NEW YORK BIOGEOGRAPHY AND BIRD DISTRIBUTION

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New York State has few (if any) sharply delineated biological communities. Although the traveler who moves from Lake Erie to the Hudson River, or from Pennsylvania to Canada, notices changes in the landscape and in land use, the natural communities of living organisms do not fall into sharp clear patterns of distribution. It might be said that the entire State is one natural community with minor variations due to local climatic, physiographic, and geologic conditions. No part of New York is completely "natural" as this huge biotic community is masked and modified by various types and intensities of agriculture and forestry.

Yet even the casual observer in New York notices many differences between the forested mountains of the Adirondacks and the rolling agricultural land of the lake plains, between the steep ridge and valley topography of the southern tier counties and the equally steep but dome-like mountains of the Catskills. An ornithologist also notices differences in kinds and numbers of birds which live in different parts of the State. Some rare species in the Adirondacks are abundant in the lake plains, for example, and some common species in the Hudson valley are rare in the St. Lawrence valley.

Drawing a map to show these differences in bird distribution is a difficult task. Two quite different methods of approach are possible. The first is to determine the distribution of many individual species and from these data to draw conclusions on the presence and geographic boundaries of ecological communities. This method, although most logical, is not easy to apply. No two species have identical range limits so a great deal of judgment must be used to fix boundaries of communities. At the present time not enough is known about bird distribution to make this practical for New York.

The second method is indirect. It involves study of distribution of environmental conditions which affect birds, and synthesizing from this study a map which shows the areas which are relatively uniform in physical, chemical, and biological conditions. Such a map is not a map of bird distribution. Rather it is a rational and logical attempt to map bird habitats. Factors which must be considered include natural vegetation, land use, topography, soils, geology, climate, and many others. None of these components of the environment are simple, and all of them are interrelated in many complex ways. In drawing the map the investigator attempts to recognize *"logical* ecological types." The use of the word logical does not imply that there are illogical ecological types (except as they exist in the mind of man) since an ecological type must mean a community of organisms which have mutual relations to each other and common relations to the environment. Such a community cannot be illogical. The phrase — logical ecological types — is used to indicate that human judgment is used to recognize the types. The map is not the result of a precise scientific investigation, but must be considered a theory on the distribution of natural biological communities. This theory should be critically tested and examined to determine if it is valid.

This preliminary report is made to present such a theory of community distribution. It is hoped that many ornithologists will test the theory to

determine if it is a valid expression of bird distribution in New York State.

Three limitations have been put on the work: 1. that the biotic regions recognized should be related to a continent-wide system of recognized standing; 2. that the communities recognized should be evident to amateur ornithologists and ecologists and not need a high degree of training and experience to make them useful; and 3. that the communities should be based on conditions as they exist under the present intensity of land use which has so radically altered the original or natural vegetation.

No biotic community is ever entirely limited to one geographic area. There are always examples of particular communities which are far removed in space from the main center of distribution of that community. These "exceptions" do not invalidate the biogeographic classification. They should be considered merely as unique but normal situations where a small sample of one ecologic type is set down in a larger matrix of another ecologic type. For example, a cool sphagnum bog in the midst of a warm dry oak forest should not be considered an invalidation of the ecological classification of the area as an oak forest with its associated plants and animals.

In this kind of work there is a temptation to select "indicator" species; to state that if a particular plant or animal species is present it is an indicator of a particular biotic community. Such an attempt would be premature for New York birds. Perhaps with further experience with the system proposed here, it may be possible to assign indicator species to the Biotic Provinces and Biotic Districts.

