RELATION OF TEMPERATURE TO EARLY MIGRANTS

BY JOHN S. MAIN

In an article by Bissonnette entitled "Photoperiodicity in Birds", in the WILSON BULLETIN of last December, there is an interesting discussion of the spring migration, and of the factors that operate to make the birds start. We are referring now not to the physiological changes leading up to the migration movement, nor the cause of these changes. As to that there is a wide difference of opinion among the physiologists themselves. Rowan, it appears, now favors the effect of increased exercise upon the gonads, having abandoned his original theory as to the direct effect of light. Bissonnette suggests an inherent rhythm of the anterior pituitary controlling the sex cycle, with light as an auxiliary. Kendeigh believes that environmental conditions are the efficient agent, acting both directly and through the medium of the endocrine system. Some stress food, some the thyroids, others the declination angle of the sun.

What we are here concerned with, however, is not the so-called conditioning process, but something quite different. It is the actual moment of departure, and the forces that finally arouse in the bird an uncontrolable impulse to begin its northward flight, for there is reason to believe that another factor becomes dominant at this time and furnishes the stimulus for action.

The agent above referred to, at least in respect to our early migrants, is none other than temperature. And yet, strangely enough, none of the persons mentioned by Mr. Bissonnette, with the single exception of Kendeigh, seem willing to admit that this is the case; and when evidence is adduced showing that when temperature is higher than usual, migration is earlier, it is dismissed with the statement that the warmer days may be due to less over-cast skies. That this explanation is not a sound one I believe the following remarks will show.

I must here take the liberty of referring to an article that appeared in the WILSON BULLETIN (XLIV, 1932, 10-12) a few years ago, in which I reviewed an abnormally warm week in February of 1930. In that week, starting with the 17th, all previous heat records were broken, not only for the Madison region but for hundreds of miles to the south, the average temperatures being from 23 to 28 degrees above normal. This warm wave was accompanied by an abnormally early migration. Of seven species of small birds that are commonly the first to arrive, all appeared from two to three weeks

before their usual time. In fact, their return, in nearly every case, antedated by a week or more any previous record.

What was the meaning of this coincidence of warm weather and early migration? Since it is well known that the temperature at the place of departure is more important than that at the place of arrival, an examination was made of the records from various stations of the U. S. Weather Bureau as to the temperatures that prevailed to the south of us during the period in question, and it was found that the reports from all were substantially the same. For example, a station 150 miles to the south gave the following summary: "Warmest February but one in 75 years. The week ending February 25 was the warmest winter week in 50 years or more, and as warm as the normal last week in April." The answer to our question is obvious.

I was interested to see that Roberts, in his recently published "Logbook of Minnesota Bird Life", makes the same observations, both as to that year and the year following, to which reference will presently be made. His data as to temperature and arrival dates corroborate those above given, as well as the conclusions arrived at.

But what about the sunlight? Could not that have been a contributing factor? As to this, the answer is simple. Both in January and February of that year the hours of sunshine throughout the region were less than normal, while for the days during which the migrants must have been starting the hours of sunshine averaged very much less than normal.

Another circumstance may well be mentioned. It so happened that February of the following year was also exceptional, being even warmer than that of 1930. In this case, however, the heat in the winter home of the migrants was more evenly distributed, the week starting the 17th having a mean temperature of only 10 degrees above normal. The result was that, even though the hours of sunshine were greater than for the same week of the previous year, the migrants referred to did not appear until much later—in fact, not appreciably before their usual time.

Cole, in his experiments with Mourning Doves, showed the effect of sustained light in hastening reproductive activity, but he also called attention to the fact that on a chart graphing the spring migration of doves over a period of years, there was no correlation between their northward advance and the increasing length of day. Supplementing this, examinations made of early migrating blackbirds this spring, at the University of Wisconsin, showed no enlargement of the gonads or other indications of sexual activity.

It is obvious that physiological changes induced by light do not take place overnight, but are a gradual process. In experiments made by Cole and Rowan two months or more were required to activate the gonads, even under forced lighting conditions that simulated continuous daily sunshine. Migrating birds, moreover, show no preference for clear days over cloudy ones. Indeed, the great majority of our small birds travel chiefly by night.

Returning to the subject of temperature, Roberts, in referring to the birds first seen in the spring, says: "These are the birds that migrate on a temperature schedule and are early or late as the spring is early or late."

Kendeigh, following a similar statement, gives an excellent description of bird waves. He says: "The theory as to how bird waves are formed is that species keep moving northward until they come to a low temperature barrier, where they stop. Several species and many individuals thus become concentrated just below the barrier. Then, when the barrier is lifted by a rise in temperature, they all move forward at the same time."

Cooke, in a well known passage, refers to the isotherm of 35 degrees as "the line of spring", and in speaking of the early Robins describes the sudden rise in temperature under the influence of the chinook winds, the rapid advance of this isothermal line resulting therefrom, and how the birds accelerate their speed to keep up with it. In this connection it is noteworthy that the temperature in that week of February, 1930, was 15 degrees above Cooke's line of spring.

That temperature may have a decisive effect upon birds during their migration is beyond dispute, and if such is the case it is difficult to see why it may not have an equal effect on them at the commencement of their northward flight. If not, just when would it start to function? Is there any reason to suppose that birds are more sensitive to heat or cold at the end of the first day's journey than at the start?

What we have been discussing is unseasonably warm weather in relation to the early migrants, since here the effect of temperature stands out in clearest relief. Later on, as warm days become the rule rather than the exception, and as physiological changes complete their cycle, the part that temperature plays in initiating migration will probably be less important, and will certainly be less easy to define. It is, however, one of the ever-present environmental factors that are an integral part of a bird's life. It must be borne in mind that wild birds in their winter home are normal, active individuals, continually

exposed to all their surroundings and responsive to them to a degree beyond our comprehension, in confirmation of which we need only point to the innumerable theories advanced by physicists in an effort to explain the ability of birds to find their way, theories that run all the way from terrestrial magnetism to specially sensitive membranes of the ear.

In the words of Lansborough Thompson, "One does not necessarily attach importance to the behavior of birds not wholly subject to natural conditions."

MADISON, WISC.

HIGHWAY CASUALTIES IN CENTRAL ILLINOIS DURING 1937

BY WILLIAM CHARLES STARRETT

Students of nature have long been aware of the disastrous rôle the automobile plays in destroying our wildlife; however, it has never been pointed out to what degree this destruction is carried throughout an entire year in a given area. Most of the literature on this subject is a summary of a trip across a number of states during one season. It is the purpose of the writer to show the amount of casualties through one year, 1937, in Central Illinois. No doubt the death rate due to automobiles fluctuates from one year to another, varying with the temperature, humidity, and precipitation (Dreyer, 1935). Also the rate will change due to animal cycles of abundance. According to Stoner (1936) the mortality varies among species in different localities. The writer was greatly impressed by this fact while making a tour through New York State and New England in 1933, by the great amount of skunks seen dead on the highways in comparison to Illinois. The following results may then be applied to Central Illinois, and used only as a comparison to other sections and regions of North America.

The focal point of this study was Peoria, Illinois, from which place 219 trips were taken for a total of 7,529 miles, averaging 34.56 miles per trip. The greatest distance from Peoria was eighty miles. Mileage and observations were kept only on well traveled highways in the country. Domesticated animals, such as poultry, dogs, and cats were omitted, confining the survey to wildlife only.

Central Illinois is located in the heart of the agricultural belt of the Middle West; consequently, most of the land is tilled, the chief crops being corn, wheat, and oats. This view is occasionally broken by an oak-hickory grove.