United States Department of Agriculture
Natural Resources Conservation Service

CEAP Conservation Insight
Conservation Effects Assessment Project
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Conservation Practices Benefit Shrubland Birds in New England

Summary Findings

Echoing downward trends in early successional habitats, shrubland nesting bird populations in New England have declined precipitously in recent decades.

A literature synthesis was conducted to establish the state of our understanding of the New England shrubland bird community. Key revelations include:

- Shrubland birds are **not** edge species as previously thought.
- Shrubland birds are habitat specialists that occupy sites during only a brief period of plant succession.

A combined analysis of bird data collected in shrublands across New England showed that—

- some shrubland birds prefer taller vegetation (>1.5 m) with abundant shrub cover while others prefer lower (<1.5 m) vegetation with fewer shrubs and abundant forb cover;
- some invasive shrubs provide suitable nest substrates; and
- while low density suburban development had neutral effects on many shrubland birds, at least three species in steep decline are adversely affected by development.

An estimate of available shrubland habitat in Massachusetts revealed that about 20 percent is attributed to deliberate early-successional habitat management programs. These habitats support nearly half of some shrubland bird species in the State. At least 22 percent of these habitats are provided by USDA conservation practices.

Background

Shrubland birds and their habitats have varied in extent in the northeastern United States from vast plains and savannahs during the Pleistocene to scattered tree falls and gaps following the displacement of Native Americans from the eastern seaboard. Currently, shrubland habitats are likely at or near an historical low in the region following an 80-year decline in anthropogenic and natural disturbances. As the habitats created by these disturbances have declined, so have the disturbance-dependent wildlife associated with them, including shrubland birds (Askins 1993). Most shrubland bird species are restricted to nesting in low shrub-dominated habitats with little or no tree canopy cover, and are unable to establish territories and nest in closed canopy forested habitats. Species designated as shrubland birds in this assessment are listed in table 1.

Due to declining populations, management for shrubland birds is widely recognized as a high conservation priority. These species are identified by most State Wildlife Action Plans as species of greatest conservation need, and regional priorities and conservation goals have been established to help address population declines (Rich et al. 2004).

By their nature, shrubland habitats are ephemeral and revert to conditions unsuitable for shrubland birds and other disturbance-dependent organisms within a decade or two. Although routine human activities such as the management of powerline corridors and logging can create and maintain habitat for shrubland birds, the continued declines in shrublands and the species that depend on them suggest that these activities by themselves are insufficient. Thus, programs to maintain shrubland habitats necessarily include active management,

Approximately 78 percent of the shrubland habitat in New England is in the form of regenerating clearcuts following timber harvest.

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such as mowing, prescribed burning and silvicultural treatments. These practices are often costly and may take place at the expense of mature forest habitat.

Detailed information on the habitat needs of shrubland birds helps ensure that habitat development investments achieve the maximum benefit and that management practices are well conceived and able to withstand public scrutiny. The U.S. Department of Agriculture (USDA) has assumed a central role in supporting habitat management programs for shrubland birds and other disturbance-dependant wildlife. With cost-share assistance from USDA conservation programs (e.g., Environmental Quality Incentives Program [EQIP], Wildlife Habitat Incentives Program [WHIP], Wetlands Reserve Program [WRP], and Conservation Reserve Program [CRP]), landowners are using conservation practices such as Early Successional Habitat Development/ Management (NRCS Practice Code 647) to help provide these shrubland habitats in New England and elsewhere. These efforts have resulted in the restoration and reclamation of thousands of acres of shrubland habitat. However, better understanding of shrubland bird biology will lead to more effective management and support objective assessments of conservation practice effects.

Assessment Approach

This assessment focuses on establishing the state of our knowledge of the habitat needs and management of shrubland bird species and uses this knowledge to assess the effects of USDA program-supported conservation practices on shrubland birds in New England. This project was carried out as an element of the Wildlife Component of the Conservation Effects Assessment Project (CEAP). Assessment components include (1) a comprehensive literature synthesis, (2) analysis of combined existing bird survey data sets, and (3) implications drawn from the synthesis and analysis on shrubland bird response to USDA conservation programs in New England.