Figure 1 indicates that in New York two major divisions or Biotic Provinces are recognized, and that these are divided into 11 subdivisions or Biotic Districts. The two Biotic Provinces cover large geographic areas and include one or more major ecologic associations (Dice 1943). Each Biotic Province covers a large and continuous geographic area and may be distinguished from neighboring provinces by type of vegetation, ecological climax, flora, fauna, climate, physiography, and soil. The Biotic Districts are continuous areas within Biotic Provinces which are recognizable ecological units that differ in less important respects. The 11 Biotic Districts delineated in Figure 1 are identical with the "Game Ranges" recognized by Smith (1955). His divisions are based on differences in geology, topography, physiography, climate, soils, water areas, vegetation, land use, and game species found or likely to succeed therein. In a few places names of the districts are not the same as used by Smith, but the district boundaries are the same. This adoption of Smith's areas is an indication of the regard I have for his work.

In the past several years I have tried to relate bird distribution to these Biotic Provinces and Biotic Districts. Data available have been so limited that a real test of the soundness of these divisions in relation to bird distribution has not been possible. The map and brief descriptions of the areas are being published at this time in the hope that many ornithologists working in all parts of the State will test this "system" to see if it is valid and to see where modifications are needed. All suggestions from those who use this ecological classification will be appreciated.

CAROLINIAN BIOTIC PROVINCE

The "lowland" areas of the State are termed the Carolinian Biotic Province following the terminology of Dice (1943) and not differing significantly from the area Merriam (1898) termed the Carolinian Life Zone (or Faunal Area). Considerable other precedent exists for grouping the Long Island, lower Hudson, and lake plains areas. The Carolinian Biotic Province as shown in Figure 1 corresponds quite closely with the A and B Zones of Bray (1930) and Hotchkiss (1932); it is the Cenral Forest Region of the Society of American Foresters (1954); the deciduous forest biome as mapped by Pitelka (1941); and it includes both the beech-maple and the oak-chestnut regions of Braun (1950).

The most conspicuous feature of most of the Carolinian Biotic Province is the level to gently rolling topography. The Southeastern Highlands Biotic District is an exception to this, and limited local areas within some of the other districts show sharp relief. Soils in general are of high to medium productivity (Howe, 1933) with bedrock materials made up chiefly of limestones, shales, and slates (except in the Southeastern Highlands and on Long Island) (Cline, 1955). The growing season averages about 160 days or longer over most of the Province with an average mean temperature during the growing season of about 65 degrees Fahrenheit or higher (Mordoff, 1949).

The climax vegetation of this Province is a very diversified hardwood forest. Chestnut was originally an important constituent with several species

of oaks, hickories, and some tulip poplar in many parts of the Province. Conifers are not conspicuous in the subclimax or climax vegetation.

Land use by man has greatly modified the "landscape" today. Much of the area has fertile soils and a great human population to utilize the agricultural production. Although the type of agriculture is variable depending on local soil conditions, local climate, and availability of markets, most of the Province has an intensive type of land use.

Four biotic districts are recognized in the Carolinian Biotic Province, all of them based on Smith's (1955) Game Ranges.

Lake Plain Biotic District. (Map number 1.) This District borders the Great Lakes and is characterized by its gently rolling topography. It is bounded on the south by the sharp change in topography between the lake plains and the hilly Appalachian Plateau. Much of the original hardwood forest of the District has been eliminated or modified by the intensive agriculture which has been practiced for many years. A very high percentage of the District is intensively cultivated for a variety of cereal grains and for truck crops, and some is used for pasture and orchards. The remaining forests are generally on the poorly drained sites or on local areas of poor soils. Even these forests have been greatly modified by logging, pasturing, and fire, and few indicate their climax character at the present time.

Hudson Valley Biotic District. (Map number 2.) This District extends from the southern end of Lake George southward along the Hudson to the Southeastern Highlands District and along the ancient river valley to the New Jersey border. Mountainous terrain in surrounding areas makes the District distinct and easy to recognize. The Adirondacks and Catskills form its western border and the Taconics, the Rensselaer Plateau, and the Southeastern Highlands mark the eastern border. Most of these lands have been cleared for agriculture and urban development, and much of the District is still intensively used for general farming, truck gardening, and for orchards. The original climax oak-chestnut forest and its associated species are difficult to find.

