

be pursued and a landscape-level model that will help identify and facilitate management of red-shouldered hawk habitat should be developed.

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Broad-winged Hawk

Order: Falconiformes
Family: Accipitridae
Buteo platypterus

The broad-winged hawk is a small, crow-sized buteo (fig. 5.106). It was selected as a Species of Greatest Conservation Need because it has experienced declines within the core of its range and is sensitive to forest fragmentation. The state is an important migration corridor for broad-wings. Partners in Flight considers them a species of High Regional Concern and a Priority Species for Conservation Attention in Pennsylvania (Rosenberg 2004). Broad-wings are included on the Species of Greatest Conservation Need lists in seven northeastern states. Global populations are Secure (G5, NatureServe 2009).

GEOGRAPHIC RANGE

Broad-wings breed in deciduous or mixed deciduous-coniferous forests from central Alberta, east across Canada to New Brunswick and Cape Breton Island, Nova Scotia, then south through east-central Texas and south and east along the Gulf Coast to northern Florida. Prime range occurs mainly east of the Mississippi River from Maryland north through southern Canada. Greatest densities occur in northern

New York, Vermont, New Hampshire, and northward in spruce-hardwood forests (Robbins et al. 1986, Titus et al. 1989).

Broad-wings winter commonly from southern Mexico, south through Middle America and South America to northern Peru and southern Brazil (Goodrich et al. 1996). They are regularly recorded in south Florida, Cuba, Haiti, Puerto Rico, and West Indies during winter months. A few recent records suggest some birds may linger into December in some northern states during mild weather. Pennsylvania harbored at least one broad-wing through early winter 2004 near Beltzville Lake, eastern Pennsylvania, and one in a prior winter (Miller 1994). Increasingly warmer winters due to climate change may allow greater numbers to winter farther north than found in the past.

DISTRIBUTION AND RELATIVE ABUNDANCE IN PENNSYLVANIA

Broad-wings nest in larger forests throughout the state (McWilliams and Brauning 2000). They are likely rare within the highly fragmented forests of southeastern Pennsylvania or southwestern Pennsylvania, preferring forests of more than 40 acres, although larger patches may be needed where continuous forest is not found nearby (Grimm and Yahner 1986; L. Goodrich, personal observations). Pennsylvania provides abundant habitat for this species throughout the northern counties where forest remains extensive. The high proportion of fragmented forests throughout most of the southern part of the state probably limits nesting habitat, particularly around urban areas of Philadelphia and Pittsburgh (Goodrich et al. 2002). They prefer a mixed deciduous-conifer forest habitat and occur more commonly in northern counties where the northern hardwood forest predominates (Grimm and Yahner 1986, Goodrich et al. 2002). During the Pennsylvania Breeding Bird Atlas of the 1980s, broad-wings were sighted in every county, with the highest concentrations of confirmed nesting within the Pocono Plateau, Appalachians, and Allegheny Plateau regions (Senner and Goodrich 1992). In recent atlas efforts, the distribution appears similar (fig. 5.107).

The only estimate of the state population was derived by Partners in Flight using United States Fish and Wildlife Service Breeding Bird Survey data (Rosenberg 2004), resulting in an estimate of 36,000 birds in the state's forested habitat, with the largest numbers occurring in the Appalachian Mountains. The global population of broad-winged hawks had been estimated to



Fig. 5.106. The Broad-winged Hawk, *Buteo platypterus*. Photo courtesy of Vic Berardi.

