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The Spring Migration of Birds at the East Part of Polish Baltic Coast

Operation Baltic paper No. 27

[Pp. 121-262 and 45 text-figs.]

Wiosenny przelot ptaków we wschodniej części polskiego wybrzeża Bałtyku
Prace Akcji Bałtyckiej. Nr 27

Весенний перелёт птиц в восточной части поьлского побережья Балтийского моря
Работы Балтийской операции. Но. 27

Abstract. Material collected by the method of visual observation and catching birds in nets during their spring migration on the Hel Peninsula in 1963—1967 and on the Mierzeja Wiślana (Vistula Spit) in 1966—1967 is presented. The three main parts of the paper provide the author's methodological conceptions concerning the working-out material collected by the above-mentioned methods, a description of migration dynamics, and a biometric analysis of the birds trapped. The degrees of generalization based on such material are presented and a suitable system of symbols is proposed in the course of methodological considerations, The biometric part contains an analysis of the population composition of migrating birds. Population differentiations have been found between successive waves of migrants and between birds flying over the two observation points. The variability of biometric parameters of populations in the consecutive years is also discussed.

CONTENTS

I. INTRODUCTION

The phenomenon of spring migration of birds is far less known than their autumn migration and there are relatively few publications given to it. Many of the existing papers are based on phenological data — records of the first bird seen or heard (e. g. ZABŁOCKA, 1959; RODIONOV, 1968; VEROMAN, 1961; STOLBOV, 1961; RENDAHL, 1965, 1968, 1969; SOUTHERN, 1939) — far more rarely they arise from systematic field observations (REA, 1961; ULFSTRAND, 1959; MATHIASSON, 1960, 1961, 1962; the group of investigators from the Ribatchy station: LULEYEVA, 1961, 1967; BELOPOLSKY and ODINTSOVA, 1969; ODINTSOVA, 1969, 1970). This situation may have been caused by the overestimation of the significance of phenological data (usually collected on the occasion of some other work) for the description of spring migration. Now this attitude seems incorrect; the appearance of the first individuals (qualitative phenomenon) does not at all reflect the course of migration, which can be described only by means of quantitative data. The necessity of investigation made by quantitative methods prompted the extension of the Operation Baltic on the spring period. Another reason for carrying out studies in spring was a complete lack of information about spring migration on the Polish coast of the Baltic Sea — except for the purely faunistic data provided by TISCHLER (1941) and observations made by ZIMMERMANN (1908) — and the fact that no biometric studies had been made in spring (no publications up to 1966 in the literature I had at my disposal). I have found hardly five papers on biometric studies in spring published later: SOIKKELI (1966), DURMAN (1967), ASH (1969) and FRY, ASH and FERGUSON-LEES (1970). The foregoing reasons marked out the range of topics for the first paper based on materials gathered in spring. In that paper I attempted to elucidate the phenomenon under study from fairly many angles so that in the second stage it might be possible to carry out more detailed studies and comparisons (thus it corresponds to the projected series of autumn „standard studies" — BUSSE and KANIA, 1970). The following problems emerged as the fundamental points of such an approach to the subject: 1) a faunistic description, i. e. the quantitative presentation of spring migration, 2) the sketching — in so far as possible — of the differentiation of migrants in respect of populations, and 3) the analysis of the influence of weather on migration. The first two problems have been considered in the present paper.

II. METHODS AND THEIR DISCUSSION

A. Field Study

Material for study was collected in the field by a team of workers under the scheme of the Operation Baltic at the observation points on the Hel Peninsula

(54°46'N, 18°28'E) in 1963—1967 and on the Mierzeja Wiślana (Vistula Spit — 54°21'N, 19°19'E) in 1966—1967. The time of observations in particular years is given in Fig. 1. Investigation was made by standard methods of the Operation Baltic described by Busse and Kania (1970). Briefly speaking, the field work consisted of 15-minute observations of bird passage made every hour and the removal of birds from nets (or traps) and biometric examination also every hour. These activities were continued from dawn to dark. The number of nets at either observation point was constant in a given year and ranged from 50 to 70 in particular years. In 1964 and 1965 birds were also caught in a Heligoland-type trap, which was effectual only in 1965. The birds caught were measured (wing length, tail length and from 1965 onward, wing-formula) and weighted. Their fat deposit and, if possible, their sex and age were determined, the last two on the basis of plumage characters.

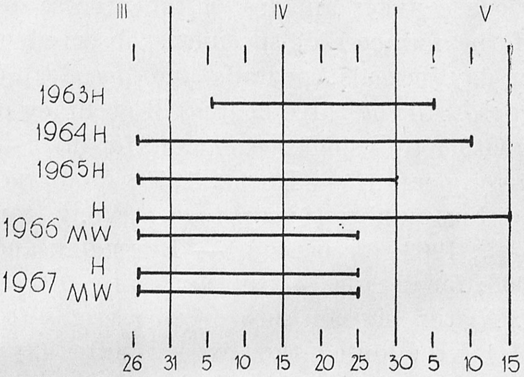

Fig. 1. Time of studies in particular years. The ranges given are the times of observations and trapping except at Hel in 1966, when no observations were made from 4 to 7 Apr. and from 20 Apr. to the end of investigation in that year

Sketches showing the situation of the observation points in the terrain have been published in the above-cited paper on the methods used (Busse and Kania, 1970; observation points: Hel in 1962—1967 and Mierzeja Wiślana II).

B. Elaboration of Material

The present paper is divided into two main parts: a faunistic description of passage and the elaboration of biometric data about the birds trapped.

The review of the faunistic data obtained from our own visual observations and on the basis of trapped birds needs no comments. The presentation of migration dynamics is however more complicated. The manner of presentation of material that characterizes a bird passage is very various in different papers. There have been extremely varied approaches to the problem in attempts to present quantitative data. The least accurate method is the giving of cumulative numbers of specimens observed during their passage over a given observation point. This method is nevertheless sometimes employed by Swedish and Soviet authors (e. g. ULFSTRAND, 1956, 1957; MATHIASSON, 1957; MESHKOV, 1961). However, the data of this type are quite useless for comparison, especially if generalization reaches the degree when cumulative numbers are given for different species (e. g. LEINS and KASPARSON, 1961; LULEYEVA, 1961). Only the characterization of a passage by the numbers of birds flying over in successive time periods conveys an idea of the process of this phenomenon. The specification of the numbers of specimens observed or trapped in consecutive five- or ten-day periods (pentads and decades) has generally been applied for this purpose. All the three degrees of accuracy calculated are encountered in reference either to a single year (e. g., for days — BRUDERER, 1966, 1967; FUCHS, 1968; for pentads — BUSSE, 1972; for decades — ULFSTRAND, 1959; RABØL, 1967) or to a number of years together (e. g., for days — RENDAHL, 1965; EDELSTAM et al., 1963; for pentads — BERTHOLD and BERTHOLD, 1968; LACK and LACK, 1966; for decades — LENNERSTEDT, 1958; ULFSTRAND, 1959; BELOPOLSKY, 1967). As the division into decades seems to be too general, in the present paper I have adopted the divisions into days and pentads.

