The Raven

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The Virginia Society of Ornithology, Inc. exists to encourage the systematic study of birds in Virginia, to stimulate interest in birds, and to assist the conservation of wildlife and other natural resources. All persons interested in those objectives are welcome as members. Present membership includes every level of interest, from professional scientific ornithologists to enthusiastic amateurs.

Activities undertaken by the Society include the following:

1. An annual meeting (usually in the spring), held in a different part of the state each year, featuring talks on ornithological subjects and field trips to nearby areas.
2. Other forays or field trips lasting a day or more and scheduled throughout the year so as to include all seasons and to cover the major physiographic regions of the state.
3. A journal, *The Raven,* published twice yearly, containing articles relevant to Virginia ornithology as well as news of the activities of the Society and its chapters.
4. A newsletter, the *VSO Newsletter,* published quarterly, containing current news items of interest to members and information about upcoming events and pertinent conservation issues.
5. A journal, *Virginia Birds: A Quarterly Journal of Ornithological Sightings in the Commonwealth,* published quarterly and contains records of bird sightings from the different regions of the Commonwealth.
6. Study projects (nesting studies, winter bird population surveys, etc.) aimed at making genuine contributions to ornithological knowledge.

In addition, some local chapters of the Society conduct their own programs of meetings, field trips and other projects.

Those wishing to participate in any of the above activities, or to cooperate in advancing the objectives of the Society, are cordially invited to join and should contact the Membership Secretary. Annual dues are $20.00 for active members, $35.00 for sustaining members, $60.00 or more for contributing members, $500.00 for life members, and $25.00 for family members.

New manuscripts and queries about *The Raven* should be sent to Raven Editors John and Jennifer Styrsky: ravensubmissions@lynchburg.edu. Queries and comments about Virginia Birds should be directed to Evan Spears e3sprears@gmail.com.

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ERRATA

Due to unforeseen circumstances, the publication of *The Raven* by the Virginia Society of Ornithology has been erratic and there are now errors in the correspondence of publication year and volume number. As a result:

Volume 88 should have been published in 2017. Instead, this volume was published in 2017 and 2018.

Volume 89(1) should have been published in 2018. Instead, it was published in 2019 with the papers receiving a 2019 publication year.

Volume 89(2) and Volume 90 were recently published as a single edition with a 2019 publication year.

The present edition of *The Raven* contains:

Volume 91, which should have been published in 2020 and will carry a 2020 publication date.

Volume 92 will be published at the end of 2021 and carry the correct 2021 publication date.

Historical Status of the Ivory-billed Woodpecker in Virginia

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Abstract

There is archaeological and historical evidence of the past occurrence of the Ivory-billed Woodpecker (*Campephilus principalis*) in Virginia. This paper reviews records that have been previously reported, disputes the validity of a purported collection of a specimen between the border of West Virginia and Virginia, presents newly uncovered evidence, and examines the implications of these and other records with regard to the historic range and biology of this species.

Introduction

While there is little evidence for the past occurrence of the Ivory-billed Woodpecker (*Campephilus principalis*) in Virginia and West Virginia, there are vague references in documents during the settlement era and a small number of archaeological discoveries. Jackson (2006) was skeptical about the past occurrence of the species in the states in question, but formerly obscure sources have become more accessible since that time. As members of bird records committees know, new records of rare birds can be difficult to assess. The difficulties are compounded when investigating historical material. Records of non-game bird species are especially difficult to unravel because the first settlers did not head to new areas with field guides in their pockets and were more concerned about eating than ornithology. In examining such records, it is useful to have standards for what constitutes admissible evidence and how to weigh it. There are at least eight kinds of evidence that can be entertained in a discussion of ornithological records – whether modern, historical, or archaeological (outlined in Leese 2006b). The strongest evidence includes, in descending order of strength, documented specimens in accredited museums, curated photographs or recordings, a documented sight record, or archeological evidence with clear context. Weaker evidence, in declining strength, includes a sight reference (less documentation than a full modern record), references in neighboring areas (for instance, a species that is known to occur in North Carolina is more likely to occur in Virginia than a species whose nearest record is California), and habitat suitability. In the case of the ivory-bill, habitat suitability is difficult to assess because there is no agreed upon formula for its past habitat. Virginia's strongest level of evidence is archaeological records, although a number of sight references also exist for the commonwealth.

In the case of the Ivory-billed Woodpecker, the species' similarity to the Pileated Woodpecker (*Dryocopus pileatus*) complicates the situation further. Therefore, to qualify as a valid record or reference, historical evidence must either:

1. Provide enough description to establish identification as an ivory-bill or a pileated. For instance, a record of a "large woodpecker" does not qualify. One that specifies "large woodpecker with a white bill" would qualify; or
2. Come from an observer who has elsewhere demonstrated knowledge of the differences between the two species or whose reputation suggests enough skill to distinguish one from the other.

The historical references presented below come from many different levels of reliability, but these basic rules will help in sorting the available data.

Records from Neighboring States

Maryland: There are few records of the ivory-bill from Maryland, with most references likely dependent on Audubon's (1842) note that "now and then an individual of the species may be accidentally seen in Maryland." Audubon does not mention direct observation or collection of an ivory-bill in Maryland, so this assertion is open to question. The only other piece of evidence from Maryland comes from Parker Gillmore's *Adventures Afloat and Ashore* (1873), in which he claims to have seen one at Princess Anne, near the Chesapeake. Leese (2016a) provides a fuller review of records from Maryland, as well as New Jersey and Pennsylvania.

West Virginia: Almost all records from this state are problematic in one way or another. The most superficially promising of these is attributed to Alexander Wilson. Hall (1983) relates:

> *During the short time in which Alexander Wilson lived in Shepherdstown, Jefferson County, he collected an Ivory-billed Woodpecker someplace between Martinsburg and Winchester, Virginia…*

On the surface, this appears to be a very strong record with location information and a collection supporting it. However, no specimen exists, and there is no mention of it in Wilson's surviving letters. Wilson's stay in the area (in 1794 or 1795) was brief, and few letters remain from that period (Hunter 1983).

This record appears to have entered the literature through Hall who misinterpreted Maurice Brooks' speculation about the location (1944):

> *Wilson records this species from Virginia in such a way as to make it quite possible that his reference was to that part of the Shenandoah Valley now included in Berkeley and Jefferson Counties, West Virginia. He collected between Martinsburg and Winchester, but the locality for the ivory-bill observation will probably never be determined.*

Brooks (1944) did not include a bibliography in his work, instead referring to E. A. Brooks' earlier bibliography (1938). The earlier Brooks did not reference anything to suggest that Wilson encountered the ivory-bill in West Virginia.

A careful reading of Brooks (1944) shows that he merely described Virginia as the northern limit of the ivory-bill's range following Wilson's assertion: "I believe however, that few of them are ever seen to the north of Virginia, and very few even in that state" (Wilson 1828). Brooks then pointed out that in Wilson's day the northern part of Virginia included post-Civil War West Virginia. While Brooks described Wilson's collecting foray between Martinsburg and Winchester, he did not say that Wilson collected an ivory-bill, only that he collected specimens in the area. Since there is no reference elsewhere to Wilson's observation or collection of an ivory-bill in West Virginia eastern panhandle, Hall's assertion should be rejected as an unfortunate misinterpretation of Brooks.

One other putative sight record for the state is the second-hand story of Fr. C. Delaux who conversed with a farmer about the edibility of woodpeckers "like the Indian Hen, but larger with white bills" (Haller 1940). Fr. Delaux hunted for an example of the species for a few weeks before successfully killing one and not enjoying the resulting meal. Although a rather late record, it has many details that make it appear to be valid. There are two archaeological records from West Virginia, from the Fairchance Mound in Marshall County and the Buffalo site in Putnam County. The Fairchance record (Parmalee 1967) is of a lower bill, but because the site includes 49 burials along with "village debris and mound fill" (Guilday and Tanner 1969) one cannot rule out that the object arrived as a trade item. Similarly, at the Buffalo site in Putnam County "a single beak" (Guilday 1971) was removed from midden debris (although Hall, 1983 and Jackson, 2006 claim that it was a partial skull).

Middens are prehistoric trash heaps, where Native Americans left cooking remains and other refuse. There is much evidence of prehistoric trade in the crests and bills of ivory-billed woodpeckers, with some found among tribes in Wisconsin and even farther north (Leese 2006c). However, there is no clear evidence that bills had trade value farther south and east. Moreover, the fact that one of the finds involved only a lower mandible, rather than a complete bill or head, may suggest that it was a food item (Leese 2006b) rather than a ceremonial or ornamental one. The bone has not been found in the Illinois State Museum where Guilday states it was placed, nor in the collections of the University of Tennessee or the Carnegie Museum of Natural History, where Illinois curators thought it might have been placed.

*Kentucky***:** There is firm evidence of the existence of the Ivory-billed Woodpecker in Kentucky in historical times (reviewed in Leese 2006a). According to Audubon, the species nested in Kentucky and Indiana (Audubon 1842). Later in the 19th century, Charles J. O'Malley (1884) noted the species' presence, as well as the similar Pileated Woodpecker, on Powell's Lake in Henderson and Union Counties:

> The crimson-crested woodpecker (*picus principalis*) [sic] is there, too, nor is the glossy, black-coated woodcock wanting, although his species is rapidly passing away from our forests…

Tennessee: Although every state that it borders has solid records of Ivory-billed Woodpeckers, Tennessee has none, except a reference from Audubon, which is unclear as to whether the encounter was in Tennessee or across the Mississippi River (Jackson 2006).

North Carolina: Lee (1999) reviewed the few records for the state, one of which belongs to Alexander Wilson. In addition to those records, Leese (2019) notes two other records from the Carolinas: two eggs apparently collected from Wilmington, North Carolina and two skins held by the Museum für Naturkunde in Berlin, Germany that list only "Carolina" for the location of the specimens. No records from North Carolina are from areas immediately adjoining Virginia.

