J. Field Ornithol. 86(4):337–344, 2015 DOI: 10.1111/jofo.12127

Wintering Golden Eagles on the coastal plain of South Carolina

Mark Vukovich,[1,4] Kelsey L. Turner,[2] Tracy E. Grazia,[3] Thomas Mims,[3] James C. Beasley,[2] and John C. Kilgo[1]

[1] *U.S.D.A. Forest Service, Southern Research Station, P. O. Box 700, New Ellenton, South Carolina 29809, USA*
[2] *Savannah River Ecology Laboratory, Warnell School of Forestry and Natural Resources, University of Georgia, P. O. Box Drawer E, Aiken, South Carolina 29802, USA*
[3] *U.S.D.A. Forest Service, Savannah River, P. O. Box 700, New Ellenton, South Carolina 29809, USA*

Received 22 June 2015; accepted 25 September 2015

ABSTRACT. Golden Eagles (*Aquila chrysaetos*) are rare winter residents in eastern North America, with most found along the Appalachian Mountains and few reported on the coastal plain of the Carolinas. We used remote cameras baited with wild pig (*Sus scrofa*) and white-tailed deer (*Odocoileus virginianus*) carcasses to detect, age, and individually identify Golden Eagles on the U.S. Department of Energy's Savannah River Site on the coastal plain of South Carolina. We identified eight individual Golden Eagles during the winters of 2013–2014 and 2014–2015, with one detected during both winters. We detected eagles for 19 and 66 calendar days during the winters of 2013–2014 and 2014–2015, respectively, with two adult eagles detected for 30 and 31 calendar days in 2014–2015. Eagles typically scavenged on carcasses for a few days, left, and then returned when cameras were baited with another carcass, suggesting they had remained in the area. These observations suggest that large tracts of forests on the coastal plain may be important wintering areas for some Golden Eagles and, further, that other areas in the coastal plain of the southeastern United States may also harbor wintering eagles. Identification of wintering areas of Golden Eagles in the east will be an important step in the conservation of this protected species, and camera traps baited with carcasses can be an effective tool for such work.

RESUMEN. **Invernada de *Aquila chrysaetos* en la llanura costera de Carolina del Sur**
El águila *Aquila chrysaetos* es un residente invernal rara en el este de América del Norte, donde la mayoría se encuentra a lo largo de las montañas Apalaches y pocos han informado sobre su presencia en la llanura costera de las Carolinas. Utilizamos cámaras remotas cebadas con cerdos salvajes (*Sus scrofa*) y venado de cola blanca (*Odocoileus virginianus*) carcasas para detectar, edad, e identificar individuos de *A. chrysaetos* en el Departamento de Energía de Savannah River Site (SRS) de Estados Unidos en la llanura costera de Carolina del Sur. Se identificaron ocho individuos de *A. chrysaetos* durante los inviernos de 2013–2014 y 2014–2015 con uno detectado en ambos inviernos. Detectamos águilas durante 19 y 66 días durante los inviernos de 2013–2014 y 2014–2015, respectivamente, con dos águilas adultas detectadas durante 30 y 31 días en 2014–2015. Las águilas normalmente limpian las carcasas en los canales durante unos días, se fueron, y luego regresaron cuando las cámaras se volvieron a cebar con otra carcasa, lo que sugiere que habían permanecido en la zona. Estas observaciones sugieren que grandes extensiones de bosques de la llanura costera pueden ser áreas invernales importantes para algunos individuos de *A. chrysaetos*, además, otras zonas de la llanura costera del sureste de los Estados Unidos también pueden albergar águilas invernantes. Identificación de las áreas invernales de *A. chrysaetos* en el este será un paso importante en la conservación de esta especie protegida y cámaras trampa con cebo con cadáveres puede ser una herramienta eficaz para este tipo de trabajo.

