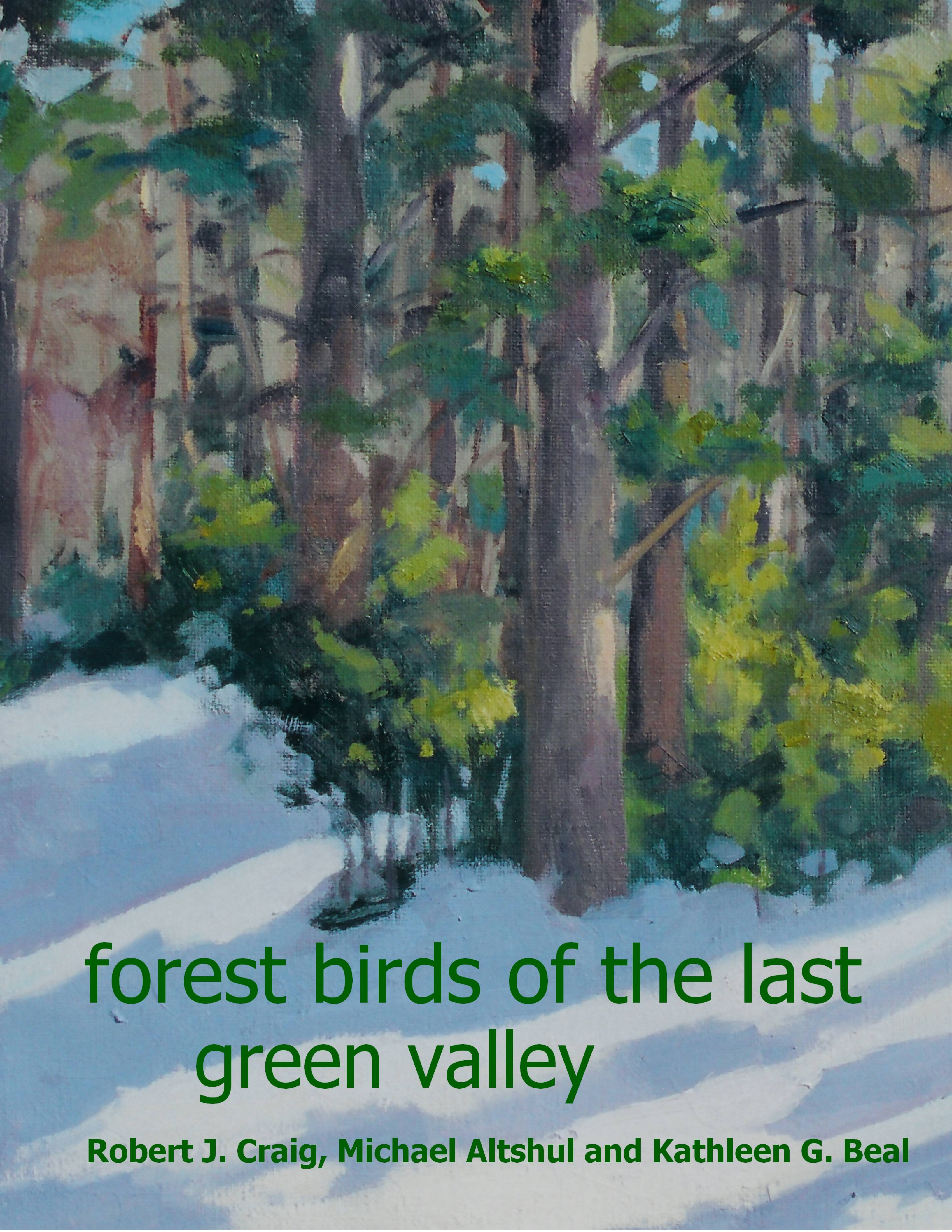

forest birds of the last green valley

Robert J. Craig, Michael Altshul and Kathleen G. Beal

Forest Birds of the Last Green Valley:

The Density Distribution, Habitat Ecology, and Conservation of the Forest Birds of Eastern Connecticut

Robert J. Craig

Bird Conservation Research, Inc.
90 Liberty Highway
Putnam, CT 06260

Michael Altshul

Green Valley Institute
College of Agriculture and Natural Resources
University of Connecticut
139 Wolf Den Rd.
Brooklyn, CT 06234

Kathleen G. Beal

Department of Biology
300 College Park
University of Dayton
Dayton, OH 45469-2320

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Foreword

One might say that the forest flew north on the wings of birds. Our present forests, dominated as they are by oaks, began their tenure on the Connecticut landscape about 6,000 years ago. From their scattered refugia in the Southeast, oaks colonized the emerging post-glacial landscape as acorns were dispersed by species like the lowly Blue Jay. Although it would be simplistic to assert that these forests were established solely by the actions of birds, certainly birds were one of the key agents of dispersal for the large-seeded oaks. We may, therefore, think of two communities, one of trees and one of birds, as being intimately connected since their origins. In this volume, the legacy of this long relationship is documented.

This work records for the first time patterns of bird species diversity and community population density for eastern Connecticut. Moreover, it details the distribution and density of individual bird species in this region. The densities of populations studied show numerous associations with habitat, and density patterns show as well a relationship with broad geographic patterns in habitat distribution. The elucidation of these patterns, both for community parameters and for individual species, provides tools for understanding the ecological processes that drive distributions.

In addition to providing insights into large-scale ecological phenomena, this volume is intended to be a database for the resource management community. Lessons to be gleaned from the data provided include (1) even common forest birds are not distributed uniformly across the landscape, (2) forest bird species exhibit highly heterogeneous habitat needs and (3) there is a profound summer-winter shift in the distributions of even "permanent resident" species. As a consequence, (4) no one forest tract, even a large one, supports the entire compliment of forest bird species. Each tract is demonstrated to have its own characteristics, which favors certain species and discourages others. Hence, only protection of a series of such tracts appears likely to ensure the long-term persistence of the regional forest bird community.

Despite the enormous volumes of data gathered and synthesized to produce this work, the research presented is of a snapshot in time. It may be thought of as a starting point, and not yet a complete statement, for understanding the processes driving large-scale patterns in our regional forest bird community.

Robert J. Craig
Putnam, Connecticut
2003

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INTRODUCTION

Although not precisely a valley, the drainages of the Quinebaug, Shetucket, and Thames Rivers of eastern Connecticut do indeed encompass an area that is still green. Some of the greatest remaining expanses of natural landscapes from Washington to Boston characterize the region (Rosenberg et al. 1999). However, eastern Connecticut is rapidly growing (Connecticut Office of Policy and Management 2002), and within one more generation this landscape is likely to undergo a revolution in appearance. Throughout the East Coast, similar revolutions are underway, and it appears left to the present generation to make critical decisions about the future persistence of the region's natural features (Craig 2002). However, making sound conservation decisions requires an extensive resource database. Hence, a key goal of this investigation is to provide a broad scale database for the region's forest avifauna.

In addition to their value in documenting resource distribution, broad scale studies permit investigation of ecological processes that operate at the landscape level. Scale is a critical issue in interpreting ecological phenomena, in that differing community processes may act at differing scales. For example, ecological studies conducted at a generally wider scope show greater stability in populations and species composition than at smaller scales. Dynamic processes that involve regional microhabitat patchiness are also best revealed by broader investigations. Moreover, greater insights may be obtained into species-habitat relationships when a broader perspective is employed, because species that use multiple microhabitats are better characterized by them (Wiens 1989). Therefore, we report not only data useful to resource managers, but also investigate large scale patterns in bird communities, and explore the influences of large scale habitat variation on these communities.

Historical background.- The avifauna of Connecticut has been the subject of major historical surveys, including those of Linsley (1843), Merriam (1877), Sage et al. (1913), Mackenzie (1961), Manter (1975), Zeranski and Baptist (1990), and Clark (1999). Furthermore, Dowhan and Craig (1976) and Craig (1979) reported the historic distribution and conservation status of rare Connecticut birds. Principal large scale, quantitative surveys of Connecticut birdlife include works by Askins et al. (1987), Craig (1987, 1990), and Bevier (1994). Moreover, Breeding Bird Surveys (U.S. Fish and Wildlife Service), Christmas Counts (National Audubon Society), and Summer Bird Counts (Connecticut Ornithological Association) (e.g. Zeranski and Purnell 2001) are run annually. These three efforts yield information on relative abundance. Furthermore, aerial mid-winter counts of coastal waterfowl numbers are conducted each year by the Connecticut Department of Environmental Protection (Merola 1991).

At present, the most complete source for summer distributions of Connecticut birds is *The Atlas of Breeding Birds of Connecticut* (Bevier 1994). Breeding bird atlases of this type have proliferated in recent decades, and have added significantly to our knowledge of continental bird distributions. Their strength is in documenting the local presence of species, particularly rare species, because they employ numerous observers working over extensive areas. They also provide broad scale confirmation of breeding. However, as with other large-scale surveys (James et al. 1996, Thomas 1996) they have weaknesses. Bevier (1994) observed that in Connecticut level of survey effort varied among locations and, consequently, that particularly absence data must be interpreted with caution. Moreover, differences in observer experience are a potentially large (McDonald 1981, Davis 1981) but unquantified source of data variance.

Scope.- In this volume, we extend these earlier works by mapping the density distribution of forest birds inhabiting eastern Connecticut. For each species, we further estimate total populations, provide quantitative evaluations of habitat affinities, and examine variance in populations. Moreover, we relate landscape-level variation in habitats with geographic patterns of population density, species richness, and community density.

By combining a conservation perspective with basic ecological investigation, we also work toward improving the sophistication of resource management practice. Our data permit refinement and reassessment of traditional views of forest management for wildlife (e.g. Irvin 2000), and yield a multi-faceted approach to forest bird conservation.

METHODS

THE ENVIRONMENT

Physical environment.- Eastern Connecticut has a bedrock geology characterized by gneisses, schists and granites. These are overlain in numerous locations by glacial sediments of varying depths (Stone et al. 1999), and major drainages are characterized by glacial outwash (Ilgen et al. 1966, Roberts 1981). The interplay of chemical and physical weathering, as well as glacial events on these parent materials, have yielded soils of varying but frequently poorer quality in this region. One of the principal agricultural values of many of the local soils, e.g. Brookfield-Brimfield, Charlton-Hollis, Saco-Rippowam-Pootatuck and Charleton-Canton-Leicester, is for timber production (Ilgen et al. 1961, Roberts 1981).

Based on characteristics of its physical and biotic environments, eastern Connecticut has been divided into four ecological provinces (ecoregions): the Northeast Uplands, Northeast Hills, Southeast Hills, and Eastern Coastal ecoregions. The Northeast Uplands has the lowest mean annual temperatures, shortest frost-free growing season, and steeply hilly topography reaching elevations of ca 400 m. In contrast, the Eastern Coastal Ecoregion has the highest mean annual temperatures, longest frost-free growing season, and lowest lying topography, with elevations below 120 m (Dowhan and Craig 1976). Although conditions in eastern Connecticut indeed represent a continuum from north to south, such subdivisions prove useful in focusing attention on regional differences in natural features.

The summer of 2001 was moderately dry. The summer of 2002 followed an exceptionally dry spring, although June itself had rainfall typical for the month. The winter of 2001-2002 was notable in its mild conditions and lack of snow cover. The winter of 2002-2003 was, in contrast, unusually cold and snowy. During these years, for much of February over 0.5 m of snow covered the ground.

Vegetation.- Within this region, forest cover varies from 69% in the north (Tolland Co.) to 63% in the south (New London Co.). The most widespread forest associations are those dominated by oaks, hickories and birches (Alerich 1999, Table 1). On more mesic northern sites (Fig. 1), Northern Red Oak (*Quercus borealis*) occurs in varying mixtures with White Oak (*Q. alba*), Shagbark Hickory (*Carya ovata*), Red-Pignut Hickory (*C. ovalis-glabra* complex), Black Birch (*Betula lenta*), Red Maple *(Acer rubrum*) and American Hornbeam (*Carpinus caroliniana*). Toward the south and in more xeric locations, Black Oak (*Q.* velutina) progressively replaces Northern Red Oak (although both may co-occur), and frequently associates with Black Birch, Red-Pignut Hickory and Red Maple. Also more common at xeric locations throughout the region are White Oak, American Chestnut (*Castanea dentata*), albeit as root-sprout saplings, and Bigtooth Aspen (*Populus grandidentata*). At the most xeric sites, particularly on sandy, glacial deposits and rocky ridges (Fig. 2), Chestnut Oak (*Q.* prinus) and Scarlet Oak (*Q. coccinea*) often become predominant. Mockernut Hickory (*C. tomentosa*), Black Cherry (*Prunus serotina*) and Sassafras (*Sassafras albidum*) join the various oak-hickory-birch assemblages, particularly toward the coast (Dowhan and Craig 1976, R. Craig pers. obs; Fig. 3).

Other mesic deciduous forests of richer soils and coves (Fig. 3) are those vegetated by Sugar Maple (*A. saccharum*), Red Maple, White Ash (*Fraxinus Americana*), American Beech (*Fagus grandifolia*), Yellow Poplar (*Liriodendron tulipifera*), Yellow Birch (*B. lutea*) and Butternut (*Juglans cinerea*), although oaks and hickories are common associates as well. Deciduous associations of hydric (swamp) soils (Fig. 4) are frequently dominated by Red Maple, which is joined in these situations by such species as Yellow Birch, Black Tupelo (*Nyssa sylvatica*), Black Ash (*F. nigra*), Green Ash (*F.* pennsylvanica) and Swamp White Oak (*Q. bicolor*). River bottom and floodplain communities (Fig. 6) are dominated by Red Maple, Green Ash, Black Tupelo, Swamp White Oak, Bitternut Hickory (*C. cordiformis*), American Elm (*Ulmus americana*), Slippery Elm (*U. rubra*), Sycamore (*Platanus occidentalis*), Eastern Cottonwood (*Populus deltoides*), Black Willow (*Salix nigra*) and,

FIG. 1. Winter aspect of oak-dominated forest, Nathan Hale State Forest, Coventry, CT. Mature Black Oak is in foreground.

FIG. 2. Xeric, deciduous, ridge top forest on the Narragansett Trail, North Stonington, CT. Scarlet and Chestnut Oak comprise the canopy, and Huckleberry predominates in the understory.

FIG. 3. Coastal forest at Barn Island Wildlife Management Area, Stonington , CT showing dense Catbriars (*Smilax rotundifolia*) in the understory and a canopy of Black Oak and Mockernut Hickory.

FIG. 4. Winter aspect of a deciduous swamp in Pachaug State Forest, Voluntown, CT. Dominant trees are Red Maple and Yellow Birch; understory is Highbush Blueberry and Black Alder.

FIG. 5. Old growth Yellow Birch in mesic maple-beech-birch forest in Adirondack Park, N.Y.

FIG. 6. Floodplain forest along the Connecticut River, Portland, CT. Multi-trunked Silver Maples characterize the canopy, and sparse woody growth is typical of the understory.

FIG. 7. Mixed conifer-northern hardwood forest at Bigelow Hollow State Park, Union, CT. White Pine is in the mid-ground with Mountain Laurel (*Kalmia latifolia*).

FIG. 8. Old growth Eastern Hemlock forest at Old Furnace State Park, Killingly, CT. Open understory is typical of these types of forests.

FIG. 9. Winter aspect of xeric Eastern White Pine-oak forest at Kollar Wildlife Management Area, Tolland, CT.

FIG. 10. Pitch Pine-dominated ridge top forest on Mt. Misery, Voluntown, CT. Scrub Oak and Huckleberry predominate in the understory.

FIG. 11. Dead stand of Eastern Hemlock at Devil's Hopyard State Park, East Haddam, CT.

FIG. 12. Spruce plantation at Pachaug State Forest, Voluntown, CT.

FIG. 13. Eastern Hemlock-Yellow Birch-Red Maple swamp at Bigelow Hollow State Park, Union, CT.

FIG. 14. Atlantic White Cedar-dominated swamp at Pachaug State Forest, Voluntown, CT. Rhododendron (*Rhododendron maximum*) and Mountain Laurel form a dense understory in this swamp.

particularly along the largest rivers, Silver Maple (*A. saccharinum*) and Pin Oak (*Q. prinus*) (Dowhan and Craig 1976, R. Craig pers. obs).

Native coniferous associations occur throughout the region, although they are most extensive to the north in Tolland and Windham Counties (Alerich 1999), and especially in the Northeast Uplands ecoregion (Dowhan and Craig 1976, Table 1). Particularly in the north, deciduous trees of mesic environments are joined by Eastern White Pine (*Pinus strobus*) and Eastern Hemlock (*Tsuga canadensis*) to form conifer-northern hardwood associations (Fig. 7). These conifers may form nearly pure hemlock-white pine stands at mesic locations. Moreover, in cove sites associated with rivers and streams (Fig. 8), Eastern Hemlock occurs in nearly pure groves, although the introduced Wooly Adelgid (*Adelges tsugae*) is presently decimating hemlock stands (Fig. 11) in Connecticut (U.S. Forest Service 2002).

Conifer associations also may be found at xeric sites. Particularly in northern Connecticut and near the Connecticut-Rhode Island border, Eastern White Pine joins with oaks and hickories to form pine-oak associations (Fig. 9). Pitch Pine (*P. rigida*) is locally common at such locations, and occasionally assumes dominance on sandy soils and rocky ridges (Fig. 10). Planted stands of Red Pine (*P. resinosa*), rather frequent in eastern Connecticut into the 1980s, are now largely eliminated as a consequence of disease and subsequent logging. Moreover, limited stands of planted (Fig. 12) Norway Spruce (*Picea abies*), White Spruce (*P. glauca*), White Fir (*Abies concolor*), Douglas-fir (*Pseudotsuga menziesii*) and European Larch *(Larix decidua*) occur occasionally, primarily in State-owned forests and in Christmas tree plantations (Dowhan and Craig 1976, R. Craig pers. obs).

In hydric situations, Eastern White Pine and Eastern Hemlock may co-occur with deciduous swamp species to form conifer-swamp hardwood associations (Fig. 13). Atlantic White-cedar (*Chamaecyparis thyoides*) may occur in these mixed stands, although it also predominates in muck and peat soils (Fig. 14), with Black Spruce (*Picea nigra*) as an occasional coniferous associate (R. Craig pers. obs.).

Conifers also are important elements of successional forests. Eastern White Pine is a common to predominant member of forests regenerating after logging or abandonment. However, its prevalence as a successional species diminishes from north to south. Moreover, Eastern Redcedar (*Juniperus virginiana*) is a common to predominant element of successional forests, with its prevalence as a successional species increasing from north to south (Dowhan and Craig 1976).

STUDY AREAS

During this study, we established 51 transects (Fig. 15), with each traversing ca 3.2-4 km of forest. All sites were situated on public land or land with public access. Within this constraint, transect selection followed generally a randomized block protocol, such that we chose sites to cover all geographic regions of eastern Connecticut. Along each transect we established 15 stations for sampling bird populations and habitat features (765 total stations).

Habitat evaluation.- After each survey period for birds, we visually evaluated six habitat variables to a 70 m radius from each sampling station (Table 1): 1) forest type, 2) vegetation type, 3) moisture regime, 4) diameter of canopy trees at breast height (dbh), 5) canopy cover, and 6) understory density. We also estimated canopy height, although we dropped this measure from final consideration because it was overly redundant with dbh. We later re-visited all sites to refine and verify these measurements.

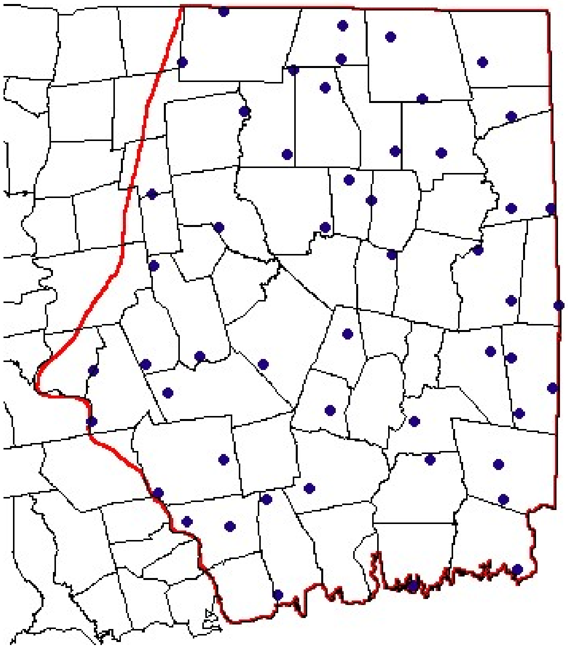

FIG. 15. The distribution of study areas in eastern Connecticut.

To determine forest type, we estimated conifer cover to the nearest 10% by categorizing ca 30 canopy trees as deciduous or coniferous. Forest type consisted of three categories: 1) deciduous: $\leq$10% evergreen conifers, 2) mixed: 20-60% evergreen coniferous, 3) coniferous: $\geq$ 70% evergreen conifers. Vegetation types represented major associations of tree species encountered: 1) oak–dominated (e.g. oak-hickory-birch), 2) mesic/hydric mixed deciduous; e.g. maple-birch-ash, 3) conifer (hemlock-white pine)- northern hardwood, 4) pine-oak, 5) conifer (hemlock, plantation conifers, white pine), 6) mixed sites, e.g. half xeric oak, half hydric mixed deciduous. Subdivisions of these categories may be recognized, e.g. upland vs. swamp conifer-hardwood associations, but to improve statistical analyses we combined similar categories.

Moisture regimes were based on examination of soil conditions and on the presence of vegetative indicator species: 1) hydric: poorly drained or muck and peat soils dominated by swamp trees and such understory species as Sweet Pepperbush (*Clethra alnifolia*), Highbush Blueberry (*Vaccinium corymbosum*), Swamp Azalea (*Rhododendron viscosum*), Spicebush (*Lindera benzoin*), Black Alder (*Ilex verticillata*), Speckled Alder (*Alnus rugosa*), Withrod (*Viburnum cassinoides*), Cinnamon Fern (*Osmunda cinnamomea*) and *Sphagnum* mosses, 2) mesic: various silt loam and sandy loam soils dominated by such species as Eastern Hemlock, White Ash, Sugar Maple, Red Oak, Shagbark Hickory, American Beech, Hobblebush (*Viburnum alnifolium*) and Nannyberry (*V. lentago*). and 3) xeric: exposed bedrock and sandy, gravelly, and rocky soils dominated by canopy species like Chestnut Oak, Scarlet Oak and Pitch Pine, and such understory species as Huckleberry (*Gaylussacia baccata*), Lowbush Blueberry (*V. angustifolium, V. vacillans*), Scrub Oak (*Q. ilicifolia*), Post Oak *(Q. stellata*) and Bracken Fern (*Pteridium aquilinum*). In practice, we distinguished swamp sites as hydric, dry ridges and sandy uplands as xeric, and used mesic as a broader category describing intermediate situations.

We divided prevailing canopy tree dbh into three categories: 1) young forest: $\leq$ 15 cm, 2) mature forest: >15-45 cm, and 3) old growth: > 45 cm. Most stands had canopy trees with ca 25-40 cm dbh, although much larger trees punctuated many. However, they occurred only rarely in sufficient numbers to classify as truly old growth. To document such older trees, we also measured their dbh with a tape.

We similarly divided canopy cover into three categories: 1) open: $\leq$40% canopy cover, 2) semi-open: 50-60% cover, and 3) closed: $\geq$70% cover. Most undisturbed forests classified as closed, whereas selectively logged forests or stands with $\geq$20% forest gaps (e.g. blowdowns or dead trees) were semi-open. Open stands were generally heavily logged sites or early old field stages reverting to forest.

We evaluated understory density for larger shrubs and saplings ca 1-4 m tall rather than for low ground covers and herbaceous growth: 1) open: $\leq$20% cover; 2) moderate: 30-60% cover, and 3) dense: $\geq$70% cover. Typically, dense hemlock stands and heavily deer-browsed forests had open understories, whereas swamps and forests with semi-open canopies classified as dense. We classified situations intermediate between these as having moderate density.

Transects.- Tabular data alone (Table 2) do not adequately characterize the distinctive features of each transect. Hence, brief descriptions of each follow:

1. *Natchaug State Forest, Pomfret-Eastford.*- This site was a predominantly xeric oak-dominated forest with canopy trees averaging 20-35 cm dbh. We encountered some trees to 45 cm dbh. Three stations skirted an extensive Red Maple swamp, and one was in hemlock-swamp hardwoods. Two stations bordered largely clearcut but regenerating areas.

2. *Boston Hollow, Ashford.*- Mesic hemlock-white pine-hardwood forest predominated in this steeply hilly area. Two stations were on a xeric Chestnut Oak ridge, and four were in largely pure white pine and hemlock. Canopy trees were typically 20-40 cm dbh, although larger trees were common, and three stations exhibited old growth conditions with trees to 70 cm dbh.

3. *Thompson Lake, Thompson.*- Xeric white pine-oak forest and conifer-swamp hardwood associations predominated. Three stations were in largely pure white pine, and three were within 100 m of Thompson Lake. Canopy trees were typically 20-40 cm dbh, but larger trees were fairly common. One stand classified as old growth, and had trees to 90 cm dbh.

4. *Putnam Heights, Putnam.*- Xeric white pine-oak associations prevailed here. In addition, five stations were in mesic mixed deciduous forest, with one near a deciduous swamp, one near a stream, and one near a vernal pool. Canopy trees were commonly 20-40 cm dbh, and we encountered some to 75 cm.

5. *Yale Forest, Eastford-Union.*- Mesic hemlock-white pine-hardwood associations prevailed, and five stations had largely pure cover by conifers. Terrain was steeply hilly, three stations bordered swamps, and three were within 100 m of Bigelow Brook. Canopy tree dbh was typically 20-45 cm, although larger trees were common. Four stations classified as old growth, with trees to 66 cm dbh, and three passed through selectively logged areas.

6. *Goodwin and Natchaug State Forest, Hampton-Chaplin.*- Oak, white pine-oak, and conifer (white pine and plantation spruces) associations predominated. Two stations were within 100 m of a pond, and five were in regenerating forest partly to largely clearcut (formerly Red Pine plantations). Canopy tree dbh was generally 20-40 cm, although some trees to 55 cm were present.

7. *Pumpkin Hill Wildlife Management Area, Chaplin.*- Mesic to xeric oak-dominated forest predominated, but mesic, mixed deciduous associations also occurred. One station was within 100 m of a beaver pond, one bordered a small old field, and three were in selectively logged forest. The dbh of canopy

trees was typically 20-40 cm. However, larger trees to 86 cm dbh were fairly common.

8. *Nipmuck State Forest, Union*.- Mesic hemlock-white pine-harwood forest on steeply hilly terrain predominated. Four stations also had nearly pure coniferous growth. One station was within 100 m of Mashapaug Lake, one was within 100 m of swamp, one was near a swampy stream, and four were in selectively logged forest. Canopy trees averaged 20-45 cm dbh, and one station classified as old growth. Large trees to 90 cm dbh were present throughout.

9. *Wolf Den State Park, Pomfret*.- Although primarily oak-dominated forest, three stations were in white pine-oak, and three were in mesic hemlock-hardwood associations bordering a ravine. Canopy trees averaged 20-45 cm dbh, with some trees to 65 cm dbh also present.

10. *Quanduck Brook, Sterling-Killingly*.- This varied site had stations in white pine-swamp hardwoods (4), oak-dominated (3), and conifer-dominated (hemlock, white pine; 5) forests. Some Pitch Pine was on xeric uplands, and Atlantic White-cedar was uncommon in an extensive Red Maple swamp. Five stations were in or bordered this swamp. Canopy trees averaged 20-40 cm dbh, but some trees to 90 cm dbh were present.

11. *Shenipset State Forest, Stafford-Somers*.- Principally oak-dominated, this transect also had four stations in white pine-oak forest and one in mesic hemlock-hardwood forest. One station bordered an old field, and two were in partly logged locations. Canopy trees were typically 20-45 cm dbh, but trees to 100 cm dbh were fairly common.

12. *Rock Spring Preserve, Scotland*.- This location had oak- and mesic, mixed hardwood-dominated forest. Two stations were in hemlock-white pine groves, four were in the open floodplain forest of the Little River, one was in a Red Pine plantation, and two bordered early successional forests. Canopy trees averaged 20-50 cm dbh. Larger trees to 55 cm dbh were fairly common, particularly along the river.

13. *Mansfield Hollow, Mansfield*.- Although typically xeric white pine-oak forest on sandy-gravelly soil, this site also had four stations in largely pure conifer stands of white and Pitch Pine. Three stations were within 100 m of the Natchaug River, three bordered early successional forests, and six were within 100 m of Mansfield Hollow Lake. Most canopy trees were 20-40 cm dbh, but larger trees to 70 cm dbh were fairly common.

14. *Nathan Hale State Forest, Coventry-Andover*.- Mesic, oak-dominated forest was most frequent at this site. Other stations were in mesic mixed hardwoods (3), mesic hemlock-hardwoods (2), and bordering clearcut forest (1). Canopy trees were typically 20-40 cm dbh, with larger trees to 70 cm dbh fairly common.

15. *Gay City State Park, Hebron*.- This forest was primarily mesic and oak-dominated. Two stations were in white pine-hardwoods, five were near streams, two bordered a Red Maple swamp, and four were within 100 m of a marshy pond. The dbh of canopy trees averaged 20-45 cm, but trees to 75 cm were fairly common.

16. *Pachaug State Forest, Sterling*.- This predominantly xeric, open, oak-dominated forest had Pitch Pine-Scrub Oak as uncommon associates, and white pine common as saplings in the understory. There were two stations in hemlock-white pine-swamp hardwoods, three in white pine-spruce-larch plantations, two in selectively logged areas, and one in early successional forest. The canopy was composed of generally smaller trees averaging 15-40 cm dbh, although some trees to 65 cm dbh were present.

17. *Nipmuck State Forest, Willington-Ashford*.- Mesic-xeric oak-dominated forest characterized this site. Two stations bordered a Red-Maple swamp, and two had hemlock-white pine-hardwood cover. Canopy trees averaged 20-50 cm dbh, and trees to 90 cm dbh were fairly common.

18. *Pole Bridge Road, Woodstock*.- A four-wheel drive road provided public access to this predominantly mesic hemlock-white pine-hardwood forest. Two stations were in partially logged areas, one bordered a Red Maple swamp, and one was dominated by hemlock-white-pine. Prevailing canopy tree dbh was 20-45 cm, but larger trees to 75 cm were fairly common.

19. *Nipmuck Trail, Willington*.- This varied forest featured oak-dominated and mesic, mixed hardwood forest. Two stations passed through mesic hemlock-white pine-hardwood forest, two were in largely pure hemlock-white pine, and one was in a dying stand of Red Pine. Moreover, four stations were within 100 m of the Fenton River, one was near a stream, and one had been selectively logged. Canopy trees averaged 20-45 cm dbh, but trees to 84 cm dbh were common, and one station classified as old growth.

20. *Quinebaug State Management Area, Plainfield*.- Another varied site, this one featured floodplain deciduous forest, white pine groves, and white pine-Pitch Pine-oak stands. Six stations were within 100 m of the Quinebaug River, and two of these were within 100 m of fields. One station was in young, xeric forest, and two were in selectively logged forest. Prevailing dbh of canopy trees was 20-40 cm, and some large trees to 120 cm were present along the river.

21. *Pachaug State Forest, Plainfield*.- Xeric, oak-dominated forest characterized this site. One station bordered a deciduous swamp, one was in a white pine-larch plantation, two had been selectively logged, and one was within 100 m of a pond. Canopy trees averaged 20-40 cm dbh, and some trees to 50 cm dbh were present.

22. *Old Furnace State Park, Killingly*.- A hemlock-dominated ravine and white pine-oak forest characterized this site. Five stations were along a xeric Scarlet Oak-dominated ridge where stands of Pitch Pine also occurred. One station bordered an old field, another bordered a selectively logged area, and two bordered marshy to wooded deciduous wetlands. Most canopy trees had a dbh of 20-40 cm. Large trees to 90 cm were present, particularly in the hemlock ravine, which in spots approached old growth conditions.

23. *Bolton Notch State Park, Bolton-Vernon*.- Xeric-mesic, oak-dominated forest occurred most commonly here. Four stations were on xeric ridge tops vegetated by Scarlet and Chestnut Oak mixed with Pitch Pine. Two stations were in selectively logged sites, and two bordered forest openings along a stream. Canopy trees averaged 20-35 cm dbh, and some trees to 70 cm dbh were present.

24. *Kollar Wildlife Management Area, Tolland*.- This forest was dominated by xeric-mesic white pine-oak. Four stations had cover by oak-dominated forest, one was in largely pure white pines, two bordered logged clearings, and one bordered a deciduous swamp. Typical canopy trees had 20-35 cm dbh, and some trees to 60 cm dbh were present.

25. *Nipmuck State Forest, Stafford*.- Oak-dominated and mesic, mixed deciduous forest characterized this site. One station was in largely pure white pine forest, four were within 100 m of an open Red Maple swamp, two were adjacent to streams, and seven were in selectively logged areas. Prevailing dbh of canopy trees was 20-40 cm, but some larger trees to 80 cm dbh were present.

26. *Quarry Road, Woodstock*.- A four-wheel drive road provided public access to an area of mesic oak and hemlock-white pine-hardwood forest. Six stations were within 100 m of an open Red-maple swamp, and three were in selectively logged forest. Canopy trees were typically 20-40 cm dbh, and trees to 70 cm dbh were fairly common.

27. *Meshomasic State Forest, East Hampton-Portland*.- This forest covered a largely xeric, oak-dominated ridge top. Two stations were in mesic, mixed deciduous forest, and one was within 100 m of Mine Brook. Trees averaged 20-35 cm dbh, but larger trees to 90 cm dbh were present, particularly in mixed deciduous forest.

28. *Hopeville Pond State Park, Griswold*.- Largely xeric and oak-dominated, this forest also had four stations vegetated in part by white pine-spruce-Red Pine plantations. Seven stations were in regenerating, cutover forest, and one bordered a stream. Trees were typically 20-35 cm dbh, although some to 60 cm dbh were present.

29. *Nehantic State Forest, Lyme*.- Mesic-xeric oak-dominated forest was present nearly throughout this area. One station bordered an open Red Maple swamp, four were in regenerating logged areas, one was near a swampy stream, and one bordered an old field. Characteristic canopy tree dbh was 20-35 cm, and some trees to 55 cm were present.

30. *Pequot Trail, Preston*.- This site had oak-dominated associations present nearly throughout. Four stations were within 100 m of a power line clearing, one was in a selectively logged area, two were near vernal pools, one bordered a marsh, three were within 100 m of a swamp, and two were near streams. Canopy trees were typically 20-40 cm dbh, but we encountered some trees to 58 cm dbh.

31. *Bluff Point State Park, Groton*.- Vegetated by xeric, oak-dominated forest, this coastal location also featured dense Catbriar (*Smilax rotundifolia*) patches interspersed with open, deer-browsed understory. Two stations bordered old fields, and one was near a stream. Canopy trees averaged 20-40 cm dbh, and some trees to 65 cm dbh were present.

32. *Bartlett Brook Wildlife Management Area, Lebanon*.- Mesic oak-dominated and mixed deciduous forest characterized this area. Eight stations bordered deciduous swamps. Canopy trees were typically 20-40 cm dbh, and some trees to 120 cm dbh were present.

33. *Devil's Hopyard State Park, East Haddam*.- Oak-dominated forest was the principal cover at this location. Four stations were in a hemlock-white pine-hardwoods, four were in deciduous forest regenerating after heavy mortality of diseased hemlocks, and five were along streams. Typical canopy trees were 20-50 cm dbh, but trees to 100 cm dbh were common. Six stations classified as old growth.

34. *Narragansett Trail, North Stoninington*.- Characterized by oak-dominated forest, this site also had stations in mesic mixed hardwoods (3), hemlock-hardwoods (2) and largely pure hemlocks (2). However, hemlocks were suffering disease-related mortality. Five stations bordered swamps, two bordered a stream, and five were on a xeric ridge. Prevailing canopy tree dbh was 20-40 cm, but trees to 70 cm were fairly common.

35. *Day Pond State Park, Colchester*.- This largely oak-dominated forest also had five stations in white pine-hemlock-hardwoods and two near streams. Most canopy trees were 20-40 cm dbh, but trees to 70 cm dbh were fairly common.

36. *Pachaug Trail, Voluntown*.- This transect passed through largely xeric, oak- and white pine-oak-dominated forest. In addition, stations were in white pine (2) and spruce-pine plantations (1), bordering a Red Maple swamp (1), and near streams (2). Six stations were in young, regenerating forest, logged areas, and dead Red Pines. Typical canopy trees were 15-35 cm dbh, with few larger trees present.

37. *Hurd State Park, East Haddam*.- A more mesic location sloping to the Connecticut River, this forest was characterized by mixed deciduous and oak-dominated forest. Three stations were within 100 m of the Connecticut River, one bordered a deciduous swamp, another bordered a stream, and two bordered old fields. Most hemlocks in this area were dead or dying. Canopy trees were typically 20-45 cm dbh, but large trees to 145 cm dbh were fairly common.

38. *Bear Hill Wildlife Management Area, Bozrah*.- Mesic, oak-dominated forest nearly throughout, this forest had one station bordering a swamp, three in heavily logged areas regenerating to young forest, and one within 100 m of a field. Characteristic canopy tree dbh was 20-40 cm, but some trees to 115 cm dbh were present.

39. *Salmon River State Forest, Colchester-Hebron*.- In large part oak-dominated, this site also had three stations with hemlock-hardwoods and one with largely pure hemlock. Two stations bordered deciduous swamps, two bordered streams, one was in an young, regenerating forest, and three were in selectively logged areas. Canopy trees were typically 20-40 cm dbh, but some trees to 84 cm dbh were present.

40. *Barn Island Wildlife Management Area, Stonington*.- Although largely oak-dominated, six stations on this coastal transect were in mesic, mixed deciduous forest. Three stations were within 100 m of tidal marsh, and one was within 100 m of an old field. Dense shrubs and vines, particularly Catbriar, characterized the understory. Canopy trees were generally 20-40 cm dbh, but we encountered some trees to 55 cm. Although not present along the route, American Holly (*Ilex opacum*) is present as an infrequent native, extending into this area from more abundant populations in southern Rhode Island.

41. *Pequot Trail, Ledyard*.- Heavily dominated by oaks, this forest had only one site with hemlock cover. Two stations had been selective logged in the past, three bordered deciduous swamps, three were near streams, and one bordered an old field. Most canopy trees were 20-40 cm dbh, and some larger trees to 75 cm dbh were present.

42. *Rocky Neck State Park, East Lyme*.- A generally xeric, oak-dominated forest, this rocky headland bordered the coast. As such, Post Oak, Catbriar, and other scrub and vine species formed a dense understory. One station was within 100 m of a field, one was near a stream, and one was within 100 m of a tidal marsh. Typical canopy trees were 20-35 cm dbh, and some trees to 80 cm dbh were present.

43. *Chapman's Pond Preserve, East Haddam*.- Sloping to a tidal pond in the Connecticut River, this site was dominated by mesic, mixed deciduous forest. One station was in mixed hemlock-hardwood, but most hemlocks on the tract were dead from disease, leaving forest gaps filling with deciduous species. Large gaps were at two stations, one station bordered a stream, one bordered a swamp, and five were within 100 m of the Chapman's Pond-tidal marsh complex. Prevailing dbh of canopy trees was 20-40 cm, and larger trees to 80 cm were fairly common.

44. *Nehantic Trail, Voluntown*.- This route principally traversed xeric, oak-dominated forest. However, two stations were in hemlock-white pine forest, and five were in or bordered deciduous and Atlantic White-cedar-hemlock-hardwood swamps. One station was in Pitch Pine-white pine-oak ridgetop forest, one was at a stream, and two were in largely open, logged areas. Canopy trees were generally 20-35 cm dbh, and we encountered some trees to 58 cm dbh.

45. *Nehantic State Forest, East Lyme*.- Another oak-dominated forest, this one was largely mesic to swampy. Seven stations bordered largely deciduous swamps, although Atlantic White-cedar occurred in them as well. Canopy tree dbh was typically 20-40 cm, but some trees to 74 cm dbh were present.

46. *Salmon River State Forest, Marlborough*.- Mesic-xeric, oak-dominated forest characterized this site. Only one station had mesic, mixed deciduous forest. Two stations bordered young, regenerating forest, and one was within 100 m of Dickinson Creek. Typical canopy trees were 20-40 cm dbh, and some larger trees to 48 cm dbh were present.

47. *Bailey's Ravine Preserve-Franklin Swamp, Franklin*.- This varied site featured stations in a ravine with largely pure hemlock-white pine (4), and hemlock-white pine-hardwood (3). Stations also were in xeric white pine-oak (4), oak-dominated forest (4), near a pond (1), and near a stream (1). Prevailing canopy tree dbh was 20-40 cm, but trees to 74 cm dbh were present, especially in the ravine.

48. *Assekonk Swamp Wildlife Management Area, North Stonington*.- Most stations along this transect were in mesic, mixed hardwood forest. Three bordered an extensive Red Maple swamp, one was in an old field, and four passed near spruce-pine-larch plantations. Most canopy trees averaged 20-40 cm dbh, but some trees to 65 cm dbh were present.

49. *Chaney Sanctuary, Montville*.- Mesic-xeric, oak-dominated forest characterized this site throughout. One station was near a stream, and one was in logged forest regenerating with young trees. Canopy trees were typically 20-40 cm dbh, and some trees to 130 cm were present.

50. *Selden Creek Preserve, Lyme*.- Although predominantly hemlock-white pine-hardwood and oak-dominated forest, this slope to the Connecticut River was rapidly losing all of its hemlocks. Dead and dying hemlock stands were present at most stations, although two were still largely pure hemlock-white pine. One station bordered a stream, one a vernal pool, and four

were within 100 m of tidal marshes and creeks. Most canopy trees were 20-45 cm dbh, and trees to 55 cm dbh were present.

51. *Pachaug State Forest, Voluntown*.- Largely xeric and oak-dominated, this forest also had stations in white pine-oak (2) and largely pure white pine (1). One station was at a stream, one bordered an old field, and seven bordered partly logged, regenerating young forest. Canopy trees were typically 20-40 cm dbh, and some large trees to 100 cm dbh were present.

BIRD SURVEYS

We used the Variable Circular Plot (VCP) technique to quantitatively survey bird populations. It has wide utility in evaluating populations at the landscape level and over a variety of terrains (Reynolds et al. 1980, Scott et al. 1986). Moreover, it has a well-developed theoretical underpinning that permits the construction of statistical confidence intervals (CI) around population estimates (Buckland et al. 2001).

We gathered field data for VCP analyses along transects through primarily forested landscapes. At each of 15 points/ transect, we estimated the horizontal distance at first detection to all birds encountered. The vast majority of detections were aural, and we distinguished between detections of singing, territorial males and vocalizations by species not generally distinguishable to sex.

Our sampling period at each station was eight minutes, a time used frequently in VCP surveys (e.g. DeSante 1981, Scott et al. 1986). It is a period short enough to approximate an instantaneous count (minimize movement of birds), yet long enough to adequately record all birds present. We occasionally detected rarer bird species, particularly raptors, outside this sampling period. If we found no other individuals during the survey, we included such detections in our survey.

Routes began at first light (ca 05:15 in summer, 07:00 in winter) and lasted ca 3.5-4 h. We performed surveys under conditions of low wind and at most minimal precipitation. Survey routes followed existing hiking trails where possible in order to expeditiously complete surveys and to easily re-locate survey points. Except for old logging roads that did not break the forest canopy, we avoided using forest roads. When no paths were available, we followed compass bearings through the forest.

Survey points were at least 225 m apart (determined by pacing, with 260 paces ≈ 225 m) to ensure that we did not encounter the same individual at >1 station. When necessary, we placed survey points further apart to avoid double-counting. In practice, we occasionally detected loudly vocal or widely ranging individuals at two stations. In such instances, we entered their presence into calculations for only one station.

We limited our summer field observations to between 20 May and 5 July, the height of the local breeding season for forest birds, to minimize alteration of survey results due to behavioral changes (Skirvin 1981). Similarly, we limited our winter observations to 15 December to 28 February, the heart of the local winter season. We surveyed northeastern Connecticut (Transects 1-26) in the summer of 2001 and winter of 2001-2002, and surveyed southeastern Connecticut (Transects 27-51) in the summer of 2002 and winter of 2002-2003. To minimize any effects of seasonality on geographic patterns of species richness and density, we visited sites in random order.

Although we recorded during surveys all birds encountered regardless of habitat affiliation, in analyses we considered only those species associated with forest. We broadly defined such species as those that inhabit 1) unbroken forest, 2) forest openings caused by tree fall or selective logging, 3) closed to partly open swamps, and 4) forested river banks. These constituted principal habitat patch types within the broader category of forest landscape, with the last three often referred to as forest gaps. We did not include in detailed analyses species that were associated primarily with marshes, shrub swamps, extensive fields, large clear-cuts, open water, or species detected flying high overhead, whose presence was unrelated with the forest environment. However, we do describe briefly all species casually encountered.

The use of the VCP technique is limited to those individuals with advanced identification skills and experience estimating distance of sounds over a variety of terrains. Even with such constraints, observer differences in perception can be great (McDonald 1981, Davis 1981). Hence, in this study we employed one observer (R. Craig, whose experience with this technique dates to 1971) to eliminate this source of variance. Furthermore, to maximize consistency in distance estimation, during each survey we directly measured the distance to at least several vocalizing birds.

We performed a duplicate survey at a route during both winter and summer studies. Comparison of duplicate surveys provided an initial view of daily variance in observations. We also duplicated a winter and summer survey the following year to learn about annual variance in findings, although a more complete assessment of annual variance will be the focus of longer term ongoing studies.

ANALYSIS

Model.- We calculated population estimates from our field data with Distance 3.5 software (Thomas et al.

1998). We followed the recommendations of Buckland et al. (2001) in developing a protocol for choosing a detection function that best approximated the characteristics of our detection distances. Choosing the model was an iterative process, involving exploratory data analysis and progressive refinements of the analysis to yield a model that best predicted density with minimized variance. Based on initial plots of detection probability vs. detection distances for each species, we grouped similar distance observations, often into five to eight categories to minimize data "heaping" in detection distances and to improve the robustness of density estimations. We sought cut points for these intervals that were between favored rounding distances. We further truncated detection data to eliminate the largest 5-10% of values, thereby facilitating model fitting by eliminating outliers. We sought a model that yielded a smooth curve with near 100% detection probability at the left shoulder.

We next explored the fit of detection data to uniform, half-normal, and hazard-rate key functions with cosine, simple polynomial, and hermite polynomial expansions. We focused on six models recommended by Buckland et al. (2001): uniform/cosine, uniform/simple polynomial, half normal/cosine, half normal/hermite polynomial, hazard rate/cosine and hazard rate/simple polynomial. We evaluated model fit by visual inspection of plotted data, with Akaike's Information Criterion and with chi-square goodness of fit tests. Once we chose the best-fitting model, we computed population density and empirically estimated its variance.

In instances where species occurred in flocks, e.g. Black-capped Chickadee (*Poecile atricapilla*), we performed analyses with bird flock (clusters) as the basis of measurement. We tested whether the size of clusters was increasingly underestimated with distance, and adjusted analyses to account for any distance effects (see Buckland et al. 2001).

Model fitting is most effective for species in which >60 distance estimations have been made, a criterion not satisfied by rarer species in this study. For such species, e.g. Cerulean Warbler (*Dendroica cerulea*), we estimated density to the extent our data allowed. Meaningful model fitting was generally not possible with <20 estimates.

In instances where species occurred year round, when samples were adequate we computed separate detection functions for winter and summer. However, we pooled detection data for rarer species, assuming that even though doing so might increase variance in population estimates, such pooled data still provided a superior population estimate to that obtained with smaller numbers of detection distances. In most such instances, this assumption appeared reasonable, as detectability did not appear to alter greatly between seasons.

An important clarification in terms of interpreting density and population estimates is that computations refer to these parameters only *within* forest habitats. For most species studied, which occur solely in forests, these computations also refers to their regional values. However, for species occurring in additional habitats (e.g. Gray Catbird, *Dumatella carolinensis,* which inhabits forest gaps as well as other more open landscapes), the computations refer only to their values within forest.

Density mapping.- In addition to making estimates of species densities for the entire region, we computed densities for each transect. Because any one transect might under- or over-represent particular habitats or miss the presence of rare species, for mapping purposes we averaged densities of species at one transect with its two geographically nearest neighbors to compute (based on 45 samples) moving averages. Moreover, based on forest statistics for eastern Connecticut (Alerich 1999), we converted population densities to total population estimates for Tolland, Windham and New London counties.

In order to prepare maps, we first plotted on a printed base map of the study area the locations of each transect. We converted this map to computerized images by scanning it at 150 DPI. Once computerized, we georeferenced these images using ERDAS Imagine software to Connecticut State Plane, North American Datum of 1983. The reference file employed was statewide town boundary data from the Environmental and Geographic Information Center, Connecticut Department of Environmental Protection. We also located ground control points at the intersections of town or town/state boundaries, and used first-order polynomial geocorrection, and gave the resulting images a 50-scale-foot pixel resolution.

We generated transect points as a point-based shapefile in ESRI ArcView Geographic Information Systems (GIS) software, based on the georeferenced map images. To locate transects, we placed points at their middle. In the two cases where transects consisted of two parts, we placed our point midway between the two transect segments. We gave each transect a unique numeric identity which we placed in an attribute field titled "Transect".

We joined our smoothed density data stored on Microsoft Excel spreadsheets to our file of transect points, and then generated new point-oriented shapefiles that included transect numbers and coded bird species names. From the point-oriented shapefiles, we produced polygon-oriented shapefiles. With Image Analyst software, we divided each polygon shapefile into individual polygons called Vonoroi diagrams. These diagrams are series of convex

TABLE 1. Comparisons of the number of stations/ transect in each of the principal vegetation types of eastern Connecticut. SD = standard deviation, NECT = Northeast Connecticut, SECT = Southeast Connecticut.

	Oak-dominated	Mixed deciduous	Conifer-northern hardwoods	Pine-oak	Conifer-dominated	Mixed
Ecoregion						
NE Uplands						
Mean	3.5	0.8	7.0	0.3	3.3	0.3
SD	3.7	1.5	4.0	0.5	2.2	0.5
NE Hills						
Mean	6.2	1.8	2.3	2.8	1.5	0.4
SD	4.2	1.9	3.0	2.9	1.9	0.7
SE Hills						
Mean	9.0	3.0	1.4	0.7	0.8	0.2
SD	3.9	3.3	1.9	1.3	1.2	0.6
SE Coastal						
Mean	12.7	2.3	0.0	0.0	0.0	0.0
SD	3.2	3.2	0.0	0.0	0.0	0.0
Region						
NECT						
Mean	5.8	1.7	3.0	2.4	1.8	0.3
SD	4.2	1.8	3.5	2.8	2.0	0.7
SECT						
Mean	9.4	2.9	1.2	0.6	0.7	0.2
SD	4.0	3.3	1.9	1.3	1.1	0.6

polygons, with each surrounding a transect point located such that any other point in a given polygon is closer to the central point of that polygon than to that of any other polygon within a plane of convex polygons.

Because Image Analyst processes only whole numbers, we multiplied our data by 100 to facilitate analysis. We titled each shapefile, and converted data back to original units by dividing by 100. We listed these divided values in the attribute table for each species in a column labeled "Density".

We subdivided density data into classes using the Natural Breaks statistical method. Based on inspection of data, we assigned bird species with a maximum density of less than 10 males or birds/km^2 to two classes. For species with minimum densities greater than 10, we divided values into three classes. Mapped data from these classes generated polygons with sides equidistant between adjacent transect locations. We combined adjacent polygons of the same density class to yield maps highlighting regions with similar values.

Inspection of data indicated that for most species, presence at >10 transects was required to generate useful maps. However, for certain species independent data indicated that presence at even <10 transects still yielded valid maps. We use these criteria in presenting mapped data.

Population variance.- Data gathered during this survey may be thought of as single season snapshots of regional populations. Such populations undergo annual and long term changes in numbers and distributions. To gain perspective on our observations with respect to such variance, we further evaluated our summer data in light of annual variance in Breeding Bird Surveys (Sauer et al. 2001). This survey generates data that are not habitat-specific and concern relative rather than absolute abundance, but annual changes in Breeding Bird Surveys appear to provide gross indications of long term population fluctuations (Geissler and Noon 1981, Craig 2002). For each species, we calculated the coefficient of variation (CV) for data from 1966-2000 Breeding Bird Surveys for continent-wide data and for data from southern New England (10 routes in Massachusetts, Connecticut, Rhode Island). This served as an indicator of expected percent annual population fluctuation.

For analysis of trends with the Breeding Bird Survey, we followed Peterjohn et al. (1997) and used the linear route regression procedure based on

TABLE 2. Habitat characteristics of forest transects. Vegetation column lists most common vegetation type and its percent cover: 1 = oak-dominated, 2 = mixed deciduous, 3 = conifer-northern hardwood, 4 = pine-oak, 5 = conifer-dominated

Transect		Forest	Vegetation	Moisture	dbh	Canopy	Understory
1	Mean	1.1	1- 87%	2.4	2.0	2.8	2.1
	SD	0.3		0.7	0.0	0.4	0.7
2	Mean	2.1	3- 60%	2.1	2.2	2.9	2.4
	SD	0.7		0.4	0.4	0.3	0.8
3	Mean	2.1	4- 47%	2.3	2.0	2.8	2.1
	SD	0.5		0.6	0.4	0.4	0.5
4	Mean	1.5	4- 47%	2.2	2.0	2.7	2.5
	SD	0.5		0.7	0.0	0.5	0.5
5	Mean	2.3	3- 60%	1.9	2.3	2.6	1.9
	SD	0.6		0.2	0.5	0.5	0.6
6	Mean	1.7	1- 40%	2.1	1.9	2.6	1.9
	SD	0.8		0.4	0.2	0.5	0.4
7	Mean	1.0	1- 73%	2.6	2.0	2.8	2.1
	SD	0.0		0.5	0.0	0.4	0.4
8	Mean	2.1	3- 60%	2.3	2.1	2.7	2.1
	SD	0.6		0.5	0.3	0.5	0.5
9	Mean	1.4	1- 60%	2.2	2.0	3.0	2.2
	SD	0.5		0.4	0.0	0.0	0.4
10	Mean	2.1	4- 27%	2.2	1.9	2.7	2.5
	SD	0.8		0.7	0.3	0.5	0.5
11	Mean	1.3	1- 73%	2.3	2.0	2.8	2.0
	SD	0.5		0.5	0.0	0.4	0.1
12	Mean	1.5	1- 33%	2.0	1.9	2.6	2.1
	SD	0.5		0.0	0.2	0.6	0.7
13	Mean	2.1	4- 60%	2.7	2.0	2.8	2.0
	SD	0.6		0.5	0.1	0.4	0.4
14	Mean	1.1	1- 67%	2.0	2.0	2.9	2.5
	SD	0.4		0.0	0.0	0.5	0.5
15	Mean	1.1	1- 73%	2.1	2.0	2.9	2.2
	SD	0.4		0.5	0.0	0.4	0.4
16	Mean	1.6	1- 60%	2.7	2.0	2.5	2.7
	SD	0.8		0.6	0.1	0.5	0.5
17	Mean	1.1	1- 60%	2.3	2.0	2.6	2.0
	SD	0.4		0.5	0.0	0.5	0.4
18	Mean	2.1	3- 87%	2.0	2.0	2.7	2.0
	SD	0.3		0.0	0.0	0.5	0.6
19	Mean	1.5	2- 33%	2.0	2.1	2.9	1.9
	SD	0.7		0.0	0.3	0.3	0.5
20	Mean	1.9	2,4,8- 27%	2.3	2.0	2.3	2.3
	SD	0.8		0.5	0.0	0.5	0.4
21	Mean	1.1	1- 80%	2.6	2.0	2.7	2.2
	SD	0.3		0.5	0.0	0.5	0.4
22	Mean	2.1	4,5- 33%	2.5	2.1	2.9	1.9
	SD	0.7		0.5	0.3	0.4	0.8
23	Mean	1.3	1- 60%	2.5	2.0	2.5	2.5
	SD	0.5		0.5	0.0	0.5	0.5
24	Mean	1.7	4- 60%	2.5	2.0	2.8	2.4
	SD	0.6		0.5	0.0	0.4	0.5
25	Mean	1.2	1- 47%	2.1	2.0	2.4	2.0
	SD	0.6		0.5	0.0	0.5	0.0
26	Mean	1.7	3- 40%	2.0	2.0	2.5	2.4
	SD	0.5		0.0	0.0	0.5	0.5
27	Mean	1.0	1- 87%	2.6	2.0	2.9	2.1
	SD	0.0		0.5	0.0	0.4	0.3
28	Mean	1.4	1-47%	2.5	1.9	2.5	2.6
	SD	0.5		0.5	0.2	0.5	0.5
29	Mean	1.0	1- 87%	2.5	2.0	2.6	2.4
	SD	0.0		0.6	0.0	0.5	0.5
30	Mean	1.0	1- 93%	2.3	2.0	2.7	2.2
	SD	0.0		0.5	0.0	0.5	0.4
31	Mean	1.0	1- 100%	2.8	2.0	2.4	2.0
	SD	0.0		0.4	0.0	0.7	1.0
32	Mean	1.0	1- 60%	1.6	2.0	2.7	2.9
	SD	0.0		0.5	0.0	0.5	0.3
33	Mean	1.4	1- 73%	2.0	2.4	2.8	2.3
	SD	0.7		0.0	0.5	0.4	0.5
34	Mean	1.5	1- 47%	2.3	2.0	2.5	2.4
	SD	0.7		0.5	0.0	0.5	0.7
35	Mean	1.4	1- 60%	2.1	2.0	2.9	2.2
	SD	0.5		0.3	0.0	0.3	0.7
36	Mean	1.6	1- 53%	2.9	1.8	2.4	2.9
	SD	0.8		0.3	0.4	0.7	0.4
37	Mean	1.0	2- 60%	2.0	1.9	2.5	2.1
	SD	0.0		0.0	0.3	0.5	0.4
38	Mean	1.0	1- 93%	2.1	2.0	2.7	2.6
	SD	0.0		0.3	0.1	0.6	0.5
39	Mean	1.3	1- 47%	2.2	1.9	2.5	2.4
	SD	0.6		0.5	0.3	0.5	0.6
40	Mean	1.0	1- 60%	2.1	2.0	2.7	3.0
	SD	0.0		0.3	0.0	0.5	0.1
41	Mean	1.1	1- 67%	2.1	2.0	2.9	2.5
	SD	0.5		0.4	0.0	0.4	0.5
42	Mean	1.0	1- 93%	2.8	2.0	2.9	2.7
	SD	0.0		0.4	0.0	0.3	0.5
43	Mean	1.1	2- 80%	2.0	2.0	2.7	1.7
	SD	0.3		0.1	0.0	0.5	0.5
44	Mean	1.4	1- 67%	2.4	2.0	2.5	2.5
	SD	0.7		0.6	0.0	0.7	0.5
45	Mean	1.0	1- 67%	1.9	2.0	2.8	2.3
	SD	0.0		0.4	0.0	0.4	0.5
46	Mean	1.0	1- 93%	2.5	2.0	2.6	2.4
	SD	0.0		0.5	0.1	0.5	0.5
47	Mean	2.0	1,4,5- 27%	2.3	2.0	2.7	1.7
	SD	0.8		0.5	0.0	0.5	0.6
48	Mean	1.3	2- 60%	2.0	2.0	2.5	2.8
	SD	0.5		0.4	0.0	0.6	0.4
49	Mean	1.0	1- 100%	2.3	2.0	2.7	2.2
	SD	0.0		0.5	0.0	0.6	0.6
50	Mean	1.7	3- 47%	2.1	2.0	2.6	1.4
	SD	0.7		0.3	0.0	0.5	0.5
51	Mean	1.4	1- 53%	2.6	2.0	2.4	2.9
	SD	0.6		0.5	0.1	0.6	0.4
Ecoregion							
NE Uplands							
	Mean	1.9		2.1	2.1	2.7	2.1
	SD	0.7		0.4	0.3	0.5	0.6
NE Hills	SD						
	Mean	1.6		2.3	2.0	2.7	2.2
	SD	0.7		0.5	0.2	0.5	0.5
SE Hills	Mean	1.2		2.2	2.0	2.6	2.3
	SD	0.5		0.5	0.2	0.5	0.6
SE Coasta	Mean	1.0		2.6	2.0	2.7	2.6
	SD	0.0		0.5	0.0	0.6	0.7
Region							
NECT	Mean	1.6		2.3	2.0	2.7	2.2
	SD	0.7		0.5	0.2	0.5	0.5
SECT	Mean	1.2		2.3	2.0	2.6	2.4
	SD	0.5		0.5	0.2	0.5	0.6

estimating equations. This method tends to produce more precise results, based on larger sample sizes, and also does not lead to biased estimates relative to those produced by the LOESS-based route regression approach of James et al. (1996) in this "linear" estimation procedure.

For winter data, we analyzed population variance and trends from 1966-2002 Christmas Counts available from the National Audubon Society. When the data were not normally distributed, we used Kendall's tau to search for significant population trends. When normally distributed, we used six regression models (linear, logistic, exponential, logarithmic, quadratic and power function) to search for a curve that best predicted trends in survey data.

In addition to these broad scale studies, we compared our data with other published and unpublished sources of broad-scale and long-term observations on birds for this region. Particularly with respect to interpreting north-south trends in population densities, we make comparisons with data in the *Atlas of Breeding Birds of Connecticut* (Bevier 1994) and with those in *Connecticut Birds* (Zeranski and Baptist 1990). Such comparison provides independent verification of trends uncovered during this study.

In terms of long term observations, we focused particularly on three Breeding Bird Census plot studies, notable because of their long duration. These studies were of a second growth deciduous forest and climax hemlock-white pine-hardwood forest in northwestern Connecticut, and an oak-hemlock forest in southeastern Connecticut. For each, we examined a 10-year sample of results published in *American Birds* in 1983-1984, and in *The Journal of Field Ornithology* in 1989-1996. No similar long-term plot studies were available for winter, although we compared our data with a Winter Bird Population Study conducted for three years in a mature broadleaf-coniferous forested wetland, and published in *The Journal of Field Ornithology* in 1991-1993.

Comparisons with plot studies have limitations, however, because data from them are representative of conditions at only specific, comparatively small sites (plots were 10-23 ha) rather than from a sample of all available forest habitats. Population densities derived from such plots are inherently more variable than those from broader scale investigations (Wiens 1989). Moreover, because they focus on specific sites, they frequently appear to produce estimates of populations much higher than those of studies considering the entire range of available habitats.

Habitats.- We investigated geographic distributions in habitat for the six variables we measured. These habitat features comprise categorical variables and, therefore, are best analyzed using nonparametric statistical procedures. Moreover, they are not all unrelated (orthogonal) measures. For example, canopy cover may be expected to be inversely related to understory density. To search for such correlations among the variables, we employed Kendall's tau and Spearman's rho tests. Because of the expected correlations among some of the variables, we generally examined habitat relationships in light of individual variables rather than from deriving a single composite but statistically invalid variable (e.g. principal component) from them. Moreover, we believe that for this study examining the response of species to individual habitat variables is of greatest value. For all statistical analyses, we employed SPSS Version 11 computer software.

Even within the heading of nonparametric analyses, habitat evaluations from each station along a transect cannot be considered truly independent samples; i.e. forest 225 m away from a survey station is more likely to be the same as at that station than a location much further away. A method of regional analysis that makes use of all habitat data but eliminates non-independence is to compute average values of habitat variables for each transect. Exploratory data analysis showed that such averages still do not meet the assumptions of parametric statistics, so we compared regions with the Kruskal-Wallace test. To improve the power of this test and to eliminate zeros in categories, we merged for analysis the four ecoregions into two: Northeast and Southeast Connecticut.

An alternative method of analysis makes use of the original data. We selected for habitat analysis data from the first, middle, and last station of each transect. The at least 1600 m between these stations ensured reasonably the independence of these observations. This type of analysis also permitted us to investigate the distribution of vegetation types, which we could not consider using Kruskal-Wallace tests. By again dividing habitat observations into those from Northeast and Southeast Connecticut, we cross-tabulated habitat categories and performed chi-square tests on them. To eliminate zeros in categories, we merged our one record of mixed vegetation with those for predominantly conifer forest, which it most resembled. We also merged one observation for young forest with those of mature forest to create a single dbh category (young-mature), and merged two intermediate measures of dbh into the remaining two categories. Similarly, we merged two measures of open canopy with those of semi-open to create a single category (open-semi-open), two intermediate measures of moisture regime with those of hydric, and three intermediate levels of understory density with the three principal categories. In all cases, we made decisions on category changes based on data in our original field notes.

Habitat affiliation.- In association with our habitat analyses at each survey station, we recorded for birds

TABLE 3. Kruskal-Wallis test for significant differences between Northeast and Southeast Connecticut in habitats. Probability (*P*) values: * = significant, ** = highly significant. N = 51, df = 1.

	Test	*P*
Forest type	13.1	0.00**
Moisture regime	0.0	0.97
dbh	1.8	0.17
Canopy cover	1.7	0.20
Understory cover	4.7	0.03*

TABLE 4. Frequencies of observations for habitat categories, and chi-square tests for significant differences among them. NECT = Northeast Connecticut, SECT = Southeast Connecticut Probability (*P*) values with superscript 1 have > 20% of cells with expected values < 5; * = significant, ** = highly significant.

	Category				
	1	2	3	x^2	*P*
Forest type					
NECT	36	32	10	22.1	0.00**
SECT	62	10	3		
Moisture regime					
NECT	3	51	24	0.6	0.75^1
SECT	2	46	27		
dbh					
NECT		74	4	0.6	0.68^1
SECT		73	2		
Canopy cover					
NECT		21	57	1.4	0.23
SECT		27	48		
Understory cover					
NECT	7	52	19	9.5	0.01**
SECT	6	33	36		

detected at <70 m radius of our survey points (within the habitat evaluation radius) their habitat associations. By examining data from all individuals/species encountered within this area, we generated quantitative profiles of habitat use for most forest species encountered. Comparison of use profiles with habitat availability, as determined from our sampling stations, yielded inferences into affiliation of species with particular habitat conditions. To test for significant departures in a species' habitat use from habitat availability (as measured at our 153 independent sampling stations), we performed chi-square analyses of use vs. availability when sample size was sufficient (no expected values < 1, ≤ 20% of expected values < 5). To improve the power of tests, we collapsed categories when necessary. When we made <10 observations of habitat use for a species, we do not provide tabular summaries of findings, but rather describe them qualitatively. When examining habitat affiliations of flocking species, we used only statistically independent data (one observation/flock) in analyses.

An alternative approach we used for examining habitat affiliations was to compare population densities computed for transects with mean habitat conditions at each. Because this approach is based on average conditions, it is likely to be less sensitive in identifying habitat affiliations than direct measures of individuals occupying habitats. However, we expected that it would still provide information on broad influences of habitats on populations. Because there were zeros in density data, particularly for uncommon species, and because most of the habitat data did not meet the assumptions of parametric statistics, we employed Kendall's tau tests to search for significant correlations among population density and habitat variables. Based on inspection of our data, we did not attempt such analyses on species occurring at <20 sites.

Community parameters.- We determined species richness by compiling species lists for each transect. From these, we calculated a smoothed, cumulative richness values for each transect by totaling the species at a transect with those of its two nearest neighboring transects. Similarly, we computed community density by first totaling the numbers of individuals found at each transect. We then averaged these numbers with those of a transect's two nearest neighbors. As with species densities, we mapped smoothed values of community richness and density with ESRI Arcview software.

We also examined unsmoothed species richness (i.e. species diversity) and community density for regional differences. Exploratory data analysis demonstrated that both these variables met reasonably the assumptions of parametric statistics, so we employed an independent samples Student's *t* test to compare richness and density data for Northeast and Southeast Connecticut. We further examined richness and density to determine whether seasonal or annual trends existed in survey results, thereby inserting additional sources of bias in our interpretations. In this instance, we employed linear and curvilinear regression analyses to search for trends.

TABLE 5. Frequencies of observations for vegetation types, and chi-square tests for regional differences between them. NECT = Northeast Connecticut, SECT = Southeast Connecticut. Probability (*P*) values: ** = highly significant difference.

		NECT
SECT		
Oak-dominated	27	51
Mesic mixed deciduous	10	11
Conifer-northern hardwood	16	4
Pine-oak	14	6
Conifer	11	3
χ^2	22.4	
P	0.0**	

DATA STRENGTHS AND LIMITATIONS

Population data gathered in this study have advantages over earlier large scale surveys of this region: 1) they record a wide range of quantitative data on bird populations over a broad area, 2) they provide a statistical sample for the entire region, thereby allowing inferences to be drawn about not only positive but negative data, 3) they have been gathered in a less labor intensive manner with reduced sources of variance, and 4) they permit analysis of large scale community patterns and processes.

Despite these strengths, any large-scale survey of bird populations has data limitations. Even though we have considered here annual sources of population variation, we have not yet performed duplicate surveys that will permit us to assess more completely annual variance for our area. Such analysis is the goal of our ongoing studies on this system. Furthermore, populations also change within a season (Anderson et al. 1981). For example, pairs of birds may vacate or establish territories during the breeding season. Because we placed our transects throughout eastern Connecticut and visited them in a random order, our data may be considered to represent average seasonal conditions.

Although we have eliminated observer differences as a source of variance, any observer is likely to have perceptual biases, which result in estimates departing from true values (Cyr 1981, Scott et al. 1981). We have minimized this by having an observer with long experience and training with our survey procedures (Kepler and Scott 1981). However, our data must be considered to have some systematic bias due to observer perception.

TABLE 6. Correlation matrix of habitat variables, with values for Kendall's tau (*t*) and Spearman's rho (*p*). Probability (*P*) values: * = significant difference, ** = highly significant difference. N = 153. F = forest type, M = moisture regime, D = dbh, C = canopy cover, U = understory cover.

	M	D	C	U
F				
t	-0.02	0.15	-0.10	-0.06
p	-0.02	0.15	-0.10	-0.06
P	0.84	0.06	0.21	0.48
M				
t		-0.17	-0.08	0.15
p		-0.17	-0.08	0.15
P		0.04*	0.35	0.06
D				
t			0.06	-0.09
p			0.06	-0.09
P			0.43	0.26
C				
t				-0.23
p				-0.23
P				0.00**

Another sources of limitation is that some forest species, notably owls, are not detected well by the procedures used in this survey. Moreover, species other than forest inhabitants are generally not considered. Because this survey employed a population sampling protocol rather than intensively surveying all areas, the potential for missing the rarest species is increased, although in practice we encountered nearly all extant breeding forest birds of eastern Connecticut during this survey.

One final note concerns our choosing to conduct large numbers of univariate statistical tests. Readers are cautioned that erroneous statistical significance results in a small number of such tests. By choosing the 0.01 confidence (99% probability) level for tests, this effect is minimized. Readers are advised to treat significance levels of 0.05 as preliminary indications of significance rather than as strong statistical evidence.

RESULTS AND DISCUSSION

HABITAT

Three of the six habitat variables showed north-south trends. Conifer cover declined to virtually none at the coast (Table 2).

TABLE 7. Species richnesses (R) and transect densities (D in birds/transect) for the 51 study sites.

Transect	Summer		Winter	
	R	D	R	D
1	34	167	10	38
2	35	171	8	20
3	36	148	14	103
4	32	170	15	111
5	41	184	10	40
6	39	183	15	71
7	39	186	13	44
8	34	162	8	28
9	29	148	9	38
10	43	194	12	64
11	35	159	12	62
12	48	210	18	80
13	49	221	11	45
14	40	169	7	28
15	39	180	6	37
16	36	180	7	22
17	34	175	8	27
18	40	178	11	40
19	34	166	15	77
20	45	214	15	63
21	40	202	10	29
22	36	156	8	36
23	38	188	11	30
24	29	147	15	58
25	39	198	11	58
26	38	178	10	53
27	39	180	12	70
28	42	216	15	79
29	42	193	16	85
30	40	200	25	128
31	33	190	10	79
32	43	204	13	88
33	34	172	11	25
34	43	201	15	43
35	35	178	11	25
36	37	164	11	30
37	40	180	11	64
38	40	170	13	67
39	40	195	11	78
40	34	183	17	75
41	37	166	15	95
42	30	143	15	78
43	40	188	15	58
44	44	174	15	51
45	32	161	16	46
46	31	163	11	65
47	35	180	16	77
48	36	174	17	120
49	32	176	18	161
50	44	218	16	148
51	37	183	14	36

Progressive reduction in cover by hemlock, white pine and conifer-northern hardwood associations produced this trend (Table 1). Understory density, in contrast, increased from north to south, despite no corresponding geographic decrease in canopy cover. Moisture regime, dbh and canopy cover showed no consistent differences between regions (Table 2).

