A METEOROLOGICAL ANALYSIS OF THE 1958 ISLAND BEACH NETTING DATA

By Gilbert S. Raynor

Bird migration in all its manifold aspects has fascinated observers for many years and numerous capable ornithologists have studied this phenomenon. Three phases of migration, however, while under active investigation, remain little understood. They are: 1. What factors, external and internal, cause a bird to come into a physiological condition of readiness to migrate? 2. What factors, presumably external, cause a bird to migrate on one specific day or night and not on another? 3. How is the navigation performed? This paper is concerned exclusively with question 2.

Some relationship between bird migration and weather has long been recognized but many previoud workers in the field were handicapped by lack of meteorological training or experience. As a result of the writer's life-long interest in birds and his association with a meteorological research group, a study was begun in 1954 of the relationships between nocturnal spring migration and weather conditions. (See: Raynor, G. S., 1956, Meteorological Variables and the Northward Movement of Nocturnal Land Bird Migrants. The Auk, Vol. 73, No. 2, pp. 153-175.) This study was based on observations of arrival and departure sent by many cooperating observers but analysis of these observations indicated that a more objective measure of migration would be desireable. This paper, therefore, is based upon the 1958 Island Beach netting data.

The plan of this study was to use the Island Beach data as a measure of the occurrence and volume of migration in the area and to compare these data with various meteorological variables in the hope of finding significant relationships. To accomplish this objective, it was necessary to evaluate the mist-netting data and to assemble, plot, average and analyze a large quantity of weather data. These were separated into two classes: 1. Those variables such as temperature, temperature change, surface wind, sky condition and low level stability which might influence a bird to initiate or postpone a migratory flight and 2. those variables such as wind direction and speed aloft and upper air stability which would influence a bird after he became airborne. The position and movements of frontal systems, high and low pressure areas, cloud and precipitation were also considered.

Any study of bird migration is handicapped by a vast amount of ignorance. If we know the date and location of arrival, we seldom know the point of departure and vice versa. We rarely know the exact time of either arrival or departure nor do we usually know the route travelled or the altitude or speed of flight. Since so many vital facts are always missing, it is necessary to start with a series of assumptions if we are to form even tentative conclusions concerning the meteorology of bird migration. Some of these are taken for granted. We assume, for instance, that fall migrants normally fly in a southerly direction and that arrival at a given point implies departure from a more northerly one.

Other basic considerations are not so generally recognized. It is commonly accepted, however, that a bird will not migrate until he reaches a state of physiological readiness no matter how favorable conditions may be for migration. Conversely, we believe that after a bird has attained this state of readiness, he will not normally perform a migratory flight until favorable conditions prevail.

In studying the relationships of migration with weather conditions, we must recognize that the weather at the point of arrival has no bearing on the bird's decision to begin the flight. Therefore, when working with arrival data, it is necessary to compute the probable flight path of the migrant and trace him back to his general departure area. This may be done by making reasonable assumptions concerning flight speed, altitude of flight and the desired flight direction and knowing the wind forces acting on the bird. For the purpose of this study, I have assumed a flight speed of 20mph, a mean flight altitude of 2,000 feet and a desired direction down the coastal plain roughly parallel to the coast and the mountains.

Finally, since the study is based on netting data, it is necessary to assume that the number of migrants per net hour caught from day to day is at least a rough measure of the volume of migration taking place in the region.

Netting data available for the study were the daily totals of each species banded at Island Beach in 1958 and the number of net hours. Since only nocturnal migrants were banded in sufficient numbers to warrant study, other species were eliminated. Also, those species such as the Catbird and Yellowthroat which are summer residents at Island Beach were discarded since it was impossible to distinguish residents from true migrants. The number of migrants per net hour was then computed and used as the basic measure of migration. Fig. 1 shows the number of daily captures of all birds and of nocturnal migrants only. The pattern is similar although the proportion of migrants increased during the period.

In an attempt to eliminate the bias caused by the effects of local weather conditions upon netting success, a correction factor was applied to the number of migrants per net hour to determine what the catch probably would have been each day if all days had been uniformly favorable. Since no record of local weather was kept, the correction factor was based upon the nearest reports available from Weather Bureau sources. As shown in Fig. 2, the weather correction failed to change the general pattern of capture and the uncorrected figures were used in the following analysis.

