

REVERSAL OF LIFE ZONES IN THE HUDSON HIGHLANDS, WITH REFERENCE TO THE AVIFAUNA

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The New York City Area, as delineated by Bull (1964), encompasses a rich avifauna due to its diversity of habitats. Adding significantly to this abundance is the Hudson Highlands and its southern extension, the Ramapo Mountains. These are a series of rugged, rolling hills and ridges rising from near sea level to approximately 430 m elevation, enough to increase precipitation and locally modify climate. Southeastern New York and northern New Jersey have been problematical for biogeographers, because the fauna and flora of this region do not precisely fit into a regional categorization. Rather, they are a mixture of species from the north, south, and west together with typical eastern species.

The life zone concept was proposed by Merriam (1898), who hypothesized that the distribution of biota could be organized into zones based on temperature, especially minimum temperatures. He coined the now familiar terms Hudsonian, Canadian, Transition, and Upper Austral for life zones. Eaton (1906) criticized Merriam's work, suggesting that bird distributions are better described by vegetation type than by zones based on temperature. Dice (1922) felt that the best way to characterize faunal or biotic areas is by noting the dominance of particular habitats. Dice later (1943) chose the term *biotic province*, defined as a continuous unit reflecting climate, physiography, and soil type similarities, but most importantly, a center of biotic differentiation. He placed the Hudson Highlands in the Carolinian province (equivalent to the Upper Austral Life Zone) and delineated the Canadian province a short distance to the northwest (Catskills-Pocono plateau areas). Fables (1955) regarded assignment of all of New Jersey to the Carolinian province as an oversimplification of a complicated area which contains three life zones. Studies by Robichaud and Buell (1973) suggest that climax vegetation for all of northern New Jersey is Beech-Sugar Maple forest (northern hardwoods), perhaps indicating that a more appropriate status of the area northward from the fall line (the geological boundary between the Piedmont and the Coastal Plain) would be Canadian. It is interesting that Nichols (1935) suggested that Eastern Hemlock forms a northern extension of the deciduous forest formation and may be an ecological unit distinct from the northern coniferous forests. Charney (1980) noted the expansion of hemlocks into deciduous forest in the Hudson Highlands.

The most accurate map of "life zones" in the New York City Area may be the work of Pitelka (1941), who related avian distributional data to major biotic communities. He stressed the importance of avian ecological niche requirements, and noted that there was a consistent correlation of birds with life form of plants rather than with specific dominants. Pitelka somewhat diplomatically placed the Hudson Highlands in the Deciduous Forest, and outlined a Coniferous-Deciduous Forest Ecotone and Oak-Pine Ecotone lying short distances to the north and south, respectively. The Hudson Highlands clearly contains many elements from both, so in effect, he may have delineated an ecotone between two ecotones. Shelford (1945) placed the New York Area in the "Oak-Wild Turkey" Biome.

In a typical life zone, the vegetation and fauna become more boreal with increasing elevation. However, in the Hudson Highlands the reverse occurs, with northern and southern elements juxtaposed. In great part this probably is not due to juxtaposition of northern and southern forest stands by shifting post-glacial climates (Braun 1938), but rather to various edaphic and topographic factors. Ridge tops and upper slopes in the area have a thin layer of topsoil, and rainfall tends to run off the steep slopes rather than infiltrate. Furthermore, intense sun and wind exposure serve to magnify this xeric condition. Thus, the relatively sterile soils of high elevations are dominated by the more drought adapted plants such as Chestnut Oak (*Quercus prinus*), Pitch Pine (*Pinus rigida*), and Scarlet Oak (*Quercus coccinea*). Sometimes admixtures of Pignut Hickory (*Carya glabra*) or Eastern Red Cedar (*Juniperus virginiana*) occur. Shrubs such as lowbush blueberry (*Vaccinium* spp.) and Scrub Oak (*Quercus ilicifolia*) frequently occur in the under story or in openings. Good examples of this more southern community can be found at the summits of Bear Mountain, Ramapo Torne Mountain, and Storm King Mountain, where Rufous-sided Towhee, Ovenbird, and Red-eyed Vireo are common. Frequently observed also are Great Crested Flycatcher, Northern Flicker, and, in burned areas, Eastern Bluebird.

A different plant community, descending 100-200 meters into the valleys, coves, and ravines, thrives in areas of deeper, richer, more mesic soils. Here are found the northern hardwoods — Sugar Maple (*Acer saccharum*), American Beech (*Fagus grandifolia*), and Yellow Birch (*Betula alleghaniensis*), along with Red Oak (*Quercus rubra*), White Ash (*Fraxinus americana*) and a host of other tree species. Hemlock (*Tsuga canadensis*) and White Pine (*Pinus strobus*) frequently occur as co-dominants. Birds with northern affinities,

such as Blackburnian Warbler, Solitary Vireo, and Canada Warbler, often breed in this boreal-like community. Northern Goshawk has nested since at least 1964 (Speiser and Bosakowski 1984), preferring secluded, mature or old growth tracts of mixed forest. Some other northern species typically found here include Veery, Brown Creeper, and Winter Wren. Black-throated Blue Warbler and Dark-eyed Junco are somewhat scarce but regular breeders, and White-throated Sparrow may nest (Speiser 1981). Plantations of Norway Spruce (*Picea abies*), European Larch (*Larix decidua*), and Red Pine (*Pinus resinosa*) have been important in attracting numbers of breeding Red-breasted Nuthatch and Golden-crowned Kinglet (Kane *et al.* 1974; Speiser *op. cit.*).

Biogeographers have been somewhat confused by the area of southeast New York and northern New Jersey and, perhaps, so are some birds. Populations of northern and southern birds are not strictly segregated. For instance, Hermit Thrush is sometimes found on ridge tops where Mountain Laurel (*Kalmia latifolia*) and lowbush blueberry form a substantial understorey. Acadian Flycatcher, a poorly named southern species, favors nesting along streamsides shaded by beech and hemlocks. Black-throated Blue Warbler and Hooded Warbler, northern and southern species respectively, sometimes sing and nest on the same hillside draped with Great Rhododendron (*Rhododendron maximum*) and Mountain Laurel under an open forest canopy. A vivid example was during June 1979, when Speiser observed singing Yellow-rumped, Blackburnian, Prairie, and Yellow-throated Warblers in the same area of the southwest corner of Sterling Lake in Orange County. We also have noted Acadian Flycatchers singing in an active Northern Goshawk nest tree, Red-bellied Woodpecker in the same forest with Brown Creeper, and White-eyed Vireo singing within earshot of Solitary Vireo.

Deed (1976) suggested the importance of the lower Hudson Valley as a route for the northward spread of southern species such as the Carolina Wren and Northern Cardinal. Origins of northern bird species in the Hudson Highlands are more obscure, with northwestern Connecticut and northeastern Pennsylvania perhaps serving as significant sources. All this adds up a great diversity of bird species just a short drive from downtown Manhattan.

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