In order to facilitate orientation in the degrees of generalization (or accuracy) of materials concerning the dynamics of migration, I have used a uniform system of designations in this paper. All the data that characterize the dynamics (numbers of birds trapped or observed in individual periods) are marked with the symbol P. The digital index (1 or 5) beside the letter P indicates the time units that the given data refer to: P_1 stands for daily dynamics of migration, P_5 for pentad dynamics. The letter index (y or s) shows whether the data come from single years (y) or are sums of results for all the years of investigation together (s). The symbols are as a rule applied with two indices (a digit and a letter): P_{5y}, P_{5s} (data concerning the pentad dynamics of migration in particular years and those concerning the pentad dynamics in all the years together); I have simplified the symbol P_{1y} (daily dynamics of migration in a single year) into the form P_1, because I consider the daily dynamics of migration exclusively separately for particular years, as the cumulative daily dynamics for several years (P_{1s}) gives a very distorted picture of migration, which is evidenced by the huge irregularity of the curves in the phenological paper by RENDAHL (1965) on the arrival of cuckoos in Sweden. The symbol P_s denotes the data which escape grouping (e. g. the beginning and end of passage, quantitative share of females, etc.). The symbol of the degree of generalization may be preceded by the abbreviated and bracketed name of one or both observation points from which the material has been obtained, e. g. the designation (H + MW) P_{5s} informs that we are here concerned with the cumulative material from Hel and Mierzeja Wiślana grouped in pentads for a number of years.

Particular degrees of accuracy have their advantages and disadvantages and are suitable for different purposes. Admittedly, the most valuable material is contained in tables and graphs which illustrate passage in successive days for one year and one observation point (P_1). This most accurate information about migration affords possibilities of close analyses of the passage itself and its weather conditions and of detailed comparisons of own material with that obtained by other investigators. The publication of data of this sort is often indispensable in order to justify divisions of a passage into waves or to analyse the wavy character of passage at different observation points (BUSSE and KANIA, 1970). A very considerable size of such tables and figures is their shortcoming. A more general picture of the course of migration is acquired with the next degree of generalization, the pentad passage in particular years (P_{5y}). A comparison of the P_{5y} graphs from various years provides general information about the fact whether in a given year the passage occurred earlier or later than in another year. Graphs with more than one peak indicate the occurrence of differentiations in respect of waviness, but themselves cannot be used as the basis for analytical divisions. A one-peak curve of this type does not prove lack of differentiation in waviness, nor can it give evidence of homogeneity. The disregard of this principle in CZAJA-TOPIŃSKA'S (1969) study caused serious errors in interpretation. The generalization achieved by the giving of the cumulative passage (P_{5s}) is, in my opinion, the most appropriate form of the faunistic description of migration; it makes a direct orientation in the average picture of a passage possible. The addition of data from many years may bring into relief the existing wavy differentiation of the passage (this is the only way of its detection with less frequent species), but it may as well blur these differences if the time of passage undergoes greater changes in particular years than does the interval between the waves. In an extreme case a great change in the time of passage may cause the occurrence of an additional peak, corresponding to no wave-type differentiation, in the cumulative graph. All the three basic degrees of generalization (P_1, P_{5y}, P_{5s}) are necessary to obtain a full picture of the phenomenon, since they represent its different aspects.

In discussing the representations of the dynamics of migration, I must touch on another subject, namely, on the adequacy of the reflection of the actual intensity of passage with the observation methods used. Generally speaking, the data used for the illustration of the passage of night migrants are the results of the trapping of foraging birds or those having a rest in the study area in the day-time, and in the case of day migrants they are the results of visual observation. Some species are characterized by a mixed type of migration (e. g. genus *Turdus*, *R. regulus*). In some species migrating in mixed flocks in daylight (e. g. genus *Fringilla*) the quantitative determination of the passage of a less numerous species on the basis of visual observations is hardly possible and at any rate charged with a grievous error. In such cases the use of data from trapping may prove helpful in the description of the course of migration. It appears impossible to describe daily passages of thrushes (*Turdus philomelos* and *T. iliacus*) on the basis of visual observations. Fig. 2 illustrates the difficulties encountered. There are two essential irregularities here: during the maximum passage of specimens not identified down to species (curve A) the curves of passage of specimens identified (B and C) show no maxima. *T. iliacus* outnumbers the other identified specimens but it forms hardly 30 per cent of the trapped birds. These species often fly in mixed flocks and the quantitative relations are frequently estimated on the basis of voices. The first of the irregularities erose from rather great difficulties in identification of the species in large flocks, frequently flying over, and therefore a great many specimens observed were noted as „*Turdus*" (*T. philomelos* + *T. iliacus*). The fact that specimens flying in a large flock utter calling voices considerably more rarely (birds flying singly call most frequently) may also be of some importance here. The other difficulty is presumably connected with the generally more frequent utterance of voices by *T. iliacus*. As a result of the analysis of Fig. 2

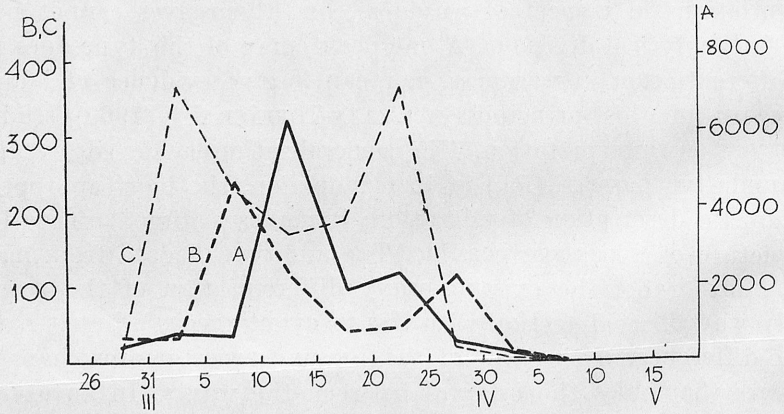

Fig. 2. A comparison of the results of visual observations concerning *Turdus philomelos* and *Turdus iliacus*. A — observations of all specimens of this genus not identified more closely, B — *Turdus philomelos*, C — *Turdus iliacus*. Axis x — time, axis y — number of specimens (designations of the scales correspond to those of the curves)

the cumulative passage of these two species has been represented on the basis of the data from visual observations and the passage of either of these species separately on the basis of the data obtained by trapping.

Another problem is what proportion of the flock passes within the range of observation of an ornithologist armed with binoculars. Here are three limiting factors: 1) great height of the passage, 2) possible changes in the route of passage over the study area and 3) the inefficiency of observers during very abundant passages.

The occurrence of the first of these limitations is confirmed by radar studies (e. g. Parslow, 1962) and field studies (e. g. Deelder, 1949; Fuchs, 1968). Passages at a height corresponding to the limit of distinguishability of a bird as a flickering spot when seen through binoculars magnifying 8 or even 11 times were observed during studies carried out under the scheme of the Operation Baltic (Okulewicz and Tomiałojć, 1964). In spring such high passages are particularly characteristic of fine weather and slight winds. A phenomenon observed on the Hel Peninsula in 1964 indicates a considerably high passage of Great Tits *Parus major*, which usually fly very low. On 5 April there was a big passage of Great Tits towards the end of the peninsula (7900 specimens according to visual observations — total of specimens counted in a 15-minute observation multiplied by 4). Then 732 birds were ringed. On the following three days (6—8 April) Great Tits flew exclusively from the end of the peninsula inland. On these days 2140 specimens were captured and some of them wore rings put on on 5 April. With all the birds trapped on 6 April excluded (they might have spent the night in the study area), out of the remaining 1535 specimens only 14 (0.9%) appeared to have been ringed on 5 April, on their passage towards the end of Hel. Using the routine method for the determination of population size on the basis of the frequency of recaptures of ringed specimens (this population may be treated as isolated in the peninsula during the 4 days discussed), we obtain the number of the birds which flew over the observation point on 5 April as that of the order of 80000. A comparison of this number with nearly 8000 birds observed shows that 90% of the birds were flying out of the range of vision of the observer.

