:lined in size by 12 percent over the past five years (Brauning and Siefken 2004).

Threats to feeding habitat are related primarily to incremental loss of wetlands and undisturbed riparian stream reaches. Because this species appears to feed opportunistically on available prey, exotic and invasive prey species are not an issue. Continued loss of wetlands, however, would unfavorably affect food sources. Continued growth of Pennsylvania's rural human population may reduce the bird's access to wetland/riparian feeding habitat simply because of increased human encounters. Fish hatcheries are frequently visited by great blue herons, which may cause considerable losses if waterways are unprotected (Parkhurst et al. 1992). However, these losses can be prevented with the use of netting or electric fencing for exclusion (Mott and Flynt 1995; Pitt and Conover 1996). The remaining threats to feeding habitat relate to contaminants, which do not presently appear to adversely affect reproductive success. Acid mine drainage, however, resulting in fishless river segments and streams, continues to persist in the Susquehanna River West Branch, where great blue herons are largely absent (Schwalbe and Ross 1992).

CONSERVATION AND MANAGEMENT NEEDS

Protection methods for large breeding colonies in glaciated provinces need to be developed, especially with regard to heronries on private property. Easements, purchases, and public education need to be considered. To protect foraging habitat, wetland losses need to be curbed and buffers implemented both for large wetlands and riverine riparian areas.

MONITORING AND RESEARCH NEEDS

Existing survey methods, relying on volunteers, in addition to Pennsylvania Game Commision biologist field surveys, are adequate to monitor the breeding population of this large colonial breeder. Existing wetland survey methods used by the second *Atlas of Breeding Birds in Pennsylvania* should adequately quantify use of wetland habitats. Targeted riverine habitats can be surveyed by canoe. Effectiveness of conservation actions can be determined by nest count trends for implementation areas over a five-year period, Breeding Bird Survey data, or other heron encounter-rate data, such as canoe surveys and wetland surveys. Colony size or other identified habitat variables influencing colony longevity and growth can be used to alter conservation tactics where limited resources are available to protect important breeding areas.

Immediate research/survey needs for this species include a review of current population status and recent trends within the state. This information can be obtained by analyzing the existing nest count database (Pennsylvania Game Commission 2002) and by new field counts using standard counting techniques (Gibbs et al. 1988, Brucker 1992, Brauning and Siefken 2004, Dodd and Murphy 1995, Graham et al. 1996). Productivity estimates from new field data, in addition to trend inferences from these data, would help to identify problems in specific colonies or regions. The relationship between colony size and longevity should be examined using the existing database (Pennsylvania Game Commision 2002) to help in prioritizing colony protection measures. Other habitat-related factors can also be included in these analyses.

Author: ROBERT M. ROSS, UNITED STATES GEOLOGICAL SURVEY

Sharp-shinned Hawk

Order: Falconiformes
Family: Accipitridae
Accipiter striatus

The sharp-shinned hawk is listed as a Species of Greatest Conservation Need because it is a rare breeder within the state and has shown apparent population declines in much of its range (fig. 5.102). Pennsylvania provides critical habitat for breeding, migrating, and wintering sharp-shins and may provide an important link from the prime nesting areas in the boreal forest to the more dispersed nesting population of the southern Appalachians. It is currently not considered Threatened or Endangered within the state. The sharp-shin is listed as a Species of Greatest Conservation Need

Fig. 5.102. The Sharp-shinned Hawk, *Accipiter striatus*. Photo courtesy of Shawn Carey.

in eight northeastern states. Partners in Flight ranks the sharp-shin as a species of High Regional Conservation Concern for the Appalachian Bird Conservation Region, which encompasses most of Pennsylvania. It is listed as globally Secure (G5, Natureserve 2009).