Virginia References from Unspecified Locations

Jefferson (1781-82) listed the ivory-bill in *Notes on the State of Virginia*, which then included present-day Kentucky and West Virginia. Holt (2013) suggested that Jefferson's list was based on personal observations. If the observation was indeed first-hand, the record would come from within the Virginia's current borders, since Jefferson never traveled south of Norfolk or west of Falling Spring, several miles east of today's West Virginia border. Audubon's (1842) assertion that the species sometimes occurred in Maryland suggests that he too counted Virginia within the range of

the species. As noted, Wilson (1828) identified Virginia as the northern limit of the ivory-bill's range. Audubon (1842) did so implicitly by naming Maryland as the northernmost limit. Wilson and Audubon may have been the basis for later Virginia claims, such as Ward (1880). One later reference may not be dependent upon Audubon and Wilson. Writing much later, Maurice Thompson (1885) notes:

> *I have been informed that the ivory-bill is occasionally found in the Ohio valley; but I have never been able to discover it north of the Cumberland range of mountains.*

Thompson, best known as a novelist, wrote frequently about local life and lore. While not a trained ornithologist, he appears to have had sufficient knowledge of the area to make such a claim, having observed ivory-bills in Georgia and Mississippi (1885). An occurrence below or within the Cumberland range of mountains would put the ivory-bill firmly within the western area of the commonwealth.

Site-specific References

A more geographically specific reference to the species comes from the westernmost part of Virginia, in Washington County. Part of a tall tale involving James Musick and a bear hunt includes Mr. Musick's crawling out of a cave in the spring to get "a place in the sun an' watch them big white-billed peckerwoods a-maulin' on the dead trees" (*in* Ward 1983). The story is set in western Virginia between 1832 and 1848, the years of the family's residence there before moving to Kentucky. While any tall tale must be considered critically and cautiously, such stories can provide an insight into early fauna (Bigony 1982). The detail of "white-billed" in the story certainly suggests the ivory-bill as the bird being described, and there is no reason for embellishment on that point within the flow of the story about bears. The presence of ivory-bills in Virginia's western mountains seems plausible, especially when weighed with the archaeological evidence presented below.

Nearer the coast, another possible sight report comes from the Richmond area during the Civil War. Colonel Theodore Lyman served under General Meade of the Army of the Potomac for three years during the Civil War, including the protracted Richmond-Petersburg campaign. On November 24, 1864, Col. Lyman (1922) took a ride in the woods after his Thanksgiving meal and records:

> *Then there was a pileated woodpecker (not known with us), a great fowl, as big as a crow; black with white feathers in his wings, an ivory beak and a gay scarlet cockade. He thought himself of great account, and pompously hopped up and round the trunks of trees, making a loud, chattering noise, which quite drowned the wee birds, like a roaring man in a choir. The pompous old thing was very much scared when I approached, and flew away, but soon began his noise on a distant tree.*

This is probably one of the few cases in which someone seems to have confused a Pileated Woodpecker with an Ivory-billed instead of the inverse, more usual problem (although Wilson may have; see Leese 2016a). Lyman was an accomplished enough naturalist that it seems incredible that he had no knowledge of the Pileated Woodpecker, even though the species may have been extirpated from his native Massachusetts. In this letter, he seems to suggest a different variety of Pileated Woodpecker, and his further description, especially the "white feathers in his wings" and "ivory beak" shows that he likely encountered an ivory-bill. The "chattering noise" appears unusual for ivory-bills, but may match the "conversational chatter" noted by Dennis (*in* Jackson 2006).

Archaeological Remains

The pre-Columbian presence of the ivory-bill in the western mountains of Virginia is confirmed by archaeological evidence. Daugherty's Cave, a site in Russell County, was excavated extensively and shows signs of human occupancy across many time periods in Virginia's prehistory. Among the many bones found in a general midden deposit was a metatarsus of an Ivory-billed Woodpecker (Benthall 1990). The bone was removed from Zone A, Level 3 of the excavation, placing it in the Late Woodland time period (approximately 900-1650 CE). Because of a few misidentifications noted from this project, this bone's identity was re-confirmed by Dr. Storrs Olson of the Smithsonian in 2009.

The context of this bone suggests that it is from an individual that was killed and eaten locally. There is no evidence of trade in body parts, other than heads or bills, from anywhere in North America so this leg bone did not arrive at the site via trade. Its presence in a midden makes it virtually certain that the bird was killed and eaten locally (Leese 2006b). During prehistoric times, Ivory-billed Woodpeckers occurred in the western parts of Virginia.

Meaning for the Biology of the Ivory-billed Woodpecker

These records for Virginia, along with multiple records as far north as Ohio, Indiana, and perhaps even Michigan (Schreffler et al 2019) demonstrate that the range of the ivory-bill was wider than previously believed. One could argue that these northern records were only vagrant individuals, but the sheer number of records indicates either a resident population or an area that was used regularly by the species. Early settlers and naturalists would not have noted a vagrant species with the frequency with which the ivory-bill was noted.

An expanded range for the ivory-bill raises important and inter-related questions about the species' habitat requirements, degree of food specialization, and mobility. While there are only scraps of evidence, some observations can be made.

Habitat: The prevailing vision of the ivory-bill is as a species dependent upon old growth forests (Walters and Crist 2005, Hill et al 2006), with a fairly narrow combination of habitat factors available only in the American south. However, its documented presence in more northern forests greatly expands the possibilities of the habitat the species used; it was found not just in the gum and cypress complex of the south but also hardwood and pine forests of northern and upland habitats. Clearly, the species was capable of using habitats besides southern forests.

A more important, though not exclusive, habitat factor appears to be the presence of rivers. The species was certainly present away from rivers on occasion as noted above. But most observations in the upper Ohio valley tend to center on major rivers. Ferrall's observation in Indiana (Leese 2006b, Leese 2016b), Hopkins' in Ohio (Leese 2011), and the archaeological remains in Ohio (Leese 2006b) come from near major rivers. The assertion that rivers are key corridors for this species (Jackson 2006) seems correct. This more cosmopolitan view of the species habitat is in conflict with the prevailing public view, but not with the work of ivory-bill scholars. Tanner (1942) titles a chapter "**Habitats** of the Ivory—billed Woodpecker" (emphasis added). Jackson (2006) similarly acknowledges a wider range of habitat, and Snyder (2007) made that reality a central point of his work.

Food specialization: The clear lack of habitat specialization in the ivory-bill may encourage some to jump to the conclusion, already popular for the species, that it was also not a food specialist. But one should be careful before making such a conclusion; while food and habitat specialization appear as clear corollaries of each other, they should be separated also. A species may have a very clear food specialty, but still make use of various habitats, perhaps in different seasons of the year such as Chimney Swifts (*Chaetura pelagica*) and Common Loons (*Gavia immer*). Thus, just the establishment that the species used varied habitats is not adequate to establish that it was not a food specialist.

While the species likely favored *Cerambycid* beetles (Jackson 2006), the only three stomachs for the species ever studied actually show a majority of vegetative matter (Tanner 1942). Jackson (2006) even describes the species fully as an "opportunist" (2006), and Snyder (2007) argues that there is not enough evidence to conclude that the species was a specialist.

However, some degree of specialization in wood boring beetle larvae, albeit not without flexibility, may still be possible. Trees in all habitats weaken and die and are then used by various beetles and other insects. The decay process varies dramatically between forest types and based on human logging practices (Jackson 2006). Thus, ivory-bills may have used various habitats in order to find their favored food. While beetle larvae were certainly not their only food source, the Ivory-billed Woodpecker seems well-adapted to making them the cornerstone of its diet, with various adaptations for that purpose (Bock and Miller 1959). Its use of various habitats may simply be evidence of that strong preference in its biology.

The historical evidence presented here is not adequate to settle the food specialization issue. Early settlers simply were not counting and identifying beetles. However, anyone arguing the species was a food specialist must account for the fact that the only stomach contents ever examined for the species suggest that it was an omnivore. Similarly, anyone arguing that it was not a specialist must account for the anatomical adaptations identified by Bock and Miller for ivory-bills and other *Campephilus* woodpeckers. The most responsible conclusion may be that the species preferred beetle larvae, especially *Cerambycids*, but made use of a variety of food resources. It is open to speculation whether or not the species relied more heavily on *Cerambycids* while raising its young.

Mobility: The ivory-bill appears to have been much more nomadic than is commonly believed, and this factor must become part of our image of the natural history of this species. Previous work on the ivory-bill lends weight to the nomadic hypothesis. Tanner (1942) suggests that because the species was highly dependent on beetles, it had to be able to leave an area if that food source declined. Tanner presented demographic evidence from bill sizes and observations of wild birds to argue that ivory-bills "were not sedentary birds" (1942). It is remarkable that even though Tanner (1942) noted evidence of the species' ability to cover long distances, he did not understand this as evidence against a habitat specialization hypothesis. Dennis (1967) rearticulated that position by describing the ivory-bill as a "disaster species," able to take advantage of a large area of decaying trees and then move on to a new locale. Steinberg (2008) also suggests that the species was more mobile than commonly accepted.

Most records from the mid-Atlantic and upper Ohio River valley are of only single birds, so one cannot posit the ivory-bill as a fully nomadic species moving around in family groups, at least not in the northern part of its range. However, it was clearly more mobile than is generally accepted, and perhaps juvenile dispersal accounts for some of these northern records. As noted above, the records are just too frequent for vagrancy to be their only source.

Final thoughts: This emerging image of the species as less of a habitat specialist than is commonly believed suggests that a different, more holistic paradigm is needed to explain its decline. The wholesale timbering of southern

forests contributed heavily to the ivory-bill's decline, but the range may have been shrinking, from north to south, even before the era of intensive logging began, and the species was adaptable enough that logging of the southern forests alone does not explain its disappearance (Snyder 2007). Snyder amplifies the work of others in questioning both the food and habitat specialization hypotheses, and he proposes human depredation as the leading factor in the species' decline (2007). The ivory-bill appears not to have been a habitat specialist, but it may have still had a strong food preference (contra Snyder) in those various habitats. These old records appear with too much frequency to be accounted for with only vagrants, and the species likely made regular use of these northern forests if they did not have a small resident population there.