Key words: Aquila chrysaetos, camera trap, carcass, open pine forest, southeast, wild pig

Golden Eagles are rare winter residents in eastern North America, with most occurring at higher elevations along the Appalachian Mountains and others at lower elevations elsewhere (Millsap and Vana 1984, Dennhardt et al. 2015). Golden Eagles in the east are highly migratory and migrant populations have recently been estimated at 5000 individuals along the Appalachian migration corridor (Dennhardt et al. 2015). Little is known about the winter ecology of Golden Eagles in the east (Katzner et al. 2012, Dennhardt et al. 2015), but recently developed technologies have enhanced our ability to address this information gap. For example, satellite telemetry suggests that Golden Eagles use forested areas more frequently in the east than in western North America (Miller 2012). In addition, camera traps baited with deer carcasses

[4]Corresponding author. Email: mvukovich@fs.fed.us

have become important tools in determining the distribution, natural history, and migration phenology of Golden Eagles (Katzner et al. 2012, 2015, Jachowski et al. 2015). Although camera-trap data suggest that wintering populations may be highest in the north-central Appalachian Mountains of Pennsylvania, West Virginia, and Virginia (Katzner et al. 2012), few bait stations have been established in the southeastern United States.

Observers have reported occasional sightings of Golden Eagles during the winter along the coastal plain of the Carolinas, Georgia, Florida, and Alabama (Sprunt and Chamberlain 1949, Burleigh 1958, Imhof 1962, Mayer et al. 1985, Sullivan et al. 2009), but most reports provide no information about habitats used by wintering eagles. Katzner et al. (2012) suggested that some Golden Eagles, particularly pre-adults, winter on the coastal plain of the Carolinas, and possibly south along the Atlantic Coast into Florida. However, the last comprehensive survey of Golden Eagles in the southeastern United States was over 30 yr ago and only four eagles were recorded in South Carolina during that survey (Millsap and Vana 1984). Additional information is clearly needed concerning the status and characteristics of the wintering population of Golden Eagles in the southeastern United States. Using camera traps baited with carcasses, our objective was to document the presence, number, and ages of Golden Eagles wintering on the U.S. Department of Energy's Savannah River Site (SRS) in the Upper Coastal Plain of South Carolina and to describe the habitats where they were detected.

METHODS

The SRS is a 78,000-ha National Environmental Research Park in Aiken and Barnwell counties, South Carolina. Located in the Upper Coastal Plain and Sandhills physiographic province, the SRS is 30 km south of the Piedmont Plateau. Loblolly (*Pinus taeda*) and longleaf pine (*Pinus palustris*) forests dominate upland sites and are managed on 50-yr rotations, except for 34,831 ha managed for endangered Red-cockaded Woodpeckers (*Picoides borealis*) where the two pine species are managed on 100- or 120-yr rotations, respectively. Woodpecker habitat management resulted in mature, open-canopy pine forest maintained by frequent prescribed fire (Johnston 2005). Other portions of the SRS were burned less frequently. Bottomland hardwood and bald cypress (*Taxodium distichum*)—tupelo (*Nyssa aquatic*) forests dominate floodplains of the Savannah River and major tributaries.

On 4 and 14 December 2013, we observed and photographed an adult Golden Eagle soaring low over the northeastern portion of the SRS. On 28 December 2013, we deployed a camera trap baited with a white-tailed deer (*Odocoileus virginianus*) carcass (camera trap EC1, where EC is eagle camera) in that area. Over the remainder of winter 2013–2014 and during winter 2014–2015, we documented eagles feeding on carcasses at additional camera traps. We included data obtained from three camera traps (one used in both 2013–2014 and 2014–2015, two used only in 2014–2015) deployed specifically to detect eagles (ECs) and also obtained data from 45 camera traps (during 2013–2014) deployed as part of a separate study investigating vertebrate scavenging ecology (hereafter, scavenging cameras or SCs). Besides EC1, one EC was deployed in a field and one in a mature pine forest, and SCs were deployed in clearcuts and immature pine, mature pine, and bottomland hardwood habitats (Table 1). ECs (Reconyx HC600, Holmen, WI; HCO Scoutguard 565FV, Norcross, GA) were deployed from December to March 2013–2014 and 2014–2015 and took images at 1-min intervals at each trigger event. SCs (Reconyx PC900) were deployed from 17 December 2013 to 1 April 2014 and took images at 1-min intervals, but with bursts of three images at each trigger event. We placed all cameras on trees or posts ~1 m above ground and 2–3 m from bait. We baited camera traps with road-killed white-tailed deer or wild pig (*Sus scrofa*) carcasses. We also obtained some wild pig carcasses from the SRS wild pig control program, which employs contractors to trap and euthanize pigs. We secured carcasses with stakes and typically checked cameras after 1 week of operation.