GEOGRAPHIC RANGE

The continental subspecies of the sharp-shin (*Accipiter striatus velox*) breeds throughout the boreal forest of Canada and northern United States and in eastern North America. Its range extends south within the eastern deciduous forest through the Appalachians into the northern region of the Gulf Coast states. Pennsylvania lies in the middle of the breeding range in the eastern United States and in the northern part of the wintering range (Bildstein and Meyer 2000). Eastern flyway wintering birds extend south from New England through the southern United States to Texas east to Florida and south into the Caribbean (Clark 1985, Goodrich and Smith 2008, N. Bolgiano, unpublished data). Pennsylvania may be a keystone state within the eastern range as it provides critical habitat for breeding, resident, wintering, and migrant birds. South of Pennsylvania nesting birds appear restricted primarily to the Appalachians (Bildstein and Meyer 2000).

DISTRIBUTION AND RELATIVE ABUNDANCE IN PENNSYLVANIA

Before 1900, sharp-shins were found regularly across the state (Goodrich 1992b). Persecution, as well as widespread forest cutting during the early 1900s, probably limited their range in Pennsylvania through midcentury. Today, nesting sharp-shins can be found throughout most of Pennsylvania although they are closely allied with higher elevations and the more forested regions of the state (Goodrich 1992b, McWilliams and Brauning 2000; fig. 5.103). Overall, the large home range size of this species results in this bird being rare across the state even where habitat is adequate. This species' preference for larger, undisturbed forests may preclude it from most urbanized or agricultural areas of the southeast, as well as regions near Pittsburgh where forests are highly fragmented (Goodrich et al. 2002). Prime sharp-shin habitat would lie in northern forests where larger patches of mixed conifer forest still exist.

Little information exists on the abundance of this species. The United States Fish and Wildlife Service Breeding Bird Survey does not monitor this species effectively (Sauer et al. 2004); however, the North

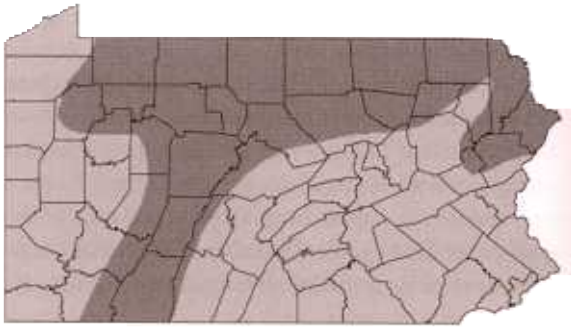

Fig. 5.103. Primary (darker shading) and secondary (lighter shading) distribution of the Sharp-shinned Hawk, *Accipiter striatus*.

American Landbird Conservation Plan estimates a global population of 1.1 million sharp-shins based on the Breeding Bird Survey data (Rich et al. 2004). Estimates on the breeding grounds are extremely suspect as all authors suggest regional population assessments are difficult because of the secretive nature of nesting birds and the widely dispersed distribution among nests (Bildstein and Meyer 2000). Migration counts at eastern watch sites plummeted in the late 1980s and early 1990s, particularly along the coast where juvenile birds concentrate (Panko 1990, Kerlinger 1992). Subsequent analyses of Christmas Bird Count data showed that wintering numbers were apparently increasing in northeastern states during the same period, and migration count declines could reflect an increase in "short-stopping" behavior (Duncan 1996, Viverette et al. 1996). Sightings from the Christmas Bird Count (www.audubon.org) and the Great Back Yard Bird Count (www.birdsource.org) imply that sharp-shins may winter in greater numbers in southeastern Pennsylvania, than in northern Pennsylvania and along the Coastal Plain to the east and south (Duncan 1996, Viverette et al. 1996)

The increasing abundance of bird feeders may be allowing greater numbers to winter in the northeastern states and eastern Canada as compared with previous years (Bolgiano 2005). Rebounds in migration counts during the late 1990s and thereafter, particularly at Cape May, suggest that at least some part of the observed decline may have been due to a real population change in northeastern birds (Bolgiano 2005). Wintering sharp-shins appear to be increasing or stable across the mid-Atlantic region (Bolgiano 1997). Recent sophisticated analyses of migration counts at seven eastern sites show no significant decline of –0.59 percent per year at Waggoner's Gap from 1990 to 2000 and a highly significant decline of –3.34 percent per year at

Hawk Mountain for the same period ($p < 0.01$; Farmer et al. 2008).