Both Kruskal-Wallis (Table 3) and chi-square tests (Table 4) verified these trends by showing highly significant differences in forest type between Northeast and Southeast Connecticut. Similarly, both tests showed significant regional differences in understory density. Moisture regimes, dbh, and canopy cover showed little trend between regions. Chi-square analysis further showed that vegetation types had highly significant regional differences (Table 5).

Tests for correlations among five of the habitat variables (vegetation type was not comparable with the others) showed inverse correlations between soil moisture and dbh, (Table 6). Hence, wetter soils were associated with larger trees. This relationship was due in large part to very large Eastern White Pines, Eastern Hemlocks, Red Oaks, White Ashes, and Yellow Poplars found predominantly in mesic to wet cove sites, where such species make their best growth (Harlow and Harrar 1969). Similarly, more open forest canopy was significantly associated with increased understory cover. Not surprisingly, the increased light reaching the forest floor of open forest canopies stimulates more vigorous vigorous understory growth. Correlations between forest type and dbh, and moisture regime and understory density also approached statistical significance.

BIRD SURVEYS

The 51 survey routes covered ca 180 km of forest habitat. We established 765 survey points, 390 in Northeast Connecticut, and 375 in Southeast Connecticut. On these, we recorded 9187 summering individuals of 98 species, and 3123 wintering individuals of 48 species. Of these, 80 summering species and 41 wintering species classified as forest-associated. Moreover, neither species richness

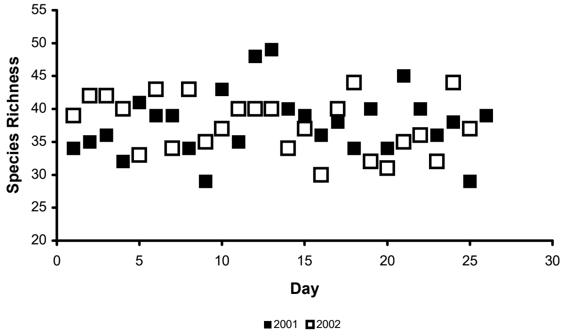

FIG. 16. Summer species richness showed no relationship with order of survey.

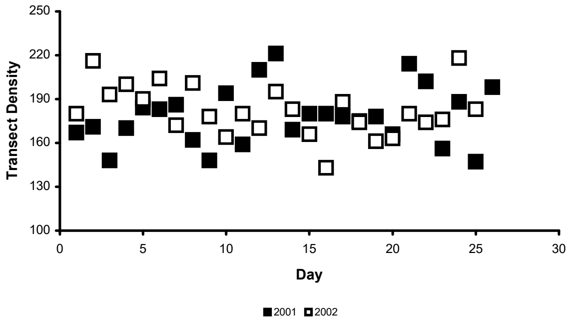

FIG. 18. Summer transect density (birds/transect) showed no relationship to order of survey.

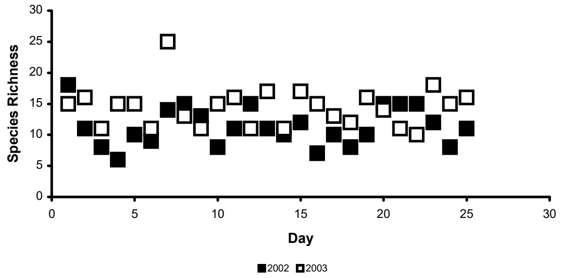

FIG. 17. Winter species richness showed no relationship with order of survey.

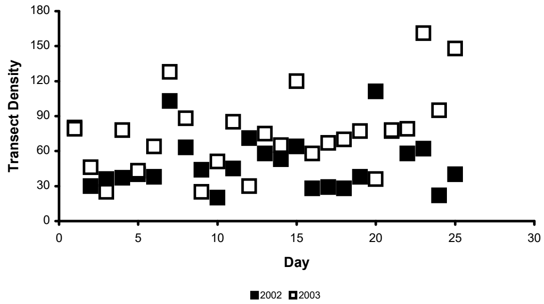

FIG. 19. Winter transect density (birds/transect) showed no relationship to order of survey.

(summer: *f* = 0.16, 1, 49 df, *P* = 0.69, Fig. 16; winter: *f* = 0.03, 1, 48 df, *P* = 0.87, Fig. 17) nor community density (summer: *f* = 0.29, 1, 49 df, *P* = 0.59, Fig. 18; winter: *f* = 3.10, 1, 48 df, *P* = 0.09, Fig. 19) showed any significant trend for seasonal shifts in values.

Species richness.- Summer species richness averaged 37.7 ± 4.6 species, and ranged from 29 (Kollar Wildlife Management Area, Wolf Den State Park) to 49 (Mansfield Hollow State Park; Table 7). Figures were virtually identical for Northeast (37.8 ± 4.9) and Southeast Connecticut (37.6 ± 4.3), and Student's *t* test showed no significant difference between them (*t* = 0.1, 49 df, *P* = 0.90). Smoothed summer richnesses averaged 53.6 ± 4.8, and ranged from 42 (Barn Island Wildlife Management Area) to 63 (Rock Spring Preserve). Figures were similar for Northeast (54.5 ± 4.5) and Southeast Connecticut (52.8 ± 5.1).

Plotted, smoothed summer richnesses (Fig. 20) showed a trend toward increasing richness from the Massachusetts border to approximately the southern boundary of the Northeast Hills Ecoregion. Smoothed richnesses generally declined in the Southeast Hills Ecoregion, and reached their lowest levels along the southeastern coastal portion of the study area. A small area of higher richnesses occurred along the lower Connecticut River.

This pattern appears to be a function of more boreal-associated species reaching their southern range limit and Southeastern-associated species reaching their northern range limit in central Connecticut (see species accounts). North and south of this zone, richness declines as these northern and southern elements in the fauna drop out. The validity of this pattern is supported by data cited in individual species accounts that verify

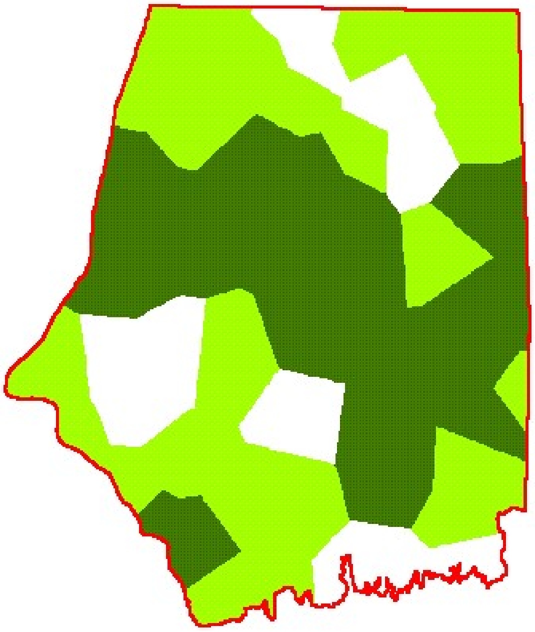

FIG. 20. Summer species richness showed a pattern of decreasing richness toward the north and south. Light = 42-49, medium = 50-55, dark = 56-63 species/transect.

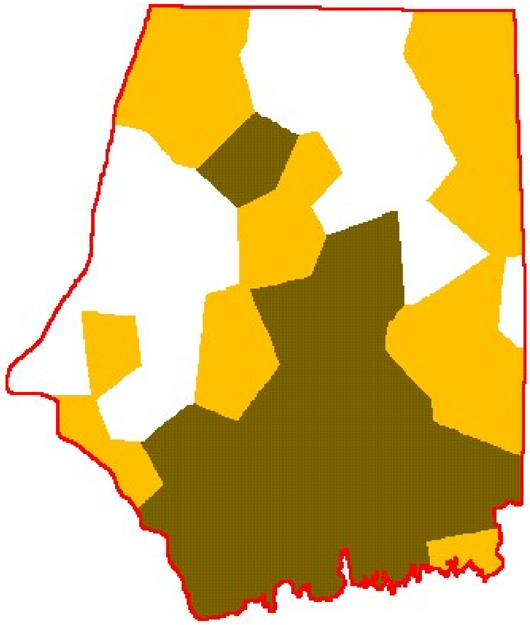

FIG. 21. Winter species richness was greatest in Southeast Connecticut. Light = 12-17, medium = 18-21, dark = 22-28 species/transect.

the distributional limits of such species in eastern Connecticut.

Winter richnesses averaged 13.2 ± 3.6 species, and ranged from 6 (Gay City State Park) to 26 (Pequot Trail, Preston; Table 7). Figures averaged lower for Northeast (11.6 ± 3.2) than Southeast Connecticut (14.8 ± 3.4), and Student's *t* test showed a strongly significant difference between them ($t = -3.5$, 48 df, $P = 0.00$). This greater richness in Southeast Connecticut appeared despite the winter of 2002-2003 being substantially colder and with much greater snowfall than in 2001-2002. Moreover, qualitative and limited quantitative observations in Northeast Connecticut in 2002-2003 were consistent with this pattern.

Smoothed winter richnesses averaged 19.0 ± 4.0, and ranged from 12 (Boston Hollow) to 28 (Quarry Road). Figures averaged lower in Northeast (16.8 ± 3.2) than Southeast Connecticut (21.2 ± 3.4). Plotted, smoothed winter richnesses showed a general decline from north to south (Fig. 21). Such a pattern is likely a function of moderating winter conditions from north to south, which permits additional species to inhabit southern Connecticut. Indeed, we found species that more typically winter south of Connecticut, such as the American Robin (*Turdus migratorius*), Hermit Thrush (*Catharus guttatus*), Gray Catbird, Eastern Towhee (*Pipilo erythropthalmus*) and Yellow-rumped Warbler (*Dendroica coronata;* see species accounts) to predominate in or be present exclusively in southern Connecticut.

Community densities.- Summer densities averaged 180.1 ± 18.7 birds/transect, and ranged from 143 (Rocky Neck State Park) to 221 (Mansfield Hollow State Park). Densities were similar ($t = -0.7$, 49 df, $P = 0.47$) in Northeast (178.2 ± 20.0) and Southeast Connecticut (182.1 ± 17.5).

Smoothed densities averaged 180.2 ± 10.6 birds/transect, and ranged from 162.7 (Kollar Wildlife Management Area) to 204.7 (Rock Spring Preserve). Plotted, smoothed summer densities showed a geographic pattern similar

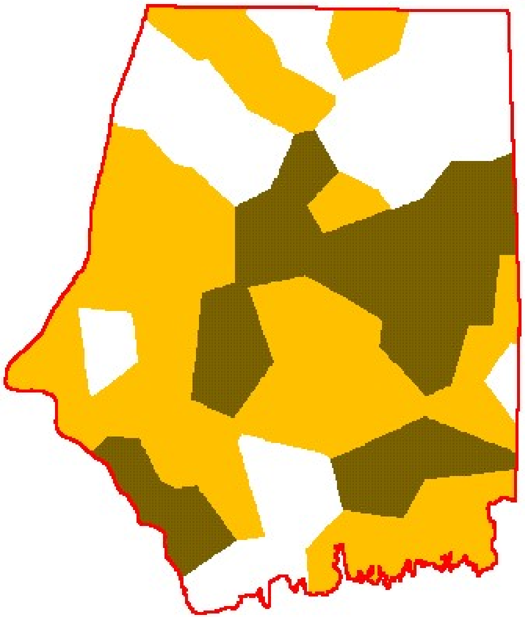

FIG. 22. Summer transect density showed a pattern of decreasing density toward the north and south. Light = 162-173, medium = 174-186, dark = 187-204 birds/transect.

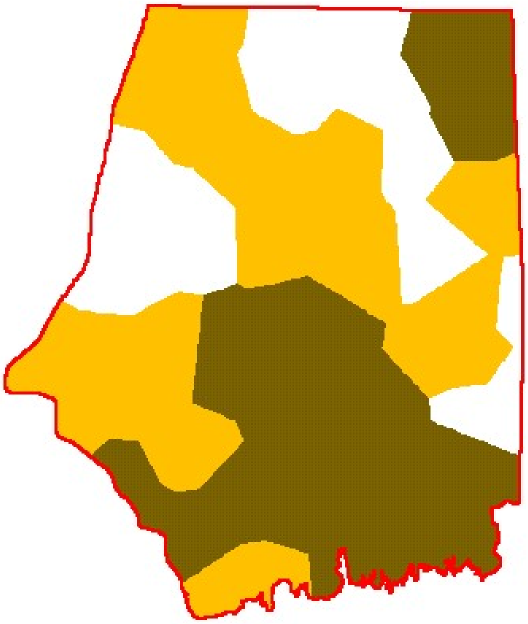

FIG. 23. Winter transect density was greatest in Southeast Connecticut. Light = 29.3-43.0, medium = 43.0-69.7, dark = 69..7-105.0 birds/transect.

to that of species richness, although not as well defined (Fig. 22). Reasons for this pattern in densities are not immediately clear, although they appear related to patterns in species richness (Fig. 24).

Winter densities averaged 62.9 ± 32.1 birds/transect, and ranged from 20 (Boston Hollow) to 161 (Chaney Sanctuary). Densities were significantly lower (t = -2.8, 48 df, P = 0.01) in Northeast (51.0 ± 23.8) than Southeast (74.8 ± 35.3). As with species richness, this difference occurred despite the dramatically harsher winter of 2002-2003 compared with that of 2001-2002. The generality of this pattern was again supported by qualitative and limited quantitative observations in Northeast Connecticut during 2002-2003. Smoothed winter densities averaged 61.4 ± 22.3 birds/transect, and ranged from 29.3 (Boston Hollow, Nipmuck State Forest) to 105.0 (Bluff Point State Park). Plotted, smoothed winter densities showed a geographic pattern of increase from north to south (Fig. 23) which, like winter species richness patterns, is likely related to the north-south moderation in climate.

Transect density showed a strongly significant, positive linear relationship with species richness for summer (f = 84.9, 1,49 df, P = 0.00, Fig. 24) and winter (f = 59.1, 1,48 df, P = 0.00, Fig. 25). The causes of these patterns merit investigation. Although such patterns can be a phenomenon of sampling (the probability of finding more species may increase with larger samples; Rosenzweig 1995), alternate hypotheses also may explain this relationship, including ones dealing with community productivity. For example, higher community productivity might lead to larger population sizes and increased ability of species to overlap niches (see Wiens 1989, Rosenzweig 1995). A practical consequence of the relationship is that species richness alone can be used as an index for evaluating an important aspect of the conservation value of forest tracts. However, such a relationship

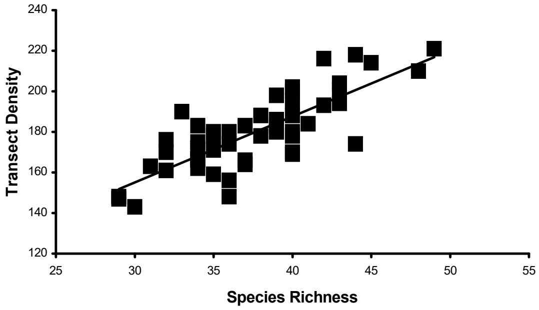

FIG. 24. Summer transect density (birds/transect) showed a strongly significant relationship with species richness.

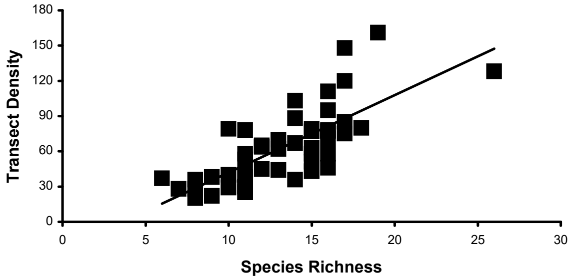

FIG. 25. Winter transect density (birds/transect) showed a strongly significant relationship with species richness.

is not universal in avian communities. Craig and Beal (unpubl. ms.) found a negative relationship between species richness and population density in bird communities of tidal marshes.

Regional trends.- A further discovery of this study was that populations of many permanent resident species rose from summer to winter. We speculate that such increases were the result of annual population recruitment, and of northern populations moving south into Connecticut during winter. Notably, a number of species had winter increases in southern Connecticut, which suggests that birds moved to climatically more moderate environments during the winter months.

We also found that population trends frequently followed habitat trends. In southern New England, forests are maturing. Hence, species associated with mature forests tended to be those showing long term population increases, whereas species of forest openings and successional habitats tended to be those undergoing long term declines. However, there were notable exceptions to these patterns, and these are detailed in the species accounts.

Another trend noted was that species often showed population declines toward their range limit. We observed this pattern for species approaching either their northern or southern range limit. Declining densities toward range limits are typical for many species (Brown 1984, Pulliam 1988).

Survey variance and effectiveness.- Although based on two years of summer and winter field work, we still view this study as a preliminary investigation into the density disribution and habitat affiliations of eastern Connecticut's forest avifauna. We present it now, however, to help fill the needs of open space planners for a document that details quantitatively the distribution of wildlife resource.

Comparison of duplicate transect surveys performed in summer and winter suggested that survey results were inherently more variable in winter. The summer duplicate transect had 85-94% of the total species encountered present on any one survey, whereas winter duplicates has 75% of the total. Similarly, summer duplicates showed no difference in community densities, whereas winter duplicates differed by 25%. The greater consistency of summer counts is likely because of the greater incidence of territoriality in summer, and greater frequency of vocal cues given by breeding birds compared with wintering ones. Moreover, nomadic movements may be expected among some species of wintering birds (e.g. flocks of boreal-nesting finches), whereas fewer summering species are likely to engage in such behaviors.

Population estimates computed in this study were often lower than those obtained from plot studies cited in species accounts. Earlier versions of the variable circular plot technique were found to overestimate densities of uncommon species and to underestimate densities of common species (DeSante 1981). However, the procedures we employed were less prone to such biases (Buckland et al. 2001).

Broad scale investigations such as this one are expected to yield lower population densities than plot studies, because they evaluate populations over areas of suitable and unsuitable habitats within the forest mosaic. Moreover, when data from plot studies are extrapolated to populations/km^2 (as we have done in this report) densities tend to be skewed upward. Furthermore, the great range in densities found in plot studies is likely due in large part to the inherently more variable nature of smaller scale estimates (Wiens 1989). Hence, we expect that our density estimates more accurately represent regional densities than those of smaller scale plot studies.

In its present form, this report is most effective at characterizing overall community patterns and the nature of the region's more common species. Fully characterizing the nature of the less common species is the focus of our ongoing investigations in southern New England. We are also preparing to duplicate this entire study in order to verify the patterns it has uncovered.

Conservation application.- In a number of properties in our region managed for conservation, a focus is on producing habitat heterogeneity. For example, logging activities on State lands are often accompanied by signs touting the value of timber management for maintaining wildlife diversity. Still other plots within forests are managed as open fields. Although such management may benefit certain species, maintaining the entire compliment of bird species in a forest ecosystem is a complex issue. Indeed, practices aimed at maintaining habitat heterogeneity also may have negative impacts on certain species. Species like the Cerulean Warbler (*Dendroica cerulea*) that require extensive tracts of mature forest fall under this heading.

The species accounts that follow illustrate that the forest bird community is a highly heterogeneous assemblage of species that requires a variety of habitat types within the forest landscape. We identified species to be associated with such habitat classes as 1) extensive, unbroken tracts of mature forest (e.g. Pileated Woodpecker, *Dryocopus pileatus*), 2) young forest (e.g. Yellow-billed Cuckoo, *Coccyzus americanus*), 3) open canopy forest (e.g. Gray Catbird, *Dumatella carolinensis*), 4) forest tree-fall gaps (e.g. American Redstart, *Setophaga ruticilla*), 5) mature conifer forest (e.g. Black-throated Green Warbler, *Dendroica virens*), young conifer forest (e.g. Magnolia Warbler, *Dendroica magnolia*), 7) deciduous forest (e.g. Red-eyed Vireo, *Vireo olivaceus*), 8) forests with dense understories (e.g. Eastern Towhee), 9) open canopy swamps (e.g. Common Yellowthroat, *Geothlypis trichas*), 10) closed canopy swamps (e.g. Northern Waterthrush, *Seiurus novaboracensis*), 11) riparian forest (e.g. Yellow-throated Vireo, *Vireo flavifrons*) and 12) pine-oak barrens (e.g. Prairie Warbler, *Dendroica discolor*). We also found that a single species may occupy more than one habitat type (e.g. Yellow-throated Vireo uses riparian forest and forest gaps). Moreover, permanent resident species changed their habitat use from summer to winter (e.g. Red-bellied Woodpecker, *Melanerpes carolinus*).

In order to maintain all bird species within a forest ecosystem, at a minimum all such habitat types must be represented. Active management like timber harvesting can be a useful tool in supplying some of these habitats. However, forest management alone is insufficient for meeting the needs of all species. The presence of many habitats is a function of landscape variables like soil moisture, soil type and topography rather than factors manipulated by forest managers.

Hence, another key feature in a conservation plan is the protection of tracts extensive enough to provide a variety of physical environments. Only extensive tracts are likely to provide the range of moisture regimes, soils, topographies, wetlands and other habitat variety necessary to support all species. Moreover, especially for those species existing at low densities, extensive tracts are essential for protecting populations that are large enough to be self-sustaining.

In our studies, we focused on exploring only those areas large enough (minimum 100 ha) to permit establishment of a survey transect. In practice, nearly all areas studied had >500 ha of contiguous forest. Despite investigating such extensive tracts, our data show that no one tract supported the entire compliment of forest bird species. Each tract had its own characteristics (see description of study sites in Methods), which favored certain species and discouraged others. Hence, even protection of a large tract is insufficient for preserving the entire forest bird community. The evidence we provide here suggests that only a series of such tracts can ensure the long-term persistence of our forest bird community.

SPECIES ACCOUNTS

Following are detailed accounts of the occurrence of the 84 forest bird species inhabiting our region. Additional notes are provided for species encountered during the survey but not studied in detail.

SHARP-SHINNED HAWK
Accipiter striatus

Density distribution.- We found only one summering Sharp-shinned Hawk during this study, an incidental detection of a bird at Putnam Heights. Moreover, the species appeared only three times on winter surveys. Our few detections of birds did not permit reliable estimation of populations, although we estimate roughly that less than 1,000 birds typically winter.

Population variance.- The coefficient of variation calculated from Breeding Bird Survey data (Sauer et al. 2001) predicted variation in continental populations as an extremely high 6,412%, apparently more a consequence of censusing difficulties than of actual population fluctuations. Despite such variance, from 1966 to 2000 populations showed a significant continental increase (mean count/ route = 0.02, trend = 7.2, P = 0.00, N = 257). Limited data from southern New England showed no clear trend.

The coefficient of variation from Connecticut Christmas Count data was 125.5%. Christmas Counts also showed a strongly significant U.S. (birds/party hr = 0.03, quadratic model r^2 = 0.96, df = 34, P = 0.00) and Connecticut increase (birds/party hr = 0.03, quadratic model r^2 = 0.91, df = 34, P = 0.00) from 1966 to 2002.

On ten line transects through the Northeast Uplands Ecoregion, Craig (1987) reported no birds. A ten year sample from Breeding Bird Census plots in Connecticut yielded no detections in oak-hemlock forest, but four occurrences (9.5 pairs/km^2) in hemlock-hardwood forest, and one occurrence (5.0 pairs/km^2) in second growth deciduous forest. A Winter Bird Study plot surveyed for three years yielded one detection of 0.5 birds/km^2. We found no other estimates of densities.

Habitat.- Our one observation of summer habitat use was of a bird using young to mature deciduous and pine-oak forest punctuated by forest openings. Breeding habitat is reported to consist of unbroken tracts of coniferous, mixed and deciduous forests, although typically forests have at least some conifers. Dense, younger forests with closed canopies may be favored (Bildstein and Meyer 2000).

Our winter observations of habitat use were of birds in mesic to xeric pine-oak forest. We found birds primarily at forest edge. Winter habitat is characterized as continuous coniferous, mixed and deciduous forest, forest edge, and more open habitats (Bildstein and Meyer 2000).

History.- The Sharp-shinned Hawk was known as a fairly common breeder by Sage et al. (1913). However, by ca 1920 breeding populations began declining, and were virtually extirpated until the 1970s, when breeders began reappearing (Zeranski and Baptist 1990). In the 1980s the species was reported in summer at seven eastern Connecticut locations (Smith and Devine 1994a). It has historically been a rare winter resident (Zeranski and Baptist 1990).

Synthesis.- Although largely absent from our summer surveys, the Sharp-shinned Hawk appears to breed occasionally in our region. As continental populations continue to grow, more breeders may appear. However, the species is notoriously difficult to survey during the breeding season, (Bildstein and Meyer 2000), so large scale surveys such as this one may be inadequate for determining breeding status.

Our few observations of habitat use were in rough agreement with reports from elsewhere. The maturation of regional forests in our region (Ward and Barsky 2000) may negatively affect the development of a breeding population, as breeders are usually associated with younger forest.

Conservation status.- Populations appear to be increasing, but are still rare in our region.

COOPER'S HAWK

Accipiter cooperii

Density distribution.- The Cooper's Hawk was among the rarest of breeding forest hawks in the region. It appeared only twice on summer surveys, at Narragansett Trail and Rocky Neck State Park. However, during the study we incidentally observed possible breeders at Putnam Heights, Bolton Notch and Thompson Lake. Our two detections of summering birds did not permit reliable estimation of populations, although we suspect that less than 60 birds summer.

Although birds also winter, we detected none during surveys, and make no estimate of winter populations. We incidentally observed wintering individuals at Putnam Heights and Thompson Lake.

Population variance.- The coefficient of variation calculated from Breeding Bird Survey data (Sauer et al. 2001) predicted variation in continental populations as an extremely high 3,780%, apparently more a consequence of censusing difficulties than of actual population fluctuations. Despite such variance, from 1966 to 2000 populations showed a significant continental increase (mean count/ route = 0.04, trend = 5.8, P = 0.00, N = 430). Limited data from southern New England showed no clear trend.

The coefficient of variation from Connecticut Christmas Count data was 113.9%. Christmas Counts also showed a strongly significant U.S. (birds/party hr = 0.03, Kendall's tau = 0.88, P = 0.00, N = 37) and Connecticut increase (birds/party hr = 0.01, Kendall's tau = 0.75, P = 0.00, N = 37) from 1966 to 2002.

On ten line transects through the Northeast Uplands Ecoregion, Craig (1987) reported no birds. A ten year sample from Breeding Bird Census plots in Connecticut yielded no detections in oak-hemlock and hemlock-hardwood forest, but 5.0 pairs/km^2 occurred four times in second growth deciduous forest. A Winter Bird Study plot surveyed for three years yielded one detection of 0.5 birds/km^2. Elsewhere, densities have been reported as 0.33- 0.02 nests/km^2 in the east (Rosenfield and Bielefeldt 1993).

Habitat.- Our five observations of summering Cooper's Hawks occurred at forest openings in deciduous and mixed forests. The species is known elsewhere in winter and summer from deciduous, mixed, and coniferous habitats, and forest edge appears to be an important habitat requirement. Moreover, it appears to be associated with more mature trees. It is tolerant of forest fragmentation, and also may occupy residential areas (Rosenfield and Bielfeldt 1993).

History.- The Cooper's Hawk was known as a common but declining breeder by Sage et al. (1913). This decline continued into the 1970s, when it was largely absent as a Connecticut breeder (Zeranski and Baptist 1990). In the 1980s it was reported in summer at seven locations in eastern Connecticut (Smith and Devine 1994b).

Synthesis.- Although we recorded Cooper's Hawks only during summer in this survey, our incidental observations over the past 10 years suggest that they have increased in our region at all seasons. This suspicion is supported by data from the Breeding Bird Survey and Christmas Count.

Our few observations of habitat use were in general agreement with reports from elsewhere. The maturation of regional forests (Ward and Barsky 2000) may be benefiting the species, but available data suggest that forest fragmentation is unlikely to negatively impact populations.

Conservation status.- Populations appear to be increasing, but are still rare in our region.

Sponsored by Alexander and Edith Rotival

NORTHERN GOSHAWK
Accipiter gentilis

Density distribution.- Although a comparatively rare species, the Northern Goshawk was the most common breeding accipiter in the region. Our six observations were inadequate for reliably estimating populations, although we suspect that ca 100-200 individuals are present winter and summer.

During summer surveys we found birds only in Northeast Connecticut. They appeared at Yale Forest, Goodwin-Natchaug State Forest, Quarry Rd., and Nipmuck State Forest (Willington-Ashford). All observations were of aggressive individuals near nests or of juvenile birds. In winter, we found birds at Pole Bridge Rd. and Nehantic State Forest. We incidentally observed wintering birds at Putnam Heights and Thompson Lake.

Population variance.- The coefficient of variation calculated from Breeding Bird Survey data (Sauer et al. 2001) predicted variation in continental populations as an extremely high 12,268%, apparently more a consequence of censusing difficulties than of actual population fluctuations. From 1966 to 2000 continental populations showed no significant trend (mean count/ route = 0.02, trend = -1.6, P = 0.53, N = 54). No data exist for southern New England.

The coefficient of variation from Connecticut Christmas Count data was 46.0%. Christmas Counts showed a significant U.S. (birds/party hr = 0.004, Kendall's tau = 0.26, P = 0.02, N = 37) and Connecticut (birds/party hr = 0.005, Kendall's tau = 0.75, P = 0.03, N = 34) increase from 1966 to 2002.

On ten line transects through the Northeast Uplands Ecoregion, Craig (1987) reported no birds. In a ten year sample of Breeding Bird Census plots in Connecticut, oak-hemlock, hemlock-hardwood and second growth deciduous forest yielded no detections. A Winter Bird Population Study plot surveyed for three years yielded one detection of 0.5 birds/km^2. Elsewhere, densities have been reported as 1.2 pairs/km^2 in Pennsylvania (Squires and Reynolds 1997).

Habitat.- Our observations of summering Northern Goshawks were in deciduous and mixed conifer-deciduous forests. Two were at forest openings, and two were in forest interior. Winter observations also were in deciduous and mixed forest.

Elsewhere in the East, the species appears to prefer extensive, mature forests of mixed conifer-hardwoods. Nests are typically in closed canopy forests, but often near small forest openings and water. In winter, extensive, mature forests and forest edge are used as well (Squires and Reynolds 1997).

History.- The Northern Goshawk was reported to be a rare breeder by Sage et al. (1913). Since the 1930s it has become increasingly common (Zeranski and Baptist 1990).

Synthesis.- Although Breeding Bird Survey data are highly variable and show no clear trend, Christmas Count data and our incidental observations suggest that the Northern Goshawk has increased its populations over the past 30 years. In winter, the species is well known as an irregular and irruptive migrant (Squires and Reynolds 1997), although no such irruptions occurred during this study.

Our few observations of habitat use were in general agreement with other reports. The maturation of regional forests (Ward and Barsky 2000) appears to be benefiting the species. However, activities like selective logging that create small forest openings also may improve habitat quality.

Conservation status.- Populations appear to be increasing, but are still rare in our region.

Sponsored by David and Jill Schroeder

RED-SHOULDERED HAWK

Buteo lineatus

Summer

Density (birds/km^2): 0.18 (95% CI: 0.12-0.25)
Density range (birds/km^2/transect): 0-0.84
Total population (birds): 479 (95% CI: 333-689)

Winter

Density (birds/km^2): 0.05 (95% CI: 0.02-0.96)
Density range (birds/km^2/transect): 0-0.28
Total population (birds): 137 (95% CI: 72-262)

Detection function (all data): uniform/cosine
$x^2 = 1.04$, $P = 0.79$, df = 3, N = 41

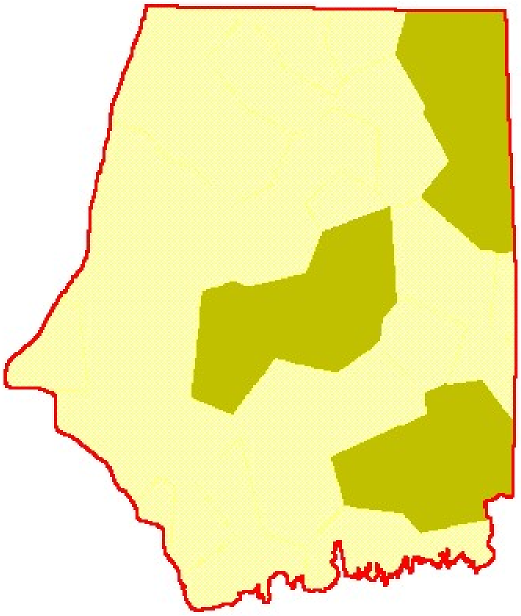

FIG. 26. Summer density of the Red-shouldered Hawk was similar in Northeast and Southeast Connecticut. Light = 0-0.2, dark = 0.2-0.5 birds/km^2.

Density distribution.- The Red-shouldered Hawk was the most commonly encountered breeding forest hawk in the region. In summer, it appeared about equally commonly (Mann-Whitney U = 324.0, $P = 0.98$, N = 51) in Northeast (0.2 ± 0.2 birds/km^2) and Southeast Connecticut (0.2 ± 0.2 birds/km^2; Fig. 26). In winter, it was rare throughout, but averaged less frequent (Mann-Whitney U = 250.0, $P = 0.07$, N = 51) in Northeast (0.02 ± 0.08 birds/km^2) than Southeast Connecticut (0.08 ± 0.13 birds/km^2; Fig. 27).

TABLE 8. Categories of suummer habitat use by summering Red-shouldered Hawks showed no correlations with population densities. $P(\tau)$ = probability level of Kendall's tau, N = 51; * = significant, ** = highly significant. F = forest type, M= moisture regime, D = dbh, C = canopy cover, U = understory density, O= oak-dominated, MH = mixed hardwoods, CN = conifer-northern hardwoods, PO = pine-oak, CO = conifer-dominated, MI = mixed sites.

	Habitat Characteristics				
	F	M	D	C	U
$P(\tau)$ summer	0.73	0.93	0.31	0.28	0.31

Because numbers of even common predators are comparatively low in natural systems, we used detection distances recorded for both seasons to improve our sample size. We believed doing so was justified because birds did not obviously change in detectability between seasons. We found them to be loudly and persistently vocal in both winter and summer (see also Crocoll 1994). Indeed, our computations of breeding density based solely on summer detections yielded estimates very similar to those we report here.

Population estimates are still based on <60 detections of vocalizing males and females, so have limited accuracy. Despite this, our summer estimates translate to ca 4-5 pairs of breeders/town, a realistic number based on our years of field observations in this region.

Population variance.- The coefficient of variation calculated from Breeding Bird Survey data (Sauer et al. 2001) predicted variation in continental populations as 115.2%. Similarly, the coefficient of variation from Connecticut Christmas Count data was 75.8%.

From 1966 to 2000, populations showed a

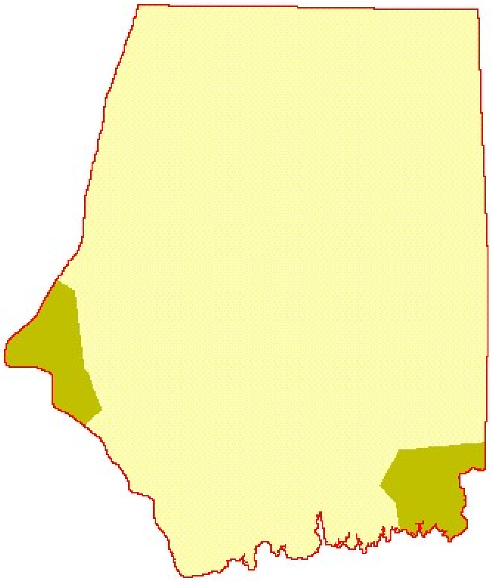

FIG. 27. Winter density distribution of the Red-shouldered Hawk averaged greatest in Southeast Connecticut. Light = 0-0.1, dark = 0.1-0.2 birds/km^2.

significant continental increase (mean count/route = 0.6, trend = 2.6, $P = 0.00$, N = 851). Limited data from southern New England was consistent with this trend. However, much of this increase has been recent. From 1966 to 1983, no significant change occurred in continental populations (mean count/route = 0.23, trend = 1.60, $P = 0.31$, N = 361) but from 1984 to 2000, a strongly significant increase occurred (mean count/route = 0.62, trend = 2.14, $P = 0.00$, N = 723).

Christmas Count data also showed a strongly significant U.S. (birds/party hr = 0.04, Kendall's tau = 0.78, $P = 0.00$, N = 37) and Connecticut (birds/party hr = 0.01, Kendall's tau = 0.47, $P = 0.00$, N = 37) increase from 1966 to 2002. As with breeding data, much of the increase has been since 1981.

On ten line transects through the Northeast Uplands Ecoregion, Craig (1987) estimated populations to be 2.5 birds/km^2, a value ten times higher than in this study. Ten year samples from three Connecticut Breeding Bird Census plots and a three year sample from a Winter Bird Population Study plot yielded no detections and, hence, no density estimates. Elsewhere, densities of pairs/km^2 have been reported as 0.2 in Michigan, 0.6 in New York, and 2.1 in Maryland (Crocoll 1994).

Habitat.- Because we encountered only one Red-shouldered Hawk within 70 m, we were unable to make habitat evaluations based on observations of individual birds. Moreover, analyses of habitat variables vs. summer population densities (Table 8) showed no correlations (winter populations were too low to compute correlations). We found summering and wintering birds primarily in mature, deciduous and mixed forests. Typically, the species is associated with extensive, mature forest, particularly in swampy areas and along streams (Crocoll 1994).

History.- The Red-shouldered Hawk has been described as historically common to uncommon in Connecticut (Sage et. al 1913, Zeranski and Baptist 1990). However, from the 1940s though 1980, Christmas Count data suggested that it was declining in areas of the East (Bednarz et al. 1990). Indeed, at 19 eastern Connecticut forests surveyed in the summers of 1975-1977, R. Craig (pers. obs.) found that only 37% of sites had Red-shouldered Hawks, compared with 61% of the (in many instances same) sites surveyed in this study.

Synthesis.- Breeding populations of the Red-shouldered Hawk in eastern Connecticut appear to have increased since the 1970s, a trend supported by data from the Breeding Bird Survey and Christmas Count. The contrary higher densities obtained by Craig (1987) likely resulted from the strip survey methods employed in this earlier study. Strip surveys tend to overestimate density in wide-ranging, loudly vocal species like the Red-shouldered Hawk. Supporting this explanation is that 0.16 birds/km of survey route were found by Craig (1987) whereas 0.21 birds/km were found in this study.

The drop in population density observed from summer to winter is expected in this migratory species. Populations largely vacate their northern range (including Connecticut) during winter (Crocoll 1994).

Our small sample prevented substantially evaluating habitat associations for the Red-shouldered Hawk. However, the coincident growth in populations and maturation of Connecticut forest habitats (Ward and Barsky 2000) is consistent with the view that mature forests favor the species.

Conservation status.- Populations appear secure, but potentially sensitive to forest fragmentation.

Sponsored by Nancy Pritchard Weiss

BROAD-WINGED HAWK

Buteo platypterus

Density distribution.- The Broad-winged Hawk was very uncommon during this study, although it was present in both Northeast and Southeast Connecticut. Based on 11 observations (insufficient for mapping), we tentatively estimate a breeding population of 1,178 individuals (0.4 birds/km^2). During surveys, we found birds at five locations each in Northeast and Southeast Connecticut, suggesting that the species was present equally throughout. Population estimates are based on detections of males and females.

Population variance.- The coefficient of variation calculated from Breeding Bird Survey data (Sauer et al. 2001) predicted variation in continental populations as a very high 549%, likely more a consequence of censusing difficulties than of actual population fluctuations. From 1966 to 2000 continental populations showed no significant trend (mean count/ route = 0.1, trend = 0.6, $P = 0.42$, N = 722). Limited data from southern New England also suggested no trend.

On ten line transects through the Northeast Uplands Ecoregion, Craig (1987) reported 2.5 birds/km^2, a value well above that found in this study. In a ten year sample of Breeding Bird Census plots in Connecticut, densities of pairs/km^2 were 2.2 $\pm$ 1.9 oak-hemlock forest and 5.2 $\pm$ 5.7 hemlock-hardwood forest. Birds appeared four times (5.0 pairs/km^2) in second growth deciduous forest. All these estimates are above that of this study.

Elsewhere, densities of pairs/km^2 have been reported as 0.2 in Wisconsin, 0.4 in Minnesota and 0.5 in New York (Goodrich et al 1996). These densities are similar to those of this study.

Habitat.- Our 11 observations of summering Broad-winged Hawks occurred in deciduous, mixed and coniferous forests. Birds were in mesic and xeric situations, although large swamps, lakes, and shores were near seven of the locations where sightings were made.

Elsewhere in the East, evidence suggests that birds occur in younger forests than those occupied by Red-shouldered Hawks. Habitat also is frequently characterized by forest openings and nearby water. Deciduous and mixed conifer-deciduous forests are used primarily. Pure conifers are used more rarely (Goodrich et al. 1996).

History.- The Broad-winged Hawk was reported to be fairly common by Sage et al. (1913). However, Zeranski and Baptist (1990) believed that it was less common in the 19th century when much of the landscape was deforested, and has become more common during the 20th century as forests have regrown.

Synthesis.- Although Breeding Bird Survey data are highly variable and show no clear trend, estimates by Craig (1987) and our incidental observations suggest that the Broad-winged Hawk has declined in eastern Connecticut over the past 30 years. Forests in this region have matured and expanded during this time (Ward and Barsky 2000), which may make habitats less suitable for a species that prefers younger forests and forest openings.

Our few observations of habitat use were in general agreement with other reports. The maturation of regional forests (Ward and Barsky 2000) may negatively impact the species, but available data indicate that forest fragmentation is unlikely to affect populations (Goodrich et al. 1996).

Conservation status.- Populations may be declining as a consequence of forest maturation.

Sponsored by Arthur Edwards Kimball-Stanley

RED-TAILED HAWK

Buteo jamaicensis

Density distribution.- The Red-tailed Hawk was very uncommon during this study. Based on 19 winter and summer observations, we tentatively estimate a breeding population of 634 individuals (0.2 birds/km^2), and a wintering population of 575 individuals (0.2 birds/km^2) in primarily forested regions of eastern Connecticut. Population estimates are based on detections of males and females.

During summer surveys, we found birds at three locations in Northeast and five locations in Southeast Connecticut. In winter, we found birds at two locations in Northeast and six locations in Southeast Connecticut. Hence, a weak trend existed for birds to occur more frequently to the south. Data were insufficient for mapping density distributions.

Population variance.- The coefficient of variation calculated from Breeding Bird Survey data (Sauer et al. 2001) predicted variation in continental populations as 20.6%. From 1966 to 2000 continental populations showed a significant increase (mean count/ route = 1.1, trend = 2.9, $P = 0.00$, N = 2859). Limited data from southern New England suggested an increase as well.

The coefficient of variation from Connecticut Christmas Count data was 59.4%. Christmas Counts showed a significant U.S. (birds/party hr = 0.40, Kendall's tau = 0.88, $P = 0.00$, N = 37) and Connecticut (birds/party hr = 0.23, power function model $r^2 = 0.91$, df = 35, $P = 0.00$) increase from 1966 to 2002.

On ten line transects through the Northeast Uplands Ecoregion, Craig (1987) reported no birds, although they were present in the study area (R. Craig pers. obs). In a ten year sample of Breeding Bird Census plots in Connecticut, birds were absent from oak-hemlock and hemlock-hardwood forest. Birds appeared three times (5.0-9.9 pairs/km^2) in second growth deciduous forest. A Winter Bird Population Study plot in a mixed forest wetland yielded 0.5 birds/km^2 during two of three years examined.

Elsewhere, densities of pairs/km^2 in the Northeast have been reported as 6.2-50 in Ohio, 8.0 in New York and 19.2 in Michigan, and 7.3-10.6 in Wisconsin. Winter densities of birds/km^2 are reported as 1.1-2.0 in Wisconsin and 0.2 in Ohio (Preston and Beane 1993).

Habitat.- Our ten observations of summering Red-tailed Hawks occurred in deciduous forests. Birds were in mesic and xeric situations. All were associated with forest edge or large forest openings. Wintering birds were similarly associated with forest edge in eight of nine cases. Elsewhere in the East, the species occupies forests more fragmented than its congeners, the Red-shouldered and Broad-winged Hawk (Preston and Beane 1993).

History.- Historical reports of Red-tailed Hawk abundance are conflicting. It is generally thought to have undergone a long term decline from the 19th to mid-20th century, but to have increased since then (Zeranski and Baptist 1990).

Synthesis.- Breeding Bird Survey and Christmas Count data indicate that the Red-tailed Hawk is undergoing a population increase. Although forests in eastern Connecticut are maturing (Ward and Barsky 2000) and the extent of opening country declining, the species appears to be prospering.

Although they nest in trees, comparatively few Red-tailed Hawks were detected during this study because they are largely absent from extensively forested regions. They were present near our study sites only when large forest openings were present, an observation in general agreement with other reports of habitat use.

Conservation status.- Populations appear to be increasing, and appear secure.

Sponsored by Helen Chase Millett-Miller

RUFFED GROUSE
Bonasa umbellus

Density distribution.- We found only four summering and one wintering Ruffed Grouse during this study. Our few detections did not permit reliable estimation of populations, although we estimate roughly that less than 1,000 birds inhabit primarily forested landscapes.

During summer surveys, we found birds at two locations in Northeast and one location in Southeast Connecticut. In winter, our only detection was of a bird in Northeast Connecticut.

Population variance.- The coefficient of variation calculated from Breeding Bird Survey data (Sauer et al. 2001) predicted variation in continental populations as a very high 433.9%, apparently more a consequence of censusing difficulties than of actual population fluctuations. From 1966 to 2000 continental populations showed a nonsignificant decline (mean count/ route = 0.3, trend = -1.6, P = 0.29, N = 559). Limited data from southern New England suggested a decline as well.

The coefficient of variation from Connecticut Christmas Count data was 64.6%. Christmas Counts showed a strongly significant U.S. (birds/party hr = 0.08, Kendall's tau = -0.47, P = 0.00, N = 37) and Connecticut (birds/party hr = 0.08, exponential model r^2 = 0.80, df = 35, P = 0.00) decline from 1966 to 2002.

On ten line transects through the Northeast Uplands Ecoregion, Craig (1987) incidentally detected the species but did not compute its densities. In a ten year sample of Breeding Bird Census plots in Connecticut, 6.9 ± 4.8 birds/km^2 were present in second growth deciduous forest, birds were absent from oak-hemlock forest, and appeared twice in hemlock-hardwood forest (9.5 pairs/km^2). A Winter Bird Population Study plot in a mixed forest wetland located no birds. Elsewhere, densities of 22 adults/km^2 are reported from prime habitat (Rusch et al. 2000).

Habitat.- Our five observations of habitat use by the Ruffed Grouse occurred in deciduous and mixed forests. Birds were in swampy to dry situations, and most were associated with open forest. One location inhabited was an open, stunted Pitch Pine-oak ridgetop forest and another was a deciduous swamp.

Our observation of birds inhabiting pine barrens-like conditions is notable in that use of this habitat appears to have been largely overlooked (but reported by Bull 1974 for the Long Island Pine Barrens). Although the Ruffed Grouse is rare to absent on the coastal plain south of Long Island, in 1972 R. Craig (pers. obs.) also observed it in similar habitats in the New Jersey Pine Barrens.

Elsewhere in Northeast, the species is reported from early successional conifer-deciduous forest. A mix of small forest openings, young forest and mature forest is thought to be optimal. In more northern areas, it is frequently associated with aspen (*Populus* spp.) forest (Rusch et al. 2000).

History.- The Ruffed Grouse was reported to be common by Sage et al. (1913). However, since the 1980s it has declined (Zeranski and Baptist 1990). Indeed, at 19 eastern Connecticut forests surveyed in the summers of 1975-1977, R. Craig (pers. obs.) found that 26% of sites had Ruffed Grouse, compared with 10% of the (in many instances same) sites surveyed in this study.

Synthesis.- Christmas Counts and data of Craig (above) indicate that the Ruffed Grouse has declined since the 1970s. The forests in eastern Connecticut are maturing (Ward and Barsky 2000), which is likely reducing the suitability of local habitats. Moreover, during the years that the Ruffed Grouse was declining, the Wild Turkey (*Meleagris gallopavo*) became established and greatly expanded its populations in eastern Connecticut (Clark 1999). The possibility that growth in turkey populations contributed to the Ruffed Grouse decline warrants investigation.

Our few observations of habitat use were in general agreement with other reports that highlight the presence of forest openings in areas occupied. The appearance of the Ruffed Grouse in pine-oak barrens suggests that early 19th century reports of Heath Hens (*Tympanuchus cupido*) in eastern Connecticut "shrubby barrens" (Sage et al. 1913) should be treated with suspicion. As no specimens or archaeological evidence of Heath Hens exist for Connecticut (Clark 1999), such reports may have been based on incorrectly identified Ruffed Grouse.

Conservation status.- Populations appear to be declining, likely as a consequence of forest maturation.

Sponsored by Susan H. Bontecou

WILD TURKEY

Meleagrus gallopavo

Summer

Density (birds/km^2): 0.7 (95% CI: 0.3-1.5)

Density range (birds/km^2/transect): 0-3.4

Total population (birds): 1,772 (95% CI: 789-3,979)

Detection function: half normal/cosine
$x^2 = 3.14$, $P = 021$, df = 2, N = 22

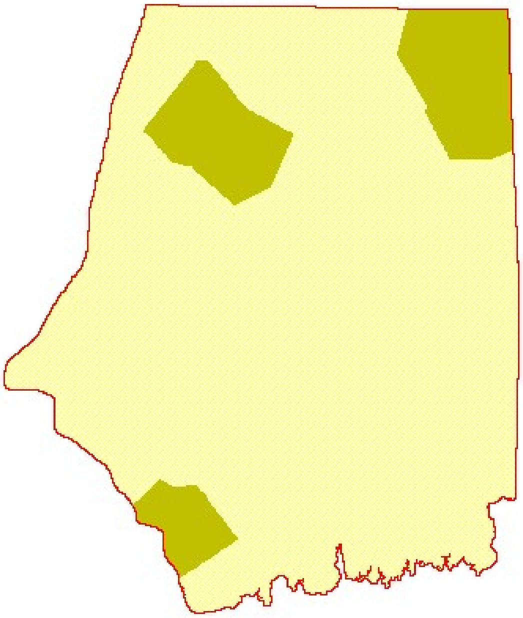

FIG. 28. Summer density of the Wild Turkey averaged greater in Northeast Connecticut. Light = 0-1.2, dark = 1.2-3.5 birds/km^2.

Density distribution.- The Wild Turkey was an uncommon inhabitant of the forests of eastern Connecticut. Its summer densities averaged greater in Northeast (0.8 ± 1.4 birds/km^2) than Southeast Connecticut (0.5 ± 1.1 birds/km^2; Fig. 28) but not significantly so (Mann-Whitney U = 297.0, $P = 0.48$, N = 51).

Population estimates are based on less than 60 detections of males and females, so have reduced accuracy. Moreover, although we found tracks of Wild Turkeys in forest habitat, we recorded them on winter transects only three times. Because of their low winter detectability, we did not make winter population estimates.

Population variance.- The coefficient of variation calculated from Breeding Bird Survey data (Sauer et al. 2001) predicted continental population variation as a very high 417%, apparently more a consequence of censusing difficulties than of actual population fluctuations. However, from 1966-2000, populations showed a strongly significant continental increase (mean count/route = 0.3, trend = 12.9, $P = 0.00$, N = 880). Limited data from southern New England suggested an increase as well.

The coefficient of variation from Connecticut Christmas Count data was 156%. Christmas Counts showed a strongly significant U.S. (birds/party hr = 0.4, Kendall's tau = 0.51, $P = 0.00$, N = 37) and Connecticut (birds/party hr = 0.4, Kendall's tau = 0.29, $P = 0.00$, N = 37) increase from 1966 to 2002.

On ten line transects through the Northeast Uplands Ecoregion, Craig (1987) incidentally detected the species but did not compute its densities. In a ten year sample of Breeding Bird Census plots in Connecticut, birds appeared twice each in hemlock-hardwood (9.5-19.0 birds/ km^2) and second growth deciduous forest (9.9 birds/km^2). They were absent from oak-hemlock forest. A Winter Bird Population Study plot in a mixed forest wetland also yielded no birds. Elsewhere, densities are estimated at generally 1-5 birds/km^2 (Eaton 1992), values similar to that of this study.

Habitat.- Our limited observations of forest habitat use by the Wild Turkey indicated that they were present in mesic to xeric, open canopy deciduous, mixed and coniferous forest. Birds were usually detected near forest edge or openings. We also made incidental summer observations of birds feeding in hayfields, croplands and lawns. Elsewhere in the Northeast, the species is reported to inhabit open, mature hardwood forests from fall to spring, and forest openings in summer (Eaton 1992).

History.- The Wild Turkey was extirpated from Connecticut by the early 19th century, but was reestablished during the 1970s when wild caught birds were released at various Connecticut locations (Zeranski and Baptist 1990).

Synthesis.- Breeding Bird Survey and Christmas Count data show that Wild Turkey populations are undergoing a continental and regional increase. They have been present in eastern Connecticut only since 1978 (Clark 1999), and have since spread over most of the region.

Despite its population expansion, we found the Wild Turkey difficult to study. It was secretive when in forest habitat and occurred in summer outside of forests. Hence, we believe our population estimates are low, and that our estimates best relate to that part of the population inhabiting primarily forested landscapes. Notably, the similar point count procedures of the Breeding Bird Survey also experienced difficulties in characterizing populations.

Our few observations of habitat use were in general agreement with other reports that highlight the presence of forest openings in areas occupied.

Conservation status.- Populations are increasing and appear secure.

Sponsored by Catherine and Steven Smith

MOURNING DOVE

Zenaida macroura

Summer

Density (males/km^2): 1.5 (95% CI: 0.9-2.5)

Density range (males/km^2/transect): 0-5.2

Total population (males): 4,110 (95% CI: 2,434-6,940)

Detection function: half normal/cosine
$\chi^2 = 5.65, P = 0.06$, df = 2, N = 148

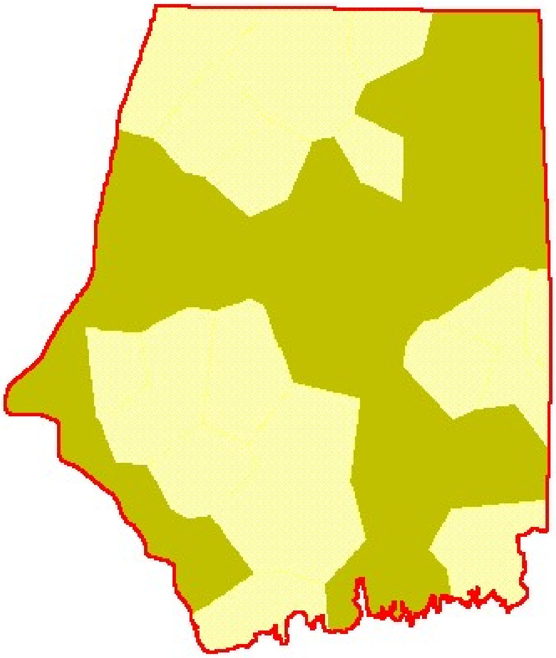

FIG. 29. In summer, the Mourning Dove occurred with similar frequency in Northeast and Southeast Connecticut. Light = 0.2-1.4, dark = 1.4-3.3 males/km^2.

Density distribution.- We recorded the Mourning Dove uncommonly on forest transects, and did so primarily because its call carried long distances from non-forested areas (Fig. 29). Its breeding densities were similar (Mann-Whitney U = 308.5, $P = 0.75$, N = 51) in Northeast (1.5 ± 1.2 males/km^2) and Southeast Connecticut (1.5 ± 1.5 males/km^2).

Because birds did not actively vocalize in winter until late February, we could not estimate densities for this season. Summer population estimates are based on detections of calling males, and refer only to that part of the population detectable from primarily forested regions.

TABLE 9. Limited summer observations of habitat use by individual Mourning Doves suggested that they inhabited forests more open, more coniferous, and drier than would be predicted by habitat availability (N = 12). Categories of summer habitat use showed no correlations with population densities. $P(\tau)$ = probability level of Kendall's tau, N = 51; * = significant, ** = highly significant (see Table 8 for abbreviation key).

	Mean Habitat Characteristics					
	F	M	D	C	U	
Availability	1.4	2.3	2.0	2.7	2.3	
Use	1.8	2.6	2.0	2.3	2.4	
$P(\tau)$	0.47	0.27	0.72	0.65	0.53	
	Percent Vegetation					
	OD	MH	CN	PO	CO	MI
Availability	51.0	13.7	13.1	13.1	8.5	0.7
Use	33.3	0.0	8.3	50.0	8.3	0.0

Population variance.- The coefficient of variation calculated from Breeding Bird Survey data (Sauer et al. 2001) predicted population variation as 1.7% for southern New England. From 1966-2000, populations showed a strongly significant regional increase (mean count/route = 23.9, trend = 1.4, P = 0.00, N = 51). However, continental data showed no significant trend (mean count/route = 29.4, trend = -0.2, $P = 0.07$, N = 3598).

The coefficient of variation from Connecticut Christmas Count data was 21.1%. Christmas Counts from 1966 to 2002 showed a strongly significant U.S. (birds/party hr = 4.1, quadratic model $r^2 = 0.56$, df = 34, $P = 0.00$) and Connecticut increase (birds/party hr = 3.8, quadratic model $r^2 = 0.36$, df = 34, $P = 0.00$).

On ten line transects through the Northeast Uplands Ecoregion, Craig (1987) reported no birds, although they were present in the study area (R. Craig pers. obs.). In a ten year sample of Breeding Bird Census plots in Connecticut, 5.2 ± 6.5 pairs/km^2 were recorded in hemlock-hardwood forest. Birds appeared once each in second growth deciduous forest (5.0 pairs/km^2) and oak-hemlock forest (6.5 pairs/km^2). These densities overlap those found in this study. We found no other quantitative population estimates for populations associated with primarily forested environments.

Habitat.- When they were observed within forests, summering Mourning Doves appeared to inhabit areas more open, more coniferous (particularly pine-oak), and drier than would be predicted by habitat availability. However, comparison of population densities with habitat features showed no significant correlations (Table 9), likely because many birds detected were actually outside of forest habitat. We generally found the species associated with forest openings and edge, particularly logged over areas and young, regenerating forest. We also observed it incidentally in a wide variety of non-forest habitats.

Elsewhere, the Mourning Dove is reported to inhabit forest edge, open woods, suburban areas and agricultural areas, but to avoid forest interiors and extensive forest. In the East, it frequently chooses conifers as nest sites (Mirarchi and Baskett 1994).

History.- The Mourning Dove was known as a common but declining resident by Sage et al. (1913). Populations increased during the 20th century (Zeranski and Baptist 1990).

Synthesis.- Breeding Bird Survey and Christmas Count data show that Mourning Dove populations are undergoing a strong regional increase despite the maturation of regional forests (Ward and Barsky 2000). Such observations suggest that the species is benefiting from other phenomena, such as the suburbanization of eastern Connecticut.

Our observations of a species association with forest openings, successional habitats and forest edge are in general agreement with other reports. The suggested association with greater conifer cover may be related to the Mourning Dove's preference for nesting in conifers.

Conservation status.- Populations are increasing and appear secure.

Sponsored by Maya Finkelstein

BLACK-BILLED CUCKOO

Coccyzus erythropthalmus

Density (birds/km^2): 0.2 (95% CI: 0.1-0.3)
Density range (birds/km^2/transect): 0-2.0
Total population (birds): 600 (95% CI: 378-953)

Detection function: uniform/polynomial
$x^2 = 1.30$, $P = 0.52$, df = 2, N = 22

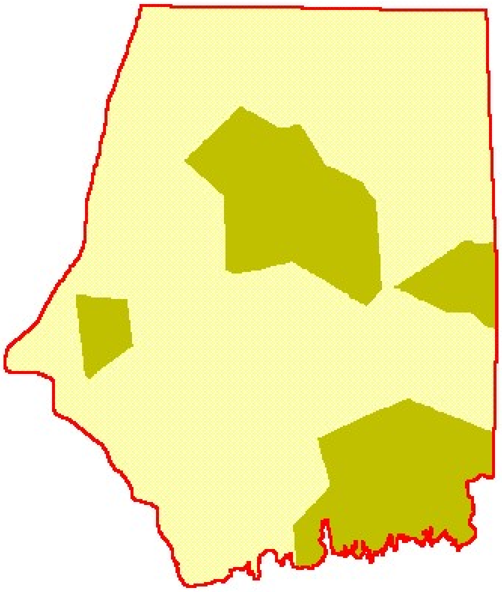

FIG. 30. The density of the Black-billed Cuckoo was similar in Northeast and Southeast Connecticut. Light = 0-0.3, dark = 0.3-1.0 birds/km^2.

Density distribution.-The Black-billed Cuckoo was one of the less commonly encountered forest birds in eastern Connecticut (Fig. 30). However, it occurred widely and relatively uniformly (Mann-Whitney U = 314.5, $P = 0.81$, N = 51) in the region. It was present at 27% of sites in Northeast (0.2 ± 0.5 birds/km^2) and 32% of sites in Southeast Connecticut (0.2 ± 0.3 birds/km^2).

In identifying this species, we used the characteristic (Hughes 1998) *cu-cu-cu-cu* call, which is uttered by both sexes. Hence, population estimates are of total individuals. However, they are based on <60 detections, so have reduced accuracy.

Population variance.- The coefficient of variation calculated from Breeding Bird Survey data (Sauer et al. 2001) predicted continental population variation as 196.5%, an indication of substantial annual variation in populations. From 1966-2000, populations showed a strongly significant continental decline (mean count/route = 0.6, trend = -1.9, $P = 0.00$, N = 1177). Limited data from southern New England were consistent with this trend.

On ten line transects through the Northeast Uplands Ecoregion, Craig (1987) incidentally detected the species but did not compute its densities. In a ten year sample of Breeding Bird Census plots in Connecticut, it occurred once (4.3 pairs/km^2) in oak-hemlock forest, but did not appear in hemlock-hardwood or second growth deciduous forest. Elsewhere, forest population densities are reported as 17 males/km^2 in West Virginia and 0.5 birds/km^2 in Michigan. (Hughes 1998).

Habitat.- The Black-billed Cuckoo occurred too infrequently for detailed evaluations of its habitat use to be made. Its infrequent occurrence also provided little data with which to compare population densities and habitat variables. We found birds at xeric and mesic sites with deciduous and mixed forest. The species occurred both inland and on all three coastal transects.

North American cuckoos are reported to be nomadic and to have populations that track outbreaks of a principal food, caterpillars (Hughes 1998). We indeed found the Black-billed Cuckoo at the only site (Mansfield Hollow) with a significant outbreak of caterpillars. However, its highest density occurred at Pumpkin Hill, which had no such outbreak.

Elsewhere, the species is reported to inhabit forest edge, tree groves, and thickets. It also occupies deciduous and mixed cover in old fields, young forest, and wetland borders.

It appears more frequent in extensive forests than the Yellow-billed Cuckoo (*C. erythropthalmus*), and populations appear greatest in unfragmented habitat (Hughes 1998).

History.- The Black-billed Cuckoo was described as a common breeder of southern Connecticut by Sage et al. (1913), although they reported that it had declined substantially from the 1890s. Zeranski and Baptist (1990) believed that although populations varied irregularly, it was more common than the Yellow-billed Cuckoo away from the coast.

Synthesis.- Breeding Bird Survey data strongly indicate that the Black-billed Cuckoo is undergoing a long term decline. Because it is typically associated with early successional forests, a factor likely driving the decline is the maturation of regional forests (Ward and Barsky 2000).

The Black-billed Cuckoo is a secretive species that may be missed by typical survey methods (Hughes 1998). Hence, population estimates based on vocalizations may be conservative. Moreover, because we sampled birds inhabiting forests, our estimates refer only to forest portions of the regional population. Despite such survey limitations, our finding that population densities are similar in Northeast and Southeast Connecticut is independently supported by distributions mapped in *The Atlas of Breeding Birds of Connecticut* (Bevier 1994).

Although not known to prefer mature interior forest, we found that the Black-billed Cuckoo was rare but regularly occurring in such habitats. Its reproductive success in these habitats is unknown, but its presence there suggests that even as regional forests mature it may remain present as a rare resident.

Conservation status.- Populations appear to be declining as a consequence of forest maturation. Habitat (but not necessarily forest) fragmentation also may negatively influence populations as the region urbanizes.

YELLOW-BILLED CUCKOO
Coccyzus americanus

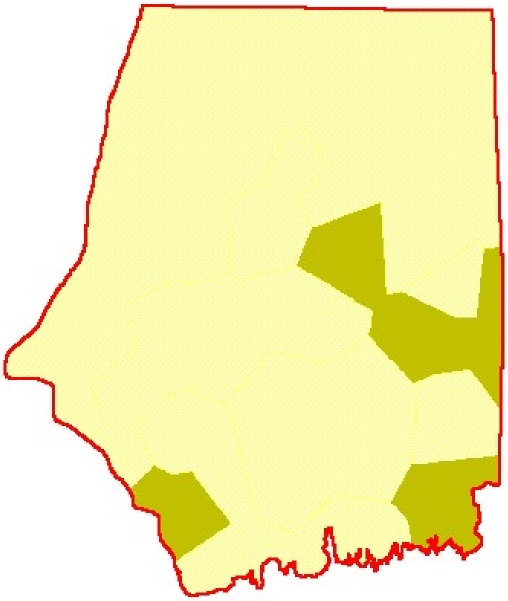

FIG. 31. The density of the Yellow-billed Cuckoo appeared to be greatest in Southeast Connecticut. Light = 0-0.6, dark = 0.6-1.6 males/km^2.

Density distribution.-The Yellow-billed Cuckoo was one of the least frequently encountered forest birds in eastern Connecticut. Based on 17 observations, we tentatively estimate a breeding population of 858 males (0.3 males/km^2). It was present at 11% of sites in Northeast and 32% of sites in Southeast Connecticut (Fig. 31), suggesting that the species occurred more frequently to the south. In identifying this species, we used the characteristic (Hughes 1999) *kowlp-kowlp-kowlp* call, which is apparently uttered only by males.

Population variance.- The coefficient of variation calculated from Breeding Bird Survey data (Sauer et al. 2001) predicted continental population variation as 3.2, a low value for a species characterized as having wide local population fluctuations (Hughes 1999). From 1966-2000, populations showed a strongly significant continental decline (mean count/route = 4.5, trend = -1.8, P = 0.00, N = 1831). Limited data from southern New England were consistent with this trend.

On ten line transects through the Northeast Uplands Ecoregion, Craig (1987) incidentally detected the species but did not compute its densities. In a ten year sample of Breeding Bird Census plots in Connecticut, it occurred twice (2.2-4.3 pairs/km^2) in oak-hemlock forest, but did not appear in hemlock-hardwood or second growth deciduous forest. These results are similar to those of this study. Elsewhere, population densities are reported as 2.5-37.5 pairs/km^2 in New Mexico, 20.5-66.2 pairs/km^2 in Arizona, and 66.3 males/km^2 in Texas. (Hughes 1999).

Habitat.- The Yellow-billed Cuckoo occurred too infrequently for detailed evaluations of its habitat use to be made. Its infrequent occurrence also provided little data with which to compare population densities and habitat variables. We found birds at xeric and mesic sites with deciduous and pine-oak forest. It occurred on only one of three coastal transects.

North American cuckoos are reported to be nomadic and to have populations that track outbreaks of a principal food, caterpillars (Hughes 1999). We indeed found the Yellow-billed Cuckoo at the only site (Mansfield Hollow) with a significant outbreak of caterpillars. However, its highest density occurred on the Nehantic Trail, which had no such outbreak.

Elsewhere, the species is reported to inhabit open woods, thickets, and scrub, often near water. It also is found in young forest and in riparian woods. It appears less frequent in extensive forests than the Black-billed Cuckoo, and populations appear greatest in unfragmented habitat (Hughes 1999).

History.- The Yellow-billed Cuckoo was described as a fairly common breeder of southern Connecticut by Sage et al. (1913). Zeranski and Baptist (1990) believed that although populations varied irregularly, it was more common than the Black-billed Cuckoo near the coast.

Synthesis.- Breeding Bird Survey data strongly indicate that the Yellow-billed Cuckoo is undergoing a long term decline. Because it is typically associated with open habitats and early successional forests, a factor likely driving the decline is the maturation of regional forests (Ward and Barsky 2000).

The Yellow-billed Cuckoo is a secretive species that may be missed by typical population survey methods (Hughes 1999). Population estimates based on vocalizations may, therefore, be conservative. Moreover, because we sampled birds inhabiting forests, our estimates refer only to forest portions of the regional population.

Although not generally thought of as a species of mature interior forest, we found that the Yellow-billed Cuckoo was a rare inhabitant of such habitats. Its reproductive success in these habitats is unknown, but its presence there suggests that even as regional forests mature it may remain as a rare resident.

The trend toward the Yellow-billed Cuckoo having greater densities in Southeast Connecticut supports Zeranski and Baptist's (1990) contention that the Yellow-billed Cuckoo is more common toward the coast. Greater density in Southeast Connecticut is also suggested by distributions mapped in *The Atlas of Breeding Birds of Connecticut* (Bevier 1994).

Conservation status.- Populations appear to be declining as a consequence of forest maturation. Habitat (but not necessarily forest) fragmentation also may negatively influence populations as the region urbanizes.

RUBY-THROATED HUMMINGBIRD

Archilochus colubris

Density distribution.- Although fairly common in non-forest habitats, we encountered few Ruby-throated Hummingbirds in the forests of eastern Connecticut. Our eight detections of summering birds did not permit reliable estimation of populations. However, seven of eight detections were in Southeast Connecticut, suggesting that they occurred more frequently to the south.

Population variance.- The coefficient of variation calculated from Breeding Bird Survey data (Sauer et al. 2001) predicted variation in continental populations as 96.7%. From 1966 to 2000 continental populations showed a strongly significant increase (mean count/ route = 0.4, trend = 2.5, P = 0.00, N = 1465). Limited data from southern New England suggested an increase as well.

On ten line transects through the Northeast Uplands Ecoregion, Craig (1987) incidentally detected the species but did not compute its densities. In a ten year sample of Breeding Bird Census plots in Connecticut, birds occurred once in oak-hemlock forest (4.3 birds/km^2) and twice in second growth deciduous forest (9.9 birds/km^2). None occurred in hemlock-hardwood forest. We found no other reports of population density.

Habitat.- We found summering birds principally in swamps, riparian areas and mesic, deciduous habitats with dense understories. In such habitats, flowering shrubs and herbs appeared to be most consistently abundant. Elsewhere, the species is reported to inhabit mixed woodland, deciduous forest, pine forest, forest edge and forest openings. It is also frequently present in gardens and orchards (Robinson et al. 1996).

History.- Sage et al. (1913) reported that the species was declining. Although considered common through the 1930s, it has become uncommon since (Colwell 1994).

Synthesis.- The Ruby-throated Hummingbird occurs locally in eastern Connecticut, and most typically in more open habitats including gardens. Extensive, mature forests appear not to be prime habitat. Hence, we found few during this study.

Despite evidence for a regional decline since the 1930s, more recent Breeding Bird Survey data suggest that a long term increase is occurring continentally and perhaps locally. An increasing population despite ongoing forest maturation (Ward and Barsky 2000) suggests that factors such as expanding suburbanization (hence, more gardens) and increased beaver activity (creating open swamps) may be benefiting the species.

Our few observations of habitat use by the Ruby-throated Hummingbird suggest that the most suitable forest habitats are those which have a consistent supply of nectar-bearing flowers. Swamps and larger streams in particular provide such habitats. In them, a procession of flowering by shrubs and herbaceous plants occurs throughout the breeding season.

Conservation status.- Populations may be increasing despite forest maturation.