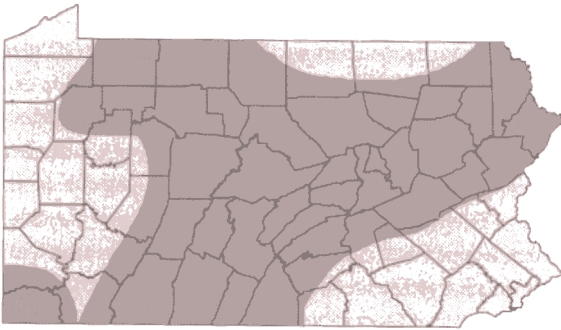


Fig. 5.107. Primary (darker shading) and secondary (lighter shading) distribution of the Broad-winged Hawk, *Buteo platyterus*.

exceed 1 million birds (Kirk and Hyslop 1998), but best estimates are derived from migration counts at Veracruz, Mexico, where biologists may count more than 90 percent of the global population of this complete migrant. From these counts, a global population estimate of 2 million to 3 million birds during postbreeding periods is most likely (Ruelas-Inzunza 2005). Viable breeders would number much fewer, as winter mortality can be high for young birds. A conservative global breeding population estimate might range from 1 to 1.75 million birds.

The broad-winged hawk was probably common in Penn's Woods before the 1800s but was considered rare by ornithologists during the early 1900s (Senner and Goodrich 1992). Widespread forest cutting in late 1800s and early 1900s undoubtedly reduced habitat for them until reforestation accelerated in the mid-1900s. Population trends appear complex, as regional populations may be exhibiting different trends. Analyses of Breeding Bird Survey data from 1966 through 1987 show a decrease at 1.1 percent per year in more-developed regions of northeastern United States (Titus et al. 1989). An analysis of Canadian Breeding Bird Survey trends from 1985 to 1994 reveal a significant decline of 3.33 percent (Kirk and Hyslop 1998).

Recent analyses of migration counts from Hawk Mountain and Waggoner's Gap, Pennsylvania, suggest a significant decline of 3.13 percent per year from 1974 to 2004 at Hawk Mountain in Pennsylvania and a non-significant long-term decline of 1.14 percent per year at Waggoner's. For the decade 1990 to 2000, broad-wing counts declined by 3.13 percent at Hawk Mountain where Waggoner's showed a significant 4.1 percent per year increase. Cape May, New Jersey, counts declined by a nonsignificant 1.42 percent per year for 1990 to 2000 while Lighthouse Point, Connecticut, counts de-

clined significantly by 2.34 percent per year (Farmer et al. 2008).

Previous analyses have suggested that different subpopulations within the eastern flyway may use the coastal and mountain routes (Miller et al. 2002), and the difference in trends from the coast inland may represent different subpopulations showing different 1993 trends. Waggoner's Gap likely draws birds from north-central Pennsylvania and Ontario, and Hawk Mountain may collect some northeastern Pennsylvania birds, as well as New England and eastern Canada birds. Cape May and Lighthouse Point may draw from a more easterly distribution. Further work is needed to identify the source populations for each count site, but the trends suggest some subpopulations may be declining. In most regions of Pennsylvania, the broad-wing is probably stable, but further monitoring is needed based on declines suggested by Pennsylvania migration counts.

COMMUNITY TYPE/HABITAT USE

Broad-wings nest in continuous or large deciduous or mixed-deciduous forests with openings and water source nearby (Goodrich et al. 1996). They often forage near small openings in the canopy (Crocoll 1984). Broad-wings will use younger forest stands than the red-shouldered hawk, but mature forests are commonly used as well (Titus and Mosher 1981). Some conifer component is preferred. No clear preference for nest tree species has been shown (Goodrich et al. 1996). They appear to avoid developed areas but may nest near dwellings on occasion and will forage along power-line corridors (Armstrong and Euler 1983). Broad-wings nest in deciduous or mixed deciduous-coniferous forest but place nests in a wide variety of trees (Goodrich et al. 1996). American chestnut (*Castanea dentata*) was formerly a typical nesting tree in the eastern United State and white (*Pinus strobus*) and red pine (*Pinus resinosa*) were used regularly in one Pennsylvania study (Grimm and Yahner 1986). Distance between broad-wing nests varies among regions with an average internest distance of $1,441 \pm 331$ m in New York ($n = 11$; Crocoll and Parker 1989), and in Wisconsin, a distance of 1,100 to 1,700 m (Rosenfield 1984). Nests in Pennsylvania appear more widely spaced (L. Goodrich, personal observation). Distance to openings and specific nest attributes vary considerably across its range.