Literature synthesis. A literature synthesis was conducted to establish the state of our knowledge of shrubland bird response to early successional habitat management in New England (Schlossberg and King 2007). This literature synthesis was directed towards identifying birds and other wildlife that are true scrub-shrub habitat obligates, and identifying relationships between abundance of these species and habitat structure and composition, spatial characteristics of habitat, and management practices. The effort centered on material published in peer-reviewed outlets; however, unpublished reports, theses, and other "gray" literature that met quality standards were included. Whereas material from New England was the focus, relevant and applicable information from ecologically similar regions of the country was also included.

Combination and synthesis of scrub-shrub bird data sets. Shrubland bird habitat use was assessed by combining data sets previously collected by the U.S. Forest Service Northern Research Station (NRS) in a variety of scrub-shrubland habitats. These included breeding bird survey data from 441 survey points characterized in table 2.

All bird data were collected using 10-minute point counts visited 3 times per season during the peak of the breeding season. To characterize habitat conditions, vegetation species composition, height, and cover measurements were taken at 20 randomly located points per point count station.

These data were combined into one large data set and analyzed using univariate comparisons of habitat at points occupied and unoccupied by each species, nested by plot. In addition, the relationship of shrubland birds with habitat variables were analyzed using multivariate statistics. Abundance was modeled in relation to treatment variables using N-mixture models with counts assumed to be Poisson distributed (Royle 2004). These models incorporated abundance and detection probability covariates to correct for varying detection probabilities among plots. In addition, canonical

Table 1. Core shrubland bird species in New England (from Schlossberg and King 2007)

Northern bobwhite *Colinus virginianus*	Eastern towhee *Pipilo erythrophthalmus*
American woodcock *Scolopax minor*	Field sparrow *Spizella pusilla*
Alder flycatcher *Empidonax alnorum*	Song sparrow *Melospiza melodia*
Willow flycatcher *Empidonax traillii*	Lincoln's sparrow *Melospiza lincolnii*
White-eyed vireo *Vireo griseus*	White-throated sparrow *Zonotrichia albicollis*
House wren *Troglodytes aedon*	Northern cardinal *Cardinalis cardinalis*
Gray catbird *Dumetella carolinensis*	Indigo bunting *Passerina cyanea*
Brown thrasher *Toxostoma rufum*	American goldfinch *Carduelis tristis*
Blue-winged warbler *Vermivora pinus*	Wilson's snipe *Gallinago delicata*
Golden-winged warbler *Vermivora chrysoptera*	Yellow-billed cuckoo *Coccyzus americanus*
Tennessee warbler *Vermivora peregrina*	Whip-poor-will *Caprimulgus vociferus*
Nashville warbler *Vermivora ruficapilla*	Ruby-throated hummingbird *Archilochus colubris*
Yellow warbler *Dendroica petechia*	Cedar waxwing *Bombycilla cedrorum*
Chestnut-sided warbler *Dendroica pensylvanica*	Magnolia warbler *Dendroica magnolia*
Prairie warbler *Dendroica discolor*	Black-and-white warbler *Mniotilta varia*
Palm warbler *Dendroica palmarum*	Canada warbler *Wilsonia canadensis*
Mourning warbler *Oporornis philadelphia*	Dark-eyed junco *Junco hyemalis*
Common yellowthroat *Geothlypis trichas*	Rusty blackbird *Euphagus carolinus*
Wilson's warbler *Wilsonia pusilla*	Carolina wren *Thryothorus ludovicianus*
Yellow-breasted chat *Icteria virens*	Ruffed grouse *Bonasa umbellus*
	Northern mockingbird *Mimus polyglottos*

correlation analysis was used to analyze multivariate correspondence between bird communities and habitat variables. Data were nested by site, and a dummy variable was included to account for different habitats being sampled in different years by different observers.

Assessment of shrubland bird response to USDA programs. The original approach to this phase of the assessment was to compare bird abundance trends reflected in U.S. Geological Survey North American Breeding Bird and U.S. Fish and Wildlife Service Woodcock Singing-ground Surveys between lands enrolled in USDA conservation programs (WHIP, EQIP, WRP, CRP), and lands not enrolled in programs. However, the amount of survey data and the scale at which they were collected rendered this approach unfeasible. Instead, geospatial estimates of the aerial extent of all major shrubland habitat types in Massachusetts (e.g., powerline corridors, silvicultural openings, beaver meadows, old fields and pitch pine-scrub oak barrens) were obtained from existing geographic information systems, timber harvest plans and landowner queries. These estimates were combined with the habitat-specific shrubland bird abundance information generated in the earlier stages of the project to estimate the number of focal shrubland bird species in each habitat, as well as the proportion of the population of each species supported by deliberate habitat management associated with USDA programs and others, versus incidental establishment of early successional habitats (e.g., powerline corridor maintenance and commercial timber harvest).