Ivory-bills once flew from Florida's cypresses to Alabama's pines to Virginia's Appalachian hardwoods. Their absence leaves a hole in the various habitats that were once their home. But the reality that they once lived in Virginia leaves the commonwealth just a bit more wild and mysterious.

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Virginia Christmas Bird Counts: 2019-2020 Season

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I seem to recall an old adage that the best birds were found under the coldest, most miserable conditions in winter, especially when it came to Christmas Bird Counts (CBCs). This CBC season provided anecdotal evidence to the contrary. The low temperatures for 2019-20 counts in Virginia ranged from 20 to 56 degrees F with that low of 20 on the Nokesville count on December 22, 2019. High temperatures ranged from 44 to 76 degrees F with that high temperature of 76 recorded in Cape Charles on December 30, 2019. Not one count had any precipitation on count day, most had partly cloudy to cloudy skies, with some clearing during the day. The 'harshest' condition encountered was morning fog on six counts.

Also contradicting that adage were the two new species added on Virginia CBCs this year. An Anna's Hummingbird was documented and photographed on the Northern Shenandoah Valley CBC on December 14, 2019. Then on December 26, 2019, a Sooty Shearwater was observed on the Chesapeake Bay Bridge Tunnel count. Several species were new for individual counts. Almost every count set local record highs and many set new high counts for multiple species. Some of these local new species and record high counts are mentioned below.

Fifty-eight Christmas Bird Counts (CBCs) were conducted in Virginia during the 2019-2020 season. The results from three of these counts are not submitted to Audubon for various reasons (Chesapeake Bay, Darlington Heights, and Giles County) but are included as part of this summary of Virginia CBCs. The Bristol (TN) count results are also included as most of the count circle is in Virginia but are officially included with Tennessee's results for Audubon. The total number of species recorded on the 2019-20 counts was 214. The total number of individuals was 878,309, which is the second lowest number seen in the last five years (low was 864,270 in 2018).

Two entirely new counts were added in 2019. The Middle Peninsula CBC includes parts of Gloucester, Middlesex, and King and Queen Counties and is compiled by Susan Crockett. The 48 participants on the Middle Peninsula count tallied 82 species for their first year. The Cedars Preserve-Jonesville CBC is in the far southwestern corner of the state west of Abington; the circle is centered in Virginia with about one-third of the circle in Tennessee. LaRoy Brandt is compiling this count where 12 observers logged 49 species this year. Unfortunately, we lost one count this year as the Peaks of Otter CBC was not conducted. We are sorry to lose this unique count that was only conducted above 1,500 feet in elevation within a circle centered at the Peaks of Otter Visitor Center. Hopefully a compiler and participants will be recruited to revive this interesting count. The only compiler change this season was Evan Spears who took over the Highland County count from Patti Reum; in doing so, Evan converted this to an Audubon CBC.

Mute Swan numbers have dropped to 34 tallied in both 2018 and 2019. This is less than a fourth of the record high number of 142 seen in 2001. The first Trumpeter Swans were encountered on Virginia CBCs in the mid-2000s and were found sporadically for the next few years. However, now they have been observed somewhere in the state on each of the three previous CBCs (2 in 2016, 4 in 2017, an amazing 17 on five counts in 2018) and this year 8 were recorded: 2 The Plains, 3 Calmes Neck & 3 Rappahannock. Only 2,699 Tundra Swan were reported this year; this is well under half the 6,767 seen in 2017 which was the highest number logged in the past twenty years.

Despite the 3,639 Gadwalls being the second lowest number reported in the last ten years, several places had record high counts: 8 Northumberland-Lancaster, 57 Warren, 22 Calmes Neck, 7 Highland County, and 6 Clifton Forge (a new species on this count). The 1,802 American Wigeon were the second highest number seen in the last ten years; CBCs with record high counts were: 150 Wachapreague, 8 Northumberland-Lancaster, and 2 Clifton Forge (a new species on this count). This year and last year, American Black Duck numbers have been about half what they were in 2017 (7,061 in 2017, 3,177 in 2018 and 3,856 in 2019). But some counts still had record high numbers of American Black Ducks: 22 Rappahannock, 3 Highland County, and 48 Clifton Forge. Blue-winged Teal were only recorded on one count this year with 17 on the Back Bay count. Despite only being detected on one count, this number is above the ten-year average of 12.

As expected, most game bird numbers were low. As many as 85 Northern Bobwhite have been found in the last ten years but fewer than that each of the last four years (67 in 2016, 56 in 2017, 32 in 2018, and 20 in 2019). Only three counts

recorded Northern Bobwhite: 8 Mathews, 11 Walkerton, and 1 Sandy River Reservoir (a new species here), for a total of 20. Three counts reported only 4 Ruffed Grouse: 1 Highland County, 1 Blackford, and 2 Wise County; this is down from 5 observed on 5 counts last year. The only game bird with encouraging numbers is Wild Turkey with 1,607 logged on this season's CBCs. An average of 39 were seen on each of 41 counts in the state plus one count week sighting. Several counts saw record high numbers of Wild Turkey: 76 Wachapreague, 55 Back Bay, 129 Nansemond River, 17 Dismal Swamp, 102 Walkerton, 163 Northumberland-Lancaster, 121 Calmes Neck, 128 Northern Shenandoah Valley, 30 Augusta County, and 151 Blacksburg. The ten-year running average for Wild Turkeys was 356 twenty years ago; today the ten-year running average has more than tripled to 1,166.

The only American White Pelicans were the 7 found on the Williamsburg count (a local high count) although Cape Charles and Back Bay had count week sightings of them. Brown Pelicans were seen on nine counts plus one count week observance; their numbers hit a ten-year high of 932 which is more than triple the 297 recorded last year. Two CBCs had local high counts for Brown Pelican (79 Williamsburg and 234 Northumberland-Lancaster).

Golden Eagles were found on the expected counts: 3 Highland County, 3 Mount Rogers-Whitetop Mountain, and 3 Blackford, but 1 was also a new species on the Nassawadox CBC for a state total of 10 (the same number seen on last year's counts). A single Northern Goshawk was documented on the Waynesboro count. This year 1,529 Bald Eagles were observed across the state on 47 counts plus 2 count week observances. Many counts had record high numbers of Bald Eagle: 63 Mathews, 50 Northumberland-Lancaster, 350 Brooke (also the highest number tallied on a single count in the state this year), 39 Central Loudon, 40 The Plains, 5 Darlington Heights, 40 Calmes Neck, 7 Highland County, and 8 Tazewell. Bald Eagle numbers have been increasing for some time as evidenced by their ten-year running average which has more than tripled to 1,241 in 2019 from 374 in 2000.

The only American Avocets were 3 at Chincoteague. The only Semipalmated Plovers were 19 at Cape Charles and 11 at Nansemond River (a local high count) for a total of 30. A single Spotted Sandpiper was detected on the Newport News count. The only Red Knots were 21 on the Cape Charles CBC. There were only 5 Purple Sandpipers seen on three counts: 1 Cape Charles, 3 Chesapeake Bay, and 1 Mathews.

A single Parasitic Jaeger was reported on the Back Bay count. The record high count of 104 Razorbills set last year was broken with 151 observed this year on two counts: 2 Chesapeake Bay and 149 Back Bay (a local high count). Little Creek recorded the only Black-legged Kittiwake, Black-headed Gull and Glaucous Gull sightings in the state this year with one each. A single Common Tern was seen on the Newport News count. Nine Royal Terns turned up on three counts: 5 Chincoteague (a local high count), 2 Little Creek, and 2 Back Bay. Four Black Skimmer were counted with 1 at Little Creek and 3 at Newport News.

The first Eurasian Collared-Dove observed on a Virginia CBC was a single bird in 2003 on the Cape Charles count. Sixteen years later, in 2019, 46 Eurasian Collared-Doves were seen on four counts plus there were two count week observances: 1 Chincoteague, 3 Cape Charles, CW Back Bay, 37 Rockingham County (a local high count), CW Blacksburg, and 5 Glade Spring. A single White-winged Dove was photographed on the Cape Charles count where it was a new species. The only other White-winged Dove documented on a Virginia CBC was 1 recorded in 1987 on the Wachapreague CBC.

Ten counts logged 16 Barn Owls. This is slightly higher than the ten-year running average which has remained around 15 since 2010. Eastern Screech Owl numbers exceeded last year's number by nearly 50 as 197 were seen this season on thirty-seven counts but only 148 last year. Great Horned Owls were tallied on thirty-six counts with a total of 142 plus two count week observations. Their ten-year running average has been declining for some time; this average dropped below 200 for the first time in 2007 and has continued to drop to only 167 this year. However, Barred Owl numbers have been increasing over the past four decades; their ten-year running average was 57 in 1989 and has nearly doubled to 99 this year. Barred Owls were recorded on thirty-three counts with a total of 124 plus one count week observation. As was the case last year, the only Long-eared Owl was encountered on the Northern Shenandoah Valley CBC. Four Short-eared Owls were found on three counts: 1 Hopewell, 1 Calmes Neck, and 2 Augusta County which is down from 8 detected on five counts last year.