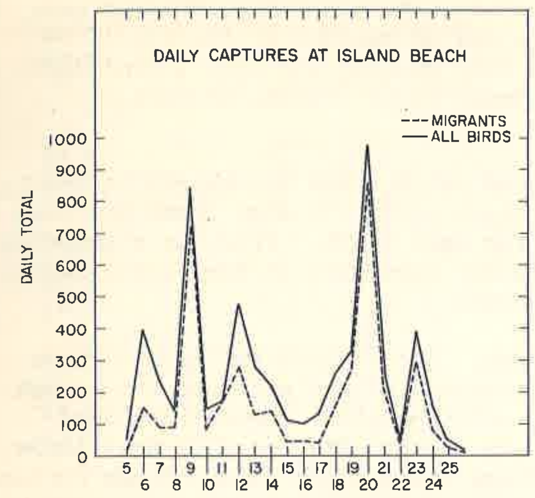

FIG. 1

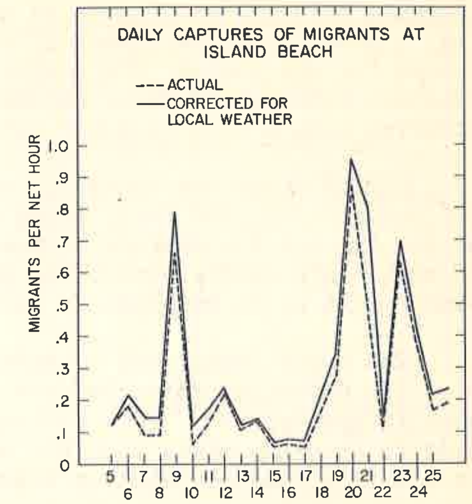

FIG. 2

Once the netting data were reduced to usable form, correlations with weather elements were made. In order to reduce the mass of weather data to a simple form that would permit graphical comparison with the netting data, most of the weather elements studied were rated on an arbitrary numerical scale ranging from 1 to 5.

Temperature was considered first. Using the upper wind data and the flight assumptions listed earlier, it was found that most flights probably originated in New York State and central New England. Since take-off normally occurs shortly after dark, the average of the 7 pm. temperatures at nine stations from Boston to Buffalo was computed for each night. The change in mean temperature from one evening to the next was also computed. Fig. 3 shows these two quantities in comparison with the netting data. It will be noted that there is little correlation with temperature and not too good a one with temperature change. Two of the large flights took place in a period of decreasing temperature but the third with a warming trend. The flight of the 9th took place on a night colder than the preceding one but those of the 20th and the 23rd with no net change.

The next procedure was to compare captures at Island Beach with other take-off conditions in the cource region. Two separate methods of rating these conditions were used. The first was based on an inspection of the surface weather map. The second was based on low-level stability data recorded by baloon-borne radiosondes. Unfortunately, radiosondes are sent aloft only twice a day from certain stations and neither ascent is now representative of nighttime conditions. The use of these data probably presents take-off conditions as more unfavorable than they actually were. Fig. 4 shows these two take-off ratings and an average of the two. Except for one period, the ratings are very similar and show a good correlation with Island Beach captures. Every large flight, in fact, occurred with a high take-off rating.

Fig. 5 shows the upper-air stability ratings for two height intervals, 0-5,000 and 5-10,000 feet, along the flight path. It also shows the best of the two and the average of the two for each night. From the standpoint of stable air aloft, conditions were fairly favorable at some level nearly every night so no conclusions can be drawn.

The upper winds were considered next. The highest rating was given when the direction coincided with the presumed flight path and the lowest when it was opposed. On a few nights, small positive corrections were made to opposing winds when the speed was light. Fig. 6 shows that there is a fairly good correlation between these ratings and Island Beach captures.

