SITE FIDELITY AND NESTING OF BROAD-WINGED HAWKS IN A SUBURBAN OHIO METROPARK

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The breeding biology and ecology of the Broad-winged Hawk (*Buteo platypterus*) have been reviewed by Burns (1911), Bent (1937), and Goodrich *et al.* (1996). Studies have been done in Kansas (Fitch 1974); in New York (Matray 1974, Crocoll and Parker 1989); in Minnesota (Keran 1978); in Maryland (Titus and Mosher 1981, Janik and Mosher 1982); in Wisconsin (Rosenfield 1984); in Ontario, Canada (Armstrong and Euler 1982); and at the edge of their range in both Alberta, Canada (Rusch and Doerr 1972) and South Dakota and Wyoming (Stephens and Anderson 2003). In Ohio they are considered uncommon to common nesters along the Allegheny Plateau and locally distributed in the northeastern part of the state (Peterjohn 2001). They are uncommon nesters in the greater Cleveland region (Rosche 2004). Peterjohn and Rice (1991) indicate that Broad-winged Hawks have undergone a statewide increase since the 1930s, yet their breeding chronology in Ohio is poorly documented. While Broad-winged Hawks (BWHA) have been associated with extensive, mature forests (Burns 1911, Bent 1937), their breeding in fragmented areas along suburban edges is less studied. This is a report of nesting Broad-winged Hawks from 1997 through 2014 in a Cleveland, Ohio suburban metropark.

STUDY AREA

This study evolved from an ongoing breeding raptor survey conducted by park volunteers in the Cleveland Metroparks. Early survey results piqued our interest in BWHA since they have been reported irregularly, with only a few nesting reports, in northeast Ohio over the past 100 years as published in *The Cleveland Bird Calendar* (Note 1).

Our study site was in the Brecksville Reservation (41.31766N -81.61581W). The Cleveland Metroparks acquired this land, which had been farmed and logged, by 1922. The 1,250 ha (3,089 ac) reservation in southern ***Cuyahoga*** is on the edge of the glaciated Allegheny Plateau. It lies about 14 miles south of Cleveland, ***Cuyahoga***, and 20 miles north of Akron, ***Summit***. The combined population of those counties is about 1.8 million. The reservation is on the eastern edge of Brecksville, a mostly residential outer suburb of Cleveland (population 13,500) where lot size varies from about 0.19 ha (0.46 ac) to 0.56 ha (1.4 ac). A mix of residential and commercial land abuts the reservation on its northern, southern and western edges. The Cuyahoga Valley National Park, Cuyahoga River, Cuyahoga Valley Scenic Railroad, and Riverview Road bound the eastern edge of the reservation. Chippewa Creek flows to the Cuyahoga River through the park's northern portion.

Oak-hickory (*Quercus-Carya*) and beech-maple (***Fagus-Acer***) associations dominate the mature, second growth, forest in the reservation. A few small conifer plantations are widely interspersed. Fields, both grassed and shrubby, are present. Seven distinct gorges, steep slopes, ravines, and streams exist within the reservation where the elevation drops from 320 m above mean sea level (ASL) to 194 m ASL at the Cuyahoga River. The reservation is traversed by three primary paved roads (12 km), and bridle (18 km), biking (6 km) and hiking trails (16 km), including portions of the Buckeye Trail; it is dotted with pavilions and picnic areas; a riding stable and adjoining paddocks are present; a golf course (74 ha) lies in the southwest corner. In the late 1990s a severe gypsy moth (*Lymantria dispar*) outbreak defoliated portions of the reservation, particularly white oaks (*Q. alba)* (Sekura *et al.* 2005). Dead oak trees, subsequently resulting in large canopy openings, are present throughout the park. White oak accounted for nearly two thirds of the overall oak mortality in the adjacent Cuyahoga Valley National Park during that time (Note 2). Over the last five years the emerald ash borer (*Agrilus planipennis*) has decimated ash trees (*Fraxinus sp*). A large population of white-tailed deer (*Odocoileus virginianus*) has destroyed the understory.

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METHODS

Using the spot-mapping technique, Wallin and others periodically conducted nesting bird surveys on a 20 ha plot of this reservation during May-Jun from 1941-2002 (Chasar and Chasar 2004). During Jun 1996, volunteers conducted a point count bird survey throughout the reservation (A. Kozlenko, unpublished data). No BWHAs were recorded in either study. This could suggest that they were absent, particularly in the early years when this forest was young, but perhaps they were not detected.