There is a possibility of a local change in the track of passage in the case of a broad tract of land (it does not occur to a greater extent on Hel). This phenomenon, as dependent on meteorological conditions, was described in literature, chiefly for autumn migration (HESELBJERG-CHRISTENSEN and ROSENBERG, 1964; RABØL, 1964; ULFSTRAND, 1960). In the spring it occurs in the Mierzeja Wiślana and is dependent on the direction of passage. The birds that move in the proper direction (to the east) mostly follow the line of dunes along the northern border of the spit, whereas the nearly whole stream of birds in the reversed (westward) passage is concentrated over its southern border. The route of reversed spring passages coincides accurately with that of normal autumn passages.

The limitation caused by the observer's inefficiency becomes obvious when the number of passing birds reaches hundreds of specimens per minute and each interruption of watching to write down an observation result makes a gap in observation. ENEMAR (1964) also wrote about that.

All these limitations cause that the material of data for analysis is to some extent distorted in comparison with reality. In particular cases (e. g. the above-mentioned passage of Great Tits) the deviation may be quite considerable. The afore-named authors, interested in this problem, think however that the rejection of this method of study would impoverish our knowledge of migration in an essential manner, for so far there are no more accurate methods of direct study of some aspects of this phenomenon. Personally, I believe that the material obtained will be fairly reliable, provided the conclusions be drawn with due circumspection and the possibility of distortions be kept in mind continuously.

The working out of the biometric part of this study presented the greatest difficulties, since publications of this type, based on measurements of living birds, began to appear a relatively short time ago and are not, as yet, very numerous (GORDON, 1961; BEER and BOYD, 1962; BUSSE, GROMADZKI and SZULC, 1963; EVANS, 1964 a and b; WHITE and GITTINS, 1964; SCOTT, 1965; SOIKKEILI, 1966; DURMAN, 1967; JOHANESSON, 1967; BUSSE, 1967a, 1968; NITECKI, 1969; ASH, 1969; GRIFFITH, 1970; FRY, ASH and FERGUSON-LEES, 1970; MOREAU and DOLP, 1970). Moreover, no interest at all was taken in the non-systematic approach to variation in measurable body characters until little more than ten years ago (SUTTER, 1946; SCOTT, 1962; HOŁYNSKI, 1965; STRAWINSKI, 1966; BLONDEL, 1967). In the available literature there are no records of attempts to systematize biometric studies methodically and thus it is impossible to carry out extensive comparisons in this respect. The focussing of activities under the scheme of the Operation Baltic on this type of studies and their broad treatment in the present work call for the construction of a system that would permit the effective utilization of biometric data. The assumption that birds that come from different regions (and thus differing in the frequency of alleles of various genes) can be told one from another on the basis of some measurable characters is the point of departure for studies on bird migration on the basis of biometric analysis. Since here we are not concerned with the differentiation of particular individuals belonging to different populations, but with that of whole groups of birds, the initial data must be given a form fit for statistical analysis. Thus the whole of considerations deals with the statistical values of different biometric characters, here referred to as biometric parameters of a population, and the fundamental value is the arithmetic mean (M). Measures of dispersion and veracity play only an auxiliary role in this case and serve to compare mean values (though in some cases populations may differ also in the value of dispersion). The groups being compared are regarded as differentiated when the mean values of a parameter differ statistically significantly. In this study I have assumed the signficance of differences at the level of 0.01. Thus the first possible element of differentiation analyses is the comparison of means, which may be expressed as the examining of a null hypothesis in the form

$$M_A - M_B = 0\ (?) \qquad (1)$$

by a t test:

$$t = \frac{M_A - M_B}{m_{A-B}}, \qquad m_{A-B} = \sqrt{m_A^2 + m_B^2}$$

where M is the artithmetic mean and m the standard error. This is the basic method of examination for differentiation so far applied in biometric studies. Now a new possibility of comparisons has emerged. They are based on a recently discovered phenomenon of variation in the biometric parameters of a population in consecutive years (BUSSE, 1972; MACHALSKA in litt.). Variation observed in parameters is not identical in different populations, which allows the distinction of population groups, if the differences in the oscillation of the parameters in consecutive years are significant. This boils down to the examination of a null hypothesis in the form

$$(M_{A1} - M_{A2}) - (M_{B1} - M_{B2}) = 0 \; (?) \qquad (2)$$

also by a t test, although here the obtaining of the t value is more complicated. The standard error of differences between the values of M for successive years is calculated first ($m_{rA} = m_{A1-A2} = \sqrt{m_{A1}^2 + m_{A2}^2}$ and m_{rB} in an analogous way), then the error of the difference between these differences (m_{rA-B}) is determined using the same formula (from m_{rA} and m_{rB}) and, finally, the value obtained is substituted in the equation

$$t = \frac{(M_{A1} - M_{A2}) - (M_{B1} - M_{B2})}{m_{rA-B}}$$

Some examples of significant differences in oscillation will be given in the discussion of biometry in *Regulus regulus*.

Using these two methods for the detection of differentiations, we may begin to determine groups whose differentiation will be expected. Having at our disposal material from a certain period of time and at least two different places, we may expect two fundamental types of differentiation, a territorial and a temporal. We shall meet with territorial differentiation, when there are differences between birds flying over different observation points, and with temporal differentiation, when there are differences between groups of birds flying successively over one and the same observation point. The detection of territorial and temporal differences at the same time indicates a derivative type of territorial-temporal differentiation. The course of analysis presented below is designed to demonstrate the type of differentiations occurring in the material. The point of departure are daily passage graphs (P_1). The passage curves of all species are ununiform in nature; passage peaks and their groupings, defined as waves (according to Busse and Kania, 1970), can be distinguished in them, although a passage wave may also be formed by a single distinct peak.

On the basis of a daily graph (P_1) the material is divided into portions determined by the time of passage. Further these portions will be termed basic units (designation: B_{py} where B is the symbol of biometric data, p indicates its basic nature, and y is identical with „y" from the system of designations for migration dynamics and points to the fact that the material comes from one year). An essential thing, defining the limits of basic units, is the system of peaks and minima of passage. A case in which a basic unit would be assigned to each peak, even if of one-day duration, would be ideal, since it would afford the possibility for the keenest insight into the structure, not only that of the population, but even of the passage wave. Such an accurate division is however rarely permitted by the amount of material, because an appropriately large sample is necessary to prove the significance of the differences. A comparison of the biometric parameters of basic units is the point of departure for answering the question whether or not the species under examination is differentiated into groups which migrate through a given point in succession. If so, the basic units are combined, several in a set, further referred to as an annual territorial-temporal group (B_{Gy}), and if they all differ significantly from each other, each of them is simply regarded as such a group. If there is no differentiation, all the units are combined together and thus they constitute a peculiar case, an annual territorial group (B_y), including the material from the whole period of passage. Next the correspondence of annual groups distinguished in consecutive years is established and the successive degree of generalization — cumulative territorial-temporal groups (B_G) — obtained by adding up appropriate annual groups (B_{Gy}). Here, the obtaining of the sum for all the specimens from a given observation point and thus of the cumulative territorial group (B_s) is also a peculiar case (occurring as a rule when there is no differentiation within the material). Cumulative groups may be defined as „populations". Only temporal-type differentiations can be detected in biometric analyses of material from one observation point. The qualification of a group as „territiorial-temporal" emphasizes that its distinction is closely connected with a definite area, from which the data have been obtained. Hence it is necessary to apply the symbol with a designation of the area for which the group has been distinguished. Thus the symbol $(H)B_G$ denotes the cumulative territorial-temporal group for Hel, $(MW)B_G$ the same group for the Mierzeja Wiślana, and $(H + MW)B_G$ for these two points together.