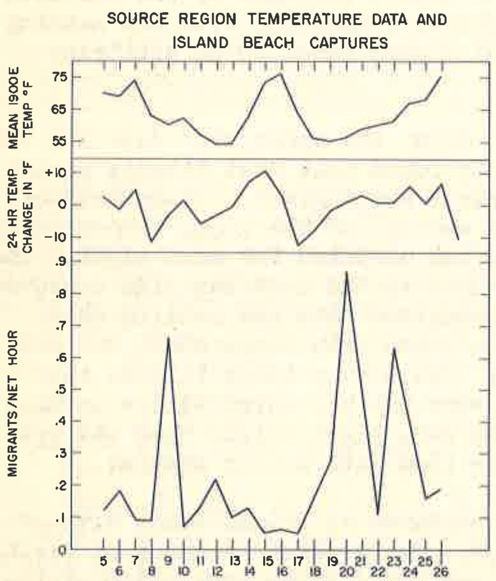

FIG. 9

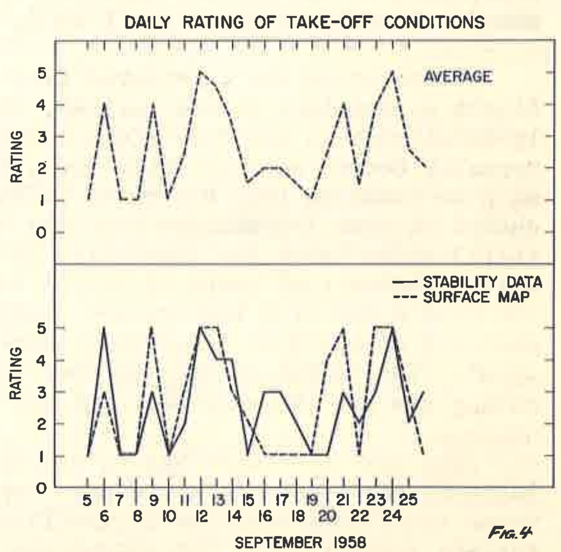

FIG. 4

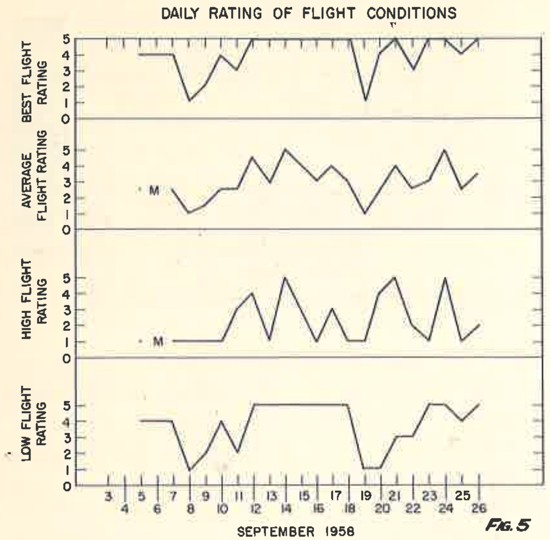

FIG. 5

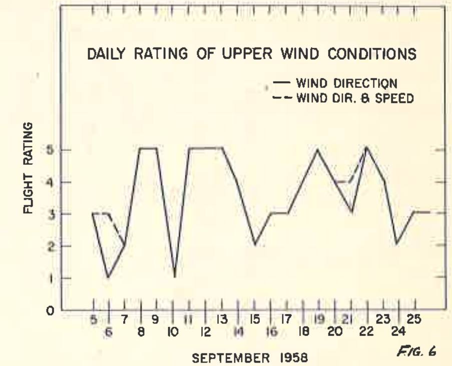

FIG. 6

For a successful nocturnal flight to take place, both take-off and flight conditions must be favorable. Therefore, two composite take-off and flight ratings were computed to compare with the net data as shown in Fig. 7. Here, we see that the correlation is again very good and it seems evident that the parameters used are actually significant to fall migrants.

The next procedure was to test the assumption that the daily captures at Island Beach are a good measure of migration. Since the data from Ocean City were also available, a comparison of the two stations was made as shown in Fig. 8. Since the pattern is nearly identical, and the day to day species composition very similar, we may conclude that both stations were sampling the same movements and that captures at either are a good measure of migration.

A study of the probable source region of each individual flight was made next. Although captures of new birds were made every day, the data do not indicate flights every night. If birds did arrive each night, however, Fig. 9 shows the most likely source region for each flight. The numerals show the probable origin of the flights sampled at Island Beach on the date of the numeral. Those circled are the important flights. Since the calculations of these source regions involve many uncertainties, the spots numbered on the map are meant to represent a broad, general region rather than specific localities. If the assumptions made were not valid for a particular flight, the actual source region may be far removed from that calculated.