Broad-winged Hawks are complete migrants and return to Ohio between 05 and 15 Apr (Peterjohn 2001) and to the Cleveland region during the first third of the month (Rosche 2004). We have heard BWHAs in the Brecksville Reservation as early as 08 Apr and we began our search for courting birds around the middle of that month. Initially we limited our searches to a small portion of the reservation but in 2007 expanded the area to about 750 ha. Most of our observations occurred between 6:30 and 8:30 am, on foot, following BWHA visual and vocal cues. Their "wheeou" courtship call indicating copulation (Bent 1937, Goodrich *et al.* 1996) helped us locate pairs. We did not employ vocal callbacks. Based upon prior work in forested regions (Rosenfield 1984, Crocoll and Parker 1989) and given our smaller fragmented area, we did not expect to find more than one or two nests per year. Broad-winged Hawks, while often returning to the same general area, usually build new nests (Burns 1911, Bent 1937, Matray 1974). After the first few years of observing the returning BWHAs, we realized that more than one pair was probably present. Their site fidelity made it easier to find nests and we broadened our search without systematically searching the reservation. Once the female began incubating, usually by the first week in May, we tried to visit each nest into mid-Jul to determine nest fate. All observations of nests were from the ground, using binoculars or a scope. We did not look for nests in 2009.

In the fall, after leaves had fallen, the latitude and longitude of nests were recorded with a WAAS-enabled Garmin GPS 60, where the indicated error was ± 8 m. Distances between nests were calculated (Note 3) with no correction for GPS error. Nest heights were determined using a Suunto clinometer and 30 m tape measure. The diameter at breast height (dbh) of the trees was measured with a diameter tape (cm).

RESULTS AND DISCUSSION

Habitat characteristics. Partly due to the reservation's configuration, all Broad-winged Hawk nests were close to, and sometimes directly above, foot paths, roads, or picnic areas. Twenty-three nest trees are on ridge tops or at the upper edge of slopes. Most nests had stands of large, dead white oaks nearby. Distances to openings have been determined significant for nest placement (Burns 1911, Keran 1978, Titus and Mosher 1981). The mean distance of nests to openings (e.g., roads, fields, and picnic areas) in the Brecksville study was 58 ± 52 m (range 1-200 m, n=38). This value is about the median of values summarized by Goodrich *et al.* (1996). Small streams at slope bases and permanent and vernal wet areas are present near all nest sites. This positive association has been noted (Titus and Mosher 1981). Rosenfield (1984) attributed the close spacing of six of 15 nests to local wet areas and the high nest density to a mix of habitat types which provided increased upland and edge habitat. The forest fragmentation in this study is significantly greater than that in large forested studies, but Peterjohn and Rice (1991) indicate nests have been reported in Ohio from woodlots of 20 ha (50 ac) or less in proximity to larger forests. One nest in a black walnut (*Juglans nigra*) was directly behind a residence, in the middle of the backyard, surrounded by a woodlot. A white oak that was used three times (1999, 2002, and 2008) is on a hillside 75 m from a pavilion, open grassy area, and small parking lot.

Newton (1979) stated that nesting site requirements and food availability are the main factors in nest dispersion, and raptors adjust

nest distances based on those criteria. Toland (1986) found in his Missouri study on raptor hunting success that, among six buteos, Broad-winged Hawks spent the most time perch-hunting. Small raptors like the BWHA feed on small prey and require less territory than larger raptors. In Maryland, eastern chipmunks (*Tamias striatus*) were the most common food (Janik and Mosher 1982) while in Kansas nestling birds and snakes were preyed on most frequently (Fitch 1974). Studies indicate that amphibians are an important prey where they are available. Palmer (1988) suggested that the female may feed on amphibians in preparation for egg laying. Brewster in Bent (1937) said that BWHA visits coincided with spawning toads. In the Brecksville Reservation deer browse has opened up the understory and may also be an important factor in foraging. We did not try to identify prey.

Nest tree selection. Goodrich *et al.* (1996) summarized the choice of tree species as that which seemed to be most common in an area, although white oak was used more often than expected in Maryland (Titus and Mosher 1981, 1987). Historically, Burns (1911) reported that a preferred tree was American chestnut (*Castanea dentata*). Table 1 summarizes the number of nests we found each year. In this survey 19 nests (50%) were in white oak and eight nests (21%) in tulip (*Liriodendron tulipifera*). No nest was used more than once. Rosenfield (1984) reported that BWHA usually build a new nest in a different tree in a reoccupied nesting area.

