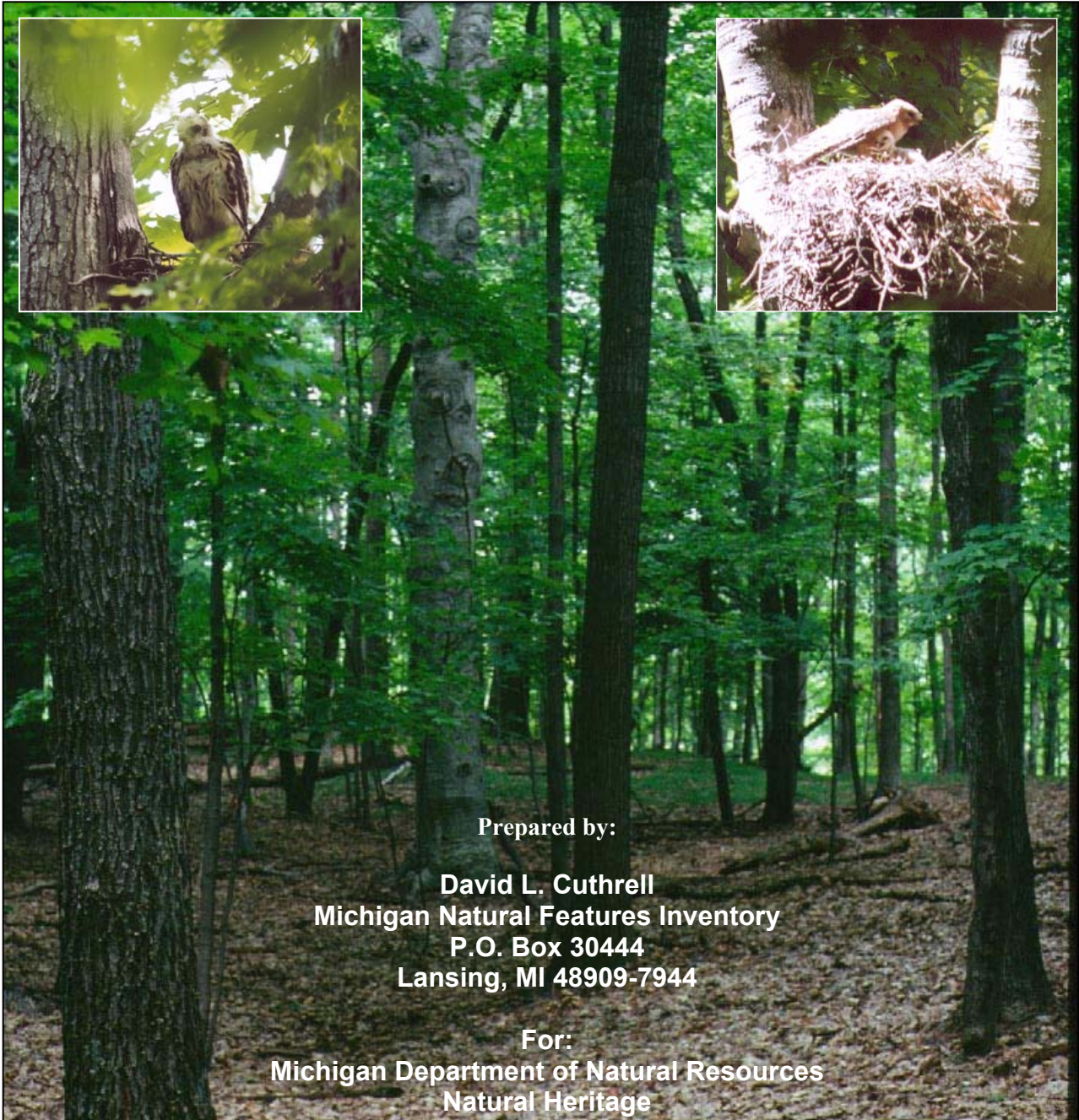

**Woodland Raptor Surveys on Southern Michigan
State Game Areas with an Emphasis on the Red-shouldered
hawk (*Buteo lineatus*)**



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Top left: Immature red-shouldered hawk, Traverse City Forest Area, June 2000, by David L. Cuthrell

Top Right: Adult female shading young chicks from the sun, Indian River Forest Area, June 2001, by David L. Cuthrell

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ABSTRACT

In the early part of the 20th century the red-shouldered hawk (*Buteo lineatus*) was a common bird in southern Michigan. Since then its breeding range may have shifted from southern Michigan to the Northern Lower Peninsula (NLP). Currently the red-shouldered hawk is listed as state threatened in Michigan. Few raptor studies have been conducted in southern Michigan in recent years. In addition, the red-shouldered hawk is a state threatened species for which concern has been expressed regarding impacts of management. Currently, there is a lack of information on this species' distribution and productivity in southern Michigan as well as the impacts of land use practices.