Last year the only hummingbird species encountered was a single Ruby-throated Hummingbird in Cape Charles; this year, not a single Ruby-throated Hummingbird was tallied. But a variety of other hummingbirds made up for that. A Black-chinned Hummingbird was well documented on the Williamsburg count and is under review by the Virginia Avian Records Committee (VARCOM); the only other Black-chinned Hummingbird recorded on a Virginia CBC was one on the Lynchburg count in 2007. As mentioned earlier, an Anna's Hummingbird was observed and photographed (Figure 1) on the Northern Shenandoah Valley count; this bird was submitted and has already been accepted by VARCOM. Three Rufous Hummingbirds: 1 Rappahannock and 2 Blacksburg, were seen for the first

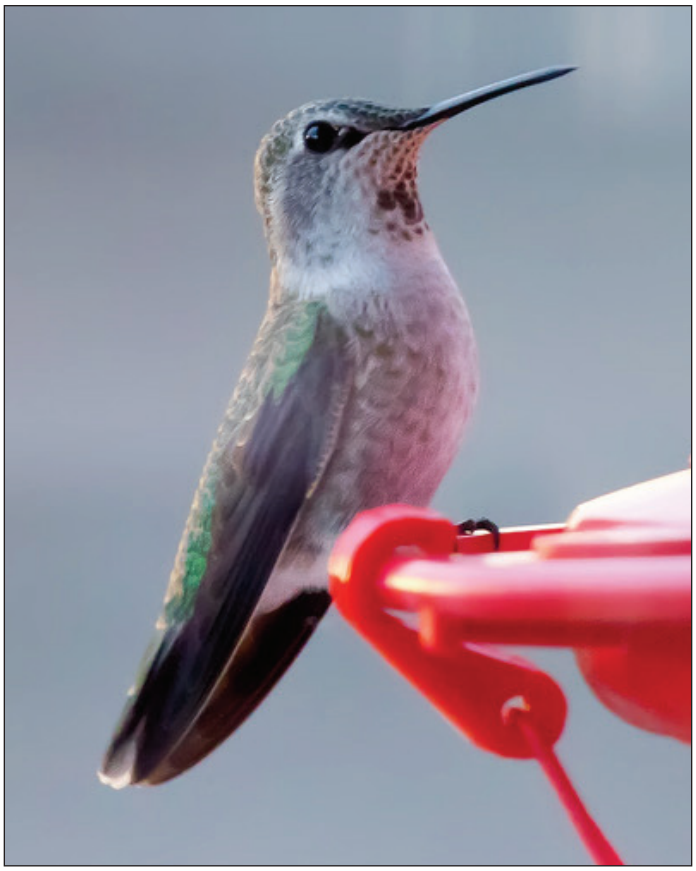

FIGURE 1. Anna's Hummingbird photographed 5 December 2019 on the 2019 Northern Shenandoah Valley CBC. Photograph courtesy of Dave Boltz.

time since 2017 when one was found and this year, they were all photographed.

Although no Red-cockaded Woodpeckers were reported this year after being recorded for the last three years on the Dismal Swamp CBC, other woodpeckers were seen in abundance in 2019: Red-headed Woodpecker (415), Red-bellied Woodpecker (3,932), Yellow-bellied Sapsucker (1,156), Downy Woodpecker (2,704), Hairy Woodpecker (461), Northern (Yellow-shafted) Flicker (2,773) and Pileated Woodpecker (1,309). Many counts established new high counts for more than one woodpecker species this year.

Ash-throated Flycatchers were found for the second year in a row. In 2018 a single Ash-throated Flycatcher was seen at Back Bay. Surprisingly in 2019, an Ash-throated Flycatchers were documented on each of three counts:1 Little Creek, 1 Nansemond River, and 1 Dismal Swamp (photographed in Dismal Swamp, Figure 2).

Loggerhead Shrikes numbers were about the same this year when 10 were seen (1 Calmes Neck, 1 Northern Shenandoah Valley, 1 Blacksburg, 2 Glade Spring, 4 Blackford, and 1 Bristol) as 12 were reported last year.

FIGURE 2. Ash-throated Flycatcher photographed on the 2019 Dismal Swamp CBC. Photograph courtesy of Cindy Hamilton.

Five counts recorded single White-eyed Vireos: Chincoteague, Back Bay, Nansemond River, Northumberland-Lancaster, and Sandy River Reservoir (this last one was photographed); three of these are coastal counts where White-eyed Vireos show up fairly regularly but this was a new species for Northumberland-Lancaster and Sandy River Reservoir. A single Yellow-throated Vireo was photographed on the Cape Charles CBC where it was a new species (Figure 3). The only other time a Yellow-throated Vireo was tallied on a Virginia CBC was on the Back Bay

FIGURE 3. Yellow-throated Vireo photographed on the 2019 Cape Charles CBC. Photograph courtesy of Michael Walter.

count in 1970. The second highest number of Blue-headed Vireos, 29, were seen this year; the highest was 30 in 1992. The ten-year running average for Blue-headed Vireos has been around 10 for most of the time since 2000 but this ten-year average may start rising if these high numbers continue as 20 Blue-headed Vireos were found in 2018.

The 74 House Wrens were below the 95 from 2018. But the 95 House Wrens reported last year were the most seen in the last twenty years and there were years in that period where the numbers recorded were in the teens, so 74 is still an encouraging number. The 27 Sedge Wrens observed were on six Coastal counts including one found as far west as Hopewell (where it was photographed, Figure 4); this is the second highest number reported in the last ten years (33 were detected in both 2011 and 2012). Marsh Wren numbers were the second highest in the last twenty years as 51 were documented on nine counts compared to the high for the period of 53 in 2016. This is especially encouraging as the lowest numbers since 2000 were 5 and 4 recorded in 2009 and 2010, respectively. A record high count of Carolina Wrens was a pleasant surprise since the very first ones were logged on a CBC in Virginia in 1909 as 6,962 were tallied this year!

FIGURE 4. Sedge Wren photographed on the 2019 Hopewell CBC. Photograph courtesy of Ellison Orcutt.

Warbler species were not as numerous: 5 Black-and-white Warbler, 39 Orange-crowned Warbler, 14 Common Yellowthroat, CW American Redstart (photographed in Clifton Forge), 1 Yellow Warbler (photographed in Hopewell, Figure 5), 111 Palm Warblers (including 7 identified as Western & 3 identified as Eastern), 323 Pine Warbler, 10,047 Yellow-rumped (Myrtle) Warbler, 1 Yellow-throated Warbler (CW Little Creek, and Williamsburg), and 1 Wilson's Warbler (Manassas-Bull Run).

FIGURE 5. Yellow Warbler photographed on the 2019 Hopewell CBC. Photograph courtesy of Arun Bose.

Nelson's Sparrow numbers were up as 21 were seen compared to only 9 in 2018 and 5 in 2017. Their ten-year running average has dropped to the mid-teens for the past four years. Saltmarsh Sparrow numbers were also up with 37 compared to 8 in 2018 and none in 2017. This upward trend continues with Seaside Sparrows as 19 were recorded this year compared to 6 in 2018 and 4 in 2017. American Tree Sparrow reverses the trend with only 18 logged this year compared to 33 in 2018 and 27 in 2017. This is the lowest number of American Tree Sparrows found in the last fifty years of CBCs. Since the range for American Tree Sparrows has shrunk to the point that only the area along the northern border of the state is included in their winter range, this is not too surprising. Chipping Sparrow numbers have been increasing; over 2,000 were tallied this year and last year (2,230 in 2019 and 2,203 in 2018). Their ten-year running average is now 1,789 and has been steadily increasing since 2000 when this average was only 583. Field Sparrow numbers continue to decline; 1,559 were reported in 2019. Their ten-year running average is now 1,613 which is far below its peak of over 4,000 in the mid-1980s.

The only Lark Sparrow recorded on a Virginia CBC was a new species photographed on the Little Creek count (Figure 6); Lark Sparrows have been observed on three Virginia CBCs since 2010 (Cape Charles in 2010, Waynesboro in 2011, and Back Bay in 2016). Fox Sparrow numbers were low this year with only 275 found; but their ten-year running average has been around 400 since 2015 so hopefully this was just one low year. Dark-eyed (Slate-colored) Junco numbers have been falling; for the past five years, their numbers have been below 20,000, dipping close to 10,000 this year (18,900 in 2015, 19,567 in 2016, 18,472

FIGURE 6. Lark Sparrow photographed on the 2019 Little Creek CBC. Photograph courtesy of Una Davenhill.

in 2017, 13,281 in 2018 and only 10,103 in 2019). White-crowned Sparrow numbers in 2019 were less than half what they were in 2018 (1,482 seen in 2018 versus 636 in 2019). However, White-throated Sparrow numbers have been fairly stable for twenty years; the ten-year running average has been around 20,000 since the mid 2000s. This year 18,820 White-throated Sparrow were tallied.

The only Vesper Sparrows were 2 reported at Cape Charles. This is below the ten-year running average of around 5 that we've tallied since the mid 2000s. The Savannah Sparrow numbers vary somewhat year-to-year but their ten-year running average has hung around 1,000 since 2010. This year 883 Savannah Sparrows were seen which is slightly above the 831 observed last year. Ipswich Savannah Sparrows were logged on five counts this year: 18 Chincoteague, 10 Wachapreague, 20 Cape Charles, 3 Little Creek, and 11 Back Bay, so the total number of Savannah Sparrows including the Ipswich subspecies recorded this year is 945. Song Sparrow numbers have been similar for the last three years as 10,420 were found in 2017, 10,118 in 2018 and 10,063 this year. Lincoln's Sparrow usually turns up on a count or two each year; this year was no exception with 1 reported at Hopewell and 1 at Fort Belvoir. For five of the last six years, Fort Belvoir has recorded at least one Lincoln's Sparrow. Swamp Sparrow numbers have been fairly consistent for the last three years (1,524 in 2017, 1,464 in 2018 and 1,423 this year). The number of Eastern Towhees has increased every year for the last four years (985 in 2016, 1,039 in 2017, 1,152 in 2018 and 1,200 this year).

Red-winged Blackbird numbers vary significantly from year-to-year; this year 75,208 were logged which is back up from 35,539 last year, but is still nowhere near the ten-year high of 188,136 from 2011. The number of Eastern Meadowlark was 1,179 which is up from the ten-year low of 878 last year. Rusty Blackbird numbers were over triple their number from last year as 1,440 were seen this year compared to 381 last year. Nine Brewer's Blackbirds were documented on two counts this year: 6 Back Bay and 3 Walkerton (a new species for this count), after being missed last year. Common Grackle numbers are more than double what they have been for the previous three years (18,105 in 2016, 21,247 in 2017, 16,038 in 2018 and 46,271 in 2019). Boat-tailed Grackle numbers were above 1,000 at 1,007; that many haven't been reported since 1,078 in 2011. Brown-headed Cowbird numbers were up at 5,274 after only being in the 3,000s for the last four years. The 27 Baltimore Oriole (Figure 7) were the highest number observed in the last forty years. Local record highs for Baltimore Oriole occurred on two counts: 9 Little Creek and 2 Charlottesville.