Findings

Shrubland birds defined. The literature synthesis, containing nearly 500 references, produced the first comprehensive list of shrubland birds based on actual objective criteria rather than previously relied-upon expert opinion (table 1, Schlossberg and King 2007). Forty-one species meet the shrubland habitat obligate criteria.

Sparse New England shrublands—declining shrubland birds . The composition of the shrubland bird community varies substantially by geographic region. Scrub-shrub habitat is uncommon and declining in New England, making up roughly 12 percent of the land area (Schlossberg and King 2007). Seventy-one percent of this habitat is in Maine, which is largely outside the range of some high priority species such as prairie, blue-winged and golden-winged warblers, with far less shrubland habitat in southern New England. Seventy-eight percent of New England's shrubland habitat is regenerating forest created by timber harvest, but the proportion of New England's forests in an early-successional stage is much lower than in other regions of the eastern United States. Twenty-one shrubland bird species have shown long- or short-term declines in New England, and declining species outnumber increasing species by three to one. These declines have become more pronounced in the past few decades, and are most severe in central and southern New England, whereas populations are relatively stable in the northern part of the region.

Habitat use varies among species. Though 90 percent of the species will nest in clearcuts, some species occur only in other types of scrub-shrub habitats. Thus, no single type of management will accommodate all of the region's shrubland bird species.

Shrubland birds avoid edges. Published data from the literature supported a formal meta-analysis on whether shrubland bird species actually are edge-species, as they are widely characterized in the literature. This analysis involved data for 17 species from seven studies that compared the abundances of birds in the interiors and edges of regenerating clearcuts surrounded by mature forest. The meta-analysis clearly showed that shrubland birds avoid edges (Schlossberg and King 2008). All 17 species tested had higher abundances in patch centers than along edges, and these edge effects were significant for eight of those species.

The key implication of this result is that small or irregular patches dominated by edge are unlikely to provide suitable habitat for shrubland birds. This edge avoidance might explain the results of studies that have shown shrubland birds are less abundant in small (< 1 ha, or 2.5 acres) than larger (> 4 ha, or 10 acres) patches. Although the exact size thresholds beyond which abundance no longer increases have yet to be identified, clearly patches < 1 ha (2.5 ac) are below the optimum. Thus, management for these declining species should involve providing large patches and minimizing edges. These findings demonstrate the importance of testing widely accepted ecological classifications and the need to view landscape ecology from the perspective of non-forest wildlife.

Shrubland bird abundance changes with succession. A second meta-analysis supported by the literature examined the response of shrubland birds to succes-

Table 2. Northern Research Station breeding bird survey data sources used in the combined analysis of shrubland bird habitat use data

Data Source	Survey years	No. of survey points
Massachusetts powerline corridors	2002–03	75
New Hampshire managed wildlife openings	2003–04	70
Massachusetts managed wildlife openings	2004–05	27
Massachusetts regenerating clearcuts	2004–05	23
Massachusetts scrub-oak barrens	2004–06	16
Massachusetts beaver impoundments	2005–06	50
New Hampshire & Connecticut wildlife openings	2006–07	180

sion following even-aged forest management (Schlossberg and King 2009a). Using bird abundance data from previous studies in regenerating clearcuts, the area under abundance-time regression curves was used to estimate the proportion of regenerating forest actually used by each bird species. Of the 28 species for which sufficient data were available, 14 showed significant changes in abundance over time. For six species, abundance was highest immediately after logging and decreased thereafter (decreaser response species). Abundances of seven other species were initially low, peaked roughly 10 years after harvest, and declined thereafter (modal response species). To illustrate these patterns, figure 1 presents abundance-time regression curves from the meta-analysis, along with regional decreasing population trends, for two modal species and two decreaser species.

Based on these results, shrubland birds would be expected to occupy a mean of just 53 percent (SD±17 percent) of regenerating forests up to 20 years old. Thus, current estimates of habitat availability for shrubland birds in New England may be too high by a factor of two. These findings also suggest that managed openings should be maintained on longer rotations than are currently used, providing habitat for birds that prefer older regeneration. Although species response is highly variable, habitat use by many shrubland species declines when tree canopy closure progresses into the 20 to 40 percent range.