Southeastern Highlands Biotic District. (Map number 3.) The rough topography of this District sets it apart from surrounding areas. The thin, stony, acid soils are of low productivity. Although much of the less rugged area was at one time cultivated, now most of the area is covered by relatively poor quality tree growth. The original forest was of oak and chestnut. Now oak predominates in most areas. The climate is mild because of the proximity of the ocean with a growing season of around 180 days. This District is an interesting mixture of vegetation with many southern species which survive because of the mild climate and with some northern species which find conditions suitable on the thin acid soils. Special study should be made of this District to determine if the bird fauna is more like the Carolinian or the Canadian Biotic Province. It is here called Carolinian because of the mild climate.

Coastal Plain Biotic District. (Map number 4.) Long Island and the southern portion of Westchester County are included in this District. The outstanding feature of the area is the mildness and stability of the climate due to the moderating influence of the ocean. The growing season of 180 to 195 days (Mordoff, 1949), the longest in the State, encourages growth of species which do not survive in other parts of New York. Most of the

western part of this District is covered by urban development, and intensive land use characterizes the entire area.

CANADIAN BIOTIC PROVINCE

The highlands that dominate the rest of New York State are best termed the Canadian Biotic Province following the terminology of Dice (1943). This is in general agreement with the area called the Alleghanian Faunal Area of the Transition Life Zone by Merriam (1898). With only minor changes it is the C and D Zones of Bray (1930) and Hotchkiss (1932). It is the Northern Forest Region of the Society of American Foresters (1954). It is the hemlock-white pine-northern hardwood region of Braun (1950). And it includes both the coniferous forest biome and coniferous-deciduous forest ecotone as mapped by Pitelka (1941).

Topography, geology, and soils vary within this large region but many fundamental similarities make it desirable to group the seven biotic districts into one province. Most of the Province is dominated by hills, ridges, and mountains. Glaciation has been an important force in removal of original soil materials and depositing other materials. The soils are of medium to low productivity (Howe, 1933) and in most cases are strongly acid in reaction (Cline, 1955).

The climate of this Province is quite severe with long cold winters. The growing season over most of the area is less than 150 days and in the Adirondacks may be less than 100 days (Mordoff, 1949). Snow usualy accumulates in the winter and may remain on the ground in spring even when vegetation in the Carolinian Biotic Province has broken dormancy and is turning green. Average temeperature in the growing season is less than 60 degrees Fahrenheit in the Adirondacks and is generally not over 65 degrees in the rest of the Province.

The climax forest of the Canadian Biotic Province is a hardwood forest in which sugar maple is usually conspicuous. Beech, yellow birch, and basswood are abundant hardwood components of the climax, and hemlock is usually present in mixture with the hardwoods with its abundance controlled by local edaphic and climatic conditions.

In the Adirondacks, red spruce and balsam fir dominate considerable areas, but in most instances these coniferous stands are due to local conditions. The spruce slope types on the mountaintops and the spruce flat stands in the valley bottoms are only restricted examples of a northern vegetation type set in a matrix of hardwood forest which provides the ecological character of the entire biotic community. Many persons have separated the Adirondacks as a separate ecological unit because of the coniferous component of the vegetation. It seems better to distinguish the Adirondacks as a biotic district but not give the area the rank of a province.

Land use has not modified the "landscape" of the Canadian Biotic Province as drastically as in the Carolinian. Although some intensive agriculture is practiced, particularly on the valley floors, the character of the Canadian is a woods with agricultural inclusions rather than a cleared area with woody inclusions. Soil fertility is the chief factor which has limited agricul-

tural use and the vast majority of lands, once used for crops but now abandoned, occur here. The extent of agricultural use varies in the different biotic districts of the Canadian Biotic Province.

Seven biotic districts are recognized in the Canadian Biotic Province, following Smith's (1955) Game Ranges.