Irruptive species were not expected in great numbers this year but a few showed up across the Commonwealth. A total of 36 Red-breasted Nuthatch were seen on eleven counts. Sixteen counts recorded 65 Purple Finches. Four CBCs tallied 9 Pine Siskins.

As in the past, species data for all of the Virginia CBCs is tabulated into one large table. But that table is no longer being published in *The Raven* to accompany this report. This comprehensive table listing all fifty-eight counts with all of the species reported on each count plus the numbers for each species can be viewed by clicking on the 2019 link on the Christmas Bird Count page on the VSO website (https://www.virginiabirds.org/events/christmas-bird-counts). Details on individual Audubon CBCs can also be found on the National Audubon Society's Christmas Bird Count website at http://netapp.audubon.org/cbcobservation/.

FIGURE 7. Baltimore Oriole photographed 6 December 2019 on the 2019 Charlottesville CBC. Photographed courtesy of Marshall Faintich.

Barn Owl Nest Box Productivity in Prince William and Fauquier Counties Virginia, 1986-2009

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Abstract

In a study area in Northern Virginia nest boxes placed for Barn Owls (*Tyto alba*) in retired silos were monitored annually for occupancy and productivity from 1986-2009. The percentage of available boxes occupied by Barn Owls varied yearly, ranging from 23-85% with a mean occupancy rate of 56 ± 0.13%. The success rate, defined as nests from which at least one Barn Owl fledged per occupied nest box, varied yearly from 57-95%, averaging 81 ± 0.09%. During this study, a total of 1928 Barn Owls fledged from 571 occupied nest boxes; a mean of 3.3 ± 0.79 owls fledged per occupied box with a declining trend of 0.7% annually.

Intoduction

The Barn Owl (*Tyto alba*) is the most widely distributed owl species in the world, inhabiting every continent except Antarctica. Its habitat includes open farmland, grassland, and marshes where small rodents, its preferred prey, are abundant (Marti et al. 2005). Barn Owls nest and roost in a variety of natural cavities such as those found in trees, cliffs, caves, and riverbanks. Man-made structures are also utilized by nesting Barn Owls and include abandoned houses, church steeples, barn lofts, duck blinds, empty water towers, haystacks, and nest boxes (Colvin et al. 1984). Breeding pairs are limited by the availability of nest sites in proximity to adequate densities of small mammals, particularly Meadow Voles (*Microtus pennsylvanicus*). Barn Owl populations can decline severely during extended cold periods with heavy snow cover (Marti et al. 2005). Loss of suitable foraging habitat and nesting sites are known to adversely affect Barn Owl populations (Marti et al. 2005), however, nest box programs can be used as a management tool to increase numbers (Colvin et al. 1984).

During 1985 and 1986, a statewide Barn Owl survey was conducted in Virginia; it suggested Barn Owls should be listed as state threatened due to population declines (Rosenburg 1986). Currently Barn Owls are listed in Virginia as "a species of special concern" (Virginia Department of Wildlife Resources 2021). A large scale, long-term Barn Owl nest box study was initiated in the Northern Virginia Piedmont in 1986 by Ken Bass and Mark Causey with the help of monetary contributions from William Thomas and the Metropolitan Washington Raptor Society. Additional nest boxes were provided by Chuck Rosenburg (Causey 1989). Discussed herein are the results from annual monitoring of occupancy and productivity in Barn Owl nest boxes in silos from 1986 to 2009.

Methods

The study area comprises a long oval from central Prince William County, just southwest of Manassas including the towns of Bristow and Nokesville and extending southwest to Bealeton at state route 17 in south central Fauquier County including the towns of Midland, Calverton, and Catlett, all somewhat centered on state route 28. The land encompasses an area of approximately 19,500 hectares. Habitat was mostly former dairy farms and some active beef cattle farms where approximately 35-40% of open fields were fallow or pastureland at the beginning of the study. By 2009 only 5-10% of the fields were fallow and the remaining fields were intensively farmed with corn, soybeans, and tame hay being the major crops.

Barn Owl nest boxes were initially installed in both barns and silos in 1986 and 1987 but, after finding zero occupancy of nest boxes in barns, all nest boxes were relocated into silos by 1988. The data presented here is solely derived from nest boxes in silos. Wood nest boxes were placed at the top or three-quarters of the way up silos of various heights. In open top silos, boxes were placed at a height such that they would receive as little direct sunlight as

possible during the hot summer months. Initially, nest boxes in capped silos were constructed with a 30 x 60 cm floor and 30 cm walls. We quickly learned that the first design was too small for large broods, therefore, all boxes were redesigned beginning in 1988 with a 45 x 60 cm floor and 30 cm walls. In both designs half of the top was covered with plywood. In uncapped silos nest boxes had the same floor dimensions but the front panel measured 60 cm tall with a 15.24 cm entrance/exit hole at a 30 cm height from the floor. The roof was completely covered and sloped to allow rain runoff.

Initial nest box visits were made between mid-March and early July. Autumn nest visits were made in some years during early November to early December. Silos were climbed by Mark Causey or his assistants, Ken Bass or Kennon Smith, to visually determine nest box contents and/or age of the young. Depending on the stage of incubation or brooding, return visit timing was calculated such that nestlings at 5-6 weeks of age were likely to survive and successfully fledge. If young owls were estimated to be older than 6 weeks, silos were not climbed to prevent premature fledging and possible injury. Following each nest visit a raccoon repellent, such as Dog-Away spray, was applied around the base of the silo chute or moth balls were placed in a mesh bag and hung from a lower step of the silo chute.

An occupied nest box is defined as one in which at least one fresh Barn Owl egg was observed. A successful nest is defined as one in which at least one young fledged (Steenhof and Newton 2007). Number fledged is based on nestlings that survive in the nest to at least 5-6 weeks of age. Statistical analyses were performed using Excel.

Results

Figure 1 presents the number of available nest boxes (bars) and the percentage that were occupied by Barn Owls (dashed line) by year. Over the 24-year period, from 1986 to 2009, there was an average of 41 available nest boxes (n = 985; range = 16-52). The occupancy rate varied from a low of 23% in 1986 to a high of 85% in 1993. The mean occupancy rate over the 24-year study period was 56.8 ± 0.13% with no significant trend (n = 571 total occupied boxes).

Over the 24-year period, we calculated the success rate, as defined by Steenhof and Newton (2007). We had 571 occupied nest boxes with 475 nests that produced at least one young reaching 5-6 weeks of age (Fig. 2). The overall success rate was 82.5 ± 0.09% with annual fluctuation from a low of 57% in 2003 to a high of 95% in 2004. Linear regression of success rate over time indicates an insignificant annual rate of decline (Fig. 2). We found that the success rate remained stable during the 24 years of this study as indicated by the nearly flat trend line ($r^2 = 0.0.135$, $y = 0.0015x + 0.8436$).

Productivity, based on numbers of Barn Owls fledging per nest box, decreased slightly during the 24-year study period (Fig. 3). Numbers of Barn Owls fledged per successful box (mean = 3.9 ± 0.70) declined slightly at a rate of 0.7% per year or 15% over 24 years. Between 1986 and 2009, a total of 1928 Barn Owls were fledged during this nest box program.

Known second nesting attempts and success rates

Searches were conducted for second nesting attempts during late autumn in ten different nesting seasons. In 5 of the 10 years in which we investigated, second nesting attempts by Barn Owls were observed at 16 sites, of which

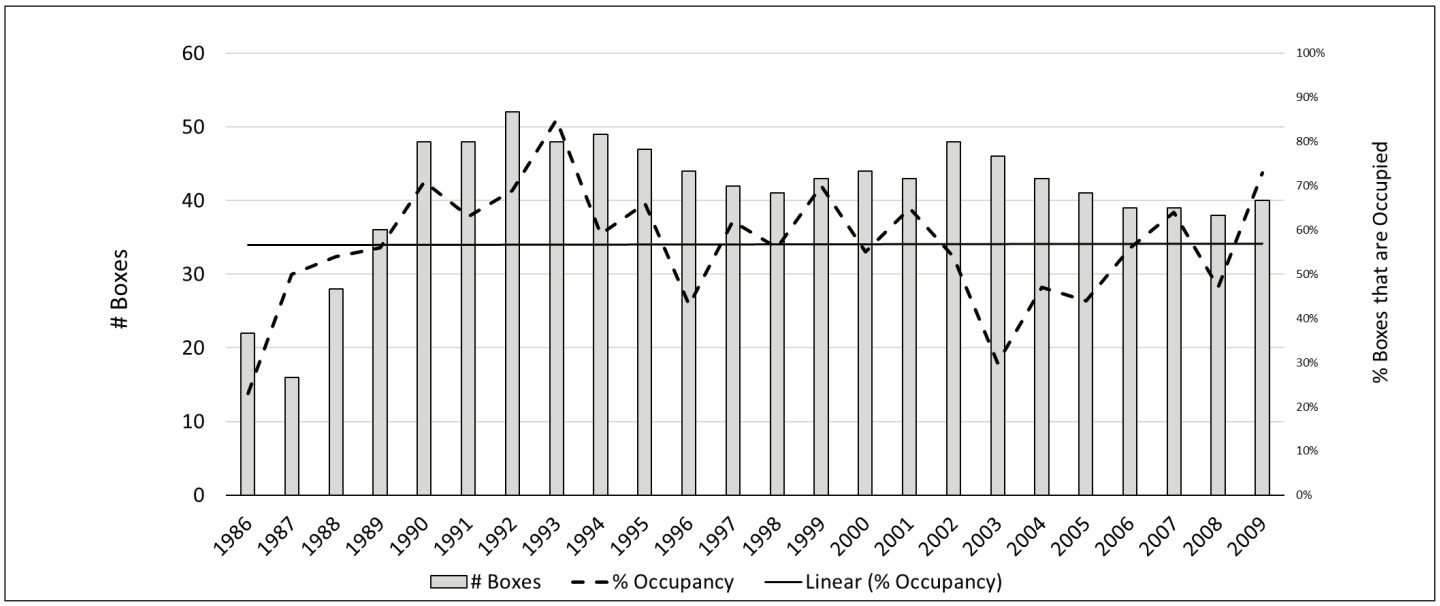

FIGURE 1. Number of Barn Owl nest boxes and annual occupancy rates in Northern Virginia from 1986-2009. The percentage occupancy trend line is flat with an $r^2 = 2E-05$ and the equation is $y = 8E-05x + 0.5665$.