COMMUNITY TYPE/HABITAT USE

Sharp-shinned hawks are widespread in mixed and coniferous northern forests in the breeding season, with many birds selecting larger forests blocks away from human habitation (Meyer 1987, Bildstein and Meyer 2000). The sharp-shinned hawk breeds primarily within conifer or mixed forest stands (Palmer 1988b, Wiggers and Kritz 1994, Trexel et al. 1999) but will also nest in a wide variety of deciduous stands (Platt 1976, Joy et al. 1994). Sharp-shinned hawks tend to nest in stands with higher densities of shorter and smaller trees and higher percentages of conifers than Cooper's hawks (Rosenfield et al. 1991, Trexel et al. 1999). In some studies, younger stands were selected presumably for their higher tree density (Joy 1990, Coleman and Bird 1999). In boreal forests, nests have been located near human activity areas in a large forest (Coleman and Bird 1999). However, in one Pennsylvania study, nests only were found in the continuous forests away from human activity areas, so further information on this aspect is needed. Nests were often placed within 140 m of a forest opening, possibly to facilitate foraging opportunities (Grimm and Yahner 1986).

Research on wintering and migration habitat use has been limited. Some birds may hunt more edge or suburban habitats during winter and have been noted to visit bird feeders regularly (Dunn and Tessaglia 1994). In migration, female sharp-shins apparently seek out larger forest patches in rural areas for resting and feeding en route (L. Goodrich, unpublished data). Birds migrating along the Kittatinny Ridge in Pennsylvania roosted in forest habitat exclusively, with juveniles roosting in the continuous forest of the Ridge for 25 percent of their roost nights. Females may be more apt to select large forests similar to nesting habitat, while the smaller males may be found in more transitional, suburban, or open habitats; however, few data are available on intraspecific differences (Meyer 1987).

LIFE HISTORY AND ECOLOGY

Although highly secretive on nesting grounds, sharp-shinned hawks are regular and common migrants at migration watch sites continent-wide and are regularly observed on their nonbreeding grounds, particularly where bird feeders concentrate their prey (Davis 1992). Prey comprises small birds (>90%), particularly passerines, with an occasional insect or small mammal (Bildstein and Meyer 2000). The high dependence of boreal forest sharp-shins on songbirds has led to the suggestion that sharp-shin populations may cycle with spruce budworm specialist cycles (Bolgiano 2005). Banding return patterns suggest most birds do not survive beyond four to five years of age with a maximum-recorded age of thirteen (Keran 1981).

The sharp-shin is a partial migrant in Pennsylvania, thus nesting birds may include birds that migrate every year, birds that migrate some years, and birds that rarely migrate. In addition, Pennsylvania hosts birds that may winter within the state but nest farther to the north and birds that are in passage through the state on migration.

This species is presumed to be monogamous and pairs raise only one brood per year (Meyer 1987, Delannoy and Cruz 1988, Palmer 1988b). Some females may breed at one-year-old, but most will first breed at age two or older. In Pennsylvania, the sharp-shin builds its nest and lays eggs from May through mid-June and young fledge from July through September (McWilliams and Brauning 2000). Sharp-shinned hawks establish breeding territories with internest distances of 1–5 km (Reynolds and Wight 1978, Meyer 1987, Jacobs 1999).

THREATS

Loss of habitat, declines in prey populations, collisions with stationary or moving objects, disturbance at nest sites, and shooting are some of the threats suggested for this species, although little is known about their regional influence on populations (Viverette et al. 1996, Bildstein and Meyer 2000). In Pennsylvania, loss or alteration of nesting habitat may be the largest threat. As forest fragmentation and increased residential sprawl continue statewide, the habitat for this species is increasingly reduced. Loss or rarity of undisturbed conifer stands or thicker forest types may also reduce nest site availability. An increase in the nonnative hemlock woolly adelgid (*Adelges tsugae*) and the associated decline of eastern hemlock (*Tsuga canadensis*) populations also may reduce the availability of nesting sites in the southern counties. This species may benefit from forest cutting as it prefers thicker forests, although research on habitat use is limited.