We assigned ages of photographed eagles based on molt patterns and used U.S. Geological Survey Bird Banding Laboratory age classes (Bloom and Clark 2001, Wheeler 2003), but we used the term adult for after-fourth-year eagles. We individually identified eagles by their molt patterns, distinctive gray marbling of the rectrices and secondaries, distinct patches of white on their rectrices and secondaries, or

Table 1. Habitat and age of timber stands at sites with camera traps and the number of times Golden Eagles were photographed at each site at the Savannah River Site in South Carolina during the winters of 2013–2014 and 2014–2015.

Year	Habitat	Number of camera traps	Number used by eagles	Mean age of timber stands at sites (year)	Range in age of timber stands (year)
2013–2014					
	Clearcut	13	4	<1[a]	>1–5
	Hardwood	9	0	73	33–92
	Immature pine	12	0	22.6	13–35
	Mature pine	12	1	55.3	33–77
2014–2015					
	Clearcut	1	1	3[b]	
	Field	1	1	N/A[c]	
	Mature pine	1	1	107	

[a]Clearcuts were surveyed either <1 yr after replanting or had not yet been replanted, except the site containing camera trap EC1, which had been replanted 2 yr prior to survey.
[b]Camera trap EC1 was re-used in 2014–2015.
[c]Field created in 2000 and maintained in short grass.

a combination of these characters. Pre-adult and adult Golden Eagles are known to retain feathers, including rectrices, for >1 yr (Bloom and Clark 2001, Ellis and Kéry 2004), thus potentially permitting identification of some individuals from photographic evidence during consecutive winters. If photographs did not permit individual identification, we classified an eagle's identity as unknown.

RESULTS

Winter 2013–2014. We detected eagles at five of 46 camera traps. We used 49 carcasses ($N = 45$ wild pigs and four white-tailed deer) at 46 camera traps for variable periods (range = 21–72 d) from 17 December 2013 to 1 April 2014 ($N = 106$ d; Fig. 1). Average elapsed time from deployment to detection of an eagle at these traps was 11.2 d (range = 5–20). Camera traps detected Golden Eagles for 17 calendar days between 7 January and 11 March 2014. Among the 1102 images of Golden Eagles, we identified four unique individuals (Table 2). We could not identify 32.6% of eagles in images and detected unknown eagles on seven calendar days (20 January–15 February 2014). GOEA3 was detected at two camera traps (SC8 and SC9) located 1.1 km apart (Table 2).

We summarized combined habitat characteristics of eagle and SC traps that either detected ($N = 5$ in 2013–2014; $N = 3$ in 2014–2015) or did not detect ($N = 41$ in 2013–2014) Golden Eagles in both winters (Table 1). Among the five camera traps that detected Golden Eagles in 2013–2014, four were in clearcuts and one was under a forest canopy (Fig. 1). Camera trap EC1 was in a 13.2-ha clearcut with 2-yr-old longleaf pine interspersed with broomsedge (*Andropogon virginicus*) and was surrounded by a mostly contiguous 50- to 80-yr-old mature longleaf and loblolly pine forest managed for Red-cockaded Woodpeckers (Fig. 1). Camera trap SC7 was in a 22.8-ha clearcut with 1-yr-old planted loblolly pine and broomsedge. Camera traps SC8 and SC9 were in 32.7- and 37.5-ha clearcuts, respectively, that had visible bare ground and slash (Fig. 1). Camera trap SC41was in a stand of 57-yr-old slash pine (*Pinus elliotii*) with an intact canopy that was thinned in 2004 (Fig. 1).