Shrubland birds differ in shrub structure preferences. Combined analysis of breeding bird data previously collected by the NRS from all of the principal shrubland habitat types in the region enabled broader generalizations to be made than through individual short-term, local-scale studies. This analysis revealed that only half of the 12 shrubland birds examined actually preferred areas with greater shrub cover (Schlossberg et al. 2010). An additional four species appeared to prefer areas with lower-stature vegetation and greater forb cover. Eight species showed positive associations with cover of individual plant species, with *Spiraea* spp., willows (*Salix* spp.), alders (*Alnus* spp.), and invasive exotics being the most important. Based on these findings, two broad categories of shrubland habitat preferences emerged: (1) areas of tall (>1.5 m) vegetation with abundant shrub cover and (2) areas of shorter (<1.5 m) vegetation with abundant forb cover but fewer shrubs.

Invasive shrubs provide nesting substrates. Another issue examined with the combined analyses of NRS datasets was the issue of exotic, invasive plants, which are an important conservation problem in the Northeast. Birds frequently use invasive plants as nest substrates, but effects of invasives on avian nesting success have been equivocal in past studies. Combined dataset analysis focused on the effects of invasive woody plants on avian nest-site selection and nesting success in western Massachusetts shrublands (Schlossberg and King 2010). At the nest scale, the effects of invasive versus native substrates on nesting success as well as differences among individual invasive species were tested. At the patch scale, effects of invasive prevalence on nesting success in natives and invasives were examined.

These analyses revealed that, as a whole, shrubland birds preferred invasive substrates. Of two species sufficiently abundant for individual analysis, gray catbirds preferred invasive substrates, but chestnut-sided warblers showed no preference for natives or invasives.

At the nest scale, nests of gray catbirds placed in invasive substrates were more successful than those in natives. Chestnut-sided warblers and all species combined, however, had equal nest success in invasives and natives. No differences in nest success for nests in different species of invasive substrates or in invasive substrates with and without thorns were detected.

At the scale of the patch, nest success in invasive substrates increased with the prevalence of invasives on a site. Nest success in native plants did not change with invasive prevalence. This finding may be attributed to the tendency for thickets of invasive plants to be larger on sites with more invasive cover. These findings illustrate the complex interac-

The white-throated sparrow is a shrubland bird species that has experienced a steep breeding population decline in New England in recent decades.

tion of different factors that can determine how invasive plants affect avian nesting success, and that control of invasive woody plants should be neutral for most shrubland birds. These findings also suggest that while management actions should favor native plants, the nesting substrate functions that invasive exotic shrubs may play in the interim should be recognized. This is particularly relevant in abandoned pastures and old field settings dominated by exotic shrub species.

Exurban development impacts some rapidly declining shrubland birds. The NRS datasets were used to evaluate the effects of housing development in rural areas, which is the fastest-growing type of land use in the United States, on shrubland birds. For avian conservation, development near natural habitats is a problem because it can reduce abundance and nesting success of birds and increase brood parasitism by brown-headed cowbirds (*Molothrus ater*). In southern New England, populations of shrubland birds are declining rapidly while exurban development is widespread and increasing.