Sponsored by Erika Baldwin

RED-BELLIED WOODPECKER
Melanerpes carolinus

Summer

Density (birds/km^2): 1.5 (95% CI: 1.0-2.1)

Density range (birds/km^2/transect): 0-4.1

Total population (birds): 3,965 (95% CI: 2,759-5,698)

Detection function: half normal/cosine
$x^2 = 3.68$, $P = 0.45$, df = 4, N = 72

Winter

Density (birds/km^2): 2.1 (95% CI: 1.5-3.2)

Density range (birds/km^2/transect): 0-10.7

Total population (birds): 5,908 (95% CI: 4,044-8,633)

Detection function: uniform/cosine
$x^2 = 1.04$, $P = 0.90$, df = 4, N = 81

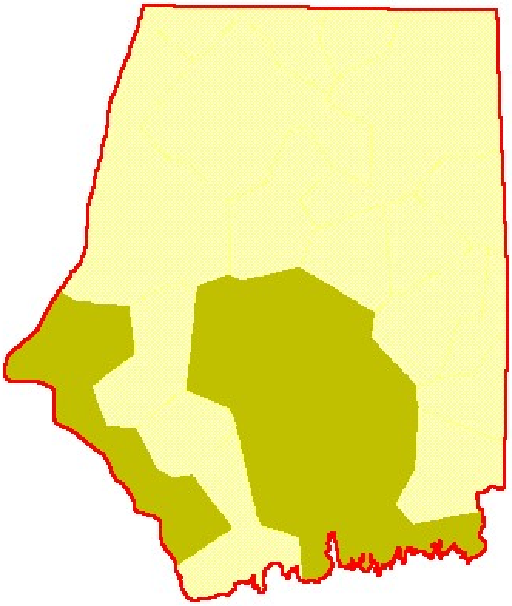

FIG. 32. In summer, Red-bellied Woodpecker density was greatest in Southeast Connecticut. Light = 0-1.7, dark = 1.7-4.5 birds/km^2.

Density distribution.- The Red-bellied Woodpecker was an uncommon inhabitant of eastern Connecticut. Its summer density

TABLE 10. Limited observations on habitat use by wintering Red-bellied Woodpeckers showed that birds has a strong association with deciduous forest (N = 17). Summer population densities were correlated with decreasing soil moisture. Winter population densities showed a correlation with increasing deciduous forests. $P(t)$ = probability level of Kendall's tau, N = 51; * = significant, ** = highly significant (see Table 8 for abbreviation key).

	Mean Habitat Characteristics				
	F	M	D	C	U
Availability	1.4	2.3	2.0	2.7	2.3
Winter use	1.0	2.2	2.0	2.6	2.2
Summer$P(t)$	0.49	0.04*	0.21	0.71	0.98
Winter $P(t)$	0.01**	0.32	0.29	0.64	0.24

	Percent Vegetation					
	OD	MH	CN	PO	CO	MI
Availability	51.0	13.7	13.1	13.1	8.5	0.7
Winter use	88.2	11.8	0.0	0.0	0.0	0.0

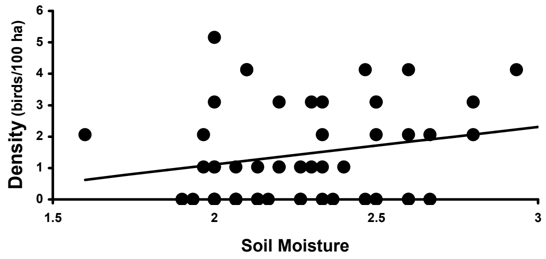

FIG. 33. Summer population density showed a weak but significant correlation with decreasing soil moisture.

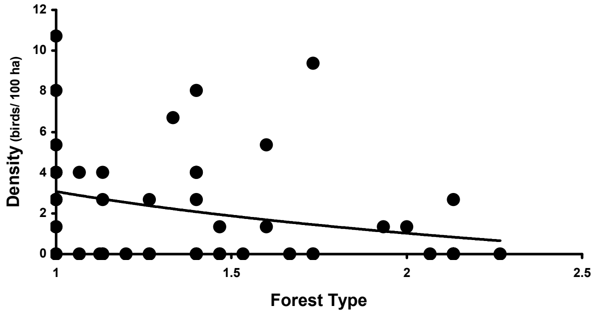

FIG. 34. Winter population density showed a weak but significant correlation with increasing deciduous cover.

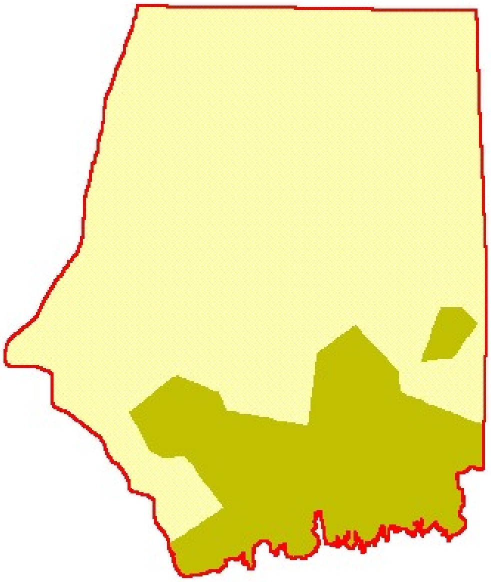

FIG. 35. In winter, Red-bellied Woodpecker density was greatest in Southeast Connecticut. Light = 0-3.1, dark = 3.1-7.1 birds/km^2.

increased significantly (Mann-Whitney U = 163.5, P = 0.00, N = 51) from Northeast (0.8 ± 1.1 birds/km^2), to Southeast Connecticut (2.1 ± 1.6 birds/km^2; Fig. 32).

In winter, populations appeared to grow over those of summer, particularly in Southeast Connecticut. As in summer, it increased significantly in density (Mann-Whitney U = 103.0, P = 0.00, N = 51) from Northeast (0.6 ± 1.1 birds/km^2), to Southeast Connecticut (3.7 ± 3.0 birds/km^2; Fig. 35). Population estimates are based on detections of vocalizing males and females.

Population variance.- The coefficient of variation calculated from Breeding Bird Survey data (Sauer et al. 2001) predicted variation in continental populations as 2.5%. From 1966 to 2000, continental populations showed a strong increase (meancount/route = 6.4, trend = 0.6, P = 0.00, N = 1573). Limited data from southern New England suggested an increase as well.

Connecticut Christmas Counts had a coefficient of variation of 124.0%. Christmas Counts showed a similar significant population increase on U.S. (birds/party hour = 0.3, Kendall's tau = 0.63, P = 0.00, N = 37 years) and Connecticut counts (birds/party hour = 0.1, Kendall's tau = 0.92, P = 0.00, N = 37 years).

On ten line transects through the Northeast Uplands Ecoregion, Craig (1987) found no Red-bellied Woodpeckers. In a ten year sample of Breeding Bird Census plots in Connecticut, densities of pairs/km^2 were 2.6 ± 2.4 in oak-hemlock forest, 3.0 ± 5.3 in second growth deciduous forest, and none in hemlock-hardwood forest. In winter, three year densities were 1.4-3.7 birds/km^2 in a Connecticut mixed forest wetland. These estimates overlap but average higher than those of this study.

Habitat.- We made few summer observations on habitat use by individual Red-bellied Woodpeckers, and these showed no clear differences with habitat availability, although birds tended to be more frequent in xeric pine-oak forest. Summer population densities were indeed correlated with increasingly xeric conditions (Table 10, Fig. 33).

Winter yielded larger samples (although still inadequate for statistical tests), and these showed a strong association with deciduous forest. Winter population densities also showed a correlation with increasingly deciduous forests (Table 10, Fig. 34).

Elsewhere, the species is associated with mature deciduous or mixed forest in either wet (bottomland, floodplain) or dry conditions. In the South, it is typical of pine-oak forest. Comparatively high density tree and understory cover is characteristic of habitats used in much of the East (Shackelford et al. 2000).

History.- The Red-bellied Woodpecker was a rarity in Connecticut before 1960 (Sage et. al 1913, Zeranski and Baptist 1990). However, since the 1970s it has increased explosively at this, its northern range limit (Clark 1994a).

Synthesis.- Data from the Breeding Bird Survey and Christmas Counts show that populations of the Red-bellied Woodpecker have increased dramatically in southern New England. It now ranges even into the highest elevations of northeastern Connecticut, where as recently as the 1980s (Craig 1987) it was absent. However, its greatest density, winter and summer, remains in Southeast Connecticut.

We observed population increases from summer to winter in a number of permanent resident species, including this one. Such increases likely reflect recruitment of first year birds into the population. Moreover, some movement into Southeast Connecticut is possible, as the species appears to vacate northern portions of its range during winter (Shackelford et al. 2000). Our data indeed suggest that a slight winter decline occurred in Northeast Connecticut populations. However, additional data are needed to separate annual population variation from geographic trends.

The prevalence of the Red-bellied Woodpecker in xeric forests, including pine-oak forests, is consistent with its habitat preferences in the Southeast, where populations reach their greatest densities (Shackelford et al. 2000). Its apparent winter movement into more deciduous forests may reflect altering forest resource (e.g. food) conditions during the winter season. Alternatively, such an association may be a byproduct of population movement into climatically milder coastal locations, where deciduous forests predominate (Table 4,5).

Conservation status.- Populations are growing and appear secure.

Sponsored by Irene and Steve Dune

YELLOW-BELLIED SAPSUCKER
Sphyrapicus varius

Density distribution.- The Yellow-bellied Sapsucker was among the rarest of summering birds in eastern Connecticut. We found a single summering individual at Nipmuck State Forest, Stafford. The species normally winters south of New England, and no birds appeared on winter surveys. Because of its rarity we make no population estimate for the region.

Population variance.- The coefficient of variation calculated from Breeding Bird Survey data (Sauer et al. 2001) predicted variation in continental populations as 30.9%. From 1966 to 2000 continental populations showed no significant trend (mean count/ route = 0.3, trend = -0.2, P = 0.72, N = 645). Very limited data from southern New England suggested a population increase.

On ten line transects through the Northeast Uplands Ecoregion, Craig (1987) reported no birds, although calling individuals were present in the study area until the end of May (R. Craig pers. obs.). In a ten year sample of Breeding Bird Census plots in Connecticut, birds occurred four times (5.0-19.8 pairs/km^2) in second growth deciduous forest. None occurred in oak-hemlock forest or hemlock-hardwood forest. Elsewhere, 35 ± 13 pairs/km^2 have been reported in New Hampshire (Holmes et al. 1986).

Habitat.- Our only observation of a summering Yellow-bellied Sapsucker was in an open beaver-associated swamp with much of the canopy composed of dead trees. Red Maple and Yellow Birch bordered the swamp. This habitat was similar to ones where we have encountered summering individuals in Northwest Connecticut.

Elsewhere, the species is reported in summer from young deciduous and mixed conifer-deciduous forests. It is often associated with riparian habitat and selectively logged areas where deciduous trees predominate. In winter, more deciduous and open habitats are used, and bottomland forest is frequently inhabited (Walters et al. 2002).

History.- The Yellow-bellied Sapsucker was reported to be rare in winter and summer by Sage et al. (1913). It appears to have become increasingly common at all seasons during the 20th century (Zeranski and Baptist 1990).

Synthesis.- Only one other possible breeding record exists for the Yellow-bellied Sapsucker in our region (Devine and Smith 1994), so the species is clearly a marginal summer resident with us. However, if regional populations are indeed growing, additional summering birds may be expected in the future.

In eastern Connecticut, the only region containing the type of physical environment typically inhabited by this northerly distributed species is the southern tip of the Taconic Plateau (Northeast Uplands Ecoregion). It is in this area where our one observation of the Yellow-bellied Sapsucker occurred. Our one observations of habitat use there was in general agreement with other reports of habitat use.

Conservation status.- Populations may be increasing at present. However, regional populations could respond negatively to the ongoing maturation of southern New England's forests.

Sponsored by Steffen Hviid

DOWNY WOODPECKER

Picoides pubescens

Summer

Density (birds/km^2): 6.5 (95% CI: 5.1-8.2)
Density range (birds/km^2/transect): 0-26.3
Total population (birds): 17,641 (95% CI: 13,912-22,370)

Detection function: uniform /cosine
$\chi^2 = 9.73$, $P = 0.14$, df = 6, N = 163

Winter

Density (birds/km^2): 10.3 (95% CI: 8.1-13.0)
Density range (birds/km^2/transect): 3.2-22.6
Total population (birds): 27,983 (95% CI: 22,039-35,532)

Detection function: half normal/cosine
$\chi^2 = 9.92$, $P = 0.27$, df = 8, N = 159

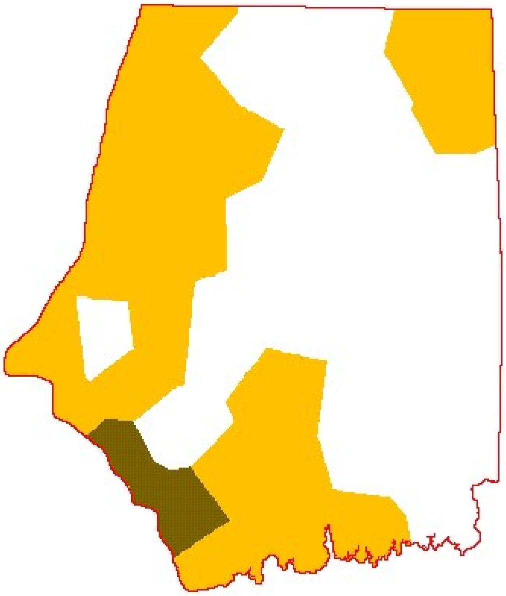

FIG. 36. In summer, Downy Woodpecker density averaged greater in Southeast Connecticut. Light = 2.7-6.1, medium = 6.1-10.1, dark = 10.1-15.5 birds/km^2.

TABLE 11. Observations of habitat use by individual Downy Woodpeckers showed no significant differences from habitat availability. Comparison of population densities with habitat features also showed no significant correlations. $P(\chi^2)$ = probability level of chi-square tests, N = 50 summer, 72 winter; $P(\tau)$ = probability level of Kendall's tau, N = 51 summer, 50 winter; * = significant, ** = highly significant (see Table 8 for abbreviation key).

	Mean Habitat Characteristics				
	F	M	D	C	U
Availability	1.4	2.3	2.0	2.7	2.3
Summer use	1.3	2.2	1.9	2.6	2.3
$P(\chi^2)$	0.43	0.46	0.13	0.39	0.15
$P(\tau)$	0.82	0.35	0.77	0.85	0.41
Winter use	1.3	2.3	2.0	2.7	2.4
$P(\chi^2)$	0.56	0.68	0.67	0.58	0.42
$P(\tau)$	0.06	0.11	0.70	0.37	0.27

	Percent Vegetation					
	OD	MH	CN	PO	CO	MI
Availability	51.0	13.7	13.1	13.1	8.5	0.7
Summer use	52.0	20.0	12.0	6.0	6.0	4.0
$P(\chi^2)$	0.56					
Winter use	50.0	19.4	11.1	12.5	5.6	1.4
$P(\chi^2)$	0.84					

Density distribution.-The Downy Woodpecker was a fairly common inhabitant of the forests of eastern Connecticut. Its breeding densities averaged lower in Northeast (5.7 ± 3.3 birds/km^2) than Southeast Connecticut (7.2 ± 5.7 birds/km^2; Fig. 36), but not significantly so (Mann-Whitney U = 301.0, $P = 0.65$, N = 51).

As with a number of permanent resident species, winter populations appeared greater than those of summer. Winter densities also averaged lower in Northeast (8.9 ± 5.0 birds/km^2) than Southeast Connecticut (11.6 ± 6.4 birds/km^2; Fig. 37), but not significantly so (Mann-Whitney U = 242.5, $P = 0.16$, N = 51). Population estimates are based on detections of calling males and females.

Population variance.- The coefficient of variation calculated from Breeding Bird Survey data (Sauer et al. 2001) predicted population variation as 18.2% for southern

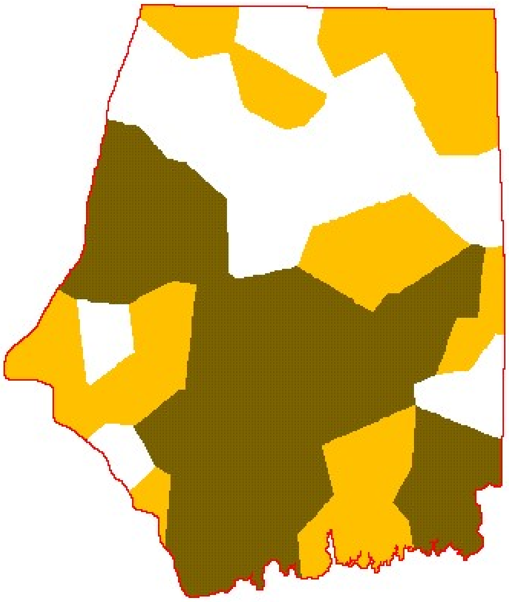

FIG. 37. In winter, Downy Woodpecker density averaged greater in Southeast Connecticut. Light = 4.3-7.5, medium = 7.5-11.9, dark = 11.9-20.5 birds/km^2.

New England. From 1966-2000, populations showed no significant regional (mean count/route = 4.2, trend = 1.1, P = 0.16, N = 50) or continental trend (mean count/route = 1.3,trend = -0.0, P = 0.94, N = 2555).

Christmas Count data predicted population variation as 15.7% for Connecticut. From 1966-2001, populations also showed no significant Connecticut (birds/party hour = 0.6, quadratic model r^2 = 0.00, df = 34, P = 0.99) or U.S. trend (birds/party hour = 0.9, quadratic model r^2 = 0.03, df = 34, P = 0.61).

On ten line transects through the Northeast Uplands Ecoregion, Craig (1987) reported 5.1 birds/km^2, a value similar to that of this study. In a ten year sample of Breeding Bird Census plots in Connecticut, densities of pairs/km^2 were 6.5 ± 3.2 in oak-hemlock forest, 16.1 ± 4.6 in hemlock-hardwood forest, and 19.3 ± 10.0 in second growth deciduous forest. A Winter Bird Survey plot in a deciduous-coniferous wetland had 7.0-10.2 birds/km^2. These densities overlap those found in this study. In New Hampshire, breeding densities are reported as 2.6 ± 1.3 birds/km^2 (Holmes et al. 1986).

Habitat.- Observations of habitat use by individual Downy Woodpeckers showed that they used forests habitats in approximately the proportions at which they were available. Moreover, proportionate use of habitats was remarkably consistent from winter to summer. Comparison of population densities also showed no correlations with habitat features (Table 11).

One summer habitat affiliation is suggested by an area of greater density along the lower Connecticut River (Fig. 36). This concentration was likely related to a massive die-off of Eastern Hemlock in the area.

Elsewhere, the species is reported to inhabit especially deciduous forests, although it also occurs in coniferous forests, albeit at lower densities. Younger, open forests and riparian forests are thought to be favored. Moreover, it occupies orchards and even suburban landscapes (Jackson and Ouellet 2002).

History.- The Downy Woodpecker was known as a common summer resident even in the 19th century when forest extent was limited. It remained a common breeder during the 20th century (Sage et al. 1913, Zeranski and Baptist 1990).

Synthesis.- Breeding Bird Survey and Christmas Count data show that the Downy Woodpecker has a stable regional population, a trend corroborated by comparison of our results with earlier transect studies of Craig (1987). Such population stability likely makes even our more inherently variable winter data highly comparable among years.

We observed population increases from summer to winter in a number of permanent resident species, including this one. Fig. 37 illustrates that winter populations concentrate in the southern 2/3 of Connecticut. Such increases likely reflect recruitment of first year birds into the population. However, migration from northern areas into Connecticut is possible as well, although such movements are poorly documented (Jackson and Ouellet 2002).

The lack of association with any habitat variable suggests that the Downy Woodpecker is a habitat generalist. Its status as one of the East's most abundant woodpecker species (Jackson and Ouellet 2002) supports this view, as does its population stability despite regional forest maturation (Ward and Barsky 2000). Such maturation should pose fewer problems for habitat generalists than for early successional species.

Conservation status.- Populations are stable, although forest fragmentation presents a potential long term threat. However, because of the species' ability to tolerate even suburban landscapes, its continued survival in our region seems assured.

Sponsored by Dr. Charles Baldwin

HAIRY WOODPECKER
Picoides villosus

Summer

Density (birds/km^2): 1.4 (95% CI: 0.8-2.5)
Density range (birds/km^2/transect): 0-7.1
Total population (birds): 3,816 (95% CI: 2,181-6,675)

Winter

Density (birds/km^2): 2.9 (95% CI: 1.9-4.6)
Density range (birds/km^2/transect): 0-14.2
Total population (birds): 7,978 (95% CI: 5,114-12,447)

Detection function (all data): uniform/cosine
$\chi^2 = 7.51$, $P = 0.28$, df = 6, N = 61

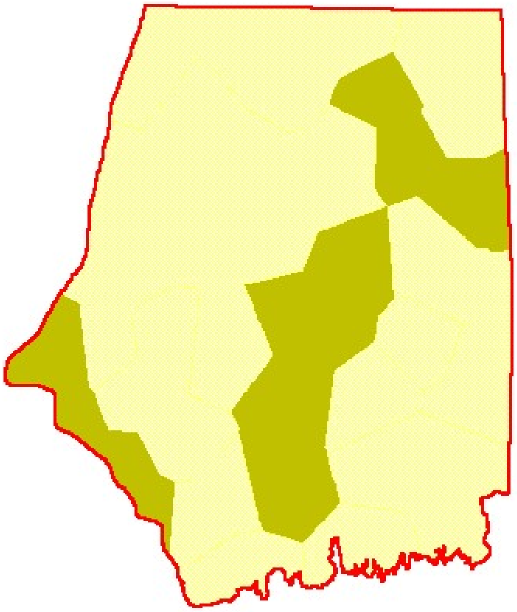

FIG. 38. Summer Hairy Woodpecker densities were similar in Northeast and Southeast Connecticut. Light = 0-1.2, dark = 1.2-4.8 birds/km^2.

TABLE 12. Limited observations of habitat use by wintering Hairy Woodpeckers suggested that birds inhabited forests with canopies more open than would be predicted by habitat availability (N = 21). Comparison of winter densities with habitat features similarly showed a nearly significant correlation with more open canopies. $P(\tau)$ = probability level of Kendall's tau, N = 50; * = significant, ** = highly significant (see Table 8 for abbreviation key).

	Mean Habitat Characteristics				
	F	M	D	C	U
Availability	1.4	2.3	2.0	2.7	2.3
Winter use	1.3	2.1	2.0	2.3	2.4
Winter $P(\tau)$	0.76	0.28	0.76	0.06	0.23

	Percent Vegetation					
	OD	MH	CN	PO	CO	MI
Availability	51.0	13.7	13.1	13.1	8.5	0.7
Winter use	38.1	38.2	4.8	14.3	4.8	0.0

Density distribution.-The Hairy Woodpecker was an uncommon inhabitant of the forests of eastern Connecticut. Its summer densities were similar (Mann-Whitney U = 305.0, $P = 0.65$, N = 51) in Northeast (1.5 ± 2.1 birds/km^2) and Southeast Connecticut (1.3 ± 2.0 birds/km^2; Fig. 38).

As with a number of permanent resident species, winter populations appeared greater than those of summer. However, winter densities averaged lower in Northeast (2.3 ± 3.6 birds/km^2) than Southeast Connecticut (3.6 ± 3.6 birds/km^2; Fig.39), although not significantly so (Mann-Whitney U = 231.5, $P = 0.09$, N = 51).

Population estimates are based on detections of calling males and females. Because detectability appeared similar in summer and winter, we pooled seasonal detection data in order to improve population estimates.

Population variance.- The coefficient of variation calculated from Breeding Bird Survey data (Sauer et al. 2001) predicted population variation as 119.0% for southern New England. From 1966-2000, populations showed a significant regional decline (mean count/route = 0.8, trend = -2.6, $P = 0.01$, N = 46) but a strong continental increase (mean

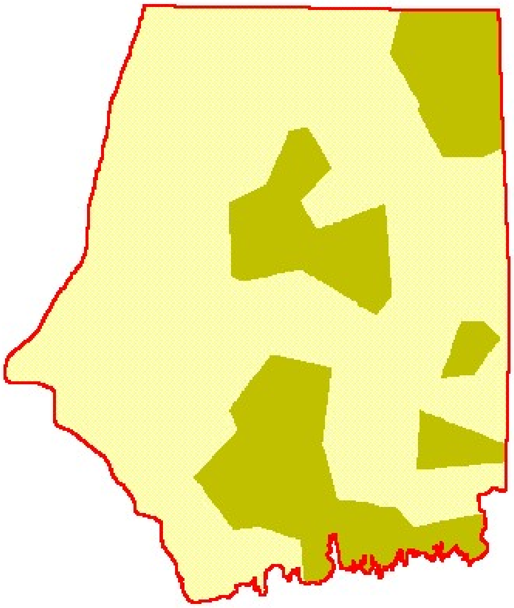

FIG. 39. Winter Hairy Woodpecker densities were similar in Northeast and Southeast Connecticut. Light = 0-3.6, dark = 3.6-8.3 birds/km^2.

count/route = 0.5, trend = 1.5, *P* = 0.00, N = 2115).

Christmas Count data predicted population variation as 43.6% for Connecticut. From 1966-2001, populations also showed a significant Connecticut (birds/party hour = 0.3, Kendall's tau = -0.72 *P* = 0.00, N = 37) and U.S. decline (birds/party hour = 0.2, Kendall's tau = -0.58, *P* = 0.00, N = 37).

On ten line transects through the Northeast Uplands Ecoregion, Craig (1987) reported 4.1 birds/km^2. In a ten year sample of Breeding Bird Census plots in Connecticut, densities of pairs/km^2 were 14.6 $\pm$ 2.7 in oak-hemlock forest, 13.8 $\pm$ 4.7 in hemlock-hardwood forest, and 11.4 $\pm$ 8.1 in second growth deciduous forest. A Winter Bird Survey plot in a deciduous-coniferous wetland had 2.8-4.7 birds/km^2. These densities average higher those found in this study.

Elsewhere, breeding densities in eastern forests are estimated to average 12.5 pairs/km^2. In Maryland, 15 pairs/km^2 have been estimated (Jackson et al. 2002), and 18 $\pm$ 8 birds/km^2 are reported from New Hampshire (Holmes et al. 1986).

Habitat.- We made few observations of habitat use by individual Hairy Woodpeckers in summer, and observed birds at too few locations to compute correlations of summer densities with habitat features. However, they appeared to prefer more deciduous forests at this season. Moreover, as with the Downy Woodpecker, a denser population of Hairy Woodpeckers appeared along the lower Connecticut River (Fig. 38). This concentration was likely related to a massive die-off of Eastern Hemlock in the area.

Limited observations of habitat use by wintering Hairy Woodpeckers suggested that birds inhabited forests with canopies more open than would be predicted by habitat availability. Comparison of winter densities with habitat features similarly showed a nearly significant correlation with more open canopies (Table 12).

Elsewhere in the Northeast and eastern Canada, the species is described as being primarily one of mature forest. However, it also occurs in habitats that are more open and even in suburban landscapes, as long as mature shade trees are present. It appears to prefer deciduous and mixed forest over coniferous forest (Jackson et al. 2002).

History.- The Hairy Woodpecker was known as an uncommon summer resident even in the 19th century when forest extent was limited (Zeranski and Baptist 1990). Sage et al. (1913) believed that numbers increased in winter.

Synthesis.- Breeding Bird Survey and Christmas Count data suggest that the Hairy Woodpecker is undergoing a regional population decline, a trend corroborated by comparison of our results with earlier transect studies of Craig (1987). Such a decline is unexpected in light of the still extensive and maturing forests of the region, which should provide ample habitat for the species. The decline in spite of suitable habitat conditions suggests that some other factor is affecting populations.

We observed population increases from summer to winter in a number of permanent resident species, including this one. Such increases likely reflect recruitment of first year birds into the population. However, migration from northern areas into Connecticut also appears likely, as several lines of evidence indicate that southward movement of Canadian populations occurs during winter (Jackson et al. 2002). An area of higher winter densities along the coast (Fig. 39) is likely a consequence of this movement.

The winter trend toward association with more open forest canopies is consistent with other reports of birds using habitats that are more open. Despite this, from our limited data the species may be best described as a forest habitat generalist.

Conservation status.- Populations are declining, and forest fragmentation presents a potential long term threat. However, the large and maturing expanse of forest in our region should provide ample suitable habitat at present.

Sponsored by Claire Hamlisch

NORTHERN FLICKER

Colaptes auratus

Summer

Density (birds/km^2): 0.2 (95% CI: 0.1-0.3)
Density range (birds/km^2/transect): 0-1.0
Total population (birds): 516 (95% CI: 287-928

Winter

Density (birds/km^2): 0.1 (95% CI: 0.1-0.3)
Density range (birds/km^2/transect): 0-1.4
Total population (birds): 395 (95% CI: 209-744)

Detection function (all data): uniform/cosine
$\chi^2 = 0.87$, $P = 0.93$, df = 4, N = 35

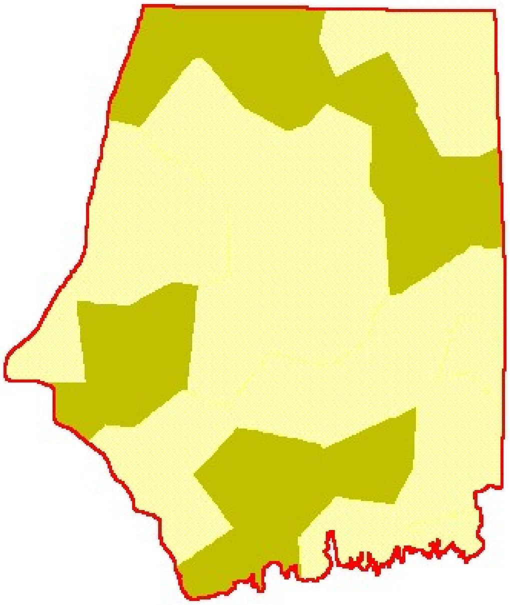

FIG. 40. Summer Northern Flicker densities were similar in Northeast and Southeast Connecticut. Light = 0-0.2, dark = 0.2-0.5 birds/km^2.

Density distribution.-The Northern Flicker was a rather rare inhabitant of the forests of eastern Connecticut. Its summer densities were similar (Mann-Whitney U = 313.0, P = 0.78, N = 51) in Northeast (0.2 ± 0.3 birds/km^2) and Southeast Connecticut (0.2 ± 0.3 birds/km^2; Fig. 40) as were its winter densities (Northeast: 0.1 ± 0.2 birds/km^2; Southeast: 0.2 ± 0.4 birds/km^2: Mann-Whitney U = 270.0, P = 0.13, N = 51). Winter occurrence was too infrequent to map.

Detectability appeared similar in summer and winter, so we pooled seasonal detection data in order to improve population estimates. However, estimates are based on <60 detections of calling males and females, so have reduced accuracy. Because the Northern Flicker primarily inhabits environments other than forest, densities reported here refer only to that part of the population associated with forested regions.

Population variance.- The coefficient of variation calculated from Breeding Bird Survey data (Sauer et al. 2001) predicted continental population variation as 8.9%. From 1966-2000, populations showed a significant regional (mean count/route = 5.6, trend = -3.7, P = 0.00, N = 51) and continental (Yellow-shafted subspecies) decline (mean count/route = 2.6, trend = -2.7, P = 0.00, N = 2405).

Christmas Count data predicted population variation as 78.2% for Connecticut. From 1966-2001, populations also showed a strongly significant Connecticut (birds/party hour = 0.2, Kendall's tau = 0.67 P = 0.00, N = 37), and U.S. (Yellow-shafted subspecies) decline (birds/party hour = 0.3, quadratic model $r^2 = 0.30$, df = 34, P = 0.00). However, a plot of U.S. data showed a decline ending ca 1990 followed by a shallow population increase since.

On ten line transects through the Northeast Uplands Ecoregion, Craig (1987) found birds incidentally to surveying, but computed no population estimates. In a ten year sample of Breeding Bird Census plots in Connecticut, 25.9 ± 1.9 pairs/km^2 were found in oak-hemlock forest and 13.4 ± 10.0 pairs/km^2 were in second growth deciduous forest. It occurred four times (9.5-14.2

birds/km^2) in hemlock-hardwood forest. A Winter Bird Survey plot in a deciduous-coniferous wetland had 2.3 birds during one winter. These densities average higher those found in this study. We found no other measures of population density in primarily forested regions.

Habitat.- The few birds detected during this survey yielded little data with which to uncover habitat affiliations. We found birds primarily at forest edge, in selectively logged areas, and in open swamps. Elsewhere, the species also is associated with forest edge, open woods, and open swamps. Burned-over forest appears particularly suitable, although it is common in suburban areas as well (Moore 1995).

History.- The Northern Flicker was known as a common breeder by Sage et al. (1913). Although it retains that status, its numbers declined during the 20th century (Zeranski and Baptist 1990).

Synthesis.- Breeding Bird Survey and Christmas Count data suggest that the Northern Flicker is undergoing a regional population decline. Such a decline in this primarily forest edge and open country species is expected because the forests of the region are maturing (Ward and Barsky 2000).

The strongly migratory Northern Flicker populations of our region (Moore 1995) declined only modestly in abundance from summer to winter. Our inability to uncover habitat affiliations is primarily a consequence of our small sample and low population densities encountered in forest habitat.

Conservation status.- Populations are declining, although logging and the ability of the species to inhabit suburban areas should ensure its future in our region.

PILEATED WOODPECKER
Dryocopus pileatus

Summer

Density (birds/km^2): 0.06 (95% CI: 0.0.03-0.13)
Density range (birds/km^2/transect): 0-0.52
Total population (birds): 167 (95% CI: 80-347)

Winter

Density (birds/km^2): 0.10 (95% CI: 0.06-0.19)
Density range (birds/km^2/transect): 0-0.78
Total population (birds): 283 (95% CI: 151-531)

Detection function (all data): uniform/cosine
$x^2 = 5.88$, $P = 0.44$, df = 6, N = 32

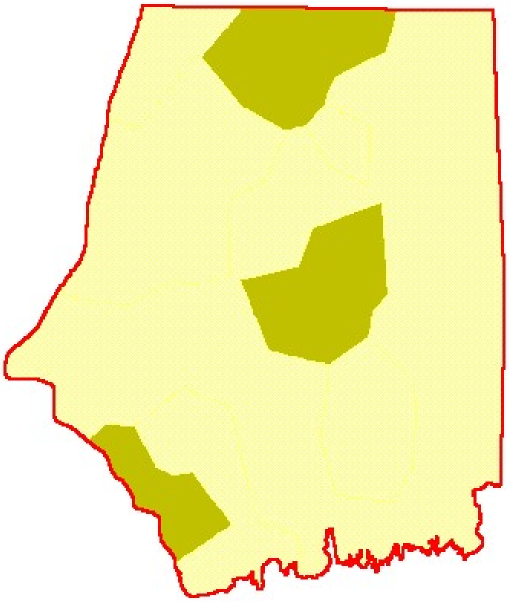

FIG. 41. Summer Pileated Woodpecker densities were similar in Northeast and Southeast Connecticut. Light = 0-0.2, dark = 0.2-0.5 birds/km^2.

Density distribution.-The Pileated Woodpecker was a rather rare inhabitant of the forests of eastern Connecticut. Its summer densities were similar (Mann-Whitney U = 298.0, $P = 0.46$, N = 51) in Northeast (0.08 ± 0.16 birds/km^2) and Southeast Connecticut (0.04 ± 0.10 birds/km^2; Fig. 41), as were its winter densities (Northeast: 0.09 ± 0.18 birds/km^2; Southeast: 0.11 ± 0.21 birds/km^2: Mann-Whitney U = 300.0, $P = 0.75$, N = 51; Fig. 42). As with a number of permanent resident species, winter populations appeared greater than those of summer.

Detectability appeared similar in summer and winter, so we pooled seasonal detection data in order to improve population estimates. However, estimates are based on <60 detections of calling males and females, so have reduced accuracy.

Population variance.- The coefficient of variation calculated from Breeding Bird Survey data (Sauer et al. 2001) predicted continental population variation as 27.5%. From 1966-2000, populations showed a significant continental increase (mean count/route = 1.0, trend = 1.5, $P = 0.00$, N = 1776). Limited data from southern New England were consistent with this trend.

Christmas Count data predicted population variation as 53.4% for Connecticut. From 1966-2001, populations also showed a significant Connecticut (birds/party hour = 0.02, Kendall's tau = 0.71 $P = 0.00$, N = 37), and United States increase (birds/party hour = 0.07, Kendall's tau = 0.796, $P = 0.00$, N = 37).

On ten line transects through the Northeast Uplands Ecoregion, Craig (1987) incidentally found birds, but computed no population estimates. In a ten year sample of Breeding Bird Census plots in Connecticut, no birds were found in oak-hemlock forest, but 5.7 ± 4.9 pairs/km^2 were in hemlock-hardwood forest. It occurred three times (5.0-14.9 pairs/km^2) in second growth deciduous forest. A Winter Bird Survey plot in a deciduous-coniferous wetland had no birds. These densities average higher those found in this study. Elsewhere in the East, breeding densities were estimated as 7 males/km^2 in West Virginia (Bull and Jackson 1995).

Habitat.- The few birds detected during this survey yielded little data with which to

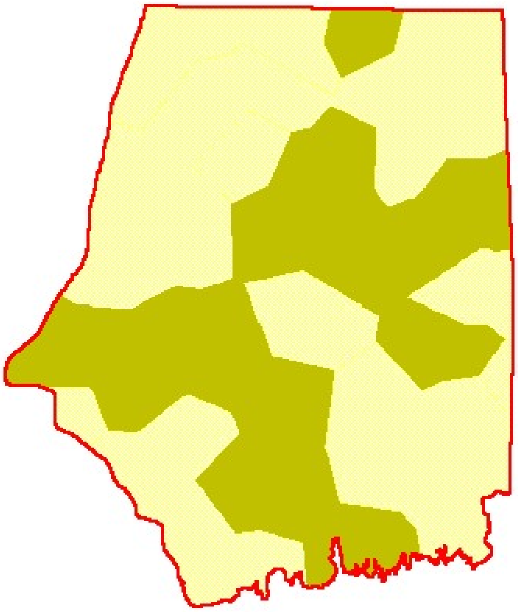

FIG. 42. Winter Pileated Woodpecker densities were similar in Northeast and Southeast Connecticut. Light = 0-0.1, dark = 0.1-0.3 birds/km^2.

uncover habitat affiliations. We generally found birds associated with mature, deciduous and mixed forests.

Elsewhere, the species is typically associated with late successional coniferous and deciduous forests, or younger forests with some large, dead trees. In the Southeast, bottomland forest and more mesic forests appear to be preferred (Bull and Jackson 1995).

History.- The Pileated Woodpecker was a rare resident in the 19th century when forest extent was limited (Sage et al. 1913). It became more common during the 20 th century as forests expanded (Zeranski and Baptist 1990).

Synthesis.- Breeding Bird Survey and Christmas Count data suggest that the Pileated Woodpecker is undergoing a regional population increase. Such an increase is expected because the still extensive forests of the region are maturing (Ward and Barsky 2000).

Population increases from summer to winter likely reflect recruitment of first year birds into the population. However, migration from northern areas into Connecticut also appears likely, as several lines of evidence indicate that southward movement of Canadian populations occurs during winter (Bull and Jackson 1995).

Our inability to uncover habitat affiliations was primarily a consequence of our small sample and low population densities encountered. However, our qualitative view that birds were most closely associated with late successional forests was consistent with other reports.

The higher summer density of Pileated Woodpeckers along the lower Connecticut River (Fig. 41) was notable in that both the Downy and Hairy Woodpecker showed similar concentrations in this area. These species appear to be benefiting from the massive die-off of Eastern Hemlock occurring in the area. However, in winter this effect diminishes for all three species.

Conservation status.- Populations are increasing. The large and maturing expanse of forest in our region provides ample habitat at present, but forest fragmentation presents a potential long term threat.

Sponsored by Ronald J. Tillen

EASTERN WOOD-PEWEE

Contopus virens

Density (males/km^2): 5.4 (95% CI = 4.7-6.2)
Density range (males/km^2/transect): 1.1-10.6
Total population (males): 14,684 (95% CI = 12,784-16,865)

Detection function: uniform/polynomial
$\chi^2 = 6.27$, $P = 0.18$, df = 4, N = 259

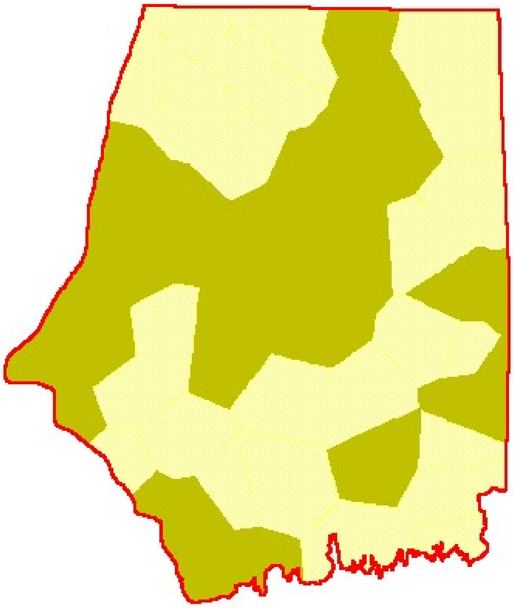

FIG. 43. Summer densities of the Eastern Wood Pewee were similar in Northeast and Southeast Connecticut. Light = 2.5-5.0, dark = 5.0-8.1 males/km^2.

Density distribution.- The Eastern Wood-Pewee was an uncommon to fairly common forest species in the region. Populations were similar (Mann-Whitney U = 293, $P = 0.54$, N = 51) in Northeast (5.7 ± 3.2 males/km^2) and Southeast Connecticut (5.1 ± 2.2 males/km^2; Fig. 43). Population estimates are based on detections of singing males.

Population variance.- The coefficient of variation calculated from Breeding Bird Survey data (Sauer et al. 2001) predicted variation in southern New England populations as 24.0%. From 1966 to 2000, populations showed a significant continental decline (mean count/route = 3.4, trend = -1.7, $P = 0.00$, N = 2068). Regional populations showed a non-significant decline (mean count/route = 4.2, trend = -1.1, $P = 0.30$, N = 50).

TABLE 13. Observations of habitat use by individual Eastern Wood-Pewees showed no significant differences with habitat availability. Population densities showed a significant correlation with canopy cover. $P(\chi^2)$ = probability level of chi-square tests, N = 54; $P(\tau)$ = probability level of Kendall's tau, N = 51; * = significant, ** = highly significant (see Table 8 for abbreviation key).

	Mean Habitat Characteristics				
	F	M	D	C	U
Availability	1.4	2.3	2.0	2.7	2.3
Use	1.2	2.4	2.0	2.8	2.1
$P(\chi^2)$	0.07	0.21	-	0.07	0.13
$P(\tau)$	0.88	0.72	0.89	0.02*	0.13

	Percent Vegetation					
	OD	MH	CN	PO	CO	MI
Availability	51.0	13.7	13.1	13.1	8.5	0.7
Use	72.2	5.6	9.3	9.3	1.9	1.9
$P(\chi^2)$	0.06					

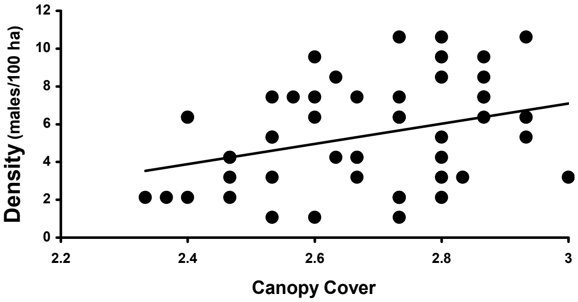

FIG. 44. Population density showed a variable but significant increase with increasing canopy cover.

On ten line transects through the Northeast Uplands Ecoregion, Craig (1987) reported 16.0 ± 15.6 birds/km^2. When our estimate is multiplied by two to yield breeding individuals/km^2, this earlier value statistically overlapped but averaged greater than that of this study.

In a ten year sample of Breeding Bird Census plots in Connecticut, densities of pairs/km^2 were 9.4 $\pm$ 3.6 in oak-hemlock forest, 13.8 $\pm$ 10.6 in hemlock-hardwood forest, and 21.8 $\pm$ 13.8 in second growth deciduous forest. These estimates also overlap but average higher than those of this study. In contrast, plot studies in New Hampshire yielded densities of 3 $\pm$ 6 birds/km^2 (Holmes et al. 1986), a value below that of this study. Elsewhere, densities of pairs/km^2 have been reported as 7-40 in Michigan, 0-25 in Wisconsin, 32-86 in Illinois, and 10-25 in Georgia (McCarty 1996).

Habitat.- Observations of habitat use by individual Eastern Wood-Pewees showed no significant differences with habitat availability. However, our data suggested (approaching statistically significance) that birds occupied forests averaging more deciduous and more closed-canopied than those available. They also were particularly prevalent in oak-dominated forest. Population density also showed a significant correlation with increasing canopy cover (Table 13, Fig. 44).

Elsewhere, the species is reported from deciduous and coniferous forests, but particularly forest openings and edge, and possibly more xeric environments. Some studies have found that it predominates in more open forests, but others have not. It also has been reported to have greater populations in forests with reduced understory density and in forests of intermediate age (McCarty 1996).

History.- The Eastern Wood-Pewee has been described historically as a common Connecticut breeder (Sage et. al 1913, Zeranski and Baptist 1990). Hence, it was likely as common in the 19th century as the abundance of its forest habitat allowed.

Synthesis.- The lower population densities of this study compared with earlier estimates of Craig (1987) are consistent with the strongly significant decline in continental densities demonstrated by the Breeding Bird Survey. The maturation of regional forests (Ward and Barsky 2000) may be responsible for driving a local decline if, as reports from elsewhere suggest, the species prefers younger and more open forest. Despite data suggesting that the Eastern Wood Pewee prefers such forests, our data provide no evidence for these preferences. Instead, they indicate that it is most prevalent in closed canopy forest.

Conservation status.- Populations are declining, perhaps due to forest maturation.

Sponsored by Irving and Katherine Sheldon

ACADIAN FLYCATCHER

Empidonax virescens

Density (males/km^2): 1.5 (95% CI: 0.9-2.6)
Density range (males/km^2/transect): 0-25.0
Total population (males): 4,198 (95% CI: 2,445-7,209)

Detection function: uniform/cosine
$x^2 = 1.09$, $P = 0.78$, df = 3, N = 22

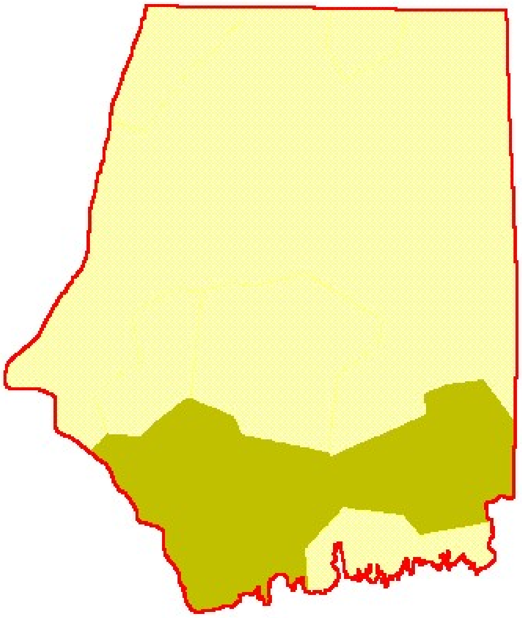

FIG. 45. Summer densities of the Acadian Flycatcher were greatest in Southeast Connecticut. Light = 0-2.4, dark = 2.4-9.5 males/km^2.

Density distribution.- The Acadian Flycatcher was one of the more uncommon forest species in the region. It occurred at only 8% of study sites in Northeast Connecticut (0.3 ± 1.0 males/km^2), although its presence increased to 32% of sites in Southeast Connecticut (2.9 ± 5.9 males/km^2; Fig. 45). This difference was statistically significant (Mann-Whitney U = 242, P = 0.02, N = 51). Population estimates are based on <60 detections of singing males, so have reduced accuracy.

TABLE 14. Observations of habitat use by individual Acadian Flycatchers suggested that they inhabited forests with greater coniferous cover and soil moisture than would be predicted by habitat availability (N = 11).

	Mean Habitat Characteristics				
	F	M	D	C	U
Availability	1.4	2.3	2.0	2.7	2.3
Use	1.7	1.8	2.0	2.6	2.2

	Percent Vegetation					
	OD	MH	CN	PO	CO	MI
Availability	51.0	13.7	13.1	13.1	8.5	0.7
Use	18.2	27.3	36.4	0.0	18.2	0.0

Population variance.- The coefficient of variation calculated from Breeding Bird Survey data (Sauer et al. 2001) predicted variation in continental populations as 11.2%. From 1966 to 2000, Breeding Bird Survey data showed no significant continental population trend (mean count/route = 2.1, trend = 0.1, P = 0.72, N = 944). However, from 1966 to 1983 average counts/route were 1.1, compared with 2.2 birds/route from 1984 to 2000. Such a change suggests that at least a small population increase occurred since 1966. The species was too infrequent on counts in southern New England for meaningful population estimates to be computed.

On ten line transects through the Northeast Uplands Ecoregion, Craig (1987) reported 2.2 birds/km^2, a value similar to that of this study when our estimates are multiplied by two to yield breeding individuals/km^2. However, this Northeast Connecticut estimate is higher than what we found for that region. Elsewhere, densities of birds/km^2 have been reported as 12 in Georgia, 180 in West Virginia, 100 in Maryland and Tennessee, 39-64 in Arkansas, and 12-56 in Illinois (Whitehead and Taylor 2002).

In a ten year sample of Breeding Bird Census plots in Connecticut, the species occurred once in oak-hemlock forest (8.6

pairs/km^2) and twice (9.5-14.3 pairs/km^2) in hemlock-hardwood forest, but was absent in second growth deciduous forest. These estimates are within the range computed in this study.

Habitat.- Based on limited data from individual birds, the Acadian Flycatcher appeared to inhabit forests with greater coniferous cover and soil moisture than would be predicted by habitat availability. (Table 14). These choices are reflected in its infrequent use of oak-dominated forest and greater use of mesic, mixed hardwood and conifer-hardwood forest. The species occurred too infrequently to compare population densities with habitat variables. Elsewhere, it is reported to inhabit mature, undisturbed forests, particularly in swampy areas and along streams (Whitehead and Taylor 2002).

History.- The Acadian Flycatcher has been described as historically rare to uncommon in Connecticut (Sage et. al 1913, Zeranski and Baptist 1990). It was reported to have declined regionally earlier in the 20th century, but to have increased since the 1960s (Clark 1994b). However, into the 1970s it was still rare in eastern Connecticut. At 19 eastern Connecticut forests surveyed in the summers of 1975-1977, R. Craig (pers. obs.) found that only 5% of sites had Acadian Flycatchers, compared with 20% of the (in many instances same) sites surveyed in this study.

Synthesis.- The weak population increase suggested by the Breeding Bird Survey and data of Craig (above) provide evidence for a regional increase by the Acadian Flycatcher. Maturation of forest has been cited as a factor benefiting this species (Whitehead and Taylor 2002), so it is likely prospering from the aging of regional forests (Ward and Barsky 2000).

The distributions mapped in this survey demonstrate that most of the region's population is situated in Southeast Connecticut, a region in which it now appears well-established. Distributions mapped in *The Atlas of Breeding Birds of Connecticut* (Bevier 1994) suggest a similar density pattern.

Our limited data showing a relationship with wetter sites and more heavily coniferous cover are similar to other reports of habitat use. Because such habitats are widespread in our region, other geographic factors may be limiting the species' occurrence to primarily Southeast Connecticut.

Conservation status.- Populations appear to have increased. However, they may be vulnerable to forest fragmentation.

LEAST FLYCATCHER

Empidonax minimus

Density distribution.- We encountered few Least Flycatchers in the forests of eastern Connecticut. From our ten detections of calling males, we tentatively estimate a population of 1,180 males (0.4 males/km^2) in primarily forested landscapes. Nine of ten observations were of birds in Northeast Connecticut, suggesting that greatest numbers are in this region.

Population variance.- The coefficient of variation calculated from Breeding Bird Survey data (Sauer et al. 2001) predicted variation in continental populations as 6.2%. From 1966 to 2000, continental populations showed a strongly significant decline (mean count/ route = 4.4, trend = -0.9, $P = 0.00$, N = 1239). Limited data from southern New England suggested a decline as well.

On ten line transects through the Northeast Uplands Ecoregion, Craig (1987) reported 8.1 birds/km^2, a value well above that of this study. In a ten year sample of Breeding Bird Census plots in Connecticut, none occurred in oak-hemlock, hemlock-hardwood or second growth deciduous forest. Elsewhere, densities of pairs/km^2 are reported as 140 in New Hampshire, 150 in Ontario, 200 in Michigan, and 200-300 in Virginia. However, on the broader geographic scale of the Maritime Provinces of Canada, 0.4-0.7 birds/km^2 are reported (Briskie 1994).

Habitat.- We found summering birds in open, deciduous and mixed forests with generally mesic conditions. They were typically associated with open riparian areas, although they also occurred in upland forest openings.

Elsewhere, reports of habitat use are conflicting, with authors reporting preference for denser forest, open forest, young forest, mature forest, drier microhabitats and wetter microhabitats. The species is most typically reported to inhabit semi-open and second growth deciduous and mixed forest, swamp and bog edges, and shrubby fields. Greatest densities are found in open woodland, but in areas of greater forest patch size (Briskie 1994).

History.- The Least Flycatcher appears to have declined since the 19th century (Zeranski and Baptist 1990), when successional habitats were likely much more abundant than at present.

Synthesis.- Data from the Breeding Bird Survey and Craig (1987) suggest that the Least Flycatcher has declined locally. The decline is likely related to the maturation (Ward and Barsky 2000) of regional forests.

The species is at the southern periphery of its range in eastern Connecticut, so its predominance in Northeast Connecticut is expected. Declining densities toward range limits are typical for many species (Brown 1984, Pulliam 1988).

Our few observations of habitat use by the Least Flycatcher were consistent with the view that it prefers forest openings such as those associated with wetlands. Extensive, mature forest appears not to be prime habitat in our area.

Conservation status.- Populations appear to be declining locally. The maturation of southern New England's forests is likely responsible for the decline.

EASTERN PHOEBE

Sayornis phoebe

Summer

Density (males/km^2): 1.4 (95% CI: 0.7-2.5)

Density range (males/km^2/transect): 0-10.8

Total population (males): 3,707 (95% CI: 2,041-6,733)

Detection function: uniform/cosine

$x^2 = 0.19$, $P = 0.91$, df = 2, N = 32

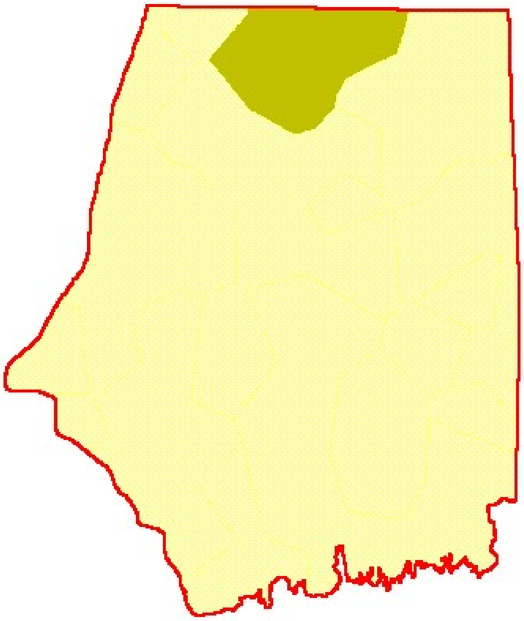

FIG. 46. Summer densities of the Eastern Phoebe averaged higher in Northeast Connecticut. Light = 0-2.2, dark = 2.2-5.8 males/km^2.

Density distribution.- Although a frequent summer resident of more open eastern Connecticut environments, the Eastern Phoebe also was an uncommon inhabitant of the region's forests (Fig. 46). Forest densities averaged higher in Northeast (1.8 ± 2.8 birds/km^2) than Southeast Connecticut (1.0 ± 1.4 males/km^2) but not significantly so (Mann-Whitney U = 297.0, $P = 0.54$, N = 51).

The population densities computed in this survey do not represent total populations for the region, but only estimates of that portion of the population inhabiting forests. Population estimates are based on <60 detections of singing males, so have reduced accuracy.

The species also occurs as a rare winter resident, particularly in early winter. During this study we found only one wintering individual, at Pequot Trail, although in previous years we also have found them at the Quinebaug State Management Area. We attempted no winter density estimate from such limited data.

TABLE 15. Population densities of the Eastern Phoebe showed no significant correlations with habitat. $P(t)$ = probability level of Kendall's tau, N = 51; * = significant, ** = highly significant (see Table 8 for abbreviation key).

	Habitat Characteristics				
	F	M	D	C	U
$P(t)$	0.56	0.60	0.87	0.16	0.33

Population variance.- The coefficient of variation calculated from Breeding Bird Survey data (Sauer et al. 2001) predicted variation in southern New England populations as 6.4% From 1966-2000, populations showed no significant trend in this region (mean count/route = 7.0, trend = 0.1, $P = 0.78$, N = 50). Continentally, however, populations increased significantly (mean count/route = 1.9, trend = 1.2, $P = 0.00$, N = 1909).

On 10 line transects through the Northeast Uplands Ecoregion, Craig (1987) reported densities as 2.9 birds/km^2, a value very similar to that of this study when our estimates are multiplied by two to yield breeding individuals/km^2. In a ten year sample of Breeding Bird Census plots in Connecticut, densities of pairs/km^2 were 4.6 ± 3.1 in oak-hemlock forest, 0 in hemlock-hardwood forest, and 8.4 ± 2.4 in second growth deciduous forest. These estimates are within the range computed in this study.

Habitat.- Limited data from individual

Eastern Phoebes suggested that they occupied habitats that averaged more open, moist, and coniferous than those available. However, these trends were not supported by population data, which showed no significant correlations with habitat variables. The species is reported to nest near forest edge, water, and forest interiors where suitable nest sites occur (e.g. ledges, banks and other overhangs; Weeks 1994).

History.- The Eastern Phoebe was described as a common to abundant Connecticut resident by Sage et al. (1913). Zeranski and Baptist (1990) speculated that it had since declined, but Clark (1994c) suspected that expanding human habitation increased the regional number of nesting sites.

Synthesis.- Data from the Breeding Bird Survey and Craig (1987) suggest that populations of the Eastern Phoebe are stable in eastern Connecticut. Its ability to inhabit forested and non-forested landscapes likely assists in producing such stability.

Fig. 46 suggests that a denser population inhabits the forests of the Northeast Uplands ecoregion. The Eastern Phoebe is widely distributed across North America, so the reasons for such a relationship are unclear.

The extent to which the Eastern Phoebe inhabits interior forest is often not recognized, yet in this study many of our observations were made in such areas. Although it was too uncommon to adequately assess its use of forest habitats, our limited data suggested that it occurred most frequently in more open and moister forest environments like forest gaps associated with streams and swamps.

Conservation status.- Likely because of its versatility in habitat choice, regional populations appear secure.

Sponsored by John Kuchle

GREAT CRESTED FLYCATCHER
Myiarchus crinitus

Density (birds/km^2): 8.6 (95% CI = 6.7-11.0)
Density range (birds/km^2/transect): 0-28.4
Total population (birds): 23,336 (95% CI = 18,195-30,005)

Detection function: uniform/cosine
$\chi^2 = 1.25$, $P = 0.53$, df = 2, N = 157

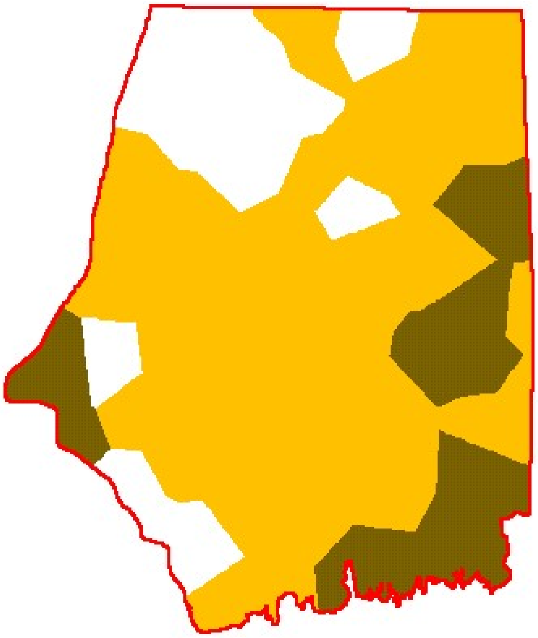

FIG. 47. Summer densities of the Great Crested Flycatcher were similar in Northeast and Southeast Connecticut, but showed an increase along the eastern Connecticut border. Light = 0.9-5.6, medium = 5.6-10.2, dark = 10.2-16.7 males/km^2.

Density distribution.- The Great Crested Flycatcher was an uncommon to fairly common forest species in eastern Connecticut. Populations densities averaged lower in Northeast (7.9 ± 5.1 birds/km^2) than Southeast Connecticut (9.4 ± 6.2 birds/km^2; Fig. 47), but not significantly so (Mann-Whitney U = 294, $P = 0.55$, N = 51). Population estimates are based on detections of calling males and females.

TABLE 16. Observations of habitat use by individual Great Crested Flycatchers suggested that birds inhabited forests drier than would be predicted by habitat availability. Population densities showed no significant correlations with habitat. $P(\chi^2)$ = probability level of chi-square tests, N = 47; $P(t)$ = probability level of Kendall's tau, N = 51; * = significant, ** = highly significant (see Table 8 for abbreviation key).

	Mean Habitat Characteristics				
	F	M	D	C	U
Availability	1.4	2.3	2.0	2.7	2.3
Use	1.3	2.4	2.0	2.6	2.4
$P(\chi^2)$	0.57	0.08	0.56	0.73	0.23
$P(t)$	0.15	0.65	0.66	0.11	0.26

	Percent Vegetation					
	OD	MH	CN	PO	CO	MI
Availability	51.0	13.7	13.1	13.1	8.5	0.7
Use	51.1	19.1	14.9	12.8	2.1	0.0
$P(\chi^2)$	0.58					

Population variance.- The coefficient of variation calculated from Breeding Bird Survey data (Sauer et al. 2001) predicted variation in southern New England populations as 17.3%. From 1966 to 2000, regional populations significantly declined, (mean count/route = 3.2, trend = -1.6, P = 0.00, N = 51), although continental populations showed no decline (mean count/route = 3.7, trend = -0.0, P = 0.90, N = 2186).

On ten line transects through the Northeast Uplands Ecoregion, Craig (1987) reported 9.2 birds/km^2, a value similar to that of this study. In a ten year sample of Breeding Bird Census plots in Connecticut, densities of pairs/km^2 were 15.4 ± 3.3 in oak-hemlock forest, 18.1 ± 9.5 in hemlock-hardwood forest, and 9.9 ± 8.7 in second growth deciduous forest. These estimates are within the range computed in this study.

Habitat.- Individual Great Crested Flycatchers showed a nearly significant inverse relationship with moisture regime, but comparisons of population densities with habitat variables yielded no significant correlations (Table 16). The species is typically reported to inhabit open, deciduous and mixed woodland, as well as orchards, maturing old fields, and park-like settings (Lanyon 1997).

History.- The Great Crested Flycatcher has been described historically as an uncommon to fairly common Connecticut breeder (Sage et. al 1913, Zeranski and Baptist 1990). Populations likely increased as forests re-grew during the 20th century (Clark 1994d).

Synthesis.- The population densities found in this study were similar to but averaged slightly lower than those of earlier transect estimates of Craig (1987). This small decline was consistent with the significant decline in regional densities, although we noted no substantial decline. Because eastern Connecticut's forests are still extensive (Ward and Barsky 2000), any decline in our area may be minimal.

Although forest maturation might be expected to drive population declines in species preferring open forests, our data provide no evidence that the Great Crested Flycatcher prefers such habitats, even though it has been reported to do so. Instead, they indicate that forests are used in approximately the proportions at which they are present.

The species showed a trend toward using forests averaging more xeric than those available, which may relate to its greater population densities found along the eastern Connecticut border (Fig. 47). Forests in this area are characteristically xeric, because they develop on glacial-derived sand and gravel deposits (see Study Areas in Methods).

Conservation status.- Populations are declining, albeit weakly in extensive forest, and are likely vulnerable to forest fragmentation.

Sponsored by Irving and Katherine Sheldon

EASTERN KINGBIRD

Tyrannus tyrannus

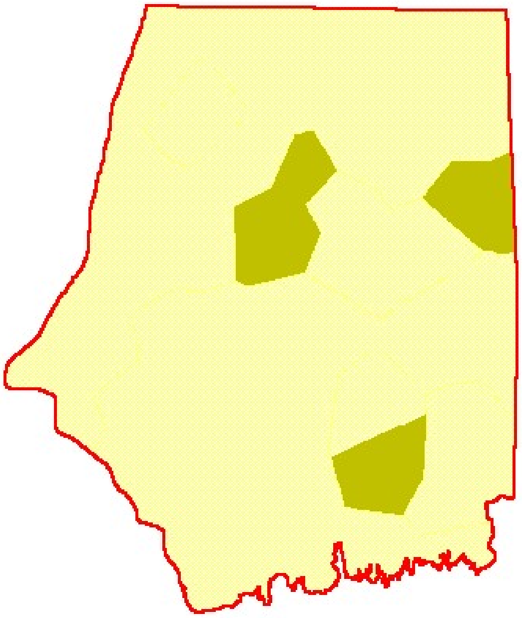

FIG. 48. Summer densities of the Eastern Kingbird were similar in Northeast and Southeast Connecticut. Light = 0-1.4, dark = 1.4-4.2 birds/km^2.

Density distribution.- Although fairly common in non-forest habitats, the Eastern Kingbird was very uncommon in eastern Connecticut forests (Fig. 48). Based on 17 observations of calling males and females, we tentatively estimate a population in primarily forested landscapes as 1,890 birds (0.7 birds/km^2). It was present at 27% of sites in Northeast and 24% of sites in Southeast Connecticut, suggesting that it was present similarly throughout the region.

Population variance.- The coefficient of variation calculated from Breeding Bird Survey data (Sauer et al. 2001) predicted population variation as 11.8% for southern New England. From 1966-2000, populations showed a strongly significant regional (mean count/route = 5.9, trend = -2.6, $P = 0.00$, N = 50) and continental (mean count/route = 4.3, trend = -1.0, $P = 0.00$, N = 2643) decline.

On ten line transects through the Northeast Uplands Ecoregion, Craig (1987) reported no birds, although they were present in the study area (R. Craig pers. obs.). In a ten year sample of Breeding Bird Census plots in Connecticut, it was absent in oak-hemlock and second growth deciduous forest, but occurred twice (4.8 pairs/km^2) in hemlock-hardwood forest. We found no estimates of population densities in primarily forested landscapes.

Habitat.- The Eastern Kingbird occurred too infrequently for detailed evaluations of its habitat use to be made. Its infrequent occurrence also provided little data with which to compare population densities and habitat variables. We most routinely found birds associated with open wetlands, such as beaver swamps and marsh edges, selectively logged and disturbed forests, and forest edge along rivers. Outside of forest, we found it in suburban landscapes.

Elsewhere, the Eastern Kingbird is considered a savannah species often associated with swamps and riparian areas. It is also reported from disturbed forest, burned over forest, and early successional landscapes (Murphy 1996).

History.- The Eastern Kingbird was described as a common breeder by Sage et al. (1913) and Zeranski and Baptist (1990).

Synthesis.- Breeding Bird Survey data strongly indicate that the Eastern Kingbird is undergoing a long term population decline. Because it is typically associated with forest openings and early successional landscapes, a factor likely driving the decline is the maturation of regional forests (Ward and Barsky 2000). Our observation of the species being largely associated with forest openings and particularly wetlands is consistent with other reports for the species.

Conservation status.- Populations are likely declining as a consequence of forest maturation. However, its versatility in habitat use should ensure its persistence in our region, albeit at reduced densities.

WHITE-EYED VIREO
Vireo griseus

Density distribution.- Although more common outside of mature forest, the White-eyed Vireo appeared rarely in the forests of eastern Connecticut. Our seven observations of singing males were inadequate for reliably estimating population density, although we expect less than 1000 breeding pairs are present in primarily forested landscapes.

We found birds at 4% (one bird) of Northeast and 16% (six birds) of Southeast Connecticut transects, suggesting that birds occurred more frequently to the south. Four observations were on coastal transects (Bluff Point, Barn Island), one was near the coast (Assekonk Swamp), and another was along the Connecticut River (Selden Creek).

Population variance.- The coefficient of variation calculated from Breeding Bird Survey data (Sauer et al. 2001) predicted variation in continental populations as 3.8%. From 1966 to 2000 continental populations showed no significant trend (mean count/ route = 5.4, trend = 0.3, P = 0.22, N = 1072). Limited data from southern New England also showed no trend.

On ten line transects through the Northeast Uplands Ecoregion, Craig (1987) reported no birds. In a ten year sample of Breeding Bird Census plots in Connecticut, 4.1 + 2.8 pairs/km^2 occured in oak-hemlock forest. No birds occurred in hemlock-hardwood or second growth deciduous forest. Elsewhere, up to 200-300 pairs/km^2 can occur in appropriate habitat (Hopp et al. 1995).

Habitat.- We found summering birds in mesic to xeric, open canopy deciduous forest. Birds inhabited dense shrubs and vines at these locations. Elsewhere, the species inhabits mid- to late successional deciduous habitats where dense understory is present. Forest borders with dense shrubbery and open, streamside thickets are also used (Hopp et al. 1995).

History.- The White-eyed Vireo has been known to be most common in southern Connecticut since the 19th century (Sage et al. 1913). It appears to fluctuate in density at this, its northern range limit (Zeranski and Baptist 1990).

Synthesis.- The White-eyed Vireo was generally not present in the primarily mature forest habitats surveyed in this study, although our few observations of its habitat use were consistent with other reports for the species. Because it often occurs in scrubby, successional habitats, its presence in many locations is likely to be ephemeral. However, such habitats are perpetuated by physical conditions at the coast (e.g. salt spray, coastal storms), so more frequent occurrence there is to be expected. Moreover, because the species approaches its northern range limit in eastern Connecticut (Hopp et al. 1995), a pattern of declining density to the north is also typical for many species (Brown 1984, Pulliam 1988).

Conservation status.- Populations are largely limited to open forests and scrubby, successional habitats, so may decline as forests mature. However, the species is likely to persist along the coast where physical conditions favor persistence of suitable habitats.

YELLOW-THROATED VIREO
Vireo flavifrons

Density (males/km^2): 6.2 (95% CI: 4.4-8.6)
Density range (males/km^2/transect): 0-22.2
Total population (males): 16,834 (95% CI: 12,106-23,409)

Detection function: uniform/cosine
$x^2 = 1.79$, $P = 0.62$, df = 3, N = 71

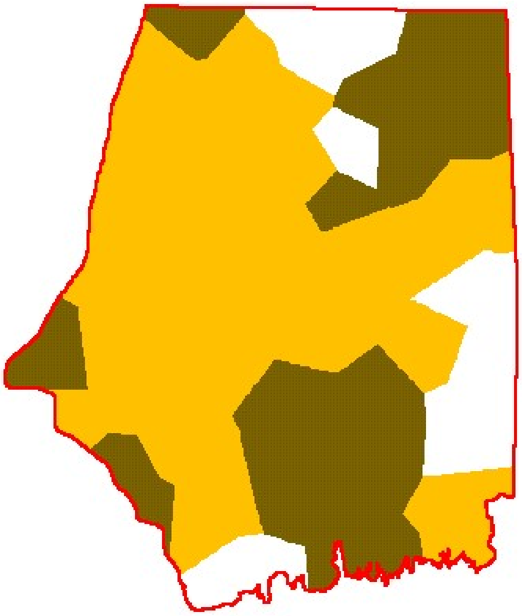

FIG. 49. Summer densities of the Yellow-throated Vireo were similar in Northeast and Southeast Connecticut. Light = 0-3.0, medium 3.0-7.4, dark = 7.4-14.8 males/km^2.

Density distribution.- The Yellow-throated Vireo was an uncommon to fairly common breeder in the forests of eastern Connecticut. Densities averaged higher in Southeast (6.9 ± 5.7 males/km^2) than Northeast Connecticut (5.5 ± 6.4 males/km^2; Fig. 49) but not significantly so (Mann-Whitney U = 266.5, P = 0.25, N = 51). Population estimates are based on detections of singing males.

TABLE 17. Observations of habitat use by individual Yellow-throated Vireos showed that they inhabited forests significantly moister and with more mixed hardwoods than would be predicted by habitat availability. Comparison of population densities with habitat features showed a significant negative correlation with forest type. $P(x^2)$ = probability level of chi-square tests, N = 44. $P(t)$ = probability level of Kendall's tau, N = 51; * = significant, ** = highly significant (see Table 8 for abbreviation key).