Little is known about its habitat use on migration. Birds migrate in large flocks, and anecdotal observa-

tions suggest they seek out forests en route. During winter, broad-wings are seen using forest borders, coffee plantations, and both second-growth and primary forests. Observations in Veracruz, Mexico, show birds may roost several in one tree, where perch sites are limited or flock size is large (L. Goodrich, personal observation).

LIFE HISTORY AND ECOLOGY

Broad-wings take a variety of food items with amphibians, insects, mammals, and juvenile birds the most common prey. Diet depends on local availability of prey. Overall, most prey captured are between 10 and 30 g body mass (Goodrich et al. 1996). Small mammals and amphibians are the most frequent prey and provide the greatest biomass in most studies (Errington and Breckenridge 1938, Fitch 1974, Matray 1974, Crocoll 1984). Their propensity for amphibians (mainly frogs and toads) may explain their association with water (Rusch and Doerr 1972, Mosher and Matray 1974, Crocoll 1984, Rosenfield et al. 1984). Continued declines in amphibian populations may affect this species in the future (Beebee and Griffiths 2005). A variety of invertebrates are taken by nesting birds (Goodrich et al. 1996).

Broad-wings are presumably monogamous, and at least one pair remained together longer than one year (Matray 1974). Nests are built by mid-May in Pennsylvania and surrounding states, and egg laying occurs in May (Goodrich et al. 1996). Hatching generally occurs in mid-June in the northeastern United States with fledging in July or early August (Goodrich et al. 1996). They have only one clutch per year but will replace a clutch if the first is destroyed (Burns 1911).

Most nest loss occurs in the egg stage and results from predation (Crocoll and Parker 1989). In western New York, predation accounted for half the loss of nests (Crocoll and Parker 1989). The great horned owl (*Bubo virginianus*) was responsible at most nests, including killing adults during the incubation phase of the nesting cycle. Other nest predators include the raccoon (*Procyon lotor*) and American crows (*Corvus brachyrhynchos*; Rosenfield 1984). In western New York, nest success was greater for a new nest than a rebuilt nest, greater for adult/adult pairs compared with adult/second-year bird pairs, greater in deciduous-mixed woodlands compared with conifer plantations, and greater for nests distant from woodland openings (Crocoll and Parker 1989).

Broad-wings usually do not breed until they are

older than one year, but yearlings are reported breeding with adults on occasion (Burns 1911, Crocoll and Parker 1989). Adults probably attempt to breed every year (Crocoll and Parker 1989) but occasionally may not do so. In the only study in which adults were banded, one out of two pairs returned to nest within 400 m of the previous nest (Matray 1974). The broad-winged hawk is a complete migrant and leaves Pennsylvania by late September.

THREATS

The increasing fragmentation of forests in Pennsylvania and the Northeast through human development may be increasing stress on nesting birds, although the extent of this effect is unclear. More than 50 percent of Pennsylvania forests are considered edge forest and would be unsuitable for nesting broad-wings (Goodrich et al. 2002). Nest predation and competition with other raptors can have a substantial effect on productivity in some areas (Crocoll 1984). Increasing populations of Cooper's hawks may limit nesting near forest edges.

Amphibians are an important component of the broad-wing diet. Global climate change and acidic deposition are some of the factors implicated in a widespread decline in amphibian populations, including species in the northeastern United States (Beebee and Griffiths 2005). The effects of this community-level change on broad-wing densities and productivity are unknown. They will feed on nestlings and small mammals; however, because a large proportion of their diet appears to be composed of amphibians, some effect on nest productivity is possible. Maintaining the health of all forest communities will benefit this sensitive pinnacle predator of the eastern deciduous forests.