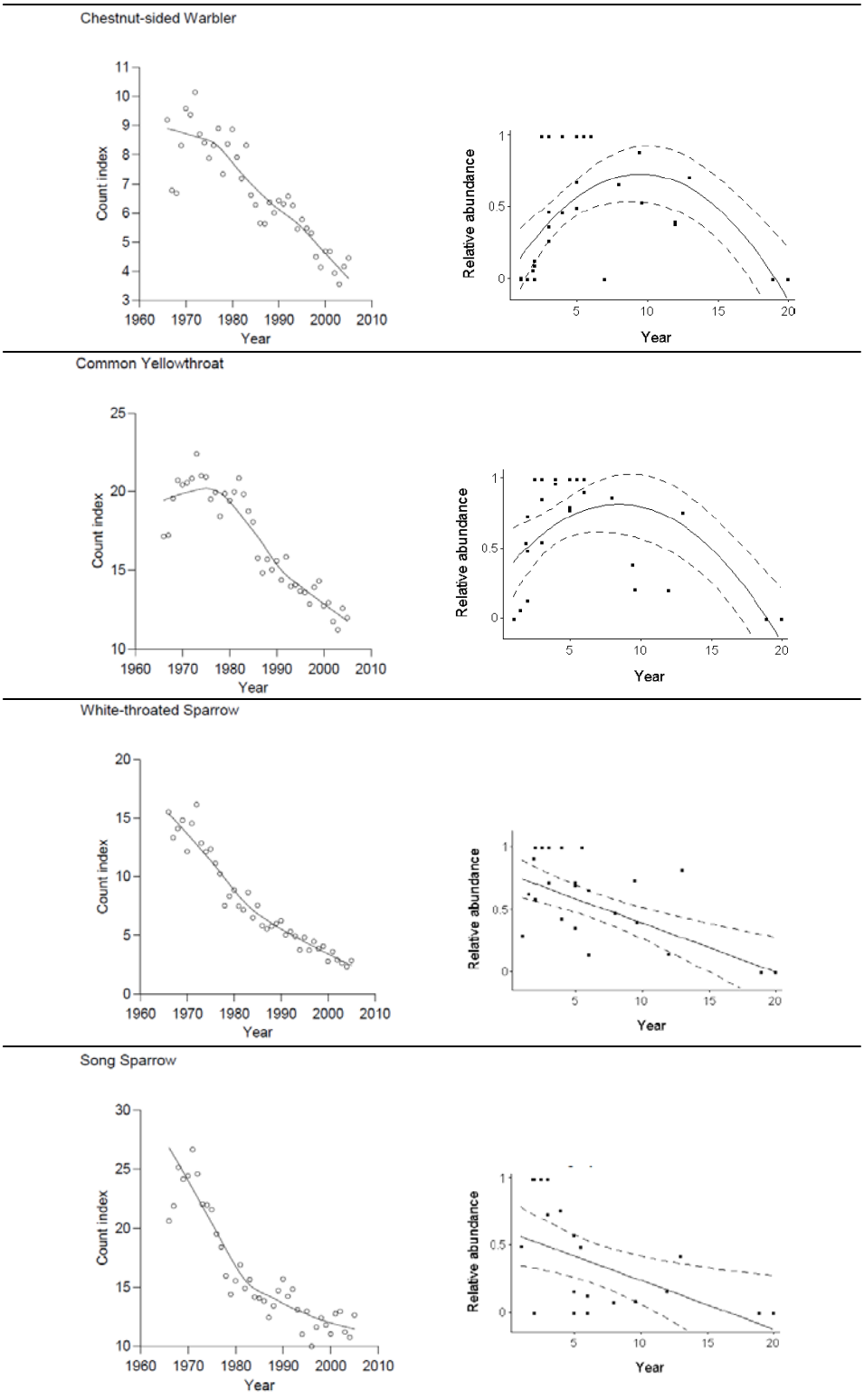
The analysis assessed the effects of landscape-scale low-density housing development on abundance and nesting success of birds in shrublands in western Massachusetts. Study sites included beaver wetlands, utility rights-of-way managed as shrublands, regenerating clearcuts, and mechanically treated old fields. Of 15 focal bird species, five increased with development within 1 km of study sites whereas eastern towhee and white-throated sparrow decreased.

Abundances of avian nest predators increased with development, but abundances of small mammals and brown-headed cowbirds did not. Prairie warblers had lower nest success in more developed areas, but for seven bird species development in the surrounding landscape did not affect nesting success. Brood parasitism by brown-headed cow-

Figure 1 Long-term population trends and abundance in harvested clearcuts as a function of time since logging for two modal and two decreaser shrubland birds in New England. For additional species, see Schlossberg and King (2007, 2009a).

Long-term population trend in New England. Data based on mean count per entire Breeding Bird Survey route, each of which includes 50 3-minute point counts (Sauer et al. 2005). Note that scales on the y-axis differ among species.

Abundance in clearcuts as a function of time since logging. Data points are from a meta-analysis of successional changes in bird populations after logging. Regression curve (solid line) and 95 percent confidence intervals (dashed lines) are based on the best model according to Akaike Information Criterion with correction for finite sample size.



birds was higher on sites with more development. Overall, three species were negatively affected by development (eastern towhee, white-throated sparrow, and prairie warbler), and all three of these species are declining rapidly in New England. Housing development in the surrounding landscape should be a consideration in management of these species. For other shrubland birds, however, low-density housing development at the landscape scale appears to have neutral effects.

USDA programs support shrubland birds in New England. The purpose of this assessment was to establish the degree to which active management, particularly conservation practices implemented through USDA conservation programs, supports shrubland birds in the Northeast. Disturbance-dependent habitats such as grasslands and shrublands are declining in many regions. To mitigate these declines, government agencies are using anthropogenic disturbances such as logging and mowing to mimic natural disturbances that set back forest succession. Because these programs can be costly, measuring their effectiveness is important.