Three state game areas (Allegan, Dansville, and Barry) were visited during March through June 1999-2002. A total of 7 red-shouldered hawk breeding territories were discovered during the study, all located at Allegan State Game Area. The most territories occupied in any given year however were five. We found that nesting territories had a high re-occupancy rate (71%) among areas surveyed over the four

year study period but nest re-occupancy rates were very low (11%). Nest productivity parameters fluctuated widely during our study with only 43% of all nests being successful (range of 0-100%). Over the course of our study brood size averaged 2.0 young per successful nest and 1.6 young per active nest. Nest predation rates were fairly low with 15% of nests being depredated.

Our habitat analysis indicated that nests tended to be placed in large, mature, super-canopy, deciduous trees and the nest itself was placed on average $14.9\text{m} \pm 0.53\text{m}$ above the ground. At the local site level, canopy height, basal area, tree density, canopy closure, and average tree diameter at breast height (dbh) appear important in nest site selection. By utilizing both a landscape and nest site approach, insight on distribution and habitat use can be gained which will facilitate sound management of this species. Information from this study is also being used to assess abundance and distribution of the hawk in southern Michigan, which will help determine the appropriate state-listing status for this raptor.

INTRODUCTION

The red-shouldered hawk (*Buteo lineatus*) is currently listed as a state threatened species in Michigan. Historically it was considered one of the most common diurnal raptors in the Southern Lower Peninsula (SLP) (Barrows 1912). However, by the mid-1900's this species had become uncommon in southern Michigan. Population declines have been primarily attributed to loss of forest and wetland habitats. Presumably, as a result of habitat loss, populations shifted their breeding range from southern Michigan to the more forested portions of the state in the Northern Lower Peninsula (NLP) (Brewer et al. 1991). Currently, there are two primary sources of distributional information concerning this species in Michigan. These include the Breeding Bird Atlas with 119 confirmed nests documented during the 1980's (Brewer et al. 1991), and the Michigan Natural Features Inventory's Biological Conservation Database with ~ 250 confirmed nests documented since the early 1980's (Natural Heritage Biological and Conservation Data System 2001). Distributional patterns from each of these databases mirror each other rather closely. Two distinct population clusters are evident, one centered in the NLP, including Emmet and Cheboygan counties, and the other centered in the Manistee County area. Only scattered occurrences of confirmed red-shouldered hawk nests occur in the SLP and the Upper Peninsula (see special animal abstract in Appendix I).

This species is a woodland raptor that requires forested landscapes composed of deciduous or mixed forests. The prototypical habitat for this species is mature forested floodplains (Johnsgard 1990). Upland hardwood systems are also utilized when wetland complexes are juxtaposed or interspersed among them (Craighead and Craighead 1969, Postupalsky 1980, Bednarz and Dinsmore 1981, Cooper et al. 1999,

Cooper and Cuthrell 2000, Cuthrell and Cooper 2001). In Michigan this species has been most frequently documented in hardwood stands composed of well stocked pole or saw timber, particularly hardwood complexes with associated wetland habitats. Birds have also been documented in older aspen stands, lowland poplar stands, cedar swamps, lowland conifers, and occasionally in pine communities (Cooper and Cuthrell 2000). Red-shouldered hawks are strongly associated with wetlands and the core of a breeding pair's territory typically encompasses wetland habitat. Wetlands such as beaver ponds, wet meadows, and lowland forests are utilized primarily for foraging purposes (Howell and Chapman 1997). Small upland openings are also used to some extent for foraging habitat (Evers 1994). Red-shouldered hawks typically nest in stands of timber with greater than 70% canopy closure (Bryant 1986) and relatively open understories (Evers 1994). Nests are most frequently placed high (usually just below the canopy) in mature deciduous trees and within close proximity of wetland habitat (Titus and Mosher 1981, Woodfry 1986, Ebbers 1986, Cooper et al. 1999). Mature maple, beech, birch, and aspen are frequently used nest trees in Michigan (Ebbers 1989, Cooper et al. 1999). However, any tree species with the appropriate structure (i.e., a multi-pronged crotch just below the canopy) can be utilized.