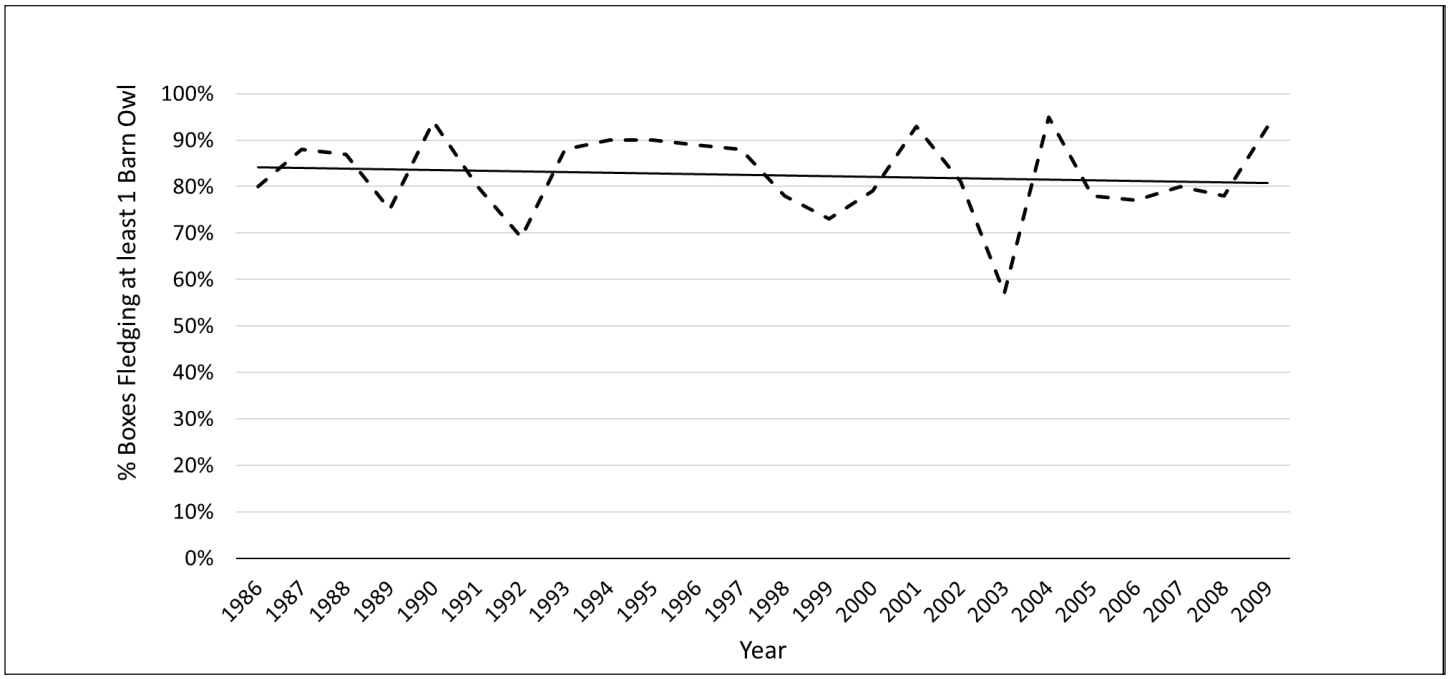

FIGURE 2. Percentage of occupied Barn Owl nest boxes that produced at least one fledgling by year (i.e., % of occupied boxes that were successful).

15 (94%) were successful. These second nesting attempts could represent either a new pair or a second attempt by the same pair of owls, but since adult owls were not captured and color marked, it is impossible to make a definitive conclusion.

Discussion and Recommendations

In the mid-1980s, Rosenburg (1986) conducted a statewide survey for the Virginia Game Commission (now the Virginia Department of Game and Inland Fisheries) and concluded that the area around Nokesville in Prince William County had one of the highest concentrations of Barn Owls in Virginia (pers. comm).

Occupancy of Barn Owl nest boxes during this research varied widely by year and there was no discernable trend over 24 years. However, productivity, as measured by the number of young fledged per nest box, showed a non-significant decline during the same period (see Figure 3). This situation is contrary to American Kestrels (*Falco sparverius*), whose populations have declined for decades for uncertain reasons. Occupancy rates in some American Kestrel nest box programs is decreasing while maintaining a steady number of fledglings per nest (Smallwood et al 2009).

Productivity of Barn Owls is dependent on many variables including, but not restricted to temperature and precipitation patterns, nest predation, age and experience of adults, hatching success, and prey populations (Marti 1994, Otteni et al 1972). Rosenburg's Barn Owl study in Virginia reported similar productivity in nest boxes: 3.0 young fledged per occupied box and 3.5 fledged per successful box. He documented that Barn Owl productivity is approximately 0.4-0.6 fledglings/nest higher in nest boxes than in natural cavities or other nest sites (Rosenburg 1986).

In a nest box study in Israel, occupancy of nest boxes by Barn Owls was not related to weather variables, but numbers of young fledged per nest was correlated with precipitation and temperature during the breeding season (Charter et al 2017). In their northern U.S. range, Barn Owls are susceptible to die-offs during cold periods with 12 cm or more snow cover (Marti and Wagner 1985, Errington 1931). Two of the present authors (LM and JM) have made similar observations in a study area in the Shenandoah Valley of Virginia (Morrow and Morrow, unpubl. data). Although winter weather is known to kill Barn Owls, it is not a major factor in long-term population trends in the Shenandoah Valley or in Great Britain (Taylor, 1992), probably because Barn Owls can repopulate a region rapidly with immigration and their high reproductive rate (Marti 1994, Marti et al 2005).

The major factor affecting the Barn Owl population in Northern Virginia is loss of foraging habitat and nest sites due to residential and commercial development, and conversion of hayfields and pastures to row crops (Rosenburg 1986, Peterjohn 1989). It is difficult to make meaningful recommendations to preserve Barn Owls in this increasingly urbanized area, as most land is privately owned, and Barn Owls have no legal protection to support/mandate land uses that benefit them.

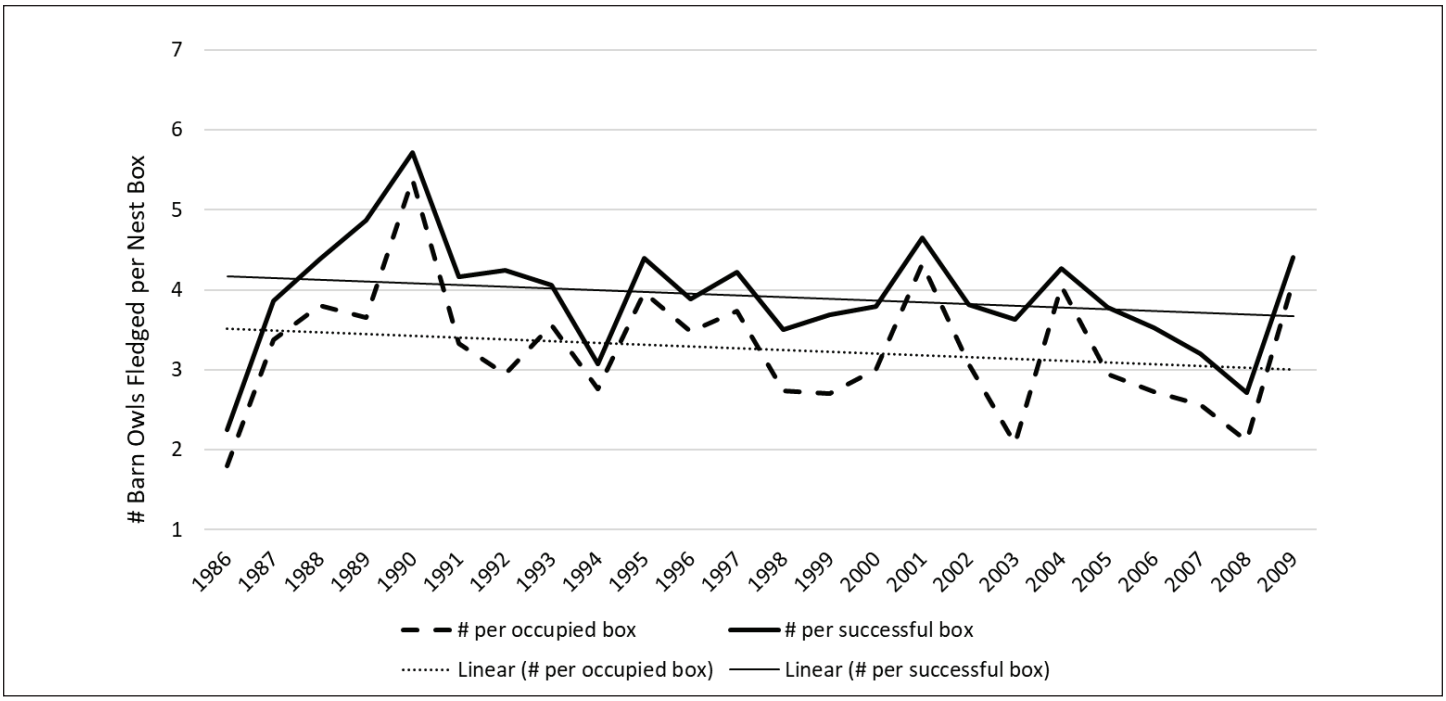

FIGURE 3. Numbers of Barn Owls fledging per Barn Owl nest box by year, expressed per occupied or per successful nest box. The trend line for # fledglings per occupied box decreased slightly with an $r^2 = 0.0379$ and the equation is $y = 0.0223x + 3.536$. The trend line for # fledglings per successful box also decreased slightly with an $r^2 = 0.0457$ and the equation is $y = 0.0216x + 4.1893$.