	Mean Habitat Characteristics				
	F	M	D	C	U
Availability	1.4	2.3	2.0	2.7	2.3
Use	1.2	2.1	2.0	2.6	2.2
$P(x^2)$	0.07	0.03*	-	0.37	0.09
$P(t)$	0.04*	0.75	0.70	0.61	0.96

	Percent Vegetation					
	OD	MH	CN	PO	CO	MI
Availability	51.0	13.7	13.1	13.1	8.5	0.7
Use	52.3	31.8	11.4	4.5	0.0	0.0
$P(x^2)$	0.02*					

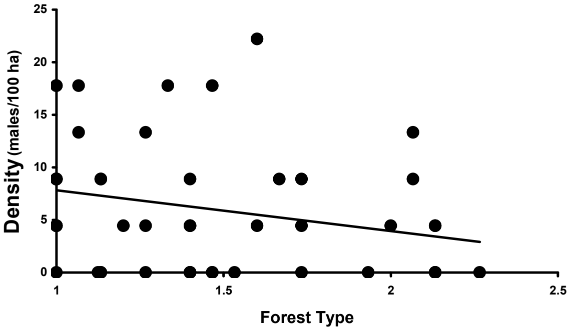

FIG. 50. Population density showed a variable but significant decrease with increasing deciduous forest cover.

Population variance.- The coefficient of variation calculated from Breeding Bird Survey data (Sauer et al. 2001) predicted variation in continental populations as 42.8%. From 1966-2000, populations showed a significant continental increase (mean count/route = 0.9, trend = 0.8, P = 0.05, N = 1241). Limited data from southern New England suggested no trend.

On ten line transects through the Northeast Uplands Ecoregion, Craig (1987) reported 1.3 birds/km^2, a value below that of this study when our estimates are multiplied by two to yield breeding individuals/km^2. In a ten year sample of Breeding Bird Census plots in Connecticut, the species was absent in oak-hemlock forest, had 3.8 ± 4.9 pairs/km^2 in second growth deciduous forest, and had 7.9 ± 5.8 pairs/km^2 in hemlock-hardwood forest. These estimates are similar to those of this study.

In Maryland, populations have been reported as ranging from 3-19 males/km^2. In the Southeast, populations averaged 5.1 ± 0.51 males/km^2 (Rodewald and James 1996).

Habitat.- Data from individual Yellow-throated Vireos demonstrated that they inhabited forests significantly moister than would be predicted by habitat availability. They also inhabited proportionately more deciduous forests (particularly mixed hardwoods), a finding corroborated by the significant correlation between population density and forest type (Table 17, Fig. 50). A near significant relationships existed with declining understory density. We typically found birds associated with tree fall gaps, riparian areas, and other small forest openings, although we found no significant association with more open forests.

The species is reported to inhabit a variety of forest edge habitats, park-like situations, and tree fall gaps in forest interior. These openings are often associated with mesic stream borders. Although generally absent from unbroken forest and pure coniferous forest, it is associated with mature forest, regions with a high proportion of forest cover, and reduced shrub density (Rodewald and James 1996).

History.- The Yellow-throated Vireo was known as a fairly common Connecticut breeder in the 19th century (Sage et al. 1913). However, populations appeared to decline from ca 1910 to the 1960s (Zeranski and Baptist 1990).

Synthesis.- Populations of the Yellow-throated Vireo are undergoing a long term increase. Although this increase is non-significant in southern New England, evidence from previous transect studies provides support for a population increase in this region. A factor potentially driving the increase is the maturation of regional forest (Ward and Barsky 2000).

The trend toward higher population density in Southeast Connecticut may be related to the species' more frequent presence in deciduous forest, which predominates in this region (Table 3,4,5). Observed habitat associations with deciduous cover and increased soil moisture are consistent with other reports of habitat use.

Conservation status.- Populations are increasing continentally, and may be profiting from forest maturation. However, the species appears vulnerable to forest fragmentation.

BLUE-HEADED VIREO

Vireo solitarius

Density (males/km^2): 2.4 (95% CI: 1.3-4.5)
Density range (males/km^2/transect): 0-15.8
Total population (males): 6,585 (95% CI: 3,527-12,296)

Detection function: half normal/cosine
$x^2 = 1.64$, $P = 0.80$, df = 4, N = 23

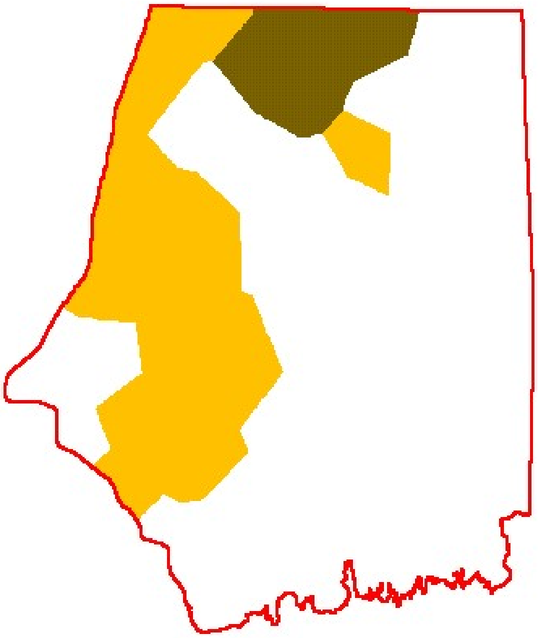

FIG. 51. Summer densities of the Blue-headed Vireo averaged greatest in Northeast Connecticut. Light = 0-1.8, medium 1.8-5.3, dark = 5.3-14.1 males/km^2.

Density distribution.-The Blue-headed Vireo was an uncommon breeder in the forests of eastern Connecticut. Densities averaged higher in Northeast (3.0 ± 5.0 males/km^2) than Southeast Connecticut (1.5 ± 3.9 males/km^2; Fig 51) but not significantly so (Mann-Whitney U = 265.5, P = 0.14, N = 51). Population estimates are based on <60 detections of singing males, so have reduced accuracy.

Population variance.- The coefficient of variation calculated from Breeding Bird Survey data (Sauer et al. 2001) predicted that variation in continental populations was 74.5%. From 1966-2000, these populations showed a significant increase (mean count/route = 1.1, trend = 5.0, P = 0.00, N = 649). Limited data from southern New England suggested no population trend.

TABLE 18. Limited observations of habitat use by individual Blue-headed Vireos suggested that they inhabited forests more coniferous, drier, and with more open understory than would be predicted from habitat availability (N = 15; see Table 8 for abbreviation key).

	Mean Habitat Characteristics				
	F	M	D	C	U
Availability	1.4	2.3	2.0	2.7	2.3
Use	1.9	2.0	1.9	2.5	2.0

	Percent Vegetation					
	OD	MH	CN	PO	CO	MI
Availability	51.0	13.7	13.1	13.1	8.5	0.7
Use	20.0	13.3	40.0	0.0	20.0	6.7

On ten line transects through the Northeast Uplands Ecoregion, Craig (1987) reported 24.0 ± 20.5 birds/km^2, a value averaging well above that of this study even when our estimates are multiplied by two to yield breeding individuals/km^2. In a ten year sample of Breeding Bird Census plots in Connecticut, the species was absent in oak-hemlock forest, had 1.5 ± 2.4 pairs/km^2 in second growth deciduous forest, and 39.9 ± 14.6 pairs/km^2 in hemlock-hardwood forest. Elsewhere, 1-27 males/km^2 have been found in northern conifer habitats, and 4-17 males/km^2 in mature hardwoods (James 1998).

Habitat.- Limited observations of habitat use by individual Blue-headed Vireos suggested that they inhabited forests more coniferous, drier, and with more open understories than would be predicted by habitat availability (Table 18). We found birds especially in northern hardwoods-hemlock-pine associations. However, it also was present in deciduous forest. The species occurred at too few sites to compare population densities with habitat features.

Elsewhere, the Blue-headed Vireo is reported to inhabit a variety of northern forest types, including coniferous forest, mixed conifer-hardwoods, and northern hardwood forest. Forests occupied are characteristically extensive, with closed canopies, and without dense understory cover. However, they also may be found near small forest openings or forests bordering wetlands (James 1998).

History.- The Blue-headed Vireo appears to have increased and decreased at various times since the 19th century. Deforestation is presumed to have reduced its numbers during the 19th century, and weather events may have driven several declines since then (Zeranski and Baptist 1990). It generally has been considered an uncommon to rare Connecticut breeder (Sage et al. 1913, Zeranski and Baptist 1990).

Synthesis.- Populations of the Blue-headed Vireo appear to be undergoing a long term increase, although this increase has been non-significant in southern New England. Factors potentially driving the increase are the maturation of regional forests and succession of forest stands to northern hardwoods (Ward and Barsky 2000).

Although uncommon, the Blue-headed Vireo was more widespread in eastern Connecticut than previously noted (Clark 1994e). Its trend toward higher density in Northeast Connecticut may be related in part to its proportionately higher use of conifer-hardwood forest. Forests are significantly more coniferous in Northeast compared with Southeast Connecticut (Table 3,4,5).

The comparatively low density of birds found in this study compared with Craig (1987) is in part a consequence of the earlier work being performed in the heart of the species' eastern Connecticut range. Moreover, this study considered all forest types in the region, whereas Craig (1987) focused on the northern hardwood-hemlock-pine forests favored by the species. Notably, the Northeast Uplands Ecoregion remains its stronghold in eastern Connecticut (Fig. 51).

The tendency of the Blue-headed Vireo toward inhabiting forests with more conifers and more open understory (although based on a small sample) is consistent with other observations of habitat use (James 1998). Its use of deciduous forest has been previously undescribed for our area (Clark 1994e).

Conservation status.- Populations are increasing continentally, and the species appears more widespread than previously noted.

Sponsored by Marcus Lussier-Keilch

WARBLING VIREO

Vireo gilvus

Density distribution.- Although fairly common outside of extensive forest, the Warbling Vireo was very uncommon in the forests of eastern Connecticut. From our 13 detections of singing males, we tentatively estimate a population of 703 (0.3 males/km^2) in primarily forested landscapes. We found birds at 38% (12 birds) of Northeast and 4% (one bird) of Southeast Connecticut transects, suggesting that birds occurred more frequently to the north.

Population variance.- The coefficient of variation calculated from Breeding Bird Survey data (Sauer et al. 2001) predicted variation in continental populations as 5.9%. From 1966 to 2000 continental populations significantly increased (mean count/ route = 3.9, trend = 1.3, $P = 0.00$, N = 2005). Limited data from southern New England showed no trend.

On ten line transects through the Northeast Uplands Ecoregion, Craig (1987) reported no birds. In a ten year sample of Breeding Bird Census plots in Connecticut, no birds occurred in hemlock-hardwood, second growth deciduous or oak-hemlock forest. Elsewhere, 12-240 pairs/km^2 have been reported in western portions of the species' range (Gardali and Ballard 2000).

Habitat.- We found summering birds in mesic to xeric, open canopy deciduous forest and forest edge. Twelve of 13 observations were in Northeast Connecticut, suggesting that populations predominated there. Elsewhere, the species is reported to inhabit mature, deciduous woodlands bordering streams, other wetlands, and clearcuts. Woods inhabited typically have open canopies, and tract size does not appear to be a limiting factor (Gardali and Ballard 2000).

History.- The Warbling Vireo was described by Sage et al. (1913) as a common breeder in more open Connecticut habitats. Numbers appear to have declined in the early 20th century, but to have rebounded since the 1960s. (Zeranski and Baptist 1990).

Synthesis.- The Warbling Vireo is generally not present in the primarily mature forest habitats surveyed in this study. However, despite the maturation of regional forests, our incidental observations in eastern Connecticut suggest that the species has increased over the past 30 years. Such a view is consistent with continental Breeding Bird Survey data. Our few observations of habitat use were typical of other reports for the species.

Conservation status.- Populations may be increasing, and do not appear affected by habitat fragmentation.

RED-EYED VIREO
Vireo olivaceus

Density (males/km^2): 35.5 (95% CI: 31.8-39.6)
Density range (males/km^2/transect): 10.4-59.9
Total population (males): 96,704 (95% CI: 86,284-107,830)

Detection function: half normal/cosine
$\chi^2 = 5.57$, $P = 0.13$, df = 3, N = 695

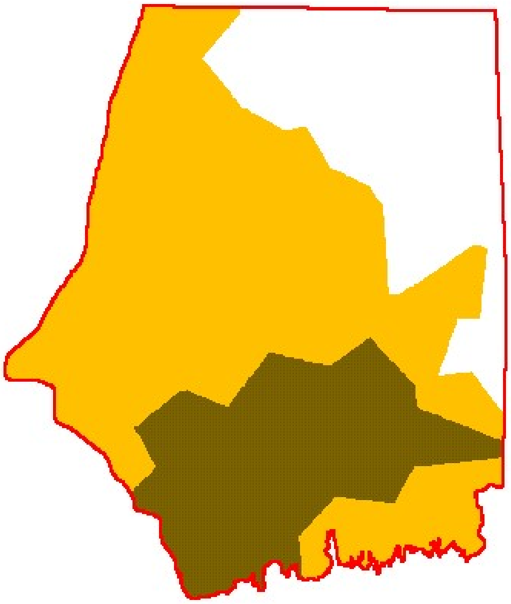

FIG. 52. Summer densities of the Red-eyed Vireo were greatest in Southeast Connecticut. Light = 15.6-29.5, medium 29.5-45.2, dark = 45.2-62.5 males/km^2.

Density distribution.-The Red-eyed Vireo was one of the most abundant, ubiquitous breeders in the forests of eastern Connecticut. Densities significantly increased ($t = -3.5$, df = 48.2, $P = 0.00$) from north (29.3 ± 12.2 males/km^2) to south (42.0 ± 13.4 males/km^2; Fig. 52). Population estimates are based on detection of singing males.

Population variance.- The coefficient of variation calculated from Breeding Bird Survey data (Sauer et al. 2001) predicted variation in populations as 3.8% for southern New England. From 1966-2000, populations showed no significant trend in this region (mean count/route = 16.6, trend = -0.7, P = 0.28, N = 51), although continentally they increased significantly (mean count/route = 11.6, trend = 1.3, P = 0.00, N = 2415).

TABLE 19. Observations of habitat use by individual Red-eyed Vireos showed that they inhabited forests that were more deciduous, had more closed canopies, and had more oak-dominated forest than would be predicted by habitat availability. Comparison of population densities with habitat features also demonstrated a significant correlation. $P(\chi^2)$ = probability level of chi-square tests, N = 281; $P(t)$ = probability level of Kendall's tau, N = 51; * = significant, ** = highly significant (see Table 8 for abbreviation key).

	Mean Habitat Characteristics				
	F	M	D	C	U
Availability	1.4	2.3	2.0	2.7	2.3
Use	1.2	2.2	2.0	2.8	2.2
$P(\chi^2)$	0.00**	0.18	0.55	0.00**	0.56
$P(t)$	0.01**	0.88	0.43	0.82	0.76

	Percent Vegetation					
	OD	MH	CN	PO	CO	MI
Availability	51.0	13.7	13.1	13.1	8.5	0.7
Use	64.4	15.7	8.9	7.5	1.8	1.8
$P(\chi^2)$	0.00**					

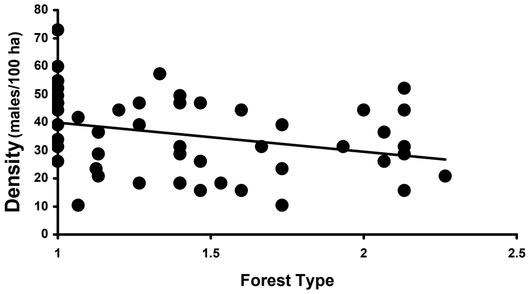

FIG. 53. Population density significantly increased with increasing deciduous cover.

On ten line transects through the Northeast Uplands Ecoregion, Craig (1987) reported 65.2 ± 23.0 birds/km^2, a range very similar to that of this study, when our estimates are multiplied by two to yield breeding individuals/km^2.

In a ten year sample of Breeding Bird Census plots in Connecticut, densities of pairs/km^2 were 45.2 ± 7.8 in oak-hemlock forest, 91.7 ± 31.5 in hemlock-hardwood forest, and 132.2 ± 32.3 in second growth deciduous forest. These estimates overlap but average higher than the range computed in this study. Earlier plot studies have shown densities ranging from 19.0-237.6 birds/km^2 for Connecticut (Craig 1987). Elsewhere, densities of pairs/km^2 have been reported as 17-100 in Illinois, to 160 in New Hampshire, to 150 in the southeastern U.S., 120 in Quebec, and 10-120 in Arkansas (Cimprich et al. 2000).

Habitat.- Data from individual Red-eyed Vireos demonstrated that they inhabited forests which averaged more deciduous than would be predicted by habitat availability. This relationship was reflected in their more frequent presence in oak-dominated forests and less frequent presence in conifer-containing forests than would be predicted by habitat availability. Moreover, the species occurred in forests with canopies averaging more closed than those available. Examination of population density vs. habitat variables corroborated the association of the Red-eyed Vireo with more deciduous forests (Table 19, Fig. 53).

Elsewhere, the species inhabits deciduous and mixed forests, but is absent from sites where understory is sparse. It is most abundant in the forest interior, but may be found near small forest gaps. Where conifers predominate, it preferentially occurs along streams where deciduous trees are most abundant. Densities have been found to be greater in mesic, bottomland forests than in xeric uplands (Cimprich et al. 2000).

History.- The Red-eyed Vireo has been reported as historically common to abundant (Sage et. al 1913, Zeranski and Baptist 1990). During the 19th century, when the regional landscape was largely deforested (Ward and Barsky 2000), the species appears to have remained common within available forest habitat.

Synthesis.- The population densities computed in this survey are similar to those of earlier transect estimates of Craig (1987). The similarity in these estimates is supported by data from the Breeding Bird Survey, which show little evidence for a regional population trend, and comparatively low population variance.

The increasing Red-eyed Vireo density from north to south may be explained in part by its observed use of deciduous forests, a forest type more prevalent in Southeast Connecticut (Table 1, 2, 3, 4). Its tendency toward inhabiting deciduous, closed-canopy forests is consistent with other observations of habitat use (Cimprich et al. 2000), although its only weak association with moister habitats is not. Its predominance in forests with closed canopies also verifies that it is a characteristic species of forest interiors.

Conservation status.- Populations appear secure, but are likely vulnerable to forest fragmentation.

Sponsored by Barbara A. Lussier

BLUE JAY
Cyanocitta cristata

Summer

Density (birds/km^2): 6.2 (95% CI: 4.8-8.0)
Density range (birds/km^2/transect): 0-12.8
Total population (birds): 16,845 (95% CI: 12,987-21,849)

Detection function: uniform/cosine
$\chi^2 = 0.32$, $P = 0.96$, df = 3, N = 320

Winter

Density (birds/km^2): 1.5 (95% CI: 1.0-2.1)
Density range (birds/km^2/transect): 0-11.2
Total population (birds): 4,033 (95% CI: 2,834-5,738)

Detection function: half normal/cosine
$\chi^2 = 0.92$, $P = 0.63$, df = 2, N = 244

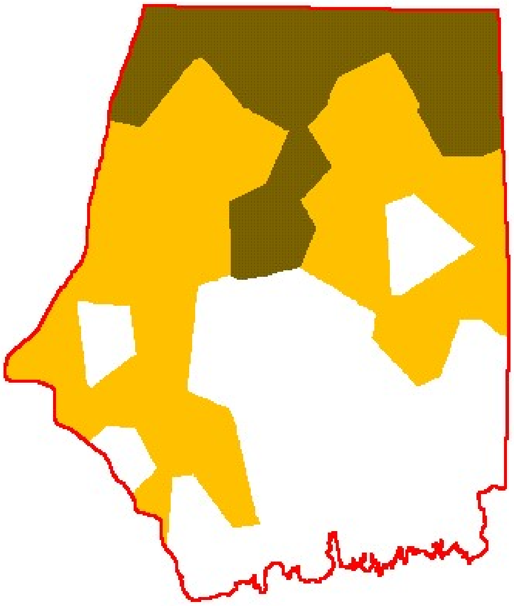

FIG. 54. Summer densities of the Blue Jay were greatest in Northeast Connecticut. Light = 2.0-4.9, medium 4.9-7.2, dark = 7.2-10.5 birds/km^2.

TABLE 20. Observations of summer habitat use by individual Blue Jays showed that they inhabited forests significantly more coniferous than would be predicted by habitat availability. In winter, they inhabited primarily deciduous forests. Comparison of population densities with habitat features showed no significant relationships. $P(\chi^2)$ = probability level of chi-square tests, N = 39 summer, N = 25 winter; $P(t)$ = probability level of Kendall's tau, N = 51; * = significant, ** = highly significant (see Table 8 for abbreviation key).

	Mean Habitat Characteristics				
	F	M	D	C	U
Availability	1.4	2.3	2.0	2.7	2.3
Summer use	1.8	2.3	1.9	2.8	2.4
$P(\chi^2)$	0.02*	0.76	0.26	0.10	0.42
$P(t)$	0.09	0.94	0.83	0.43	0.08
Winter use	1.2	2.3	1.9	2.6	1.9
$P(t)$	0.08	0.33	0.10	0.11	0.57

	Percent Vegetation					
	OD	MH	CN	PO	CO	MI
Availability	51.0	13.7	13.1	13.1	8.5	0.7
Summer use	35.9	5.1	15.4	20.5	23.1	0.0
$P(\chi^2)$	0.03*					
Winter use	68.8	12.5	12.5	0.0	0.0	6.3

Density distribution.-The Blue Jay was a fairly common inhabitant of the forests of eastern Connecticut. Its breeding densities were significantly greater ($t = 3.5$, $P = 0.00$, N = 51) in Northeast (7.7 ± 3.5 birds/km^2) than Southeast Connecticut (4.7 ± 2.7 birds/km^2; Fig. 54). In winter, its densities significantly reversed (Mann-Whitney U = 140.0 , $P = 0.00$, N = 51), with Southeast (2.3 ± 2.6 birds/km^2) having populations greater than Northeast Connecticut (0.7 ± 0.7 birds/km^2; Fig. 55).

Population estimates are based on detections of calling males and females. Because the Blue Jay also occurs in non-forest habitats, estimates refer only to that part of the population inhabiting primarily forested landscapes.

Population variance.- The coefficient of variation calculated from Breeding Bird Survey data (Sauer et al. 2001) predicted

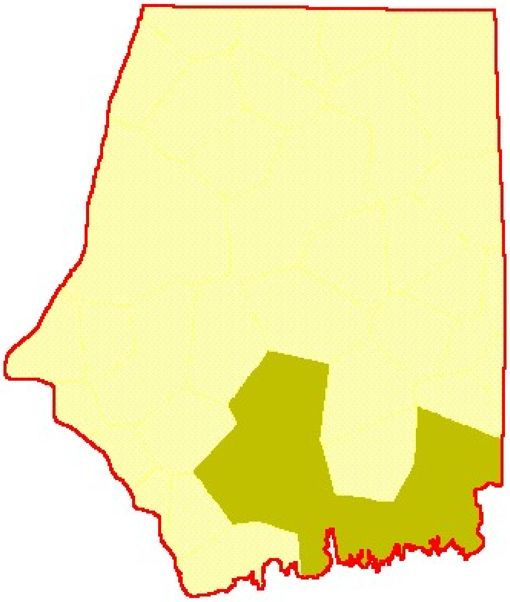

FIG. 55. Winter densities of the Blue Jay were greatest in Southeast Connecticut. Light = 0-2.3, dark = 2.3-5.9 birds/km^2.

population variation as 1.6% for southern New England. From 1966-2000, populations showed a strongly significant regional (mean count/route = 24.3, trend = -2.9, $P = 0.00$, N = 51) and continental decline (mean count/route = 9.2, trend = -1.1, $P = 0.00$, N = 2484).

Christmas Count data predicted population variation as 23.5% for Connecticut. From 1966-2001, populations showed a nonsignificant Connecticut decline (birds/party hour = 4.2, quadratic model $r^2 = 0.04$, df = 34, $P = 0.55$). U.S. populations showed a strongly significant decline (birds/party hour = 2.0, quadratic model $r^2 = 0.27$, df = 34, $P = 0.01$).

On ten line transects through the Northeast Uplands Ecoregion, Craig (1987) reported 8.8 birds/km^2, a value similar to but above that of this study. In a ten year sample of Breeding Bird Census plots in Connecticut, densities of pairs/km^2 were 14.4 ± 4.2 in oak-hemlock forest, 27.1 ± 5.5 in hemlock-hardwood forest, and 14.9 ± 8.4 in second growth deciduous forest. These densities average higher than those found in this study. A Winter Bird Survey plot in a deciduous-coniferous wetland showed 14.4-73.5 birds/km^2. Elsewhere, densities of birds/km^2 reported from forest habitat include 6.5-29 in Illinois (Tarvin and Woolfenden 1999) and 2 ± 4 in New Hampshire (Holmes et al 1986).

Habitat.- Observations of summer habitat use by individual Blue Jays showed that they inhabited forests significantly more coniferous than would be predicted by habitat availability. In particular, birds used pine-oak and pure coniferous forests in greater proportion than their availability. Although samples were too small to conduct statistical tests, wintering individuals were infrequent in conifers, and inhabited primarily deciduous forest. Comparison of population densities with habitat features showed no significant relationships in either summer or winter (Table 20). We found the species to be a regular inhabitant of the forest interior, although it appeared to be more common outside of forests where we did not sample.

Elsewhere, the Blue Jay is reported to inhabit deciduous, mixed and coniferous forest, although the presence of oaks, beeches, hickories and other mast-producing trees appears important, as these nuts form an important part of the winter diet. It also occurs in wooded suburban habitats. It may prefer forest edge (Tarvin and Woolfenden 1999).

History.- The Blue Jay has been known as a common Connecticut resident since the 19th century (Sage et al. 1913, Zeranski and Baptist 1990).

Synthesis.- Breeding Bird Survey and Christmas Count data suggest that Blue Jay populations are undergoing a long term decline in southern New England. The decline may be related to the maturation of regional forests (Ward and Barsky 2000) if forest edge is indeed a preferred habitat. However, maturation-related conversion of forests from mast producing trees to maples and birches also may be playing a role.

The winter decline observed in Blue Jay numbers is expected because the species is strongly migratory (Tarvin and Woolfenden 1999). A greater population in Southeast compared with Northeast Connecticut during this season is likely due partly to southward migration to milder climates. Populations at the coast were indeed densest (Fig. 55). However, because winter populations are inherently variable (based on reported coefficients of variation), additional data on annual population change will be required to evaluate the generality of this observed pattern.

The association of breeding Blue Jays with more coniferous habitats is previously unreported, yet we found evidence for such an association at both the individual and population (nearly significant) level. This association may explain in part their greater summer density in Northeast Connecticut (Fig. 55), where conifers are more abundant (Table 3,4,5). Although the species may prefer forest edge or non-forest habitats, we found no evidence that it was more frequent in open forest.

The Blue Jay's tendency toward winter predominance in oak-dominated forest also is likely related to its winter requirement for oak mast. Moreover, this requirement may partly explain its prevalence in Southeast Connecticut, where forests are more oak-dominated (Table 5).

Conservation status.- Populations are declining. However, the species is versatile in habitat use, so its long term persistance in our region seems assured.

Sponsored by David Chase Kimball-Stanley

AMERICAN CROW
Corvus brachyrhynchos

Summer

Density (birds/km^2): 0.7 (95% CI: 0.6-0.8)
Density range (birds/km^2/transect): 0-2.4
Total population (birds): 1,795 (95% CI: 1,550-2,077)

Detection function: uniform/polynomial
$\chi^2 = 2.51$, $P = 0.47$, df = 3, N = 248

Winter

Density (birds/km^2): 0.7 (95% CI: 0.5-0.9)
Density range (birds/km^2/transect): 0-2.1
Total population (birds): 1,827 (95% CI: 1,344-2,484)

Detection function: half normal/cosine
$\chi^2 = 3.06$, $P = 0.21$, df = 2, N = 473

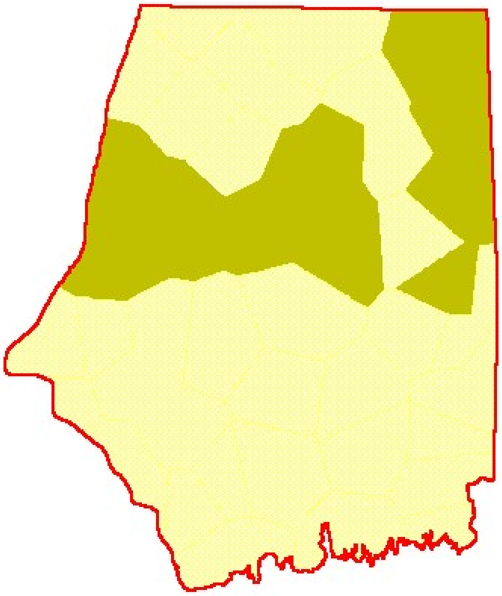

FIG. 56. Summer densities of the American Crow averaged greatest in Northeast Connecticut. Light = 0.1-0.8, dark = 0.8-1.9 birds/km^2.

TABLE 21. Comparison of American Crow population densities with habitat features showed a significant correlation with increasing canopy cover in summer. No correlations were evident in winter. *P*(*t*) = probability level of Kendall's tau, N = 51; * = significant, ** = highly significant (see Table 8 for abbreviation key).

	Habitat Characteristics				
	F	M	D	C	U
Summer *P*(*t*)	0.85	0.69	0.27	0.02*	0.57
Winter *P*(*t*)	0.32	0.72	0.49	0.95	0.92

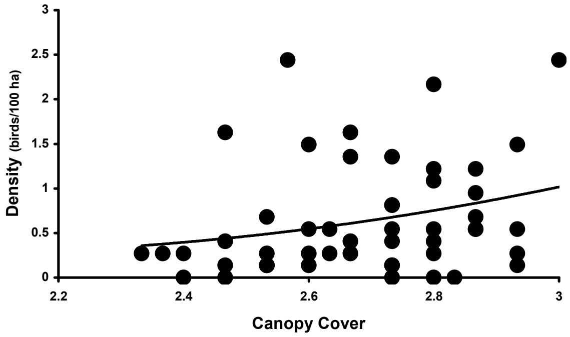

FIG. 57. Summer population density showed a variable but significant increase with increasing canopy cover.

Density distribution.-Although common in our region, the American Crow was an infrequent inhabitant of the forests of eastern Connecticut. Most detections were of birds heard at great distances that were likely out of forest habitat. Others were observed flying overhead, but few were actually in forests. Summer populations detected from forest habitat averaged greater in Northeast (0.8 ± 0.8 birds/km^2) than Southeast Connecticut (0.4 ± 0.4 birds/km^2; Fig. 56), but not significantly so (Mann-Whitney U = 250.0, *P* = 0.16, N = 51). In winter, populations showed a similar nonsignificant trend (t = 0.4, *P* = 0.71, N = 51) in Northeast (0.7 ± 0.5 birds/km^2) and Southeast Connecticut (0.6 ± 0.4 birds/km^2; Fig. 58). Population estimates are based on detections of calling males and females, and refer only to that part of the population inhabiting primarily forested landscapes.

Population variance.- The coefficient of

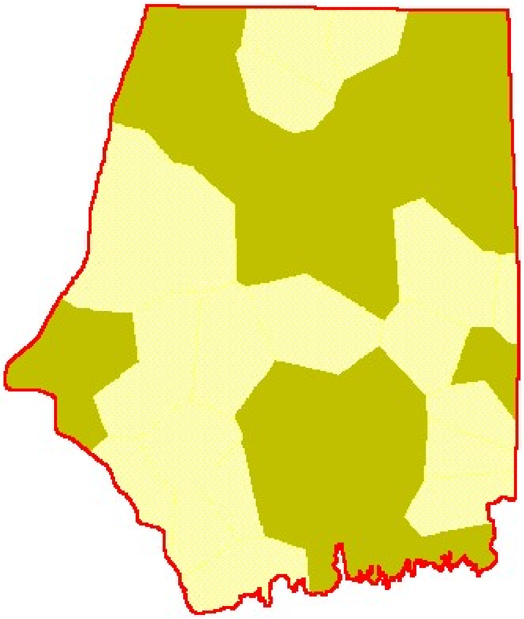

FIG. 58. Winter densities of the American Crow averaged greatest in Northeast Connecticut. Light = 0.1-0.6, dark = 0.6-1.1 birds/km^2.

variation calculated from Breeding Bird Survey data (Sauer et al. 2001) predicted population variation as 1.4% for southern New England. From 1966-2000, populations showed a significant regional (mean count/route = 36.3, trend = 2.5, P = 0.00, N = 51) and continental increase (mean count/route = 21.6, trend = 1.1, P = 0.00, N = 3229).

Christmas Count data predicted population variation as 44.1% for Connecticut. From 1966-2001, populations also showed a strongly significant Connecticut (birds/party hour = 13.0, power function model r^2 = 0.33, df = 34, P = 0.00) and U.S. increase (birds/party hour = 9.1, Kendall's tau = 0.42, P = 0.00, N = 37).

On ten line transects through the Northeast Uplands Ecoregion, Craig (1987) reported no birds. In a ten year sample of Breeding Bird Census plots in Connecticut, densities of birds/km^2 were 4.3-8.7 in oak-hemlock forest, 15.2 $\pm$ 4.4 in hemlock-hardwood forest, and 12.9 $\pm$ 3.5 in second growth deciduous forest. These densities average higher than those found in this study. A Winter Bird Survey plot in a deciduous-coniferous wetland showed 29.8-72.1 birds/km^2 (in an otherwise suburban landscape, however). We found no other densities reported for forested eastern landscapes.

Habitat.- Comparison of American Crow summer populations with habitat features showed a significant correlation with increasing canopy cover, but no correlations were evident in winter (Table 21, Fig. 57). Too few birds appeared in interior forest to evaluate habitat use by individual birds. Elsewhere, the species is reported to inhabit forest edge and open habitats, including human-associated landscapes, but to be less common in habitats with no trees (Verbeek and Caffrey 2002).

History.- The American Crow was known as a common resident in the 19th century (Zeranski and Baptist 1990). Sage et al. (1913) believed that migratory activity occurred in Connecticut.

Synthesis.- The American Crow was only marginally a bird of forest habitats, although because of its detectability at even great distances we report on it here. Breeding Bird Survey and Christmas Count data show that the species is increasing regionally. The summer association of greater populations with more closed forests is inconsistent with other reports that the species avoids extensive forest, and instead inhabits forest edge or areas with scattered trees. Such a finding is likely artifactual, as most of our crow detections were at several hundred to 1000 m, a distance at which our habitat measurements were not representative.

Conservation status.- Populations are increasing, and human activity appears to benefit populations.

Sponsored by Wayne Paquette

COMMON RAVEN
Corvus corax

Density distribution.- The Common Raven was a rare bird in the forests of eastern Connecticut. We found summering individuals at Bolton Notch, Pequot Trail (Ledyard), and Chaney Sanctuary. We incidentally observed birds at Boston Hollow and Yale Forest. Wintering birds appeared at Boston Hollow, Yale Forest, Nipmuck State Forest (Union), Pole Bridge Road, Bolton Notch and Chaney Sanctuary. From our limited data, we tentatively estimate a summer population of 41 (0.01 birds/km^2), and a winter population of 62 (0.02 birds/km^2). Population estimates are based on detections of males and females.

Population variance.- The coefficient of variation calculated from Breeding Bird Survey data (Sauer et al. 2001) predicted variation in continental populations as 30.9%. From 1966 to 2000 continental populations showed a strongly significant increase (mean count/ route = 6.0, trend = 2.9, P = 0.00, N = 1614). Very limited data from southern New England also suggested an increase.

The coefficient of variation from U.S. Christmas Count data was 41.3%. Christmas Counts showed a significant U.S. (birds/party hr = 0.39, power function model r^2 = 0.95, df = 35, P = 0.00) increase from 1966 to 2002. Adequate winter data were not available from Connecticut.

On ten line transects through the Northeast Uplands Ecoregion, Craig (1987) reported no birds, although at least two individuals were present in the study area (R. Craig pers. obs). In a ten year sample of Breeding Bird Census plots in Connecticut, no birds occurred in oak-hemlock, hemlock-hardwood or second growth deciduous forest.

Elsewhere in the East, populations are reported as 0.03 pairs/km^2 in Virginia, a value similar to that of our tentative estimate. Other estimates of density in the extensive range of the species are 0.06-33 birds/km^2 (Boarman and Heinrich 1999).

Habitat.- Our 15 observations of Common Ravens were in deciduous and mixed conifer-deciduous forest. However, because the species is wide-ranging, associating it with specific habitats is difficult. Elsewhere, a broad range of open and forested habitats are occupied, although in the Northeast it is most typically associated with wilderness. (Boarman and Heinrich 1999).

History.- The Common Raven was reported to be an extremely rare visitor by Sage et al. (1913). Since the 1980s it has become increasingly common at all seasons (Zeranski and Baptist 1990).

Synthesis.- The Common Raven has clearly increased in eastern Connecticut since the early 1980s, when only one pair was present (R. Craig pers. obs.). It has now extended its range nearly to Long Island Sound. Based on Breeding Bird Survey and Christmas Count data, this adaptable species appears likely to continue expanding its local populations.

Although based on very limited data, our population calculations suggest an increase in winter over summer, perhaps due to recruitment during the breeding season. Moreover, migration into Connecticut from more northern areas may occur, as the species exhibits migatory behavior (Boarman and Heinrich 1999).

Conservation status.- Populations are increasing. This adaptable species may continue to prosper in our region.

Sponsorship in Memory of Edward L. Lussier

BLACK-CAPPED CHICKADEE
Poecile atricapillus

Summer

Density (birds/km^2): 14.7 (95% CI: 12.4-17.3)
Density range (birds/km^2/transect): 0-27.7
Total population (birds): 39,934 (95% CI: 33,907-47,033)

Detection function: hazard/cosine
$\chi^2 = 15.38$, $P = 0.12$, df = 10, N = 243

Winter

Density (birds/km^2): 19.5 (95% CI: 13.9-27.2)
Density range (birds/km^2/transect): 0-44.1
Total population (birds): 53,050 (95% CI: 38,034-73,993)

Detection function: hazard/cosine
$\chi^2 = 7.87$, $P = 0.45$, df = 8, N = 265

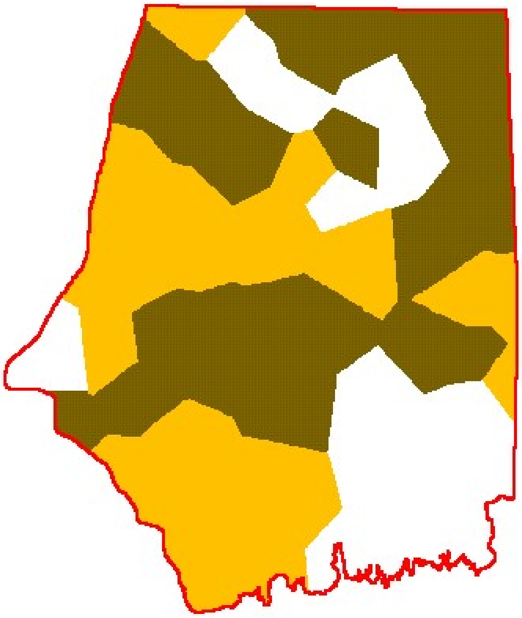

FIG. 59. Summer densities of the Black-capped Chickadee were similar in Northeast Connecticut. Light = 7.2-11.3 medium = 11.3-15.4, dark = 15.4-22.6 birds/km^2.

TABLE 22. Observations of summer habitat use by individual Black-capped Chickadees showed no significant differences from habitat availability. In winter, birds used moister forests than would be predicted by habitat availability. Comparison of population densities with habitat features also showed no significant correlations. $P(\chi^2)$ = probability level of chi-square tests, N = 97 summer, 118 winter; $P(t)$ = probability level of Kendall's tau, N = 51; * = significant, ** = highly significant (see Table 8 for abbreviation key).

	Mean Habitat Characteristics				
	F	M	D	C	U
Availability	1.4	2.3	2.0	2.7	2.3
Summer use	1.5	2.2	2.0	2.7	2.3
$P(\chi^2)$	0.64	0.46	-	0.92	0.61
$P(t)$	0.42	0.41	0.14	0.22	0.25
Winter	1.5	2.1	2.0	2.6	2.3
$P(\chi^2)$	0.89	0.02*	-	0.08	0.57
$P(t)$	0.70	0.89	0.09	0.11	0.62

	Percent Vegetation					
	OD	MH	CN	PO	CO	MI
Availability	51.0	13.7	13.1	13.1	8.5	0.7
Summer use	49.5	9.3	21.6	11.3	8.2	0.0
$P(\chi^2)$	0.43					
Winter use	42.4	18.6	15.3	8.5	11.0	4.2
$P(\chi^2)$	0.16					

Density distribution.-The Black-capped Chickadee was a common inhabitant of the forests of eastern Connecticut. Its breeding densities were similar (Mann- Whitney U = 298.0, $P = 0.61$, N = 51) in Northeast (14.8 ± 5.2 birds/km^2) and Southeast Connecticut (14.5 ± 8.3 birds/km^2; Fig. 59).

As with a number of permanent resident species, winter populations appeared greater than those of summer. Winter densities averaged lower in Northeast (17.2 ± 10.0 birds/km^2) than Southeast Connecticut (21.9 ± 11.4 birds/km^2; Fig. 60), but not significantly so ($t = -1.5$, $P = 0.13$, df = 49). Population estimates are based on detections of flocks of calling males and females.

Population variance.- The coefficient of

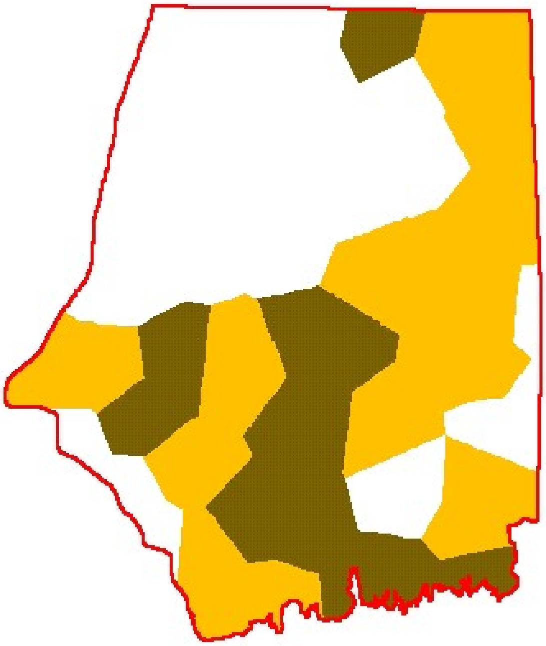

FIG. 60. Winter densities of the Black-capped Chickadee averaged greatest in Southeast Connecticut. Light = 6.1-17.2, medium = 17.2-25.7, dark = 25.7-39.2 birds/km^2.

variation calculated from Breeding Bird Survey data (Sauer et al. 2001) predicted population variation as 2.0% for southern New England. From 1966-2000, populations showed a nearly significant regional (mean count/route = 17.8, trend = 0.7, $P = 0.06$, N = 51) and strongly significant continental increase (mean count/route = 3.5, trend = 1.4, $P = 0.00$, N = 1699).

Christmas Count data predicted population variation as 18.8% for Connecticut. From 1966-2001, populations showed a strongly significant Connecticut increase (birds/party hour = 6.0, quadratic model $r^2 = 0.56$, df = 34, $P = 0.00$). However, the shape of the curve fitted to the population data indicated an increase followed by a decline. U.S. populations also showed a strongly significant increase (birds/party hour = 2.1, Kendall's tau = 0.48, $P = 0.00$, N = 37).

On ten line transects through the Northeast Uplands Ecoregion, Craig (1987) reported 21.7 ± 8.2 birds/km^2, a value similar to that of this study. In a ten year sample of Breeding Bird Census plots in Connecticut, densities of pairs/km^2 were 31.9 ± 9.9 in oak-hemlock forest, 35.6 ± 9.8 in hemlock-hardwood forest, and 28.2 ± 9.9 in second growth deciduous forest. These densities overlap those of this study. A Winter Bird Survey plot in a deciduous-coniferous wetland showed 92.6-235.3 birds/km^2. In New Hampshire, breeding densities are reported as 8 ± 11 birds/km^2 (Holmes et al. 1986).

Habitat.- Observations of summer habitat use by individual Black-capped Chickadees showed no significant differences from habitat availability. In winter, birds used moister forests than would be predicted by habitat availability. Comparison of population densities with habitat features also showed no significant correlations (Table 22).

Elsewhere, the species is reported to inhabit deciduous, mixed and coniferous forest. It also occurs in open woodland and other types of disturbed habitats, such as old fields and even suburban habitats. It may prefer forest edge (Smith 1993).

History.- The Black-capped Chickadee has been known as a common Connecticut resident since the 19th century. However, two declines have been detected since 1968 (Sage et al. 1913, Loery 1994a).

Synthesis.- Breeding Bird Survey and Christmas Count data show that Black-capped Chickadee populations are undergoing a long term increase in southern New England, although populations significantly fluctuate. Data from Northwest Connecticut support the occurrence of such fluctuations (Loery et al. 1987).

Comparison of Fig. 59 and 60 suggest that populations shift from the northern 2/3 of the region in summer to the southern 2/3 in winter. Such movement, well known for the species (Smith 1993), is indicative of winter migration into more climatically mild, southern portions of their range. However, additional investigation is required to verify the generality of this pattern.

The lack of association with most habitat variables illustrates that in many regards the species is a habitat generalist. Its winter association with moister forests is not reported, but may be related to a shift in distribution of food from summer to winter.

Conservation status.- Populations are variable but generally increasing. Because the species tolerates even suburban landscapes, its long term survival in our region seems assured.

Sponsored by Sandy Betner, Chickadee Cottage Bed and Breakfast

TUFTED TITMOUSE
Baeolophus bicolor

Summer

Density (birds/km^2): 20.2 (95% CI: 14.4-17.6)

Density range (birds/km^2/transect): 2.7-37.6

Total population (birds): 54,962 (95% CI: 49,272-61,308)

Detection function: uniform /cosine
$\chi^2 = 5.45$, $P = 0.24$, df = 4, N = 383

Winter

Density (birds/km^2): 25.9 (95% CI: 20.0-33.4)

Density range (birds/km^2/transect): 0-91.4

Total population (birds): 70,532 (95% CI: 54,660-91,013)

Detection function: uniform /polynomial
$\chi^2 = 3.42$, $P = 0.18$, df = 2, N = 170

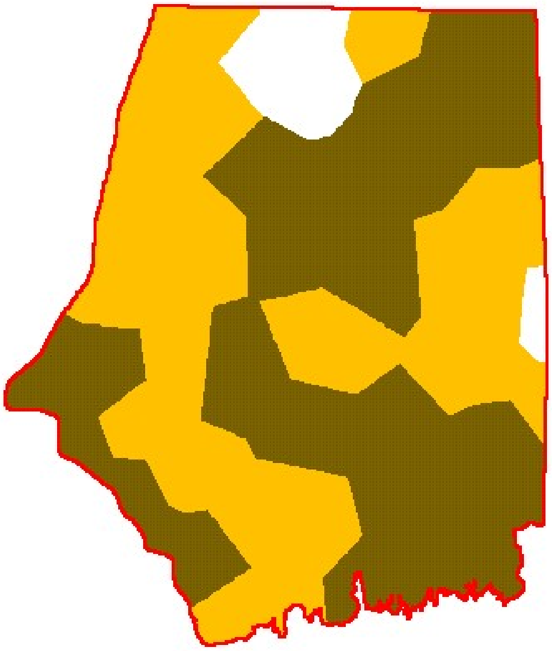

FIG. 61. Summer densities of the Tufted Titmouse were greatest in Southeast Connecticut. Light = 5.4-10.8, medium = 10.8-19.7, dark = 19.7-27.8 birds/km^2.

TABLE 23. Observations of summer habitat use by individual Tufted Titmice showed no significant differences from habitat availability. In winter, individual birds inhabited forests significantly more deciduous than would be predicted by habitat availability. Comparison of population densities with habitat features showed a significant winter correlation with increasing deciduous cover and decreasing canopy cover. $P(\chi^2)$ = probability level of chi-square tests, N = 160 summer, 198 winter; $P(\tau)$ = probability level of Kendall's tau, N = 51; * = significant, ** = highly significant (see Table 8 for abbreviation key).

	Mean Habitat Characteristics				
	F	M	D	C	U
Availability	1.4	2.3	2.0	2.7	2.3
Summer use	1.4	2.2	2.0	2.7	2.3
$P(\chi^2)$	0.40	0.18	0.70	0.45	0.90
$P(\tau)$	0.11	0.62	0.91	1.00	0.90
Winter use	1.2	2.2	2.0	2.6	2.4
$P(\chi^2)$	0.00**	0.46	-	0.40	0.18
$P(\tau)$	0.02**	0.41	0.24	0.03*	0.97

	Percent Vegetation					
	OD	MH	CN	PO	CO	MI
Availability	51.0	13.7	13.1	13.1	8.5	0.7
Summer use	51.9	17.5	11.3	11.9	5.6	1.9
$P(\chi^2)$	0.72					
Winter use	60.0	22.7	8.2	4.5	0.9	3.6
$P(\chi^2)$	0.00**					

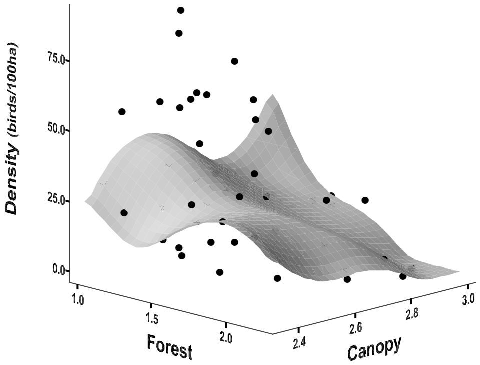

FIG. 62. Winter population density increased with increasing deciduous cover and decreasing canopy cover.

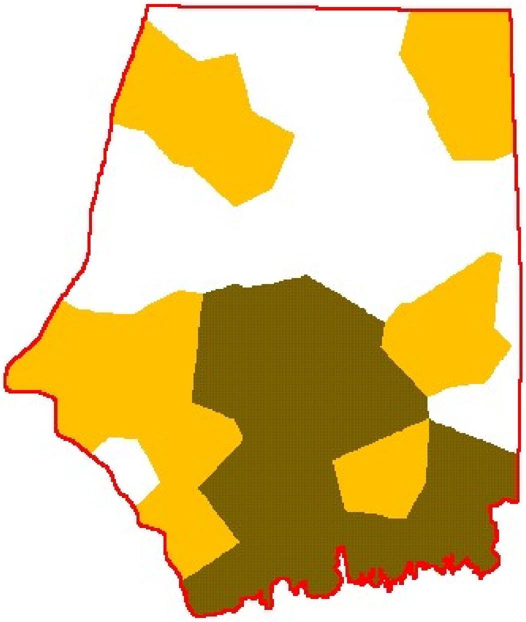

FIG. 63. Winter densities of the Tufted Titmouse were greatest in Southeast Connecticut. Light = 2.5-17.8, medium = 17.8-38.1, dark = 38.1-66.0 birds/km^2.

Density distribution.-The Tufted Titmouse was one of the most common inhabitants of the forests of eastern Connecticut. Its breeding densities were significantly higher (t = -2.8, P = 0.01, df = 49) in Southeast (23.0 ± 6.5 birds/km^2) than Northeast Connecticut (17.5 ± 7.5 birds/km^2; Fig. 61).

As with a number of permanent resident species, winter populations appeared greater than those in summer. Winter densities again were significantly higher (Mann-Whitney U = 138.0, P = 0.00, N = 51) in Southeast (36.6 ± 23.4 birds/km^2) than Northeast Connecticut (15.2 ± 14.7 birds/km^2; Fig. 63). Population estimates are based on detections of flocks of calling males and females.

Population variance.- The coefficient of variation calculated from Breeding Bird Survey data (Sauer et al. 2001) predicted population variation as 6.8% for southern New England. From 1966-2000, populations showed a significant regional (mean count/route = 12.2, trend = 5.2, P = 0.00, N = 51) and continental (mean count/route = 8.6, trend = 1.0, P = 0.00, N = 1591) increase.

Christmas Count data predicted population variation as 32.4% for Connecticut. From 1966-2001, populations showed a strongly significant Connecticut (birds/party hour = 1.9, quadratic model r^2 = 0.83, df = 34, P = 0.00) and U.S. increase (birds/party hour = 0.7, quadratic model r^2 = 0.68, df = 34, P =0.00).

On ten line transects through the Northeast Uplands Ecoregion, Craig (1987) reported 2.4 birds/km^2, a value well below that of this study. In a ten year sample of Breeding Bird Census plots in Connecticut, densities of pairs/km^2 were 27.4 ± 5.7 in oak-hemlock forest and 26.2 ± 13.2 in second growth deciduous forest. It appeared three times (9.5 pairs/km^2) in hemlock-hardwood forest. These densities overlap those found in this study. A Winter Bird Survey plot in a deciduous-coniferous wetland had 37.7-80.9 birds/km^2.

Habitat.- Observations of summer habitat use by individual Tufted Titmice showed no significant differences from habitat availability. In winter, individual birds inhabited forests significantly more deciduous than would be predicted by habitat availability. Comparison of population densities with habitat features showed a significant winter correlation with increasing deciduous cover and decreasing canopy cover. (Table 23, Fig. 62).

Elsewhere, the species is reported to inhabit principally deciduous forest, although it also occurs in mixed forests. Diverse, low elevation, closed canopy forests appear to be preferred. It does not occur in regions receiving <61 inches of rain (Grubb and Pravosudov 1994). It also may occupy more open and even suburban areas.

History.- The Tufted Titmouse was rare in Connecticut during the 19th century. It has been established in eastern Connecticut only since the 1950s (Sage et al. 1913, Loery 1994b).

Synthesis.- Breeding Bird Survey and Christmas Count data show that Tufted Titmouse populations are undergoing a long term increase in southern New England, a trend corroborated by comparison of our results with earlier transect studies of Craig (1987). The species was still very infrequent in the Northeast Uplands Ecoregion at the time of this earlier study. Since then, it has increased greatly. As foretold by Loery (1994b), it has become the most common Parid in our region.

The greater year-round density in Southeast Connecticut is likely related to the increasing abundance of deciduous forest from north to south (Table 3,4,5). However, comparison of Fig. 59 and 60 suggests that populations shift from the northern 2/3 of the region in summer to the southern 2/3 in winter. Such movement, although weakly documented for the species (Grubb and Pravosudov 1994), is indicative of winter migration of birds into more climatically mild, southern portions of their range. However, additional investigation is required to verify the generality of this pattern. Notable also is the remaining low summer density of birds in the Northeast Uplands Ecoregion, where as recently as the early 1980s there were virtually no birds inhabiting interior forest.

The lack of summer association with habitat variables illustrates that in many regards the species is a habitat generalist. Its greater winter association with deciduous forest is consistent with other reports of habitat use, but the association of greater populations with more open canopy forest is unreported.

Conservation status.- Populations are increasing. Because of the species' ability to tolerate even suburban landscapes, its long term survival in our region appears assured.

Sponsored by Julian Harston

RED-BREASTED NUTHATCH

Sitta carolinensis

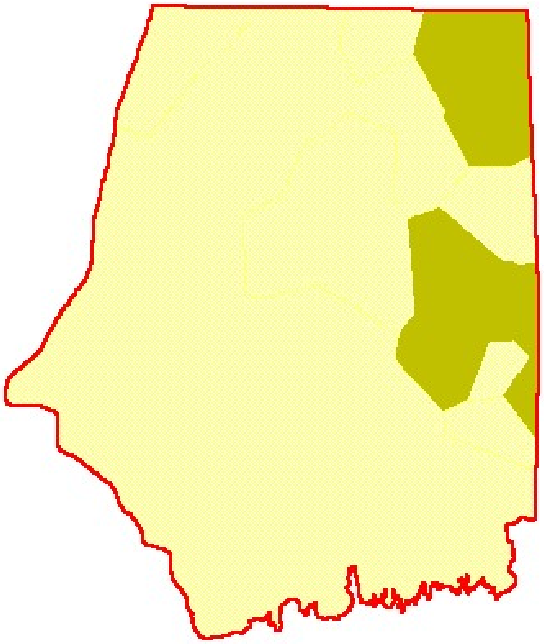

FIG. 64. Summer densities of the Red-breasted Nuthatch averaged greatest in Northeast Connecticut. Light = 0-1.4, dark = 1.4-2.7 birds/km^2.

Density distribution.-The Red-breasted Nuthatch was a very uncommon inhabitant of the forests of eastern Connecticut. Based on 15 observations, we tentatively estimate a breeding population of 1,420 individuals. It was present at 27% of sites in Northeast, but only 8% of sites in Southeast Connecticut (Fig. 64), suggesting that birds occurred more frequently to the north.

Although common in some winters, it was rare during the study period. We estimate a winter population of 223 individuals during that time. Its appeared only twice in winter, once each in Northeast and Southeast Connecticut, so we could not compute densities or map populations. Population estimates are based on <60 detections of calling males and females, so have reduced accuracy.

Population variance.- The coefficient of variation calculated from Breeding Bird Survey data (Sauer et al. 2001) predicted continental population variation as 16.3%. From 1966-2000, populations showed a strongly significant continental increase (mean count/route = 2.5, trend = 1.2, P = 0.00, N = 1070). Limited data from southern New England also suggested an increase.

Christmas Count data predicted population variation as 97.5% for Connecticut. From 1966-2001, populations showed a nonsignificant Connecticut increase (birds/party hour = 0.1, Kendall's tau = 0.17, P = 0.30, N = 37). U.S. populations showed a strongly significant increase (birds/party hour = 0.1, exponential model r^2 = 0.27, df = 35, P = 0.00).

On ten line transects through the Northeast Uplands Ecoregion, Craig (1987) reported 5.8 birds/km^2, a value well above that of this study. In a ten year sample of Breeding Bird Census plots in Connecticut, densities were 33.3 $\pm$ 11.2 pairs/km^2 in hemlock-hardwood forest. They appeared twice (5.0-9.9 pairs/km^2) in second growth deciduous forest, but none were in oak-hemlock forest. A Winter Bird Survey plot in a deciduous-coniferous wetland yielded no birds. These densities averaged higher than those found in this study. Elsewhere, breeding densities are reported as 19 males/km^2 in West Virginia and 11-50 pairs/km^2 in Quebec (Ghalambor and Martin 1999).

Habitat.- The Red-breasted Nuthatch occurred too rarely to evaluate habitat use. We found it to be largely restricted to coniferous habitats, including spruce plantations, white and red pine groves, and hemlock stands. In previous years, R. Craig (pers. obs.) also regularly found birds in hemlock-white pine-hardwood forests.

Elsewhere, the species is reported to prefer mature, diverse conifer forest, although it also is present in mixed deciduous-coniferous forest. Mixed stands containing trees such as spruce, fir, pine, hemlock, arborvitae, and larch are used, although pure pine and pure hemlock are less preferred (Ghalambor and Martin 1999).

History.- The Red-breasted Nuthatch appears to be more a more common Connecticut breeder than in the 19th century (Zeranski and Baptist 1990), when it was known from few summer locations (Sage et al. 1913).

Synthesis.- Breeding Bird Survey and Christmas Count data suggest that Red-breasted Nuthatch populations may be increasing in southern New England. However, data from Craig (1987) showed much higher densities than this study. He also found that summering Red-breasted far outnumbered White-breasted Nuthatches, a situation that is no longer true. Indeed, at some of the same transects where birds had been common in the earlier study, none were present during this investigation. Hence, some local decline appears likely in breeding populations of at least the Northeast Uplands Ecoregion. Population fluctuations are typically greatest at the range periphery (Thompson and Nolan 1973, Marti 1997), which includes Connecticut (Ghalambor and Martin 1999).

Low winter populations occurred during this study, although in some years the species is a fairly common winter resident. Great variation in annual migration into the southern portions of the range is typical for the species (Ghalambor and Martin 1999), and is reflected in the high coefficient of variation for Christmas Count data.

The summer association of birds with coniferous forests is consistent with other reports of habitat use. Its rarity in mixed conifer-hardwood forests suggests that local populations have retreated to their preferred habitats. It occupied conifer stands particularly along the eastern Connecticut border south through Pachaug State Forest (Fig. 64).

Conservation status.- Populations appear regionally stable, although forest fragmentation and loss of hemlock are potential threats to long term stability.

Sponsored by the Town of Thompson

WHITE-BREASTED NUTHATCH
Sitta carolinensis

Summer

Density (birds/km^2): 8.6 (95% CI: 5.6-13.3)

Density range (birds/km^2/transect): 2.1-24.7

Total population (birds): 23,505 (95% CI: 15,293-36,125)

Detection function: half normal/cosine
$\chi^2 = 1.91, P = 0.17$, df = 1, N = 214

Winter

Density (birds/km^2): 12.1 (95% CI: 9.6-15.2)

Density range (birds/km^2/transect): 1.8-42.4

Total population (birds): 32,853 (95% CI: 26,092-41,366)

Detection function: half normal/cosine
$\chi^2 = 6.44, P = 0.16$, df = 4, N = 341

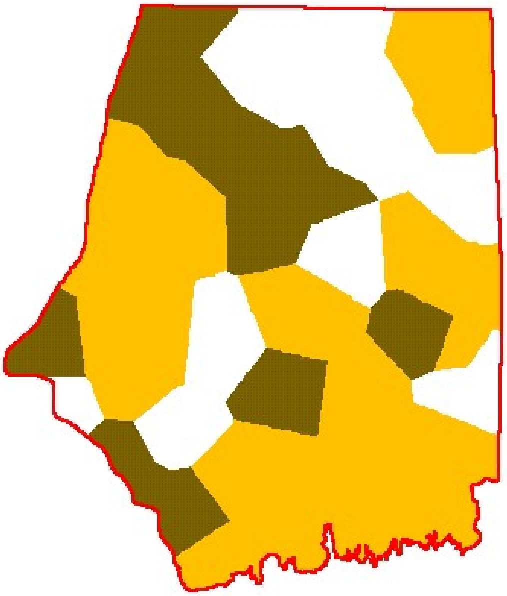

FIG. 65. Summer densities of the White-breasted Nuthatch were similar in Northeast and Southeast Connecticut. Light = 3.4-6.9, medium = 6.9-9.6, dark = 9.6-14.4 birds/km^2.

TABLE 24. Observations of summer habitat use by individual White-breasted Nuthatches showed that they inhabited forests with significantly more oak-dominated and mixed hardwood forests than would be predicted by habitat availability. In winter, individual birds were in forests that were significantly more mesic than predicted. Comparison of population densities with habitat features showed no significant relationships. $P(\chi^2)$ = probability level of chi-square tests, N = 59 summer, 77 winter; $P(t)$ = probability level of Kendall's tau, N = 51; * = significant, ** = highly significant (see Table 8 for abbreviation key).

	Mean Habitat Characteristics				
	F	M	D	C	U
Availability	1.4	2.3	2.0	2.7	2.3
Summer use	1.3	2.2	2.0	2.7	2.3
$P(\chi^2)$	0.25	0.39	0.16	0.90	0.61
$P(t)$	0.67	0.59	0.50	0.71	0.88
Winter use	1.3	2.1	2.0	2.6	2.2
$P(\chi^2)$	0.10	0.02*	-	0.71	0.87
$P(t)$	0.34	0.50	0.69	0.14	0.85

	Percent Vegetation					
	OD	MH	CN	PO	CO	MI
Availability	51.0	13.7	13.1	13.1	8.5	0.7
Summer use	54.2	16.9	13.6	5.1	3.4	6.8
$P(\chi^2)$	0.05*					
Winter use	51.9	11.7	18.2	11.7	2.6	3.9
$P(\chi^2)$	0.22					

Density distribution.-The White-breasted Nuthatch was a common inhabitant of the forests of eastern Connecticut. Its breeding densities were similar (Mann-Whitney U = 304.5, $P = 0.70$, N = 51) in Northeast (8.6 ± 6.3 birds/km^2) and Southeast Connecticut (8.6 ± 4.7 birds/km^2; Fig. 65). In winter, its densities averaged lower in Northeast (11.0 ± 7.3 birds/km^2) than Southeast Connecticut (13.1 ± 9.7 birds/km^2; Fig. 66), but not significantly so (Mann-Whitney U = 280.5 , $P = 0.53$, N = 51). Population estimates are based on detections of calling males and females.

Population variance.- The coefficient of variation calculated from Breeding Bird Survey data (Sauer et al. 2001) predicted pop-

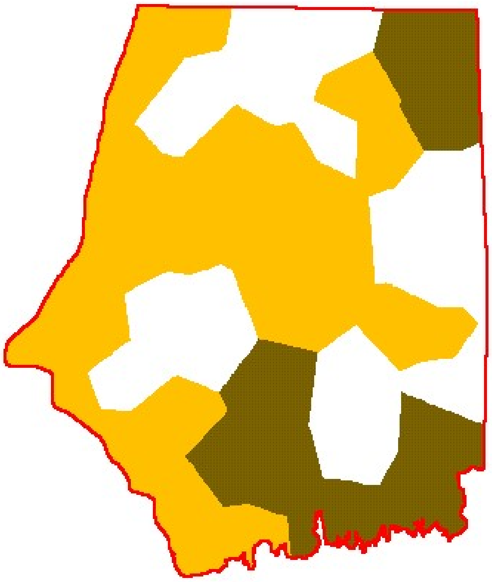

FIG. 66. Winter densities of the White-breasted Nuthatch averaged greater in Southeast Connecticut. Light = 4.1-9.4, medium = 9.4-15.9, dark = 15.9-25.4 birds/km^2.

ulation variation as 18.0% for southern New England. From 1966-2000, populations showed no regional trend (mean count/route = 4.3, trend = 0.4, P = 0.59, N = 51), but a strongly significant continental increase (mean count/route = 1.0, trend = 2.2, P = 0.00, N = 1831).

Christmas Count data predicted population variation as 15.2% for Connecticut. From 1966-2001, populations showed no significant Connecticut trend (birds/party hour = 1.0, Kendall's tau = 0.04, P = 0.55, N = 37). U.S. populations, in contrast, showed a significant increase (birds/party hour = 0.4, quadratic model $r^2 = 0.27$, df = 34, P = 0.00).

On ten line transects through the Northeast Uplands Ecoregion, Craig (1987) reported 1.7 birds/km^2, a value below that of this study. In a ten year sample of Breeding Bird Census plots in Connecticut, densities of pairs/km^2 were 8.6 ± 4.5 in oak-hemlock forest, 12.8 ± 5.5 in hemlock-hardwood forest, and 19.8 ± 8.1 in second growth deciduous forest. A Winter Bird Survey plot in a deciduous-coniferous wetland had 19.1-30.2 birds/km^2. These densities average higher than those found in this study.

Elsewhere, breeding densities reported from forest habitat include 19 males/km^2 in West Virginia, 1-10 pairs/km^2 in Ontario, 3-7 pairs/km^2 in Missouri (Pravosudov and Grubb 1993), and 23 ± 17 birds/km^2 in New Hampshire (Holmes et al 1986). Winter populations are reported as 11.6 birds/km^2 in Kentucky and 19 birds/ km^2 in West Virginia (Pravosudov and Grubb 1993).

Habitat.- Observations of summer habitat use by individual White-breasted Nuthatches showed that they inhabited forests with significantly more oak-dominated and mixed hardwood forests than would be predicted by habitat availability (N = 59). In winter, individual birds were in forests that were significantly more mesic than predicted. Comparison of population densities with habitat features showed no significant relationships in either summer or winter (Table 24). We found the species to be widely distributed through a variety of forest habitats.

Elsewhere, the White-breasted Nuthatch is reported to inhabit mature, deciduous forest, although it also is present in mixed deciduous-coniferous forest. It is believed to prefer forest edge (Pravosudov and Grubb 1993).

History.- The White-breasted Nuthatch has been known as a fairly common Connecticut resident since the 19th century (Sage et al. 1913). Zeranski and Baptist (1990) speculate that its numbers increased during the 20th century as forest extent expanded.

Synthesis.- Breeding Bird Survey and Christmas Count data suggest that White-breasted Nuthatch populations are at least stable in southern New England, but increasing continentally. Data from Craig (1987) for eastern Connecticut support the possibility of a regional increase. The regional maturation of forest in southern New England

(Ward and Barsky 2000) is likely responsible for this increase.

We observed population increases from summer to winter in a number of permanent resident species, including this one. Such increases likely reflect recruitment of first year birds into the population. However, migration from northern areas into Connecticut also appears likely, as several lines of evidence indicate that southward movement of northern populations occurs during winter, perhaps particularly juveniles (Pravosudov and Grubb 1993).

Although not as strongly as in some permanent resident species, populations of the White-breasted Nuthatch appeared to drift south during the winter months (Fig. 66). Such movement, although weakly documented for the species (Pravosudov and Grubb 1993), is indicative of winter migration of birds into more climatically mild, southern portions of their range. However, additional investigation is required to verify the generality of this pattern.

The summer association of greater populations with deciduous forest associations is consistent with other reports of habitat use. The winter association with more mesic habitats is unreported.

Conservation status.- Populations appear regionally stable, although forest fragmentation is a potential threat to long term stability.

Sponsored by Edward Streeter

BROWN CREEPER
Certhia americana

Summer

Density (males/km^2): 2.4 (95% CI: 1.4-4.0)
Density range (males/km^2/transect): 0-15.0
Total population (males): 6,404 (95% CI: 3,328-10,713)

Winter

Density (birds/km^2): 2.4 (95% CI: 1.4-4.0)
Density range (birds/km^2/transect): 0-15.0
Total population (birds): 6,532 (95% CI: 3,905-10,926)

Detection function (all data): half normal/cosine
$x^2 = 1.69$, $P = 0.64$, df = 3, N = 48

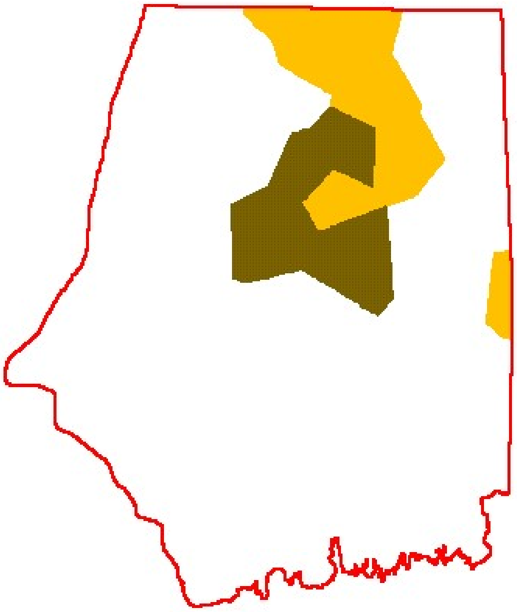

FIG. 67. Summer densities of the Brown Creeper were greatest in Northeast Connecticut. Light = 0-3.3, medium = 3.3-8.3, dark = 8.3-13.3 males/km^2.

Density distribution.-The Brown Creeper was an uncommon inhabitant of the forests of eastern Connecticut. Its breeding densities were significantly greater (Mann- Whitney U = 224.0, *P* = 0.02, N = 51) in Northeast (3.7 ± 5.2 males/km^2) than Southeast Connecticut (1.0 ± 2.5 males/km^2; Fig. 67). In winter, its densities were similar (Mann-Whitney U = 288.0, *P* = 0.58, N = 51) throughout (Northeast: 2.4 ± 2.9 birds/km^2; Southeast: 2.4 ± 4.1 birds/km^2; Fig. 68).

TABLE 25. Limited observations of summer habitat use by individual Brown Creepers suggested that they inhabited forests with more coniferous cover than would be predicted by habitat availability (N = 12). Limited winter observations showed no strong differences with habitat availability (N = 18). Comparison of population densities with habitat features showed a nearly significant correlation with increasing coniferous cover in summer. *P*(*t*) = probability level of Kendall's tau, N = 51; * = significant, ** = highly significant (see Table 8 for abbreviation key).

	Mean Habitat Characteristics				
	F	M	D	C	U
Availability	1.4	2.3	2.0	2.7	2.3
Summer use	2.0	2.3	2.1	2.6	1.9
P(*t*)	0.09	0.15	0.83	0.93	0.30
Winter use	1.6	2.1	2.0	2.6	2.3
P(*t*)	0.59	0.17	0.25	0.79	0.83

	Percent Vegetation					
	OD	MH	CN	PO	CO	MI
Availability	51.0	13.7	13.1	13.1	8.5	0.7
Summer use	25.0	8.3	8.3	25.0	33.3	0.0
Winter use	33.3	16.7	22.2	22.2	5.6	0.0

Population estimates are based on <60 detections, so have reduced accuracy. Summer population estimates are based on detections of singing males, whereas winter estimates are based on those of calling males and females.