Some threats for this long-distance migrant may occur outside of the state. Mortality on the first migration is probably quite high, given the extended flight and challenges faced en route. Preservation of forest patches along major flyways may be helpful for roosting. Starved or emaciated immature birds are found consistently in Panama during migration, suggesting that many birds may not survive their first migration (Senner and Fuller 1989). Deforestation trends in tropical America may increasingly limit available wintering habitat, but winter habitat-use studies are lacking.

Early in the century, shooting birds on migration and during breeding may have had significant effect on this species. Band recovery data suggest shooting on wintering range continues to affect this species (Robbins 1986). However, proportion of banded broad-wings

recovered as shot in Latin America dropped from 100 percent in the 1950s to 71 percent in the 1970s ($n = 38$; Goodrich et al 1996). The tendency of this species to flock in large numbers on migration makes it particularly vulnerable to potential population effects from shooting during migration. One of the largest threats to this species may be the lack of knowledge about its health and abundance within the state and region.

CONSERVATION AND MANAGEMENT NEEDS

Because the larger forest tracts of northern Pennsylvania counties may serve as a source population regionally, efforts should be made to limit fragmentation where possible. The Partners in Flight priorities for Pennsylvania recommend maintaining current populations of broad-wings. Because of the development patterns in some regions, such as the Poconos, populations may be unavoidably reduced, suggesting a need to expand other populations. Effects of fragmentation and disturbance on broad-wings should be considered in timber management plans, particularly on state lands. Short timber rotations of less than forty years may be inadequate to maintain this species as a breeder (Mitchell and Millsap 1990). Maintaining continuous forest habitat across the state should also limit interactions with potential predators, such as red-tailed hawks and great horned owls, and with nest predators, such as raccoons. Streams or wetlands need to be maintained in the vicinity of nesting territories where they may serve as important foraging sites (Keran 1978). Although shooting probably is not having a large effect on current populations, enhanced efforts in public education within and outside of the United States can only improve population sustainability in the future.

RESEARCH AND MONITORING NEEDS

The immediate research and survey needs for the broad-winged hawk include determining their abundance and density during nesting season within different forest types across the state, determining their home range size and critical habitat components in different regions of the state and assessing their tolerance for forest fragmentation and human development near nests. Research on nest productivity, population viability, and turnover among different forest types could be useful. A GIS-based landscape study comparing land cover data and degree of fragmentation in relation to broad-wing nesting distribution and densities could be informative in determining their level of sensitivity to forest loss and assisting managers in targeting areas to

conserve. In addition, knowledge of how additional forest fragmentation may affect their metapopulation and individual nest success will inform the need for further conservation attention.

The Partners in Flight prioritization process noted that Atlantic Coast populations of Pennsylvania broad-wings need conservation attention. Special priority should be given to survey broad-wings in this region and to determine abundance, distribution, and any conservation threats. An intensive study on productivity and foraging patterns would be useful in determining long-term health of this subpopulation in the state. Periodic monitoring of this population may be warranted to ensure long-term viability.

Research also is needed to design and validate population survey methods for this and other woodland raptors, particularly in light of possible regional declines. Nesting season surveys stratified by forest type and conducted across the state regularly, in combination with annual migration surveys, would provide an effective monitoring program. If the source populations for migration count sites can be defined, migration counts can be a low-cost option for state-level, long-term monitoring, and the need for nesting season surveys could be eliminated.

Research on the foraging patterns and diet of broad-wings nesting in Pennsylvania could be useful in determining whether prey number or distribution, such as amphibians, could be limiting populations in some regions. Identifying prey and quantifying abundance and relative importance from incubation period through fledging would elucidate preferences in Pennsylvania. A comparison of nests from different regions or forest communities also should occur as birds may cue on different prey regionally and different pressures may limit prey in some regions.

