

# Habitat disturbance and the decline of dominant avian species in pine barrens of the northeastern United States

“. . . disturbances may cause less desirable species to become even more abundant . . .”

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EXTENSIVE TRACTS of relatively undisturbed pine barrens exist near some of the major metropolitan areas of the northeastern United States. In addition to their gaunt beauty, barrens are ecologically special and important. An entire biological community has adapted to the frequent habitat changes wrought by fire, and beneath the barrens lie significant untapped water resources. In the past few decades barrens have been reduced in size, subjected to fire suppression and dissected by roads and developments. With these habitat alterations have come changes in flora and fauna. Interest in these ecologically distinct areas by conservation organizations has spurred both state and federal agencies to implement conservation measures. The result has been the preservation of small tracts, but whether these are satisfactory for the maintenance of characteristic pine barrens species in abundances that will insure their continued existence is yet to be determined. Before preservation and management plans can be implemented, the existing biota and the factors controlling abundances of species must be known. For pine barrens these data are scarce.

The impact of disturbances on breeding avifaunas of two New York pine barrens was examined by comparison with the relatively undisturbed pine barrens of New Jersey. Relative abundance patterns and densities of the five most abundant species were compared. To insure comparability between sites, similar censusing methods were used and a literature search was undertaken to determine the comparability of species considered here and their past status at each

of the locations. Vegetation was measured at each site to insure that comparisons were of sites similar in habitat structure and floristics.

## STUDY AREA AND METHODS

THE THREE PINE barrens included in this study were in central New Jersey, eastern Long Island and Albany, New York. Size, location and number of transects censused at each barren are given in Table 1. The New Jersey pine barren is the most extensive and undisturbed barren in the northeastern United States. Although subjected to some development, vast areas are free from human disturbance. Large tracts burn each year as a result of both natural and prescribed burns. Vegetation is dominated by canopy (>10 cm diameter breast height) Pitch Pines (*Pinus rigida*), and scrub oaks (<3 m) (*Quercus ilicifolia* and *Q. marilandica*). The Long Island barrens are dominated by the same plant species but are much more dissected by roads and developments and burns are more infrequent. These barrens have been reduced by more than 50% from their original size. Large tracts of undissected forest are scarce, but a few still remain. Where fire has been suppressed, forests are dominated by canopy oaks (*Q. coccinea* and *Q. alba*). Because of disturbed conditions, finding homogeneous tracts large enough to census birds was difficult.

The Albany "Pine Bush" is significantly smaller and more disturbed than either the barrens of Long Island or New Jersey. Albany's "Pine Bush" has been reduced from 64 km<sup>2</sup> to scattered patch-

es, with few exceeding 300 ha. It was often difficult to conduct censuses without crossing ecotones or roads. The landfill of the city of Albany, housing and industrial developments, road construction and fire suppression have all contributed to habitat deterioration. The dominant vegetation is Pitch Pine and scrub oak, but many sites are being overgrown by Quaking Aspen (*Populus tremuloides*), White Pine (*P. strobus*) and Black Locust (*Robinia pseudoacacia*). The Black Locust and aspen are generally found in disturbed habitats, while the White Pine is more a climax canopy species.

Emlen transects (Emlen 1971) were used to assess absolute and relative densities of breeding birds. Each 400m x 200m (8 ha) transect was walked twice between 0600-0900 hrs during the periods May 26-June 15, 1978 and May 20-June 9, 1979. Where possible, transects representing all seral stages were censused including recent burns (within three years), pine plains (low pines and oaks without a canopy), and pine forest of various ages and oak forest. On each transect basal area of canopy trees was measured using 9 point-quarters (Cottam and Curtis 1956). When canopy was absent, density and height of shrubs were used as determining criteria for seral stage.

## RESULTS AND DISCUSSION

RELATIVE ABUNDANCE patterns of the five most abundant avian species were similar at Long Island and New Jersey sites, but differed slightly at Albany (Fig. 1). Rufous-sided Towhee



**Figure 1.** Relative abundances of the five most numerous pine barren avian species including Rufous-sided Towhee (TOW), Common Yellowthroat (YTH), Field Sparrow (FSP), Prairie Warbler (PRW), Brown-headed Cowbird (COW), Blue Jay (*Cyanocitta cristata*) (BLJ), Ovenbird (OVN), Pine Warbler (PIN) and Brown Thrasher (BTH).