Fig. 3 shows a sequence of operations making up an analysis of material from one point. The realization of the full programme of this analysis is possible only with species trapped in abundance, and thus providing very numerous data. In a number of cases it is impossible to carry out an analysis at the level of basic units and it appears necessary to proceed directly to higher degrees of generalizations, dependent on the material possessed. Sometimes in order that the observation point in question can be compared with other points, all the specimens trapped for a number of years are used to calculate biometric parameters, and this is treated as an operation at the level of a cumulative territorial group (B_s).

In the present study the location of the boundary between groups results from the search for the greatest differentiations that repeat in the same time sequence in different years. Hence, there is a number of significant differentiations of particular parameters between basic units; this is seemingly at variance with the course of the analysis presented above, which assumes the distinction of groups on the basis of the significance of differences between basic units. The semblance of contradiction consists in that the differentiation of a single parameter at the level of basic units may have a different meaning from that it has at other levels of generalization. We do not, as yet, know the structure of populations or waves of migrating birds well enough to claim that there are no mechanisms that marshal specimens during passage (e. g. the ones that cause the birds with the longest wings to fly at the head of the wave, etc.). The finding of differentiations in several parameters in a series of years is a considerably more significant basis for division into populations than is a single difference at the level of basic units.

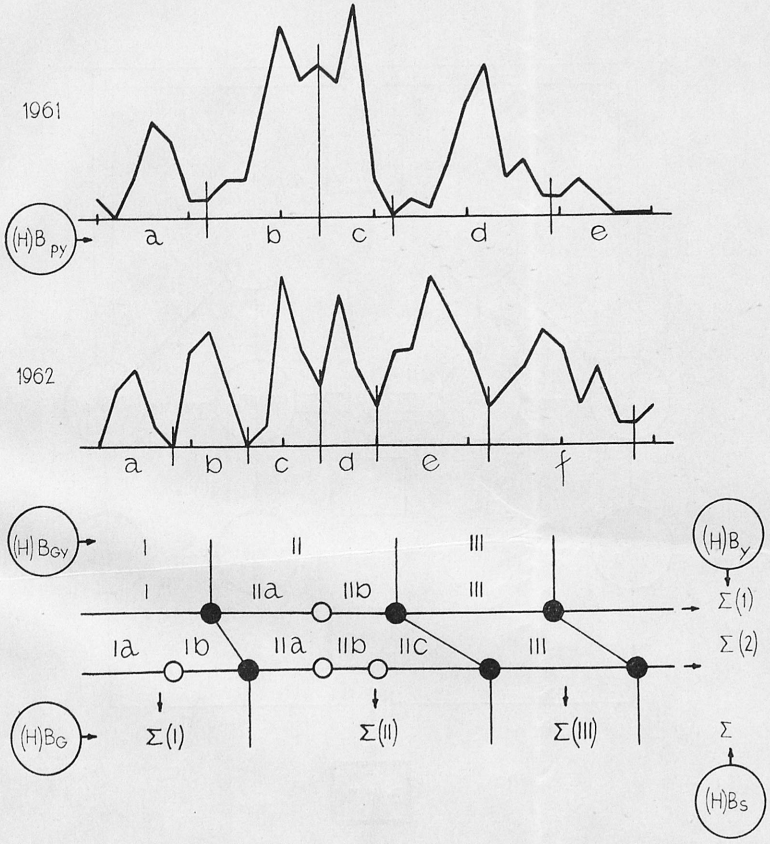

Fig. 3. Diagram of biometric analysis of materials from one observation point, based on exemplary designations of data from 1961 and 1962, as for the Hel point. Course of analysis discussed in text. B_{py} — basic units, B_{Gy} — annual territorial-temporal groups, B_G — cumulative territorial-temporal groups (sum of values from a number of years), B_y — annual territorial groups (sum of values for all specimens in one year), B_s — cumulative territorial group (sum of values for all specimens from all years)

Biometric analysis aims at finding not only differences between successive groups migrating through the same point, but also territorial differentiations between the points. Differentiations at the level of basic units (B_{py}) are not examined in territorial analyses, since the basic units form only an initial working hypothesis, which is not based on biometric data yet. This analysis consists of a comparison of the values of parameters, corresponding to each other in respect of the level of generalization, for these two points, and next of their possible combination for a common comparison with other areas. The course of this analysis is shown in Fig. 4. In the analysis of materials from two or more observation points the possibility of grouping the data increases owing to the combination of groups distinguished at analyses within the range of each single point. This is well seen in Fig 4. The combination of materials from different points is marked by brief information in brackets preceding the proper symbol of the degree of biometric generalization, e. g. the designation $(H + MW)B_y$ indicates that the materials of the annual territorial groups

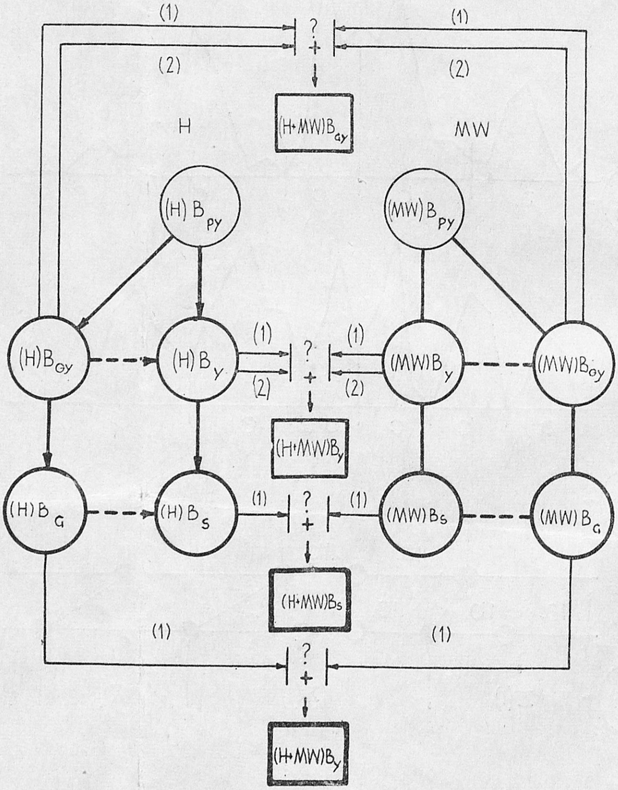

Fig. 4. Diagram of generalization and biometric analysis of materials from two observation points, on the basis of exemplary designations, as for Hel (H) and Mierzeja Wiślana (MW). Circles represent the degrees of generalization of material from one observation point, rectangles those of material from both points; designations inside circles as in Fig. 3; designations inside rectangles — analogous; the thick arrows represent the course of analysis within the range of one observation point, the thin arrows the course of comparing and possibly adding up of materials from both points; (1) checking of hypothesis about the equality of mean values $(M_A — M_B = 0?)$, (2) — checking of hypothesis about the equality of oscillations $(M_{A_1} — M_{A_2}) — (M_{B_1} — M_{B_2}) = 0?$

from Hel and Mierzeja Wiślana have been combined into a common territorial group embracing both these observation points.

As I have already mentioned at the beginning of the discussion of biometric methods, two null hypotheses may be used to determine the population differentiations: 1) the hypothesis of equality of the mean values of a parameter and 2) that of equality of the oscillations in particular years. The application of the testing of both these hypotheses is possible only for the groupings which have been distinguished in many years' sequences, and thus in annual territorial (B_{Gy}) or territorial (B_y) groups. The differentiation of the other main groups used in comparative analyses (cumulative groups — B_G and B_s) can be examined using only the first of these hypotheses.