In calculating the mean dbh of nest trees, when a tree had been used more than once for nesting, the tree was counted only one time. The mean dbh for all trees (n=35) was 62 ± 18 cm (range 30-101 cm). The mean dbh for white oak only, used 50% of the time, was 65 ± 17 cm (range 44-101 cm, n=19). The white oak used three times had the largest dbh. The mean for tulip (n=8) was 72 ± 11 cm. White oak was used for 19 out of 24 nests in Maryland (Titus and Mosher 1981), where the mean dbh for all trees was 38.0 ± 9.5 (range 25-62 cm). Dbh measurements in the current study indicate that Broad-winged Hawks selected large mature trees for nests.

The mean nest height was 22 ± 4 m (range 14-33 m, n=38). Compared to the mean (11.4 m, range 9-14.8 m) of the means from nine literature references for nest heights summarized by Goodrich *et al*. (1996), our mean nest height is substantially greater and again indicates the use of mature trees.

Courtship and incubation. Broad-winged Hawks return around mid-Apr. They are thought to mate for life (Burns 1911) and their early presence as pairs in this study suggested this. Fitch (1974) indicated that pairs were formed within one week of arrival in Kansas. Nest building is an important part of pair bonding. Both sexes sometimes brought sticks to different trees. In one pair the male, with a twig in its beak, flew to the female, copulated, and then carried the twig to a nearby tree crotch afterward. The female, however, was seldom observed going to that crotch and a nest was never completed in that tree (Chasar and Chasar 2003). We found 29 of the nests while they were being constructed (Apr 27 to May 11). Of these, 21 (70%) had females incubating by 05 May. Two pairs, which abandoned first nests in the building stage and subsequently built and used second nests, had later incubation dates.

Reproductive success. We only observed nests from the ground. We counted a total of 77 nestlings in 32 nests (Table 1), for a mean of 2.4 nestlings per nest with young and a mean of 2.1 for all 37 nests. Rosenfield (1984) thought that once eggs hatched most young eventually fledged. Crocoll and Parker (1989) describes a successful nest as one where at least one young Broad-winged Hawk fledges, where fledging is defined as sustained horizontal flight from the nest at five to six weeks [i.e. 35 to 42 days]. This is time consuming to observe, easy to miss, and birds may also return to the nest after fledging. According to Steenhof and Newton (2007) most raptor studies consider the presence of mature young, close to fledging but still in the nest, as a suitable measure of success. Specifically for

diurnal raptors, they state that a successful nest is one in which the nestling achieves 80% of its fledging age. Thus a nest with young BWHA at 28 to 33 days would indicate success. We observed 16 nests where young fledged (35 to 42 days), eight nests with branching young (29 to 31 days per Matray 1974), and four nests with young still in the nest about 60 days from the onset of incubation but not seen branching. We consider these 28 nests as successful. One nest with young was destroyed by a storm in late Jun; three nests initially with young lacked sufficient observation to draw conclusions as to success. For all nest attempts, at least 76% (28 of 37) were successful. This number closely agrees with those of Rosenfield (1984), who reported that 79% of active nests (eggs laid) were successful, and of Janik and Mosher (1982) who reported 86% of nests fledged young.

We never saw young in five nests. Since we thought the female was incubating, we conclude that those nests were either abandoned or predated. Two nests were in pines (*Pinus spp.*) which American crows (*Corvus brachyrhynchos*) frequented. In 2012 a pair of vocal BWHA was harassed for 10 minutes and driven off by seven to eight crows. The conflict occurred in a very small area within a stand of pines and the raptors were not seen in the area again that year. A late nest, poorly constructed in an American sycamore (*Platanus occidentalis*) along a busy road, was only used for a week and was probably abandoned. One nest had a raccoon (*Procyon lotor*) in it shortly after we noticed that it seemed abandoned. No obvious reason for failure was found for the fifth nest.

It is noteworthy that one nest (2014) fledged four young. Broad-winged Hawks usually lay two or three eggs, with a range of one to four (Goodrich *et al.* 1996). Burns (1911) mentioned that [only] 18 of 406 collected egg sets contained four eggs. Crocoll and Parker (1989) found one of 15 nests with a clutch of four; three of the four eggs hatched and fledged. Rosenfield (1984) found two clutches of four eggs out of 47 clutches. We could find no reference to a nest where four young fledged.

In 1997 during the gypsy moth infestation, a female sat on a nest in a white oak while gypsy moth caterpillars devoured the foliage around her. On 16 Jul the three young were branching on a totally leafless tree.