Raccoons (*Procyon lotor*) are a major predator of Barn Owl eggs and young (Rosenburg 1986, Morrow et al 2009). We recommend that all known active Barn Owl nest sites be improved by preventing mammals such as Raccoons, feral house Cats (*Felis catus*) and Opossum (*Didelphis virginiana*) from entering (Morrow and Morrow 2020). Predator-proofing will likely increase Barn Owl nest success as long as there is suitable habitat with enough prey near the nest site. Research for this study was conducted under Virginia Scientific Collection Permits 16119, 19406, 23844, 28707, and 34046.

Acknowledgements

We would like to thank Ken Bass for his efforts in approaching landowners and gaining their permission to place nest boxes on their farms and for his assistance in the field. Kennon Smith also spent many hours assisting with the field work. Thanks to Chuck Rosenburg for allowing us to incorporate 6 game commission nest boxes into our study. Finally, we appreciate the cash contributions that the Metropolitan Washington Raptor Society and William Thomas donated toward nest box building supplies.

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Registration and Management Recommendations for Barn Owl (*Tyto alba*) Roost and Nest Sites in Virginia's Northern Shenandoah Valley

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Abstract

From 2009-2015 we located and monitored 25 Barn Owl (*Tyto alba*) roost sites and 34 Barn Owl nest sites in the Shenandoah Valley Raptor Study Area of Virginia. Of these sites, 53.5 were in farm silos, 3.5 were in barns, 1 in a bean hopper and 1 in a hay dryer. Barn Owls avoid silos occupied by breeding Domestic Cats (*Felis catus*) or Raccoons (*Procyon lotor*) but will roost and nest in silos containing a small number of Rock Pigeons (*Columba livia*). Registering exact locations of Barn Owl roost and nest sites is important for future monitoring of occupancy and habitat changes. We present a registry along with a management plan to protect Barn Owl sites from mammalian predators and to potentially increase Barn Owl productivity. Recommendations include: continue monitoring active Barn Owl sites, predator-proof 44 active silos, and open sealed retired silos located in suitable habitat.

Introduction

The Barn Owl (*Tyto alba*) is widely distributed in open habitats across the world. Lack of accurate data on density and population trends in most portions of their range make Barn Owl management and conservation problematic (Marti et al. 2020). Traditional techniques used for determining populations and trends of most species, including the Breeding Bird Survey (BBS), Christmas Bird Count (CBC), and raptor migration counts, are not suitable for assessing Barn Owls for several reasons. Barn Owls are secretive, roosting in concealed locations during the day, they do not vocalize or respond to calls and, because they are nocturnal, they are not active during the hours that surveys are conducted. A BBS review acknowledges that Barn Owl survey data are not very credible (Sauer et al. 2014). Improving census techniques for Barn Owls is considered a priority for future research (Marti et al. 2020).

Barn Owls are cavity nesters, laying eggs atop shredded pellets in holes in trees, rock outcrops, caves, river and arroyo banks, church steeples, barns, cavities in buildings, drive-in movie screens, nest boxes, hay stacks, duck blinds (Scott 1971), and deer blinds (Marti et al. 2020). Our hypothesis, formulated prior to surveying, was that the highest probability of locating Barn Owls within the Shenandoah Valley Raptor Study Area (SVRSA) was to look in farm silos, which are common locally (Morrow et al. 2009).

There is a growing trend of identifying and mapping exact locations of avian species in Virginia and elsewhere for future monitoring and management. Locations of Bald Eagle (*Haliaeetus leucocephalus*) nest and roost sites are available online (Watts and Byrd 2013), as are Osprey (*Pandion haliaetus*) nest site locations (OspreyWatch 2020); Eastern Screech-Owl (*Megascops asio*) distribution in Highland County, Virginia has been described in detail (Spahr 2015); and sightings of most species are available online at websites like eBird (eBird 2020).

Reports of Barn Owl roost and nest sites in Virginia are sporadic and serendipitous (Clapp 1997, O'Bryan et al. 2008). Our objectives include: 1) create a registry with exact locations of Barn Owl roost and nest sites in the Shenandoah Valley of Virginia for future monitoring of occupancy and habitat changes; 2) manage existing active Barn Owl roost and nest sites through predator-proofing to increase breeding productivity; and 3) increase nest site availability by opening and predator-proofing retired farm silos that owls currently cannot access. We hope to inspire the creation of a statewide Barn Owl registry and monitoring program for conservation and management.

Study Area

The Shenandoah Valley Raptor Study Area of Virginia (SVRSA) is centered on Timberville, Virginia and encompasses approximately 38,300 hectares of northern Rockingham and southern Shenandoah Counties as previously described in a study of Loggerhead Shrikes (*Lanius ludovicianus*) in the area (Morrow and Morrow 2015).

Methods

Based on our hypothesis that Barn Owls prefer retired silos, we primarily looked for signs of Barn Owls occupying silos. In 2009, all 516 km of roads within the SVRSA were traveled

while looking for silos with openings large enough for Barn Owls to enter (10-12 cm minimum). Upon finding silos that appeared accessible to Barn Owls, we asked landowners' permission to check the silo for Barn Owl activity. Landowners sometimes suggested checking other farm structures including barns, bean hoppers, and a hay dryer for signs of owls. Over 150 silo sites (some sites had >1 silo) were physically surveyed for owls within the SVRSA.

An active roost site was defined as presence of Barn Owl(s), fresh pellets, molted feathers (molt begins in late April and concludes in December), and/or fresh owl excrement at least once during 2009-2015. A nest site was defined as presence of Barn Owl(s) and their eggs, eggshell fragments, or young Barn Owls (see Figs. 1 and 2) at least once during 2009-2015.

Each active Barn Owl site was plotted on USGS 1:24,000-scale topographic maps and given an alphanumeric designation as indicated in Table 1: map A is Timberville, VA; map B is New Market, VA; map C is Singers Glen, VA; map D is Broadway, VA; and map E is Tenth Legion, VA. Google Earth™ was used to plot active Barn Owls sites, record their UTM coordinates, and measure relative locations (i.e. how far apart sites were from one another). When possible, all active Barn Owl sites were subsequently visited annually during spring or summer to determine the occupancy by Barn Owls. Other researchers have found that frequent visits to Barn Owl nests did not reduce the number fledged or mass of fledgling owls compared to nests visited only once just prior to fledging, nor did multiple nest checks cause parent owls to abandon the nest sites in subsequent years (Taylor 1991).

All active sites were evaluated individually for management priority ranking, which is based on the number of years the site was active and the functional state of the silo, i.e.

FIGURE 2. Barn Owl nestling from site D1 on 28 May 2011. As typical with multi-silo sites, the smallest silo (directly behind owl's head) contains nesting Barn Owls. Photo by Lance Morrow.

FIGURE 1. Cluster of 5 nestling Barn Owls on floor of old silo site C1 photo taken by Chris Morrow on 10 June 2014.

whether the silo was occupied frequently by owls and whether predators could be excluded from the silo. Sites are ranked numerically with sites ranked #1 to be managed first, #2 sites next, and #3 sites having lowest priority (Table 1). Unranked sites are those already protected from predators and require no intervention.

Results

Fifty-nine active Barn Owl sites within the SVRSA were surveyed annually (when possible) for the presence of roosting or nesting Barn Owls (Table 1). In addition, each active site was evaluated and ranked for management priority; i.e. ranked as to when it should be predator-proofed.

It is likely that we did not identify all active Barn Owl sites within the study area for several reasons. There were probably active silos with small openings we could not see from the road. Also, several structures within towns where Barn Owls had bred in the past were not surveyed (L. Morrow, unpubl. obs.). It is known that Barn Owls roost or nest in chimneys, wells, cisterns, buildings, church steeples (Marti et al. 2020), hollow trees (Colvin et al. 1984), and bank burrows (Millsap and Millsap 1987); however, none of these potential nest sites was targeted by our survey within the SVRSA.

Most active Barn Owl roost and nest sites were found in silos (90.7%) with the remainder of the active sites in barns (5.7%), bean hoppers (1.7%), and hay dryers (1.7%). Of the 59 active Barn Owl sites, 15 (25.4%) required no work, 21 (35.6%) were ranked management priority #1, 10 (17%) were ranked #2, and 13 (22.0%) were ranked #3. Unranked sites were those already protected from predators and requiring no intervention. Remaining sites were ranked numerically by their prioritization in time; first ranked sites should be managed first, and so on.

While conducting this study, we observed a negative correlation between Barn Owls roosting and nesting in silos containing domestic cats, raccoons, or more than one or two breeding pairs of Rock Pigeons (data not shown). The effects of predation on Barn Owl productivity were not determined during this study. Some areas of the SVRSA contain suitable Barn Owl habitat and retired silos, but with sealed silos that prevent Barn Owl entry.

Discussion

By registering Barn Owl roost and nest sites, researchers can assess current populations and analyze habitat associations. In addition, future researchers can document habitat changes over time and assess how they impact Barn Owl populations. Barn Owl density is determined by habitat which supports sufficient small mammal populations coupled with availability of roost and nest sites (Colvin et al. 1984, Otteni et al. 1972). Changing agricultural practices, include shifting from hayfields and pastures to monoculture row crops due to no-till farming, reduce prey populations that Barn Owls depend upon (Colvin 1985; Colvin and McLean 1986).