(see Table 2 for binomials) was the most abundant species at these three sites, accounting for one-third of all individuals at Long Island and New Jersey and only one-fifth of the individuals at Albany. A lower abundance trend was also noted for the five most abundant species. The total proportion of the five most abundant species was 69.8% at New Jersey, 76.8% at Long Island and 58.9% at Albany. High relative abundance values of one or a few species usually indicates a harsh environment or one with low structural heterogeneity (Whittaker 1965). High relative abundance values

for the single most abundant species in bird communities (>30%) have been found on mountain tops and clearcut areas (Noon *et al.*, 1979), and for plant communities in pine barrens (Whittaker 1965). Lower values (<25%) have been found in northern temperate forest bird communities (Noon *et al.*, 1979) indicating less harsh environments. Clearly, pine barrens are harsh environments with fewer bird species than most northern temperate forests and are dominated by few species. The lower abundance trend for these species at Albany represents habitat changes which

have created a more structurally diverse or less harsh environment, allowing more species to be present with a subsequent decline in relative abundance of the most important species.

Comparing the relative abundance patterns of the five most abundant species in New Jersey with the abundance of these same species at Long Island and Albany, it is clear that differences exist (Table 2A). These species are the most characteristic of all New Jersey pine barren habitats (Leck 1979). Albany sites diverged more from the expected distribution than did those on Long Island, as was evident from the  $\chi^2$  values. The Ovenbird and Pine Warbler contributed most to these differences, while Prairie Warbler, Rufous-sided Towhee and Brown Thrasher contributed to a lesser extent. Ovenbird was found in lower numbers and on fewer transects (57.1% vs. 15.8% at Long Island and 13.3% at Albany) at both New York sites. Pine Warbler was also found on fewer transects (50.0% vs. 26.3%) and at a lower density on Long Island and was absent at Albany. While these species together accounted for 15.6% of all individuals in New Jersey, they accounted for only 3% on Long Island and less than 1% at Albany. Although Brown Thrasher and Prairie Warbler were found on far fewer transects at Albany than New Jersey (96.4% vs. 46.7% for Prairie Warbler, 71.4% vs. 33.3% for Brown Thrasher) the relative abundances did not show great differences. This means that these species were present in similar abundances to Long Island and New Jersey, but were restricted to fewer transects, probably owing to unsuitable habitat.

In many cases the absolute densities of these five species differed from New Jersey when comparable habitats were examined (Table 3). Rufous-sided Towhee and Prairie Warbler were both present in significantly lower densities in mature pine forests at both New York sites, but did not differ at any other successional stage (except that Long Island had higher densities of towhees in the pine plains habitats). The Brown Thrasher was significantly less dense in the pine plains of Long Island and a trend toward lower densities in the mature pine forest was found at both Long Island and Albany. Radical differences were found for Ovenbird and Pine Warbler. Ovenbirds were less dense in the pine forest stages at Long Island and Albany and Pine Warbler was pre-

**Table 1. Description of study areas.**

	<i>New Jersey</i>	<i>Long Island</i>	<i>Albany</i>
County	Burlington	Suffolk	Albany
Towns	Chatsworth	Brookhaven Westhampton Riverhead Rocky Point	Albany Guilderland Colonie
Lat -Long.	39°50' N, 74°30' W	40°51' N, 72°40' W	42°30' N, 73°52' W
Area (Hectares)	550,000	100,000	1200
Number of Transects	28	19	15

sent in significantly lower densities in all seral stages where it was found on Long Island. As stated earlier, the Pine Warbler was locally extirpated as a breeder at Albany. A trend toward lower densities was evident for the Ovenbird in the oak forests of Long Island. A comparable habitat to the New Jersey oak forest and pine plains does not exist at Albany, thus comparisons between these habitats at these sites was not possible. All sites where invasion by non-barrens plants had radically changed the structure of vegetation were eliminated from these comparisons. If they had been included, the differences would have been more pronounced.