Breeding Chronology. The breeding chronology of BWHA in Ohio is sketchy at best. Buchanan (1980) reported a nest in Carroll on 05 May 1943 and a nest with two young on 15 June 1939 in Jefferson. Williams (1950) wrote of a BWHA on nest in an Akron Metropolitan Park in Summit on 31 May and 15 Jun 1947. Flanagan (1971) reported that two BWHAs were seen carrying material to a tree on 15 May at Sand Run Metropolitan Park, Summit; at Chapin Forest in Lake, Howard (1969) wrote of two young hawks, heads still covered with down, near a nest on 08 Jul. Perhaps Stasko (1967) recorded the most thorough chronology in Rocky River Reservation, Cuyahoga, where he saw a nearly complete nest on 30 May, incubation on 02 Jun, two downy young on 30 Jun, and fledging between 23 and 27 Jul. Peterjohn (2001) generalizes that nest construction begins in the last half of Apr in southern Ohio but not until May near Lake Erie; clutches are expected between early May and mid-Jun; and that most young hatch in Jun and fledge by late Jul or early Aug.

Our study now sharpens and narrows those few data for northern Ohio. In the Brecksville Reservation BWHAs arrive as early as 08 Apr and begin courtship and nest building shortly thereafter. Nests are completed between 27 April and 11 May with a majority of females, in this study 70%, incubating by 05 May. Incubation is 28 to 31 days (Goodrich *et al.* 1996). Fledging begins as early as 02 Jul and can begin as late as 21 Jul. These data are supported by several BWHA nesting observations by other raptor volunteers in three other reservations of the Cleveland Metroparks (unpub. data). Interestingly, this sequence corresponds closely with studies in the Appalachian Mountains in Maryland (Janik and Mosher 1982) and in northwest Kansas (Fitch 1974).

Nest Site Fidelity. Broad-winged Hawks are noted for nest site fidelity upon their re-

turn in the spring. Matray (1974) provided concrete evidence of this in his New York study. He banded a pair in 1971 and recaptured the pair in 1972 when they nested 400 m from the 1971 nest site. Rosenfield (1984) defined a nesting area as that area within a radius of 250 m of a nest and concluded that a nesting area was considered reoccupied if, in subsequent years, an active nest was found within 250 m of a previously used nest. We overlaid the GPS coordinates of the nests onto a Google Earth map (see Figure). Included are 0.5 km "bars" representing the diameter of an imaginary circle (250 m radius times two) at each cluster of nests. While Rosenfield (1984) did not show how he arrived at his number, our nest plots are in substantial agreement with his conclusion. Whether the returning hawks were the same or different individuals is unknown.

Distance between Broad-winged Hawk nests. From the GPS coordinates we determined the distances, as the Broad-winged Hawk flies, between each active nest and its nearest active neighbor (Table 2). The mean distance between neighboring nests (n=21) for all years with multiple nesting is 0.96 ± 0.25 km (range 0.48-1.69 km). In a more expansive Wisconsin study from 1976 to 1981, Rosenfield (1984) reported the mean distances between nests to be 1.5 km in 1976, 1.7 km in 1980, and 1.1 km in 1981. In a western New York study Crocoll and Parker (1989) found that the mean distances between nests was 1441 ± 331 m. Our calculation closely aligns with the shorter distances.

Since the mean distance between nearest neighboring nests is approximately one km, it is tempting to estimate the home range required by BWHA in relation to their nearest neighbor. If the nest is taken as the center of a circle drawn with a radius of 0.5 km (half the distance to the nearest neighboring nest), the area of the circle ($A=\pi r2$) might reflect the typical minimum required territory for comfort level for nesting close to a conspecific. This calculates to 0.78 km2 or 78 ha. Fuller (as cited in Goodrich *et al.* 1996) suggested that female raptors, tied to the nest, may hunt in a small territory around the nest while the male can forage more freely, using the edge perches along fields to forage for small mammals.

Breeding Density. While the Brecksville Reservation consists of 1250 ha, we limited our search for nests to about 750 ha (7.5 km2). For the two years in which we found four nests each, we calculated a nest density of one nest per 1.9 km2. In 2014 we observed a fourth territorial pair whose nest we did not find. Reported nest densities for BWHA are one per 5.2 km2 in Wisconsin (Keran 1978); one per 2.4 km2 in Wisconsin (Rosenfield 1984); and one per 2.0 km2 in western New York (Crocoll and Parker 1989). Our result agrees well with these numbers. Dykstra *et al.* (2000) found a similar density for Red-shouldered Hawks (*Buteo lineatus*) in a suburban study in southwestern Ohio.