New England Upland Biotic District. (Map number 5.) Smith (1955) calls this area the Rensselaer Plateau-Taconic Mountain Game Range. This name is so long as to be objectionable: therefore I propose the area be called New England Upland Biotic District following the usage of some physiographers. This District is a rugged section of several different geologic origins. Soils are stony, acid and rather poorly drained. Much of the area has never been cleared for agriculture, and areas once cleared have largely reverted to forest. In many respects the forest is similar to those of the Adirondacks with most of the same tree species predominating.

St. Lawrence Biotic District. (Map number 6.) Vegetation places this large area with the Canadian Biotic Province even though it is not a highland, as is most of the rest of the Province. Forest cover of this District is a modification of the Adirondack hardwood forest including sugar maple, beech, hemlock, basswood and birch plus some oaks. Although the soils are mostly of medium productivity, some are very productive. In spite of the rather short growing season the District is quite intensively utilized for agriculture with considerable amounts of dairying and the growing of small grains.

Tug Hill Biotic District. (Map Number 7.) In some respects the Tug Hill Biotic District differs from the Adirondack District; however, in most respects it is ecologically similar. Essentially, the Tug Hill Biotic District is an outlier of the Adirondack District surrounded on all sides by lowland areas. The land-use picture is much the same as for the Adirondacks, and climate, though somewhat wetter, is not drastically different. Further investigation may lead to the combination of the Adirondack and the Tug Hill Districts. At this time they are separated for two reasons: first because the areas are geographically isolated from each other, and second because too little information on faunal differences is available.

Adirondack Biotic District. (Map number 8.) The Adirondack Biotic District is the only large District in the State which has not been subjected to intensive clearing of land for agricultural use. Here cold winters with deep snow accumulation, short growing season (90 to 140 days), and low temperature in the growing season (often well under 60 degrees) combined with low-productivity soils and remoteness from markets prevented agriculture from getting much of a start. However, the Adirondack forest is far from a virgin stand as most of it has been logged and vast areas have been burned. Sugar maple is a predominant species in most of the hardwood stands with yellow birch almost equally characteristic. Coniferous types are in important and conspicuous addition to the larger areas of hardwood forest and are considered by many to be a subclimax type of vegetation or a local edaphic climax.

Mohawk Valley Biotic District. (Map number 9.) This District is intermediate geographically and ecologically between the Adirondack and Appalachian Districts. It is limited to the narrow valley of the Mohawk

River. Original forest cover was northern hardwood dominated by beech, sugar maple and hemlock. A very high percentage of the land is under cultivation because of the fertile soils and availability of transportation and markets.

Appalachian Biotic District. (Map number 10.) Although the vast area of the "southern tier" varies considerably from west to east, there is surprising similarity throughout the District. The ancient plateau is deeply dissected by streams which generally trend north and south. Soils on the slopes are shallow, acid, and relatively poorly drained. The valley bottom soils are more fertile and it is here that agriculture is most intense. The northerly edge of the District is quite distinct and easy to recognize because the streams break out of the "hills" and meander across the rolling lake plains. The growing season averages 120 to 160 days with a mean temperature in the growing season of from 60 to 65 degrees. The climax hardwood forests are composed chiefly of sugar maple, beech, and basswood, with some hemlock. Much of the forest has been cut over but species composition has not been greatly changed by logging. A great deal of hill land has been cleared and abandoned in this District. Such abandoned areas usually revert to woody growth in a short time.

Catskill Biotic District. (Map number 11.) The Catskills differ geologically from the Appalachian Biotic District, but in many ecological respects they are similar. Soils are stony, acid, and of low to medium fertility. Farms are maintained chiefly on the narrow, somewhat more fertile valley floors. Original forest cover was dominated by beech, sugar maple, yellow birch, and hemlock with some spruce and fir at high elevations and some oaks in valley bottoms. These forests have been heavily utilized.

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