In the synthesis of the results of studies on the differences between the groups it is necessary to assume an index of differentiation so as to make it possible to determine whether the differentiarion is great or little. The index that I use in this study is very simple and universal but, unfortunately, at the same time not precise; it is expressed by the formula

$$z = \frac{\text{number of significant differences found}}{\text{number of differences examined}}$$

This index of differentiation assumes values from 0 (no differentiation) to 1 (all differences examined are significant).

At this stage we obtain a certain number of population groups (B_G or B_s), denoted by the symbols of the observation points from where they have been recorded (in the case of the territorial-temporal group also by digits indicating the order of their passage), but entirely dissociated from any breeding areas or winter quarters. The last stage, which deals with the localization of the breeding areas of the groups distinguished, is the most complicated. Now, there seem to be chances to localize these areas only in studies on autumn migrations (Busse, 1972; Kania, in press), whereas in spring studies an indirect way, i. e. a comparison with autumn observations, is the only possibility. So far, ringing does not provide enough material to utilize. The problem of localization is not being considered in this paper because of the lack of adequate comparative data from autumn studies.

As has been discussed in connection with the scheme of generalization of the data which describe migration dynamics, the necessity of giving a series of degrees of generalization for the thorough utilization of materials possessed should be emphasized. This is well illustrated by the signs of comparison in the diagram of territorial analysis (Fig. 4). The finding of differences at each level supports the general conclusion of differentiation (the lack of these differences does not however indicate homogeneity).

The presented diagram of analysis, in which the data are added up, even though significant differences have already been found (e. g. the combination of annual groups into cumulative groups — B_{Gy} into B_G), in the presence of significant oscillations of a parameter observed in different years, seems to clash with the rule that heterogeneous samples should not be combined. However, the generalization at the level of a cumulative group has a special biological meaning, independent of the significance of oscillation in particular years: populations differing in genotype have different levels of oscillation and this is just what the combined data inform about. It should also be kept in mind that all the studies carried out so far on the basis of biometric data were made at high degrees of generalization and it is only now that the consciousness of the complexity of the biometric structure may guard against danger of rash conclusions, at the same time allowing the maximum utilization of measurements taken.

In addition to the analysis of population differentiations, the biometric part of this study includes also information about the existence of oscillation of biometric parameters in successive years. Parameter values obtained at the level of annual groups (B_{Gy} and B_y) and arranged in many-year sequences have been used for this purpose. The magnitude of oscillations has been represented in the form of indices of differentiation (z — see p. 133) and stability (s). According to the definition given by BUSSE (1967b) $s = \frac{\sigma M_r}{2.58\ m_M}$, where σM_r is the standard deviation of annual means from the many-year mean and m_M the standard error of the many-year mean (the mean error of the many-year mean). The values of both these indices are greater when the oscillations

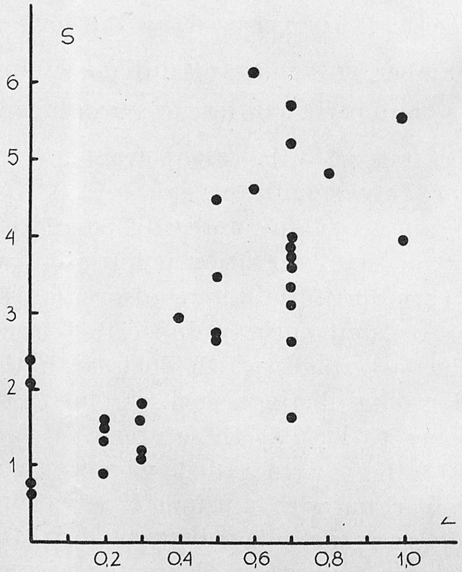

Fig. 5. Correlation of the indices of differentiation „z" and those of stability „s" for the oscillations of biometric parameters (data from Tables XII, XVIII, XXI, XXIX and XXXV)

increase (Fig. 5), the index „s" being more accurate. If we have temporal-type data (B_{Gy}) for a given species, the application of a greater generalization (B_y) in the analysis of variation with time is dispensable, because it contributes nothing new and is considerably less accurate.

III. FAUNISTIC CHARACTERISTICS OF PASSAGE

Information about the passage is given in three complementary forms: in a cumulative table of the $(H + MW)P_s$ type (Table I), in cumulative pentad graphs of the $(H + MW)P_{5s}$ type (Figs. 6—13) and in the text. All the species observed and trapped are listed in the text. All the findings are given for the species occurring in small numbers; the material concerning more abundant species is discussed briefly in the text and, in so far as possible, presented in a table and graphs. In the case of species mentioned outside this section information is given to facilitate the finding of appropriate passages in another section of this study. Data concerning the diurnal passage (type P_1) of some species are included in Section IV, since they are used in the division of biometric material into basic units. The annual pentad graphs (P_{5y}) have not been published in this paper, because the data comprised in them are the object of another study (Busse, 1974). The index of reversed passage, given in Table I and mentioned in the text, is a ratio of the number of specimens flying W-NW to the total number of birds flying in the normal direction of spring migration (SE-E-NE).

As the attention of the observers was concentrated on birds flying over the land, the data concerning water birds are not full and cannot be regarded as exhaustive faunistic information (they refer chiefly to birds observed on the wing).

All the quantitative data based on observation are the numbers actually found in 15-minute observation periods (not multiplied by 4 to obtain the total of a daily passage).

Gavia arctica (Linnaeus, 1758)

Observed: Hel — 1 May 63 (2 on the sea), 1 May 64 (2 on the sea), 3 May 63 (1).

Podiceps cristatus (Linnaeus, 1758)

Observed: Hel — 9 Apr. 63 (2), 29 Apr. 63 (10).

Phalacrocorax carbo Linnaeus, 1758

Migration (observations): Table I, Fig. 6A.

Seen at both observation points.

Ardea cinerea Linnaeus, 1758

Migration (observations): Table I, Fig. 6B.

Seen at both observation points, much more numerous on the Mierzeja Wiślana.

Table I

Times of passage of birds for Hel and Mierzeja Wiślana together — (H+MW)P_s. Explanation: column 2: 0 — data from observation, V — data from trapping; column 3: date and number of specimens — first observation, the arrow — species occurring from the beginning of observations; column 7: date and number of specimens — last observation, the arrow — species occurring to the end of observations; column 8: number of specimens observed or trapped; column 9: ratio of the number of specimens flying W-NW (reversed passage) to the number of birds of this species flying in the normal direction of spring migration (SE-E-NE)

Species	Material	Beginning of Passage	Main Passage	Waves		End of Passage	Number of Specimens	Index of Reversed Passage	♀♀ %	ad %
				Number	Dates					
1	2	3	4	5	6	7	8	9	10	11
Phalacrocorax carbo	0	→	6—20 IV	1		2 V 64 (1)	160	0.82		
Ardea cinerea	0	→		2	1—10, 16—25 IV	5 V 64 (2)	292	0.22		
Ciconia ciconia	0	26 III 67 (1)				30 IV 65 (6)	37	0.68		
Cygnus olor	0	→	to 15 IV			27 IV 63 (2)	212	0.01		
Cygnus cygnus	0	→	6—15 IV	2?		16 IV 64 (2)	144	0.08		
Mergus sp.	0	→	11—15 IV			7 V 64 (3)	318	0.12		
Buteo buteo	0	→	to 15 IV	2?	to 31 III, 6—15 IV	3 V 64 (3)	493	0.08		
Buteo lagopus	0	→	11—15 IV	2	11—15, 26—30 IV	5 V 64 (1)	100	0.02		
Accipiter nisus	0	→	11—20 IV	2	11—20, 26 IV—5 V	8 V 64 (3)	719	0.01		
	V	→	16—20 IV	2	16—20, 26 IV—5 V	12 V 66 (1)	64			
Accipiter gentilis	0	→	6—20 IV			4 V 63 (3)	47	0.06		
Circus aeruginosus	0	2 IV 66 (2)	6—30 IV			8 V 64 (2)	40	0.05		
Circus cyaneus	0	2 IV 64 (2)	6—20 IV			20 IV 64 (1)	29	0.03		
Falco tinnunculus	0	→	6—20 IV	3	to 31 III, 10—20 IV, 26 IV—10 V	8 V 64 (5)	85	0.11		