Effect of Other Nesting Raptors. Burns (1911) reported little confrontation between BWHAs and other raptors and he thought this was due to the understory haunts of the Broad-winged Hawk. We did observe interactions with a Red-tailed Hawk (*Buteo jamaicensis*) where the distance between their nests was 0.63 km. Fitch (1974) noted competition between these two buteos when food resources overlapped. In 2011 we found an active BWHA nest in close proximity to nests of Red-tailed Hawk (0.33 km), Red-shouldered Hawk (0.18 km), and Great Horned Owl (*Bubo virginianus*) (0.96 km). All four nests produced young. Crocoll and Parker (1989) reported that BWHAs nested closer to Red-shouldered Hawks (877 ± 422 m, n=12) than to its conspecific (1441 ± 331 m, n=11). We noted no interactions with Red-shouldered Hawks. Rarely, Barred Owl (*Strix varia*) and Sharp-shinned Hawk (*Accipiter striatus*) nests were found.

Cooper's Hawks (*Accipiter cooperii*) and Broad-winged Hawks were synchronous nesters. Burns (1911) observed interactions between nesting Cooper's and BWHA as both confrontational and amicable. There were eight Cooper's nests within about one km of

12 BWHA nests (about the same close mean distance between BWHA nests; vide supra) over the course of this study. Of these nests, the mean distance from the nearest BWHA nests was 0.70 ± 0.41 km (range 0.11-1.15 km, n=12). Both species' nests produced young in those years.

Human disturbance. Broad-winged Hawks were often observed perched along the roads, indifferent to passing vehicles and to people walking beneath them. The "backyard" nest had three young. The oak tree used three times is 175 m from a road intersection where vehicular traffic averages 25,000 vehicles per month, Apr through Jul (N. Lazor, pers. comm. 2010). Their nest tenacity in our study shows a tolerance for both vehicular traffic and a limited human presence. On a cautionary note, Goodrich *et al.* (1996) suggest that the impact of fragmentation is unclear and may increase stress on nesting birds.

SUMMARY

This study documents that Broad-winged Hawks can nest successfully in close proximity to their conspecific, to other raptors, and to human activity in a fragmented, wooded suburban environment. Their fidelity to Brecksville Reservation indicates that they are able to find appropriate nesting sites and sufficient food to raise young successfully. They selected mature trees for nesting. Habitat characteristics around the nests in this study include ridges, slopes, wet areas, large dead oak trees, roads and paths, and nearby open areas. Their productivity is similar to that in other studies.

The Cleveland Metroparks and the nearby Cuyahoga Valley National Park help preserve the existing habitat and limit nearby suburban sprawl. The effect of mortality of white oak and ash remain to be seen. Pesticide and herbicide contaminants from the surrounding suburbs, if carried by streams into the park, could pose a threat to prey availability and quality. Changes on the Broad-winged Hawk wintering grounds may also affect its population. To quote Economidy (1998), "Raptors are an indicator species, at the top of the food chain, and whatever affects them will ultimately affect us. That's why it is so important to monitor changes in the raptor populations and ranges."

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NOTES

1. http://www.clevelandbirdcalendar.com/
2. https://data.doi.gov/dataset/oak-mortality-evaluation-at-cuyahoga-valley-national-park-2001
3. http://boulter.com/gps/distance

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Table 1. No. of BWHA Nests and Young vs. Year

1 nest	young in nest	2 nests	young in nest	3 nests	young in nest	4 nests	young in nest
1997	3	1999	0, 3	2005	0, 2, 2	2008	0, 2, 2, 2
1998	3	2003	3, 3	2006 [1]	2, 3, 3	2010 [1]	2, 2, 3, 3
2000	1	2004 [1]	0, 2	2007	2 , 2, 2		
2001	2	2011 [1]	3, 3	2012 [1,2]	2, 0, U [2]		
2002	2	2013 [1]	2, 3	2014 [3]	2, 2, 4		

[1]Presence of additional BWHAs noted during season

[2]Found third nest after leaves fell (U)

[3]Fourth pair present April through July, no nest found

Table 2. Distances Between BWHA Nests for Years with Multiple Nests

Year	# Nests	Distance (km)[1]	Year	# Nests	Distance (km)[1]
1999	2	0.96	2008	4	0.48, 0,75, 0.88
2003	2	1.06	2010	4	0.72, 0.89, 0.96
2004	2	1.35	2011	2	1.02
2005	3	0.93, 0.96	2012	3 [2]	0.93, 1.09
2006	3	0.51, 0.99	2013	2	1.03
2007	3	1.01, 1.69	2014	3	0.95, 1.02

[1]Not corrected for GPS error

[2]One nest found after leaves fell