Winter 2014–2015. Our sampling effort was lower in 2014–2015, but we detected Golden Eagles at all three camera traps we deployed. We used 28 carcasses ($N = 11$ wild pigs and 17 white-tailed deer) at three camera traps maintained from 10 December 2014 to 11 March 2015 ($N = 92$ d; Fig. 1). An average of 11.6 d (range = 6–17 d) elapsed before a Golden Eagle was detected at camera traps. Camera traps detected Golden Eagles on 66 calendar days (25 December 2014–19 March 2015). Of

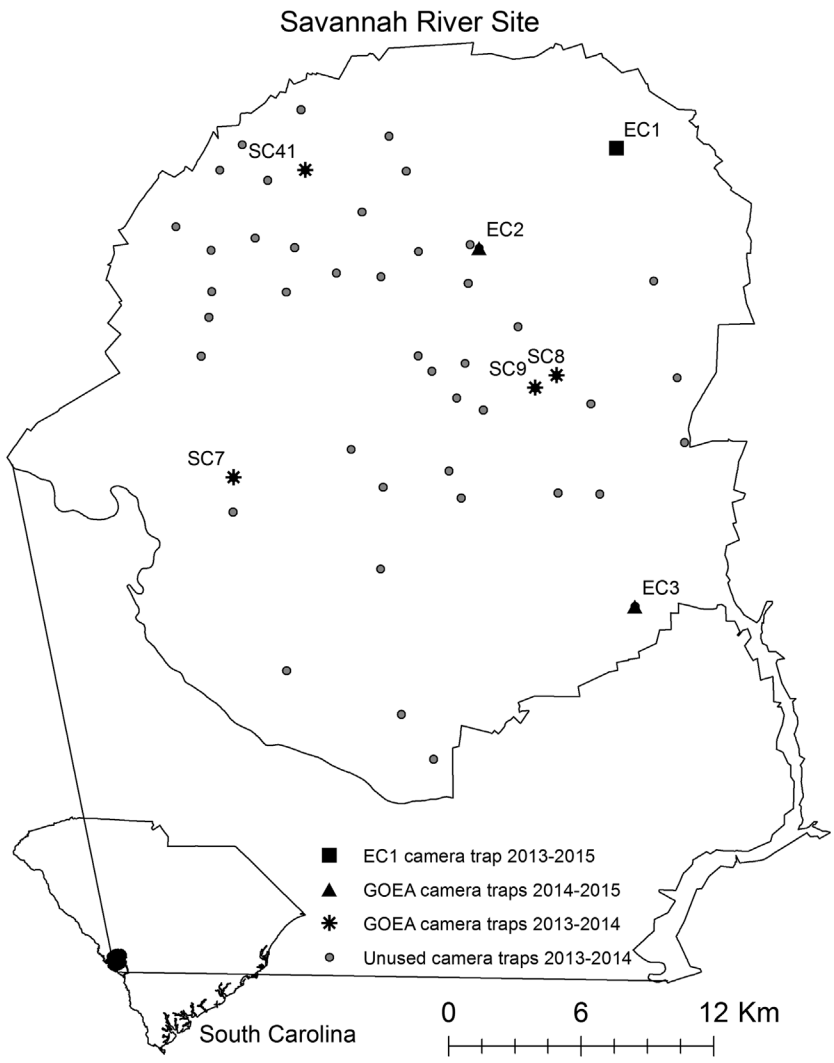

Fig. 1. Location of 48 camera traps used to survey Golden Eagles on the Savannah River Site, South Carolina, Aiken and Barnwell counties, from December 2013–2015 to March 2013–2015.