Grus grus	0	→	1—15IV	2	1—15 IV, 25—30 IV	9V 64(14)	195	0.09		
Vanellus vanellus	0	→	6—10 IV	1		28 IV 65 (1)	5 463	0.03		
Larus marinus	0	→	to 15 IV			17 IV 63 (1)	42	0.20		
Larus fuscus + *argentatus*	0	→	to 10 IV			→	2 429	1.22		
L. fuscus ad	0	→	6—25 IV	2	6—15 IV, 21—25 IV	→	407	0.75		
L. argentatus ad	0	→	to 10 IV	2(3)	to 31 III, 5—10 IV	→	337	0.69		
Larus canus	0	→	6—15 IV	?		7 V 64 (2)	312	0.25		
Larus ridibundus	0	→	1—15 IV	1(2)	1—15 IV, (26—30 IV)	2 V 63 (4)	712	0.28		
Columba oenas	0	→	1—10 IV	2 ?	1—10 IV, (16—20 IV)	5 V 63 (3)	193	0.28		
Columba palumbus	0	→	11—15 IV	2	11—15 IV, 26—30 IV	10 V 64 (44)	19 910	0.27		
Aegolius funereus	V	→	to 25 IV			9 V 64 (1)	23	—		
Dendrocopos major	0	13 IV 64	16 IV—5 V	2	16—20 IV, 26 IV—5 V	5 V 63 (1)	196	0.31		
	V	7 IV 65	16 IV—5 V	2	16—20 IV, 26 IV—5 V	3 V 63 (13)	73	—	62.5	
Jynx torquilla	V	10 IV 66 (1)	21 IV—5 V			8 V 66 (1)	15	—		
Lullula arborea	0	→	to 10 IV	2	to 10 IV, 21—25 IV	30 IV 65 (2)	1 285	0.20		
Alauda arvensis	0	→	to 10 IV	1		3 V 63 (2)	6 937	0.19		
Hirundo rustica	0	10 IV 64 (1)	26 IV			→	1 008	0.05		
Delichon urbica	0	17 IV 64 (2)	26 IV	1		→	216	0.22		
Motacilla alba	0	28 III 67 (7)	16—30 IV	1		10 V 64 (2)	790	0.54		
	V					→	22			
Anthus trivialis	0	28 III 67 (1)	26—30 IV	2	16—20 IV, 26—30 IV	11 V 64 (1v)	744	0.04		
Anthus pratensis	0	→	to 30 IV	3	to 5 IV, 16—20, 26—30 IV	8 V 64 (1)	4 504	0.18		

1	2	3	4	5	6	7	8	9	10	11
Troglodytes troglodytes	V	→	11—15 IV	1		30 IV 66 (1)	96	—		
Prunella modularis	0	→	11—15 IV	2	11—20 IV, 26 IV—5 V	3 V 63 (7)	288	0.16		
	V	→	11—20 IV	1		1 V 63 (2)	181	—		
Sylvia atricapilla	V	13 IV 64 (1)	from 6 V			→	38	—	42.5	
Sylvia curruca	V	19 IV 66 (1)	6—15 V	2	26—30 IV, 11—15 V	→	58	—		
Phylloscopus collybita	V	28 III 65 (1)	16—25 IV	1		12 V 66 (1)	182	—	(17.6)	
Phylloscopus trochilus	V	11 IV 64 (1)	from 6 V	2	21—30 IV, from 6V	→	310	—	(7.6)	
Phylloscopus sibilatrix	V	17 IV 67 (1)	6—10 V	2 ?		→	111	—		
Regulus regulus	0	→	6—10 IV	(2)		30 IV 66 (2)	909	0.04		
	V	→	6—15 IV	(1)		12 V 66 (1)	6 874	—	60.5	
Regulus ignicapillus	V	26 III 67 (1)	1—25 IV			1 V 65 (1)	31	—	55.0	
Ficedula hypoleuca	V	14 IV 67 (1)	6—15 IV	1		→	222	—	22.2	
Phoenicurus phoenicurus	V	11 IV 64 (2)	1—5 V	?		→	184	—	30.7	
Erithacus rubecula	V	→	11—20 IV	2	11—20 IV, 26—30 IV	→	7 204	—		
Turdus pilaris	0	→	11—15 IV	1(3?)		30 IV 65 (3)	2 951	1.70		
Turdus viscivorus	0	→		2	to 10 IV, 16—30 IV	5 V 64 (1)	244	0.27		
Turdus philomelos + iliacus	0	→	11—15 IV			3 V 63 (7)	12 808	0.85		
Turdus philomelos	V	→	11—15 IV	2	11—15 IV, 21—30 IV	13 V 66 (3)	1 198	—		27.7
Turdus iliacus	V	→	11—15 IV	1		10 V 64 (1)	529	—		26.8
Turdus merula	0	→	11—15 IV	1		28 IV65 (1)	695	0.01		
	V	→	to 10 IV	1		11 V 64 (1)	621	—	55.6	36.9
Aegithalos caudatus	0	→	6—10 IV			2 V 63 (4)	202	0.56		
	V	→	6—10 IV	1 (2)		29 IV 63 (3)	148	—		
Parus caeruleus	0	→	to 31 III	2 ?	to 31 III, 6—20 IV	27 IV 63 (1)	4 092	0.20		
	V	→	to 5 IV	(2)	to 5 IV, 11—15 IV	3 V 63 (1)	755	—	53.8	13.5

Parus major	0	→	6—15 IV	1		10 V 64 (2)	40 437	1.56		
	V	→	1—10 IV	1		14 V 66 (1)	6 600	—	49.6	47.6
Parus ater	0	30 III 67 (11)	16—20 IV	2	16—20 IV, 26—30 IV	7 V 64 (4)	3 056	0.31		
	V	25 III 66 (2)	16—20 IV	2	16—20 IV, 26 IV—5 V	9 V 64 (1)	1 103	—		
Certhia familiaris	V	→	to 10 IV	1		1 V 63 (1)	140	—		
Emberiza citrinella	0	→	to 31 III	(2)	to 31 III, (11 IV—10 V)	→	677	0.35	32.2	
Emberiza schoeniclus	0	27 III 67 (1)	11—20 IV			24 IV 65 (1)	100	1.78		
	V	29 III 67 (1)	11—20 IV			8 V 65 (1)	24	—		
Fringilla (coelebs)	0	→	11—20 IV			→	497 500	0.27		
Frinhilla colebs	V	→	11—20 IV			→	4353		53.3	41.1
Fringilla montifringilla	0	→	11—25 IV	2	11—15 IV, 20—25 IV	3 V 63 (1)	321	0.25		
	V	→	11—30 IV	2 ?		1 V 63 (1)	236	—	54.5	30.4
Chloris chloris	0	→	6—20 IV	2 ?		7 V 64 (2)	1 054	0.00		
Carduelis carduelis	0	→	16—20 IV	3	6—10 IV, 16—20 IV, 26 IV—5 V	→	2 345	0.22		
Carduelis spinus	0	→	16—20 IV	2	16—20 IV, 26—30 IV	→	41 837	0.12		
	V	→	16—20 IV	2	16—20 IV, 26 IV—10 V	→	910	—	48.0	36.4
Acanthis flammea	0	→	6—10 IV	2	6—10 IV, 26 IV—5 V	8 V 64 (2)	2 694	0.06		
	V	→	6—15 IV	1		28 IV 63 (1)	40	—	44.1	
Acanthis cannabina	0		6—10 IV	?		28 IV 63 (1)	4 036	0.12		
Loxia sp.	0	6 IV 63 (71)	16—20 IV	2	16—20 IV, 26—30 IV	→	5 278	0.35		
Pyrrhula pyrrhula	0	→	6—10 IV	2 (3)	6—10 IV, 16—20 IV	2 V 63 (6)	272	0.24		
Sturnus vulgaris	0	→	11—15 IV	1		→	150 770	0.31		
Garrulus glandarius	0	8 IV 64(1)	21—25 IV	2	6—15 IV, 21—30 IV	→ →	396	0.23		
	V	4 IV 67 (1)	21—25 IV	2	21—25 IV, from 1 V		82	—		