Before it can be concluded that the populations of Prairie Warbler, Pine Warbler, Ovenbird and Brown Thrasher declined at Albany and Long Island, the histories of these species at these sites must be examined. At Albany, a quantitative study was conducted in 1951 (Treacy 1953) and during the 1960s and 1970s area birders kept records of breeding birds in the "Pine Bush" (Miller 1976). Treacy's site encompassed both pine barren habitat and some open field habitat, so it was not strictly comparable to the present study. The 1951 study indicated that the Pine Warbler and Eastern Bluebird (*Sialia sialis*) were common species breeding at densities of 0.25/ha. In 1954, at least a dozen pairs of Pine Warbler were located in the Albany barrens (Bull 1974). This is equivalent to the densities of Pine Warbler found in New Jersey and Long Island. Lists from Albany during the 1960s and 1970s also include these species. There is no evidence that either of these species breeds there today. The Prairie Warbler and Ovenbird were also listed as common species by both of these sources and the Brown Thrasher was found breeding at densities com-

parable to those at Long Island and New Jersey (0.343/ha), but greater than population levels today. These comparisons with past breeding bird data indicate that three species have declined in density and range at Albany, while two have become locally extirpated as breeders.

ON LONG ISLAND, historical data are meager. Raynor (1976) found that the Brown Thrasher and Rufous-sided Towhee had declined during a 10-year study, while Mockingbird (*Mimus polyglottos*) increased in the same habitats. He suggested that Mockingbird aggressively outcompetes Brown Thrasher. The findings of the present

study support Raynor's findings for Brown Thrasher, but not for Rufous-sided Towhee. Because historical data were so scarce, undisturbed sites near Brookhaven (Raynor *et al.*, 1977) were compared with the disturbed sites censused in this study. The comparisons showed that Brown Thrasher, Ovenbird, and Pine Warbler were present at lower densities on the latter sites. These species were also absent from many transects where habitat seemed suitable. A downward trend of Pine and Prairie Warbler is supported by Salzman's (1977) contention that these species disappear quickly where development occurs. Bull (1974) also states that these species have disappeared from habitats once occupied on western Long Island, but that they are still common on eastern Long Island.

As characteristic pine barren species decline in relative and absolute abundances at Albany and to a lesser extent on Long Island, a number of other species have taken their places.

These species have been classified as edge or ecotone species (Gates and Gysel 1978) (Table 2B), and are present in higher densities at New York sites than in New Jersey. Most of these species were found in the New Jersey barrens, but were restricted to early successional habitats and roadsides. Reductions in

**Table 2A.** Relative abundance (Percent) and rank (Rank) of five characteristic pine barrens bird species.  $\chi^2$  values are for comparisons of abundance distributions of Long Island and Albany with New Jersey.

<i>Species</i>	<i>New Jersey</i>		<i>Long Island</i>		<i>Albany</i>	
	<i>Percent</i>	<i>Rank</i>	<i>Percent</i>	<i>Rank</i>	<i>Percent</i>	<i>Rank</i>
Rufous-sided Towhee <i>Pipilo erythrophthalmus</i>	32.4	1	33.8	1	20.5	1
Prairie Warbler <i>Dendroica discolor</i>	16.0	2	17.2	2	10.6	4
Ovenbird <i>Seiurus aurocapillus</i>	8.3	3	1.8	11	0.6	24
Pine Warbler <i>D. pinus</i>	7.6	4	1.4	12	0.0	—
Brown Thrasher <i>Toxostoma rufum</i>	5.5	5	4.0	6	2.3	12
TOTAL	69.8	15	58.2	32	34.0	41 +
			$\chi^2 = 10.74$		$\chi^2 = 23.70$	
			$p < .05$		$p < .001$	

Chi square ( $\chi^2$ ) is a statistic used to test whether one distribution differs significantly from another distribution. If two distributions were identical,  $\chi^2$  would = 0. The value of p indicates the probability of obtaining the particular  $\chi^2$  value even though the distributions are in fact not significantly different. Thus, the lower the value of p, the more confidence we place on the results. A p less than or equal to 0.05 is satisfactory for most uses.