1118 images of Golden Eagles, we identified five unique individuals, and 24.3% were eagles we could not identify to either a unique or known individual. Among the five eagles we identified, one was a return from 2014 (GOEA1; Table 2, Fig. 2). We detected unknown eagles on 38 calendar days (17 January–19 March 2015). Camera trap EC2 detected four unique individual eagles (Table 2), including GOEA1 and GOEA5 together on 28 February 2015. Each of these individuals was also detected at different camera traps (Table 2) located ~17.7 km (GOEA1: EC3) and 7.6 km (GOEA5: EC1) from EC2, respectively (Fig. 1).

We reused one camera trap site from 2013 to 2014 (EC1). Camera trap EC2 was in a 4.2-ha open field with broomsedge surrounded by a mixture of clearcuts and mixed-aged hardwood-pine forests (Fig. 1). Camera trap EC3 was located under a 103-yr-old longleaf and loblolly forest canopy in a Red-cockaded Woodpecker management area in the southeastern portion of the SRS (Table 1, Fig. 1).

Table 2. Eight unique individual Golden Eagles (GOEA) identified from photographs taken at seven camera traps at the Savannah River Site in South Carolina, December to March 2013–2014 and 2014–2015.

Eagle	Age[a]	Winter	Dates detected	Total days at trap	Camera trap
GOEA 1	Adult	2013–2014	7–9 January	3	SC41
		2014–2015	25–30 December	6	EC3
			26–31 January; 1–6, 11–14, 22–25, 27–28 February; 1, 3–4 March	25	EC2
GOEA 2	Adult	2013–2014	12–15 January; 8 February	5	EC1
GOEA 3	Adult	2013–2014	8, 10–11 February; 14–15 February	5	SC8
			9 March	1	SC9
GEOA 4	SY	2013–2014	10–11 March	2	SC7
GOEA 5	Adult	2014–2015	16–27 January; 8–10, 15, 28 February;	17	EC2
			30–31 January; 1–3, 18–20, 28 February; 1–2, 4–5, 11 March	14	EC1
GOEA 6	TY	2014–2015	12–14 February	3	EC1
GOEA 7	SY	2014–2015	2 February	1	EC2
GOEA 8	SY	2014–2015	31 Jan; 1, 11–15, 17–20, 23–24 February	13	EC2

[a]Adult is after-fourth-year, SY is second-year, and TY is third-year.

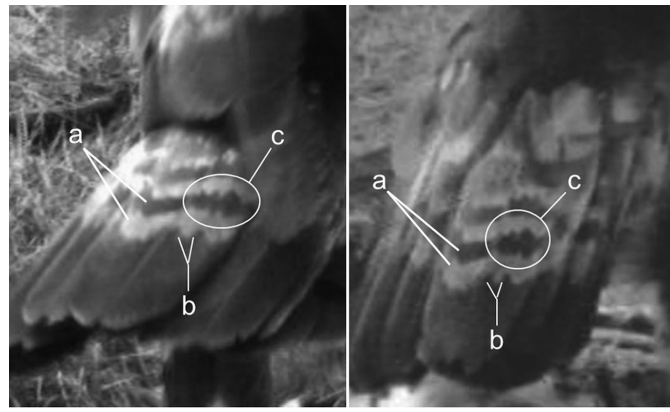

Fig. 2. Camera-trap photographs of the same Golden Eagle from winter 2014 (left) and winter 2015 (right) showing matching gray marbling patterns on a retained right-central rectrix. Letters (a, b, and c) indicate matching patterns in the two images.

DISCUSSION

We identified eight individual Golden Eagles at camera traps during two consecutive winters. We could not individually identify all eagles photographed so this represents a conservative estimate of the number of eagles using the SRS during these winters. We are unaware of a greater number of individual Golden Eagles reported from other areas on the coastal plain of the Carolinas. Our observations of eight individual eagles at the SRS matched the total number of eagles in a 4-yr winter survey effort in both South Carolina and Georgia (Millsap and Vana 1984), and suggest that the number of Golden Eagles wintering on the coastal plain of the Carolinas and Georgia is likely higher than previously thought.