Population variance.- The coefficient of variation calculated from Breeding Bird Survey data (Sauer et al. 2001) predicted continental population variation as 221.4%. From 1966-2000, populations showed no significant continental trend (mean count/route = 0.4, trend = 0.2, *P* = 0.81, N = 547). Limited data from southern New England also

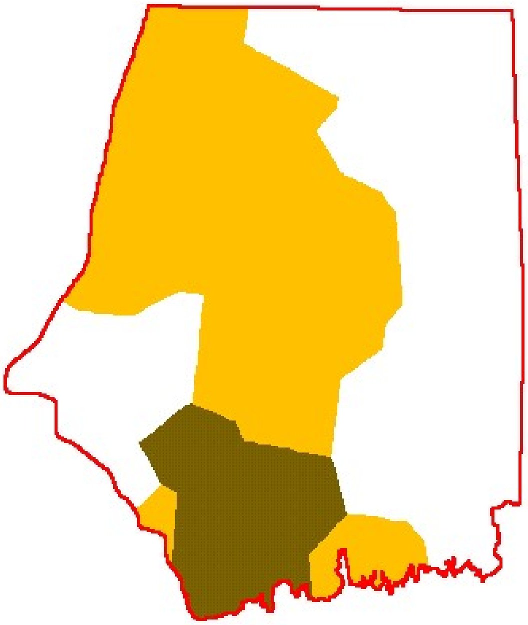

FIG. 68. Winter densities of the Brown Creeper were similar in Northeast and Southeast Connecticut. Light = 0-1.7, medium = 1.7-6.7, dark = 6.7-11.7 birds/km^2.

suggested no trend.

Christmas Count data predicted population variation as 35.4% for Connecticut. From 1966-2001, populations showed a significant Connecticut (birds/party hour = 0.1 quadratic model $r^2 = 0.39$, df = 34, $P = 0.00$) and U.S. decline (birds/party hour = 0.1, quadratic model $r^2 = 0.21$, df = 34, $P = 0.02$). In both cases, the quadratic curve fitted to population data showed that populations appeared to increase during the 1980s and to decline afterwards.

On ten line transects through the Northeast Uplands Ecoregion, Craig (1987) reported 17.4 ± 20.8 birds/km^2, a value above that of this study. In a ten year sample of Breeding Bird Census plots in Connecticut, birds were absent from oak-hemlock forest, had 24.7 ± 21.1 pairs/km^2 in hemlock-hardwood forest, and occurred four times (5.0-19.8 pairs/km^2) in second growth deciduous forest. These densities average higher than those found in this study. A Winter Bird Survey plot in a deciduous-coniferous wetland had 0.1-5.1 birds/km^2.

Elsewhere, breeding densities are reported as 48-105 pairs/km^2 in Minnesota, 15.8 ± 7.1 territories/km^2 in Pennsylvania, and 8.6-10.3 territories/km^2 in Quebec (Hejl et al. 2002). In New Hampshire, 4 ± 7 birds/km^2 are reported (Holmes et al. 1986).

Habitat.- Limited observations of summer habitat use by individual Brown Creepers suggested that they inhabited forests with more coniferous cover than would be predicted by habitat availability. Limited winter observations showed no strong differences with habitat availability. Comparison of population densities with habitat features also showed a nearly significant correlation with increasing coniferous cover in summer (Table 25). We found the species to inhabit particularly conifers and swamp habitats. Elsewhere, it is reported to prefer mature, primarily coniferous forest, although it also is present in deciduous forest in the Northeast. (Hejl et al. 2002).

History.- The Brown Creeper has increased as a Connecticut breeder since the 19th century (Zeranski and Baptist 1990). Nesting was unreported by Sage et al. (1913).

Synthesis.- Breeding Bird Survey data suggest that Brown Creeper populations are stable, but Christmas Count data indicate population fluctuations and an overall decline. Data from Craig (1987) suggest a decline as well, although this study was performed in the Northeast Upland Ecoregion, where the species is most abundant (Fig. 67). Hence, evidence for a local decline is unclear. The regional maturation of forest in southern New England (Ward and Barsky 2000) appears to be providing ample habitat at present.

We observed no population decline from summer to winter in this strongly migratory species. Populations are reported to increase in the Southeast during winter (Hejl et al. 2002), and migrants into Connecticut during winter appear to offset birds leaving the region. Birds were more widespread during winter than in summer, although their greatest concentrations were near the coast (Fig. 68).

Greater summer densities in Northeast compared with Southeast Connecticut (Fig. 67) are also suggested by distributions mapped in the *The Atlas of Breeding Birds of Connecticut* (Bevier 1994). It is likely related to the greater percent of preferred breeding habitat (conifers) in this region (Table 3,4,5). However, additional study is needed to verify this trend.

The summer association of birds with coniferous forests is consistent with other reports of habitat use. It occupied conifer stands particularly in the Northeast Uplands Ecoregion and Pachaug State Forest (Fig. 67).

Conservation status.- Populations may be declining. Although forest maturation is likely benefiting the species, forest fragmentation is a potential threat to its long term stability.

Sponsored by Carol Charter

CAROLINA WREN
Thryothorus ludovicianus

Summer

Density (males/km^2): 1.9 (95% CI: 1.2-3.0)

Density range (males/km^2/transect): 0-13.8

Total population (males): 5,166 (95% CI: 3,301-8,084)

Winter

Density (birds/km^2): 0.9 (95% CI: 0.5-1.4)

Density range (birds/km^2/transect): 0-5.1

Total population (birds): 2,258 (95% CI: 1,299-3,926)

Detection function (all data): half normal/cosine
$x^2 = 2.39$, $P = 0.30$, df = 2, N = 80

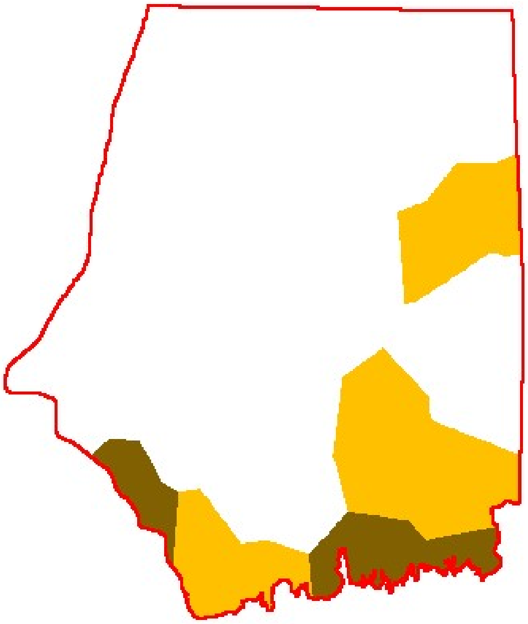

FIG. 69. Summer densities of the Carolina Wren were greatest in Southeast Connecticut. Light = 0-2.3, medium = 2.3-5.8, dark = 5.8-9.8 males/km^2.

Density distribution.- The Carolina Wren was an uncommon inhabitant of the forests of eastern Connecticut. Its breeding densities were significantly greater (Mann-Whitney U = 129.5, *P* = 0.00, N = 51) in Southeast (3.5 ± 4.4 males/km^2) than Northeast Connecticut (0.4 ± 1.7 males/km^2; Fig. 69). In winter, densities also were significantly greater (Mann-Whitney U = 196.0, *P* = 0.01, N = 51) in Southeast (1.4 ± 1.7 birds/km^2) than Northeast Connecticut (0.3 ± 0.8 birds/km^2; Fig. 70).

TABLE 26. Limited summer observations of individual Carolina Wrens suggested that they inhabited forests with lower canopy cover than would be predicted by habitat availability. They also were particularly frequent in mixed hardwoods (N = 19; see Table 8 for abbreviation key).

	Mean Habitat Characteristics				
	F	M	D	C	U
Availability	1.4	2.3	2.0	2.7	2.3
Use	1.3	2.3	2.0	2.4	2.3

	Percent Vegetation					
	OD	MH	CN	PO	CO	MI
Availability	51.0	13.7	13.1	13.1	8.5	0.7
Use	52.6	26.3	5.3	5.3	10.5	0.0

Population estimates are based on detections of singing males in summer and calling males and females in winter. Because the species was loudly vocal in winter and summer, we pooled detection distances to improve population estimates.

Population variance.- The coefficient of variation calculated from Breeding Bird Survey data (Sauer et al. 2001) predicted continental population variation as 1.8%. From 1966-2000, populations showed a strongly significant continental increase (mean count/route = 10.4, trend = 0.9, *P* = 0.00, N = 1387). Limited data from southern New England also suggested an increase.

Christmas Count data predicted population variation as 111.9% for Connecticut. From 1966-2001, populations showed a strongly significant Connecticut (birds/party hour = 0.1, Kendall's tau = 0.81, *P* = 0.00, N = 37) and U.S. increase (birds/party

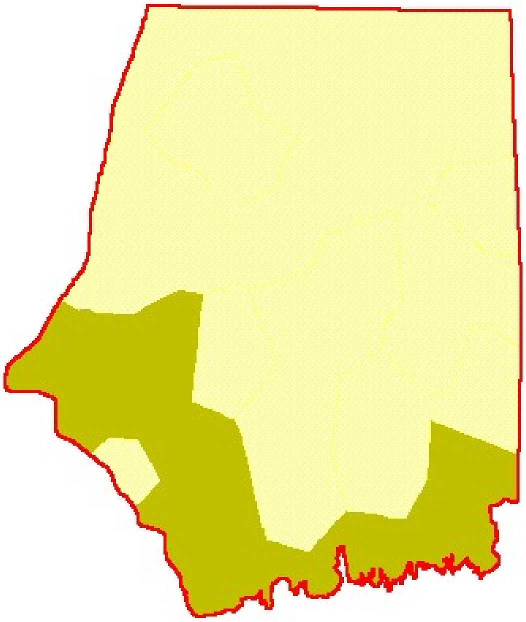

FIG. 70. Winter densities of the Carolina Wren were greatest in Southeast Connecticut. Light = 0-1.2, dark = 1.2-2.9 birds/km^2.

hour = 0.04, quadratic model $r^2 = 0.44$, df = 34, $P = 0.00$).

On ten line transects through the Northeast Uplands Ecoregion, Craig (1987) reported no birds. In a ten year sample of Breeding Bird Census plots in Connecticut, no birds were present in oak-hemlock, hemlock-hardwood, or second growth deciduous forest. A Winter Bird Survey plot in a deciduous-coniferous wetland yielded 1.9-2.3 birds/km^2, which is within the range computed in this study. We found no other population estimates for our region.

Habitat.- Limited summer observations of individual Carolina Wrens suggested that in summer they inhabited forests with lower canopy cover than would be predicted by habitat availability. They also were particularly frequent in mixed hardwoods (Table 26). We had insufficient data to examine winter habitat use by individuals or to compare population densities with habitat variables. We found the species to be associated principally with forest edge and thickets in forest openings.

Elsewhere, the Carolina Wren is reported to occupy a variety of habitats, particularly ones with with dense understories. More mesic sites appear preferred. The species also inhabits residential areas with trees and shrubs (Haggerty and Morton 1995).

History.- The Carolina Wren appears to have increased as a Connecticut breeder since the 19th century (Zeranski and Baptist 1990).

Synthesis.- Breeding Bird Survey and Christmas Count data suggest that Carolina Wren populations are increasing in southern New England and continentally. However, populations have historically fluctuated in Connecticut due to winter weather conditions at this, its northern range limit (Sage et al. 1913, see also Haggerty and Morton 1995).

The strong population decline observed from summer to winter in this apparently non-migratory species may be a consequence of reduced conspicuousness (even though calling loudly, calling less) during the winter season. Another explanation consistent with available data (Haggerty and Morton 1995) is that extensive winter mortality occurs at its northern range limit. A third possibility is that a previously unnoticed migration from the northern periphery of the range occurs after the breeding season. Supporting evidence for possible migration is that in Northeast Connecticut, R. Craig (pers. obs.) has repeatedly observed that birds disappear from breeding sites each fall, and re-appear at the same sites in spring.

The observed asociation of birds with more open canopy forest is consistent with other reports of habitat use. Its proportionately greater use of mixed hardwoods, a forest association of mesic environments, is also consistent with other reports.

Conservation status.- Populations appear to be increasing regionally. However, severe winters are likely to reverse this trend periodically.

Sponsored by Kathy and Chris Demers

HOUSE WREN

Troglodytes aedon

Density distribution.- Although common outside of forest, the House Wren was uncommon to absent in the forests of eastern Connecticut. From our 13 detections of singing males, we tentatively estimate a population of 1,840 (0.7 males/km^2) in primarily forested landscapes. We found birds at 23% of Northeast and 8% of Southeast Connecticut transects, suggesting that the species occurred more frequently to the north.

Population variance.- The coefficient of variation calculated from Breeding Bird Survey data (Sauer et al. 2001) predicted population variation as 6.1% for southern New England. From 1966-2000, populations showed a significant regional decline (mean count/route = 12.1, trend = -1.6, $P = 0.04$, N = 51), but continental increase (mean count/route = 5.4, trend = 1.1, $P = 0.00$, N = 2253).

On ten line transects through the Northeast Uplands Ecoregion, Craig (1987) reported 7.1 birds/km^2. In a ten year sample of Breeding Bird Census plots in Connecticut, densities of pairs/km^2 were 11.8 ± 10.4 in oak-hemlock forest and 4.5 ± 4.9 in second growth deciduous forest. It occurred once (9.5 pairs/km^2) in hemlock-hardwood forest. These densities overlap but average higher than those found in this study. Elsewhere, an average of 30.3 pairs/km^2 have been found in isolated Illinois woodlots.

Habitat.- We encountered too few House Wrens to evaluate their individual habitat use. Our few observations suggested that birds were associated with more deciduous forests and more mesic sites. We generally found birds at forest edge and in deciduous swamps.

Elsewhere in the East, the species is reported to inhabit forest edge, forest fragments, suburban areas and open woodland, such as wooded swamps and disturbed forest. It is generally not found in extensive forests, except in areas opened through disturbance. It also inhabits residential and agricultural areas (Johnson 1998).

History.- In Connecticut, the House Wren was described as common in the early 19th century, but declining by the late 19th century. During the early 20th century, it appears to have again increased (Sage et al. 1913, Smith and Devine 1994c).

Synthesis.- Breeding Bird Survey data show that the House Wren is declining regionally, a trend corroborated by comparison of our results with earlier transect studies of Craig (1987). The maturing forests of Connecticut (Ward and Barsky 2000) are likely responsible for the decline, because forest maturation eliminates the more open habitats occupied by the species.

Our observation that the House Wren appeared to be associated with moister forests is consistent with evidence that the species frequently occurs in swamps. Its possible association with more deciduous habitats is unreported, however. A more complete assessment of habitat use within forested landscapes awaits increased sampling.

Conservation status.- Populations appear to be declining, but should persist because the species is versatile in habitat use. Forest maturation is the likely cause of the decline.

Sponsored by the Town of Brooklyn

WINTER WREN
Troglodytes troglodytes

Summer

Density (males/km^2): 0.7 (95% CI: 0.3-1.4)

Density range (males/km^2/transect): 0-5.9

Total population (males): 1,799 (95% CI: 857-3,777)

Winter

Density (birds/km^2): 0.3 (95% CI: 0.1-0.8)

Density range (birds/km^2/transect): 0-2.0

Total population (birds): 864 (95% CI: 361-2,063)

Detection function (all data): uniform/cosine
$\chi^2 = 6.85$, $P = 0.08$, df = 3, N = 25

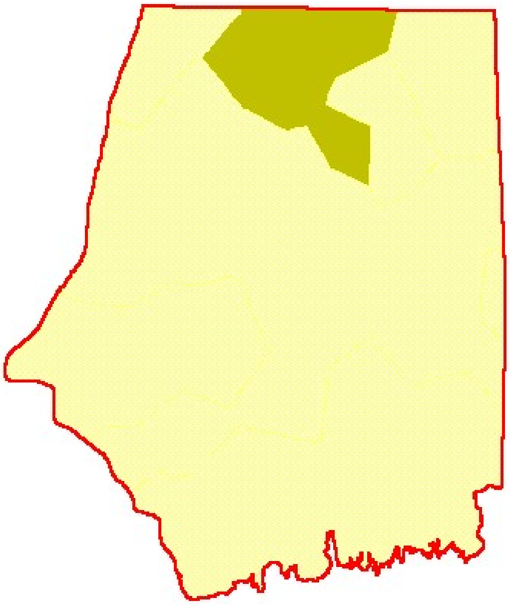

FIG. 71. Summer densities of the Winter Wren were greatest in Northeast Connecticut. Light = 0-1.3, dark = 1.3.4.6 males/km^2.

Density distribution.-The Winter Wren was a very uncommon inhabitant of the forests of eastern Connecticut. Its breeding densities were significantly greater (Mann-Whitney U = 245.5, *P* = 0.04, N = 51) in Northeast (1.1 ± 1.7 males/km^2) than Southeast Connecticut (0.2 ± 0.7 males/km^2; Fig. 71). In winter, densities were similar (Mann-Whitney U = 312.5, *P* = 1.00, N = 51) in Northeast (0.3 ± 0.7 birds/km^2) and Southeast Connecticut (0.3 ± 0.7 birds/km^2.

Because the species was loudly vocal in winter and summer, we pooled detection distances to improve population estimates. Population estimates are based on <60 detections of singing males in summer and calling males and females in winter, so have reduced accuracy.

Population variance.- The coefficient of variation calculated from Breeding Bird Survey data (Sauer et al. 2001) predicted continental population variation as 18.1%. From 1966-2000, populations showed a significant continental increase (mean count/route = 7.0, trend = 3.0, *P* = 0.02, N = 786). Limited data from southern New England showed no trend.

Christmas Count data predicted population variation as 54.5% for Connecticut. From 1966-2001, populations showed a strongly significant Connecticut increase (birds/party hour = 0.02, quadratic model r^2 = 0.37, df = 34, *P* = 0.00). The quadratic function fitted to count data suggested a population decline during the 1980s followed by a population increase since. U.S. populations also showed a strongly significant but continuous increase (birds/party hour = 0.04, power function model r^2 = 0.47, df = 35, *P* = 0.00).

On ten line transects through the Northeast Uplands Ecoregion, Craig (1987) reported 2.8 birds/km^2, a value somewhat above that of this study, but similar to that obtained for Northeast Connecticut when our estimates are multiplied by two to yield birds/km^2. In a ten year sample of Breeding Bird Census plots in Connecticut, no birds were present in oak-hemlock, hemlock-hardwood, or second growth deciduous forest. A Winter Bird Survey plot in a deciduous-coniferous wetland also yielded no birds. Elsewhere, densities of pairs/km^2 are reported as 5-55 in Maine, 20-57.5 in New Hampshire, and 12.5-20 in Ontario (Hejl et al. 2002). We found no reports of winter densities for our region.

Habitat.- The Winter Wren occurred too rarely to evaluate habitat use by individuals. It appeared to be associated with greater understory density in summer and winter. Moreover, it was largely restricted in summer to conifer-dominated wetlands. In winter, it appeared in deciduous and coniferous wetlands.

Elsewhere, the species is reported to occupy a variety of habitats, although coniferous forests achieve highest population densities. Wetlands are frequently preferred, as is old growth with abundant fallen logs. Denser understories associated with small forest openings are also used (Hejl et al. 2002).

History.- The Winter Wren appears to have increased as a Connecticut breeder since the 19th century (Zeranski and Baptist 1990). Sage et al. (1913) reported it in summer from only one location.

Synthesis.- Breeding Bird Survey and Christmas Count data indicate that Winter Wren populations are stable or increasing in southern New England. Data from Craig (1987) provide corroboration for stable populations, in that they show densities similar to that found for Northeast Connecticut. Low winter populations occurred during this study, a situation typical (R. Craig pers. obs.) for this migratory species that winters primarily in the Southeast (Hejl et al. 2002).

The significantly greater density of summering birds in Northeast Connecticut is likely related to the decline of coniferous habitats in Southeast Connecticut (Table 3,4,5). Moreover, because the species is near its southern range limit, additional geographic factors likely influence populations. The greater frequency of the Winter Wren in the Northeast Uplands Ecoregion (Fig. 71) is also suggested by distributions mapped in *The Atlas of Breeding Birds of Connecticut* (Bevier 1994).

Our observation that birds were associated with greater understory density is consistent with other reports of habitat use. The species' prevalence in wetlands also was consistent with other reports.

Conservation status.- Populations appear to be at least regionally stable. However, forest fragmentation and loss of hemlock are potential threats to long term stability.

GOLDEN-CROWNED KINGLET

Regulus satrapa

Density (birds/km^2): 40.0 (95% CI: 29.4-54.6)
Density range (birds/km^2/transect): 0-105.4
Total population (birds): 109,050 (95% CI: 79,998-148,650)

Detection function: uniforn/cosine
x^2 = 2.45, P = 0.65, df = 2, N = 95

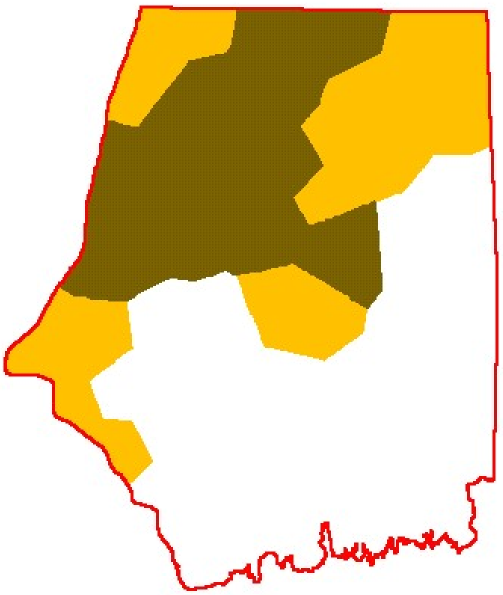

FIG. 72. Winter densities of the Golden-crowned Kinglet were greatest in Northeast Connecticut. Light = 0-28.1, medium 28.1-63.2, dark = 63.2-98.3 birds/km^2.

Density distribution.-The Golden-crowned Kinglet was an abundant to uncommon winter inhabitant of the forests of eastern Connecticut. It was absent in summer. Its winter densities were significantly higher (Mann-Whitney U = 61.5, P = 0.00, N = 51) in Northeast (64.9 $\pm$ 32.1 birds/km^2; Fig. 72) than Southeast Connecticut (15.2 $\pm$ 19.7 birds/km^2). Population estimates are based on detections of flocks of males and females.

TABLE 27. Observations of habitat use by individual Golden-crowned Kinglets showed that birds used forests significantly more mesic than would be predicted by habitat availability. Moreover, population densities were significantly greater in more coniferous forests than predicted. $P(x^2)$ = probability level of chi-square tests, N = 89; $P(t)$ = probability level of Kendall's tau, N = 51; * = significant, ** = highly significant (see Table 8 for abbreviation key).

	Mean Habitat Characteristics				
	F	M	D	C	U
Availability	1.4	2.3	2.0	2.7	2.3
Winter	1.6	2.2	2.0	2.7	2.2
$P(x^2)$	0.10	0.02*	-	0.71	0.87
$P(t)$	0.05*	0.58	0.42	0.94	0.47

	Percent Vegetation					
	OD	MH	CN	PO	CO	MI
Availability	51.0	13.7	13.1	13.1	8.5	0.7
Winter	39.3	10.1	18.0	14.6	15.7	2.2
$P(x^2)$	0.22					

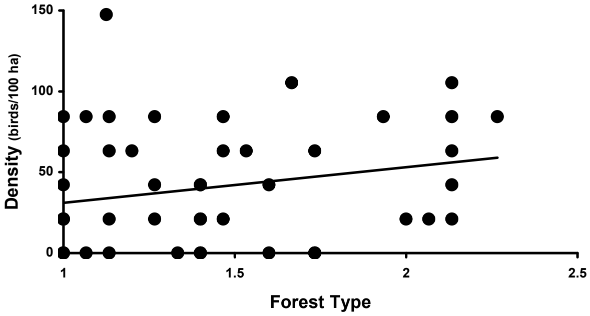

FIG. 73. Winter population density showed a variable but significant increase with increasing coniferous cover.

A major influx of Golden-crowned Kinglets into eastern Connecticut occurred during the winter of 2001-2002. Based on qualitative resurvey of several Northeast Connecticut sites the following winter, this influx was not repeated in 2002-2003. Hence, differences in densities found between Northeast and Southeast Connecticut appeared to be primarily a change in occurrence between years.

Population variance.- The coefficient of variation calculated from Breeding Bird Survey data (Sauer et al. 2001) predicted variation in continental populations as 27.3%. From 1966 to 2000 continental populations showed no significant trend (mean count/ route = 2.7, trend = -0.3, P = 0.67, N = 635). Very limited data from southern New England also suggested no increase.

Christmas Count data predicted population variation as 74.6% for Connecticut. From 1966-2001, populations showed a strongly significant Connecticut (birds/party hour = 0.3, quadratic model r^2 = 0.49, df = 34, P = 0.00) and U.S. increase (birds/party hour = 0.3, power function model r^2 = 0.42, df = 35, P = 0.00).

On ten line transects through the Northeast Uplands Ecoregion, Craig (1987) encountered no birds. In a ten year sample of Breeding Bird Census plots in Connecticut, birds also were absent from oak-hemlock, hemlock-hardwood and second growth deciduous forest. A Winter Bird Survey plot in a deciduous-coniferous wetland yielded 9.8-29.8 birds/km^2.

Elsewhere, Northeastern breeding populations are reported as 10-120 birds/km^2. In winter, densities of birds/km^2 are reported as 24.0-42.0 in Maryland, 10.3-22.5 in Ohio and 13.0-70.0 in Pennsylvania (Ingold and Galati 1997).

Habitat.- Observations of habitat use by individual Golden-crowned Kinglets showed that birds inhabited forests significantly more mesic than would be predicted by habitat availability. They also tended to use forests with more conifers. Moreover, population densities were significantly greater in more coniferous forests than predicted (Table 27). Despite these associations, the species occurred widely in a variety of forest conditions.

Elsewhere, breeding birds tolerate a variety of conditions, including coniferous, mixed and deciduous forests, open and closed forests, and forests with dense and open understories. However, the species is most typical of coniferous forests. In winter, it also uses varied habitats, including ones similar to those used during the breeding season (Ingold and Galati 1997).

History.- The Golden-crowned Kinglet has been reported in summer only since the 20th century, and may be increasing as a breeder. It was first reported breeding in eastern Connecticut in 1974 (Clark 1994f). It has historically been a fairly common winter resident (Zeranski and Baptist 1990).

Synthesis.- Although regional summer populations may be increasing, little evidence exists for such an increase in eastern Connecticut. Our inability to locate summering birds despite our intensive efforts attests to the continued rarity of summer residents. Only two other summer records are reported for eastern Connecticut (Clark 1994f).

During 2001-2002, the Golden-crowned Kinglet was the region's most abundant, ubiquitous wintering species. However, the large fluctuations in winter population densities characteristic of many winter resident species (note coefficients of variation for Christmas Counts) are illustrated by our differential findings during the two years of this study. Only additional study will permit a more complete assessment of winter density distributions.

Our observations of winter habitats were consistent with other reports, and illustrate that the species is versatile in habitat use. Even with the much lower populations observed during the winter of 2002-2003, we still observed use of a variety of habitats.

Conservation status.- The Golden-crowned Kinglet may increase as a summer resident in eastern Connecticut. Its wide tolerance for winter habitat conditions should ensure its continued prospering during this season.

BLUE-GRAY GNATCATCHER
Polioptila caerulea

Density (birds/km^2): 9.0 (95% CI: 6.3-12.7)
Density range (birds/km^2/transect): 0-45.7
Total population (birds): 24,429 (95% CI: 17,230-34,635)

Detection function: half normal/cosine
$\chi^2 = 6.29$, $P = 0.17$, df = 4, N = 110

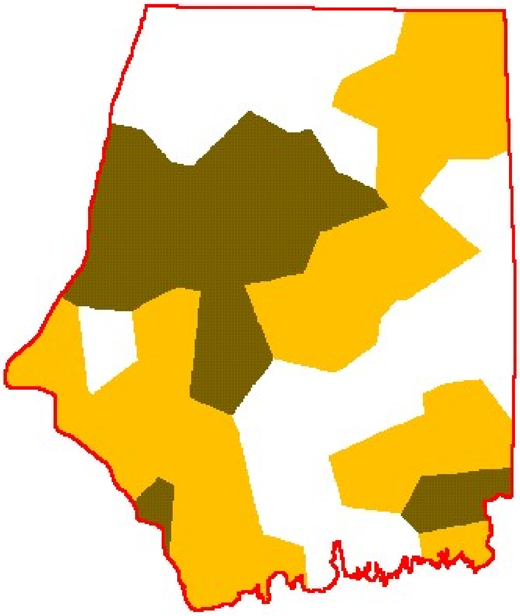

FIG. 74. Densities of the Blue-gray Gnatcatcher were similar in Northeast and Southeast Connecticut. Light = 0-6.3, medium 6.3-12.7, dark = 12.7-19.0 birds/km^2.

Density distribution.- The Blue-gray Gnatcatcher was a fairly common breeder in most forests in eastern Connecticut. Densities were virtually identical in (Mann-Whitney U = 309.0, $P = 0.76$, N = 51) Southeast (8.8 ± 9.3 birds/km^2) and Northeast Connecticut (8.6 ± 8.6 birds/km^2; Fig. 74). Population estimates are based on detections of male and female call notes.

Population variance.- The coefficient of variation calculated from Breeding Bird Survey data (Sauer et al. 2001) predicted variation in continental populations as 13.6%. From 1966-2000, continental populations increased significantly (mean count/route = 2.4, trend = 0.7, $P = 0.05$, N = 1481). Limited data from southern New England suggested an increase as well.

TABLE 28. Categories of habitat use by individual Blue-gray Gnatcatchers showed significant association with more deciduous forest, particularly mixed hardwoods. Comparison of population densities with habitat features also demonstrated a nearly significant correlation with forest cover. $P(\chi^2)$ = probability level of chi-square tests, N = 77; $P(t)$ = probability level of Kendall's tau, N = 51; * = significant, ** = highly significant (see Table 8 for abbreviation key).

	Mean Habitat Characteristics				
	F	M	D	C	U
Availability	1.4	2.3	2.0	2.7	2.3
Use	1.2	2.2	2.0	2.6	2.3
$P(\chi^2)$	0.05*	0.10	-	0.25	0.64
$P(t)$	0.07	0.75	0.42	0.67	0.11

	Percent Vegetation					
	OD	MH	CN	PO	CO	MI
Availability	51.0	13.7	13.1	13.1	8.5	0.7
Use	46.8	27.3	11.7	7.8	1.3	5.2
$P(\chi^2)$	0.01**					

On ten line transects through the Northeast Uplands Ecoregion, Craig (1987) reported 7.1 birds/km^2, a value similar to that of this study. Ellison (1994a) reviewed plot studies showing densities ranging from 10-11 birds/km^2 for Connecticut. In the southeastern U.S., populations to 331 pairs/km^2 have been found (Ellison 1992).

In a ten year sample of Breeding Bird Census plots in Connecticut, densities of pairs/km^2 were 15.4 ± 3.3 in oak-hemlock forest, 18.1 ± 9.5 in hemlock-hardwood forest and 9.9 ± 8.7 in second growth deciduous forest. These estimates are within the range of those computed in this study, although they averaged higher.

Habitat.- Data from individual Blue-gray Gnatcatchers showed that they inhabited forests more deciduous than would be predicted by habitat availability. This relationship was reflected in their more frequent presence in particularly mixed hardwood forests. The nearly significant association between forest type and population density verified the importance of the relationship (Table 28).

Elsewhere, the species is reported to occupy a broad range of habitats from shrublands to mature forest. It is present in deciduous and pine-oak forests, in swamps, riparian habitats, and in upland forests. More mesic habitats appear to be preferred (Ellison 1992).

History.- The Blue-gray Gnatcatcher was rare in Connecticut before 1950 (Ellison 1994a). Data from the Breeding Bird Survey show that the increase has been dramatic since 1966.

Synthesis.- The population densities computed in this survey are similar to but slightly higher than those of earlier transect estimates of Craig (1987). As with Breeding Bird Survey data, such findings point toward a continued regional population increase.

The tendency of the Blue-gray Gnatcatcher to inhabit forests averaging more deciduous and moist than those available is consistent with other reports for the species (Ellison 1992). Despite these tendencies, its populations were about as high in Northeast as Southeast Connecticut, even though habitats average more deciduous to the south (Table 3,4,5).

Conservation status.- Populations are increasing. However, as a forest interior species, it appears vulnerable to forest fragmentation.

Sponsored by Matthew Carroll and Kim MacDonald

EASTERN BLUEBIRD
Sialia sialis

Summer

Density (birds/km^2): 0.2 (95% CI: 0.1-0.8)
Density range (birds/km^2/transect): 0-3.8
Total population (birds): 609 (95% CI: 180-2,065)

Winter

Density (birds/km^2): 0.9 (95% CI: 0.3-2.5)
Density range (birds/km^2/transect): 0-5.7
Total population (birds): 2,381 (95% CI: 831-6,826)

Detection function (all data): hazard/cosine
$x^2 = 4.06$, $P = 0.40$, df = 4, N = 29

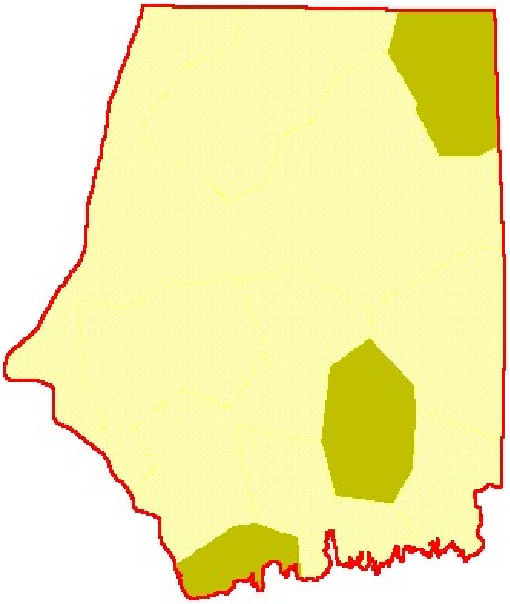

FIG. 75. Winter densities of the Eastern Bluebird were similar in Northeast and Southeast Connecticut. Light = 0-1.3, dark = 1.3-3.8 birds/km^2.

Density distribution.- Although locally common in non-forested landscapes, The Eastern Bluebird was a very uncommon resident of the forests in eastern Connecticut. In summer, it was present at one Northeast and four Southeast Connecticut locations (too few to map). In winter, it was at seven Northeast (0.8 ± 1.7 birds/km^2) and six Southeast Connecticut (0.9 ± 1.9 birds/km^2) locations, a difference that was not significant (Mann-Whitney U = 306.0, $P = 0.87$, N = 51; Fig. 75).

Because the species used similar vocalizations in winter and summer, we pooled detection distances to improve population estimates. However, estimates are based on <60 detections of and calling males and females, so have reduced accuracy. Estimates refer only to that part of the population inhabiting primarily forested landscapes.

Population variance.- The coefficient of variation calculated from Breeding Bird Survey data (Sauer et al. 2001) predicted variation in continental populations as 5.9%. From 1966-2000, continental populations increased significantly (mean count/route = 3.8, trend = 2.8, $P = 0.00$, N = 1924). Limited data from southern New England suggested an increase as well.

Christmas Count data predicted population variation as 71.6% for Connecticut. From 1966-2001, populations showed a strongly significant Connecticut (birds/party hour = 0.4, Kendall's tau = 0.65, $P = 0.00$, N = 37) and U.S. increase (birds/party hour = 0.8, Kendall's tau = 0.73, $P = 0.00$, N = 37).

On ten line transects through the Northeast Uplands Ecoregion, Craig (1987) reported no birds. In a ten year sample of Breeding Bird Census plots in Connecticut, no birds occurred in oak-hemlock, hemlock-hardwood or second growth deciduous forest. A Winter Bird Survey plot in a deciduous-coniferous wetland yielded 0.5-1.9 birds/km^2. We found no other reports of populations in primarily forested landscapes.

Habitat.- The Eastern Bluebird occurred too infrequently for detailed evaluations of its habitat use to be made. Its infrequent occurrence also provided little data with which to compare population densities and habitat variables.

We found birds in deciduous and mixed forests. In them, they were associated with small clear-cuts, forest edge and open swamps, particularly beaver swamps with dead snags and abundant marshy vegetation. Elsewhere, the species is reported to use orchards, clear-cuts, swampy habitats, savannah and xeric forest openings at ridge tops (Gowaty and Plissner 1998).

History.- The Eastern Bluebird was reported as abundant in summer and common in winter by Sage et al. (1913). During the 20th century, populations declined, although more recently they have increased (Zeranski and Baptist 1990).

Synthesis.- Breeding Bird Survey and Christmas Count data indicate that populations are increasing in southern New England. This increase is occurring despite the maturation of regional forests (Ward and Barsky 2000). Because of the species' association with more open habitats, forest maturation might be expected to negatively affect populations.

As with a number of permanent resident species, winter populations appeared greater than those of summer. This increase is likely driven by migration of northern individuals into the study area, as populations north of Connecticut are largely migratory (Gowaty and Plissner 1998).

Our limited observations of habitat use by the Eastern Bluebird were consistent with other reports for the species. Its association with beaver swamps is particularly notable, because over the same period that populations have expanded, beaver numbers have increased (R. Craig pers. obs.). Hence the species appears to be prospering from beaver activity. Nest box programs also have been cited as benefiting populations (Zeranski and Baptist 1990).

Conservation status.- Populations are increasing. The increase may be tied to beaver activity.

Sponsored by Anne Ranhoff

VEERY

Catharus fuscescens

Density (males/km^2): 21.6 (95% CI: 18.0-25.8)
Density range (males/km^2/transect): 0-43.9
Total population (males): 58,744 (95% CI: 49,029-70,383)

Detection function: uniform/cosine
$\chi^2 = 0.21$, $P = 0.98$, df = 3, N = 401

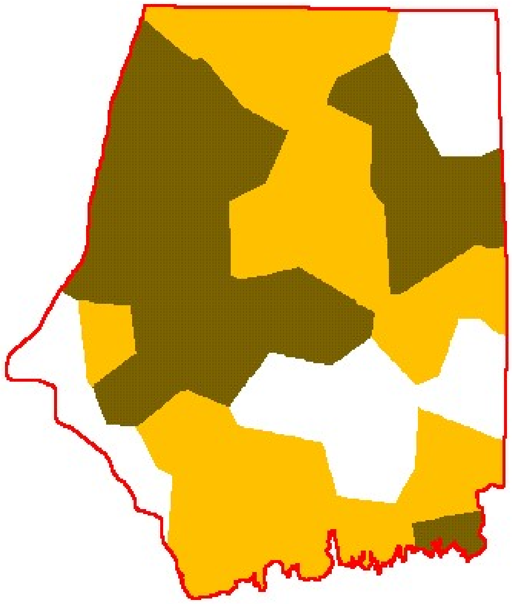

FIG. 76. Densities of the Veery were greatest in Northeast Connecticut. Light = 4.6-16.5, medium 16.5-25.6, dark = 25.6-33.8 males/km^2.

Density distribution.-The Veery was a common to abundant breeder in most forests in eastern Connecticut. Densities significantly decreased (Mann-Whitney U = 184.0, P = 0.01, N = 51) from north (26.0 ± 9.9 males/km^2) to south (17.2 ± 13.0 males/km^2; Fig. 76). Population estimates are based on detections of singing males.

Population variance.- The coefficient of variation calculated from Breeding Bird Survey data (Sauer et al. 2001) predicted variation in southern New England populations as 10.4%. From 1966-2000, populations showed a nonsignificant decline in this region (mean count/route = 6.2, trend = -0.6, P = 0.32, N = 50). Continentally, however, populations significantly declined (mean count/route = 4.5, trend = -1.3, P = 0.00, N = 1052).

TABLE 29. Observations of habitat use by individual Veeries showed that they inhabited forests nearly significantly more moist than would be predicted from habitat availability. Moreover, they tended to inhabit less oak-dominated and more conifer-hardwood forests than would be predicted. Comparison of population densities with habitat features uncovered no significant correlations. $P(\chi^2)$ = probability level of chi-square tests, N = 138; $P(t)$ = probability level of Kendall's tau, N = 51; * = significant, ** = highly significant (see Table 8 for abbreviation key).

	Mean Habitat Characteristics				
	F	M	D	C	U
Availability	1.4	2.3	2.0	2.7	2.3
Use	1.4	2.2	-	2.6	2.4
$P(\chi^2)$	0.25	0.06	0.15	0.21	0.15
$P(t)$	0.70	0.50	0.74	0.89	0.79

	Percent Vegetation					
	OD	MH	CN	PO	CO	MI
Availability	51.0	13.7	13.1	13.1	8.5	0.7
Use	43.5	16.7	20.3	10.1	5.1	4.3
$P(\chi^2)$	0.09					

On ten line transects through the Northeast Uplands Ecoregion, Craig (1987) reported 71.3 ± 38.3 birds/km^2. In a ten year sample of Breeding Bird Census plots in Connecticut, densities of pairs/km^2 were 48.3 ± 8.4 in oak-hemlock forest, 96.0 ± 15.8 in hemlock-hardwood forest, and 106.9 ± 18.6 in second growth deciduous forest. These estimates overlap but average higher than those computed in this study. Earlier plot studies in Connecticut have shown densities ranging from 95.0 to 247.0 birds/km^2 (Craig 1987), whereas plot studies in New Hampshire have shown densities of 23 ± 11 birds/km^2 (Holmes et al. 1986).

Habitat.- Observations of habitat use by individual Veeries showed that they inhabited forests nearly significantly more moist than would be predicted from habitat availability. Moreover, they tended to inhabit less oak-dominated and more conifer-hardwood forests than would be predicted. We uncovered no significant correlations between habitat variables and population densities (Table 29).

The species is typically reported to inhabit moist, deciduous forest, particularly disturbed and second growth forest. It prefers denser understory in disturbed forests. In mature forest, moisture is thought to be the key feature in habitat selection (Moskoff 1995).

History.- The Veery was described as a common Connecticut breeder by Sage et al. (1913). Zeranski and Baptist (1990) speculate that it increased during the 20th century with the regrowth of forest.

Synthesis.- Populations of the Veery appear to be undergoing a long term decline, although this decline has been non-significant in southern New England. Higher densities found in earlier Connecticut transect studies are consistent with this trend (Craig 1987). If younger forest is indeed the preferred habitat of the species, then forest maturation of the type occurring in southern New England (Ward and Barsky 2000) may be driving the decline.

The significantly higher Veery density in Northeast Connecticut may be related to its tendency to use more conifer-hardwood forest. Forests are significantly more coniferous in Northeast compared with Southeast Connecticut (Table 3,4,5). Moreover, additional geographic/climatic factors are likely contributing factors, as much of the Veery's range is north of Connecticut. Declining densities toward range limits are typical for many species (Brown 1984, Pulliam 1988).

Although the species is thought to prefer younger forest or forest with greater understory density, we found only weak, non-significant evidence for such affiliations. However, its nearly significant association with wetter conditions reflects the prevailing view that more mesic forest is preferred.

Conservation status.- Populations are declining continentally, and they appear vulnerable to forest fragmentation.

Sponsored by Irving and Katherine Sheldon

HERMIT THRUSH

Catharus guttatus

Density (males/km^2): 0.8 (95% CI: 0.6-1.1)
Density range (males/km^2/transect): 0-6.2
Total population (males): 2,287 (95% CI: 1,680-3,113)

Detection function: uniform/cosine
$\chi^2 = 2.01$, $P = 0.56$, df = 3, N = 69

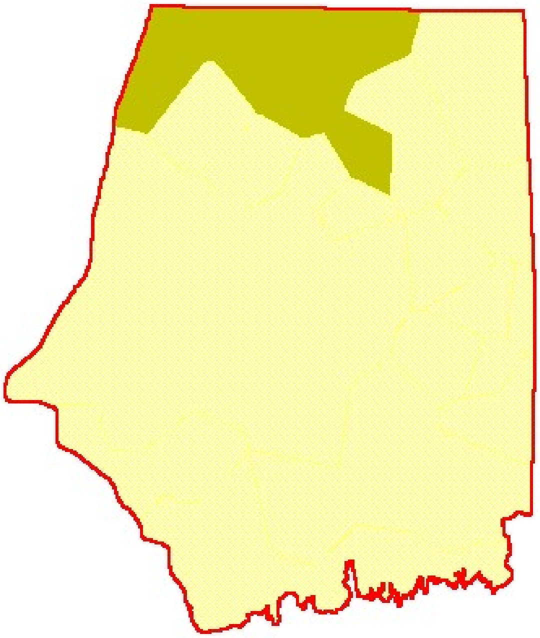

FIG. 77. Summer densities of the Hermit Thrush were greatest in Northeast Connecticut. Light = 0-1.5, dark = 1.5-4.3 males/km^2.

Density distribution.-The Hermit Thrush was an uncommon breeder in the forests of eastern Connecticut. However, it was widespread, and occurred at 53% of transects. Densities significantly decreased (Mann-Whitney U = 184.5, $P = 0.01$, N = 51) from north (1.4 ± 1.6 males/km^2) to south (0.3 ± 0.4 males/km^2; Fig. 77). Population estimates are based on detections of singing males.

The species also occurs as a rare winter resident. During this study we found individuals at Barn Island, Assekonk Swamp and Pequot Trail (Preston). We attempted no winter density estimate from such limited data.

TABLE 30. Comparison of Hermit Thrush population densities with habitat features uncovered no significant correlations. $P(\tau)$ = probability level of Kendall's tau, N = 51; * = significant, ** = highly significant (see Table 8 for abbreviation key).

	Habitat Characteristics				
	F	M	D	C	U
$P(\tau)$	0.10	0.50	0.76	0.40	0.13

Population variance.- The coefficient of variation calculated from Breeding Bird Survey data (Sauer et al. 2001) predicted variation in continental populations as 6.5%. From 1966-2000, continental populations showed a significant increase (mean count/route = 5.7, trend = 1.3, $P = 0.00$, N = 1069). Limited samples from southern New England suggested no significant trend, however.

On ten line transects through the Northeast Uplands Ecoregion, Craig (1987) reported 6.1 birds/km^2. In a ten year sample of Breeding Bird Census plots in Connecticut, the species appeared twice in oak-hemlock forest (4.3 pairs/km^2) and second growth deciduous forest (4.8 pairs/km^2), and had densities of 10.5 ± 11.4 pairs/km^2 in hemlock-hardwood forest. These estimates overlap but average higher than those computed in this study. Elsewhere, density estimates are 38 birds/km^2 in New Hampshire, 30-63 pairs/km^2 in Nova Scotia and 7-25 pairs/km^2 in West Virginia (Jones and Donovan 1996).

Habitat.- Data from individual Hermit Thrushes were too limited to draw conclusions about habitat affiliations. However, birds appeared to be associated with more xeric oak-dominated and pine-oak forests where huckleberry often formed a dense but low understory. We uncovered no significant correlations between habitat variables and population densities (Table 30).

The species is reported to inhabit a variety of northern forest types, but particularly drier forests and areas of interior forest edge. Coniferous and mixed forests are most frequently occupied (Jones and Donovan 1996).

History.- The Hermit Thrush appears to have first ranged south into Connecticut in the late 19th century (Zeranski and Baptist 1990), although Sage et al. (1913) reported it as a regular breeder in northwestern Connecticut. Since then, it has been considered an uncommon to locally common breeder of primarily northern Connecticut (Zeranski and Baptist 1990, Proctor 1994).

Synthesis.- Populations of the Hermit Thrush are undergoing a long term increase, although the extent of this increase in southern New England is unclear. Populations near their southern range limit are frequently variable (Thompson and Nolan 1973, Marti 1997), as is demonstrated also by data from the Breeding Bird Survey, and such variation masks population trends. This increase is in contrast to populations of the other forest thrushes, which are declining. A factor potentially driving the increase in the Hermit Thrush is the succession of northeastern forests to more typically "northern" conifer-hardwood forests (Ward and Barsky 2000).

The significantly higher density of the Hermit Thrush in Northeast compared with Southeast Connecticut may be related in part to its reported preference for more conifer-dominated forests. Forests become increasingly coniferous to the north (Table 3,4,5). Indeed, the presence of more coniferous habitat in the Northeast Uplands Ecoregion is likely related in part to the higher densities we found in this region (Fig. 77). Craig (1987) also found higher densities in the Northeast Uplands.

In addition to habitat, additional geographic/climatic factors are likely contributing factors in the increased density of birds in Northeast Connecticut. Much of the Hermit Thrush's range is north of Connecticut, and declining densities toward range limits are typical for many species (Brown 1984, Pulliam 1988).

Our limited data pointing toward use of more xeric habitats were consistent with other reports for the species. Our observations of birds in pine-oak forest also were consistent, although use of deciduous forests is reported less frequently.

Conservation status.- Populations are increasing, and the species appears more tolerant of forest fragmentation than other forest thrushes.

Sponsored by Irving and Katherine Sheldon

WOOD THRUSH
Hylocichla mustelina

Density (males/km^2): 12.0 (95% CI: 9.7-14.8)
Density range (males/km^2/transect): 0-25.6
Total population (males): 32,627 (95% CI: 26,431-40,275)

Detection function: half normal/polynomial
$\chi^2 = 6.44, P = 0.17$, df = 4, N = 334

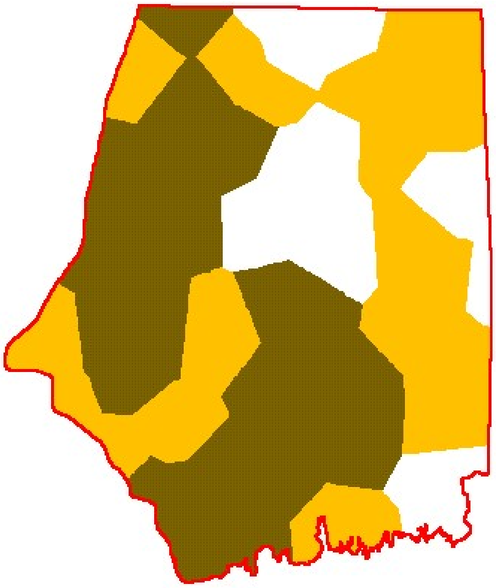

FIG. 78. Densities of the Wood Thrush were similar in Northeast and Southeast Connecticut. Light = 1.8-7.9, medium = 7.9-13.4 dark = 13.4-21.3 males/km^2.

Density distribution.-The Wood Thrush was a fairly common breeder in most forests of eastern Connecticut. Densities averaged higher in Southeast (13.2 ± 6.8 males/km^2) than Northeast Connecticut (10.8 ± 8.0 males/km^2; Fig. 78), but not significantly so (Mann-Whitney U = 256.5, *P* = 0.20, N = 51). Population estimates are based on detections of singing males.

Population variance.- The coefficient of variation calculated from Breeding Bird Survey data (Sauer et al. 2001) predicted variation in southern New England populations as 4.6%. From 1966-2000, populations showed a strongly significant regional (mean count/route = 15.2, trend = -2.1, *P* = 0.00, N = 51) and continental decline (mean count/route = 5.5, trend = -1.9, *P* = 0.00, N = 1776).

On ten line transects through the Northeast Uplands Ecoregion, Craig (1987) reported 1.2 birds/km^2, a value well below that of this study when our estimates are multiplied by two to yield breeding individuals/km^2. In a ten year sample of Breeding Bird Census plots in Connecticut, densities of pairs/km^2 were 15.4 ± 7.0 in oak-hemlock forest, 40.9 ± 25.3 in hemlock-hardwood forest, and 50.5 ± 31.3 in second growth deciduous forest. These estimates overlap but average higher than those computed in this study.

Elsewhere, populations are reported as averaging 30 ± 20 pairs/km^2, with a north-south range in density of 2 pairs/km^2 in New York to 87 pairs/km^2 in North Carolina. Plot studies of color-banded populations have

TABLE 31. Observations of habitat use by individual Wood Thrushes showed that they used significantly more deciduous and moist forests than would be predicted by habitat availability. Comparison of population densities with habitat features uncovered no significant correlations. $P(\chi^2)$ = probability level of chi-square tests, N = 80; $P(\tau)$ = probability level of Kendall's tau, N = 51; * = significant, ** = highly significant (see Table 8 for abbreviation key).

	Mean Habitat Characteristics				
	F	M	D	C	U
Availability	1.4	2.3	2.0	2.7	2.3
Use	1.2	2.1	2.0	2.8	2.4
$P(\chi^2)$	0.01**	0.01**	0.57	0.31	0.21
$P(\tau)$	0.81	0.33	0.77	0.74	0.97

	Percent Vegetation					
	OD	MH	CN	PO	CO	MI
Availability	51.0	13.7	13.1	13.1	8.5	0.7
Use	63.8	18.8	6.3	3.8	6.3	1.3
$P(\chi^2)$	0.08					

shown densities of 150 ± 28 in New Hampshire and 23 ± 14 pairs/km^2 in Deleware. Breeding Bird Census plots typically show densities of 10-50 pairs/km^2, although densities to 100 pairs/km^2 are not uncommon (Roth et al. 1996).

Habitat.- Data from individual Wood Thrushes showed that they inhabited forests significantly more deciduous and moist than would be predicted by habitat availability. This relationship was reflected in their more frequent presence (nearly significantly so) in oak-dominated and mixed hardwood forests forests than predicted. However, we uncovered no significant correlations between habitat variables and population densities (Table 31). The species is typically reported to inhabit forest interiors and, to a lesser extent, forest edges and parks. It uses deciduous and mixed forests, especially mature, mesic forest (Roth et al. 1996).

History.- The Wood Thrush was reported by Sage et al. (1913) to be a common Connecticut breeder. Zeranski and Baptist (1990) speculate that it increased during the 20th century with the regrowth of forest.

Synthesis.- Populations of the Wood Thrush appear to be undergoing a long term decline. Researchers have studied the role of forest fragmentation in causing this (Hoover et al. 1995, Hoover and Brittingham 1998, Friesen et al. 1999, Fauth 2000), but fragmentation is an unlikely agent of decline in the still heavily forested landscape of eastern Connecticut. Moreover, the association of the species with mature forest suggests that regional habitats are highly suitable. External phenomena, such as habitat degradation elsewhere, conditions on the wintering grounds or factors such as disease may be driving the decline.

Data from earlier transect studies of Craig (1987) suggest that regional populations have increased. These conflicting observations likely arose from avoidance movements by Wood Thrushes, which caused populations to be underestimated in this earlier study (see Buckland et al. 2001). In the present study, we found evidence of such movements, so grouped data into distance categories that minimized their effect. However, the earlier estimate also was made in the Northeast Uplands Ecoregion, where populations are at among their lowest densities in eastern Connecticut.

Comparison of Fig. 76, 77 and 78 show that across eastern Connecticut, the three species of interior forest thrushes occur differently. The more northerly-distributed Veery and Hermit Thrush predominate in Northeast Connecticut, whereas the Wood Thrush is more generally distributed throughout the region. Even though the Veery and Wood Thrush both are associated with more mesic forests, their centers of abundance only partly overlap. The distributional differences are likely related in part to the Veery's greater association with conifer-hardwood forests, which predominate in Northeast Connecticut, and the Wood Thrush's association with deciduous forests, which predominate in Southeast Connecticut. Notably, neither species is common in the largely xeric pine-oak forests that occur along the Southeast Connecticut-Rhode Island border.

The significantly greater Wood Thrush frequency in deciduous forest may be related to its weak trend toward having higher populations in Southeast Connecticut, where such forests are more frequent (Table 3,4,5). Its significant association with wetter conditions reflects the prevailing view that it prefers more mesic forests.

Conservation status.- Populations are declining, and appear vulnerable to forest fragmentation.

Sponsored by June Schoppe

AMERICAN ROBIN
Turdus migratorius

Summer

Density (birds/km^2): 5.9 (95% CI: 4.8-7.4)

Density range (birds/km^2/transect): 0-21.5

Total population (birds): 16,204 (95% CI: 12,947-20,278)

Detection function: uniform/cosine
$\chi^2 = 2.70, P = 0.44, \text{df} = 3, N = 113$

Winter

Density (birds/km^2): 8.0 (95% CI: 4.5-14.2)

Density range (birds/km^2/transect): 0-34.2

Total population (birds): 21,716 (95% CI: 12,187-38,693)

Detection function: uniform/cosine
$\chi^2 = 2.03, P = 0.36, \text{df} = 7, N = 70$

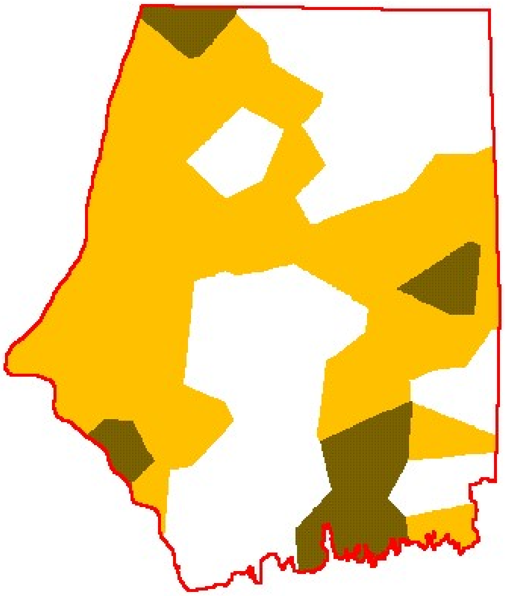

FIG. 79. Summer densities of the American Robin were similar in Northeast and Southeast Connecticut. Light = 1.8-4.5, medium = 4.5-8.1, dark = 8.1-12.5 birds/km^2.

TABLE 32. Categories of summer habitat use by individual American Robins showed no significant differences with those of habitat availability. In winter, birds inhabited forests with significantly greater understory density than would be predicted by habitat availability. Comparison of population densities with habitat features uncovered no significant correlations in summer or winter. $P(\chi^2)$ = probability level of chi-square tests, N = 43 summer, 39 winter; $P(t)$ = probability level of Kendall's tau, N = 51; * = significant, ** = highly significant (see Table 8 for abbreviation key).

	Mean Habitat Characteristics				
	F	M	D	C	U
Availability	1.4	2.3	2.0	2.7	2.3
Summer use	1.3	2.1	2.0	2.7	2.3
$P(\chi^2)$	0.16	0.15	-	0.88	0.88
$P(t)$	0.58	0.21	0.28	0.96	0.45
Winter use	1.3	2.2	2.0	2.6	2.6
$P(\chi^2)$	0.14	0.74	-	0.81	0.01**
$P(t)$	0.58	0.21	0.28	0.96	0.45

	Percent Vegetation					
	OD	MH	CN	PO	CO	MI
Availability	51.0	13.7	13.1	13.1	8.5	0.7
Summer use	53.5	25.6	7.0	7.0	6.9	0.0
$P(\chi^2)$	0.27					
Winter use	48.7	25.6	2.6	7.7	10.3	5.1
$P(\chi^2)$	-					

Density distribution.- Although an abundant summer resident in more open eastern Connecticut environments, the American Robin also was a fairly common inhabitant of the region's forests. Summer densities were similar (Mann-Whitney U = 307.5, $P = 0.74$, N = 51) in Northeast (5.7 ± 5.6 birds/km^2) and Southeast Connecticut (6.2 ± 5.9 birds/km^2; Fig. 79). In winter, populations in forests increased, and were significantly greater (Mann-Whitney U = 112.0 , $P = 0.00$, N = 51) in Southeast (23.6 ± 24.3 birds/km^2) than Northeast Connecticut (2.3 ± 4.9 birds/km^2; Fig. 80).

The estimates computed in this survey do not represent total populations for the region,

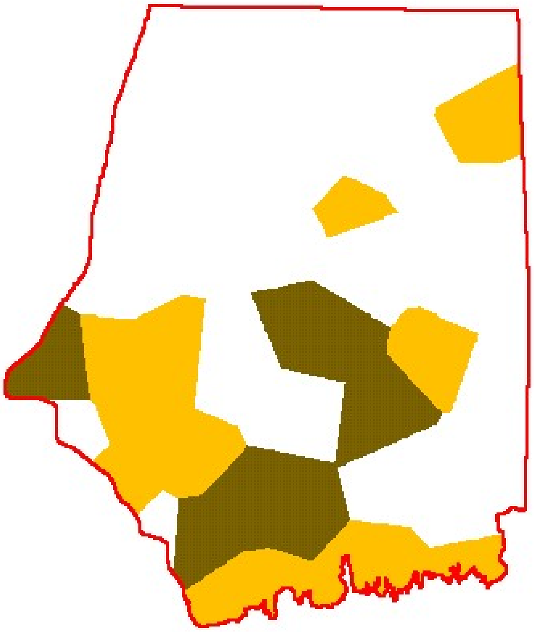

FIG. 80. Winter densities of the American Robin were greatest in Southeast Connecticut. Light = 0-5.6, medium = 5.6-22.8, dark = 22.8-39.9 birds/km^2.

but refer only that portion of the population inhabiting forests. Population estimates are based on detections of males and females in summer and flocks in winter.

Population variance.- The coefficient of variation calculated from Breeding Bird Survey data (Sauer et al. 2001) predicted variation in southern New England populations as 0.5%. From 1966-2000, breeding populations showed no significant trend in this region (mean count/route = 62.8, trend = -0.3, $P = 0.36$, N = 51). Continentally, however, populations increased significantly (mean count/route = 28.5, trend = 0.8, $P = 0.00$, N = 3369).

Christmas Count data showed the coefficient of variation for Connecticut to be 170.6%. Connecticut populations significantly increased between 1966 and 2002 (birds/party hr = 3.54, Kendall's tau = 0.60, $P = 0.00$, N = 37), but no significant U.S. population trend occurred during this period (birds/party hr = 15.2, Kendall's tau = 0.08, $P = 0.50$, N = 37).

Craig (1987) recorded birds incidentally on forest transects through Northeast Connecticut, but generated no density estimates for them. However, Holmes et al. (1986) found densities of 4 $\pm$ 3 birds/km^2 in New Hampshire, a value similar to that of this study.

In a ten year sample of Breeding Bird Census plots in Connecticut, densities of pairs/km^2 were 2.4 $\pm$ 3.1 in oak-hemlock forest, 1.2 $\pm$ 1.0 in hemlock-hardwood forest and 29.7 $\pm$ 8.1 in second growth deciduous forest. In winter, densities over three years ranged from 0-40.0 birds/km^2 in a Connecticut mixed forest wetland. These estimates overlap but average higher than those of this study.

Habitat.- Categories of summer habitat use by individual American Robins showed no significant differences with those of habitat availability. In contrast, wintering birds inhabited forests with significantly greater understory density than would be predicted by habitat availability. Comparison of population densities with habitat features uncovered no significant correlations in summer or winter. (Table 32).

We observed that major components of areas occupied were catbriars, viburnums, redcedars and other species that bore overwintering fruit, an important constituent of winter diets (Sallabanks and James 1999). Moreover, although low cell counts prevented statistical testing, birds appeared to avoid mixed conifer-deciduous forests and to be prefer mixed hardwoods in winter.

Elsewhere, forest-inhabiting birds are associated with selectively logged forest, early successional forest and forest openings. However, quantitative assessments of habitat affiliations appear surprisingly limited (Sallabanks and James 1999).

History.- The American Robin has been known as an abundant Connecticut resident since the 19th century. No regional trend is noted for its populations, other than that they likely increased during regional deforestation in the 18th and 19th centuries (Zeranski and Baptist 1990, Clark 1994g).

Synthesis.- Christmas Count data indicate that American Robin populations are increasing in southern New England, likely because more of the increasing continental breeding populations (as shown by the Breeding Bird Survey) move into the area in winter. The fact that local breeding populations are not similarly increasing may be related to the maturation of regional forests (Ward and Barsky 2000), which might be expected to reduce the amount of habitat for a species usually associated with more open habitats.

We observed population increases from summer to winter in a number of permanent resident species, including this one. Such increases likely reflect recruitment of first year birds into the population. However, as noted, migration from northern areas into Connecticut also appears likely, as the species is strongly migratory (Sallabanks and James 1999).

As with other permanent resident species, populations of the American Robin appeared to concentrate in Southeast Connecticut during the winter months (Fig. 80). Such movement is indicative of winter migration of birds into more climatically mild, southern portions of the region. Additional investigation will be required to verify the generality of this pattern, although our qualitative observations in eastern Connecticut during both years of the study are consistent with this finding.

The extent to which the American Robin inhabits interior forest is often not recognized, yet in this study many of our observations were made in such areas. Indeed, contrary to prevailing views of habitat associations (Sallabanks and James 1999), our summer observations of individual birds showed no tendency toward selection of more open forest environments, nor did population densities show any relationship to forest habitat variables. Hence, although the species' greatest summer abundance is certainly found in non-forested landscapes, it may be best thought of as widely adapted to a variety of forest and non-forest habitats.

The winter relationship of the species with increased understory density was a consequence of flocks inhabiting dense fruit-bearing vines and shrubs in more open forests and coastal forests. Its apparent concentration in more deciduous habitats may be due simply to its winter movement to Southeast Connecticut (Fig. 80), where deciduous habitat is more widespread (Table 5), although winter foods also may be more abundant in such habitats.

Conservation status.- Populations appear to be secure because the species is versatile in habitat use.

Sponsored by J. Kemler and Julia Appell

GRAY CATBIRD

Dumatella carolinensis

Summer

Density (males/km^2): 15.4 (95% CI: 12.2-19.4)

Density range (males/km^2/transect): 0-47.9

Total population (males): 41,893 (95% CI: 33,267-52,754)

Detection function: uniform/cosine

$\chi^2 = 6.42$, $P = 0.17$, df = 4, N = 131

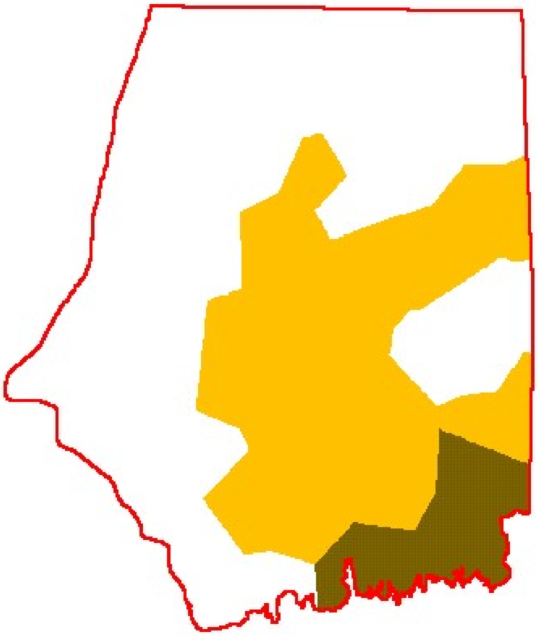

FIG. 81. Summer densities of the Gray Catbird averaged higher in Southeast Connecticut. Light = 4.0-14.0, medium = 14.0-29.9, dark = 29.9-53.9 males/km^2.

Density distribution.- Although an abundant summer resident in more open eastern Connecticut environments, the Gray Catbird also was a fairly common inhabitant of the region's forests. Densities averaged higher in Southeast (19.6 ± 17.3 males/km^2) than Northeast Connecticut (11.3 ± 10.2 males/km^2; Fig. 81), and nearly significantly so (Mann-Whitney U = 236.0, $P = 0.09$, N = 51).

TABLE 33. Observations of summer habitat use by individual Gray Catbirds showed that they occupied forest habitats that were significantly moister, with more open canopy, with denser understory and with more mixed hardwoods than would be predicted by habitat availability. Comparison of population densities with habitat features showed a significant negative correlation with dbh. $P(\chi^2)$ = probability level of chi-square tests, N = 97; $P(t)$ = probability level of Kendall's tau, N = 51; * = significant, ** = highly significant (see Table 8 for abbreviation key).

	Mean Habitat Characteristics				
	F	M	D	C	U
Availability	1.4	2.3	2.0	2.7	2.3
Use	1.3	2.1	2.0	2.2	2.6
$P(\chi^2)$	0.17	0.00**	-	0.00**	0.00**
$P(t)$	0.25	0.38	0.02*	0.42	0.05*

	Percent Vegetation					
	OD	MH	CN	PO	CO	MI
Availability	51.0	13.7	13.1	13.1	8.5	0.7
Use	42.3	30.9	9.3	6.2	7.2	4.1
$P(\chi^2)$	0.01**					

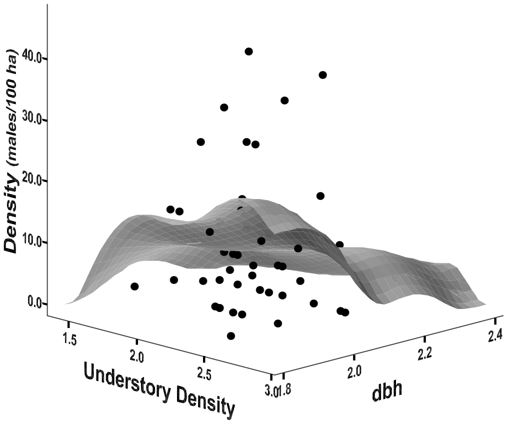

FIG. 82. Summer population density showed a significant increase with increasing understory density and decreasing tree dbh.

The species occurs as a rare winter resident. During this study, we found only one individual (at Chapman's Pond), although in previous years we have found birds occasionally throughout the region. We attempted no winter density estimate from such limited data.

The population densities computed in this survey do not represent total populations for the region, but are estimates of only that portion of the population inhabiting forests. Population estimates are based on detections of singing males.

Population variance.- The coefficient of variation calculated from Breeding Bird Survey data (Sauer et al. 2001) predicted variation in southern New England populations as 1.2%. From 1966-2000, populations showed a strongly significant increase in this region (mean count/route = 24.6, trend = 1.1, P = 0.00, N = 51). Continentally, however, populations showed no significant trend (mean count/route = 2.8, trend = -0.2, P = 0.12, N = 2171).

On ten line transects through the Northeast Uplands Ecoregion, Craig (1987) reported 5.6 birds/km^2, a value averaging below that of this study even when our estimates are multiplied by two to yield breeding individuals/km^2. In Georgia floodplain forest, 30 pairs/km^2 have been reported, although the greatest densities are found in non-forested habitats (Cimprich and Moore 1995).

In a ten year sample of Breeding Bird Census plots in Connecticut, densities of pairs/km^2 were 26.9 $\pm$ 8.2 in oak-hemlock forest, 7.1 $\pm$ 6.0 in hemlock-hardwood forest and 19.3 $\pm$ 5.9 in second growth deciduous forest. These estimates overlap but average higher than those of this study.

Habitat.- Data from individual Gray Catbirds showed that they occupied forest habitats which were significantly moister, had more open canopy and had denser understory than would be predicted by habitat availability. They also were particularly prevalent in mesic, mixed hardwood forests. Population densities were greatest along transects with denser understories, and were greatest in forests with smaller (measured by dbh) trees (Table 33, Fig. 82).

The Gray Catbird is typically reported to inhabit dense shrubs, the shrub-sapling stage in secondary successional forests, and forest edge. Smaller populations are found in interior forest (Cimprich and Moore 1995).

History.- The Gray Catbird has been known as an abundant Connecticut resident since the 19th century. Despite the reforestation of the region since then, the species has remained abundant (Zeranski and Baptist 1990).

Synthesis.- Populations of the Gray Catbird appear to be undergoing a long term increase in our region. The occurrence of an increase is corroborated by earlier transect data of Craig (1987). This increase has occurred despite the maturation of regional forests (Ward and Barsky 2000), which might be expected to negatively affect populations of a species associated primarily with successional and open forest. The increase likely reflects the adaptability of the species, which occupies forested and open habitats.

The extent to which the Gray Catbird inhabits interior forest is often not recognized, yet in this study many of our observations were made in such areas. In forests it was associated with forest gaps, particularly open canopy wetlands with dense understories. Such associations gave rise to its significant negative relationship with canopy cover and positive relationship with moisture regime, understory density, and mixed hardwood forest. Our finding of increased population density in younger forests was also consistent with other reports for the species. Although the Gray Catbird's greatest abundance is found in non-forested landscapes, it may be best thought of as widely adapted to a variety of forest and non-forest habitats.

Conservation status.- Populations are growing, and appear secure.