To support this effort, the conservation effectiveness of shrubland management for 15 bird species in Massachusetts, a representative northeastern state for which relatively complete land use data were available, was evaluated. Remotely sensed data were used to assess the total area of shrublands in Massachusetts. Analysis of a timber harvest database and consultations with land managers were then used to determine the relative contribution of early successional habitat management conducted by government agencies and non-governmental organizations (NGOs) to the total shrublands in the State. Adjustments in habitat areas were made to reflect habitat relationships of individual bird species.

The area of potential habitat for shrubland birds in Massachusetts averaged 35,000 ha (±SD of 11,300 ha). Of this total, an average of 20 percent (±15 percent) exists because of habitat management efforts of government agencies and NGOs, and these habitats support nearly half of the field sparrows and indigo buntings in the state. Early successional habitat management practices associated with USDA programs make up at least 22 percent of the shrubland habitat provided by these proactive habitat management efforts.

More research is needed. While this assessment revealed important findings, critical information gaps remain. Specifically, more research is needed on several aspects of the ecology of shrubland birds. Priorities for future research include better monitoring and assessment of scrub-shrub habitats, estimating avian demographic parameters under a variety of ecological conditions, improved monitoring of bird populations, and determining impacts of landscape structure and configuration on birds.

Putting Findings into Practice

This assessment yielded several important findings that can inform how conservation practices and programs can be implemented to maximize benefits to shrubland birds. Specifically, these findings can be integrated into applicable conservation standards such as NRCS Practice Standard 647—Early Successional Habitat Development/ Management and 643—Restoration and Management of Declining Habitats, as well as specifications and conservation program ranking factors and guidance.

- A variety of shrubland habitats on the landscape, beyond just logging clearcuts, are necessary to support shrubland bird communities.
- Patches of scrub-shrub habitat at least 1 ha (2.5 ac) in size and that minimize irregular edges are of greater benefit to shrubland birds than are smaller patches or patches with irregular edges.
- Because densities of many birds peak roughly 10 years after logging, the common practice of managing openings on shorter rotations (i.e., frequently mowing, burning, or cutting) may not allow habitat to develop sufficiently for many species to reach their potential populations. Thus, trees and shrubs allowed to grow for 10 to 15 years before returning openings to an earlier successional stage will maximize shrubland bird habitat potential.
- Because shrubland birds generally disappear from clearcuts within 20 years of logging, continually creating new shrubland habitat is vital to the maintenance of bird populations.
- Shrublands containing two distinct habitats—one containing taller (>1.5 m) vegetation with abundant shrub cover and another containing shorter (<1.5 m) vegetation with abundant forb cover but fewer shrubs—will support the range of nesting habitat preferences within the shrubland bird community.
- While management actions favor native plants, the role exotic shrubs can play in providing suitable shrubland bird nesting substrates in the interim should be recognized.
- Shrubland habitat establishment in areas of expanding housing development may have limited potential to benefit declining shrubland birds.

Given that current estimates of habitat availability are probably too optimistic, more habitat than has previously been suggested will be needed to conserve shrubland birds. This is especially true for southern New England.

Deliberate efforts to develop and maintain shrublands habitats, including those associated with USDA conservation practices and programs, are critical for conserving populations of shrubland birds and other early successional wildlife.

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The Conservation Effects Assessment Project:
Translating Science into Practice

The Conservation Effects Assessment Project (CEAP) is a multi-agency effort to build the science base for conservation. Project findings will help to guide USDA conservation policy and program development and help farmers and ranchers make informed conservation choices.

One of CEAP's objectives is to quantify the environmental benefits of conservation practices for reporting at the national and regional levels. Because fish and wildlife are affected by conservation actions taken on a variety of landscapes, the wildlife national assessment draws on and complements the national assessments for cropland, wetlands, and grazing lands. The wildlife national assessment works through numerous partnerships to support relevant studies and focuses on regional scientific priorities.

This assessment was conducted through a partnership among NRCS, the USFS Northern Research Station (NRS), and the University of Massachusetts-Amherst. Primary investigators on this project were David I. King (NRS) and Scott R. Schlossberg (U-Mass).

For more information:
www.nrcs.usda.gov/technical/NRI/ceap/