Because sharp-shins prey predominately on songbirds, they are highly sensitive to bioaccumulation of environmental contaminants (Elliot and Martin 1994). They also have shown population-level declines in response to DDT use (Snyder et al. 1973, Bednarz et al.

1990) and may be sensitive to other pesticides such as organophosphates (Viverette et al. 1990). Because much of their diet comprises Neotropical migrant songbirds, sharp-shins will accumulate organochlorine compounds and other contaminants banned in North America because their primary prey winter in areas where such pesticides are still in use. Some contaminant load was evident in sharp-shins sampled in the mid-1990s (Elliot and Shutt 1993, Wood et al. 1996). Secondary poisoning from organophosphorus and carbamate compounds has been noted and could be a factor where forests are sprayed to control forest pests (Bildstein and Meyer 2000). Shooting and persecution may affect this species, although it is not suspected to have population-level effects (Bildstein and Meyer 2000). Bird band recoveries suggest a decrease of 7.5 percent to 3.7 percent of birds shot over the past thirty years (N. Bolgiano and L. Goodrich, unpublished data). Wintering or migrant sharp-shins are frequently victims of window strikes near bird feeders. Window strikes may be an increasing threat to this species as wintering birds frequent bird-feeding stations (Dunn and Tessaglia 1994) and as housing densities increase in some regions of Pennsylvania (Goodrich et al. 2002).

CONSERVATION AND MANAGEMENT NEEDS

Because the sharp-shin is sensitive to pesticide use, large-scale pest control programs should be limited within prime nesting areas. In addition, larger forests with conifer components could be targeted for protection from development to conserve habitats for this species and others (Myers et al. 2000, Goodrich et al. 2002). As forest fragmentation and alteration continues, conflicts with humans may increase and education on the role of predators in the ecosystem should be a continued statewide conservation priority. This species may do well in industrial forests that provide younger, thicker stands intermixed with older stands. Research on habitat use throughout the life cycle is needed to provide more informed conservation objectives. The lack of an effective monitoring program for forest-breeding raptors reduces the ability of state wildlife managers to conserve this species or to respond to possible declines and may be one of the most critical threats it currently faces across the region.

MONITORING AND RESEARCH NEEDS

Research is needed to determine the most effective and efficient method of monitoring Pennsylvania nesting populations. Current information suggests that nesting birds may be too difficult to monitor at the low densities at which they occur in Pennsylvania forests (Mosher et al. 1990), but other monitoring programs could be used effectively if additional research identifies that the source populations for wintering and migrating birds could be identified using band returns, stable isotopes, or other methods (Lott and Smith 2006, Goodrich and Smith 2008). Research using marked birds to define regions used by wintering Pennsylvania birds, as well as the propensity of Pennsylvania nesting birds to migrate or overwinter, is consistently needed. Winter and migration counts have been shown to be useful to derive regional trends (Bednarz et al. 1990, Bolgiano 2004, Farmer et al. 2008). Verification of state level trends from regional patterns still needs verification, but current analyses suggest it is possible (L. Goodrich personal observation).

Another monitoring goal would be to evaluate the use of breeding season surveys by volunteers to detect sharp-shins and other woodland raptors at a level that one could detect a population change (Rosenfield et al. 1988). As part of this evaluation, researchers would need to assess variations in detection probabilities and how the effort needed compared with other approaches of long-term monitoring. Breeding-season monitoring should be conducted using tape-call, the playback approach (Mosher et al. 1990) stratified by forest type across the state.

Additional research that will assist in the long-term conservation of this species includes assessing the nesting habitat requirements for this species (i.e. breeding forest size, territory and range size), the effect of fragmentation or suburbanization, mapping the breeding density or dispersion in different forest types across the state, and describing nest-site selection for birds in Pennsylvania and the importance of conifer forests to nesting birds. Because habitat use can change across life periods and locations, it is important to determine conservation threats beyond the nesting period. Defining the wintering range and migration pathways of Pennsylvania-nesting birds would allow better delineation of monitoring tools and identify potential threats to Pennsylvania birds. Assessing habitat use of this species during winter and migration periods and comparing males to females and adults to immature birds will help determine conservation needs during the nonbreeding periods. To assess contaminant levels and effects on fitness, researchers should monitor contaminant load in resident and migrant populations as an index to exposure of this species and its songbird

prey. Periodic sampling of eggshell thickness and nest productivity for birds that are sampled for contaminant exposure could be used to assess how blood levels of contaminants relate to nesting success.