Use of the SRS by Golden Eagles may be attributable to characteristics of the area. The SRS forests are managed for timber and wildlife, with ~45% of the area managed as habitat for endangered Red-cockaded Woodpeckers. In the mountains of West Virginia and Kentucky, Golden Eagles predominantly use leafless deciduous forests rather than open areas (Katzner

et al. 2012, Miller 2012). However, Golden Eagles apparently find the open-canopy, fire-maintained pine forests of the SRS suitable for hunting and roosting. The SRS also restricts public use, with minimal anthropogenic disturbance, and some research indicates that human activity or development may negatively affect occurrence of Golden Eagles (Miller 2012, Duerr et al. 2015). However, we did not sample areas with greater disturbance levels, and our study was not designed to investigate landscape-level distribution.

Migratory Golden Eagles often exhibit winter-site fidelity (Kochert et al. 2002), and we identified one eagle, detected as an adult in 2014, again in 2015. Miller (2012) suggested that Golden Eagles may show stronger winter-site fidelity after their third winter. Our data also suggest that eagles are not just transients, but spend much of the winter at the SRS. We detected eagles for 19 and 66 calendar days during the winters of 2013–2014 and 2014–2015, respectively, and we detected two adult eagles (GOEA1 and GOEA5) for 30 and 31 calendar days, respectively, in 2014–2015. Eagles typically scavenged on carcasses for a few days, left, and then returned when new carcasses were added, suggesting they had likely remained in the area.

We deployed more camera traps in 2013–2014, but differences in how carcasses were deployed across the landscape may explain why we observed Golden Eagles on more calendar days in 2014–2015. Camera traps in 2013–2014 were scattered over a larger area and most were located under forest canopies. Eagles may not have been able to locate carcasses before they were scavenged by other animals or may not have been able to access or detect carcasses as easily under forest canopies. In contrast, carcass piles were maintained continually at two open sites (EC1 and EC2) in 2014–2015, and two carcasses were sometimes placed at once. Therefore, a combination of accessibility and availability of carcasses may explain the greater number of eagle detections in 2014–2015.

The extent to which availability of wild pig carcasses affected the occurrence of Golden Eagles at SRS is unclear, but these carcasses may represent both a potentially important resource to wintering eagles and a potential risk due to lead poisoning (Kramer and Redig 1997, Harmata and Restani 2013). Wild pigs are a destructive non-native species that are increasing in numbers and expanding their range throughout the United States (McClure et al. 2015), and control programs are increasingly being implemented to reduce their populations (Campbell and Long 2009). The SRS control program, in operation since 1985 (Mayer 2005), removed 1606 pigs in 2014 (USFS, unpubl. data). Wild pigs at SRS and elsewhere are typically live-trapped, dispatched with a gunshot to the head, and discarded in remote areas. Although we are unaware of other reports of Golden Eagles scavenging wild pig carcasses in the eastern United States, our data suggest that they readily scavenge pig carcasses. With increasing numbers of control programs in the United States, wild pig carcasses may become an increasingly important food source for Golden Eagles. Managers of wild pig control programs should be aware of the possibility of Golden Eagles feeding on carcasses and consider measures to minimize exposure of eagles to lead bullets. In addition to consideration of non-lead ammunition, some aspects of carcass disposal may help mitigate exposure. For example, placing carcasses under dense forest canopies may limit the ability of eagles to detect carcasses, although this needs additional study because Golden Eagles in the northeastern United States frequently access carcasses located under forest canopies (T. Katzner, pers. comm.). Research is also needed concerning the possible risk to wintering Golden Eagles posed by the lead ammunition in dispatched wild pigs.