Purpose of the Inventory

Currently, there is a lack of information on this species' distribution and productivity in Michigan, especially in southern Michigan including state game areas. In addition, the impacts of forest management and game management practices on red-shouldered hawk habitat use and nest productivity have not been evaluated. This

project entails systematic surveys on state game areas, reconfirmation of historical nest sites, and monitoring productivity on a representative subset of nest sites in each state game area. Information gathered from surveys and nest monitoring will be used to identify core areas of nest site concentrations on state lands, identify areas that support long-term population viability, and facilitate development of management guidelines. Further, this project, coupled with other related inventories (e.g., red-

shouldered hawk inventories on state forest lands, state park lands, natural areas, and national forest lands) should facilitate assessment of the appropriate state listing status. This report focuses on the first year of a proposed four-year study and includes an assessment of territorial re-occupancy, nest site re-occupancy, and nest productivity. In addition, habitat data at the landscape and micro habitat scales from confirmed nest sites and random points are included in this report.

METHODS

Surveys were conducted from late March – mid-May of 1999 - 2002. High priority forest areas at the Allegan State Game Area, Barry State Game Area, and Dansville State Game Area were intensively surveyed for red-shouldered hawks. Large deciduous or mixed forest complexes composed of medium to well stocked pole or saw timber with wetland habitats juxtaposed or interspersed among them were targeted for surveys. Also, select coniferous forest communities, both wetland and upland, that had a deciduous component and associated wetland habitat were surveyed as well. These types of forest/wetland complexes were delineated by analyzing state game area vegetation maps, USGS topographical maps, 1978 current land cover maps, 1998 air photos, and by consulting with Michigan Department of Natural Resources (MDNR) Wildlife personnel. Transects were placed every ¼ mile through forest habitats within compartments selected for surveys. Along each respective transect a calling station was placed every ¼ mile. At each calling station a taped conspecific red-shouldered hawk call was broadcast with a predator caller three times: at 60 degrees for 10 seconds, 180 degrees for 10 seconds, and 300 degrees for 10 seconds. This was followed by 30 seconds of listening. This calling sequence was repeated three times at each calling station. When hawks responded to the taped calls, observers intensively searched for birds

and/or a nest in the direction the call was initially heard (Kennedy and Stahlecker 1993, Bowerman pers. comm.). Raptor nest reporting forms (Appendix II) were filled out at each survey site. Confirmed nest locations from 2001 were recorded using Garmin GPS units. Nest locations were then loaded into Arc View and records were transcribed and entered into the Michigan Natural Features Inventory's Biological Conservation Database.

Productivity Surveys

During late May and early June of 1999 - 2002, all active nests were re-visited at least once to assess productivity. Only those nests where incubation was confirmed during earlier surveys were considered active. Surveys were timed during the later part of the nestling stage, usually within a couple weeks of fledging, because young birds are more conspicuous at this time. Two methods were used to assess productivity. These included on-the-ground surveys where the nest is observed from a vantage point or the base of the nest tree is inspected for white wash. A second more definitive method was looking into the nest with a mirror attached to a 15 m (50 ft) pole. A nest was considered successful if at least one young, 80% of the fledgling age, was produced (Kochert 1986).

Habitat Structure

Various habitat attributes were summarized during August 2001 for nest sites and random points by centering the nest site in a 0.04 ha (1/10 ac.) plot. These variables included (Trexel et al. 1999):

- 1) **Nest tree diameter breast height (DBH):** Diameter (cm) at breast height of nest tree.
- 2) **Nest tree height:** Height (m) of the nest tree estimated by use of a clinometer.
- 3) **Nest percentage:** Nest height/tree height X 100.
- 4) **Canopy height:** Mean height, from the forest floor to the lower portion of the canopy, from five randomly chosen trees within plot.
- 5) **Canopy closure:** The percentage of the area over the plot occluded by overstory foliage, measured by 40 ocular tube readings.
- 6) **Ground cover:** The percentage of the ground covered by ground-layer foliage.
- 7) **Sapling density:** The number of woody stems greater than shoulder height and less than 12.7 cm DBH and contained within ½ of the 0.04ha plot.
- 8) **Shrub density:** The number of low shrubs < 12.7 cm DBH and shorter than shoulder height contained within ¼ of the plot.
- 9) **Tree density:** The number of trees ≥ 15 cm DBH per 0.04 ha plot.
- 10) **Basal area:** m²/ha trees.
- 11) **Mean DBH:** Mean DBH (cm) of trees in study plot.