Because broad-wings are long-distance migrants, threats outside of Pennsylvania and outside North America also could limit Pennsylvania populations. Research is needed to better define the migration routes and wintering locations of broad-wings originating in Pennsylvania. Analyses of banding recoveries and satellite-marked birds could be useful in defining potential threats and would be useful in developing effective monitoring programs for Pennsylvania birds. If migration routes can be mapped, certain migration count sites may prove more useful for monitoring than others. Such mapping also can guide conservation action for migration roosting habitat, as well as for wintering areas.

Research on the importance of Pennsylvania as a source population for potential nesting birds in neighboring states, such as New Jersey, Delaware, and Ohio, could assist in understanding the extent of metapopulation interactions. Studies of dispersal distance and site fidelity for young broad-wings could be useful for future conservation. Following radio- and color-marked individuals for a full annual cycle could provide some important population information, and a study of marked nesting pairs monitored over many years in different regions of the state would provide some important insight into population stability.

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Sora

Order: Gruiformes

Family: Rallidae

Porzana carolina

The sora is a medium-sized rail with a yellow bill and black mask on its face (fig. 5.108). It was selected as a Species of Greatest Conservation Need because it is a rare breeder within the state and is perceived to have declined in numbers. The sora is a migratory game bird in Pennsylvania. The Pennsylvania Biological Survey ranks them as Candidate-Rare. Soras are also listed as a Species of Greatest Conservation Need by six other Northeastern states. Global populations are considered Secure (G5, NatureServe 2009).

GEOGRAPHIC RANGE

Soras breed locally in North America in suitable wetland habitat. Soras are migrants breeding across Canada and the northern United States and winter-

ing in coastal areas, the southern United States south to Central America and northern South America. Pennsylvania is on the southern limit of the breeding range (Melvin and Gibbs 1996, McWilliams and Brauning 2000). The sora is the most abundant and widely distributed rail in North America (Melvin and Gibbs 1996).

DISTRIBUTION AND RELATIVE ABUNDANCE IN PENNSYLVANIA

The sora is a rare and local nester in suitable habitat throughout most of Pennsylvania. It is confined to fairly extensive marshes. Similar to most wetland-associates, soras have declined in number. They were formerly considered abundant in suitable habitat throughout most of the state. For example, A. Poole (unpublished manuscript) reported they were abundant in marshes of the lower Delaware River. Harlow (1913) described the sora as common in suitable habitat in the northern half of the state but rare in southern sections. They were considered to be more common than the Virginia rail in the north-central part of the state and abundant in Centre County wetlands (Harlow 1912, Burleigh 1931). Todd (1940) considered the sora to be fairly common in western-tier counties from Erie south through Crawford, Mercer, and Lawrence. By the beginning of the first Breeding Bird Atlas (1983), the sora was an uncommon breeder. Several regional coordinators for the atlas reported that the sora was much more common before the atlas (Brauning 1992b). Unfortunately, we lack adequate data to quantify these declines. Breeding bird survey trend data are not available for Pennsylvania because of low numbers and the inadequacy of Breeding Bird Survey routes for monitoring many secretive wetland species.

During the first Pennsylvania Breeding Bird Atlas (1983–1989), soras were reported in eighty-eight blocks, about 2 percent of the total and some of those in only one year. Almost half of the reports were from the glaciated northwest and northeast counties. Sora breeding activity is rarely reported at Pennsylvania Society for Ornithology Special Area Project locations, despite the emphasis on wetlands. They are rarely reported in Pennsylvania Birds accounts (D. A. Gross, personal communication). There were ninety-one sora reports to the second Pennsylvania Breeding Bird Atlas. Of those, eleven were confirmed and forty-three probable. Their greatest probability of occurrence continues to be in the northwest corner of the state (fig. 5.109).



Fig. 5.108. The Sora, *Porzana carolina*. Image courtesy of Elaine R. Wilson, naturespicsonline.com.