1	2	3	4	5	6	7	8	9	10	11
Pica pica	0	→	1—5 IV, 16—20 IV	2	1—5 IV, 16—20 IV	3 V 63 (2)	59	0.47		
Corvus modedula	0	→	to 31 III	?		→	2 370	0.35		
Corvus frugilegus	0	→	1—10 IV	1		→	16 650	0.31		
Corvus corone cornix	0	→	to 31 III	2	to 31 III, 6—15 IV	→	3 039	0.30		
Corvus corax	0	→	to 5 IV			8 V 64 (1)	26	1.56		

Ciconia ciconia (Linnaeus, 1758)

Migration (observations): Table I.

Seen at both observation points.

Cygnus olor (Gmelin, 1759)

Migration (observations): Table I, Fig. 6C.

Seen at both observation points. In addition to the passing specimens, included in the table and figure, at Hel there were many specimens feeding on the Gulf of Puck, and breeding specimens were always present on the Mierzeja Wiślana.

Cygnus cygnus (Linnaeus, 1758)

Migration (observations): Table I, Fig. 6D.

Recorded at both observation points. Numerous specimens stop to feed on the Gulf of Puck; it is possible that the birds observed towards the end of March are those wintering on the Polish coast and it is only the second peak in the graph that reflects passage.

Cygnus columbianus bewickii Yarrel, 1830

Observed: Hel — 4 May 64 (1 NE).

Anser sp. Linnaeus, 1760

Observed: Hel — 28 March 65 (40 SE), 30 March 65 (7 SE), 3 Apr. 64 (10 NE), 5 Apr. 64 (49 Apr. 64 (7 SE), 10 Apr. 64 (80 SE), 6 Apr. 64 (32 SE), 7 SE), 4 May 64 (5 W).

Anser fabalis (Latham, 1787)

Observed: Hel — 27 March 65 (67 SE, 40 E). 10 Apr. 64 (20 SE), 27 Apr. 63 (5 NE).

Anser anser (Linnaeus, 1758)

Observed: Hel — 1 Apr. 66 (26 NE, 6 N), 7 Apr. 64 (12 N), 9 Apr. 63 (56 NNE), 4 May 63 (50 E).

Casarca ferruginea (Pallas, 1764)

One specimen (♀) observed and shot at Hel — 2 May 63.

Tadorna tadorna (Linnaeus, 1758)

Single or in flocks up to more than 10, seen on the Gulf of Puck off Hel for the whole period of work at the observation point. Specimens flying SE were seen between 12 Apr. and 7 May (22 specimens altogether).

Anas sp. Linnaeus, 1758

Not included in observations; fairly numerous on the Zalew Wiślany (Vistula Lagoon), recorded at the Hel point.

Aythya sp. Boie, 1822

Not included in observations; very numerous on the Zalew Wiślany.

Clangula hyemalis (Linnaeus, 1758)

Very numerous on the sea (Hel). Last observation of passing birds on 24 Apr. 63 (2 SE). Many oiled specimens were found.

Melanitta sp. Boie, 1822

Numerous on the sea (Hel). The last observation of *M. nigra* (Linnaeus, 1758) — 16 Apr. 66 (1 E). Many oiled specimens were found.

Bucephala clangula (Linnaeus, 1758)

Observed: Hel — 29 March 64 (10 SE), 30 March 65 (1 ♀).

Mergus sp. Linnaeus, 1758

Migration (observations): Table I, Fig. 6E.

Large species were observed mostly on the Hel Peninsula (on the Mierzeja Wiślana only one observation: *M. merganser*, 28 March 67—2 E). Out of the 231 large *Mergus* species determined, 183 belonged to *M. merganser* Linnaeus, 1758 and 48 to *M. serrator* Linnaeus, 1758. Last observations: *M. merganser* — 22 Apr. 67 (2 SE, 16 NW), *M. serrator* — 3 May 63 (7 on the sea), *Mergus* sp. — 7 May 64 (3 NE). *M. albellus* Linnaeus, 1758 was numerous on the Zalew Wiślany.

Aquila chrysaetos (Linnaeus, 1758)

Observed: Hel — 14 Apr. 63 (1 SE).

Aquila pomarina C. L. Brehm, 1831

Observed: Hel — 27 Apr. 63 (1 SE)

Buteo buteo (Linnaeus, 1758)

Migration (observations): Table I, Fig. 6F.

Observed at both observation points, more numerous at Hel (on the Mierzeja Wiślana the main passage of the buzzard occurs over the range of coastal dunes, situated outside the observation region). The maximum daily passage: Mierzeja Wiślana — 17 specimens (27 March 67), Hel — 44 specimens (10 Apr. 64).

Buteo lagopus (Brünnich, 1764)

Migration (observations): Table I, Fig. 6G.

Observed at both points; more numerous at Hel (on the Mierzeja Wiślana the main passage route like that of *B. buteo*). The maximum daily passage: Hel — 17 specimens (14 Apr. 63).

Accipiter nisus (Linnaeus, 1758)

Migration (observations): Table I. Fig. 6H, (trapping): Table II.

Observed and trapped at both points, but more numerous at Hel. The maximum daily passage: Mierzeja Wiślana — 6 (27 March 67), Hel — 71 (15 Apr. 65). The annual pentad graphs indicate fairly great variation in the nature of passage; in 1963 and 1967 the passage was protracted and in the other years concentrated within a short period of time.

Accipiter gentilis (Linnaeus, 1758)

Migration (observations): Table I.

Recorded at both observation points; more numerous at Hel. The maximum daily passage: Hel — 6 (10 Apr. 64).

Milvus milvus (Linnaeus, 1758)

Single specimens observed: Hel — 27 March 64, 3 Apr. 66, 16 Apr. 66, 18 Apr. 66, 30 Apr. 65, 9 May 64, 10 May 64.