This was measured by systematically placing 10 sampling points radiating from the nest tree in each of the four cardinal directions. Ground cover was measured by placing a meter stick vertically to the ground every meter along the transect line. When vegetation contacted the front edge of the stick it was counted as a hit. Total ground cover was calculated as the total number of hits/total number of points X 100.

RESULTS AND DISCUSSION

Territory Activity

A total of five active red-shouldered hawk territories (i.e., area where hawks were heard or had a freshly tended nest) were documented during the surveys. Among these active territories, three active nests (i.e., where incubation was confirmed) were located during 1999, three during 2000, four during 2001, and five during 2002.

Nest Productivity

All nests, documented during this study, were re-visited during June, 1998 - 2002. Nest productivity among southern Michigan state game areas surveyed was low during the four years (43% successful) (Table 2). Average brood size (number of young per

successful nest), from nest site data from the years of 1998 - 2002 was 2.0 young per successful nest (n=12) and the number of young per active nest was low (1.3) during the years 2001-02.

Nest predation was confirmed (e.g., claw marks on trees, predator in nest, nests torn apart, remains of adult hawk, etc.) for 15% of occupied nests between 1998 – 2001 (Table 2). The primary nest predator implicated was the raccoon (*Procyon lotor*). In a similar study in northern Michigan (Cuthrell and Cooper 2001), five adult red-shouldered hawks were killed during 2000 and 5 were killed during 2001 on or near the nest. These deaths were most likely the result of predation by great-horned owls. Jacobs and Jacobs (1997) and Ebbers (1989) also documented the raccoon and great-

horned owl as primary predators of red-shouldered hawks in Wisconsin and Michigan, respectively.

Nest success rates were low over the past four years and compare rather poorly with other studies concerning this species (Table 3). However, our sample size is extremely small and to draw any firm conclusions at this time is clearly premature. Additionally, wide variations in nesting success rates can occur annually (Jacobs and Jacobs 1997, Stavers et al. 1995, and Henny et al. 1973). Monitoring of nest success rates at Allegan State Game Area only spans a four year period and varied somewhat between years. Therefore, in order to fully assess population viability at southern Michigan state game areas, monitoring will need to continue over the next several years and continued nest searching is important to increase our sample sizes. Henny et al. (1973) felt that a recruitment rate of 1.95 young per active nest with at least 77% of all nesting attempts being successful was needed to replace annual mortality. Jacobs and Jacobs (1998) argued that Henny's model was biased too high due to a small sample size and large variation in the range of recruitment rates among years. Jacobs and Jacobs (1998) analyzed productivity data from Wisconsin using a computer population model (PD: Population Dynamics Modeling, Version 4.0 C 1989 by J.W. Grier, Zoology Dept. ND State Univ., Fargo, ND). From this model they estimated that a recruitment rate of 1.4 young per active nest with over 50% of nesting attempts being successful was needed to replace annual mortality (Jacobs pers. comm.). Recruitment rates and nest success during this study never met either of Jacobs and Jacobs estimates. This suggests that over the past four years red-shouldered hawk annual mortality has exceeded recruitment and the population in the study area acted as a population "sink (i.e., annual mortality was greater than annual recruitment).

Nest Site Variables

Nests were typically placed high ($14.9 \text{ m} \pm 0.53\text{m}$) and within a multi-pronged crotch of the tree, which concurs with results obtained by Titus and Mosher (1981). Nest trees also tended to be mature, tall, super-canopy trees (height = $24.01 \text{ m} \pm 1.3 \text{ m}$, dbh = $52.0 \text{ cm} \pm 6.3 \text{ cm}$). Nest percent (the nest height divided by the overall tree height multiplied by 100) was 62.8%. In a northern Michigan study conducted by Ebbers (1989) and a study in Maryland (Titus and Mosher 1981), nests were usually placed between 10.6 m – 18.3 m above the ground and 1/2 – 2/3 the way up the nest tree. Results from this study mirror rather closely the descriptions of nest tree structure in northern Michigan and Maryland.