Sponsored by J. Kemler and Julia Appell

CEDAR WAXWING

Bombycilla cedrorum

Summer

Density (birds/km^2): 5.8 (95% CI: 4.3-7.8)

Density range (birds/km^2/transect): 0-34.6

Total population (birds): 15,727 (95% CI: 11,630-21,266)

Winter

Density (birds/km^2): 0.3 (95% CI: 0.1-0.7)

Density range (birds/km^2/transect): 0-3.5

Total population (birds): 755 (95% CI: 293-1,947)

Detection function (all data): hazard/cosine
χ^2 = 2.60, P = 0.27, df = 2, N = 89

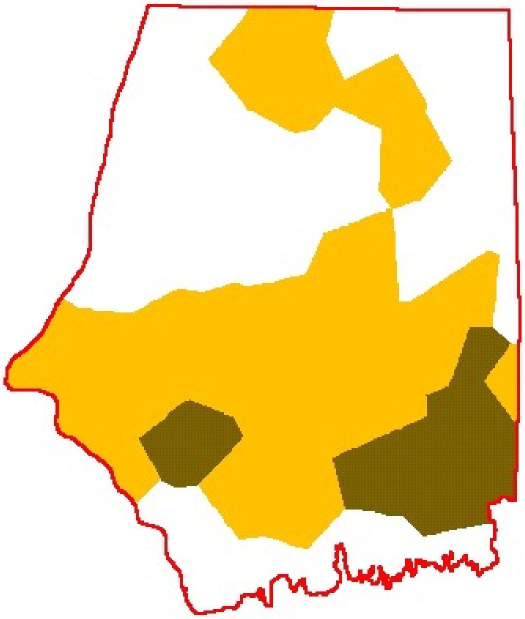

FIG. 83. Summer densities of the Cedar Waxwing were greatest in Southeast Connecticut. Light = 0-4.6, medium = 4.6-10.4, dark = 10.4-17.3 birds/km^2.

Density distribution.-The Cedar Waxwing was an uncommon to fairly common summer inhabitant of the forests of eastern Connecticut. Its breeding densities were significantly lower (Mann-Whitney U = 191.5, P = 0.01, N = 51) in Northeast (3.3 ± 4.1 birds/km^2) than Southeast Connecticut (8.3 ± 8.5 birds/km^2; Fig. 83). Population estimates are based on detections of flocks of males and females, and refer only to that part of the population inhabiting forests. Winter densities in forest were extremely low during both years of the study, so we could not map distributions for this season.

TABLE 34. Observations of summer habitat use by individual Cedar Waxwings showed that they inhabited forests with less canopy and more understory cover than would be predicted by habitat availability. Comparison of population densities with habitat features showed no significant correlations. $P(\chi^2)$ = probability level of chi-square tests, N = 52; $P(t)$ = probability level of Kendall's tau, N = 51; * = significant, ** = highly significant (see Table 8 for abbreviation key).

	Mean Habitat Characteristics				
	F	M	D	C	U
Availability	1.4	2.3	2.0	2.7	2.3
Use	1.3	2.4	2.0	2.2	2.6
$P(\chi^2)$	0.35	0.12	-	0.00**	0.01**
$P(t)$	0.15	0.91	0.61	0.83	0.21

	Percent Vegetation					
	OD	MH	CN	PO	CO	MI
Availability	51.0	13.7	13.1	13.1	7.3	0.0
Use	58.5	17.1	9.8	7.3	8.5	0.7
$P(\chi^2)$	0.77					

Population variance.- The coefficient of variation calculated from Breeding Bird Survey data (Sauer et al. 2001) predicted population variation as 14.2% for southern New England. From 1966-2000, populations showed a strongly significant regional (mean count/route = 6.4, trend = 2.5, P = 0.01, N = 46) and continental increase (mean count/route = 4.1, trend = 1.4, P = 0.00, N = 1913).

Christmas Count data predicted population variation as 101.4% for Connecticut. From 1966-2001, populations showed a strongly significant Connecticut (birds/party hour = 1.0, quadratic model r^2 = 0.77, df = 34, *P* = 0.00) and U.S. increase (birds/party hour = 1.3, Kendall's tau = 0.73, *P* = 0.00, N = 37).

On ten line transects through the Northeast Uplands Ecoregion, Craig (1987) encountered Cedar Waxwings but did not compute population densities for them. In a ten year sample of Breeding Bird Census plots in Connecticut, birds appeared once each in hemlock-hardwood (4.8 pairs/km^2) and second growth deciduous forest (5.0 pairs/km^2). It was absent from oak-hemlock forest. A Winter Bird Survey plot in a deciduous-coniferous wetland yielded birds once in three years (1.4 birds/km^2). These densities overlap those found in this study. We found no other quantitative population estimates for eastern forests.

Habitat.- Observations of summer habitat use by individual Cedar Waxwings showed that they inhabited forests with significantly less canopy and more understory cover than would be predicted by habitat availability. However, comparison of population densities with habitat features showed no significant correlations (Table 33). Data were insufficient for judging winter habitat associations. We generally found the species associated at all seasons with forest openings and edge, particularly open swamps and along larger streams.

Elsewhere, in winter and summer the species is reported to inhabit especially open woods, second growth and old fields. It avoids forest interiors, and is frequently present in riparian areas and in other locations where fruiting shrubs and trees are present (Witmer et al. 1997).

History.- The Cedar Waxwing was known as a common resident by Sage et al. (1913), a status that it retains, although winter populations are variable (Zeranski and Baptist 1990).

Synthesis.- Breeding Bird Survey and Christmas Count data show that Cedar Waxwing populations are undergoing a strong regional increase, although numbers are more variable in winter. We found few individuals during both winters of the study, suggesting that forest habitats are less suitable for the species at this season.

Our observations of a species association with more open forests and denser understories are consistent with other reports of habitat use. This association may explain in part the greater summer density of Cedar Waxwings in Southeast Connecticut (Fig. 83), where forests have greater understory density than in Northeast Connecticut (Table 3,4). Many understory shrubs like viburnums and black alder are fruit-bearing, which likely increases the attractiveness of dense understories for the species.

Conservation status.- Populations are increasing, and appear secure.

Sponsored by Charles Tillen

BLUE-WINGED WARBLER

Vermivora pinus

Density (males/km^2): 1.3 (95% CI: 0.7-2.3)
Density range (males/km^2/transect): 0-12.8
Total population (males): 3,564 (95% CI: 1,996-6,362)

Detection function: uniform /cosine
$\chi^2 = 3.47$, $P = 0.32$, df = 3, N = 26

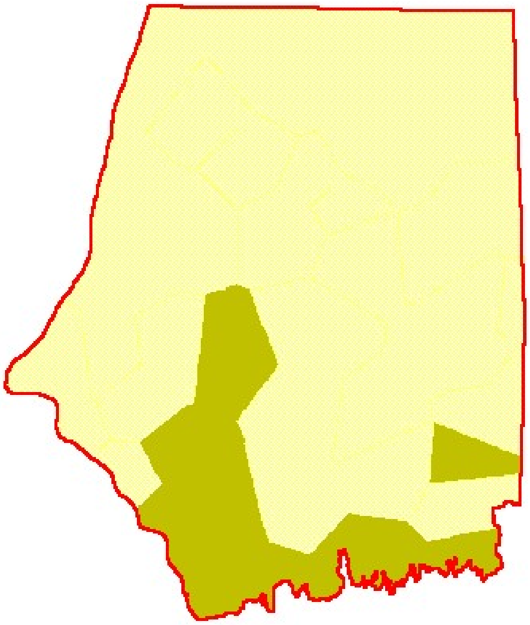

FIG. 84. Densities of the Blue-winged Warbler averaged greater in Southeast Connecticut. Light = 0-2.6, dark = 2.6-6.0 males/km^2.

Density distribution.-The Blue-winged Warbler was an uncommon and local breeder in the forests of eastern Connecticut. Its densities averaged greater in Southeast (2.2 ± 3.8 males/km^2) than Northeast Connecticut (0.5 ± 1.3 males/km^2; Fig. 84) and nearly significantly so (Mann-Whitney U = 251.0, P = 0.07, N = 51).

Because the Blue-winged Warbler inhabits environments other than forest, estimates refer only to that part of the population associated with primarily forested regions. Population estimates are based on <60 detections of singing males, so have reduced accuracy.

Population variance.- The coefficient of variation calculated from Breeding Bird Survey data (Sauer et al. 2001) predicted continental population variation as 116.9%. From 1966-2000, populations showed no significant continental trend (mean count/route = 0.6, trend = -0.5, P = 0.48, N = 462). However, limited data from southern New England suggested a significant regional decline.

On ten line transects through the Northeast Uplands Ecoregion, Craig (1987) incidentally detected the species but did not compute its densities. In a ten year sample of Breeding Bird Census plots in Connecticut, densities of pairs/km^2 were 3.4 ± 4.1 in oak-hemlock forest, 0 in hemlock-hardwood forest and 16.8 ± 8.2 in second growth deciduous forest. These densities overlap those found in this study.

Elsewhere, populations are reported to vary depending on habitat size and succession. Estimates include 15-71 males/km^2 in West Virginia and 39 males/km^2 in Ohio (Gill et al. 2001).

Habitat.- Limited observations of habitat use by individual Blue-winged Warblers suggested that they inhabited forests more deciduous, younger, with more open canopies and with denser understory than would be predicted from habitat availability. Samples were too small to conduct statistical tests on data from individuals or to compare population densities with habitat features. We typically found birds inhabiting selectively logged areas, early successional woodlands, and borders of open swamps. It occupied even small (ca. two ha) forest openings.

Elsewhere, the species is reported to inhabit forest clearcuts, old fields, early to mid-successional woodlands, and wetland borders. Dense shrubs are a typical habitat feature (Gill et al. 2001).

History.- The Blue-winged Warbler, a primarily southeastern species, expanded its populations north after the deforestation of the East in the late 18th and early 19th centuries (Bledsoe 1994, Gill et al. 2001). However, Sage et al. (1913) already considered it common in southern Connecticut.

Synthesis.- Limited Breeding Bird Survey data suggest that populations are declining regionally. The occurrence of a decline is expected because the forests of southern New England are maturing, and the species' preferred successional habitats are disappearing (Ward and Barsky 2000). Populations now may be reversing their previous expansion into Connecticut. Despite this likely decline, we found that populations continued to inhabit forests where disturbance has occurred. Logging and natural disturbance, such as tree attrition in wetlands, seem likely to continue supplying suitable habitat for the species.

The Blue-winged Warbler may be described as an early to mid-successional species. Our observation of an association with younger forest and denser shrubbery are consistent with other reports of habitat use. Its trend toward increasing population densities near the coast (Fig. 84) is likely related to its being near its northern range limit in Connecticut (Gill et al. 2001), Populations of many species decline toward their range limit (Brown 1984, Pulliam 1988). However, less forest cover in Southeast Connecticut (Alerich 1999) also may provide it with additional habitat.

Conservation status.- Populations are likely declining, although timber management practices as well as natural disturbances may be sufficient to sustain populations at a reduced level. This and other successional species may be returning to population levels more historically typical for them.

NASHVILLE WARBLER

Vermivora ruficapilla

Density distribution.- The Nashville Warbler was rare in the forests of eastern Connecticut. We found a single summering individual at Pequot Trail, Preston. Because of its rarity, we make no population estimate for the region.

Population variance.- The coefficient of variation calculated from Breeding Bird Survey data (Sauer et al. 2001) predicted variation in continental populations as 123.5%. From 1966 to 2000 continental populations showed no significant trend (mean count/ route = 7.4, trend = 1.6, P = 0.08, N = 759). Very limited data from southern New England suggested a population decline.

On ten line transects through the Northeast Uplands Ecoregion, Craig (1987) reported no birds, although summering individuals were present in the study area (R. Craig pers. obs.). In a ten year sample of Breeding Bird Census plots in Connecticut, it was absent in oak-hemlock, hemlock-hardwood and second growth deciduous forest. We found no other reports of forest population densities.

Habitat.- Our one observation of a summering Nashville Warbler was of a bird in an Eastern Redcedar-dominated old field that bordered xeric, oak forest. This habitat was similar to ones where we have encountered other local summering birds.

Elsewhere, the species is reported from forest edge, coniferous bog borders, second growth forest and open deciduous or mixed woods with dense understories. Habitats at the southern end of its range in particular include drier, cut-over forest and deciduous second growth. It is absent from unbroken, mature forest (Williams1996).

History.- The Nashville Warbler appears to have been more common as a nester in the 19th century. Since 1900, its breeding range has receded northward (Zeranski and Baptist 1990). In the 1980s it was found summering at 12 locations in eastern Connecticut (Clark 1994h).

Synthesis.- The Nashville Warbler is at the southern fringe of its range in eastern Connecticut (Williams1996), and is generally not present in the primarily mature forest habitats surveyed in this study. As a species associated with successional habitats, its presence at any one location is likely to be ephemeral. Moreover, as successional habitats mature to forest in eastern Connecticut (Ward and Barsky 2000), populations are likely to decline.

Our one observation of habitat use by the species was somewhat atypical in that Eastern Redcedar was the predominant conifer where it occurred. Selection of atypical habitats may be expected in individuals at the fringes of their range where favored conditions are largely absent.

Conservation status.- Populations are likely declining as successional habitats mature to forest.

CHESTNUT-SIDED WARBLER
Dendroica pensylvanica

Density (males/km^2): 1.4 (95% CI: 0.7-2.7)
Density range (males/km^2/transect): 0-9.4
Total population (males): 3,683 (95% CI: 1,814-7,478)

Detection function: uniform /cosine
$x^2 = 4.24$, $P = 0.24$, df = 3, N = 22

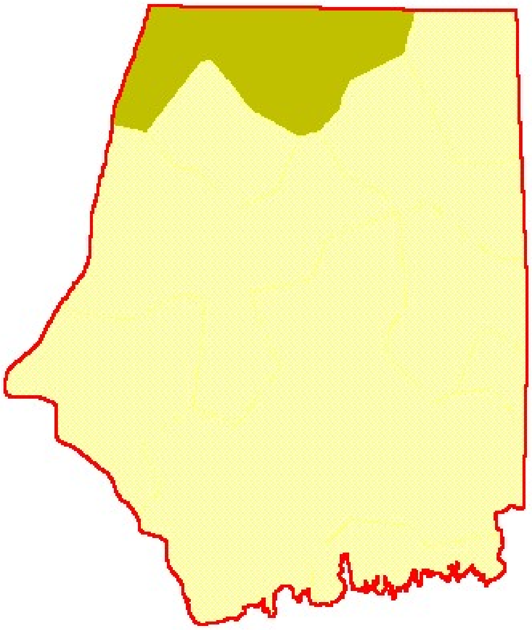

FIG. 85. Densities of the Chestnut-sided Warbler were greatest in Northeast Connecticut. Light = 0-2.1, dark = 2.1-5.2 males/km^2.

Density distribution.-The Chestnut-sided Warbler was an uncommon and local breeder in the forests of eastern Connecticut. Its densities were significantly greater (Mann-Whitney U = 208.5, $P = 0.01$, N = 51) in Northeast (2.1 ± 2.5 males/km^2) than Southeast Connecticut (0.5 ± 0.8 males/km^2; Fig.85).

Because the Chestnut-sided Warbler inhabits environments other than forest, densities reported here refer only to that part of the population associated with primarily forested regions. Population estimates are based on <60 detections of singing males, so have reduced accuracy.

Population variance.- The coefficient of variation calculated from Breeding Bird Survey data (Sauer et al. 2001) predicted variation in regional population as 26.0%. From 1966-2000, populations in southern New England showed no significant trend (mean count/route = 3.8, trend = -0.7, $P = 0.51$, N = 47), although continental populations underwent a nearly significant decline (mean count/route = 7.2, trend = -0.7, $P = 0.06$, N = 878).

On ten line transects through the Northeast Uplands Ecoregion, Craig (1987) incidentally detected the species but did not compute densities. In a ten year sample of Breeding Bird Census plots in Connecticut, densities of pairs/km^2 were 7.0 ± 3.7 in oak-hemlock forest and 23.8 ± 9.8 in second growth deciduous forest. It occurred once in hemlock-hardwood forest (4.8 pairs/km^2). These estimates average greater than those of this study.

Elsewhere, populations are reported to vary depending on successional stage. Population estimates include 68-280 males/km^2 in West Virginia open woodlands and 37-50 pairs/km^2 in Vermont successional habitats (Richardson and Brauning 1995).

Habitat.- Limited observations of habitat use by individual Chestnut-sided Warblers suggested that they inhabited forests more coniferous, younger, with a more open canopy, and with a denser understory than would be predicted from habitat availability. Samples were too small for analysis of observations. We typically found birds inhabiting selectively logged areas, clearcuts, early successional woodlands, edges of beaver swamps, and old fields with invading pines and Eastern Redcedars.

Elsewhere, the species is reported to inhabit early successional habitats with both mesic and xeric conditions. It probably was restricted originally to areas disturbed by forest fires, beaver activity, and storms (Richardson and Brauning 1995).

History.- The Chestnut-sided Warbler, a primarily northern species, expanded its populations south after the deforestation of the East in the late 18th and early 19th century (Zeranski and Baptist 1990, Richardson and Brauning 1995). Sage et al. (1913) found it to be most common in northern Connecticut.

Synthesis.- As with other species associated with successional environments, Breeding Bird Survey data suggest that the Chestnut-sided Warbler is declining continentally as forests mature and urbanization occurs. Despite this decline, we found that populations continue to inhabit forest environments where disturbance has occurred.

The species' declining population densities toward the coast (Fig. 85) are likely related to being near its southern range limit in Connecticut (Richardson and Brauning 1995). Populations of many species decline toward their range limit (Brown 1984, Pulliam 1988).

Like the Blue-winged Warbler, the Chestnut-sided Warbler appeared even in comparatively small forest openings associated with selective logging and other disturbance. Our observations of it inhabiting more open, younger forests with denser understories were consistent with other reports for the species. However, its possible association with more coniferous habitats appeared atypical. Further data are required to more rigorously examine the species' habitat associations in our region.

Conservation status.- Populations may be declining regionally, although timber management practices and natural disturbances may be sufficient to sustain populations at a reduced level.

MAGNOLIA WARBLER

Dendroica magnolia

Density distribution.- Summering Magnolia Warblers are rarely encountered in eastern Connecticut, which is south of their principal range. We found individuals at Meshomasic State Forest (probable late migrant), Nehantic State Forest, Devil's Hopyard, and Pachaug Trail. These three summer observations were inadequate for reliably estimating population density in primarily forested landscapes.

Population variance.- The coefficient of variation calculated from Breeding Bird Survey data (Sauer et al. 2001) predicted variation in continental populations as 9.2%. From 1966 to 2000 continental populations showed a strongly significant increase (mean count/ route = 6.0, trend = 1.5, $P = 0.01$, N = 545). Very limited data from southern New England showed no clear trend.

On ten line transects through the Northeast Uplands Ecoregion, Craig (1987) reported no birds, although summering individuals were present in the study area (R. Craig pers. obs.). In a ten year sample of Breeding Bird Census plots in Connecticut, birds occurred once each in hemlock-hardwood (9.5 pairs/km^2) and second growth deciduous forest (5.0 pairs/km^2). None occurred in oak-hemlock forest. Elsewhere, densities of males/km^2 have been reported as 12-71 in New York, 17-82 in Maine, 109 in Maryland, and 49-131 in West Virginia (Hall 1994).

Habitat.- We found summering birds in a logged-over stand of Red Pines that had grown up to shrubs, an old field with scattered Eastern Redcedars, and, uncharacteristically, in mature, mesic, oak-dominated forest. We incidentally observed birds in abandoned Christmas tree plantations, in mature hemlock-hardwood forests bordering swampy streams and in other old fields with Eastern Redcedars and sapling Eastern White Pines.

Elsewhere, the species appears most abundant in young, dense conifer-dominated forests, and in conifer-dominated old fields. However, it also is found in mature, mixed and conifer forests with typically dense understories (Hall 1994).

History.- Sage et al. (1913) reported possible breeders only from Northwest Connecticut. During the 20th century, the species appears to have expanded its breeding range south (Zeranski and Baptist 1990). In the 1980s it was found summering at four locations in Northeast Connecticut (Clark 1994i).

Synthesis.- The Magnolia Warbler is at the southern fringes of its range in eastern Connecticut (Hall 1994), and is generally not present in the primarily mature forest habitats surveyed in this study. As a species primarily associated with successional habitats, its presence at any one location is likely to be ephemeral. Moreover, as successional habitats mature to forest in eastern Connecticut (Ward and Barsky 2000), populations are likely to decline.

Our few observations of habitat use by Magnolia Warblers were rather atypical in that Eastern Redcedar was the predominant conifer at some locations and mature deciduous forest predominated at another. Selection of atypical habitats may be a consequence of favored habitats being largely absent at the southern edge of the range.

Conservation status.- Regional populations are likely to respond negatively to the ongoing maturation of southern New England's forests.

BLACK-THROATED BLUE WARBLER

Dendroica caerulescens

Density (males/km^2): 0.7 (95% CI: 0.4-1.2)
Density range (males/km^2/transect): 0-7.8
Total population (males): 1,967 (95% CI: 1,158-3,343)

Detection function: half normal /cosine
$\chi^2 = 0.12$, $P = 0.98$, df = 3, N = 33

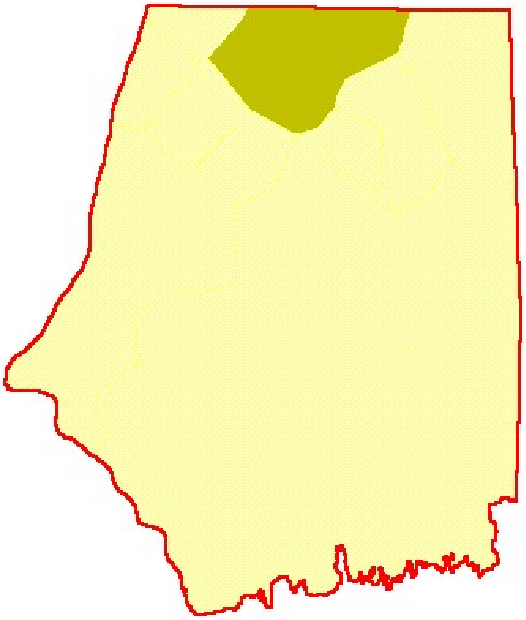

FIG. 86. Densities of the Black-throated Blue Warbler were greatest in Northeast Connecticut. Light = 0-3.4, dark = 3.4-6.7 males/km^2.

Density distribution.-The Black-throated Blue Warbler was uncommon to absent in regional forests. It occurred at 38% of sites in Northeast Connecticut (1.4 ± 2.3 males/km^2), but only 4% of sites in Southeast Connecticut (0.05 ± 0.22 males/km^2). This difference was strongly significant (Mann-Whitney U = 210, $P = 0.00$, N = 51). Population estimates are based on <60 detections of singing males, so have reduced accuracy.

Population variance.- The coefficient of variation calculated from Breeding Bird Survey data (Sauer et al. 2001) predicted continental population variation as 112.3%. From 1966-2000, populations showed no significant continental trend (mean count/route = 1.0, trend = 1.0, $P = 0.41$, N = 436). Limited data from southern New England also suggested no trend.

On ten line transects through the Northeast Uplands Ecoregion, Craig (1987) reported 9.2 birds/km^2, which is greater than that of this study even when our estimates are converted to individuals/km^2. In contrast, at 19 eastern Connecticut forests surveyed in the summers of 1975-1977, R.Craig (pers. obs.) found only 16% with Black-throated Blue Warblers, compared with 42% of the (in many cases same) sites surveyed in this study.

In a ten year sample of Breeding Bird Census plots in Connecticut, the species was absent in oak-hemlock and hemlock-hardwood forest, and present only once in second growth deciduous forest. In the heart of its breeding range in New Hampshire, populations vary between 10-90 pairs/km^2, depending on habitat quality (Holmes 1994).

Habitat.- Very limited data from individual Black-throated Blue Warblers suggested that they inhabited comparatively coniferous forests, particularly conifer-northern hardwood associations. Moreover, virtually all birds encountered during this study were associated with an understory of Mountain Laurel. They occurred even in several oak-hickory forests (where in previous years they had been absent) that had such understory.

Elsewhere, unbroken tracts of undisturbed forest are occupied, particularly conifer-northern hardwood forests. Dense, deciduous or evergreen understory cover is also typical of breeding habitat (Holmes 1994).

History.- The Black-throated Blue Warbler appears to have increased as a Connecticut nester since the late 19th century

(Zeranski and Baptist 1990), although Sage et al. (1913) considered it common in northwestern Connecticut. Historically, it has been most prevalent in northern Connecticut, but isolated breeding has been reported from southern Connecticut as well (Petit 1994).

Synthesis.- Even though data from the Breeding Bird Survey does not indicate a significant population increase for the Black-throated Blue Warbler, evidence cited from long term distributional surveys in eastern Connecticut (R. Craig pers. obs.) strongly suggests that a range expansion has occurred since the 1970s. Moreover, based on data from the *The Atlas of Breeding Birds of Connecticut* (Bevier 1994), our findings indicate that this expansion has continued since the 1980s. Notably, the species is now found in oak-hickory habitats outside its earlier range.

The species' significantly higher density in Northeast compared with Southeast Connecticut (Fig. 86) may be related in part to its association with more conifer-dominated forests. Forests become increasingly coniferous to the north (Table 3,4,5). Craig (1987) also found higher densities in the Northeast Uplands. A higher density in Northeast Connecticut is also suggested by distributions mapped in *The Atlas of Breeding Birds of Connecticut* (Bevier 1994).

Increasing densities toward the north are likely also related to additional geographic factors. The Black-throated Blue Warbler is near its southern range limit in Connecticut (Richardson and Brauning 1995). Populations of many species decline toward their range limit (Brown 1984, Pulliam 1988).

Our limited observations on this uncommon species prevented a definitive evaluation of its habitat affinities, but were consistent with the prevailing view that primarily conifer-northern hardwood forests are used. Its use of laurel thickets also is consistent with other reports of habitat use.

Conservation status.- Populations appear to be expanding, but are sensitive to forest fragmentation.

Sponsored by Juan and Diane Sanchez

YELLOW-RUMPED WARBLER

Dendroica coronata

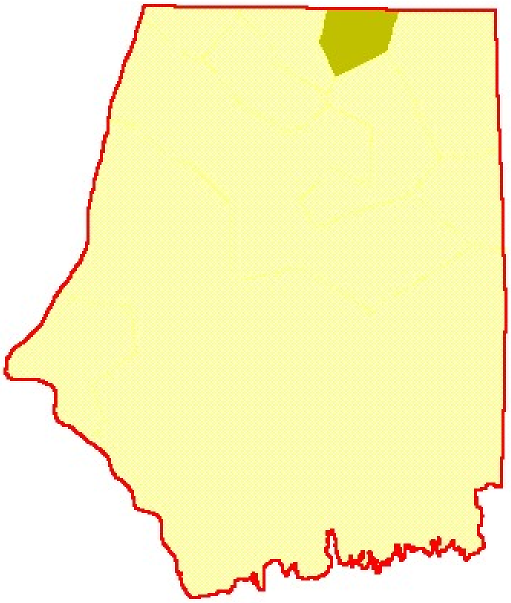

FIG. 87. Densities of the Yellow-rumped Warbler appeared greatest in Northeast Connecticut. Light = 0-2.2, dark = 2.2-4.4 males/km^2.

Density distribution.-The Yellow-rumped Warbler was a very uncommon breeder in the forests of eastern Connecticut. Based on 13 detections of singing males, we tentatively estimate a population of 1,518 males (0.6 males/km^2). It occurred at 35% of transects in Northeast but only 4% of transects in Southeast Connecticut, strongly suggesting that it occurred most frequently to the north.

The species also occurs as a rare to locally uncommon winter resident. During this study, we found birds at five transects in Southeast Connecticut (insufficient to map), although in previous years we have occasionally found individuals in Northeast Connecticut. We attempted no winter density estimate from such limited data.

Population variance.- The coefficient of variation calculated from Breeding Bird Survey data (Sauer et al. 2001) predicted population variation as 11.2% for southern New England. From 1966-2000, populations showed a strongly significant continental increase (mean count/route = 5.1, trend = 1.6, *P* = 0.01, N = 611). Limited data from southern New England suggested a significant regional increase as well.

TABLE 35. Limited observations of habitat use by individual Yellow-rumped Warblers strongly suggested that they inhabited forests more coniferous and with more open understories than would be predicted by habitat availability (N = 10; see Table 8 for abbreviation key).

	Mean Habitat Characteristics					
	F	M	D	C	U	
Availability	1.4	2.3	2.0	2.7	2.3	
Use	2.3	2.3	2.1	2.8	1.6	
	Percent Vegetation					
	OD	MH	CN	PO	CO	MI
Availability	51.0	13.7	13.1	13.1	8.5	0.7
Use	0.0	0.0	30.0	20.0	50.0	0.0

On ten line transects through the Northeast Uplands Ecoregion, Craig (1987) reported 9.2 birds/km^2. Moreover, at 19 eastern Connecticut forests surveyed in the summers of 1975-1977, R. Craig (pers. obs.) found that only 5% of sites had Yellow-rumped Warblers, compared with 20% of the (in many instances same) sites surveyed in this study.

In a ten year sample of Breeding Bird Census plots in Connecticut, it was absent in oak-hemlock forest, had 25.7 $\pm$ 21.0 pairs/km^2 in hemlock-hardwood forest and occurred twice (5.0 pairs/km^2) in second growth deciduous forest. Elsewhere, densities of pairs/km^2 are reported as 10-90 in Ontario, 40-70 in Maine and 10-770 in New Hampshire (Hunt and Flashpohler 1998). These densities average higher than those found in this study.

Habitat.- Limited data from individual Yellow-rumped Warblers strongly suggested that they inhabited forests more coniferous and with more open understories than would be predicted by habitat availability (Table 35). We found them only in hemlock, white pine and mixed conifer-northern hardwoods.

Elsewhere, the species is reported to inhabit mature coniferous and mixed conifer-deciduous forest. It is infrequent in young and deciduous forest. Predominant conifers used in the Northeast include spruces, firs and pines, with pines appearing less preferred. Populations are largely unaffected by selective logging (Hunt and Flashpohler 1998).

History.- The Yellow-rumped Warbler was not known as a breeder by Sage et al. (1913). It ranged south into Connecticut during the 20th century as forests have regrown (Clark 1994j).

Synthesis.- Breeding Bird Survey data and data of R. Craig (cited above) strongly indicate that the Yellow-rumped Warbler is undergoing a long term increase. Earlier transect studies of Craig (1987) found higher densities than this study principally because they were conducted in the heart of the species' local range (Fig. 87), where it is most abundant. A factor potentially driving the increase is the maturation of regional forests (Ward and Barsky 2000).

The greater frequency of the Yellow-rumped Warbler in Northeast compared with Southeast Connecticut (Fig. 87) may be related in part to its association with more conifer-dominated forests. Forests become increasingly coniferous to the north (Table 3,4,5). A higher density in Northeast Connecticut is also suggested by distributions mapped in *The Atlas of Breeding Birds of Connecticut* (Bevier 1994).

Increasing densities toward the north are likely also related to additional geographic factors. The Yellow-rumped Warbler is near its southern range limit in Connecticut (Hunt and Flashpohler 1998). Populations of many species decline toward their range limit (Brown 1984, Pulliam 1988).

The observed association of the Yellow-rumped Warbler with coniferous cover is consistent with other reports of habitat affiliation. Its occurrence in forests with more open understories is a consequence of the small amount of understory cover capable of growing in coniferous habitats, particularly hemlock groves.

Conservation status.- Populations appear to be increasing, but are likely sensitive to forest fragmentation.

BLACK-THROATED GREEN WARBLER

Dendroica virens

Density (males/km²): 4.0 (95% CI: 2.9-5.4)
Density range (males/km²/transect): 0-16.2
Total population (males): 10,763 (95% CI: 7,858-14,741)

Detection function: hazard /cosine
$\chi^2 = 0.65$, $P = 0.72$, df = 2, N = 112

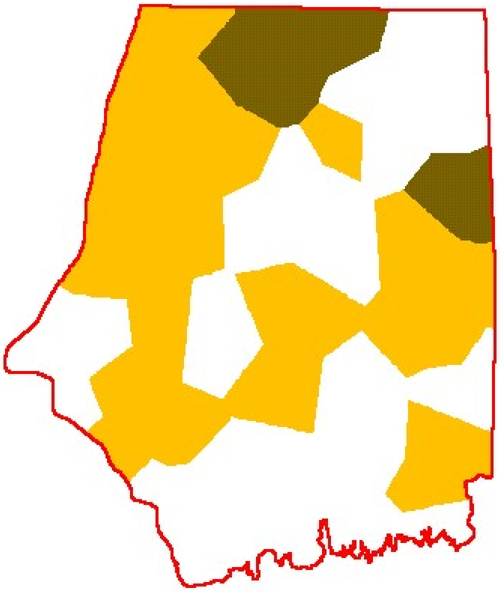

FIG. 88. Densities of the Black-throated Green Warbler averaged greater in Northeast Connecticut. Light = 0-3.1, medium = 3.1-6.7, dark = 6.7-17.1 males/km².

Density distribution.-The Black-throated Green Warbler was an uncommon breeder in the forests of eastern Connecticut. Its densities averaged greater in Northeast (5.7 ± 6.1 males/km²) than Southeast Connecticut (3.0 ± 3.8 males/km²) but not significantly so (Mann-Whitney U = 243.0, P = 0.11, N = 51). Population estimates are based on detection of singing males.

Population variance.- The coefficient of variation calculated from Breeding Bird Survey data (Sauer et al. 2001) predicted continental population variation as 23.3%. From 1966-2000, populations showed no significant continental trend (mean count/route = 2.8, trend = 0.1, P = 0.94, N = 693). Limited data from southern New England suggested a population increase for this region.

On ten line transects through the Northeast Uplands Ecoregion, Craig (1987) reported 27.5 ± 19.8 birds/km², which is greater than that of this study even when our estimates are converted to individuals/km². In a ten year sample of Breeding Bird Census plots in Connecticut, it occurred once in oak-hemlock forest (13.0 pairs/km²), had 92.7 ± 45.7 pairs/km² in hemlock-hardwood forest, and was absent in second growth deciduous forest. Moreover, Ellison (1994b) reported 25-63 pairs/km² from Connecticut plot studies. These estimates overlap but average higher than those of this study especially for

TABLE 36. Observations of habitat use by individual Black-throated Green Warblers showed that they inhabited forests significantly more coniferous, moister, with larger trees, and with lower understory density than would be predicted by habitat availability. Comparison of population densities with habitat features showed no significant correlations. $P(\chi^2)$ = probability level of chi-square tests, N = 34; $P(t)$ = probability level of Kendall's tau, N = 51; * = significant, ** = highly significant (see Table 8 for abbreviation key).

	Mean Habitat Characteristics				
	F	M	D	C	U
Availability	1.4	2.3	2.0	2.7	2.3
Use	2.3	2.1	2.1	2.8	2.0
$P(\chi^2)$	0.00**	0.05*	0.02*	0.20	0.01**
$P(t)$	0.36	0.13	0.34	0.26	0.07

	Percent Vegetation					
	OD	MH	CN	PO	CO	MI
Availability	51.0	13.7	13.1	13.1	8.5	0.7
Use	5.9	0.0	50.0	5.9	38.2	0.0
$P(\chi^2)$	-					

hemlock-hardwood forest. Elsewhere, pairs/km^2 are reported as 60-200 in Maine, depending on habitat type and other population factors, 90 in New Hampshire, 7-99 in West Virginia and 30-100 in eastern Canada (Morse 1993).

Habitat.- Data from individual Black-throated Green Warblers showed that they inhabited forests with significantly greater coniferous cover, tree dbh and soil moisture, but lower understory density than would be predicted by habitat availability. Moreover, although zeros in several categories prevented statistical analyses of vegetation data, the species clearly inhabited primarily mixed and coniferous forests. White pine, spruce plantations and especially hemlock groves were used. Examination of population density vs. habitat variables showed no significant correlations, although density approached significantly greater in forests with less dense understory (Table 36).

Elsewhere, the species is reported to inhabit conifer forest, mixed conifer-hardwood forest and at least on occasion pure hardwood forest. It occupies middle-aged to mature forest as well as coastal Pitch Pine forests and Eastern Redcedar-dominated old fields (Morse 1993).

History.- The Black-throated Green Warbler has been reported as historically common in Connecticut within its preferred hemlock forest habitat (Sage et al. 1913). However, Zeranski and Baptist (1990) speculate that it declined during the mid-20th century.

Synthesis.- Data from the Breeding Bird Survey suggest that the Black-throated Green Warbler may be undergoing a regional population increase. Earlier transect studies of Craig (1987) found higher densities than this study principally because they were conducted in the heart of the species' local range (Fig. 88), where it is most abundant. A factor potentially driving any increase is the maturation of regional forests (Ward and Barsky 2000). Despite a possible increase, the close affinity of the Black-throated Green Warbler with coniferous forests suggests that a decline may occur as the Eastern Hemlock is eliminated via disease from regional forest ecosystems.

The observed association of the Black-throated Green Warbler with coniferous cover is consistent with other reports of habitat affiliation. Its occurrence in more mesic forests with larger trees and little understory is a consequence of its affiliation with hemlock forests, which are prevalent in mesic cove sites and along streams. Hemlock stands typically have little understory. Moreover, because hemlocks are not actively harvested by the timber industry, many of eastern Connecticut's hemlock stands have attained characteristics of old growth forest, and contain among the largest trees in the state.

Conservation status.- Populations appear secure, but are likely sensitive to forest fragmentation and the loss of Eastern Hemlock from eastern Connecticut forests.

Sponsored by Irving and Katherine Sheldon

BLACKBURNIAN WARBLER
Dendroica fusca

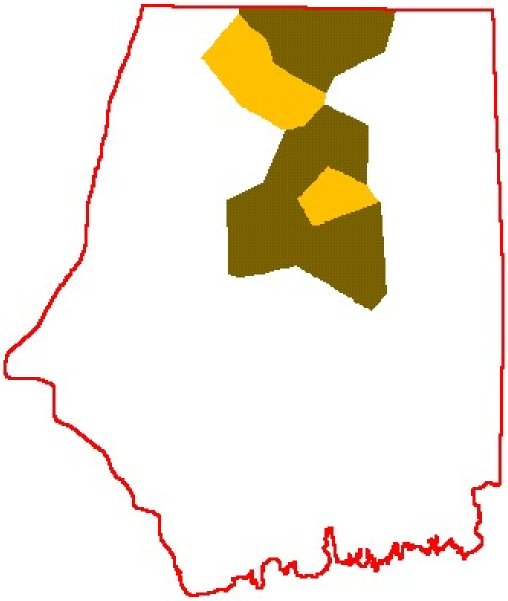

FIG. 89. Densities of the Blackburnian Warbler averaged greater in Northeast Connecticut. Light = 0-2.6, medium = 2.6-5.3, dark = 5.3-10.5 males/km^2.

Density distribution.-The Blackburnian Warbler was an uncommon and local breeder in the forests of Northeast Connecticut. We located none in the southeastern portion of the state (Fig. 89). Based on 18 detections of singing males, we tentatively estimate a population of 3,771 males (1.4 males/km^2).

Population variance.- The coefficient of variation calculated from Breeding Bird Survey data (Sauer et al. 2001) predicted continental population variation as 45.4%. From 1966-2000, populations showed a nearly significant continental increase (mean count/route = 1.3, trend = 1.1, P = 0.07, N = 520). Limited data from southern New England showed no definitive trend, but a possible decline.

On ten line transects through the Northeast Uplands Ecoregion, Craig (1987) reported 28.2 ± 23.2 birds/km^2, a value well above that of this survey. In a ten year sample of Breeding Bird Census plots in Connecticut, it was absent in oak-hemlock forest, had 109.8 ± 54.9 pairs/km^2 in hemlock-hardwood forest, and occurred three times (5.0 pairs/km^2) in second growth deciduous forest. The densities in hemlock-hardwood forest are also well above those found in this study.

Elsewhere, populations vary considerably with habitat. Reported densities of pairs/km^2 are 30-110 in Maine, 20-70 in New Hampshire, 70-170 in West Virginia and 80-120 in eastern Canada (Morse 1994).

Habitat.- Limited data from individual Blackburnian Warblers suggested that they exclusively inhabited stands of white pine and hemlock. Elsewhere, the species is reported to inhabit mature coniferous and mixed conifer-deciduous forest, although some birds occur in deciduous forest near their southern range limit. Spruces, hemlocks and pines are used in the Northeast in both upland and swamp forests (Morse 1994).

History.- The Blackburnian Warbler was thought to be a rare summer resident by Sage et al. (1913). It appears to have increased during the 20th century as forests have regrown (Clark 1994k).

Synthesis.- The population status of the Blackburnian Warbler in southern New England is unclear. Earlier transect studies of Craig (1987) found higher densities than this study principally because they were conducted in the heart of the species' local range (Fig. 89), where it is most abundant. However, the highest densities estimated on any of this study's transects were 14.2 males/km^2, still well below that found earlier. Our qualitative impression also was that birds were far less common than they had been two decades before. Hence, the species may have declined in our region. Populations near their southern range limit are frequently variable (Thompson and Nolan 1973, Marti 1997).

The greater frequency of the Blackburnian Warbler in Northeast compared with Southeast Connecticut (Fig. 89) may be related in part to its association with more conifer-dominated forests. Forests become increasingly coniferous to the north (Table 3,4,5). A higher density in Northeast Connecticut is also suggested by distributions mapped in *The Atlas of Breeding Birds of Connecticut* (Bevier 1994).

Increasing densities toward the north are likely also related to additional geographic factors. The Blackburnian Warbler is near its southern range limit in Connecticut (Morse 1994). Populations of many species decline toward their range limit (Brown 1984, Pulliam 1988).

The observed association of the Blackburnian Warbler with coniferous cover is consistent with other reports of habitat affiliation. Its occurrence in forests with more open understories is a consequence of the small amount of understory cover capable of growing in coniferous habitats, particularly hemlock groves.

Conservation status.- Populations may be declining, and are likely sensitive to forest fragmentation.

PINE WARBLER
Dendroica pinus

Density (males/km^2): 4.0 (95% CI: 2.9-5.4)
Density range (males/km^2/transect): 0-18.1
Total population (males): 10,844 (95% CI: 8,001-14,697)

Detection function: uniform /cosine
$\chi^2 = 2.19$, $P = 0.53$, df = 3, N = 67

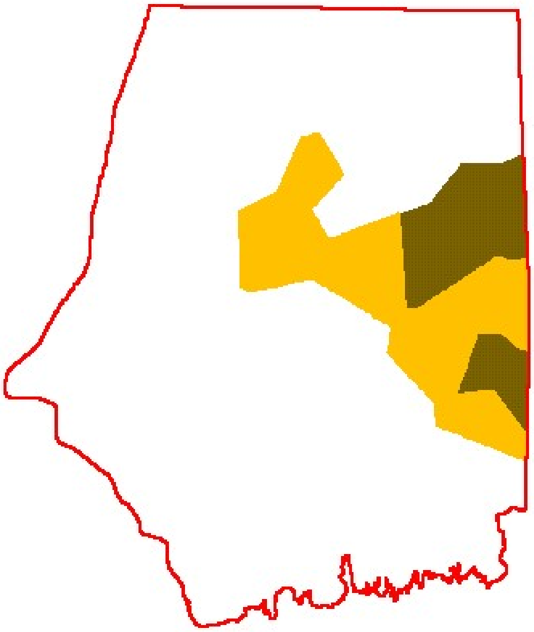

FIG. 90. Greatest densities of the Pine Warbler were concentrated along the Connecticut-Rhode Island border. Light = 0-4.0, medium = 4.0-12.1, dark = 12.1-17.2 males/km^2.

Density distribution.-The Pine Warbler was an uncommon to fairly common breeder in the forests of eastern Connecticut. Its densities averaged greater in Northeast (5.2 ± 7.4 males/km^2) than Southeast Connecticut (2.7 ± 5.5 males/km^2) and nearly significantly so (Mann-Whitney U = 241.5, $P = 0.08$, N = 51). Greatest densities were concentrated along the Connecticut-Rhode Island border Fig. 90). Population estimates are based on detection of singing males.

TABLE 37. Observations of habitat use by individual Pine Warblers showed that they inhabited forests significantly more coniferous and drier than would be predicted by habitat availability. Comparison of population densities with habitat features showed a nearly significant correlation with increasing coniferous cover. $P(\chi^2)$ = probability level of chi-square tests, N = 30; $P(t)$ = probability level of Kendall's tau, N = 51; * = significant, ** = highly significant (see Table 8 for abbreviation key).

	Mean Habitat Characteristics				
	F	M	D	C	U
Availability	1.4	2.3	2.0	2.7	2.3
Use	2.3	2.6	2.0	2.6	2.3
$P(\chi^2)$	0.00**	0.01**	0.88	0.36	0.62
$P(t)$	0.07	0.49	0.84	0.99	0.56

	Percent Vegetation					
	OD	MH	CN	PO	CO	MI
Availability	51.0	13.7	13.1	13.1	8.5	0.7
Use	10.0	3.3	10.0	30.0	46.7	0.0
$P(\chi^2)$	-					

Population variance.- The coefficient of variation calculated from Breeding Bird Survey data (Sauer et al. 2001) predicted continental population variation as 7.4%. From 1966-2000, populations showed a strongly significant continental increase (mean count/route = 4.2, trend = 1.3, $P = 0.00$, N = 939). Limited data from southern New England also suggested an increase.

On ten line transects through the Northeast Uplands Ecoregion, Craig (1987) reported no birds. Moreover, at 19 eastern Connecticut forests surveyed in the summers of 1975-1977, R.Craig (pers. obs.) found only 5% with Pine Warblers, compared with 41% of the (in many cases same) sites surveyed in this study.

In a ten year sample of Breeding Bird Census plots in Connecticut, it occurred once in oak-hemlock forest (2.2 pairs/km^2), had 21.4 ± 8.7 pairs/km^2 in hemlock-hardwood forest, and was absent in second growth deciduous forest. These densities overlap those found in this study. Elsewhere, populations are reported as 28-136 pairs/km^2 in Georgia, 20-50 males/km^2 in Texas, 25-106 males/km^2 in Maryland, 8-62 birds/km^2 in Florida, and 0.7-254 birds/km^2 in Arkansas, with densest populations often occurring in mature forests (Rodewald et al. 1999).

Habitat.- Data from individual Pine Warblers showed that they inhabited forests significantly more coniferous and dry than would be predicted from habitat availability. Moreover, although limited samples in several categories prevented statistical analyses of vegetation data, the species clearly inhabited primarily coniferous forests. Stands of Eastern White Pine and Pitch Pine were most frequently inhabited. Comparison of population densities with habitat features similarly showed a nearly significant correlation with increasing coniferous cover (Table 37). Elsewhere, the species is reported to inhabit young to mature pine forest, mixed pine-deciduous forest, and even deciduous-dominated forests as long as some pines are present. (Rodewald et al. 1999).

History.- The Pine Warbler was thought to be a rare Connecticut breeder by Sage et al. (1913). Zeranski and Baptist (1990) speculate that it declined during the mid-20th century.

Synthesis.- Breeding Bird Survey data strongly indicate that the Pine Warbler is undergoing a long term increase. Its absence from earlier line transects in eastern Connecticut (Craig 1987) in areas where it is now present corroborates this trend, as does survey data from the 1970s (R.Craig pers. obs.). A factor potentially driving the increase is the maturation of regional forests (Ward and Barsky 2000).

The observed association of the Pine Warbler with coniferous cover is consistent with other reports of habitat affiliation. Its occurrence in more xeric forests is also typical for a species that so characteristically inhabits pine forests of the sandy coastal plain. These habitat associations account for our observation that birds were concentrated along the Pachaug State Forest region of the Connecticut-Rhode Island border (Fig. 90), where xeric pine-oak forests predominate (Table 2). A higher density along the border is also suggested by distributions mapped in *The Atlas of Breeding Birds of Connecticut* (Bevier 1994).

Conservation status.- Populations appear to be increasing, but are likely sensitive to forest fragmentation.

Sponsored by Mary Sharkey

PRAIRIE WARBLER

Dendroica discolor

Density (males/km^2): 0.7 (95% CI: 0.4-1.1)
Density range (males/km^2/transect): 0-11.3
Total population (males): 1,813 (95% CI: 1,069-3,074)

Detection function: uniform /cosine
$x^2 = 1.51$, $P = 0.68$, df = 3, N = 30

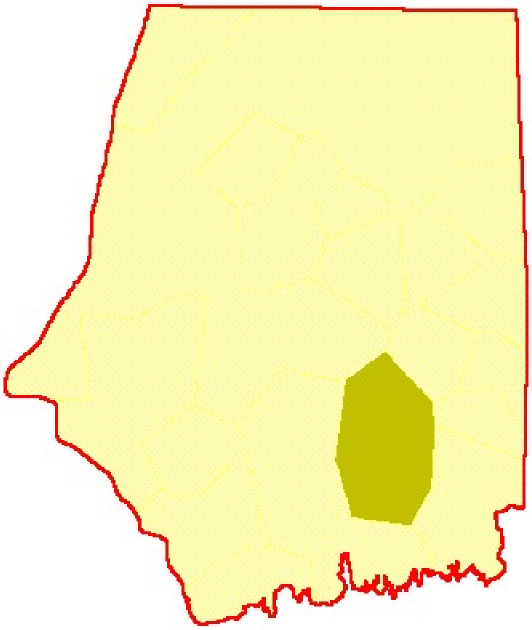

FIG. 91. Densities of the Prairie Warbler averaged greater in Southeast Connecticut. Light = 0-1.9, dark = 1.9-3.8 males/km^2.

Density distribution.-The Prairie Warbler was an uncommon and local breeder in the forests of eastern Connecticut. Its densities averaged greater in Southeast (1.0 ± 2.3 males/km^2) than Northeast Connecticut (0.4 ± 0.8 males/km^2; Fig. 91) and but not significantly so (Mann-Whitney U = 284.5, $P = 0.34$, N = 51).

Because the Prairie Warbler inhabits environments other than forest, densities reported here refer only to that part of the population associated with primarily forested regions. Population estimates are based on <60 detections of singing males, so have reduced accuracy.

Population variance.- The coefficient of variation calculated from Breeding Bird Survey data (Sauer et al. 2001) predicted continental population variation as 19.6%. From 1966-2000, populations showed a strongly significant continental decline (mean count/route = 2.1, trend = -2.2, $P = 0.00$, N = 828). Limited data from southern New England suggested a similar decline.

On ten line transects through the Northeast Uplands Ecoregion, Craig (1987) reported no birds in the largely unbroken forests surveyed. In a ten year sample of Breeding Bird Census plots in Connecticut, the species occurred once (4.3 pairs/km^2) in oak-hemlock forest, but was absent from hemlock-hardwood and second growth deciduous forest. Elsewhere, populations are reported to vary depending on successional stage. Densities of pairs/km^2 in open woodlands include 31 in Michigan and 33-48 in North Carolina and New Jersey. In Connecticut brushy pastures, 28-85 pairs/km^2 are reported (Nolan et al. 1999).

Habitat.- Because Prairie Warblers are not associated with interior forests, we made almost no observations on habitat use by individuals. We typically found birds inhabiting selectively logged areas, clearcuts, early successional woodlands, and scrubby, open pine-oak barrens. Populations were too low to compare densities with forest habitat variables.

Elsewhere, the species is reported from a variety of habitats. In our region, typical habitats include shrublands with open canopies, old fields and early to mid-successional woodlands. Xeric, scrubby, pine-oak habitats are often favored (Nolan et al. 1999).

History.- The Prairie Warbler, a primarily southeastern species, expanded its populations north after the deforestation of the East in the late 18th and early 19th century (Zeranski and Baptist 1990, Nolan et al. 1999). Sage et al. (1913) already considered it common in southern Connecticut, but it continued to extend its populations north after this time (Clark 1994l).

Synthesis.- As with other species associated with successional environments, Breeding Bird Survey data indicate that the Prairie Warbler is now declining as forests mature and urbanization occurs. Despite this decline, we found that populations continue to inhabit forest environments where more extensive disturbance has occurred or where pine-oak barrens develop on dry, sandy soil. Logging and natural disturbance seem likely to continue supplying suitable habitat for populations, albeit at reduced densities.

The Prairie Warbler may be described as an early to mid-successional species. However, it was more likely to occur in open forest barrens than other successional species, and less associated with small forest openings and wetlands than species like the Blue-winged Warbler.

Conservation status.- Populations are declining, although timber management practices and natural disturbances may be sufficient to sustain populations at a reduced level. This and other successional species may be returning to population levels more historically typical for them.

CERULEAN WARBLER
Dendroica cerulea

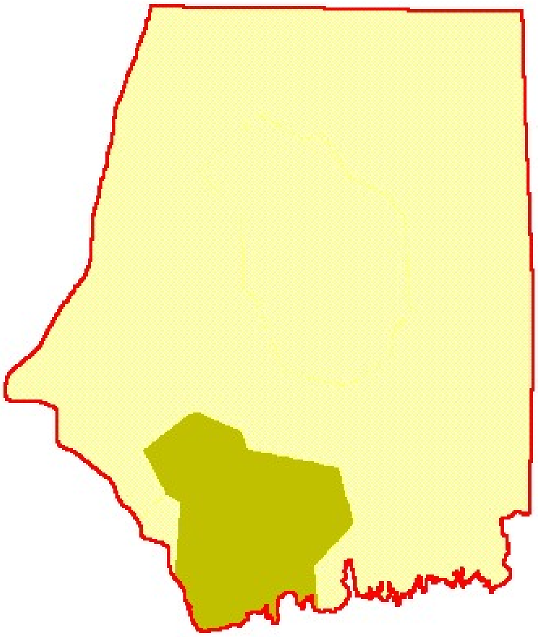

FIG. 92. Densities of the Cerulean Warbler averaged greater in Southeast Connecticut. Light = 0-3.7, dark = 3.7-9.3 males/km^2.

Density distribution.-The Cerulean Warbler was an uncommon and local breeder in regional forests. Based on 18 detections of singing males, we tentatively estimate a population of 2,670 males (1.0 males/km^2). It occurred at 8% of sites in Northeast Connecticut, and 8% of sites Southeast Connecticut, although mapped distributions (Fig. 92) suggested that densities were greater to the south.

Population variance.- The coefficient of variation calculated from Breeding Bird Survey data (Sauer et al. 2001) predicted continental population variation as 152.1%. From 1966-2000, populations showed a significant continental decline (mean count/route = 0.4, trend = -4.1, P = 0.00, N = 259). The species was too infrequent on counts in southern New England for meaningful estimates to be computed.

On ten line transects through the Northeast Uplands Ecoregion, Craig (1987) found no individuals, although he found a bird in Union immediately outside a transect strip (R. Craig pers. obs.). Moreover, in 19 eastern Connecticut forests surveyed in the summers of 1975-1977, R. Craig (pers. obs.) found Cerulean Warblers at 5% of sites, compared with 15% of (in many instance the same) sites in this study.

In a ten year sample of Breeding Bird Census plots in Connecticut, the species was absent in oak-hemlock, hemlock-hardwood, and second growth deciduous forest. Other studies have found mean densities on Breeding Bird Census plots to be 43 ± 42 pairs/km^2. Maximum densities of 82-290 pairs/km^2 were reported for such plots (Hamel 2000).

Habitat.- Limited data from individual Cerulean Warblers suggested that they inhabited only deciduous forests. Forests in which we found birds were typically mature, but varied from mesic to xeric, and had open to moderately dense understories.

Elsewhere, extensive tracts of mesic, mature, deciduous forests with open understories are occupied. Historically, large populations were reported from old growth bottomland forests. Forest fragmentation has been associated with regional population declines (Hamel 2000).

History.- The Cerulean Warbler is thought to have nested in Connecticut only since the 1930s (Zeranski and Baptist 1990). Since then, it has increased as a breeder, although it was considered rare and local into the 1990s (Ellison 1994c).

Synthesis.- Even though data from the Breeding Bird Survey indicate a significant continental population decline for the Cerulean Warbler, evidence cited from long term distributional surveys in eastern Connecticut (R. Craig pers. obs.) suggests that a modest range expansion has occurred since the 1970s. A similar population expansion has been noted for southern Ontario (Oliarnyck and Robertson

1996). However, based on data from the *The Atlas of Breeding Birds of Connecticut* (Bevier 1994), our findings indicate that populations are no more widespread than they were in the 1980s, and continue to have a center of abundance in the southwestern portion of our region (Fig. 92).

Our limited observations on this uncommon species prevented a definitive evaluation of its habitat affinities. However, our data are consistent with existing descriptions of preferred habitat as being mature, deciduous forest with open understory.

Conservation status.- Populations appear to be expanding, but are sensitive to forest fragmentation.

Sponsored by David Corsini

BLACK-AND-WHITE WARBLER
Mniotilta varia

Density (males/km^2): 7.1 (95% CI: 5.9-8.5)
Density range (males/km^2/transect): 0-29.4
Total population (males): 19,303 (95% CI: 16,174-23,039)

Detection function: hazard /cosine
$\chi^2 = 0.60$, $P = 0.74$, df = 2, N = 135

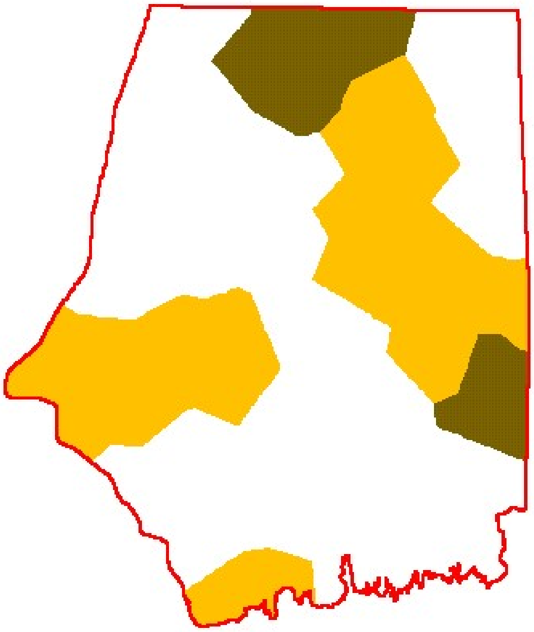

FIG. 93. Densities of the Black-and-white Warbler were similar in Northeast and Southeast Connecticut. Light = 0.9-6.3, medium = 6.3-11.6, dark = 11.6-17.0 males/km^2.

TABLE 38. Observations of habitat use by individual Black-and-white Warblers showed that they inhabited forests with significantly higher understory density than would be predicted by habitat availability. Comparison of population densities with habitat features showed no significant correlations. $P(\chi^2)$ = probability level of chi-square tests, N = 60; $P(\tau)$ = probability level of Kendall's tau, N = 51; * = significant, ** = highly significant (see Table 8 for abbreviation key).

	Mean Habitat Characteristics				
	F	M	D	C	U
Availability	1.4	2.3	2.0	2.7	2.3
Use	1.4	2.4	2.0	2.6	2.5
$P(\chi^2)$	0.81	0.11	0.73	0.46	0.01**
$P(\tau)$	0.89	0.29	0.31	0.59	0.66

	Percent Vegetation					
	OD	MH	CN	PO	CO	MI
Availability	51.0	13.7	13.1	13.1	8.5	0.7
Use	55.0	8.3	16.7	11.7	8.3	0.0
$P(\chi^2)$	0.81					

Density distribution.-The Black-and-white Warbler was an uncommon to fairly common breeder in regional forests. Its densities were similar (Mann-Whitney U = 288.5, $P = 0.47$, N = 51) in Northeast (7.4 ± 5.5 males/km^2) and Southeast Connecticut (6.7 ± 7.5 males/km^2; Fig. 93). Population estimates are based on detection of singing males.

Population variance.- The coefficient of variation calculated from Breeding Bird Survey data (Sauer et al. 2001) predicted population variation as 25.1% for southern New England. From 1966-2000, populations showed no significant trend in this region (mean count/route = 3.3, trend = -1.0, P = 0.24, N = 48) or continentally (mean count/route = 1.9, trend = 0.1, P = 0.87, N = 1193).

On ten line transects through the Northeast Uplands Ecoregion, Craig (1987) reported 35.1 ± 20.6 birds/km^2, which is greater than that of this study even when our estimates are converted to individuals/km^2. In a ten year sample of Breeding Bird Census plots in Connecticut, densities of pairs/km^2 were 22.8 ± 9.6 in oak-hemlock forest, 14.3 ± 13.6 in hemlock-hardwood forest, and 20.3 ± 11.3 in second growth deciduous forest. These estimates overlap but average higher than those of this study. Earlier plot studies in Connecticut have shown densities ranging from 0 to 100 birds/km^2 (Craig 1987).

Habitat.- Data from individual Black-and-white Warblers showed that they inhabited forests with significantly greater understory density than would be predicted by habitat availability. Field observations also suggested that they preferred drier forests, but our data show only limited evidence for this possibility. Examination of population density vs. habitat variables showed no significant correlations (Table 38).

Elsewhere, mature to second growth, deciduous to mixed forests are used, and a possible preference exists for swampy forest. Studies have shown a strong preference for mature over second growth forest and for dense understory vegetation. However, various and conflicting habitat affiliations have been reported for the species (Kricher 1995).

History.- The Black-and-white Warbler was reported as historically common, even during the early 20th century (Sage et al. 1913) when much of the state was deforested (Ward and Barsky 2000). Hence, it appears to have been as historically common as habitat extent has permitted.

Synthesis.- Although there is no evidence for a regional or continental population decline, the densities we computed suggested that populations averaged lower than they did on previous transect studies by Craig (1987). Although the population estimates from these two studies statistically overlap, our impression was that birds indeed were present at lower frequencies than formerly. Populations may have been at a low point in a population cycle during this study. However, the Black-and-white Warbler is thought to be an area sensitive, forest interior species (Kricher 1997), so populations warrant continued monitoring to detect non-cyclic declines.

The observed association of the Black-and-white Warbler with denser understories is consistent with other reports of habitat affiliation. Our suspected association with more xeric forests has not been reported for other populations, however.

Conservation status.- Populations appear secure, but are sensitive to forest fragmentation.

Sponsored by David Whall

AMERICAN REDSTART
Setophaga ruticilla

Density (males/km^2): 5.1 (95% CI: 3.9-6.7)
Density range (males/km^2/transect): 0-31.9
Total population (males): 13,991 (95% CI: 10,649-18,383)

Detection function: hazard /cosine
$\chi^2 = 0.01$, $P = 0.99$, df = 2, N = 115

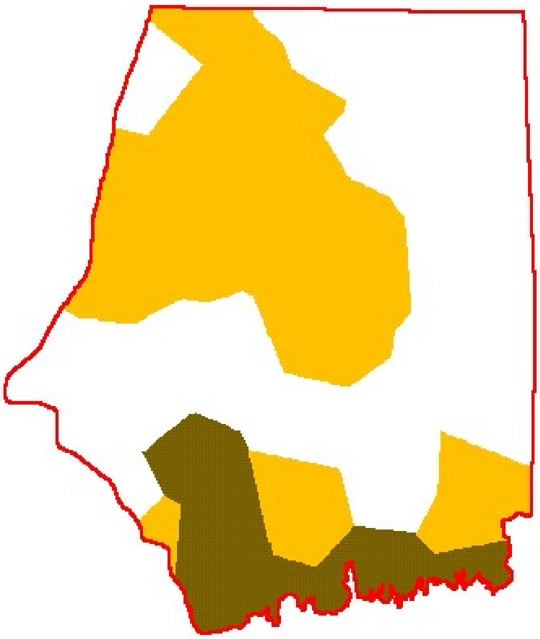

FIG. 94. Greatest densities of the American Redstart were concentrated along the Connecticut shoreline. Light = 0-3.0, medium = 3.0-11.4, dark = 11.4-18.2 males/km^2.

TABLE 39. Observations of habitat use by individual American Redstarts showed that they inhabited forests more deciduous and with more open canopies than would be predicted by habitat availability. However, no significant correlations between habitat and population densities existed. $P(\chi^2)$ = probability level of chi-square tests, N = 44; $P(t)$ = probability level of Kendall's tau, N = 51; * = significant, ** = highly significant (see Table 8 for abbreviation key).

	Mean Habitat Characteristics				
	F	M	D	C	U
Availability	1.4	2.3	2.0	2.7	2.3
Use	1.1	2.1	2.0	2.4	2.4
$P(\chi^2)$	0.00**	0.06	0.56	0.02*	0.14
$P(t)$	0.65	0.54	0.71	0.30	0.31

	Percent Vegetation					
	OD	MH	CN	PO	CO	MI
Availability	51.0	13.7	13.1	13.1	8.5	0.7
Use	59.1	31.8	4.5	0.0	2.3	2.3
$P(\chi^2)$	-					

Density distribution.- The American Redstart was uncommon to fairly common in the forests of eastern Connecticut. Its densities showed a non-significant (Mann-Whitney U = 307.0, $P = 0.78$, N = 51) increase from north (4.6 ± 6.8 males/km^2) to south (5.6 ± 8.5 males/km^2), although densities were consistently greatest along the shoreline (Fig. 94). Population estimates are based on detection of singing males.

Population variance.- The coefficient of variation calculated from Breeding Bird Survey data (Sauer et al. 2001) predicted population variation as 23.8% for southern New England. From 1966-2000, populations showed a significant increase in this region (mean count/route = 3.3, trend = 2.0, $P = 0.02$, N = 47), although continentally they showed no trend (mean count/route = 3.2, trend = -0.54, $P = 0.39$, N = 1319).

On ten line transects through the Northeast Uplands Ecoregion, Craig (1987) reported 4.3 individuals/km^2, a value lower than that of this study when our estimates are multiplied by two to yield breeding individuals/km^2. In a ten year sample of Breeding Bird Census plots in Connecticut, birds were detected twice in oak-hemlock forest (4.3 pairs/km^2), once in hemlock-hardwood forest(4.8 pairs/km^2), and averaged 21.0 ± 8.4 pairs/km^2 in second growth deciduous forest. These estimates overlap those of this study.

Elsewhere, densities of birds/km^2 have been reported as 50-440 in New Hampshire, 150-213 in New York, 71-210 in Maryland, and 130 in Tennessee (Sherry and Holmes 1997). Plot studies in young forests and old fields have shown densities ranging from 30-43 birds/km^2 for Connecticut (Ellison 1994d).

Habitat.- Data from individual American Redstarts showed that they inhabited forests more deciduous than would be predicted by habitat availability. This relationship was reflected in their much more frequent presence in mixed deciduous forests and less frequent presence in conifer-containing forests than predicted by habitat availability (although vegetation relationships could not be tested statistically because of zeros in the data). Moreover, they tended to inhabit forests with more open canopies than predicted. No significant correlations between habitat and population densities existed (Table 39). We tended to find birds associated with forest gaps. Elsewhere, the species is associated with more deciduous, mesic forests with more open canopies and denser understory (Sherry and Holmes 1997).

History.- The American Redstart has been reported in Connecticut as historically common (Sage et al. 1913) to abundant (Bent 1953), although more recently uncommon (Zeranski and Baptist 1990). The species' comparative abundance before 1950 probably reflects its frequent occurrence in younger forest (Sherry and Holmes 1997). Such habitats developed rapidly from the 1920s to the 1950s as abandoned farmland succeeded to young forest (Ward and Barsky 2000).

Synthesis.- The population densities computed in this survey are higher than those of earlier forest transect estimates of Craig (1987). Although population declines in maturing forest have been noted in northern New England (Sherry and Holmes 1997), Breeding Bird Surveys indicate that a long term increase has occurred in our region. Our data provide additional evidence for this increase.

Our findings that the American Redstart was associated with more deciduous, open canopy forest is consistent with other reports for the species. The trend toward higher densities along the coast (Fig. 94) appeared related to the more open canopies and strongly deciduous character of these forests (Table 2), and is corroborated by findings from our 2003 surveys (unpubl. data) of the Rhode Island coast.

Based on our data, the American Redstart may be characterized as a forest gap/ forest disturbance-related species, although it also has been characterized as a forest interior, area-sensitive species (see also Sherry and Holmes 1997). As long as extensive forests are present in the region, natural disturbances and forest management practices seem likely to produce a renewing source of habitat for it. Hence, even as the forest landscape continues to mature, the species seems likely to persist regionally, albeit at reduced densities.

Conservation status.- Populations appear secure, but potentially sensitive to forest fragmentation.

Sponsored by the Town of Columbia

WORM-EATING WARBLER
Helmitheros vermivorus

Density (males/km^2): 6.6 (95% CI: 4.5-9.6)
Density range (males/km^2/transect): 0-28.9
Total population (males): 17,940 (95% CI: 12,264-26,244)

Detection function: hazard /cosine
$\chi^2 = 0.28$, $P = 0.87$, df = 2, N = 128

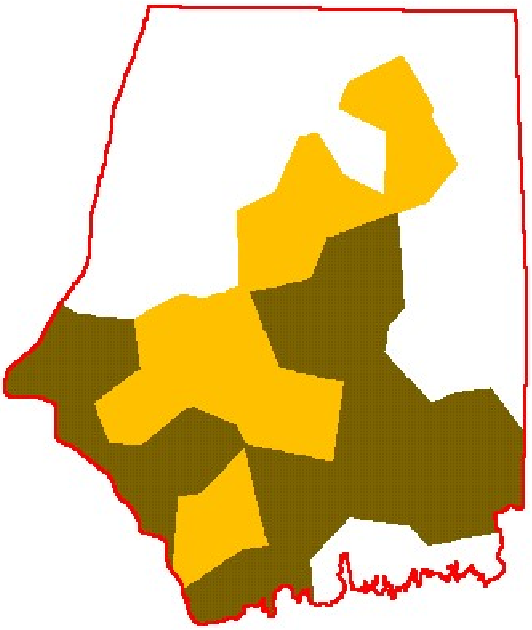

FIG. 95. Densities of the Worm-eating Warbler were greatest in Southeast Connecticut. Light = 0-5.3, medium = 5.3-9.6, dark = 9.6-16.6 males/km^2.

Density distribution.-The Worm-eating Warbler was uncommon to fairly common in the forests of eastern Connecticut. Its densities were significantly lower (Mann-Whitney U = 147.0, $P = 0.00$, N = 51) in Northeast (3.5 ± 5.2 males/km^2) than Southeast Connecticut (9.8 ± 7.4 males/km^2; Fig. 95). Population estimates are based on detection of singing males.

TABLE 40. Individual Worm-eating Warblers inhabited forests that were more deciduous than would be predicted by habitat availability, a trend corroborated by comparison of population densities with habitat features. $P(\chi^2)$ = probability level of chi-square tests, N = 59; $P(t)$ = probability level of Kendall's tau, N = 51; * = significant, ** = highly significant (see Table 8 for abbreviation key).

	Mean Habitat Characteristics				
	F	M	D	C	U
Availability	1.4	2.3	2.0	2.7	2.3
Use	1.2	2.4	2.0	2.8	2.3
$P(\chi^2)$	0.00**	0.73	0.86	0.11	0.55
$P(t)$	0.01**	0.50	0.93	0.37	0.87

	Percent Vegetation					
	OD	MH	CN	PO	CO	MI
Availability	51.0	13.7	13.1	13.1	8.5	0.7
Use	72.9	15.3	8.5	0.0	3.4	0.0
$P(\chi^2)$	-					

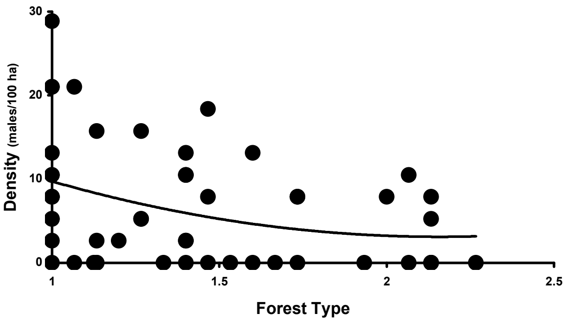

FIG. 96. Population density showed a variable but significant increase with increasing deciduous forest cover.

Population variance.- The coefficient of variation calculated from Breeding Bird Survey data (Sauer et al. 2001) predicted continental population variation as 165.4%. From 1966-2000, populations showed no significant continental trend (mean count/route = 0.5, trend = 0.8, $P = 0.37$, N = 401). Limited data from southern New England also suggested no trend.

On ten line transects through the Northeast Uplands Ecoregion, Craig (1987) reported no birds. Moreover, at 19 eastern

Connecticut forests surveyed in the summers of 1975-1977, R.Craig (pers. obs.) found only 11% with Worm-eating Warblers, compared with 65% of the (in many cases same) sites surveyed in this study. In a ten year sample of Breeding Bird Census plots in Connecticut, 3.6 ± 4.0 pairs/km^2 occurred in oak-hemlock forest, but none were in hemlock-hardwood or second growth deciduous forest. These densities average lower than those found in this study.

