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NESTING DENSITY, NEST AREA REOCCUPANCY, AND MONITORING IMPLICATIONS FOR COOPER'S HAWKS IN WISCONSIN

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ABSTRACT.—We found a stable, long-term nesting density of 331 ha/pair, and a minimal intergeneration turnover time of 6 yr for breeding Cooper's hawks (*Accipiter cooperii*) in a rural Wisconsin study site. In an urban area we documented the highest known nesting density, 272 ha/pair, reported for the species. Both rural and urban Wisconsin study sites exhibited high productivity, comparable to pre-DDT years (1929-45) for the northeastern U.S. We propose evaluating nest area reoccupancy at 6-yr intervals as a practical means of monitoring Cooper's hawk populations at the level of state and/or other management unit.

KEY WORDS: Accipiter cooperii; *Cooper's hawk; nesting density; nest area reoccupancy; population monitoring.*

Densidad de nidificación, área de reocupación de nidos y monitoreo de *Accipiter cooperii* en Wisconsin

RESUMEN.—Encontramos una estable densidad de nidificación, en el largo plazo, 331 ha/pareja y un tiempo mínimo de recambio intergenaracional de seis años para *Accipiter cooperii* reproductivos en un sitio rural de estudio, en Wisconsin. En una localidad urbana documentamos la mayor densidad de nidification conocida y reportada para esta especie, 272 ha/pareja. En ambos sitios de estudio, esta especie mostró alta reproductividad, comparable a los años pre-DDT (1929-45) para el Noreste de los Estados Unidos. Proponemos evaluar el área de reocupación de nidos en intervalos de seis años, como un promedio práctico de monitoreo de las poblaciones de *A. cooperii* a nivel de estado y/u otra unidad de manejo.

[Traducción de Ivan Lazo]

Long-term research on falconiforms in relatively stable trophic and vegetational environments has often shown a corresponding stability in the hawks' breeding densities (Newton 1991). Our studies of the Cooper's hawk (*Accipiter cooperii*) in Wisconsin have yielded another instance of stable density and nest dispersion at the highest rural density known for the species, an even higher nesting density in a heavily altered urban environment, and productivity indices—both urban and rural—consistent with historical (pre-DDT) levels. We

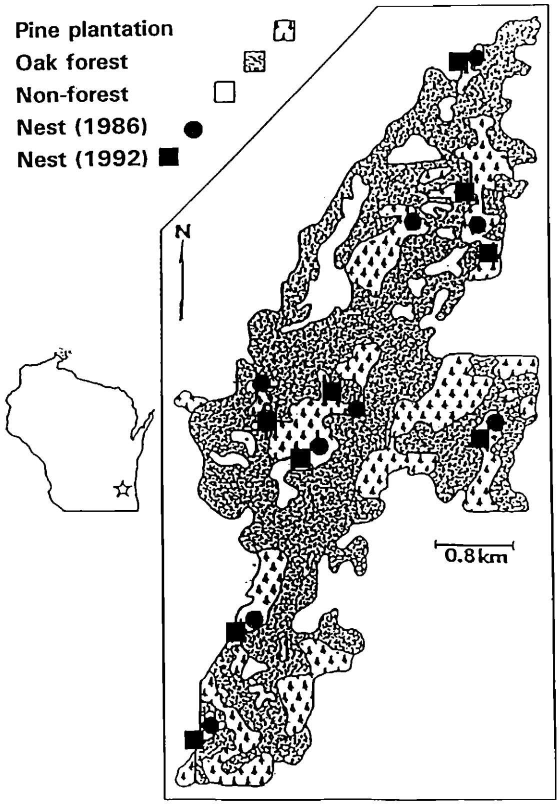

Figure 1. Distribution of Cooper's hawk nests on the rural KM study area in southeastern Wisconsin.

use these results to propose a practical monitoring technique, based on nest area reoccupancy, for a species still considered uncommon or rare in many parts of the eastern United States (Rosenfield and Bielefeldt 1993b).

METHODS

To determine nesting density (hectares per active nest), we searched intensively for Cooper's hawk nests on two study areas in Wisconsin. The 2980-ha rural area in the Kettle Moraine State Forest (hereafter KM), Waukesha County, was delineated by rectilinear roads and land survey section lines (Fig. 1). The KM area, studied 1982–93, was 40% wooded with conifer plantations contributing one-third of forest cover (for further descriptions of the KM study area, see Rosenfield et al. 1991, and Bielefeldt and Rosenfield 1992). The 3540-ha urban area in the city of Stevens Point and its suburbs (hereafter SP), Portage County, was delineated by a river on the west and section lines elsewhere (Fig. 2). The SP area, studied 1993, was a mix of residential, commercial, and industrial land uses with remnant patches of deciduous and coniferous woodland (for more description,

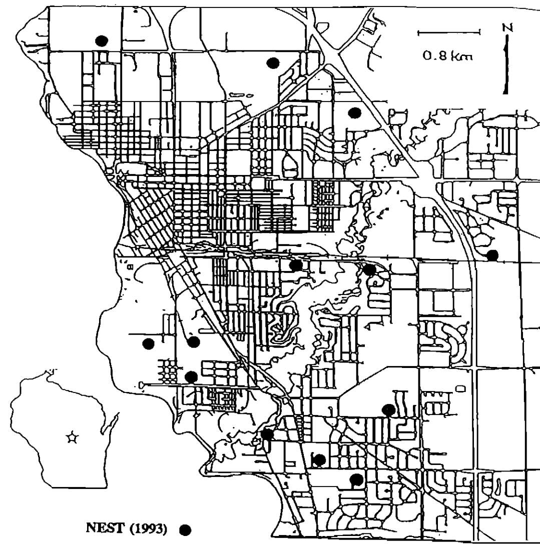

Figure 2. Distribution of Cooper's hawk nests on the urban SP study area in central Wisconsin.

see Murphy et al. 1988). We fixed the boundaries of both study areas before beginning our nest searches.