Basal area around nest sites was high with little variation around the mean (Table 4). In contrast, random points had a fairly high basal area but greater variation around the mean was evident (Table 4). These results may suggest that red-shouldered hawks select stands of timber with higher basal areas and in un-occupied habitat basal area varies considerably. Kimmel and Fredrickson (1981), Portney and Dodge (1979), and Parker (1986) all found that red-shouldered hawks prefer stands of timber for nest placement that have high basal areas ($99.5 \text{ ft}^2 - 159 \text{ ft}^2$). This study supports the results obtained by these researchers.

Other nest site variables with tight confidence intervals that were greater than attributes at random points included tree density, canopy closure, and average dbh per plot. All of these variables suggest that red-shouldered hawks prefer the dense, relatively mature portions of forest complexes for nesting habitat. Further, these results are consistent with studies conducted by Ebbers (1989), Titus and Mosher (1981), and McLeod et al. (2000).

Table 1. Red-shouldered hawk breeding territory activity at three state game areas in southern Michigan (1998 –2002).

Reproductive Variable	Allegan SGA	Barry SGA	Dansville SGA	Overall
Number of Territories ¹	1998 - 1	1998 - NA	1998 - NA	1998 - 1
	1999 - 1	1999 - NA	1999 - NA	1999 - 1
	2000 - 3	2000 - NA	2000 - NA	2000 - 3
	2001 - 5	2001 - 0	2001 - 0	2001 - 5
	2002 - 5	2002 - 0	2002 - 0	2002 - 5
New Nests ²	1999 - 0	1999 - NA	1999 - NA	1999 - 0
	2000 - 2	2000 - NA	2000 - NA	2000 - 2
	2001 - 3	2001 - 0	2001 - 0	2001 - 3
	2002 - 2	2002 - 0	2002 - 0	2002 - 2
Nest Site Fidelity ³	1999 - 0/1 (0%)	1999 - NA	1999 - NA	1999 - 0/1 (0%)
	2000 - 0/1 (0%)	2000 - NA	2000 - NA	2000 - 0/1 (0%)
	2001 - 1/2 (50%)	2001 - NA	2001 - NA	2001 - 1/2 (50%)
	2002 - 0/5 (0%)	2002 - NA	2002 - NA	2002 - 0/5 (0%)
				Average - (11%)

¹ Areas where red-shouldered hawks were observed, heard, or had a freshly tended nest during the breeding season.

² The number of newly discovered active hawk nests.

³ The percentage of nests re-utilized during successive years.

Table 2. Productivity of red-shouldered hawk nests at Allegan State Game Area, Allegan County, Michigan (1998 – 2002).

Reproductive Variable	1998	1999	2000	2001	2002	5-year Total
Percentage of Successful Nests ¹	1/1 (100%)	0/1 (0%)	0/3 (0%)	2/4 (50%)	3/5 (60%)	6/14 (43%)
Number of Young per Successful Nest ²	2.0	0	0	2.0	2.7	2.0
Number of Young Per Active Nest ³		0	0	1.0 (n=4)	1.6 (n=5)	1.3 (n=9)
Predation Rates ⁴	0/1 (0%)	NA	1/3 (33%)	0/4 (0%)	1/5 (20%)	2/13 (15%)

¹ The percentage of nests with ≥ 1 young produced to 80% of the fledgling age (4 – 4.5 weeks old)

² The average number of nestlings 80% of the fledgling age per successful nest

³ The average number of nestlings 80% of the fledgling age per active nest (this number is conservative as we did not climb the nest tree)

⁴ The percentage of nests that were destroyed by a nest predator

Table 3. Comparison of red-shouldered hawk nest success rate at Allegan State Game Area, Allegan County, Michigan with eight other North American studies.

Location	No. Nests Studied	% of Nests Successful	No. Young Fledged / Active Nest	Source
Southern California	29	66	1.34	Wiley 1975
Central and ne. Wisconsin 1990-97	557	51	1.13	Jacobs and Jacobs 2000
Central Maryland	74	68	1.58	Henny et al. 1973
Southern Ontario	6	83	1.80	Armstrong and Euler 1982
Iowa	8	88	2.90	Bednarz 1979
Northern Michigan 1986-1988	44	57	1.20	Ebbers 1989
Northern Michigan 2001	56	70	1.40	Cuthrell and Cooper 2001
So. Michigan 2001-02	14	43	1.30	This study
Southern Michigan	61	-	1.80	Craighead and Craighead 1969
Western Maryland	17	53	1.80	Janik and Mosher 1982

Table 4. Red-shouldered hawk nest site characteristics at Allegan State Game Area (1998 – 2002).