Elsewhere, males/km^2 are reported as 44 in southwest Connecticut, 1.5-7.8 in Illinois, 21 ± 4.5 in Arkansas, 22 in Kentucky, 100-150 in Maryland and 30-99 in West Virginia (Hanners and Patton 1998). These numbers overlap but average higher than those in this study.

Habitat.- Individual Worm-eating Warblers inhabited forests that were more deciduous than would be predicted by habitat availability, a trend corroborated by comparison of population densities with habitat features. Oak-dominated forests appeared to be particularly favored (Table 40, Fig. 96). We most frequently encountered birds on xeric to mesic slopes in oak-dominated forests.

Elsewhere, the species is reported to inhabit mesic to xeric mature deciduous and mixed conifer-deciduous forest on hillsides with dense shrubbery. Unfragmented, extensive forests appear to be favored (Hanners and Patton 1998).

History.- The Worm-eating Warbler was described as a fairly common breeder of southern Connecticut by Sage et al. (1913). It appears to have expanded its range during the 20th century (Zeranski and Baptist 1990).

Synthesis.- Although Breeding Bird Survey data show no long term population increase, its absence from earlier line transects (Craig 1987) in areas where it is now present, as well as data of R. Craig (above) suggests that a local increase has occurred since the 1970s. A factor potentially driving the increase is the maturation of regional forests (Ward and Barsky 2000).

The observed association of the Worm-eating Warbler with deciduous forest is consistent with other reports of habitat use, although such reports (Hanners and Patton 1998) do not specify a specific affiliation with oak-dominated forest. Moreover, unlike these reports our data do not show any association with increasing understory density, although we found the species to inhabit forests of at least moderate understory density.

The prevalence of the Worm-eating Warbler in Southeast Connecticut (Fig. 95) may be related in part to its association with oak-dominated forest, which predominates in this region (Table 3,4,5). Moreover, because it is near its northern range limit in Connecticut (Hanners and Patton 1998), additional geographic factors also likely influence populations, which tend to decline toward range limits (Brown 1984, Pulliam 1988).

Conservation status.- Populations may be increasing, but are likely sensitive to forest fragmentation.

Sponsored by Michael Koss

OVENBIRD

Seiurus aurocapillus

Density (males/km^2): 57.8 (95% CI: 47.5-70.3)
Density range (males/km^2/transect): 0-112.0
Total population (males): 157,410 (95% CI: 129,410-191,470)

Detection function: half normal/cosine
$\chi^2 = 1.98$, $P = 0.16$, df = 1, N = 974

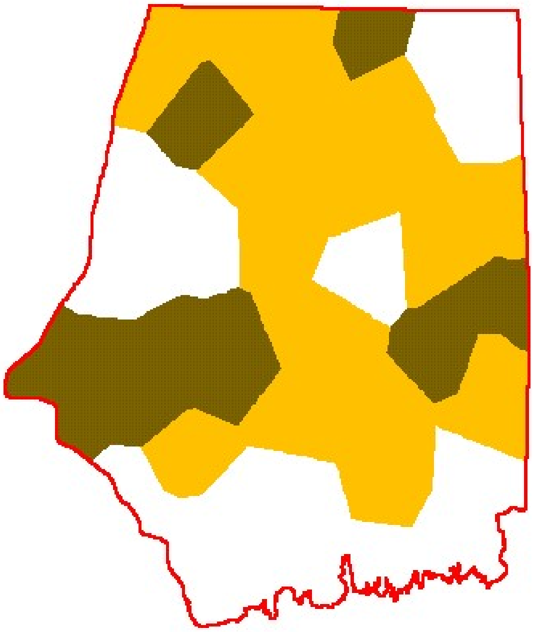

FIG. 97. Densities of the Ovenbird were similar in Northeast and Southeast Connecticut. Light = 23.2-48.4, medium = 48.4-71.6, dark = 71.6-91.8 males/km^2.

Density distribution.- Despite being uncommon to absent at some sites, the Ovenbird was the most abundant breeder in the forests of eastern Connecticut. Densities were similar ($t = 0.7$, df = 49, $P = 0.47$) in Northeast (60.3 ± 22.0 males/km^2) and Southeast Connecticut (55.2 ± 27.3 males/km^2; Fig. 97). Population estimates are based on detection of singing males.

Population variance.- The coefficient of variation calculated from Breeding Bird Survey data (Sauer et al. 2001) predicted variation in southern New England populations as 4.7%. From 1966-2000, populations showed no significant trend in this region (mean count/route = 11.5, trend = -0.0, $P = 0.94$, N = 50), although continentally they increased significantly (mean count/route = 7.6, trend = 0.6, $P = 0.00$, N = 1456).

On ten line transects through the Northeast Uplands Ecoregion, Craig (1987) reported 149.2 ± 45.7 birds/km^2, a range similar to that of this study, when our estimates are multiplied by two to yield breeding individuals/km^2. In a ten year sample of Breeding Bird Census plots in Connecticut, densities of pairs/km^2 were 35.1 ± 15.9 in oak-hemlock forest, 112.2 ± 22.3 in hemlock-hardwood forest, and 146.0 ± 20.5 in second growth deciduous forest. These estimates overlap but average higher than the range computed in this study. Other plot studies have shown densities ranging from 19.0-237.6 birds/km^2 for Connecticut (Craig 1987).

TABLE 41. Observations of habitat use by individual Ovenbirds showed that they inhabited forests which had canopies averaging more closed than those available. Comparison of population densities with habitat features yielded no significant correlations. $P(\chi^2)$ = probability level of chi-square tests, N = 401; $P(t)$ = probability level of Kendall's tau, N = 51; * = significant, ** = highly significant (see Table 8 for abbreviation key).

	Mean Habitat Characteristics				
	F	M	D	C	U
Availability	1.4	2.3	2.0	2.7	2.3
Use	1.4	2.3	2.0	2.8	2.3
$P(\chi^2)$	0.30	0.75	-	0.04*	0.12
$P(t)$	0.97	0.66	0.20	0.60	0.32

	Percent Vegetation					
	OD	MH	CN	PO	CO	MI
Availability	51.0	13.7	13.1	13.1	8.5	0.7
Use	58.1	12.0	11.5	10.5	6.2	1.7
$P(\chi^2)$	0.56					

Habitat.- Data from individual Ovenbirds demonstrated that they inhabited forests which had canopies averaging more closed than those available. Otherwise, they used habitats in approximately the proportions at which they were present. Examination of population density vs. habitat variables yielded no significant correlations (Table 41). In most regards we found the species to be a habitat generalist. However, it appeared rare or absent principally in areas along the coast and Connecticut River (Fig. 97).

Elsewhere, the Ovenbird is reported to inhabit a broad range of deciduous and mixed forest types. Only pure coniferous forests appear less preferred. It occupies young to climax forest, although studies suggest a preference for mature, closed canopy forests. The presence of extensive, unbroken forest tracts also appears to be an essential habitat feature (van Horn and Donovan 1994).

History.- The Ovenbird has been reported as historically common to abundant (Sage et. al 1913, Zeranski and Baptist 1990). During the 19th century when the regional landscape was largely deforested (Ward and Barsky 2000), the species appears to have remained common within available forest habitat.

Synthesis.- The population densities computed in this survey are similar to those of earlier transect estimates. The similarity in these estimates is supported by data from the Breeding Bird Survey, which show little evidence for a regional population trend, and comparatively low population variance.

The rarity of the Ovenbird on coastal and some Connecticut River transects (Fig. 97) may have been related to the comparatively open canopies of these sites (Table 2). Heavy die-off of hemlock is responsible for forest openings along the Connecticut River, but prevailing climatic conditions are in part responsible for openness along the coast. Moreover, some coastal areas are subject to heavy browsing of the understory by White-tailed Deer (*Odocoileus virginianus*).

Our observations of habitat use correspond well with the prevailing view that the Ovenbird occupies a variety of forest types. As in other studies, we also found that forests with greater canopy closure appeared to be particularly suitable habitat.

Conservation status.- Populations are large and appear secure, but vulnerable to forest fragmentation.

Sponsored by Diane Koss

NORTHERN WATERTHRUSH

Seiurus noveboracensis

Density (males/km^2): 0.3 (95% CI: 0.2-0.5)
Density range (males/km^2/transect): 0-1.4
Total population (males): 776 (95% CI: 427-1,410)

Detection function: uniform/polynomial
$x^2 = 1.39$, $P = 0.84$, df = 4, N = 21

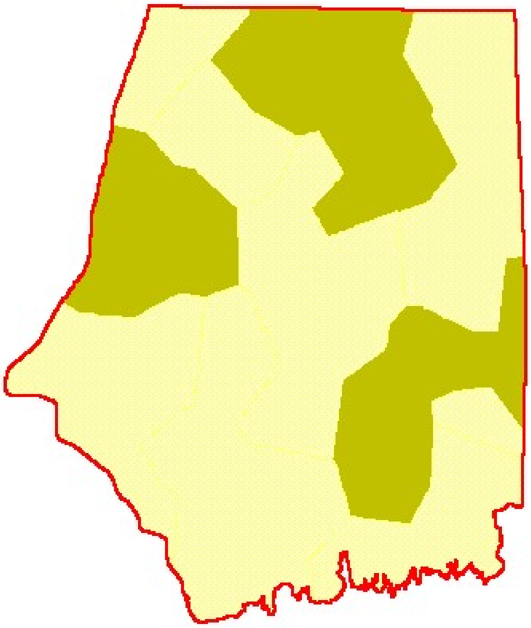

FIG. 98. Densities of the Northern Waterthrush averaged greater in Northeast Connecticut. Light = 0-0.2, dark = 0.2-0.9 males/km^2.

Density distribution.- The Northern Waterthrush was one of the least common breeding forest birds of eastern Connecticut. Its densities averaged higher in Northeast (0.3 ± 0.5 males/km^2) than Southeast Connecticut (0.2 ± 0.5 males/km^2; Fig. 98), but not significantly so (Mann-Whitney U = 269.0, P = 0.19, N = 51). Population estimates are based on <60 detections of singing males, so have reduced accuracy.

Population variance.- The coefficient of variation calculated from Breeding Bird Survey data (Sauer et al. 2001) predicted continental population variation as 33.1%. From 1966-2000, populations showed no significant continental trend (mean count/route = 1.7, trend = 0.3, P = 0.56, N = 51). Limited data from southern New England populations also showed no clear trend.

On ten line transects through the Northeast Uplands Ecoregion, Craig (1987) reported 9.2 birds/km^2, a value above that of this study even when our estimates are multiplied by two to yield breeding individuals/km^2. In a ten year sample of Breeding Bird Census plots in Connecticut, birds appeared once in oak-hemlock forest (4.3 pairs/km^2) and three times in hemlock-hardwood forest (4.8-9.5 pairs/km^2). They were absent from second growth deciduous forest. Elsewhere, population densities are reported as 0.2-10 pairs/km^2 in Ontario (Eaton 1995).

Habitat.- Northern Waterthrushes occurred too infrequently for habitat evaluations to be made for individuals. We most frequently encountered birds in conifer-dominated swamps, although they were occasionally present in deciduous swamps.

Elsewhere, the species is reported to breed in wooded swamps, particularly those with evergreen canopies and understories. They are also reported from bog thickets and shrubby margins of rivers, streams and lakes. Dense understory cover and presence of water are characteristic habitat features in most of its range (Eaton 1995).

In Connecticut, analyses of territory features demonstrated that compared with Louisiana Waterthrushes, birds inhabited wetlands with significantly more standing water, higher shrub density, more evergreen cover by moss, shrubs, and trees, and more swamp-related features like ferns and hummocks. An examination of 26 sites in eastern Connecticut further showed that Northern Waterthrush habitats were typically hemlock-deciduous swamps to the north, whereas deciduous swamps and Atlantic white-cedar swamps were more frequent to the south (Craig 1985).

History.- The Northern Waterthrush appears to have extended its range south into Connecticut during the early 20th century (Zeranski and Baptist 1990). Sage et al. (1913) did not know it as a nester.

Synthesis.- Breeding Bird Survey data indicate little long-term change in populations of the Northern Waterthrush. Earlier transect studies of Craig (1987) found higher densities than this study principally because they were conducted in a region where the species is most abundant (Fig. 98). We have observed no appreciable alteration in its distribution or abundance since the 1970s.

Although we observed few birds during this study, previous investigations (Craig 1985) have documented habitat use in our region. Its association with dense, coniferous swamps is consistent with other reported use of habitats. Indeed, among the places where the species was most frequent were the Northeast Uplands Ecoregion and the Pachaug State Forest area of the Connecticut-Rhode Island border (Fig. 98). This distribution appears related to the more frequent occurrence of coniferous forests in these regions (Table 2,3,4,5). A higher density in these area is also suggested by distributions mapped in *The Atlas of Breeding Birds of Connecticut* (Bevier 1994).

Conservation status.- Populations appear stable, but are likely vulnerable to forest fragmentation and loss of hemlock.

Sponsorship in Memory of James M. Craig

LOUISIANA WATERTHRUSH
Seiurus motacilla

Density (males/km^2): 2.9 (95% CI: 1.8-4.7)
Density range (males/km^2/transect): 0-11.4
Total population (males): 7,891 (95% CI: 4,906-12,693)

Detection function: half normal /cosine
$\chi^2 = 1.36, P = 0.71$, df = 3, N = 39

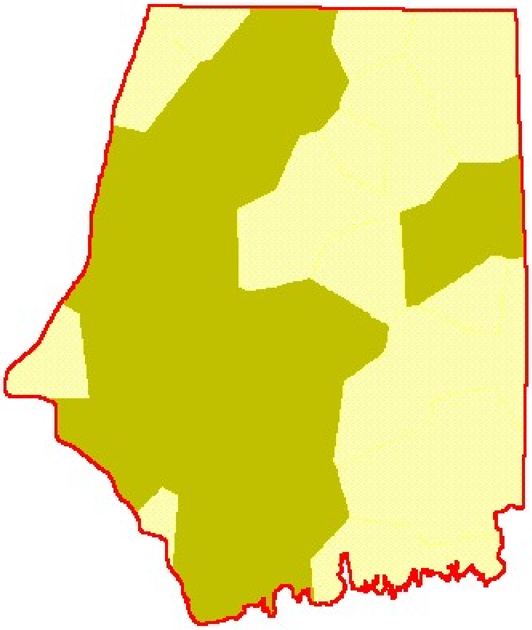

FIG. 99. Densities of the Louisiana Waterthrush averaged greater in Southeast Connecticut. Light = 0-2.5, dark = 2.5-7.9 males/km^2.

Density distribution.- The Louisiana Waterthrush was uncommon in the forests of eastern Connecticut. Its densities averaged lower in Northeast (2.5 ± 3.5 males/km^2) than Southeast Connecticut (3.3 ± 4.4 males/km^2; Fig. 99), although not significantly so (Mann-Whitney U = 296.5, P = 0.55, N = 51). Population estimates are based on <60 detections of singing males, so have reduced accuracy.

Population variance.- The coefficient of variation calculated from Breeding Bird Survey data (Sauer et al. 2001) predicted continental population variation as 166.6%. From 1966-2000, populations showed no significant continental increase (mean count/route = 0.4, trend = 0.8, P = 0.80, N = 51). Limited data from southern New England showed no clear trend.

TABLE 42. Individual Louisiana Waterthrushes inhabited forests that were moister and older than would be predicted by habitat availability. Comparison of population densities with habitat features yielded no significant correlations. $P(\chi^2)$ = probability level of chi-square tests, N = 19; $P(t)$ = probability level of Kendall's tau, N = 51; * = significant, ** = highly significant (see Table 8 for abbreviation key).

	Mean Habitat Characteristics				
	F	M	D	C	U
Availability	1.4	2.3	2.0	2.7	2.3
Use	1.6	1.9	2.3	2.6	2.3
$P(\chi^2)$	0.58	0.00**	0.00**	0.63	0.89
$P(t)$	0.11	0.79	0.14	0.40	0.88

	Percent Vegetation					
	OD	MH	CN	PO	CO	MI
Availability	51.0	13.7	13.1	13.1	8.5	0.7
Use	36.8	15.8	21.1	5.3	15.8	5.3
$P(\chi^2)$	-					

On ten line transects through the Northeast Uplands Ecoregion, Craig (1987) reported 8.1 birds/km^2, a value above that of this study even when our estimates are multiplied by two to yield breeding individuals/km^2. In a ten year sample of Breeding Bird Census plots in Connecticut, densities of pairs/km^2 were 4.6 ± 3.1 in oak-hemlock forest, none in hemlock-hardwood forest, and 7.9 ± 7.8 in second growth deciduous forest. These densities overlap but average higher than those found in this study. Elsewhere, pairs/km of stream is reported as 1.0 in Illinois, 2.5 in New York and 2.8 in Connecticut (Robinson 1995).

Habitat.- Individual Louisiana Waterthrushes inhabited forests that were moister and older than would be predicted by habitat availability. Moreover, although not statistically testable because of small samples, birds appeared to occur less in oak-dominated forests and more in forests with conifers (except for xeric pine-oak forest) than would be predicted. Comparison of population densities with habitat features yielded no significant correlations, however (Table 42). We most frequently encountered birds along rushing or swampy streams in mesic coves. Such locations tended to be unlogged areas dominated by among the largest trees in the forest, particularly hemlock, white ash, and red oak.

Elsewhere, the species is reported to breed along gravel-bottomed streams through hilly, deciduous forest and in bottomland swamps (Robinson 1995). In Connecticut, analyses of territory features demonstrated that compared with Northern Waterthrushes, birds inhabited wetlands with significantly more flowing water, lower shrub density, less evergreen cover by moss, shrubs, and trees, and fewer swamp-related features like ferns and hummocks. An examination of 26 sites in eastern Connecticut further showed that Louisiana Waterthrush habitats were dominated by conifer-deciduous cover to the north whereas deciduous cover was more frequent to the south (Craig 1985).

History.- The Lousiana Waterthrush appears to have expanded its range north during the late 19th century (Clark 1994m). It has been in contact with the range of the Northern Waterthrush for ca 100 years (Craig 1985). Sage et al. (1913) found the species most common in southern Connecticut.

Synthesis.- Because the Louisiana Waterthrush greatly reduces singing after the early breeding season (Craig 1981), population estimates based on song are potentially conservative. However, estimates appear realistic when compared with estimates obtained for other species, and also in light of our long term studies on the species (e.g. Craig 1987).

The species' trend toward having lower densities in Northeast Connecticut (Fig. 99) is likely related to its approaching its northern range limit in this region (Robinson 1995). Populations of many species decline toward their range limit (Brown 1984, Pulliam 1988).

The significant association of the Louisiana Waterthrush with mesic forests is consistent with existing data on habitat use. Moreover, its association with mature forest may explain in part its northward range expansion in a region where forests are maturing (Ward and Barsky 2000).

Conservation status.- Populations have extended their range in Connecticut, likely as a consequence of forest maturation. Hence, they are potentially threatened by forest fragmentation.

Sponsored by Eastern Connecticut Conservation District, Inc.

COMMON YELLOWTHROAT
Geothlypis trichas

Density (males/km^2): 5.0 (95% CI: 3.4-7.2)
Density range (males/km^2/transect): 0-22.4
Total population (males): 13,608 (95% CI: 9,378-19,744)

Detection function: hazard /cosine
$\chi^2 = 2.27$, $P = 0.32$, df = 2, N = 148

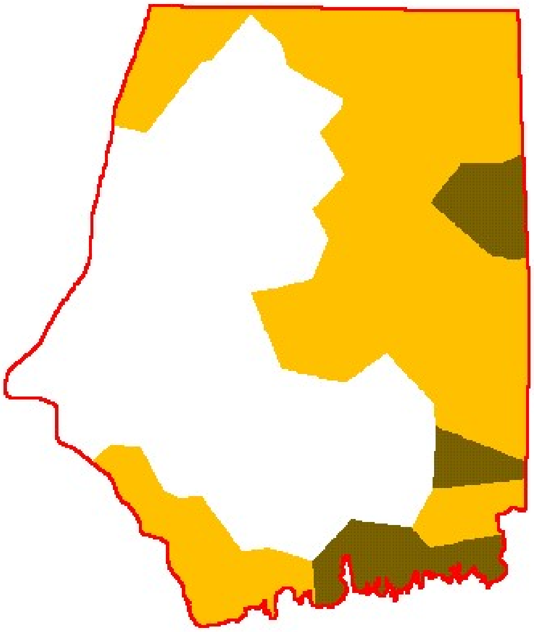

FIG. 100. Densities of the Common Yellowthroat were similar in Northeast and Southeast Connecticut. Light = 0-3.4, medium = 3.4-7.5, dark = 7.5-12.1 males/km^2.

Density distribution.- The Common Yellowthroat was uncommon to fairly common in the forests of eastern Connecticut. Its densities were similar (Mann-Whitney U = 307.0, P = 0.73, N = 51) in Northeast (5.2 ± 5.0 males/km^2) and Southeast Connecticut (4.6 ± 4.8 males/km^2; Fig. 100).

Because the Common Yellowthroat inhabits environments other than forest, densities reported here refer only to that part of the population associated with primarily forested regions. Population estimates are based on detections of singing males.

TABLE 43. Individual Common Yellowthroats inhabited forests that were moister, younger, more open, and with greater understory density than would be predicted by habitat availability. Comparison of population densities with habitat features yielded no significant correlations. $P(\chi^2)$ = probability level of chi-square tests, N = 38; $P(t)$ = probability level of Kendall's tau, N = 51; * = significant, ** = highly significant (see Table 8 for abbreviation key).

	Mean Habitat Characteristics				
	F	M	D	C	U
Availability	1.4	2.3	2.0	2.7	2.3
Use	1.5	2.1	1.7	2.1	2.6
$P(\chi^2)$	0.20	0.00**	0.00**	0.00**	0.01**
$P(t)$	0.80	0.28	0.49	0.32	0.28

	Percent Vegetation					
	OD	MH	CN	PO	CO	MI
Availability	51.0	13.7	13.1	13.1	8.5	0.7
Use	39.5	13.2	23.7	2.6	5.3	15.8
$P(\chi^2)$	-					

Population variance.- The coefficient of variation calculated from Breeding Bird Survey data (Sauer et al. 2001) predicted population variation in southern New England as 2.4%. From 1966-2000, regional (mean count/route = 17.8, trend = -1.0, P = 0.02, N = 51) and continental populations showed a significant decline (mean count/route = 7.9, trend = -0.3, P = 0.05, N = 2897).

On ten line transects through the Northeast Uplands Ecoregion, Craig (1987) reported 12.2 birds/km^2, a value similar to that of this study when our estimates are multiplied by two to yield breeding individuals/km^2. In a ten-year sample of Breeding Bird Census plots in Connecticut, densities of pairs/km^2 were 13.0 ± 3.9 in oak-hemlock forest, 9.3 ± 5.2 in hemlock-hardwood forest, and 34.2 ± 18.1 in second growth deciduous forest. Elsewhere, densities of males/km^2 are reported as 35 in

Michigan and 244-355 in Ontario, whereas 274 pairs/km^2 are reported from Maryland (Guzy and Ritchison 1999). These densities overlap but average higher than those found in this study.

Habitat.- Individual Common Yellowthroats inhabited forests that were moister, younger, more open, and with greater understory density than would be predicted by habitat availability. Moreover, although not statistically testable because of zeros in categories, birds appeared to occur more frequently in conifer-hardwood and mixed forest types than would be predicted. Comparison of population densities with habitat features yielded no significant correlations, however (Table 43). We most frequently encountered birds in open, shrubby swamps, along rivers, and in forest openings created by natural disturbance or logging.

Elsewhere, the species is reported to inhabit a wide variety of open habitats. Greatest densities are reached in densely shrubby wetlands, including swamps and riparian areas. In addition, a variety of mesic to xeric scrubby, successional habitats are occupied, including areas disturbed by fire and logging (Guzy and Ritchison 1999).

History.- Zeranski and Baptist (1990) assert that the Common Yellowthroat have undergone no historical change in population status, as earlier workers all had described the species as common.

Synthesis.- As with other species associated with successional environments, Breeding Bird Survey data indicate that the Common Yellowthroat is declining as forests mature and urbanization occurs. Despite this decline, we found that populations continue to inhabit forest environments, particularly open swamps, but also areas where disturbance has occurred. Logging and natural disturbance seem likely to continue supplying suitable habitat for populations, albeit at reduced densities.

The tendency of the Common Yellowthroat toward inhabiting forest openings and particularly open swamps is consistent with other reports of habitat use. Although present in early to mid-successional habitats, the species is more closely associated with open swamps than other species inhabiting successional environments. Moreover, it appears in smaller areas of forest disturbance than many other successional-associated species. Hence, it remains fairly common even in the maturing forests of eastern Connecticut.

Conservation status.- Populations are declining, but are likely to persist in swamps and disturbed areas.

HOODED WARBLER

Wilsonia citrina

Density (males/km^2): 1.0 (95% CI: 0.6-1.7)
Density range (males/km^2/transect): 0-6.3
Total population (males): 2,624 (95% CI: 1,507-4,567)

Detection function: half normal /cosine
$x^2 = 2.20$, $P = 0.70$, df = 4, N = 31

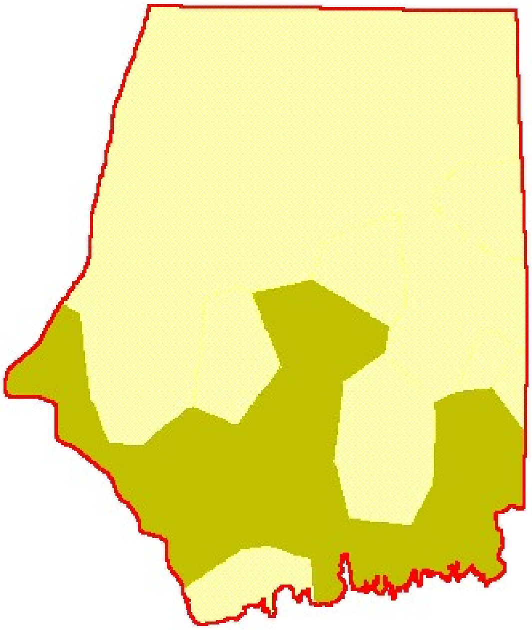

FIG. 101. Densities of the Hooded Warbler were greatest in Southeast Connecticut. Light = 0-1.6, dark = 1.6-3.7 males/km^2.

Density distribution.-The Hooded Warbler was uncommon and local in the forests of eastern Connecticut. It occurred at only 8% of sites in Northeast Connecticut (0.2 ± 0.8 males/km^2) but at 48% of sites in Southeast Connecticut (1.9 ± 2.5 males/km^2; Fig. 101.. This difference was strongly significant (Mann-Whitney U = 190.5, $P = 0.00$, N = 51). Population estimates are based on <60 detections of singing males, so have reduced accuracy.

Population variance.- The coefficient of variation calculated from Breeding Bird Survey data (Sauer et al. 2001) predicted continental population variation as 41.9%. From 1966-2000, populations showed no significant continental trend (mean count/route = 2.2, trend = 0.7, $P = 0.42$, N = 669). Limited data from southern New England also suggested no trend.

On ten line transects through the Northeast Uplands Ecoregion, Craig (1987) reported no birds. In a ten year sample of Breeding Bird Census plots in Connecticut, 8.7 ± 5.6 pairs/km^2 occurred in oak-hemlock forest, none were in hemlock-hardwood forest, and one bird appeared (9.9 pairs/km^2) in second growth deciduous forest. These densities generally overlap those found in this study. Elsewhere, densities of males/km^2 are reported as 42-70 in Pennsylvania, 7-25 in New York, 25 in Maryland, and 12-25 in Ontario (Ogden and Stutchbury 1994).

Habitat.- Limited data from individual Hooded Warblers suggested that they inhabited forests more deciduous, moister, and with more open canopies than those available. We most frequently encountered them in denser shrubbery near streams or at the edge of swamps, although our samples were too small to demonstrate significant relationships.

Elsewhere, the species is reported to inhabit forest edge, tree fall gaps and selectively logged forests which have developed a dense shrub layer. Mesic, deciduous forest appears to be preferred. Although a forest gap species, greatest populations are found in more extensive forests (Ogden and Stutchbury 1994).

History.- The Hooded Warbler was thought to be a fairly common breeder of southern Connecticut by Sage et al. (1913). It appears to have expanded its range since the mid-20th century (Zeranski and Baptist 1990).

Synthesis.- Breeding Bird Survey data indicate that Hooded Warbler populations are stable. The higher density of birds we found in Southeast Connecticut is also suggested by distributions mapped in *The Atlas of Breeding Birds of Connecticut* (Bevier 1994).

The observed association of the Hooded Warbler with open, mesic, deciduous forest is consistent with other reports of habitat affiliation. Its prevalence in Southeast Connecticut (Fig. 101) may be related in part to its association with deciduous forest, which predominates in this region (Table 3,4,5). Moreover, because it is near its northern range limit in Connecticut (Ogden and Stutchbury 1994), additional geographic factors likely influence populations, which tend to decline toward range limits (Brown 1984, Pulliam 1988).

Conservation status.- Populations appear to be increasing, but are likely sensitive to forest fragmentation.

Sponsored by Barbara David

CANADA WARBLER

Wilsonia canadensis

Density (males/km^2): 1.1 (95% CI: 0.6-1.9)
Density range (males/km^2/transect): 0-16.4
Total population (males): 2,917 (95% CI: 1,634-5,206)

Detection function: half normal/cosine
$x^2 = 2.13$, $P = 0.55$, df = 3, N = 30

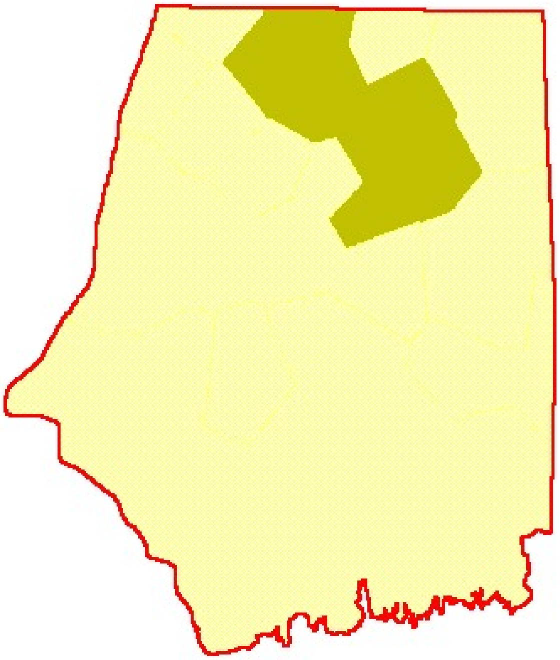

FIG. 102. Densities of the Canada Warbler were greatest in Northeast Connecticut. Light = 0-2.4, dark = 2.4-6.7 males/km^2.

Density distribution.- The Canada Warbler was uncommon and local in the forests of eastern Connecticut. Its densities were significantly higher (Mann-Whitney U = 2411.5, $P = 0.03$, N = 51) in Northeast (1.7 ± 3.6 males/km^2) than Southeast Connecticut (0.4 ± 1.5 males/km^2; Fig. 102). Population estimates are based on <60 detections of singing males, so have reduced accuracy.

Population variance.- The coefficient of variation calculated from Breeding Bird Survey data (Sauer et al. 2001) predicted continental population variation as 98.5%. From 1966-2000, populations showed a significant continental decline (mean count/route = 1.0, trend = -1.9, $P = 0.05$, N = 486). Limited data from southern New England populations also suggested a decline.

On ten line transects through the Northeast Uplands Ecoregion, Craig (1987) reported 17.8 birds/km^2, a value well above that of this study even when our estimates are multiplied by two to yield breeding individuals/km^2. In a ten year sample of Breeding Bird Census plots in Connecticut, birds were absent from oak-hemlock forest, occurred three times in hemlock-hardwood forest (9.5-19.0 pairs/km^2), and were present once (9.9 pairs/km^2) in second growth deciduous forest.

Elsewhere, density varies widely with habitat. Densities are reported as 2.5-22 pairs/km^2 in New York, 12-17, males/km^2 in New Brunswick, 3 males/km^2 in Nova Scotia, 2.5-35 pairs/km^2 in Maine, and 60 birds/km^{2}in New Hampshire (Conway 1999).

Habitat.- Limited observations of habitat use by Canada Warblers suggested that they inhabited forests more coniferous, wetter, and with more dense understory than would be predicted by habitat availability. We most frequently encountered birds in conifer-dominated swamps, although they also were present in laurel thickets in upland forest.

Elsewhere, the species is reported to breed in a wide range of deciduous and coniferous forests, although mesic, conifer-deciduous forests with dense understories appear favored. Coniferous and deciduous swamps are ocupied as well. It is present in younger and mature forest, and some evidence suggests that populations are greatest in the latter (Conway 1999).

History.- The Canada Warbler was reported by Sage et al. (1913) as an uncommon breeder of primarily northwestern Connecticut. Zeranski and Baptist (1990) provide evidence that populations increased during the 20th century as a consequence of the expansion of forest.

Synthesis.- Breeding Bird Survey data indicate a long-term populations decline in the Canada Warbler. Higher density estimates obtained by the earlier transect studies of Craig (1987) are consistent with this trend. However, the higher densities in this previous study are attributable in part to it being conducted in the heart of the species' local range (Fig. 102). Reasons for this decline are unclear, as its forest habitat is presently extensive.

The observed associations of the Canada Warbler with more coniferous forests, swamps and dense understories are consistent with other reports of habitat affiliation. Its prevalence in Northeast Connecticut (Fig. 102) may be related in part to its association with coniferous forest, which predominates in this region (Table 3,4,5). Moreover, because it is near its southern range limit in Connecticut (Conway 1999), additional geographic factors also likely influence populations, which tend to decline toward range limits (Brown 1984, Pulliam 1988).

Conservation status.- Populations appear to be declining, and are vulnerable to forest fragmentation.

SCARLET TANAGER
Piranga olivacea

Density (males/km^2): 13.7 (95% CI: 11.5-16.3)
Density range (males/km^2/transect): 1.8-21.6
Total population (males): 37,364 (95% CI: 31,438-44,407)

Detection function: uniform /cosine
$x^2 = 0.88$, $P = 0.35$, df = 1, N = 388

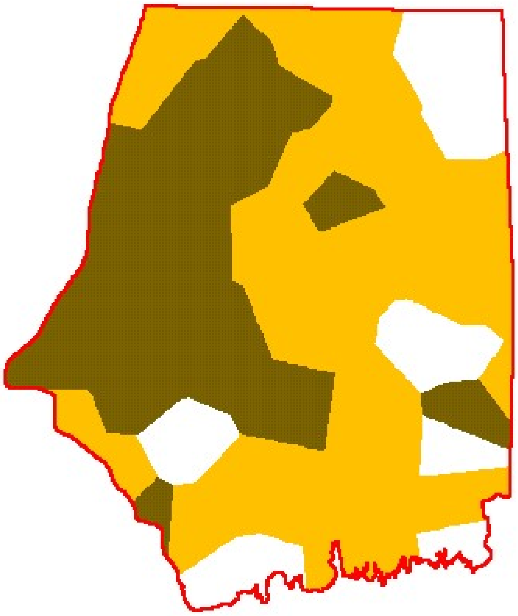

FIG. 103. Densities of the Scarlet Tanager were similar in Northeast and Southeast Connecticut. Light = 9.0-11.4, medium = 11.4-14.4, dark = 14.4-20.4 males/km^2.

Density distribution.-The Scarlet Tanager was a common breeder in the forests of eastern Connecticut. Its densities were similar (t = 0.66, P = 0.52, N = 51) in Northeast (14.1 ± 4.7 males/km^2) and Southeast Connecticut (13.3 ± 4.9 males/km^2), but appeared more abundant on the western side of the region (Fig. 103). Population estimates are based on detections of singing males.

TABLE 44. Observations of habitat use by individual Scarlet Tanagers showed that they inhabited forests nearly significantly more deciduous and with greater canopy cover than would be predicted by habitat availability. Comparison of population densities with habitat features showed no significant correlations. $P(x^2)$ = probability level of chi-square tests, N = 107; $P(t)$ = probability level of Kendall's tau, N = 51; * = significant, ** = highly significant (see Table 8 for abbreviation key).

	Mean Habitat Characteristics				
	F	M	D	C	U
Availability	1.4	2.3	2.0	2.7	2.3
Use	1.3	2.3	2.0	2.8	2.3
$P(x^2)$	0.06	0.46	-	0.08	0.85
$P(t)$	0.40	0.19	0.21	0.20	0.68

	Percent Vegetation					
	OD	MH	CN	PO	CO	MI
Availability	51.0	13.7	13.1	13.1	8.5	0.7
Use	58.9	17.8	8.4	7.5	6.5	0.9
$P(x^2)$	0.44					

Population variance.- The coefficient of variation calculated from Breeding Bird Survey data (Sauer et al. 2001) predicted population variation as 20.2% in southern New England. From 1966-2000, populations showed no significant change in regional (mean count/route = 5.2, trend = -1.5, P = 0.17, N = 50) or continental populations (mean count/route = 1.6, trend = -0.2, P = 0.39, N = 1340).

On ten line transects through the Northeast Uplands Ecoregion, Craig (1987) reported 30.4 ± 23.3 birds/km^2, a value similar to that of this study when our estimates are multiplied by two to yield breeding individuals/km^2. In a ten year sample of Breeding Bird Census plots in Connecticut, densities of pairs/km^2 were 14.9 ± 6.0 in oak-hemlock forest, 40.4 ± 22.1 in hemlock-hardwood forest, and 42.1 ± 15.2 in second growth deciduous forest. These densities overlap but average higher than those found in this study. Elsewhere, densities of birds/km^2 are reported as 42.5 ± 19.6 in New Hampshire, 52 ± 3.6 in West Virginia, and 18-30 in New York (Mowbray 1999).

Habitat.- Data from individual Scarlet Tanagers showed that they inhabited forests nearly significantly more deciduous and with greater canopy cover than those available. However, comparison of population densities with habitat features showed no significant correlations (Table 44). The species generally appeared to tolerate a wide variety of forest conditions, and we have regularly observed it in more open, park-like environments.

Elsewhere, the species is reported to inhabit a variety of forest types from mesic to xeric and from deciduous to pure coniferous. However, studies indicate a preference for mature deciduous forests, particularly where oaks are common, and for forests with reduced sapling density. It occurs occasionally in parks. Several studies have demonstrated that population density increases with forest tract size (Mowbray 1999).

History.- Zeranski and Baptist (1990) speculate that the Scarlet Tanager was less common in the 19th century when forests were less abundant than at present. However, Sage et al. (1913) also described it as a common summer resident.

Synthesis.- Breeding Bird Survey data indicate little long-term change in populations of the Scarlet Tanager. These findings are corroborated by similar population estimates from this study and earlier transect studies of Craig (1987). The maturing forests of eastern Connecticut should at present provide ample suitable habitat for this species.

The trend toward association of the Scarlet Tanager with deciduous and closed canopy forests is consistent with other reports of habitat affiliation. However, such affiliations do not account for the higher densities observed along much of the western half of the study area (Fig. 103). Reasons for this pattern are unclear, and will require further study to determine whether the pattern occurs consistently.

Conservation status.- Populations are stable, but appear sensitive to forest fragmentation.

Sponsored by Mary Eliza Kimball

EASTERN TOWHEE

Pipilo erythropthalmus

Density (males/km^2): 12.3 (95% CI: 10.1-14.9)
Density range (males/km^2/transect): 0-43.1
Total population (males): 33,439 (95% CI: 27,523-40,626)

Detection function: hazard /cosine
$\chi^2 = 7.82$, $P = 0.17$, df = 5, N = 276

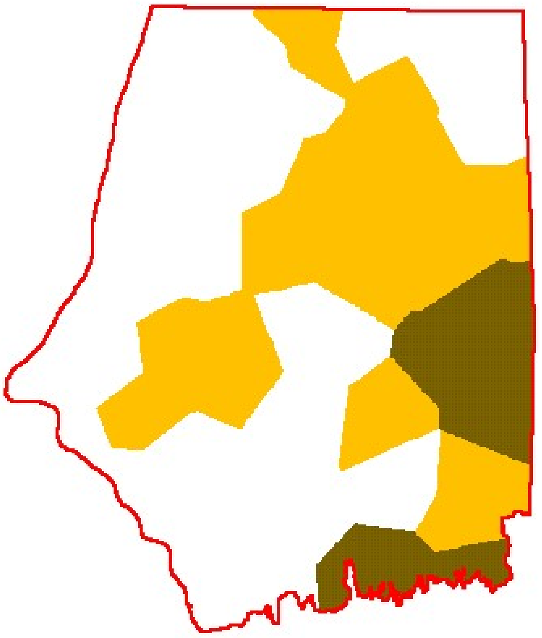

FIG. 104. Densities of the Eastern Towhee were similar in Northeast and Southeast Connecticut. Light = 9.0-11.4, medium = 11.4-14.4, dark = 14.4-20.4 males/km^2.

TABLE 45. Observations of habitat use by individual Eastern Towhees showed that they inhabited forests significantly drier, younger, with more open canopies, and with greater understory density than would be predicted by habitat availability. Comparison of population densities with habitat features also showed a significant correlation with greater understory density. $P(\chi^2)$ = probability level of chi-square tests, N = 114; $P(t)$ = probability level of Kendall's tau, N = 51; * = significant, ** = highly significant (see Table 8 for abbreviation key).

	Mean Habitat Characteristics				
	F	M	D	C	U
Availability	1.4	2.3	2.0	2.7	2.3
Use	1.4	2.4	1.9	2.3	2.8
$P(\chi^2)$	0.83	0.02*	0.00**	0.00**	0.00**
$P(t)$	0.88	0.10	0.26	0.36	0.04*

	Percent Vegetation					
	OD	MH	CN	PO	CO	MI
Availability	51.0	13.7	13.1	13.1	8.5	0.7
Use	52.6	12.3	4.4	16.7	8.8	5.3
$P(\chi^2)$	0.05*					

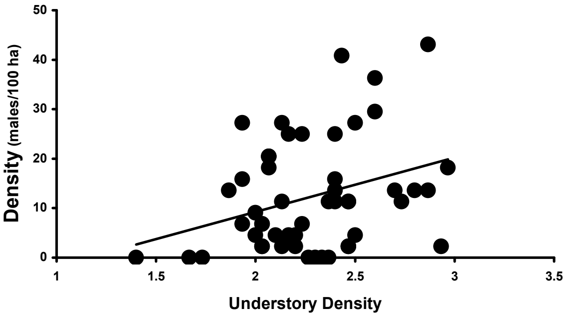

FIG 105. Population density showed a variable but significant increase with increasing understory density.

Density distribution.-The Eastern Towhee was a fairly common breeder in the forests of eastern Connecticut. Its densities were similar (Mann-Whitney U = 324.0, $P = 0.99$, N = 51) in Northeast (11.1 ± 8.4 males/km^2) and Southeast Connecticut (13.5 ± 13.5 males/km^2), although populations appeared to concentrate in the eastern half of the region (Fig. 104). Population estimates are based on detections of singing males, and refer to that part of the population inhabiting primarily forested landscapes.

The species also occurs as a rare winter resident. During this study, we found only one individual (at Bluff Point), although in previous years we have found birds occasionally throughout the region. We attempted no winter density estimate from such limited data.

Population variance.- The coefficient of variation calculated from Breeding Bird Survey data (Sauer et al. 2001) predicted population variation as 6.2% in southern New England. From 1966-2000, populations showed a strongly significant decline in regional (mean count/route = 12.2, trend = -7.2, P = 0.00, N = 51) and continental (mean count/route = 8.1, trend = -1.9, P = 0.00, N = 1695) populations.

On ten line transects through the Northeast Uplands Ecoregion, Craig (1987) reported 17.7 ± 17.7 birds/km^2, a value similar to that of this study when our estimates are multiplied by two to yield breeding individuals/km^2. In a ten year sample of Breeding Bird Census plots in Connecticut, densities of pairs/km^2 were 24.8 ± 8.7 in oak-hemlock forest, 0 in hemlock-hardwood forest, and 24.3 ± 17.4 in second growth deciduous forest. These densities overlap but average higher than those of this study. In New Hampshire, Holmes et al. (1986) found 61 ± 19 birds/km^2. Densities to 200 males/km^2 are attained in pine barren habitats (Greenlaw 1996).

Habitat.- Data from individual Eastern Towhees showed that they inhabited forests significantly drier, with smaller dbh (i.e. younger), with more open canopies, and with greater understory density than would be predicted by habitat availability. Data on population densities vs habitat variables corroborated the association with understory density (Table 45, Fig 105). Birds were particularly prevalent in xeric oak-dominated forests, xeric pine-oak forests, shrubby forest openings, and selectively logged areas that had developed a dense shrub layer.

Elsewhere, the species is reported to inhabit dense shrubs in either forests or mid- to late successional habitats. When in forest, those with an open canopy are typically chosen. Xeric environments appear favored, although it is also present in more mesic situations. Oak-hickory, mixed conifer-deciduous and coniferous habitats are used, but greatest densities are reported from pine barrens habitats (Greenlaw 1996).

History.- Sage et al. (1913) found the Eastern Towhee to be a common summer resident. Zeranski and Baptist (1990) asserted that its population status had not changed appreciably since the 19th century.

Synthesis.- Although Breeding Bird Survey data show that the Eastern Towhee is declining regionally, the species remains common. Indeed, based on a comparison of data from Craig (1987) with that of this study, populations occupying forest habitat appear stable. The maturing forests of Connecticut (Ward and Barsky 2000) are likely responsible for the regional decline because forest maturation eliminates successional habitats which the species occupies at high densities. However, within the still extensive forests of eastern Connecticut, suitable microhabitats remain present in abundance.

The observed association of the Eastern Towhee with more open, xeric, shrubby habitats is consistent with other reports of its habitat affiliations. Its prevalence in such habitats likely explains in part the higher densities observed along the Connecticut-Rhode Island border (particularly Pachaug State Forest region) and southeastern coast (Fig. 104). These habitats are widespread in these areas (Table 2).

Conservation status.- Populations are declining, but should persist, albeit at lower densities, even within mature forest as long as such forest remains extensive enough for a variety of microhabitats to be present.

Sponsored by Carol and Michael Auer

CHIPPING SPARROW
Spizella passerina

Density (males/km^2): 1.0 (95% CI: 0.6-1.6)
Density range (males/km^2/transect): 0-13.6
Total population (males): 2,639 (95% CI: 1,603-4,343)

Detection function: hazard /cosine
$\chi^2 = 1.53$, $P = 0.47$, df = 2, N = 43

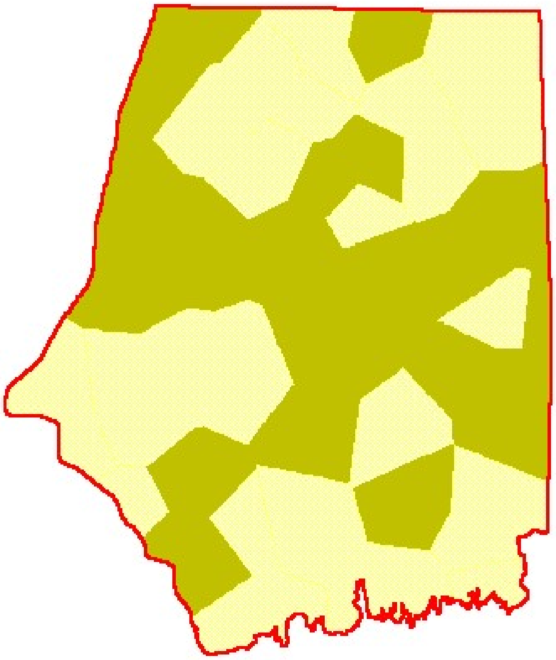

FIG. 106. Densities of the Chipping Sparrow were similar in Northeast and Southeast Connecticut. Light = 0-0.8, dark = 0.8-2.3 males/km^2.

Density distribution.- The Chipping Sparrow was an uncommon breeder in the forests of eastern Connecticut. Its densities were similar (Mann-Whitney U = 303.5, P = 0.66, N = 51) in Northeast (1.1 ± 1.3 males/km^2) and Southeast Connecticut (0.9 ± 1.1 males/km^2; Fig. 106).

Because the Chipping Sparrow inhabits environments other than forest, densities reported here refer only to that part of the population associated with primarily forested regions. Population estimates are based on <60 detections of singing males, so have reduced accuracy.

TABLE 46. Comparison of population densities with habitat features showed no significant correlations (see Table 8 for abbreviation key).

	Habitat Characteristics				
	F	M	D	C	U
$P(t)$	0.11	0.58	1.00	0.35	0.60

Population variance.- The coefficient of variation calculated from Breeding Bird Survey data (Sauer et al. 2001) predicted population variation as 2.2% in southern New England. From 1966-2000, populations showed a significant increase regionally (mean count/route = 19.4, trend = 1.3, P = 0.00, N = 51), but no trend continentally (mean count/route = 8.4, trend = -0.1, P = 0.58, N = 2864).

On ten line transects through the Northeast Uplands Ecoregion, Craig (1987) reported 16.3 birds/km^2. In a ten year sample of Breeding Bird Census plots in Connecticut, the species was absent from oak-hemlock, hemlock-hardwood and second growth deciduous forest. We found no data for other regions on populations in forested landscapes.

Habitat.- Limited observations of habitat use by individual Chipping Sparrows suggested that they inhabited forests more coniferous and open than would be predicted by habitat availability. Comparison of population densities with habitat features showed no significant correlations, however (Table 46). We typically found birds in tree fall gaps, selectively logged areas, and forest edge.

Elsewhere, the species is reported to inhabit forest openings, suburban habitats and river and pond borders. Particularly in northern portions of its range, it is associated with open, coniferous forest. Shrubbery is generally an important habitat requirement throughout (Middleton 1998).

History.- The Chipping Sparrow has been known as a common to abundant summer resident since the 19th century (Sage et al. 1913, Zeranski and Baptist (1990).

Synthesis.- Breeding Bird Survey data show that the Chipping Sparrow is increasing regionally. Because it inhabits suburban environments, it appears to be prospering despite the maturation of regional forests (Ward and Barsky 2000). Comparison of results in this study with those of Craig (1987) suggest, however, that numbers may be declining in these maturing forest landscapes.

The Chipping Sparrow's observed trends toward inhabiting more open forests with greater coniferous cover were consistent with other reports of habitat use. Because the species appears capable of using even small forest openings, populations will likely persist even in maturing forest habitat.

Conservation status.- Populations are increasing and appear secure, although they may be declining in forest habitat.

Sponsored by The Hampton Gardeners

SONG SPARROW
Melospiza melodia

Summer

Density (males/km^2): 1.1 (95% CI: 0.7-1.7)
Density range (males/km^2/transect): 0-6.0
Total population (males): 3,039 (95% CI: 1,992-4,634)

Detection function: uniform/cosine
$x^2 = 1.19$, $P = 0.55$, df = 2, N = 57

Winter

Density (birds/km^2): 0.10 (95% CI: 0.04-0.24)
Density range (birds/km^2/transect): 0-1.0
Total population (birds): 272 (95% CI: 112-661)

Detection function (all data): uniform/cosine
$x^2 = 1.19$, $P = 0.55$, df = 2, N = 62

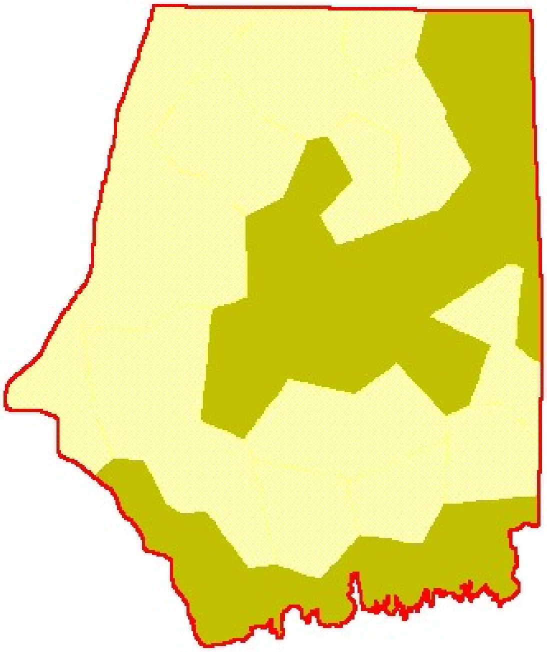

FIG. 107. Summer densities of the Song Sparrow were similar in Northeast and Southeast Connecticut. Light = 0-1.0, dark = 1.0-3.7 males/km^2.

Density distribution.- The Song Sparrow was an uncommon summer and rare winter inhabitant of the forests of eastern Connecticut. Its breeding densities were similar (Mann-Whitney U = 315.0, $P = 0.83$, N = 51) in Northeast (1.0 ± 1.4 birds/km^2) and Southeast Connecticut (1.2 ± 2.0 birds/km^2; Fig. 107).

TABLE 47. Comparison of summer population densities of the Song Sparrow with habitat features showed no significant correlations (see Table 8 for abbreviation key).

	Habitat Characteristics				
	F	M	D	C	U
$P(t)$	0.83	0.94	0.70	0.40	0.33

Summer population estimates are based on detections of singing males, whereas winter estimates assume that males and females are similarly detected. Because detection distances appeared similar year-round, we used all data to improve sample size in computing winter densities. Both refer only to that part of the population detectable from primarily forested regions. Winter populations were too low to map.

Population variance.- The coefficient of variation calculated from Breeding Bird Survey data (Sauer et al. 2001) predicted population variation as 1.0% for southern New England. From 1966-2000, populations showed a strongly significant regional (mean count/route = 24.4, trend = -1.8, $P = 0.00$, N = 51) and continental decline (mean count/route = 12.0, trend = -0.5, $P = 0.00$, N = 2565).

On ten line transects through the Northeast Uplands Ecoregion, Craig (1987) reported no birds, although they were present in the study area (R. Craig pers. obs.). In a ten year sample of Breeding Bird Census plots in Connecticut, 16.3 ± 6.6 pairs/km^2 were recorded in second growth deciduous forest. Birds appeared three times in hemlock-hardwood forest (4.8-9.5 pairs/km^2) and once in oak-hemlock forest (4.3 pairs/km^2). This general infrequency of forest occurrence is similar to that of this study. We found no other population estimates in primarily forested habitats.

Habitat.- Limited observations on habitat use by breeding Song Sparrows suggested that they inhabited deciduous forests with denser understory than would be predicted by habitat availability. However, comparison of population densities with habitat features showed no significant correlations (Table 47). Winter populations were too low to conduct analyses. We generally found the species associated with forest openings and edge, particularly open swamps and larger streams, in both summer and winter. Elsewhere, it is reported to inhabit moister habitats, including shrublands, marsh edge, coastline, clearcuts, and riparian areas, as well as suburban and agricultural areas (Arcese et al. 2002).

History.- The Song Sparrow was known as a common resident by Sage et al. (1913), although they reported that winter populations were lower. Zeranski and Baptist (1990) believed that winter populations had increased.

Synthesis.- Breeding Bird Survey data show that Song Sparrow populations are undergoing a strong regional decline. Because the species is principally associated with non-forest habitats, the maturation of regional forests (Ward and Barsky 2000) is likely in part responsible for this decline.

Our observations that the Song Sparrow was associated with forest openings and edge were consistent with other reports of habitat use. Denser populations along the coast and Connecticut River (Fig. 107) are also consistent with reports that it is frequent in riparian areas and along coastlines.

Conservation status.- Populations are declining, although because of the species' adaptability in habitat use, it is likely to persist.

Sponsored by Alfred and Heath Boote

WHITE-THROATED SPARROW
Zonotrichia albicollis

Density distribution.- Although a common winter resident in more open habitats, the White-throated Sparrow was rare in winter in the forests of eastern Connecticut. Moreover, it was absent in summer. Our eight winter observations of flocks were inadequate for reliably estimating populations in primarily forested landscapes.

Population variance.- The coefficient of variation calculated from Breeding Bird Survey data (Sauer et al. 2001) predicted variation in continental populations as 0.7%. From 1966 to 2000 continental populations showed a strongly significant decline (mean count/ route = 32.5, trend = -0.8, *P* = 0.01, N = 702). Limited data from southern New England also suggest a decline.

Christmas Count data predicted population variation as 42.8% for Connecticut. From 1966-2001, populations showed a strongly significant Connecticut increase (birds/party hour = 2.6, power function model r^2 = 0.53, df = 35, *P* = 0.00), but no significant U.S. trend (birds/party hour = 1.6, Kendall's tau = -0.12, *P* = 0.28, N = 37).

On ten line transects through the Northeast Uplands Ecoregion, Craig (1987) reported 5.1 summering birds/km^2. In a ten year sample of Breeding Bird Census plots in Connecticut, it was absent in oak-hemlock, hemlock-hardwood and second growth deciduous forest. A Winter Bird Survey plot in a deciduous-coniferous wetland yielded 6.0-19.1 birds/km^2. Elsewhere, breeding densities have been reported as 1-94.7 males/km^2 in Ontario and Quebec (Falls and Kopachena 1994).

Habitat.- Previous observations of breeding White-throated Sparrows in Northeast Connecticut were of birds in mature hemlock-white pine-hardwood forest bordering swamps and ponds (R. Craig pers. obs.). Our winter observations were of flocks at forest edge and in forest openings, including open floodplain forest with dense understory.

Elsewhere, it is reported to summer in coniferous and mixed forests, particularly those with low, dense vegetation in openings. Areas with second growth, logged areas, beaver swamps and open bogs appear to be favored. In winter, it is a typical inhabitant of forest edge, swamps, riparian areas and other more open environments with dense cover (Falls and Kopachena 1994).

History.- The White-throated Sparrow was reported as a rare breeder in Northwest Connecticut by Sage et al. (1913). After 1915, populations increased in northern Connecticut (Zeranski and Baptist 1990).

Synthesis.- The White-throated Sparrow is at the southern fringes of its breeding range in eastern Connecticut (Falls and Kopachena 1994). It has largely retired north from this region in the past few years. As with many species at their range limits, its occurrence may be expected to be erratic (Thompson and Nolan 1973, Marti 1997). Moreover, because of its preference for successional and edge habitats, the summer decline may be related to the conversion of such habitats to mature forest.

Conservation status.- Breeding populations have declined, although wintering populations appear to have increased.

DARK-EYED JUNCO
Junco hyemalis

Density distribution.- The Dark-eyed Junco was a rare summer and uncommon winter resident in the forests of eastern Connecticut. Based on 10 summer observations, we tentatively estimate a breeding population of 1,545 males (0.6 males/km^2). All summer detections were of birds in Northeast Connecticut. Summer estimates are based on detections of singing males.

Based on 14 observations, winter populations are tentatively estimated at 18,130 (6.7 birds/ km^2). Winter estimates refer only to that part of the population inhabiting primarily forested landscapes. Winter estimates are based on detections of flocks of males and females.

Population variance.- The coefficient of variation calculated from Breeding Bird Survey data (Sauer et al. 2001) predicted variation in continental populations as 10.7%. From 1966 to 2000 continental populations showed a significant decline (mean count/ route = 4.8, trend = -1.6, P = 0.00, N = 546). Very limited data from southern New England suggested a decline as well.

Christmas Count data predicted population variation as 27.5% for Connecticut. From 1966-2001, populations showed a significant Connecticut (birds/party hour = 5.1, quadratic model r^2 = 0.16, df = 34, P = 0.05) and U.S. increase (birds/party hour = 3.8, quadratic model r^2 = 0.26, df = 34, P = 0.01). In both instances, fit of data to a quadratic model suggested a population decline into the 1980s followed by an increase beginning ca 1990.

On ten line transects through the Northeast Uplands Ecoregion, Craig (1987) reported 9.2 summering birds/km^2, a value well above that of this study. In a ten year sample of Breeding Bird Census plots in Connecticut, it was absent in oak-hemlock, hemlock-hardwood and second growth deciduous forest. A Winter Bird Survey plot in a deciduous-coniferous wetland yielded 25.1-78.1 birds/km^2.

Elsewhere in the East, breeding densities have been reported as 31 $\pm$ 32 birds/km^2 in Hubbard Brook, New Hampshire, 19 pairs/km^2 in White Mountains, New Hampshire, 55 males/km^2 in Maine, and 260 males/km^2 in North Carolina (Holmes et al. 1986, Nolan et al. 2002). We found no other estimates of winter densities.

Habitat.- Our limited observations of habitat use by breeding birds suggested that mature, mixed and particularly coniferous forests are used. In winter, in contrast, flocks were virtually absent from forest interior, and were present instead in dense shrubbery at forest edge, in forest openings and in logged areas.

Elsewhere in the Northeast, the species is reported from largely coniferous forest. Its greatest abundance is reached in the White Mountains, New Hampshire in subalpine areas of low, open coniferous canopy. However, in New Hampshire it is also common in mature, unfragmented hardwood forest with dense understory. In winter, flocks inhabit riparian areas, weedy fields, forest edge and disturbed areas (Nolan et al. 2002).

History.- The Dark-eyed Junco appears to have become established as a breeder in Connecticut only in the 20th century. It has been largely but not entirely restricted as a breeder to the northwestern and northeastern hills. It also may have increased as a winter resident since the 19th century (Zeranski and Baptist 1990).

Synthesis.- As demonstrated by Breeding Bird Survey data and comparison of this study's results with earlier estimates of Craig (1987), the Dark-eyed Junco is now much less common in the region, even in the heart of its local breeding range in the Northeast Uplands Ecoregion. Both it and the White-throated Sparrow are simultaneously retiring from this southern edge of their breeding range. The range contraction is likely a consequence of the continental population decline, which is resulting in peripheral populations vacating fringe habitats.

The prevalence of breeding Dark-eyed Juncos in Northeast Connecticut may be related in part to their association with more coniferous forest, which predominates in this region (Table 3,4,5). Moreover, because the species is near its southern range limit in Connecticut (Nolan et al. 2002), additional geographic factors also likely influence populations, which tend to decline toward range limits (Brown 1984, Pulliam 1988). A higher breeding density in Northeast Connecticut is also suggested by distributions mapped in *The Atlas of Breeding Birds of Connecticut* (Bevier 1994).

Conservation status.- Breeding populations appear to be declining locally, perhaps because they are not being maintained by dispersal of individuals from the principal breeding range, where numbers are declining.

NORTHERN CARDINAL

Cardinalis cardinalis

Summer

Density (birds/km^2): 3.9 (95% CI: 3.0-5.2)

Density range (birds/km^2/transect): 0-14.2

Total population (birds): 10,738 (95% CI: 8,157-14,135)

Detection function: hazard/cosine
$x^2 = 7.82$, $P = 0.10$, df = 4, N = 99

Winter

Density (birds/km^2): 1.2 (95% CI: 0.8-1.9)

Density range (birds/km^2/transect): 0-9.2

Total population (birds): 3,255 (95% CI: 2,053-5,185)

Detection function (all data): hazard/cosine
$x^2 = 2.82$, $P = 0.42$, df = 3, N = 119

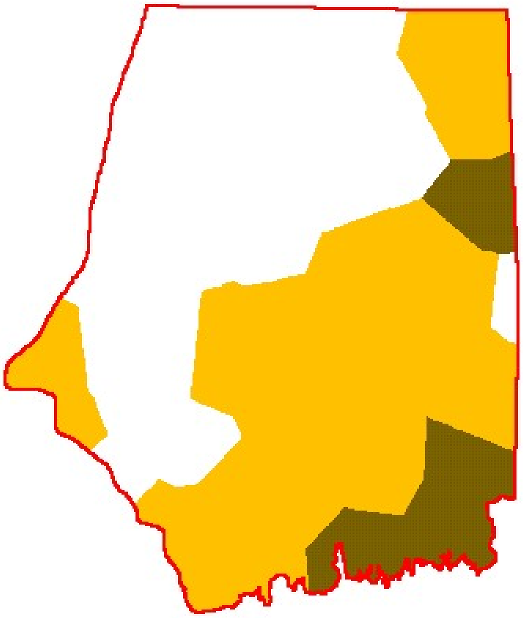

FIG. 108. Summer densities of the Northern Cardinal were greatest in Southeast Connecticut. Light = 0-2.7, medium = 2.7-6.1, dark = 6.1-10.2 birds/km^2.

TABLE 48. Observations of summer habitat use by individual Northern Cardinals showed that they inhabited forests significantly more open than would be predicted by habitat availability. Limited observations on wintering birds suggested that they used forests more deciduous, open, and with greater understory density than predicted. Comparison of summer densities with habitat features showed no significant correlations. $P(x^2)$ = probability level of chi-square tests, N = 35 summer, 16 winter; $P(t)$ = probability level of Kendall's tau, N = 51; * = significant, ** = highly significant (see Table 8 for abbreviation key).

	Mean Habitat Characteristics				
	F	M	D	C	U
Availability	1.4	2.3	2.0	2.7	2.3
Summer use	1.4	2.1	1.9	2.4	2.3
$P(x^2)$	0.43	0.08	-	0.00**	0.90
$P(t)$	0.18	0.91	0.68	0.57	0.79
Winter use	1.1	2.2	1.9	1.9	2.7

	Percent Vegetation					
	OD	MH	CN	PO	CO	MI
Availability	51.0	13.7	13.1	13.1	8.5	0.7
Summer use	42.9	17.1	14.3	11.4	5.7	8.6
$P(x^2)$	-					
Winter use	56.3	31.3	0.0	0.0	12.5	0.0

Density distribution.- Although common in non-forested habitats, the Northern Cardinal was an uncommon inhabitant of the forests of eastern Connecticut. Its breeding densities were significantly greater (Mann-Whitney U = 186.0, $P = 0.01$, N = 51) in Southeast (5.0 ± 3.3 birds/km^2) than Northeast Connecticut (2.9 ± 4.1 birds/km^2; Fig. 108), a pattern repeated in winter (Mann-Whitney U = 180.5, $P = 0.00$, N = 51; Southeast: 2.2 ± 3.1 birds/km^2; Northeast: 0.2 ± 0.6 birds/km^2; Fig. 109). Population estimates are based on detections of calling males and females, and refer only to that portion of the population inhabiting primarily forested landscapes.

Population variance.- The coefficient of variation calculated from Breeding Bird Survey data (Sauer et al. 2001) predicted population variation as 6.1% for southern New

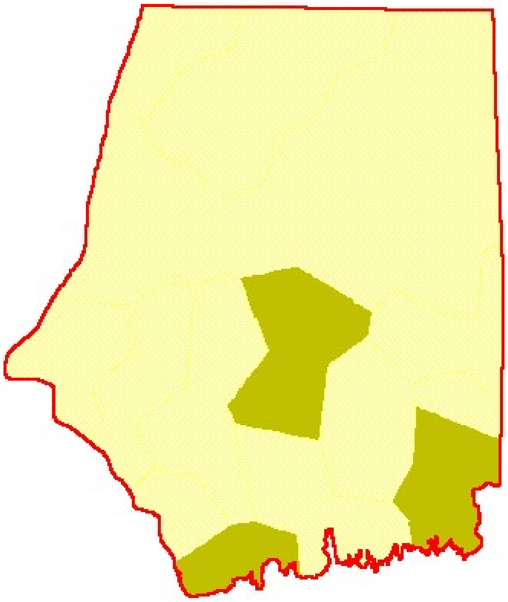

FIG. 109. Winter densities of the Northern Cardinal were greatest in Southeast Connecticut. Light = 0-2.3, dark = 2.3-5.4 birds/km^2.

England. From 1966-2000, populations showed a strongly significant regional increase (mean count/route = 13.5, trend = 3.3, P = 0.00, N = 51), but no continental trend (mean count/route = 24.3, trend = 0.0, P = 0.91, N = 2027).

Christmas Count data predicted population variation as 18.0% for Connecticut. From 1966-2001, populations showed a significant Connecticut increase (birds/party hour = 1.5, quadratic model r^2 = 0.40, df = 34, P = 0.00). U.S. populations, in contrast, showed a strongly significant decline (birds/party hour = 2.0, quadratic model r^2 = 0.25, df = 34, P = 0.01), although the plotted data showed a decline followed by an increase.

On ten line transects through the Northeast Uplands Ecoregion, Craig (1987) reported no birds. In a ten year sample of Breeding Bird Census plots in Connecticut, densities of pairs/km^2 were 17.3 ± 5.7 in oak-hemlock forest, 5.7 ± 5.8 in hemlock-hardwood forest and 6.4 ± 6.2 in second growth deciduous forest. A Winter Bird Survey plot in a deciduous-coniferous wetland had 8.4-11.6 birds/km^2. These densities average higher than those found in this study. We found no other estimates of density in primarily forested landscapes.

Habitat.- Observations of summer habitat use by individual Northern Cardinals showed that they inhabited forests significantly more open than would be predicted by habitat availability. Limited observations on wintering birds suggested that they used forests more deciduous, open, and with greater understory density than predicted. Comparison of summer densities with habitat features showed no significant correlations (Table 48). Winter populations were too low to compare densities with habitat. We found the species to be a regular inhabitant of the forest interior, where it used forest openings and open wetlands. However, it was more common outside of forests where we did not sample.

Elsewhere, the Northern Cardinal is reported to inhabit areas with shrubs and small trees, including forest edge and forest openings. Selectively logged areas, young forest, wetland borders and old fields are occupied, as well as human-associated landscapes (Halkin and Linville 1999).

History.- The Northern Cardinal was reported as extremely rare in Connecticut by Sage et al. (1913). After appearing more frequently by the 1930s, its populations dramatically increased until it inhabited the entire state by the 1960s (Zeranski and Baptist 1990).

Synthesis.- Breeding Bird Survey and Christmas Count data suggest that Northern Cardinal populations are undergoing a long term increase in southern New England. The increase of this forest edge species is unexpected in light of the maturation of regional forests (Ward and Barsky 2000). However, human population growth in the region is creating suburban habitats that are also occupied.

The observed decline from summer to winter in Northern Cardinal numbers likely reflects a movement of this non-migratory species (Halkin and Linville 1999) out of forest habitat, as detectability did not obviously change between seasons (we used summer and winter detection distances in computing winter densities). The tendency of wintering birds to occupy more open and shrubby habitats than summering birds (Table 48) supports this possibility.

The association of Northern Cardinals with more open forests is consistent with other reports of habitat use. The tendency toward greater winter association with more deciduous landscapes is unreported, but expected considering the more southerly distribution of the species.

The greater density of Northern Cardinal populations in Southeast Connecticut (Fig. 108, 109) may be related to the species' predominance in more deciduous habitats, which are most frequent in the southeast (Table 3,4,5). However, because the species is distributed principally in the southeastern U.S., (Halkin and Linville 1999), additional geographic factors also may influence populations, which tend to decline toward range limits (Brown 1984, Pulliam 1988).

Conservation status.- Populations are increasing, and appear secure.

Sponsored by Peter and Jane Vercelli

ROSE-BREASTED GROSBEAK

Pheucticus ludovicianus

Density (males/km^2): 3.7 (95% CI: 1.9-7.4)
Density range (males/km^2/transect): 0-12.5
Total population (males): 10,153 (95% CI: 5,080-20,291)

Detection function: hazard /cosine
$\chi^2 = 0.32$, $P = 0.85$, df = 2, N = 76

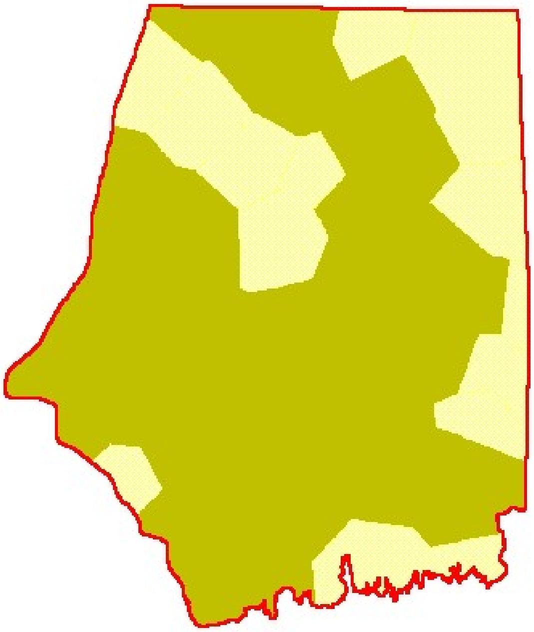

FIG. 110. Densities of the Rose-breasted Grosbeak were similar in Northeast and Southeast Connecticut. Light = 0.8-3.3, dark = 3.3-8.3 males/km^2

Density distribution.-The Rose-breasted Grosbeak was an uncommon to fairly common breeder in the forests of eastern Connecticut. Its densities were similar (Mann-Whitney U = 320.5, $P = 0.93$, N = 51) in Northeast (3.9 ± 4.2 males/km^2) and Southeast Connecticut (3.5 ± 3.2 males/km^2; Fig. 110). Population estimates are based on detections of singing males.