**Table 2B.** Relative abundance and rank of species which became more abundant in the disturbed habitats as characteristic pine barren species declined. The \* indicates Carolina Wren (*Thryothorus ludovicianus*) was present at New Jersey instead of the House Wren.

Species	New Jersey		Long Island		Albany	
	Percent	Rank	Percent	Rank	Percent	Rank
Brown-headed Cowbird <i>Molothrus ater</i>	1.4	13	2.6	8	5.4	5
Common Yellowthroat <i>Geothlypis trichas</i>	5.1	6	16.2	3	11.4	2
Field Sparrow <i>Spizella pusilla</i>	1.5	12	4.9	4	11.0	3
House Wren* <i>Troglodytes aedon</i>	1.1	15	0.6	18	3.1	8
Gray Catbird <i>Dumetella carolinensis</i>	0.8	16	1.2	13	3.0	9
Northern Oriole <i>Icterus galbula</i>	0.0	—	1.9	10	1.0	18
Indigo Bunting <i>Passerina cyanea</i>	0.0	—	0.0	—	3.4	7
Song Sparrow <i>Melospiza melodia</i>	0.0	—	0.0	—	2.0	14
Chestnut-sided Warbler <i>D. pensylvanica</i>	0.0	—	0.0	—	2.7	11
American Robin <i>Turdus migratorius</i>	0.0	—	0.0	—	1.5	16

habitat size and dissections by roads and developments have created extensive edge effects in New York barrens with subsequent increase of edge plant and bird species. A similar effect has been observed under power-line rights-of-way (Anderson 1979).

The Brown-headed Cowbird showed the largest increase of any edge species (Table 2B) and was seen on over twice as many transects at Albany and 10% more transects on Long Island than in New Jersey. The Prairie Warbler, Pine Warbler, Ovenbird, Brown Thrasher

and Rufous-sided Towhee have all been shown to act as hosts to the parasitic Brown-headed Cowbird (Bull 1974) in New York. At Albany and Long Island where this parasite was abundant, nest parasitism could have been a significant factor in reducing populations of breeding birds similar to the declines of Kirtland's Warbler (*D. kirtlandii*) in Michigan (Mayfield 1977). Owing to the taxonomic and ecological similarities of the *Dendroica* warblers found in eastern pine barrens to Kirtland's Warbler, these species may be particularly susceptible to nest parasitism. Significant increases in nest parasitism by this species have been noted in ecotonal situations in Michigan (Gates and Gysel 1978). Documenting predation at New York sites was not possible, but at Albany the chipmunk (*Tamias striatus*) and housecat (*Felis domesticus*), both known to predate on nestlings (Gates and Gysel 1978), were extremely abundant and thus the potential for predation was increased over New Jersey sites.

**A** FACTOR THAT was not considered here but must be considered when habitat management is discussed, is the critical size of habitats (Terborgh 1975). The continued welfare of many birds found in pine barrens has been found to be dependent on large contiguous tracts of habitat for successful breeding. Forman *et al.* (1976) showed that there is a minimum critical size which habitat islands must exceed before they are used

**Table 3. Densities of the five most characteristic pine barrens birds (pairs/hectare). Vegetation—Successional Stage**

	Pine Plains		Early Pine Forest			Mature Pine Forest			Oak Forest	
	NJ	LI	NJ	LI	ALB	NJ	LI	ALB	NJ	LI
Rufous-sided Towhee	1.059 p<.05	1.989	1.397	1.310	1.198	1.746	1.594	1.044 p=.02	.801	1 237
Prairie Warbler	1.344	1.792	.762	1.084	.647	.594	.434	.000 p=<.02	.070	000
Ovenbird	---	---	.222	.000 p=.014	.000 p=.014	.458	.081 p<.02	.182 t	.809	517 t
Pine Warbler	---	---	.247	.053 p=.029	.000 p=.005	.628	.110 p<.002	.000 p<.02	.204	000 t
Brown Thrasher	.513	.104 p=.018	.192	.227	.118 t	.246	.163 t	.098 t	.000	080