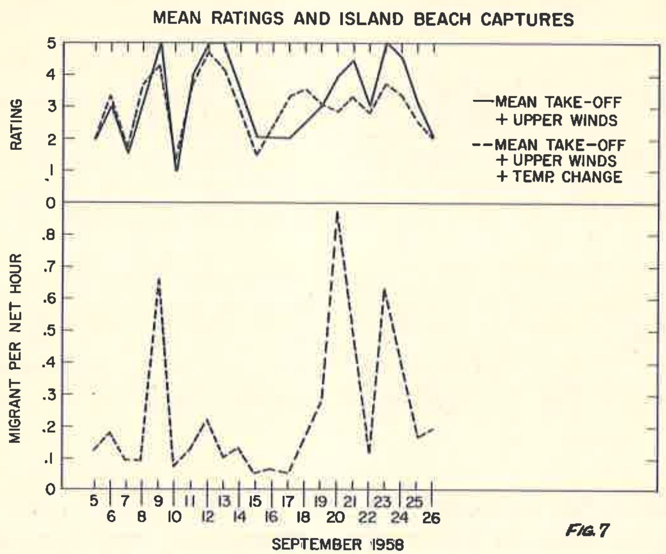

FIG. 7

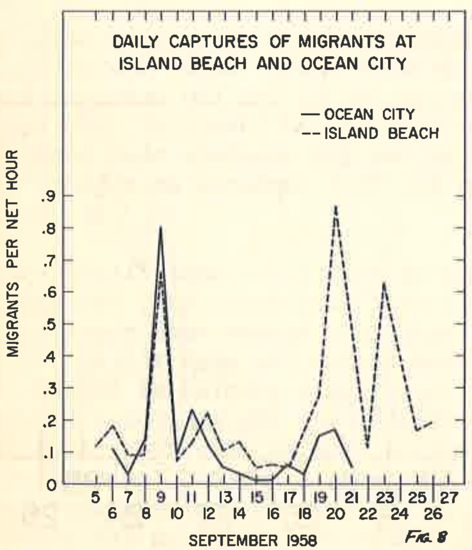

FIG. 8

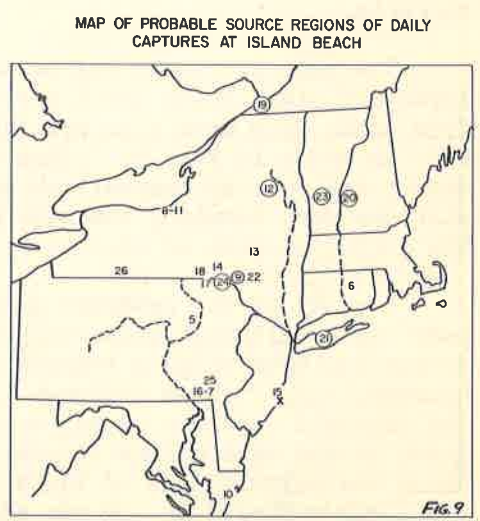

FIG. 9

After this phase of the study was complete, data on repeats became available. These confirmed the belief that flights did not occur on every night and gave some hints as to when each major flight departed. The flights which are believed to have actually taken place are shown in Fig. 10 where the numerals refer to the day the flight arrived and the length of the bars is roughly proportional to the size of the flight. Thus, we see that ten flights probably took place in the twenty-one day period. Most remained for two or three days and then departed, leaving only a few stragglers.

Certain tentative conclusions can be drawn from this study:

1. Flights of nocturnal fall migrants do not occur every night but only when favorable conditions exist.
2. Flights remain on the average for two or three days or until favorable departure conditions occur.
3. Both favorable take-off conditions in the source region and favorable flight conditions en route are necessary for a successful flight.