TABLE 49. Observations of habitat use by individual Rose-breasted Grosbeaks showed that they used forest habitats in proportions similar to those available. Comparison of population densities with habitat features also showed no significant correlations. $P(\chi^2)$ = probability level of chi-square tests, N = 24; $P(t)$ = probability level of Kendall's tau, N = 51; * = significant, ** = highly significant (see Table 8 for abbreviation key).

	Mean Habitat Characteristics				
	F	M	D	C	U
Availability	1.4	2.3	2.0	2.7	2.3
Use	1.2	2.3	2.0	2.7	2.2
$P(\chi^2)$	0.21	-	-	0.85	0.36
$P(t)$	0.81	0.50	0.79	0.25	0.69

	Percent Vegetation					
	OD	MH	CN	PO	CO	MI
Availability	51.0	13.7	13.1	13.1	8.5	0.7
Use	70.8	8.3	8.3	8.3	0.0	4.2
$P(\chi^2)$	-					

Population variance.- The coefficient of variation calculated from Breeding Bird Survey data (Sauer et al. 2001) predicted population variation as 33.2% in southern New England. From 1966-2000, populations showed a significant decline in regional (mean count/route = 3.5, trend = -2.4, $P = 0.05$, N = 50) and continental populations (mean count/route = 2.5, trend = -0.8, $P = 0.01$, N = 1260).

On ten line transects through the Northeast Uplands Ecoregion, Craig (1987) reported 1.8 birds/km^2, a value very similar to that of this study when our estimates are multiplied by two to yield breeding individuals/km^2. In a ten year sample of Breeding Bird Census plots in Connecticut, the species was present once (2.2 pairs/km^2) in oak-hemlock forest, was absent in hemlock-hardwood forest, and had 9.4 ± 7.9 pairs/km^2 in second growth deciduous forest. These densities are similar to those found in this study.

Higher populations have been found in successional Connecticut habitats, including

29-100 birds/km^2 in abandoned pastureland and 31-43.5 birds/km^2 in young, deciduous forest (Ellison 1994e). In New Hampshire, Holmes et al. (1986) found 61 ± 19 birds/km^2. Densities of males/km^2 have been reported as 12.5 in New York and 5-20 in Vermont. In the Great Smokey Mountains, 3-6 pairs/km^2 were reported (Wyatt and Francis 2002). These densities overlap those reported in this study.

Habitat.- Observations of habitat use by individual Rose-breasted Grosbeaks showed that they used forest habitats in proportions similar to those available. They tended to inhabit forests averaging more deciduous, but not significantly so. Comparison of population densities with habitat features also showed no significant correlations (Table 49). Our impression was that the species occurred in more open forests or in association with forest gaps, but our modest sample does not support this impression.

Elsewhere, the Rose-breasted Grosbeak is reported to inhabit deciduous and mixed woodland, particularly forest openings and wetland borders. It also inhabits second growth woodland, suburban areas, parks, gardens and orchards. It prefers mesic sites over xeric oak-dominated cover, deciduous over coniferous habitats, and avoids closed canopy forest (Wyatt and Francis 2002).

History.- The Rose-breasted Grosbeak may have been rare in Conecticut before the mid-19th century (Zeranski and Baptist 1990). Later, it was termed common and increasing by Sage et al. (1913).

Synthesis.- Breeding Bird Survey data show that the Rose-breasted Grosbeak is declining regionally. The maturing forests of eastern Connecticut (Ward and Barsky 2000) are likely driving the decline. However, when compared with this study, earlier transects of Craig (1987) suggest that populations in mature forest are stable. Extensive, mature forest appears to have sufficient suitable microhabitats for the species to persist.

Our inability to uncover any significant habitat associations for the species is likely a consequence of our modest sample of habitat observations. Our impression that the species was associated with deciduous forest and forest openings is consistent with other reports of habitat use.

Conservation status.- Populations are declining as forests mature, but should persist at a lower density within mature forest. Within mature forest, populations appear to be stable.

Sponsored by Kenneth Goldsmith

INDIGO BUNTING
Passerina cyanea

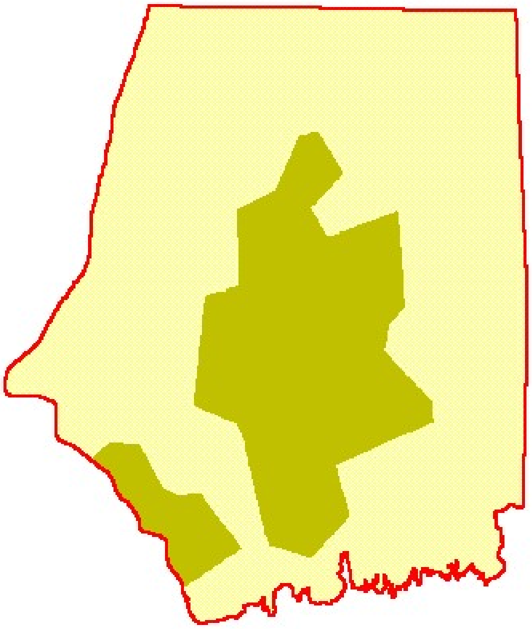

FIG. 111. Densities of the Indigo Bunting appeared greater in Southeast Connecticut. Light = 0-0.5, dark = 0.5-1.2 males/km^2

Density distribution.- Although fairly common at forest edge, the Indigo Bunting was one of the least common breeders of forested eastern Connecticut. Based on 17 observations, we tentatively estimate populations of primarily forested landscapes as 626 males (0.2 males/km^2). Its was present at 12% of Northeast and 28% of Southeast Connecticut transects, suggesting that it occurs more frequently to the south (Fig. 111).

Population variance.- The coefficient of variation calculated from Breeding Bird Survey data (Sauer et al. 2001) predicted population variation as 38.0% in southern New England. From 1966-2000, populations showed a strongly significant decline in regional (mean count/route = 2.6, trend = -4.6, *P* = 0.00, N = 50) and continental populations (mean count/route = 12.9, trend = -0.7, *P* = 0.00, N = 2026).

On ten line transects through the Northeast Uplands Ecoregion, Craig (1987) found no birds. In a ten year sample of Breeding Bird Census plots in Connecticut, the species was absent from oak-hemlock, hemlock-hardwood, and second growth deciduous forest. We found no other estimates of densities in primarily forested landscapes.

Habitat.- We gathered no quantitative data on habitat use by individual Indigo Buntings. We found birds associated with forest edge, logged areas, forests bordering marshes and, incidentally to surveys, forests bordering gardens and farm fields. Elsewhere, the species is reported to inhabit forest openings, riparian habitats, swamps, open deciduous woods and old fields. It is absent from closed canopy forest (Payne 1992).

History.- The Indigo Bunting has been known as a common summer resident since the 19th century, although more recently it has been declining (Sage et al. 1913, Zeranski and Baptist 1990).

Synthesis.- Breeding Bird Survey data show that the Indigo Bunting is declining regionally. The maturing forests of Connecticut (Ward and Barsky 2000) are likely responsible for the decline, because forest maturation eliminates the more open habitats that it occupies. Unlike some species associated with forest opening, it does not appear capable of occupying small openings resulting from the loss of one or a few trees. However, our observations of it inhabiting open swamps, river edge, logged areas and other human-associated habitats likely will ensure its long term persistence in our region.

Conservation status.- Populations are declining, but should persist because of the species' versatility in habitat use.

Sponsored by the Town of Eastford

BROWN-HEADED COWBIRD
Molothrus ater

Density (birds/km^2): 7.0 (95% CI: 5.6-8.7)
Density range (birds/km^2/transect): 0-15.8
Total population (birds): 19,046 (95% CI: 15,372-23,599)

Detection function: hazard /cosine
$\chi^2 = 3.52$, $P = 0.47$, df = 4, N = 180

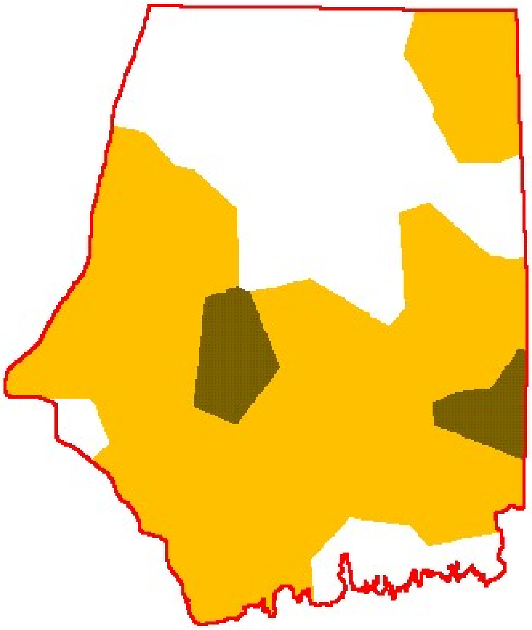

FIG. 112. Densities of the Brown-headed Cowbird were greatest in Southeast Connecticut. Light = 2.6-5.9, medium = 5.9-9.9, dark = 9.9-13.9 birds/km^2

Density distribution.-The Brown-headed Cowbird was a fairly common summer inhabitant of the forests of eastern Connecticut. Its densities averaged significantly higher (Mann-Whitney U = 154.5, $P = 0.00$, N = 51) in Southeast (9.1 ± 3.9 birds/km^2) than Northeast Connecticut (5.0 ± 3.9 birds/km^2; Fig. 112).

Because the Brown-headed Cowbird inhabits environments other than forest, densities reported here refer only to that part of the population associated with primarily forested regions. Population estimates are based on detections of calling males and females. Although in winter it also is occasionally present in non-forested habitats, none were detected in forest during this study.

TABLE 50. Observations of habitat use by individual Brown-headed Cowbirds showed that they inhabited forests with significantly denser understories than would be predicted by habitat availability. Comparison of population densities with habitat features corroborated this significant relationship. $P(\chi^2)$ = probability level of chi-square tests, N = 60; $P(\tau)$ = probability level of Kendall's tau, N = 51; * = significant, ** = highly significant (see Table 8 for abbreviation key).

	Mean Habitat Characteristics				
	F	M	D	C	U
Availability	1.4	2.3	2.0	2.7	2.3
Use	1.4	2.1	2.0	2.5	2.4
$P(\chi^2)$	0.93	0.11	0.73	0.06	0.05*
$P(\tau)$	0.16	0.43	0.73	0.40	0.02*

	Percent Vegetation					
	OD	MH	CN	PO	CO	MI
Availability	51.0	13.7	13.1	13.1	8.5	0.7
Use	55.0	11.7	11.7	8.3	10.0	3.3
$P(\chi^2)$	0.63					

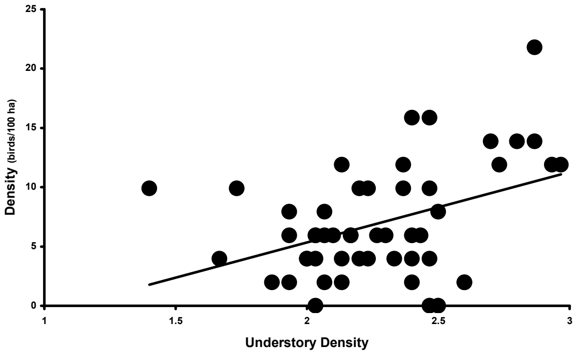

FIG. 113. Population density showed a variable but significant increase with greater understory density.

Population variance.- The coefficient of variation calculated from Breeding Bird Survey data (Sauer et al. 2001) predicted population variation as 13.7% for southern New England. From 1966-2000, populations showed a strongly significant continental (mean count/route = 13.5, trend = -1.0, P = 0.00, N = 3624) and non-significant regional decline (mean count/route = 6.9, trend = -0.5, P = 0.55, N = 51).

On ten line transects through the Northeast Uplands Ecoregion, Craig (1987) reported 20.4 ± 15.2 birds/km^2, a value above that of this study. In a ten year sample of Breeding Bird Census plots in Connecticut, densities of birds/km^2 were 15.6 ± 10.3 in oak-hemlock forest, 9.0 ± 6.5 in hemlock-hardwood forest, and 5.9 ± 6.9 in second growth deciduous forest. These densities overlap those found in this study. We found no other estimates of population densities from primarily forested landscapes.

Habitat.- Observations of habitat use by individual Brown-headed Cowbirds showed that they inhabited forests with significantly denser understories than would be predicted by habitat availability. Comparison of population densities with habitat features corroborated this significant relationship (Table 50, Fig. 113).

Elsewhere, the species is reported to inhabit principally grasslands, disturbed areas, thickets and suburban habitats, with woodland edge appearing to be preferred. It avoids extensive forests, but may invade forest as a consequence of forest fragmentation (Lowther 1993).

History.- The Brown-headed Cowbird has been known as a common to abundant summer resident since the 19th century. It is thought to have increased in our region during the deforestation of the 18th and 19th centuries (Sage et al. 1913, Zeranski and Baptist 1990).

Synthesis.- Breeding Bird Survey data show that the Brown-headed Cowbird is declining continentally and perhaps regionally, a trend corroborated by comparison of our results with earlier transect studies of Craig (1987). The maturing forests of Connecticut (Ward and Barsky 2000) are likely responsible for any regional decline because forest maturation eliminates the more open habitats occupied by the species. However, The Brown-headed Cowbird's propensity toward inhabiting residential areas and agricultural land likely will ensure its long term persistence in our region.

The significant association of the Brown-headed Cowbird with denser understories and, hence, with more open forests (these variables are inversely correlated; Table 6), is consistent with the view that the species is primarily one of more open and edge habitats. Denser understories themselves are unlikely to be an important habitat requirement, as the species does not appear to use such areas.

Higher densities of Brown-headed Cowbirds in Southeast Connecticut (Fig. 112) may be related to the reduced forest cover in this region compared with Northeast Connecticut (Alerich 1999). The more fragmented nature of the forest may permit more cowbirds to penetrate forested areas.

Conservation status.- Populations may be declining, but should persist because the species is versatile in habitat use. Forest fragmentation may permit more individuals of this nest parasitic species to penetrate forested areas, thereby making forest patches less suitable for other forest specialists.

BALTIMORE ORIOLE

Icterus galbula

Density (males/km^2): 3.4 (95% CI: 2.2-5.4)
Density range (males/km^2/transect): 0-18.5
Total population (males): 9,379 (95% CI: 6,016-14,623)

Detection function: uniform /cosine
$x^2 = 1.86$, $P = 0.60$, df = 3, N = 38

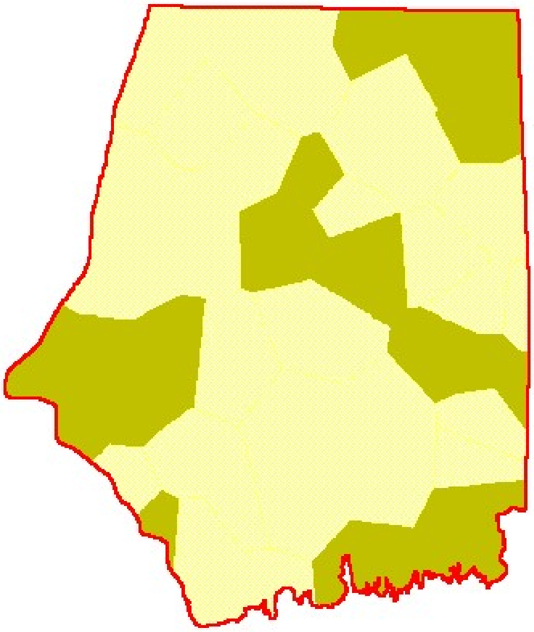

FIG. 114. Densities of the Baltimore Oriole averaged greater in Southeast Connecticut. Light = 0-3.1, dark = 3.1-7.7 males/km^2

Density distribution.-The Baltimore Oriole was an uncommon breeder in the forests of eastern Connecticut. Its densities averaged higher in Southeast (3.8 ± 3.8 males/km^2) than Northeast Connecticut (2.8 ± 3.9 males/km^2) but not significantly so (Mann-Whitney U = 324.0, $P = 0.99$, N = 51).

Because the Baltimore Oriole inhabits environments other than forest, densities reported here refer only to that part of the population associated with primarily forested regions. Population estimates are based on <60 detections of singing males, so have reduced accuracy.

TABLE 51. Observations of habitat use by individual Baltimore Orioles showed that they used forest habitats in proportions similar to those available. Comparison of population densities with habitat features showed no significant correlations. $P(x^2)$ = probability level of chi-square tests, N = 22; $P(t)$ = probability level of Kendall's tau, N = 51; * = significant, ** = highly significant (see Table 8 for abbreviation key).

	Mean Habitat Characteristics				
	F	M	D	C	U
Availability	1.4	2.3	2.0	2.7	2.3
Use	1.4	2.3	2.0	2.5	2.3
$P(x^2)$	0.78	0.89	-	0.19	0.99
$P(t)$	0.35	0.26	0.39	0.26	0.46

	Percent Vegetation					
	OD	MH	CN	PO	CO	MI
Availability	51.0	13.7	13.1	13.1	8.5	0.7
Use	36.4	27.3	22.7	9.1	4.5	0.0
$P(x^2)$	-					

Population variance.- The coefficient of variation calculated from Breeding Bird Survey data (Sauer et al. 2001) predicted population variation as 2.9% in southern New England. From 1966-2000, populations showed a strongly significant decline in regional (mean count/route = 12.5, trend = -3.2, $P = 0.00$, N = 51) and continental (mean count/route = 2.9, trend = -0.6, $P = 0.00$, N = 1743) populations.

On ten line transects through the Northeast Uplands Ecoregion, Craig (1987) reported 12.2 birds/km^2, a value above that of this study even when our estimates are multiplied by two to yield breeding individuals/km^2. In a ten year sample of Breeding Bird Census plots in Connecticut, the species appeared three times (4.3-8.7 pairs/km^2) in oak-hemlock forest, was present twice (4.7-9.5 pairs/km^2) in hemlock-hardwood forest, and had densities of 5.9 ± 9.0

pairs/km^2 in second growth deciduous forest. These densities overlap those found in this study. Elsewhere, 46.9 pairs/km^2 are reported from Vermont, and 37 males/km^2 are reported from West Virginia (Rising and Flood 1998).

Habitat.- Data from individual Baltimore Orioles showed that they used forest habitats in proportions similar to those available. They appeared somewhat more prevalent in open canopy forests, but this trend was not statistically significant. Moreover, they were frequent in mixed hardwood forests, although this trend could not be tested statistically because of zeros in categories (Table 51).

Elsewhere, the species is reported to inhabit woodland edge, riparian woods, and open areas with scattered trees. It strongly prefers deciduous over coniferous forest (Rising and Flood 1998).

History.- The Baltimore Oriole has been known as a common to abundant summer resident since the 19th century (Sage et al. 1913, Zeranski and Baptist (1990). Clark (1994n) thought that a decline in regional populations had been brought about by the maturation of regional forests.

Synthesis.- Breeding Bird Survey data show that the Baltimore Oriole is declining regionally, a trend corroborated by comparison of our results with earlier transect studies of Craig (1987). The maturing forests of Connecticut (Ward and Barsky 2000) are likely responsible for the decline because forest maturation eliminates the more open habitats occupied by the species. However, the species' propensity toward inhabiting residential shade trees likely will ensure its long term persistence in our region. Moreover, our data indicate that it is capable of persisting in suitable microhabitats within extensively forested landscapes, albeit at lower densities.

The modest samples of habitat use showed no significant association with habitat variables. However, the species' tendency toward inhabiting more open canopy and mixed hardwood forests (often associated with riparian areas) was consistent with its reported habitat affiliations.

Conservation status.- Populations are declining, but should persist even within mature forest as long as such forest remains extensive enough for a variety of microhabitats to be present.

Sponsored by Diane Bradley

PURPLE FINCH

Carpodacus purpureus

Density distribution.- We rarely encountered the Purple Finch in the forests of eastern Connecticut. Our five summer and no winter detections were inadequate for reliably estimating populations. All observations were of birds in Northeast Connecticut.

Population variance.- The coefficient of variation calculated from Breeding Bird Survey data (Sauer et al. 2001) predicted variation in continental populations as 15.7%. From 1966 to 2000 continental populations showed a strongly significant decline (mean count/ route = 2.2, trend = -1.7, $P = 0.00$, N = 940). Limited data from southern New England also suggested a decline.

Christmas Count data predicted population variation as 69.4% for Connecticut. From 1966-2001, populations showed a strongly significant Connecticut (birds/party hour = 0.3, quadratic model $r^2 = 0.51$, df = 34, $P = 0.00$) and U.S. decline (birds/party hour = 0.3, quadratic model $r^2 = 0.52$, df = 34, $P = 0.00$).

On ten line transects through the Northeast Uplands Ecoregion, Craig (1987) reported 1.8 summering birds/km^2. In a ten year sample of Breeding Bird Census plots in Connecticut, 13.8 + 8.5 pairs/km^2 were present in hemlock-hardwood forest. It was absent in oak-hemlock and second growth deciduous forest. A Winter Bird Survey plot in a deciduous-coniferous wetland also yielded no birds. Elsewhere, densities of breeding pairs/km^2 have been reported as 5.8-9.5 in Connecticut, 7.5-32.8 in New York and 14.0-48.8 in Maine (Wootton 1996).

Habitat.- During this study, we found birds in coniferous and mixed hemlock-white pine-hardwood forests. They inhabited forest interior and edge, and used both mesic and xeric habitats. Previous observations of breeding Purple Finches in Connecticut were of birds at the edge of a mature hemlock ravine and in a grove of mixed conifers bordering a forest opening (R. Craig pers. obs.)

Elsewhere, the species is reported to occupy primarily coniferous and mixed forests, particularly mesic ones and ones bordering riparian areas and bogs. Edge appears to be an important habitat requirement. Consequently, conifer groves and ornamental plantations also are used. Mature deciduous forest appears to be less suitable habitat. In winter, it uses a wide variety of habitats, including forested and open habitats in which conifers are typically present (Wootton 1996).

History.- The Purple Finch was reported as most common in Northwest Connecticut by Sage et al. (1913). Populations appear to have fluctuated since the 19th century (Zeranski and Baptist 1990).

Synthesis.- Breeding Bird Survey and Christmas Count data show that Purple Finch populations are declining regionally. The maturing forests of Connecticut (Ward and Barsky 2000) are likely responsible for the decline, because forest maturation eliminates the more open habitats occupied by the species.

The Purple Finch is near the southern boundary of its breeding range in eastern Connecticut (Wootton 1996). Its apparent predominance in the northern part of the state is likely a consequence of the characteristic population decline that occurs toward range limits (Brown 1984, Pulliam 1988), probably in part because of the decline in coniferous habitat from north to south.

Our few observations of habitat use were consistent with other reports that birds inhabit coniferous and mixed forest and forest edge. However, two of our four observations were of birds in xeric habitats, which are less typical for the species.

Conservation status.- Breeding and wintering populations appear to be declining.

Sponsored by Judith Radasch

COMMON REDPOLL
Carduelis flammea

Density distribution.- Although common during some winters, we encountered this irruptive winter visitor only once during the study period. Hence, we generate no population estimate for it.

Population variance.- Christmas Count data predicted population variation as 87.1% for Connecticut. From 1966-2001, populations showed a significant Connecticut increase (birds/party hour = 0.3, Kendall's tau = 0.44, *P* = 0.00, N = 37), but no U.S. trend (birds/party hour = 1.5, Kendall's tau = 0.05, *P* = 0.66, N = 37). A Winter Bird Survey plot in a deciduous-coniferous wetland yielded no detections. We found no reports of winter densities, other than that they are variable (Knox and Lowther 2000).

Habitat.- Our single observation of a wintering bird was made in mature white pine-hemlock-hardwood forest. Outside the study period, we have found birds in coniferous and mixed habitats in closed and open canopy forest. We also have found birds in weedy marsh edges. Elsewhere, winter habitat is described as open woodland and birch, alder and willow scrub (Knox and Lowther 2000).

History.- Zeranski and Baptist (1990) described the the Common Redpoll as an erratic winter visitor, a status they believed had not changed in the past century.

Synthesis.- The Common Redpoll is an irruptive species that in eastern Connecticut occasionally winters in large numbers. During this study, some birds were present in the region during the winter of 2001-2002, but fewer appeared in 2002-2003.

Conservation status.- Wintering populations are highly variable but generally increasing. The maturation of regional forest may be reducing the amount of suitable habitat.

PINE SISKIN
Carduelis pinus

Density distribution.- Although individuals occasionally remain to breed during years after large winter incursions, we found no breeders during this study. They also occurred infrequently in winter during this study, and only in Northeast Connecticut. Based on 14 observations, winter populations are tentatively estimated at 702 (0.3 birds/ km^2) during the study period. Winter estimates are based on detections of flocks of males and females. Estimates refer only to that part of the population inhabiting primarily forested landscapes.

Population variance.- The coefficient of variation calculated from Breeding Bird Survey data (Sauer et al. 2001) predicted variation in continental populations as 9.3%. From 1966 to 2000 continental populations showed a strongly significant decline (mean count/ route = 5.9, trend = -1.8, P = 0.00, N = 830). No data were available from southern New England.

Christmas Count data predicted population variation as 156.0% for Connecticut. From 1966-2001, populations showed no significant Connecticut (birds/party hour = 0.2, Kendall's tau = -0.17, P = 0.70, N = 37), or U.S. trend (birds/party hour = 0.6, quadratic model r^2 = 0.04, df = 34, P = 0.51)

On ten line transects through the Northeast Uplands Ecoregion, Craig (1987) reported 3.0 summering birds/km^2. In a ten year sample of Breeding Bird Census plots in Connecticut, no birds occurred in hemlock-hardwood, second growth deciduous or oak-hemlock forest. A Winter Bird Survey plot in a deciduous-coniferous wetland also yielded no birds. Elsewhere, breeding densities have been reported as 0-80 birds/km^2 in Utah. We found no reports of winter densities, other than that they are variable (Dawson 1997).

Habitat.- We found wintering birds principally in mixed white pine-hemlock-hardwood forest, but also in pine-oak and deciduous forest. They occurred in forest interior and edge. In years past, we have found breeders in conifer-northern hardwood forests in the Northeast Uplands Ecoregion. Elsewhere, the species typically breeds in open coniferous forest, but also in mixed and deciduous forest. It appears to prefer conifers in winter, but may be found in a variety of other forest and non-forest habitats (Dawson 1997).

History.- Sage et al. (1913) reported no Connecticut breeders. Zeranski and Baptist (1990) described it as a rare and irregular nester.

Synthesis.- The Pine Siskin is an irruptive species that in eastern Connecticut occasionally winters in large numbers. Although individuals remained to breed after the large winter incursions of the early and mid-1980s, breeding populations have since disappeared. During this study, some birds were present in the winter of 2001-2002, but fewer appeared present in 2002-2003. Hence, the apparent prevalence of the species in Northeast Connecticut is likely more a function of annual variance in abundance than an actual geographic trend.

Our few observations of habitat use were typical of those reported to be used by the species.

Conservation status.- Wintering populations are highly variable. Breeding is likely to occur only after years of large winter incursions.

AMERICAN GOLDFINCH
Carduelis tristis

Summer

Density (birds/km^2): 12.7 (95% CI: 10-7-15.0)

Density range (birds/km^2/transect): 0-32.8

Total population (birds): 34,493 (95% CI: 29,071-40,927)

Detection function: hazard/cosine
$\chi^2 = 40.9, P = 0.00, \text{df} = 2, N = 197$

Winter

Density (birds/km^2): 7.5 (95% CI: 4.1-6.8)

Density range (birds/km^2/transect): 0-31.1

Total population (birds): 20,342 (95% CI: 15,520-26,662)

Detection function (all data): hazard/cosine
$\chi^2 = 9.47, P = 0.05, \text{df} = 4, N = 96$

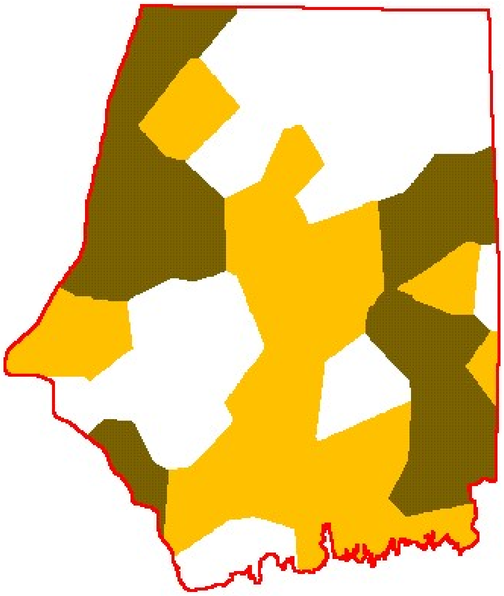

FIG. 110. Summer densities of the American Goldfinch were similar in Northeast and Southeast Connecticut. Light = 2.2-9.8, medium = 9.8-14.2, dark = 14.2-19.7 birds/km^2.

TABLE 52. Observations of summer habitat use by individual American Goldfinches showed that they inhabited forests significantly more open than would be predicted by habitat availability. In winter, birds inhabited forests significantly more deciduous than predicted. Comparison of summer densities with habitat features showed a no significant correlations, but winter densities were correlated with increasingly deciduous forests. $P(\chi^2)$ = probability level of chi-square tests, N = 99 summer, 73 winter; $P(t)$ = probability level of Kendall's tau, N = 51; * = significant, ** = highly significant (see Table 8 for abbreviation key).

	Mean Habitat Characteristics				
	F	M	D	C	U
Availability	1.4	2.3	2.0	2.7	2.3
Summer use	1.4	2.3	2.0	2.5	2.3
$P(\chi^2)$	0.77	0.50	-	0.01**	0.75
$P(t)$	0.46	0.21	0.41	0.70	0.87
Winter use	1.1	2.2	1.9	1.9	2.7
$P(\chi^2)$	0.01**	0.95	-	0.10	0.16
$P(t)$	0.01**	0.78	0.92	0.71	0.11

	Percent Vegetation					
	OD	MH	CN	PO	CO	MI
Availability	51.0	13.7	13.1	13.1	8.5	0.7
Summer use	46.5	16.2	8.1	17.2	12.1	0.0
$P(\chi^2)$	0.51					
Winter use	53.4	30.1	4.1	5.5	4.1	2.7
$P(\chi^2)$	0.01**					

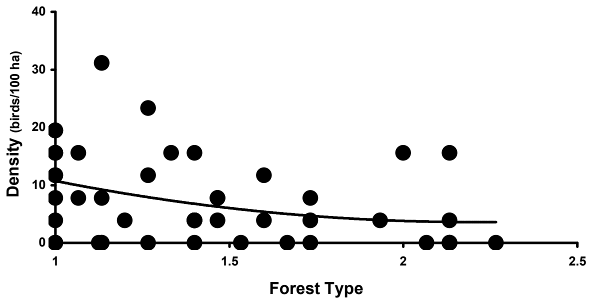

FIG. 111. Winter densities of the American Goldfinch showed a variable but significant relationship with increasingly deciduous forest.

Density distribution.- Although most characteristic of open habitats, the American Goldfinch also was a fairly common inhabitant of the forests of eastern Connecticut. Its

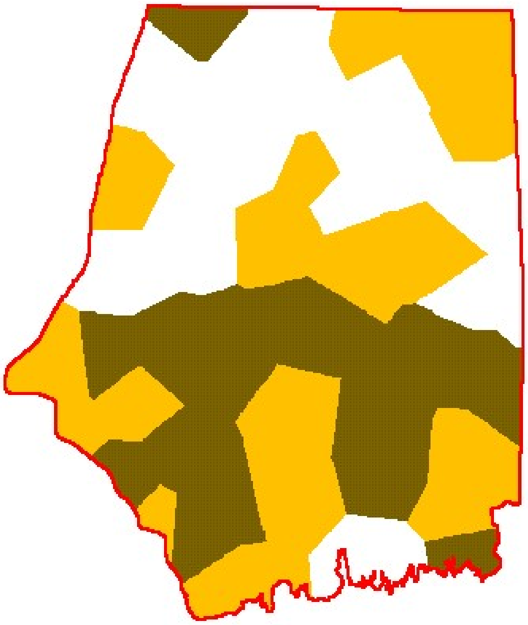

FIG. 112. Winter densities of the American Goldfinch were greatest in Southeast Connecticut. Light = 0-3.9, medium = 3.9-10.4, dark = 10.4-16.9 birds/km^2.

breeding densities were similar (Mann-Whitney U = 305.0 , P = 0.70, N = 51) in Northeast (12.6 ± 8.2 birds/km^2) and Southeast Connecticut (12.7 ± 6.4 birds/km^2; Fig. 110). In winter, densities were significantly greater in Southeast (11.7 ± 7.7 birds/km^2) than Northeast Connecticut (3.3 ± 4.9 birds/km^2; Fig. 112) (Mann-Whitney U = 180.5 , P = 0.00, N = 51. Population estimates are based on detections of flocks of calling males and females, and refer only to that portion of the population inhabiting primarily forested landscapes.

Population variance.- The coefficient of variation calculated from Breeding Bird Survey data (Sauer et al. 2001) predicted population variation as 13.0% for southern New England. From 1966-2000, populations showed no significant regional (mean count/route = 9.3, trend = 2.0, P = 0.10, N = 51) or continental trend (mean count/route = 5.8, trend = -0.4, P = 0.09, N = 2581).

Christmas Count data predicted population variation as 37.3% for Connecticut. From 1966-2001, populations showed no significant Connecticut (birds/party hour = 1.7, Kendall's tau = 0.11, P = 0.36, N = 37) or U.S. trend (birds/party hour = 2.1, quadratic model r^2 = 0.06, df = 34, P = 0.36).

On ten line transects through the Northeast Uplands Ecoregion, Craig (1987) reported no birds, although they were present in the study area (R. Craig pers. obs). In a ten year sample of Breeding Bird Census plots in Connecticut, birds appeared once (2.2 pairs/km^2) in oak-hemlock forest, were absent in hemlock-hardwood forest, and appeared once (5.0 pairs/km^2) in second growth deciduous forest. A Winter Bird Survey plot in a deciduous-coniferous wetland had 28.4-69.3 birds/km^2. We found no other estimates of density in primarily forested landscapes.

Habitat.- Observations of summer habitat use by individual American Goldfinches showed that they inhabited forests significantly more open than would be predicted by habitat availability. In winter, birds inhabited forests significantly more deciduous than predicted. Comparison of summer densities with habitat features showed no significant correlations, but winter densities were correlated with increasingly deciduous forests.

We found birds particularly in the vicinity of forest openings, riparian areas and open swamps. Elsewhere, the American Goldfinch is reported to inhabit weedy fields, floodplains, forest edge, early successional growth, orchards and gardens (Middleton 1993).

History.- The American Goldfinch was reported as abundant by Sage et al. (1913). Zeranski and Baptist (1990) speculate that populations declined during the 20th century as forests re-grew.

Synthesis.- Despite the maturation of regional forests (Ward and Barsky 2000), Breeding Bird Survey and Christmas Count data suggest that American Goldfinch populations are stable in southern New England. The observed decline from summer to winter in American Goldfinch numbers is expected, because the species is strongly migratory from northern parts of its range, including Connecticut (Middleton 1993). Migration also explains the concentration of birds in Southeast Connecticut during the winter season.

The association of the American Goldfinch in summer with more open forests is consistent with other reports of habitat use. The tendency toward greater winter association with more deciduous landscapes is unreported, but may be related to the winter concentration of populations in Southeast Connecticut, where deciduous habitats predominate (Table 3,4,5).

Conservation status.- Populations are stable, and appear secure.

Sponsored by the Town of Brooklyn

SPECIES DETECTED INCIDENTALLY TO SURVEYS

AMERICAN WOODCOCK (*Scolopax minor*).- One summer observation at Rock Spring. This species was not readily detected by the methods we employed.

EASTERN SCREECH OWL (*Otus asio*).- One summer observation near Meshomasic State Forest. This species was not readily detected by the methods we employed.

GREAT HORNED OWL (*Bubo virginianus*).- One summer and two winter observations. This species was not readily detected by the methods we employed.

BARRED OWL (*Strix varia*).- Four summer and two winter observations. This species was not readily detected by the methods we employed.

WHIP-POOR-WILL (*Caprimulgus vociferus*).- One observation at Pumpkin Hill of a nesting bird, and one incidental observation near Pole Bridge Road. This species was not readily detected by the methods we employed.

LITERATURE CITED

ALERICH, C.L. 1999. Forest statistics for Connecticut. U.S. Department of Agriculture, Forest Service, Northeastern Research Station Resource Bulletin NE-147.

ARCESE, P., M.K. SOGGE, A.B. MARR and M.A. PATTEN. 2002. Song Sparrow (*Melospiza melodia*). *In* The Birds of North America, No. 704 (A. Poole and F. Gill, Eds.). The Birds of North America, Inc. Philadelphia, PA.

ANDERSON, B.W., R.D. OHMART and J. RICE. 1981. Seasonal changes in avian densities and diversities. Pages 262-264. I*n* Estimating numbers of terrestrial birds. (C. J. Ralph and J.M Scott, Eds.). Studies in Avian Biology No. 6.

ASKINS, R.A., M.J. PHILBRICK and D.S. SUGENO. 1987. Relationship between the regional abundance of forest and the composition of forest bird communities. Biological Conservation 39:129-152.

BEDNARZ, J.C., D. KLEM, Jr., L.J. GOODRICH and S.E. SENNER. 1990. Migration counts of raptors at Hawk Mountain, Pennsylvania as indicators of population trends, 1934-1986. Auk 107:96-109.

BEVIER, L.R. 1994. The atlas of breeding birds of Connecticut. Connecticut Geological and Natural History Survey Bulletin 113.

BILDSTEIN, K.L. and K. MEYER. 2000. Sharp-shinned Hawk (*Accipiter striatus*). *In* The Birds of North America, No. 482 (A. Poole and F. Gill, Eds.). The Birds of North America, Inc. Philadelphia, PA.

BLEDSOE, A.H. 1994. Blue-winged Warbler. Pages 294-295. *In* (L.R. Bevier, Ed.). The atlas of breeding birds of Connecticut. Connecticut Geological and Natural History Survey Bulletin 113.

BOARMAN, W.I. and B. HEINRICH. 1999. Common Raven (*Corvus corax*). *In* The Birds of North America, No. 476 (A. Poole and F. Gill, Eds.). The Birds of North America, Inc. Philadelphia, PA.

BRISKE, J.V. 1994. Least Flycatcher (*Empidonax minimus*). *In* The Birds of North America, No. 99 (A. Poole and F. Gill, Eds.). The Birds of North America, Inc. Philadelphia, PA.

BROWN, J.H. 1984. On the relationship between abundance and distribution of species. American Naturalist 124:255-279.

BUCKLAND, S.T., D.R. ANDERSON, K.P BURNHAM, J.L. LAAKE, D.L. BORCHERS and L. THOMAS. 2001. Introduction to distance sampling. Oxford University Press, Oxford, U.K.

BULL, E.L. and J.E. JACKSON. 1995. Pileated Woodpecker (*Dryocopus pileatus*). *In* The Birds of North America, No. 148 (A. Poole and F. Gill, Eds.). The Birds of North America, Inc. Philadelphia, PA.

BULL, J. 1974. Birds of New York State. Doubleday, Garden City, NY.

CIMPRICH, D.A. and F.R. MOORE. 1995. Gray Catbird (*Dumatella carolinensis*). *In* The Birds of North America, No. 167 (A. Poole and F. Gill, Eds.). The Birds of North America, Inc. Philadelphia, PA.

CIMPRICH, D.A., F.R. MOORE and M.P. GUILFOYLE. 2000. Red-eyed Vireo (*Vireo olivaceus*). *In* The Birds of North America, No. 527 (A. Poole and F. Gill, Eds.). The Birds of North America, Inc. Philadelphia, PA.

CLARK, G.A., Jr. 1999. Birds of Storrs, Connecticut and vicinity. Third edition. Natchaug Ornithological Society, Storrs, CT.

CLARK, G.A., Jr. 1994a. Red-bellied Woodpecker. Pages 188-189. *In* (L.R. Bevier, Ed.). The atlas of breeding birds of Connecticut. Connecticut Geological and Natural History Survey Bulletin 113.

CLARK, G.A., Jr. 1994b. Acadian Flycatcher. Pages 204-205. *In* (L.R. Bevier, Ed.). The atlas of breeding birds of Connecticut. Connecticut Geological and Natural History Survey Bulletin 113.

CLARK, G.A., Jr. 1994c. Eastern Phoebe. Pages 212-213. *In* (L.R. Bevier, Ed.). The atlas of breeding birds of Connecticut. Connecticut Geological and Natural History Survey Bulletin 113.

CLARK, G.A., Jr. 1994d. Great Crested Flycatcher. Pages 214-215. *In* (L.R. Bevier, Ed.). The atlas of breeding birds of Connecticut. Connecticut Geological and Natural History Survey Bulletin 113.

CLARK, G.A., Jr. 1994e. Blue-headed Vireo. Pages 286-287. *In* (L.R. Bevier, Ed.). The atlas of breeding birds of Connecticut. Connecticut Geological and Natural History Survey Bulletin 113.

CLARK, G.A., Jr. 1994f. Golden-crowned Kinglet. Pages 258-259. *In* (L.R. Bevier, Ed.). The atlas of breeding birds of Connecticut. Connecticut

Geological and Natural History Survey Bulletin 113.

CLARK, G.A., Jr. 1994g. American Robin. Pages 272-273. *In* (L.R. Bevier, Ed.). The atlas of breeding birds of Connecticut. Connecticut Geological and Natural History Survey Bulletin 113.

CLARK, G.A., Jr. 1994h. Nashville Warbler. Pages 300-301. *In* (L.R. Bevier, Ed.). The atlas of breeding birds of Connecticut. Connecticut Geological and Natural History Survey Bulletin 113.

CLARK, G.A., Jr. 1994i. Magnolia Warbler. Pages 308-309. *In* (L.R. Bevier, Ed.). The atlas of breeding birds of Connecticut. Connecticut Geological and Natural History Survey Bulletin 113.

CLARK, G.A., Jr. 1994j. Yellow-rumped Warbler. Pages 312-313. *In* (L.R. Bevier, Ed.). The atlas of breeding birds of Connecticut. Connecticut Geological and Natural History Survey Bulletin 113.

CLARK, G.A., Jr. 1994k. Blackburnian Warbler. Pages 316-317. *In* (L.R. Bevier, Ed.). The atlas of breeding birds of Connecticut. Connecticut Geological and Natural History Survey Bulletin 113.

CLARK, G.A., Jr. 1994l. Prairie Warbler. Pages 320-321. *In* (L.R. Bevier, Ed.). The atlas of breeding birds of Connecticut. Connecticut Geological and Natural History Survey Bulletin 113.

CLARK, G.A., Jr. 1994m. Louisiana Waterthrush. Pages 336-337. *In* (L.R. Bevier, Ed.). The atlas of breeding birds of Connecticut. Connecticut Geological and Natural History Survey Bulletin 113.

CLARK, G.A., Jr. 1994n. Northern Oriole. Pages 392-393. *In* (L.R. Bevier, Ed.). The atlas of breeding birds of Connecticut. Connecticut Geological and Natural History Survey Bulletin 113.

COLWELL, R.K. 1994. Ruby-throated Hummingbird. Pages 182-183. *In* (L.R. Bevier, Ed.). The atlas of breeding birds of Connecticut. Connecticut Geological and Natural History Survey Bulletin 113.

CONNECTICUT OFFICE OF POLICY AND MANAGEMENT. 2002. Census 2000 population counts for Connecticut Municipalities and Counties. Connecticut Office of Policy and Management, Hartford, Connecticut.

CONWAY, C.J. 1999. Canada Warbler (*Wilsonia canadensis*). *In* The Birds of North America, No. 421 (A. Poole and F. Gill, Eds.). The Birds of North America, Inc. Philadelphia, PA.

CRAIG, R.J. 1979. The rare vertebrates of Connecticut. U.S. Soil Conservation Service, Storrs, Connecticut.

CRAIG, R.J. 1985. Comparative habitat use by Louisiana and Northern waterthrushes. Wilson Bull. 97:347-355.

CRAIG, R.J. 1987. Population densities of forest birds in northeastern Connecticut. Conn. Warb. 7:27-31.

CRAIG, R.J. 1990. Historic trends in the distributions and populations of estuarine marsh birds of the Connecticut River. Univ. Conn. Agr. Expt. Sta. Research Report 83.

CRAIG, R.J. 2002. Endangered species, provincialism, and a continental approach to bird conservation. Bird Conservation Research Contribution 7:1-17.

CROCOLL, S.T. 1994. Red-shouldered Hawk (*Buteo lineatus*). *In* The Birds of North America, No. 107 (A. Poole and F. Gill, Eds.). The Birds of North America, Inc. Philadelphia, PA.

CYR, A. 1981. Limitation and variability in hearing ability in censusing birds. Pages 327-333. I*n* Estimating numbers of terrestrial birds. (C. J. Ralph and J.M Scott, Eds.). Studies in Avian Biology No. 6.

DAVIS, D.E. 1981. Summarizing remarks. Page 390. I*n* Estimating numbers of terrestrial birds. (C. J. Ralph and J.M Scott, Eds.). Studies in Avian Biology No. 6.

DAWSON, W.R. 1997. Pine Siskin (*Carduelis pinus*). *In* The Birds of North America, No. 280 (A. Poole and F. Gill, Eds.). The Birds of North America, Inc. Philadelphia, PA.

DESANTE, D.F. 1981. A field test of the variable circular plot censusing technique in a California coastal scrub breeding bird community. Pages 177-185. I*n* Estimating numbers of terrestrial birds. (C. J. Ralph and J.M Scott, Eds.). Studies in Avian Biology No. 6.

DOWHAN, J.J., and R.J. CRAIG. 1976. Rare and endangered species of Connecticut and their habitats. Connecticut Geological and Natural History Survey Report of Investigations 6.

EATON, S.W. 1992. Wild Turkey (*Meleagris gallopavo*). *In* The Birds of North America, No. 22 (A. Poole and F. Gill, Eds.). The Birds of North America, Inc. Philadelphia, PA.

EATON, S.W. 1995. Northern Waterthrush (*Meleagris gallopavo*). *In* The Birds of North America, No. 182 (A. Poole and F. Gill, Eds.). The Birds of North America, Inc. Philadelphia, PA.

ELLISON, W.G. 1992. Blue-gray Gnatcatcher (*Polioptila caerulea*). *In* The Birds of North America, No. 23 (A. Poole and F. Gill, Eds.). The Birds of North America, Inc. Philadelphia, PA.

ELLISON, W.G. 1994a. Blue-gray Gnatcatcher. Pages 260-261. *In* (L.R. Bevier, Ed.). The atlas of breeding birds of Connecticut. Connecticut

Geological and Natural History Survey Bulletin 113.

ELLISON, W.G. 1994b. Black-throated Green Warbler. Pages 314-315. *In* (L.R. Bevier, Ed.). The atlas of breeding birds of Connecticut. Connecticut Geological and Natural History Survey Bulletin 113.

ELLISON, W.G. 1994c. Cerulean Warbler. Pages 322-323. *In* (L.R. Bevier, Ed.). The atlas of breeding birds of Connecticut. Connecticut Geological and Natural History Survey Bulletin 113.

ELLISON, W.G. 1994d. American Redstart. Pages 326-327. *In* (L.R. Bevier, Ed.). The atlas of breeding birds of Connecticut. Connecticut Geological and Natural History Survey Bulletin 113.

ELLISON, W.G. 1994e. Rose-breasted Grosbeak. Pages 352-353. *In* (L.R. Bevier, Ed.). The atlas of breeding birds of Connecticut. Connecticut Geological and Natural History Survey Bulletin 113.

EVANS OGDEN, L.J. and B.J. STUCHBURY. 1994. Hooded Warbler (*Wilsonia citrina*). *In* The Birds of North America, No. 110 (A. Poole and F. Gill, Eds.). The Birds of North America, Inc. Philadelphia, PA.

FALLS, J.B. and J.G. KOPACHENA. 1994. White-throated Sparrow (*Zonotrichia albicollis*). *In* The Birds of North America, No. 128 (A. Poole and F. Gill, Eds.). The Birds of North America, Inc. Philadelphia, PA.

GARDALI, T. and G. BALLARD. 2000. Warbling Vireo (*Vireo gilvus*). *In* The Birds of North America, No. 551 (A. Poole and F. Gill, Eds.). The Birds of North America, Inc. Philadelphia, PA.

GEISSLER, P.H. and B.R. NOON. 1981. Estimates of avian population trends from the North American Breeding Bird Survey. Pages 42-51. I*n* Estimating numbers of terrestrial birds. (C. J. Ralph and J.M Scott, Eds.). Studies in Avian Biology No. 6.

GHALAMBOR, C.K. and T.E. MARTIN. 1999. Red-breasted Nuthatch (*Sitta canadensis*). *In* The Birds of North America, No. 459 (A. Poole and F. Gill, Eds.). The Birds of North America, Inc. Philadelphia, PA.

GILL, F.B., R.A. CANTERBURY and J.L. CONFER. 2001. Blue-winged Warbler (*Vermivora pinus*). *In* The Birds of North America, No. 716 (A. Poole and F. Gill, Eds.). The Birds of North America, Inc. Philadelphia, PA.

GOODRICH, L.J., S.C. CROCOLL and S.E. SENNER. 1996. Broad-winged Hawk (*Buteo platerypteris*). *In* The Birds of North America, No. 218 (A. Poole and F. Gill, Eds.). The Birds of North America, Inc. Philadelphia, PA.

GOWATY, P.A. AND J.H. PLISSNER. 1998. Eastern Bluebird (*Sialia sialis*). *In* The Birds of North America, No. 381 (A. Poole and F. Gill, Eds.). The Birds of North America, Inc. Philadelphia, PA.

GREENLAW, J.S. 1996. Eastern Towhee (*Pipilo erythropthalmus*). *In* The Birds of North America, No. 262 (A. Poole and F. Gill, Eds.). The Birds of North America, Inc. Philadelphia, PA.

GRUBB, T.C. Jr and V.V. PRAVOSUDOV. 1994. Tufted Titmouse (*Paus bicolor*). *In* The Birds of North America, No. 86 (A. Poole and F. Gill, Eds.). The Birds of North America, Inc. Philadelphia, PA.

GUZY, M.J. and G. RICHARDSON. 1999. Common Yellowthroat (*Geothlypis trichas*). *In* The Birds of North America, No. 448 (A. Poole and F. Gill, Eds.). The Birds of North America, Inc. Philadelphia, PA.

HAGGERTY, T.M. and E.S. MORTON. 1995. Carolina Wren (*Thryothorus ludovicianus*). *In* The Birds of North America, No. 188 (A. Poole and F. Gill, Eds.). The Birds of North America, Inc. Philadelphia, PA.

HALKIN, S.L. and S.U. LINVILLE. 1999. Northern Cardinal (*Cardinalis cardinalis*). *In* The Birds of North America, No. 440 (A. Poole and F. Gill, Eds.). The Birds of North America, Inc. Philadelphia, PA.

HALL G.A. 1994. Magnolia Warbler (*Dendroica magnolia*). *In* The Birds of North America, No. 136 (A. Poole and F. Gill, Eds.). The Birds of North America, Inc. Philadelphia, PA.

HAMIL, P.B. 2000. Cerulean Warbler (*Dendroica cerulea*). *In* The Birds of North America, No. 136 (A. Poole and F. Gill, Eds.). The Birds of North America, Inc. Philadelphia, PA.

HANNERS, L.A. and S.R. PATTON. 1998. Worm-eating Warbler (*Helmitheros vermivorus*). *In* The Birds of North America, No. 367 (A. Poole and F. Gill, Eds.). The Birds of North America, Inc. Philadelphia, PA.

HARLOW, W.M. and E.S HARRAR. 1969. Textbook of dendrology. McGraw-Hill, New York, NY.

HEJL, S.J., J.A. HOLMES and D.E. KROODSMA. 2002. Winter Wren (*Troglodytes troglodytes*). *In* The Birds of North America, No. 623 (A. Poole and F. Gill, Eds.). The Birds of North America, Inc. Philadelphia, PA.

HEJL, S.J., K.R. NEWLON, M.E. MCFADZEN, J.S. YOUNG AND C.K. GHALAMBOR. 2002. Brown Creeper (*Certhia familiaris*). *In* The Birds of North America, No. 669 (A. Poole and F. Gill, Eds.). The Birds of North America, Inc. Philadelphia, PA.

HOLMES, R.T. 1994. Black-throated Blue Warbler (*Dendroica caerulescens*). *In* The Birds of North

America, No. 87 (A. Poole and F. Gill, Eds.). The Birds of North America, Inc. Philadelphia, PA.

HOLMES, R.T., T.W. SHERRY and F.W. STURGES. 1986. Bird community dynamics in a temperate deciduous forest: long-term trends at Hubbard Brook. Ecological Monographs 56:201-220.

HOPP, S.L., A. KIRBY and C.A. BOONE. 1995. White-eyed Vireo (*Vireo griseus*). *In* The Birds of North America, No. 168 (A. Poole and F. Gill, Eds.). The Birds of North America, Inc. Philadelphia, PA.

HUGHES, J.M. 1999. Yellow-billed Cuckoo (*Coccyzus americanus*). *In* The Birds of North America, No. 418 (A. Poole and F. Gill, Eds.). The Birds of North America, Inc. Philadelphia, PA.

HUGHES, J.M. 2001. Black-billed Cuckoo (*Coccyzus erythropthalmus*). *In* The Birds of North America, No. 587 (A. Poole and F. Gill, Eds.). The Birds of North America, Inc. Philadelphia, PA.

HUNT, P.D. and D.J. FLASHPOLER. 1998. Yellow-rumped Warbler (*Dendroica coronata*). *In* The Birds of North America, No. 376 (A. Poole and F. Gill, Eds.). The Birds of North America, Inc. Philadelphia, PA.

INGOLD, J.L. and R. GALATI. 1997. Golden-crowned Kinglet (*Regulus satrapa*). *In* The Birds of North America, No. 99 (A. Poole and F. Gill, Eds.). The Birds of North America, Inc. Philadelphia, PA.

ILGEN, L.W., A.W. BENTON, K.C. STEVENS, Jr. and A.E. SHEARIN. 1966. Soil survey of Tolland County, Connecticut. U.S. Department of Agriculture, Soil Conservation Service Series 1961, No. 35.

IRVIN, D.S. 2000. What's going on in our state forests? Connecticut Woodlands 65:4-8.

JACKSON, J.A. and H. OUELETT. 2002. Downy Woodpecker (*Picoides pubescens*). *In* The Birds of North America, No. 613 (A. Poole and F. Gill, Eds.). The Birds of North America, Inc. Philadelphia, PA.

JACKSON, J.A., H. OUELETT and B.J.S. JACKSON. 2002. Hairy Woodpecker (*Picoides pubescens*). *In* The Birds of North America, No. 702 (A. Poole and F. Gill, Eds.). The Birds of North America, Inc. Philadelphia, PA.

JAMES, F.C., C.E. MCCOLLOCH, and D.A. WIEDENFELD. 1996. New approaches to the analysis of population trends in land birds. Ecology 77:13-27.

JAMES, R.D. 1998. Blue-headed Vireo (*Viireo solitarius*). *In* The Birds of North America, No. 379 (A. Poole and F. Gill, Eds.). The Birds of North America, Inc. Philadelphia, PA.

JOHNSON, L.S. 1998. House Wren (*Dendroica magnolia*). *In* The Birds of North America, No. 380 (A. Poole and F. Gill, Eds.). The Birds of North America, Inc. Philadelphia, PA.

JONES, P.W. and T.M. DONOVAN 1996. Hermit Thrush (*Catharus guttatus*). *In* The Birds of North America, No. 261 (A. Poole and F. Gill, Eds.). The Birds of North America, Inc. Philadelphia, PA.

KEPLER, C.B. and J.M. SCOTT. 1981. Reducing bird count variability by training observers. Pages 366-371. I*n* Estimating numbers of terrestrial birds. (C. J. Ralph and J.M Scott, Eds.). Studies in Avian Biology No. 6.

KNOX, A.G. and P.E. LOWTHER. 2000. Common Redpoll (*Carduelis flammea*). *In* The Birds of North America, No. 99 (A. Poole and F. Gill, Eds.). The Birds of North America, Inc. Philadelphia, PA.

KRICHER, J.C. 1995. Black-and-white Warbler (*Mniotilta varia*). *In* The Birds of North America, No. 158 (A. Poole and F. Gill, Eds.). The Birds of North America, Inc. Philadelphia, PA.

LINSLEY, J.H. 1843. A catalogue of the birds of Connecticut. American Journal of Science and Arts 44:249-274.

LOERY, G. 1994a. Black-capped Chickadee. Pages 240-241. *In* (L.R. Bevier, Ed.). The atlas of breeding birds of Connecticut. Connecticut Geological and Natural History Survey Bulletin 113.

LOERY, G. 1994b. Tufted Titmouse. Pages 242-243. *In* (L.R. Bevier, Ed.). The atlas of breeding birds of Connecticut. Connecticut Geological and Natural History Survey Bulletin 113.

LOWTHER, P.E. 1993. Brown-headed Cowbird (*Molothtrus ater*). *In* The Birds of North America, No. 47 (A. Poole and F. Gill, Eds.). The Birds of North America, Inc. Philadelphia, PA.

MACKENZIE, L. 1961. The birds of Guilford, Connecticut. Peabody Museum of Natural History, Yale University, New Haven, CT.

MANTER, J.A. 1975. Birds of Storrs, Connecticut and vicinity. Second edition. Natchaug Ornithological Society, Storrs, CT.

MARTI, C.D. 1997. Lifetime reproductive success in Barn Owls near the limits of the species' range. Auk 114: 581-592.

MCCARTY, J.P. 1996. Eastern Wood-pewee (*Contopus virens*). *In* The Birds of North America, No. 245 (A. Poole and F. Gill, Eds.). The Birds of North America, Inc. Philadelphia, PA.

MCDONALD, L. 1981. Summarizing remarks. Pages 388-389. I*n* Estimating numbers of terrestrial birds. (C. J. Ralph and J.M Scott, Eds.). Studies in Avian Biology No. 6.

MEROLA, P.R. 1991. Waterfowl population studies. Connecticut Department of Environmental

Protection, Wildlife Bureau, Federal Aid Project Report W-49-R-16.

MERRIAM, C.H. 1877. A review of the birds of Connecticut. Connecticut Academy of Science 4:1-150.

MIDDLETON, A.L.A. 1993. American Goldfinch (*Carduelis tristis*). *In* The Birds of North America, No. 80 (A. Poole and F. Gill, Eds.). The Birds of North America, Inc. Philadelphia, PA.

MIDDLETON, A.L.A. 1998. Chipping Sparrow (*Spizella passerina*). *In* The Birds of North America, No. 334 (A. Poole and F. Gill, Eds.). The Birds of North America, Inc. Philadelphia, PA.

MIRARCHI, R.E. and T.S. BASKETT. 1994. Mourning Dove (*Zenaida macroura*). *In* The Birds of North America, No. 117 (A. Poole and F. Gill, Eds.). The Birds of North America, Inc. Philadelphia, PA.

MOLDENHAUER, R.R. and D.J. REGELSKI. 1996. Northern Parula (*Parula americana*). *In* The Birds of North America, No. 215 (A. Poole and F. Gill, Eds.). The Birds of North America, Inc. Philadelphia, PA.

MOORE, W.S. 1995. Northern Flicker (*Colaptes auratus*). *In* The Birds of North America, No. 166 (A. Poole and F. Gill, Eds.). The Birds of North America, Inc. Philadelphia, PA.

MORSE, D.H. 1993. Black-throated Green Warbler (*Dendroica virens*). *In* The Birds of North America, No. 55 (A. Poole and F. Gill, Eds.). The Birds of North America, Inc. Philadelphia, PA.

MORSE, D.H. 1994. Blackburnian Warbler (*Dendroica fusca*). *In* The Birds of North America, No. 102 (A. Poole and F. Gill, Eds.). The Birds of North America, Inc. Philadelphia, PA.

MOSKOFF, W. 1995. Veery (*Catharus fuscecens*). *In* The Birds of North America, No. 142 (A. Poole and F. Gill, Eds.). The Birds of North America, Inc. Philadelphia, PA.

MOWBRAY, T.B. 1999. Scarlet Tanager (*Piranga olivacea*). *In* The Birds of North America, No. 22 (A. Poole and F. Gill, Eds.). The Birds of North America, Inc. Philadelphia, PA.

MURPHY, M.T. 1996. Eastern Kingbird (*Tyrannus tyrannus*). *In* The Birds of North America, No. 253 (A. Poole and F. Gill, Eds.). The Birds of North America, Inc. Philadelphia, PA.

NOLAN, V, Jr., E.D.KETTERSON and C.A. BUERKLE. 1999. Prairie Warbler (*Dendroica discolor*). *In* The Birds of North America, No. 455 (A. Poole and F. Gill, Eds.). The Birds of North America, Inc. Philadelphia, PA.

NOLAN, V, Jr., E.D.KETTERSON, D.A. CRISTOL, C.M. ROGERS, E.D. CLOTFELTER, R.C. TITUS, S.J. SCHOECH AND E. SNAJDR. 2002. Dark-eyed Junco (*Troglodytes troglodytes*). *In* The Birds of North America, No. 716 (A. Poole and F. Gill, Eds.). The Birds of North America, Inc. Philadelphia, PA.

PAYNE, R.B. 1992. Indigo Bunting (*Dendroica magnolia*). *In* The Birds of North America, No. 4 (A. Poole and F. Gill, Eds.). The Birds of North America, Inc. Philadelphia, PA.

PETERJOHN, B. G., J. R. SAUER, and W. A. LINK. 1997. The 1994 and 1995 summary of the North American Breeding Bird Survey. Bird Populations 3:48-66.

PETIT, K.E. 1994. Black-throated Blue Warbler. Pages 310-311. *In* (L.R. Bevier, Ed.). The atlas of breeding birds of Connecticut. Connecticut Geological and Natural History Survey Bulletin 113.

PRAVOSUDOV, V.V. and GRUBB, T.C. Jr. 1993. White-breasted Nuthatch (*Sitta carolinensis*). *In* The Birds of North America, No. 54 (A. Poole and F. Gill, Eds.). The Birds of North America, Inc. Philadelphia, PA.

PRESTON, C.R. and R.D. BEANE. 1993. Red-tailed Hawk (*Buteo jamaicensis*). *In* The Birds of North America, No. 52 (A. Poole and F. Gill, Eds.). The Birds of North America, Inc. Philadelphia, PA.

PROCTOR, N.S. 1994. Hermit Thrush. Pages 268-269. *In* (L.R. Bevier, Ed.). The atlas of breeding birds of Connecticut. Connecticut Geological and Natural History Survey Bulletin 113.

PULLIAM, H.R. 1988. Sources, sinks, and population regulation. American Naturalist 132:652-661.

REYNOLDS, R.T., J.M. SCOTT and R.A. NUSSBAUM. 1980. A variable circular plot method for estimating bird numbers. Condor 82:309-313.

RICHARDSON, M. and D.W. BRAUNING. 1995. Chestnut-sided Warbler (*Dendroica pensylvanica*). *In* The Birds of North America, No. 190 (A. Poole and F. Gill, Eds.). The Birds of North America, Inc. Philadelphia, PA.

RISING, J.D. and N.J. FLOOD. 1998. Baltimore Oriole (*Icterus galbula*). *In* The Birds of North America, No. 384 (A. Poole and F. Gill, Eds.). The Birds of North America, Inc. Philadelphia, PA.

ROBERTS, A. 1981. Soil survey of Windham County, Connecticut. U.S. Department of Agriculture, Soil Conservation Service.

ROBINSON, T.R., R.R. SARGENT and M.B. SARGENT. 1996. Ruby-throated Hummingbird (*Archilochus colubris*). *In* The Birds of North America, No. 204 (A. Poole and F. Gill, Eds.). The Birds of North America, Inc. Philadelphia, PA.

ROBINSON, W.D. 1995. Louisians Waterthrush (*Seiurus motacilla*). *In* The Birds of North America, No. 151 (A. Poole and F. Gill, Eds.). The Birds of North America, Inc. Philadelphia, PA.

RODEWALD, P.G., J.H. WITHGOTT and K.G. SMITH. 1999. Pine Warbler (*Dendroica pinus*). *In* The Birds of North America, No. 438 (A. Poole and F. Gill, Eds.). The Birds of North America, Inc. Philadelphia, PA.

RODEWALD, P.G. and R.D. JAMES. 1996. Yellow-throated Vireo (*Vireo flavifrons*). *In* The Birds of North America, No. 247 (A. Poole and F. Gill, Eds.). The Birds of North America, Inc. Philadelphia, PA.

ROSENBERG, K.V., R.W. ROHRBAUGH, Jr., S.E. BARKER, R.S. HAMES, J.D. LOWE, and A.A. DHONT. 1999. A land manager's guide to improving habitat for Scarlet Tanagers and other forest-interior birds. The Cornell Lab of Ornithology, Ithaca, NY.

ROSENZWEIG, M.L. 1995. Species diversity in space and time. Cambridge, New York, NY.

ROSENFIELD, R.N. and J. BIELDEFELDT. 1993. Cooper's Hawk (*Accipiter cooperii*). *In* The Birds of North America, No. 75 (A. Poole and F. Gill, Eds.). The Birds of North America, Inc. Philadelphia, PA.

ROTH, RR., M.S. JOHNSON and T.J. UNDERWOOD. 1996. Wood Thrush (*Hylocichla mustilena*). *In* The Birds of North America, No. 246 (A. Poole and F. Gill, Eds.). The Birds of North America, Inc. Philadelphia, PA.

RUSCH, D.H., S.DESTEFANO, M.C. REYNOLDS AND D. LAUTEN. 2000. Ruffed Grouse (*Bonasa umbellus*). *In* The Birds of North America, No. 515 (A. Poole and F. Gill, Eds.). The Birds of North America, Inc. Philadelphia, PA.

SAGE, J.H., L.B. BISHOP, and W.P. BLISS. 1913. The birds of Connecticut. Conn. Geol. Nat. Hist. Surv. Bull. 20.

SALLABANKS, R. and F.C. JAMES. 1999. American Robin (*Turdus migratorius*). *In* The Birds of North America, No. 462 (A. Poole and F. Gill, Eds.). The Birds of North America, Inc. Philadelphia, PA.

SAUER, J. R., J. E. HINES, I. THOMAS, J. FALLON and G. GOUGH. 2000. The North American Breeding Bird Survey, Results and Analysis 1966-1999. Version 98.1, USGS Patuxent Wildlife Research Center, Laurel, MD.

SCOTT, J.M., S. MOUNTAINSPRING, F.L. RAMSEY and C.B. KEPLER. 1986. Forest bird communities of the Hawaiian Islands: their dynamics, ecology and conservation. Studies in Avian Biology No. 9.

SCOTT, J.M., F.L. RAMSEY and C.B. KEPLER. 1981. Distance estimation as a variable in estimating bird numbers. Pages 334-340. I*n* Estimating numbers of terrestrial birds. (C. J. Ralph and J.M Scott, Eds.). Studies in Avian Biology No. 6.

SHACKELFORD, C.E., R.E. BROWN and R.N. CONNER. 2000. Red-bellied Woodpecker (*Melanerpes carolinus*). *In* The Birds of North America, No. 136 (A. Poole and F. Gill, Eds.). The Birds of North America, Inc. Philadelphia, PA.

SHERRY, T.W. and R.T. HOLMES. 1997. American Redstart (*Setophaga ruticilla*). *In* The Birds of North America, No. 277 (A. Poole and F. Gill, Eds.). The Birds of North America, Inc. Philadelphia, PA.

SMITH, D.G. and A. DEVINE 1994a. Sharp-shinned Hawk. Pages 94-95. *In* (L.R. Bevier, Ed.). The atlas of breeding birds of Connecticut. Connecticut Geological and Natural History Survey Bulletin 113.

SMITH, D.G. and A. DEVINE 1994b. Cooper's Hawk. Pages 96-97. *In* (L.R. Bevier, Ed.). The atlas of breeding birds of Connecticut. Connecticut Geological and Natural History Survey Bulletin 113.

SMITH, D.G. and A. DEVINE 1994c. House Wren. Pages 252-253. *In* (L.R. Bevier, Ed.). The atlas of breeding birds of Connecticut. Connecticut Geological and Natural History Survey Bulletin 113.

SMITH, S.M. 1993. Black-capped Chickadee (*Parus atricapillus*). *In* The Birds of North America, No. 39 (A. Poole and F. Gill, Eds.). The Birds of North America, Inc. Philadelphia, PA.

SQUIRES, J.R. and R.T. REYNOLDS. 1997. Northern Goshawk (*Accipiter gentilis*). *In* The Birds of North America, No. 298 (A. Poole and F. Gill, Eds.). The Birds of North America, Inc. Philadelphia, PA.

TARVIN, K.A. and G.E. WOOLFENDEN. 1999. Blue Jay (*Cyanocitta cristata*). *In* The Birds of North America, No. 469 (A. Poole and F. Gill, Eds.). The Birds of North America, Inc. Philadelphia, PA.

THOMAS, L. 1996. Monitoring long-term population changes: why are there so many analysis methods? Ecology 77:49-58.

THOMAS, L., J.L. LAAKE, , J.F. DERRY, S.T. BUCKLAND, D.L. BORCHERS, D.R. ANDERSON, K.P BURNHAM, S. STRINDBURG, S.L. HEDLEY, F.F.C. MARQUS, J.H. POLLARD and R.M. FEWSTER. 1998. Distance 3.5. Research Unit for Wildlife Population Assessment, University of St. Andrews, St. Andrews, UK.

THOMPSON, C.F., and V. NOLAN Jr. 1973. Population biology of the Yellow-breasted Chat in southern Indiana. Ecological Monographs 43:145-171.

U.S. FOREST SERVICE. 2002. Hemlock wooly adelgid. U.S. Forest Service Web Site, www.fs.fed.us/na/morgantown/fhp/hwa/hwasite.html.

VAN HORNE, M.A. and T. DONOVAN. 1994. Ovenbird (*Seiurus aurocapillus*). *In* The Birds of North America, No. 88 (A. Poole and F. Gill, Eds.). The Birds of North America, Inc. Philadelphia, PA.

VERBEEK, N.A.M. and C. CAFFEY. 2002. American Crow (*Corvus brachyrhynchos*). *In* The Birds of North America, No. 647 (A. Poole and F. Gill, Eds.). The Birds of North America, Inc. Philadelphia, PA.

WALTERS, E.L., E.H. MILLER and P.E. LOWTHER. 2002. Yellow-bellied Sapsucker (*Sphyrapicus varius*). *In* The Birds of North America, No. 662 (A. Poole and F. Gill, Eds.). The Birds of North America, Inc. Philadelphia, PA.

WEEKS, H.P. Jr. 1994. Eastern Phoebe (*Sayornis phoebe*). *In* The Birds of North America, No. 94 (A. Poole and F. Gill, Eds.). The Birds of North America, Inc. Philadelphia, PA.

WHITEHEAD, D.R. and T. TAYLOR. 2002. Acadian Flycatcher (*Empidonax virescens*). *In* The Birds of North America, No. 614 (A. Poole and F. Gill, Eds.). The Birds of North America, Inc. Philadelphia, PA.

WIENS, J.A. 1989. The ecology of bird communities. Cambridge, New York, NY.

WILLIAMS, J.M. 1996. Nashville Warbler (*Vermivora ruficapilla*). *In* The Birds of North America, No. 205 (A. Poole and F. Gill, Eds.). The Birds of North America, Inc. Philadelphia, PA.

WITMER, M.C., D.J. MOUNTJOY AND L. ELLIOT. 1997. Cedar Waxwing (*Bombycilla cedrorum*). *In* The Birds of North America, No. 309 (A. Poole and F. Gill, Eds.). The Birds of North America, Inc. Philadelphia, PA.

WOOTTON, J.T. 1996. Putple Finch (*Carpodacus purpureus*). *In* The Birds of North America, No. 208 (A. Poole and F. Gill, Eds.). The Birds of North America, Inc. Philadelphia, PA.

WYATT, V.E. and C.M. FRANCIS. 2002. Rose breasted Grosbeak (*Pheucticus ludovicianus*). *In* The Birds of North America, No. 692 (A. Poole and F. Gill, Eds.). The Birds of North America, Inc. Philadelphia, PA.

ZERANSKI, J.D. and T.R. BAPTIST. 1990. Connecticut Birds. University Press of New England, Hanover, NH.

ZERANSKI, J.D. and F.R. PURNELL, Jr. 2001. The 2001 Connecticut summer bird count. Connecticut Warbler 21:155-172.

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