Camera traps baited with carcasses represent an efficient and cost-effective technique for detecting and obtaining information about wintering Golden Eagles. We were able to detect age, individually identify, and even document some local movements of Golden Eagles among camera traps and between years without capturing or marking individuals. Mark-recapture studies of populations of Golden Eagles (Dennhardt et al. 2015) and Imperial Eagles (*Aquila heliaca*; Rudnick et al. 2008) have been conducted using non-invasive techniques, and use of such techniques is desirable, particularly when studying animals with low reproductive potential that may be affected by capture and handling (Marzluff et al. 1997, Gregory et al. 2003). Our results suggest that use of spatially explicit capture-recapture techniques may provide estimates of eagle population densities (Royle et al.

2009, 2013). Importantly, the way carcasses and cameras are positioned may affect the ability of investigators to identify individual eagles. For example, we found that eagles tended to approach from the dorsal side of carcasses, so better images of spread rectrices were obtained when cameras faced the dorsal side of the carcass. In addition, using multiple cameras per site with different angles and trigger intervals would provide more detailed information. However, even with the best angles and multiple cameras, identification of individual Golden Eagles from photographs may be difficult where population densities are high, so supplemental marking may be required in such situations.

The discovery of regularly wintering Golden Eagles at SRS suggests that other areas in the coastal plain of the United States may also support populations of wintering eagles. Identification of these wintering areas of Golden Eagles will be an important step in the conservation of this protected species, and camera traps baited with carcasses can be an effective tool for such work. Numbers of wintering Golden Eagles on the coastal plain are likely higher than previously thought and additional study is needed to better document their occurrence and population status.

ACKNOWLEDGMENTS

We thank R. Hamilton, D. Hammett, and J. Nance for outstanding work in the field, and P. Johns for supplying road-killed carcasses. We also thank C. Sutton and B. Wheeler for assistance with individual identification and ageing of Golden Eagles, D. Forsythe for facilitating identification, and T. Katzner and J. Petranka for reviewing the manuscript. Funding was provided by the United States Department of Energy – Savannah River Operations Office through the USDA Forest Service – Savannah River under Interagency Agreement DE-AI09-00SR22188 and Award Number DE-FC09-07SR22506 to the University of Georgia Research Foundation.

LITERATURE CITED

Bloom, P. H., and W. S. Clark. 2001. Molt and sequence of plumages of Golden Eagles and a technique for in-hand ageing. North American Bird Bander 26: 97–116.

Burleigh, T. D. 1958. Georgia birds. University of Oklahoma Press, Norman, OK.

Campbell, T. A., and D. B. Long. 2009. Feral pig damage and damage management in forested ecosystems. Forest Ecology and Management 257: 2319–2326.

Dennhardt, A. J., A. E. Duerr, D. Brandes, and T. E. Katzner. 2015. Integrating citizen-science data with movement models to estimate the size of a migratory Golden Eagle population. Biological Conservation 184: 68–78.

Duerr, A. E., T. A. Miller, K. L. Cornell Duerr, M. J. Lanzone, A. Fesnock, and T. E. Katzner. 2015. Landscape-scale distribution and density of raptor populations wintering in anthropogenic-dominated desert landscapes. Biodiversity and Conservation 24: 2365–2381.

Ellis, D. H., and M. Kéry. 2004. Variable retention times for rectrices at different loci in a Golden Eagle. Journal of Raptor Research 38: 270–275.

Gregory, M. J. P., A. G. Gordon, and R. Moss. 2003. Impact of nest-trapping and radio-tagging on breeding Golden Eagles *Aquila chrysaetos* in Argyll, Scotland. Ibis 145: 113–119.

Harmata, A. R., and M. Restani. 2013. Lead, mercury, selenium, and other trace elements in tissues of Golden Eagles from southwestern Montana, USA. Journal of Wildlife Diseases 49: 114–124.

Imhof, T. A. 1962. Alabama birds. University of Alabama Press, Tuscaloosa, AL.

Jachowski, D. S., T. Katzner, J. L. Rodrigue, and W. M. Ford. 2015. Monitoring landscape-level distribution and migration phenology of raptors using a volunteer camera trap network. Wildlife Society Bulletin 39: 553–563.