Comparisons of absolute densities of five characteristic pine barrens birds from New Jersey (NJ), Long Island (LI) and Albany (ALB). Four seral stages were compared and were grouped on the basis of basal area of canopy Pitch Pines and oaks; pine plains lacked a canopy, early pine forest (<10 m<sup>2</sup>/ha), late pine forest (>10 m<sup>2</sup>/ha) and oak forest (>15 m<sup>2</sup>/ha of oaks). A Mann-Whitney U-test was used to test for differences between the sites. t indicates that no significant difference was found, but that a trend may be present.

for breeding by Ovenbird and Brown Thrasher. The evidence presented here supports these findings and suggests inclusion of the Pine Warbler and Prairie Warbler to the list of habitat size-dependent species. Further investigation of habitat size requirements of pine barren birds is necessary before management and preservation plans can be implemented.

## SUMMARY

**H**ABITAT ALTERATIONS such as size reduction, dissection and fire suppression have resulted in large scale changes in the structure of pine barren avian communities. Disturbances have left small tracts of barrens bounded by habitats unsuitable or less suitable as breeding areas of characteristic pine barren birds. Reduced abundance and absolute densities of Prairie Warbler, Brown Thrasher, Ovenbird and Pine Warbler have occurred in some habitats at Albany and Long Island. The Pine Warbler and Eastern Bluebird no longer breed at Albany. Gray Catbird, American Robin, Northern Oriole, Brown-headed Cowbird, Indigo Bunting and Field Sparrow have become more numerous in these ecotone or edge habi-

tats. Nest parasitism by the Brown-headed Cowbird and predation by other animals may be high on these disturbed sites. Further disturbances at Albany and Long Island may cause less desirable species to become even more abundant, while characteristic pine barren species may further decline or disappear.

## LITERATURE CITED

- ANDERSON, S.H. 1979. Changes in forest bird species composition caused by transmission-line corridor cuts. *Am. Birds*. 33:3-6.
- BULL, J. 1974. Birds of New York State Doubleday/Natural History Press, Garden City, N.Y.
- COTTOM, G. and J.T. CURTIS. 1956. The use of distance measures in phytosociological sampling. *Ecology* 37:451-460.
- EMLEN, J.T. 1971. Population densities of birds derived from transect counts. *Auk* 88:323-342.
- FORMAN, R.T.T., A.E. GALLI and C.F. LECK. 1976. Forest size and avian density diversity in New Jersey woodlots with some land use implications. *Oecologia* 26:1-8.
- MAYFIELD, H. 1977. Brown-headed Cowbird: agent of extermination? *Am. Birds* 31:107-113.
- MILLER, R. 1976. Mammals and birds of Albany's pine bush. In D. Rittner, ed. Pine bush: Albany's last frontier. Pine Bush Historic Preservation Project, Albany, N.Y. pp. 171-188.
- NOON, B.R., V.P. BINGMAN and J.P. NOON. 1979. The effects of changes in habitat on northern hardwood forest bird communities. Proc. of Workshop: Non-game Birds. Minnesota. USDA Forest Service Technical Report NC-51. pp 33-48.
- RAYNOR, G.S. 1976. Decrease in breeding Brown Thrashers and Rufous-sided Towhees on central Long Island. *Kingbird* 26:190-193.
- \_\_\_\_\_. J.J. RUSCICA, J.H. CLINTON AND D.L. LARSEN. 1977. The 1977 breeding bird censuses and vegetation surveys in two successional stages of oak-pine forest. Brookhaven Nat'l Laboratories Upton, N.Y.
- SALZMAN, E. 1977. Some notes on breeding birds in the eastern Long Island pine barrens. *Linnaean News-Letter* 31 (4)
- TERBORGH, J. 1975. Faunal equilibrium and the design of wildlife preserves, In F.B. Golley & E. Medina, eds. Tropical ecological systems. Springer-Verlag. pp 369-379.
- TREACY, E.D. 1953. Birds of Albany County, N.Y. pine-oak barrens. *Kingbird* 3:84-86.
- WHITTAKER, R.H. 1965. Dominance and diversity in land plant communities *Science* 147:250-260.

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