Structural Attribute	Nest Site (n = 4)	Random Point (n = 2)
Nest Height	14.93 m \pm 0.53m (49 ft \pm 1.73 ft)	
Nest Tree Height	24.01 m \pm 1.34 m (78.8 ft \pm 4.4 ft)	
Nest Percent	62.85% \pm 4.61%	
Nest Tree dbh	52.01 cm \pm 6.27 cm (20.5 in \pm 2.47 in)	
Canopy Height	18.26 m \pm 0.15 m (59.9 ft \pm 0.49 ft)	7.89 \pm 2.47 m (25.9 ft \pm 8.1 ft)
Basal Area	10.3 m ² \pm 0.9 m ² (115 ft ² \pm 9.57 ft ²)	0.76 m ² \pm 0.15 m ² (25 ft ² \pm 5 ft ²)
Tree Density/0.04 plot	14.5 \pm 0.5	4.0 \pm 2.0
Sapling Density	80.75 \pm 28.88	108.5 \pm 85.5
Shrub Density	37.25 \pm 4.66	76.5 \pm 30.5
Canopy Closure	91.8% \pm 2.8%	12.5% \pm 5.0%
Average Tree dbh/0.04 plot	12.78 \pm 0.89	7.58 \pm 0.58
Ground Cover	44.0% \pm 6.69%	66.25% \pm 13.75%

Table 5. Red-shouldered hawk nest site characteristics at Allegan State Game Area in comparison to nest site characteristics at seven northern Michigan State Forest areas (1998-2001).

Structural Attribute	ASGA Nest Sites (n = 4)	Northern MI Nest Sites (n = 44)
Nest Height	14.9 m \pm 0.53m (49.0 ft \pm 1.7 ft)	14.1 m \pm 0.37 m (46.2 ft \pm 1.2 ft)
Nest Tree Height	24.01 m \pm 1.3 m (78.8 ft \pm 4.4 ft)	25.26 m \pm 0.56 m (82.9 ft \pm 1.8 ft)
Nest Percent	62.8% \pm 4.6%	56.4% \pm 1.5%
Nest Tree dbh	52.0 cm \pm 6.3 cm (20.5 in \pm 2.47 in)	50.1 cm \pm 1.8 cm (19.7 in \pm 0.7 in)
Canopy Height	18.26 m \pm 0.15 m (59.9 ft \pm 0.49 ft)	16.12 m \pm 0.48 m (52.9 ft \pm 1.6 ft)
Basal Area	10.3 m ² \pm 0.9 m ² (115 ft ² \pm 9.6 ft ²)	11.1 m ² \pm 1.1 m ² (123 ft ² \pm 12.7 ft ²)
Tree Density/0.04 plot	14.5 \pm 0.5	19.1 \pm 1.1
Sapling Density	80.7 \pm 28.9	62.8 \pm 9.5
Shrub Density	37.3 \pm 4.7	84.0 \pm 13.7
Canopy Closure	91.8% \pm 2.8%	88.3% \pm 1.2%
Average Tree dbh/0.04 plot	12.8 \pm 0.89	10.7 \pm 0.22
Ground Cover	44.0% \pm 6.7%	42.3% \pm 4.2%

CONCLUSIONS

Red-shouldered hawk surveys on southern Michigan state game areas were highly successful and greater insight into habitat utilization and distribution patterns within each game area was gained. Further, all reproductive parameters (i.e., territorial re-occupancy, nest site fidelity, nest success, brood size) fluctuated widely and/or were lower than other studies concerning this species. However, long-term trend data concerning productivity measures are needed to fully assess population viability.

The results from inventories and continued nest monitoring, in southern Michigan game areas, as well as on private land, should help provide very valuable information. This information can be used to identify core areas of nest site concentrations that support long-term viability, facilitate development of management guidelines for southern Michigan, assess the impacts of forest management practices on habitat use and productivity, and evaluate the red-shouldered hawk's true status in Michigan.

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APPENDIX I

Red-shouldered Hawk Special Animal Abstract

APPENDIX II

MNFI Raptor Nest Reporting Form

APPENDIX III

Locational Data of red-shouldered hawk nests at Allegan State Game Area

(Copies distributed to MDNR Game Area Managers Only)

Sensitive data, do not distribute