles County	5										
VA-GI-05	Giles County	3				1						
VA-GI-06	Giles County	2										
VA-GI-11	Giles County											
VA-GI-12	Giles County											
VA-GI-13	Giles County			1n								
VA-GI-14	Giles County											
VA-GI-15	Giles County	2										
VA-TA-05	Tazewell County	6										4
VA-TA-07	Tazewell County	40	20									
VA-TA-08	Tazewell County	10, 1n										
VA-TA-01	Tazewell County											
VA-DI-05	Dickenson County											
VA-DI-07	Dickenson County			1n								
VA-DI-09	Dickenson County											
KY-HA-02	Harlan County	12										

Appendix II: -continued-

Code	County	TUVU	BLVU	CORA	PEFA	RTHA	BAEA	RSHA	SSHA	BWHA	GHOW	RODO
KY-HA-04	Harlan County			1n								
KY-HA-08	Harlan County											
KY-HA-09	Harlan County	3										
VA-WA-06	Washington County			1n								
VA-WA-02	Washington County											
VA-WA-07	Washington County	3										
VA-WA-08	Washington County			1n								
VA-LE-13	Lee County	3										
VA-SC-02	Scott County											
WV-GR-10	Grant County	4	2									4
WV-GR-08	Grant County											
WV-GR-13	Grant County	12	3									
WV-GR-14	Grant County	20			1	1						
WV-GR-05	Grant County						1					
VA-WR-03	Warren County											
WV-PE-13	Pendleton County	2		1n								
WV-PE-14	Pendleton County	2										
WV-PE-17	Pendleton County	3										
WV-PE-08	Pendleton County			2n								
WV-PE-16	Pendleton County	4										
WV-PE-24	Pendleton County											
WV-PE-23	Pendleton County											4
VA-RP-06	Rappahannock County	8										
VA-RP-02	Rappahannock County	8		1n				1				
VA-PA-03	Page County	4										
VA-MD-02	Madison County											
VA-MD-03	Madison County											
VA-MD-01	Madison County											
VA-HI-03	Highland County	3										
VA-AU-03	Augusta County											
WV-FA-02	Fayette County											
WV-FA-08	Fayette County	3										

Appendix II: -continued-

Code	County	TUVU	BLVU	CORA	PEFA	RTHA	BAEA	RSHA	SSHA	BWHA	GHOW	RODO
WV-FA-10	Fayette County			1n								
WV-FA-12	Fayette County											
WV-FA-14	Fayette County											
WV-FA-18	Fayette County	36						2	1			
WV-FA-19	Fayette County							1				
WV-FA-23	Fayette County	2						1				
WV-FA-25	Fayette County	6										
WV-SU-01	Summers County		2			1						
VA-BO-01	Botetourt County											
KY-PI-01	Pike County											
VA-GI-07	Giles County											
VA-TA-09	Tazewell County	15										
VA-TA-10	Tazewell County	25										
VA-DI-02	Dickenson County	2										
VA-WI-01	Wise County											
VA-RU-02	Russell County	4										
VA-SM-02	Smyth County											
VA-LE-01	Lee County											
VA-LE-07	Lee County	3										
VA-LE-08	Lee County	2										
VA-LE-14	Lee County											
VA-SC-01	Scott County	4		1n								
VA-SM-03	Smyth County			1n								
VA-LE-15	Lee County											
WV-GR-04	Grant County											
WV-GR-16	Grant County		2	1n								
WV-GR-21	Grant County											
WV-GR-23	Grant County											
WV-HA-06	Hardy County	4										
WV-PE-22	Pendleton County											
WV-PE-29	Pendleton County	4				1						
WV-PE-28	Pendleton County	2								1		

Appendix II: -continued-

Code	County	TUVU	BLVU	CORA	PEFA	RTHA	BAEA	RSHA	SSHA	BWHA	GHOW	RODO
VA-RP-04	Rappahannock County											
VA-RP-03	Rappahannock County	4										
VA-AL-01	Albemarle County											
WV-FA-09	Fayette County	2										
WV-FA-20	Fayette County											
KY-PI-02	Pike County											
VA-TA-03	Tazewell County											
VA-TA-04	Tazewell County	2										
VA-DI-04	Dickenson County											
VA-DI-03	Dickenson County	3										
VA-RU-01	Russell County					1						
KY-BE-01	Bell County											
VA-WA-01	Washington County	20										
WV-GR-18	Grant County											
WV-HA-03	Hardy County											
WV-PE-18	Pendleton County	8				1						
WV-PE-19	Pendleton County	10										
VA-RH-09	Rockingham County											
VA-RH-10	Rockingham County	4										
VA-RH-11	Rockingham County	4										
VA-RH-12	Rockingham County	3										
VA-RH-01	Rockingham County	15										
VA-PA-04	Page County	14		3, 1n								
VA-PA-08	Page County	8										
WV-FA-01	Fayette County	3										
WV-FA-03	Fayette County	2										
WV-FA-04	Fayette County	4										
WV-FA-05	Fayette County	24										
WV-FA-06	Fayette County	14										
WV-FA-15	Fayette County	12		2n								
VA-RB-01	Rockbridge County	2	1									
VA-RB-02	Rockbridge County	4	2									