The purpose of this study was to collect baseline data on Barn Owl populations from 2009-2015 in the northern Shenandoah Valley of Virginia. Within the SVRSA Barn Owls are common where there is adequate foraging habitat and retired silos. The area with the highest known Barn Owl density within the SVRSA is located about 4 km southwest of Broadway in Rockingham County; it had 8 active Barn Owl sites within one square mile (259 ha). This finding is likely due to the local preponderance of hayfields, which support the Barn Owls' preferred prey, small mammals such as the meadow vole (*Microtus pennsylvanicus*). Because Barn Owls breed at an early age, and have large clutches with the potential to raise multiple broods per year, a good strategy for augmenting populations is to make high-quality nest sites available (Chien and Ritchison 2011). We posit that Barn Owls in the SVRSA are currently constrained by availability of suitable nest sites and the study area can support more breeding Barn Owls. Barn Owls are not territorial of foraging areas (Smith and Marti 1976), and there are sealed retired silos that are potential nest sites if owls are allowed access. Our survey found that Barn Owls strictly avoided silos that were occupied by house cats or northern raccoons, perhaps due to the threat of predation by these mammalian predators. Data from over 24,000 nest attempts monitored by Nest Watch citizen scientists indicates predator guards on nest boxes can increase nest success by up to 7% over nest boxes without guards (Bailey and Bonter 2017). It is our contention that the Barn Owl nest sites will similarly benefit from predator-proofing by increasing the proportion of successful nests.

We estimate that, with active management to protect roosting and nesting sites from mammalian predators, the SVRSA could conservatively fledge over 200 young Barn Owls annually. However, this estimate of Barn Owls fledglings could be much higher, as many Virginia Barn Owls breed again in the fall, producing fledglings in November and December (M. Causey pers. comm.). Herein, we present a cost-effective management plan for known breeding sites, including predator-proofing and opening inaccessible retired silos in the SVRSA, to protect and promote a sustainable Barn Owl population.

Recommendations

Recommendations include: continuing this monitoring program; implementing predator-proofing of active roost and nest sites (starting with # 1 ranked sites); and opening the tops of sealed retired silos situated in suitable Barn Owl habitat. Ideally, an organization like The Virginia Society of Ornithology, local Audubon or Virginia Master Naturalists chapters, or the Center for Conservation Biology would manage the project.

Silos with management rankings can be predator-proofed using custom-cut plywood and hinges to seal the bottom of their chutes, thereby preventing mammalian predators and perhaps snakes from entering the bottom of the silo. Material costs of this Barn Owl management plan to predator-proof silos is approximately $65 per site. The estimated time for a team of 2 people to accomplish predator-proofing is approximately 5 man hours per silo, thus 2 people can predator-proof 3 silos per day. The procedure for monitoring a predator-proofed silo is to verify that the Barn Owls are not nesting on top of the plywood. A peep-hole could be drilled into the side of the chute above the plywood; or someone can enter the silo at the lowest chute door to check to see where owls are nesting. After predator-proofing is accomplished, we recommend opening the chute doors from 3 m up to the top because fledging of Barn Owls is enhanced if there are perches within the silo (pers. obs.). We have found dead fledglings inside silos with no internal perches and suspect the young owls never fledged because they were not strong enough to fly vertically from the bottom of the silo to the top opening (typically 10-30 m).

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Table 1. Active Barn Owl Sites in the SVRSA, 2009-2015, with Management Recommendations

							Years Active				Management Priority Ranking			
Site	Location (UTM)	Known Breeding Site	Known Roost Site	Silo	Barn	Other	1	2 to 3	4 to 5	6 to 7	None	#1	#2	#3
A1	17S 692915.92 m E 4288253.42 m N		1	1			1					1		
A2	17S 689377.79 m E 4282415.22 m N	1		1						1	1			
A3	17S 686932.21 m E 4279050.62 m N		1	1				1						1
A4	17S 695620.01 m E4284385.73 m N		1	1				1						1
A5	17S 692460.60 m E 4281371.28 m N		1	1					1			1		
A6	17S 691930.24 m E 4279688.36 m N	1		0.5*	0.5			1					1	
A8	17S 692047.00 m E 4278359.00 m N	1		1					1		1			
A9	17S 692289.76 m E 4277854.80 m N	1		1				1			1			
A10	17S 692678.50 m E 4277694.12 m N	1				1				1	1			
A11	17S 690906.95 m E 4278017.38 m N		1		1		1				1			
A12	17S 691561.61 m E 4277703.02 m N		1	1			1							1
B1	17S 696489.01 m E 4286613.44 m N	1		1					1			1		
B2	17 S 696010.25 m E 4279254.85 m N	1		1					1			1		

CONTINUED. Table 1. Active Barn Owl Sites in the SVRSA, 2009-2015, with Management Recommendations

							Years Active				Management Priority Ranking			
Site	Location (UTM)	Known Breeding Site	Known Roost Site	Silo	Barn	Other	1	2 to 3	4 to 5	6 to 7	None	#1	#2	#3
B3	17S 696577.17 m E 4279589.82 m N	1		1						1		1		
B4	17S 697023.40 m E 4278143.71 m N	1		1			1				1			
B5	17S 697687.45 m E 4278359.23 m N	1		1						1		1		
B6	17S 698365.44 m E 4278998.71 m N	1		1			1				1			
B13	17 S 701451.74 m E 4277779.28 m N		1	1				1					1	
B15	17 S 697277.79 m E 4278348.11 m N		1		1			1						1
B30	17S 696685.37 m E 4289286.29 m N	1		1					1			1		
B31	17S 699047.00 m E 4288379.00 m N		1	1				1				1		
B19	17S 702940.47 m E 4279987.42 m N		1	1			1							1
C1	17S 683998.87 m E 4274093.62 m N	1		1						1		1		
C2	17S 683017.09 m E 4271779.64 m N		1	0.5*	0.5			1				1		
C3	17S 682039.23 m E 4269679.19 m N	1		1					1			1		
C4	17S 680498.74 m E 4268898.75 m N		1	1				1			1			

CONTINUED. Table 1. Active Barn Owl Sites in the SVRSA, 2009-2015, with Management Recommendations

							Years Active				Management Priority Ranking			
Site	Location (UTM)	Known Breeding Site	Known Roost Site	Silo	Barn	Other	1	2 to 3	4 to 5	6 to 7	None	#1	#2	#3
D1	17S 686080.08 m E 4276839.21 m N	1		1						1		1		
D2	17S 686305.26 m E 4275235.29 m N	1		1				1				1		
D3	17S 687744.56 m E 4274788.60 m N		1	1			1							1
D4	17S 689596.19 m E 4275184.65 m N	1		1					1			1		
D6	17S 688265.77 m E 4273280.88 m N	1		1						1	1			
D7	17S 689090.22 m E 4273367.63 m N	1		1				1			1			
D8	17S 688911.06 m E 4272811.50 m N	1				1	1				1			
D9	17S 688219.58 m E 4272602.71 m N	1		1				1					1	
D10	17S 688950.72 m E 4272376.22 m N	1		1			1				1			
D11	17S 689377.44 m E 4272527.60 m N	1		1					1			1		
D12	17S 689690.89 m E 4271985.61 m N	1		0.5*	0.5					1		1		
D13	17S 689923.48 m E 4272923.28 m N	1		1						1		1		
D14	17S 691396.43 m E 4273765.65 m N		1	1				1						1

CONTINUED. Table 1. Active Barn Owl Sites in the SVRSA, 2009-2015, with Management Recommendations

Site	Location (UTM)	Known Breeding Site	Known Roost Site	Silo	Barn	Other	Years Active				Management Priority Ranking			
							1	2 to 3	4 to 5	6 to 7	None	#1	#2	#3
D15	17S 693933.34 m E 4274064.78 m N	1		1				1			1			
D16	17S 692801.99 m E 4271983.46 m N	1		1				1					1	
D17	17S 693256.82 m E 4271859.40 m N		1	1			1							1
D18	17S 687075.29 m E 4270704.04 m N		1	1			1							1
D19	17S 686354.00 m E 4269753.00 m N	1		1						1	1			
D20	17S 688543.76 m E 4269162.75 m N	1		1						1			1	
D22	17S 688241.88 m E 4273412.44 m N		1	1					1			1		
D23	17S688815.88 m E 4269976.61 m N		1	1				1					1	
D25	17S 689491.13 m E 4271590.64 m N		1	1			1							1
D27	17S 693703.90 m E 4274254.77 m N		1	1				1				1		
E1	17S 696808.00 m E 4274806.00 m N	1		1				1						1
E2	17S 696620.40 m E 4274065.94 m N	1		1						1		1		
E3	17S 698190.92 m E 4273565.15 m N		1	1			1							1

CONTINUED. Table 1. Active Barn Owl Sites in the SVRSA, 2009-2015, with Management Recommendations

							Years Active				Management Priority Ranking			
Site	Location (UTM)	Known Breeding Site	Known Roost Site	Silo	Barn	Other	1	2 to 3	4 to 5	6 to 7	None	#1	#2	#3
E4	17 S 700041.00 m E 4275454.00 m N	1		1						1	1			
E6	17S 698464.31 m E 4272219.37 m N		1	1				1						1
E7	17S 698149.10 m E 4272021.92 m N		1	1				1					1	
E8	17S 698421.33 m E 4271547.66 m N		1	1			1						1	
E9	17S 697521.69 m E 4270214.94 m N	1		1						1		1		
E12	17S 697150.00 m E 4273571.00 m N	1		1				1					1	
E13	17 S 697584.00 m E 4277552.00 m N		1	1			1						1	
TOTALS	**59 Sites** * indicates site was partly in barn, partly in silo	**34**	**25**	**53.5**	**3.5**	**2**	**15**	**21**	**9**	**14**	**15**	**21**	**10**	**13**

INFORMATION FOR CONTRIBUTORS

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