Author: LAURIE J. GOODRICH, HAWK MOUNTAIN SANCTUARY

Red-shouldered Hawk

Order: Falconiformes
Family: Accipitridae
Buteo lineatus

The red-shouldered hawk was selected as a Species of Greatest Conservation Need because it is a rare breeder within the state and depends on extensive areas of riparian and bottomland forest (fig. 5.104). The red-shouldered hawk has been declining across its range throughout this century (Brauning 1992a, Partner In Flight 2004). Red-shouldered hawks are listed as a Species of Greatest Conservation need by eight northeastern states and are listed as Endangered by New Jersey. Global populations are considered Secure (G5, NatureServe 2009) .

GEOGRAPHIC RANGE

The red-shouldered hawk occurs in North America, exclusive of the Rocky Mountain Region (Genoways and Brenner 1985). In the East, the red-shouldered hawk is found from the eastern edge of the Great Plains to the Atlantic Coast, with the largest populations in the Southeast, particularly on the Gulf Coast. From Maryland south through Florida, birds are not highly migratory and may be residents or move only a short distance (Wheeler 2003). A western population breeds west of Sierra Nevada and southwest Oregon to northern Baja California (Crocoll 1994). Only northernmost populations are migratory, and they winter from southern Wisconsin, Oklahoma, southern Ohio, and southern New England, south to the Gulf Coast and Mexico.

DISTRIBUTION AND RELATIVE ABUNDANCE IN PENNSYLVANIA

In Pennsylvania, the red-shouldered hawk occurs as both a year-round resident and a migrant (Crocoll 1994). During the first Pennsylvania Breeding Bird Atlas in the late 1980s, individuals were recorded in 15 percent of the blocks across the state, although breeding was confirmed in only 3 percent of the blocks (Brauning 1992a). Statewide, the presence of this species is highly correlated with the proportion of total forest land, with the greatest concentration of breeding bird records coming from the Glaciated Section of northwest Pennsylvania and from the Allegheny High Plateau in the north-central portion of the state (fig. 5.105). These areas support large contiguous tracts of forest and provide relatively intact mature and lowland forest preferred by this species (Brauning 1992a). Although the present distribution of this species in the state is similar to what it was early in the century, low numbers exist throughout much of its historic range (Brauning 1992a).

COMMUNITY TYPE/HABITAT USE

Throughout its range in North America and in Pennsylvania, breeding habitat for the red-shouldered hawk occurs in relatively extensive lowland, deciduous, or mixed forests, interspersed with small openings or marshes (Brauning 1992a). Hardwoods are preferred for nesting, which occurs in mature, contiguous hardwood or mixed hardwood forest (Kimmel and

Fig. 5.104. The Red-shouldered Hawk, *Buteo lineatus*. Photo courtesy of Bob Gress.

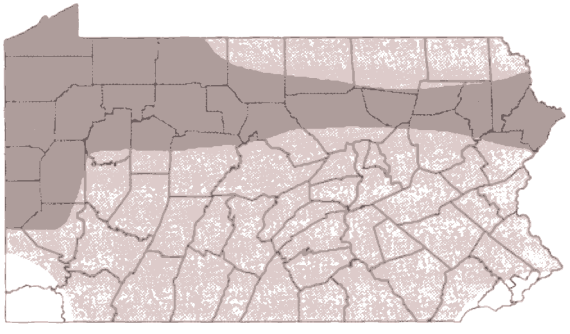

Fig. 5.105. Primary (darker shading) and secondary (lighter shading) distribution of the Red-shouldered Hawk, *Buteo lineatus*.