Appendix II: -continued-

Code	County	TUVU	BLVU	CORA	PEFA	RTHA	BAEA	RSHA	SSHA	BWHA	GHOW	RODO
VA-RB-03	Rockbridge County	3										
WV-SU-02	Summers County											
WV-SU-03	Summers County											
KY-PI-03	Pike County											
VA-GI-01	Giles County											
VA-GI-03	Giles County	3										
VA-GI-04	Giles County											
VA-GI-08	Giles County	8									1n	
VA-GI-09	Giles County											
VA-GI-10	Giles County	4										
VA-DI-06	Dickenson County	5		1n								
VA-DI-01	Dickenson County	4										
VA-DI-08	Dickenson County											
VA-RU-03	Russell County											
KY-HA-05	Harlan County	4										
KY-HA-06	Harlan County	2										
KY-HA-07	Harlan County											
VA-SM-01	Smyth County											
VA-WA-03	Washington County											
VA-WA-04	Washington County			1n								
VA-WA-05	Washington County											
VA-LE-02	Lee County											
VA-LE-05	Lee County	15, 1n										
WV-GR-11	Grant County											
WV-GR-06	Grant County	4										
VA-GR-01	Grayson County	3										
VA-CA-01	Carroll County	2										
WV-TU-01	Tucker County											
WV-TU-02	Tucker County	14		1n								
VA-LE-09	Lee County											
WV-GR-20	Grant County					1						
WV-HA-04	Hardy County	4										

Appendix II: -continued-

Code	County	TUVU	BLVU	CORA	PEFA	RTHA	BAEA	RSHA	SSHA	BWHA	GHOW	RODO
VA-SH-02	Shenandoah County	15										
WV-PE-27	Pendleton County	5										
VA-HI-01	Highland County	5										
VA-HI-02	Highland County											
VA-TA-06	Tazewell County	5										
VA-RU-04	Russell County	5										
KY-HA-01	Harlan County	4		1n								
VA-LE-06	Lee County	5										
WV-GR-15	Grant County											
WV-HA-05	Hardy County	3				1						
VA-WR-02	Warren County											
WV-PE-15	Pendleton County	4										
WV-PE-21	Pendleton County											
VA-AG-01	Alleghany County	1										
VA-BO-02	Botetourt County	4										
VA-TA-02	Tazewell County											
VA-LE-03	Lee County											
VA-LE-04	Lee County											
WV-GR-07	Grant County	6										
WV-GR-19	Grant County											
WV-PE-11	Pendleton County	6		1n		1						4
WV-PE-04	Pendleton County						1					
VA-RP-01	Rappahannock County	14		1n								
VA-RH-20	Rockingham County	10	28									
VA-RH-18	Rockingham County	22										
VA-RH-19	Rockingham County											
VA-RH-17	Rockingham County	4										
VA-RH-13	Rockingham County											
VA-RH-07	Rockingham County											
VA-RH-04	Rockingham County	4										
VA-RH-02	Rockingham County	3										
VA-PA-09	Page County											

Appendix II: -continued-

Code	**County**	**TUVU**	**BLVU**	**CORA**	**PEFA**	**RTHA**	**BAEA**	**RSHA**	**SSHA**	**BWHA**	**GHOW**	**RODO**
VA-AU-01	Augusta County											
KY-HA-03	Harlan County	2		1n								
WV-GR-03	Grant County											
WV-GR-02	Grant County	6										
WV-GR-01	Grant County											
WV-PE-12	Pendleton County	8										
WV-PE-07	Pendleton County	8										
WV-PE-06	Pendleton County											
WV-PE-05	Pendleton County	3										
WV-PE-03	Pendleton County	5				1n						
WV-PE-02	Pendleton County	15										
WV-PE-01	Pendleton County	12										14
VA-RH-06	Rockingham County											
VA-RH-05	Rockingham County	8										
VA-RH-03	Rockingham County	6										
VA-PA-10	Page County											
VA-AU-02	Augusta County	4										
VA-AG-02	Alleghany County	2										
VA-WY-01	Wythe County											
VA-LE-10	Lee County	5										
VA-LE-11	Lee County											
VA-LE-12	Lee County											