In the context of population stability (see below), mark-recapture data from the KM in 1986 and 1992 revealed minimal intergenerational turnover time more clearly than similar data from other study years. In the years considered here, all 18 nests in the KM (1986, 1992) and 12 of 13 nests in SP (1993) were found at pre-laying or incubation stages of breeding. We excluded one SP nest found at the nestling state and used the remaining 30 in calculating nest success. In both areas we counted most clutches, banded all nestlings $\geq$14 d of age, and trapped and banded most breeding adults at known nests (Rosenfield and Bielefeldt 1993a).

We used number of bandable nestlings per successful nest to compare productivity on our study areas with comparably reported historical data for the northeastern United States (Henny and Wight 1972). We measured interyear nest distances on 1:4800 aerial photos. A nesting area was considered reoccupied when we found a nest in subsequent year(s) within an arbitrary search area (ca. 800 m diameter) centered on the site's original nest (Rosenfield and Bielefeldt 1992), as discovered 1982–85.

RESULTS AND DISCUSSION

We found nine nests (all in pine plantations on the rural KM study area in 1986 (Fig. 1), for a minimal density of 331 ha per active nest. In 1992, all nine of these nesting areas (again plantations) were reoccupied, with a median interyear nest distance of 335 m (range = 30–665 m); no additional nests were found in 1992. These 1986 and 1992 nesting densities were at the time the highest reported for the species, and

Table 1. Productivity indices on the rural KM and urban SP study areas in 1986, 1992, and 1993.

	KM 1986	KM 1992	SP 1993
$\bar{x}$ clutch size (*N*)	3.7 (6)	4.3 (7)	4.2 (9)
$\bar{x}$ bandable young/successful nest (*N*)	3.3 (7)	3.8 (8)	4.0 (9)
% nest success (*N*)	78 (9)	89 (9)	75 (12)

approximately 2–5 times greater than those previously published (Rosenfield et al. 1991). We marked all breeding adults at the 1986 KM nests; subsequent trapping and banding at these same nesting areas in following years showed that all the 1986 adults had been replaced by new breeders by 1992. For males we know that replacement was not a result of movement between nesting areas; we have strong evidence from our mark-recapture studies statewide (>200 nests, 1980–93) that male Cooper's hawks show lifetime fidelity to breeding sites (Rosenfield and Bielefeldt unpubl. data). We have detected only nine interyear movements between nesting areas in females during 14 yr of statewide study, and mortality rates appear similar for both sexes (Rosenfield and Bielefeldt unpubl. data). We therefore assume that replacement of females over 6 yr on the KM involves the deaths of previous breeders. Both nesting density and nest dispersion were thus stable during a complete 6-yr intergenerational turnover of breeding adults at all known nest sites on the KM study area. These data provide another example of long-term stability of falconiform densities in stable environments (see Newton 1991).

In 1993, we found 13 nests on the urban SP study area (Fig. 2), where density (272 ha per active nest) exceeded the KM density. Means for clutch size and number of bandable young per successful nest, and nest success on both sites (Table 1), were similar to those reported in other recent studies (Rosenfield and Bielefeldt 1993b). Means for clutch size and number of bandable young were also comparable to historical data for pre-DDT years (1929–45) in the northeastern United States (Henny and Wight 1972).

Nest site habitat on the urban SP area was characterized by small, highly fragmented woodlots (1–12 ha) potentially subject to much human disturbance. All nests in the rural KM area were located in conifer plantations, which might be regarded as inferior to natural forests in carrying capacity for raptors (Newton 1991). Nevertheless, both urban and rural sites exhibited high productivity and density. Some researchers have suggested that the Cooper's hawk is an area-sensitive species that may be adversely affected by forest fragmentation and loss of nest site habitat (Bosakowski et al. 1993, Robinson 1991 and references therein). Our results on the urban SP area do not support this premise.

Monitoring Implications. Population stability and nest area reoccupancy could, of course, be monitored in the long term by resurveying study areas at intervals approximating the maximum known longevity of a species, thereby excluding the potential effect of nest area fidelity. However, the mandates of conservation agencies may require that they survey populations at intervals shorter than a species' longevity. The longevity record for the Cooper's hawk is 12 yr (Rosenfield and Bielefeldt 1993b). Reoccupancy of all KM nesting areas with a complete intergenerational turnover of breeding adults in the relatively short span of 6 yr suggests a way of using reoccupancy to monitor the stability or possible declines of a breeding population of Cooper's hawks on an arbitrary area, such as a management unit, where more intensive techniques are not feasible. From a management standpoint, a practical cost-efficient monitoring procedure for Cooper's hawks in Wisconsin (or some other area) could be implemented by evaluating nest area reoccupancy at 6-yr intervals when the influence of site fidelity by previous breeders has been minimized. If a studied population exhibits long-term use of breeding sites by different adults (i.e., recruitment), then the population must be at least stable. For management purposes it is usually impractical to determine if the population is sustained by local recruits; nonetheless, if recruitment is adequate, conservation agencies might not need to emphasize active management of this species.

We have used our unpublished data on nest site fidelity and adult mortality to assess intergenerational turnover time for the KM population. However, it is unnecessary to determine fidelity or mortality when monitoring other study areas if similar turnover times are assumed. We stress that knowledge of the source of recruits on a given study area is not required for management purposes on that area. We emphasize that our results on nesting reoccupancy and turnover time were obtained in a relatively stable environment. Other monitoring intervals or regimes may be needed in areas of more frequent and extensive alterations of nesting habitat, and monitoring sites must be objectively selected (Johnson and Larson 1994).

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