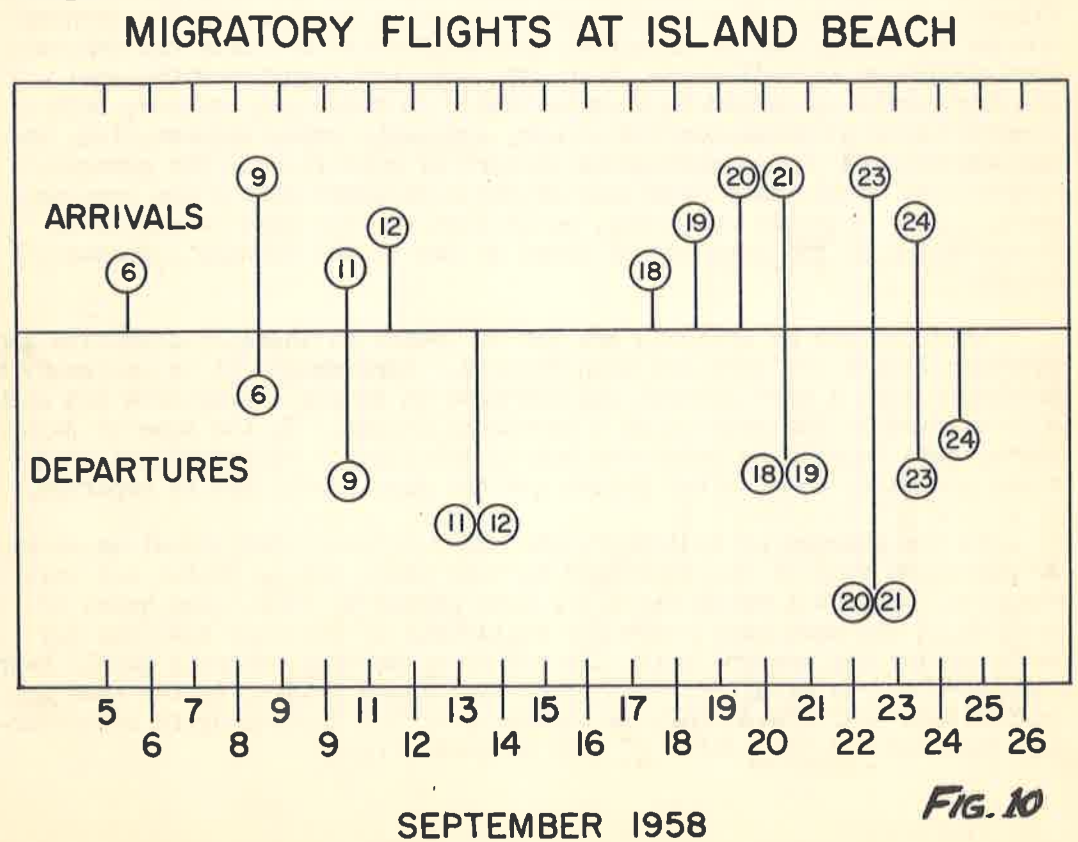

FIG. 10

4. Favorable take-off conditions include light surface winds, relatively good weather and stable air in the lowest layers.
5. Favorable flight conditions include a favoring wind direction and probably stable air at the flight level.

Since the meteorological variables of interest can be predicted, it seems likely that the occurence and magnitude of migratory flights could be forecast on the preceding day. If other commitments permit, this will be attempted during the coming fall.

Continuing studies on the relationship between weather and nocturnal bird migration are planned by the writer who would appreciate the assistance of bird banders and other interested observers. Any observation of migration would be welcome if it can definitely be related to a specific night. Sight or sound observations of migrants passing overhead at night are most valuable. Departure data are also vitally needed. However, since nocturnal migrants often tend to drift in their direction of travel while feeding during the day, the presence of a bird one day and its absence at the station the following day do not necessarily mean a nocturnal flight took place. If a bird is observed going to roost in the evening and is definitely absent from that spot at sunrise the next morning, a true departure is indicated. Such data reported together with local weather conditions would be most helpful. In reporting weather, such general terms as clear, partly cloudy, overcast, rain, showers, fog, etc. are adequate to give a reasonable picture of conditions. The general temperature range and an estimate of the wind speed during the evening, calm, light, moderate or strong, would complete the most needed data. Observations of the presence of frost or dew in the morning are also helpful.

Observations on arrivals are not as useful as those on departure and overhead flight but they are also desired. Here again, it is necessary to determine that a bird present did not move in from a nearby area but actually arrived at the station by a nocturnal flight. In the case of major waves, this is easy to determine but in the case of an individual or a small movement, doubt often exists and the case should not be reported.

In the absence of these definite observations, statistical measures of migration such as the data used in this study can be useful but only when available on a daily basis for some period of time. Two hours of netting at the same hour every day would tell us far more than all day netting over the weekend only. In addition, netting projects should keep complete records of all repeats other than those retaken by the same net on the same day. These tell us something of the diurnal drift of nocturnal migrants and the length of stay of each flight.

This study would have been impossible without the assistance of Mr. and Mrs. Stanley Dickerson who tabulated, summarized and made available the extensive netting data. Mr. Chandler Robbins kindly furnished the Ocean City data. The Meteorology Group at the Brookhaven National Laboratory made available the meteorological information. Appreciation is also expressed to each bander whose efforts originated the netting data.

Manorville, Long Island, New York

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A TRAP FOR "PEEP" AND MEADOWLARKS

By Ralph K. Bell

To catch "Peeps" - small sandpipers - and Meadowlarks, we use a heart-shaped trap at our farm pond. This trap is set along the water's edge with lead-in wires of 1" x 2" mesh, one foot high, fastened to the trap on both sides. Two sizes of traps are used as illustrated.

The necks of the entrances can be straight or S-curved in shape. The curved entrance makes it harder for the birds to escape, but likewise the birds do not enter so readily. Cowfeed can be used for bait for Meadowlarks, Vesper Sparrows, Savannah Sparrows, Cowbirds, Redwings, Starlings, etc. We use no bait for peeps, in fact we did not catch any of them this summer because a mine crack drained all the water from the pond. We used the bare ground in the pond to catch many field birds and even caught about 1000 young Starlings there in July.

Clarksville, Pa.

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