Johnston, P. 2005. Red-cockaded Woodpecker. In: Ecology and management of a forest landscape: fifty years on the Savannah River Site (J. C. Kilgo and J. I. Blake, eds.), pp. 301–312. Island Press, Washington, D.C.

Katzner, T., T. A. Miller, J. Rodrigue, and S. Shaffer. 2015. A most dangerous game: death and injury to birds from porcupine quills. Wilson Journal of Ornithology 127: 102–108.

———, B. W. Smith, T. A. Miller, D. Brandes, J. Cooper, M. Lanzone, D. Brauning, C. Farmer, S. Harding, D. E. Kramer, C. Koppie, C. Maisonneuve, M. Martell, E. K. Mojica, C. Todd, J. A. Tremblay, M. Wheeler, D. F. Brinker, T. E. Chubbs, R. Gubler, K. O'Malley, S. Mehus, B. Porter, R. P. Brooks, B. D. Watts, and K. L. Bildstein. 2012. Status, biology, and conservation priorities for North America's eastern Golden Eagle (*Aquila chrysaetos*) population. Auk 129: 168–176.

Kochert, M. N., K. Steenhof, C. L. McIntyre, and E. H. Craig. 2002. Golden Eagle (*Aquila chrysaetos*). In: The Birds of North America (A. Poole, ed.). Cornell Lab of Ornithology, Ithaca, NY.

Kramer, J. L., and P. T. Redig. 1997. Sixteen years of lead poisoning in eagles, 1980–95: an epizootiologic view. Journal of Raptor Research 31: 327–332.

Marzluff, J. M., M. S. Vekasy, M. N. Kochert, and K. Steenhof. 1997. Productivity of Golden Eagles wearing backpack radiotransmitters. Journal of Raptor Research 31: 223–227.

Mayer, J. 2005.Wild hog. In: Ecology and management of a forest landscape: fifty years on the Savannah River Site (J. C. Kilgo and J. I. Blake, eds.), pp. 374–379. Island Press, Washington, D.C.

Mayer, J. J., R. T. Hoppe, and R. A. Kennamer. 1985. Bald and Golden eagles on the Savannah River Plant, South Carolina. Oriole 50: 53–57.

McClure, M. L., C. L. Burdett, M. L. Farnsworth, M. W. Lutman, D. M. Theobald, P. D. Riggs, D. A. Grear, and R. S. Miller. 2015. Modeling and mapping the probability of occurrence of invasive wild pigs across the contiguous United States. PLoS ONE 10: e0133771.

Miller, T. 2012. Movement ecology of Golden Eagles (*Aquila chrysaetos*) in eastern North America. Ph.D. dissertation, Pennsylvania State University, State College, PA.

Millsap, B. A., and S. L. Vana. 1984. Distribution of wintering Golden Eagles in the eastern United States. Wilson Bulletin 96: 692–701.

Royle, J. A., R. B. Chandler, R. Sollmann, and B. Gardner. 2013. Spatial capture-recapture. Academic Press, Waltham, MA.

———, K. U. Karanth, A. M. Gopalaswamy, and N. S. Kumar. 2009. Bayesian inference in camera trapping studies for a class of spatial capture-recapture models. Ecology 90: 3233–3244.

Rudnick, J. A., T. E. Katzner, E. A. Bragin, and J. A. DeWoody. 2008. A non-invasive genetic evaluation of population size, natal philopatry, and roosting behavior of non-breeding eastern Imperial Eagles (*Aquila heliaca*) in central Asia. Conservation Genetics 9: 667–676.

Sprunt, A., and E. B. Chamberlain. 1949. South Carolina bird life. University of South Carolina Press, Columbia, SC.

Sullivan, B. L., C. L. Wood, M. J. Lliff, R. E. Bonney, D. Fink, and S. Kelling. 2009. eBird: a citizen-based bird observation network in the biological sciences. Biological Conservation 142: 2282–2292.

Wheeler, B. K. 2003. Raptors of eastern North America. Princeton University Press, Princeton, NJ.