Milvus migrans (Boddaert, 1783)

Single specimens observed: Mierzeja Wiślana — 1 Apr. 66, 11 Apr. 67,

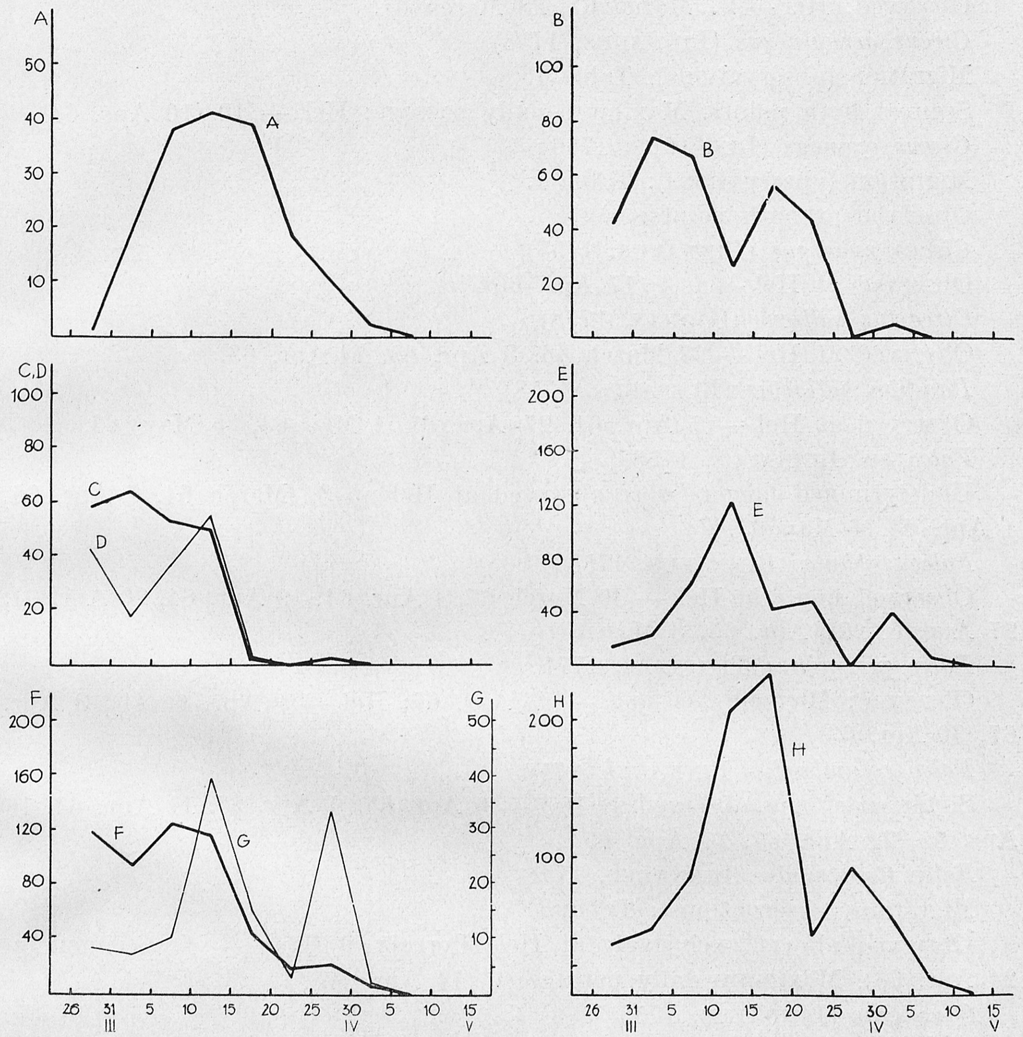

Fig. 6. Cumulative pentad graphs of passage (P_{5S}). Results of observations (O); passage directions have not been taken into account. Horizontal axis — time, vertical axis — number of specimens: sum of all specimens found in the given pentad at both observation points together in all the years of investigation. A—*Phalacrocorax carbo*, B — *Ardea cinerea*, C — *Cygnus olor*, D — *C. cygnus*, E — *Mergus* sp., F — *Buteo buteo*, G — *B. lagopus*, H — *Accipiter nisus*

15 Apr. 66, 17 Apr. 66; Hel — 31 March 64, 25 Apr. 64, 27 Apr. 63, 2 May 63.

Haliaeëtus albicilla (LINNAUES, 1758)

Single specimens observed: Mierzeja Wiślana — 2 Apr. 67, 7 Apr. 67; Hel — 27 March 64, 10 Apr. 64, 14 Apr. 65, 17 Apr. 65.

Pernis apivorus (LINNAEUS, 1758)

Observed twice at Hel: 1 Apr. 66, 14 Apr. 63.

Circus sp. LACÉPÈDE, 1799

Observed: Hel — 27 March 67, 28 March 67.

Circus aeruginosus (LINNAEUS, 1758)

Migration (observations): Table I.

Seen at both points. Maximum daily passage: Hel — 10 (10 Apr. 63).

Circus cyaneus (LINNAEUS, 1766)

Migration (observations): Table I.

Observed at both points.

Circus pygargus (LINNAEUS, 1758)

Observed at Hel — 1 ♂ (17 Apr. 66).

Circaetus gallicus (GMELIN, 1788)

Observed at Hel — 27 March 66, 8 Apr. 63, 14 Apr. 63.

Pandion haliaetus (LINNAEUS, 1758)

Observed at Hel — 5 Apr. 64, 27 Apr. 65, 1 May 63, 4 May 63.

Falco sp. LINNAEUS, 1758

Undetermined falcons were observed at Hel on 31 March 64, 7 Apr. 66, 4 Apr. 64, 4 May 63.

Falco subbuteo LINNAEUS, 1758

Observed singly at Hel — 30 March 67, 4 Apr. 64, 19 Apr. 64, 20 Apr. 64, 27 Apr. 64, 27 Apr. 65, 8 May 64.

Falco peregrinus TUNSTALL, 1771

Observed: Mierzeja Wiślana — 23 Apr. 67; Hel — 4 Apr. 66 (4), 3 Apr. 67, 30 Apr. 63.

Falco columbarius LINNAEUS, 1758

Single specimens observed at Hel — 6 Apr. 65, 7 Apr. 63, 11 Apr. 63, 16 Apr. 65, 24 Apr. 65, 27 Apr. 65.

Falco tinnunculus LINNAEUS, 1758

Migration (observations): Table I.

Observed almost exclusively at Hel (Mierzeja Wiślana — 1 specimen on 24 Apr. 66). Maximum daily passage: 6 (14 Apr. 65).

Grus grus (LINNAEUS, 1758)

Migration (observations): Table I, Fig. 7A.

Observed at both points; more numerous at Hel (Mierzeja Wiślana — 4 specimens on 1 Apr. 66, 2 on 5 Apr. 66, 4 on 15 Apr. 67). Maximum daily passage — 38 (10 Apr. 64). Prevailing flight direction — SE (167 specimens) and NE (22).

Rallus aquaticus LINNAEUS, 1758

Heard many times in reeds on the Mierzeja Wiślana, the first observation on 2 Apr. 67.

Fulica atra LINNAEUS, 1758

Occurring in large numbers on the Mierzeja Wiślana all the time these observations were made.

Haematopus ostralegus LINNAEUS, 1758

Observed at Hel — 27 March 65 (1 S), 28 March 66 (8 E), 15 Apr. 66 (5 E).

Vanellus vanellus (LINNAEUS, 1758)

Migration (observations): Table I, Fig. 7B.

Observed at both points. Maximum daily passage: Mierzeja Wiślana 340 (1 Apr. 66), Hel — 899 (8 Apr. 64). Flight direction: N (250 specimens), NE (632), E (633), SE (3,984), S (83), SW (53), W (6), NW (20). The SE direction prevails at Hel, the E one at the Mierzeja Wiślana. Passage mostly confined to one pentad. The term of the main passage ranges between the last pentad of March and the second pentad of April in different years.

Charadrius sp. Linnaeus, 1758

Observed at Hel — 23 Apr. 67 (4).

Pluvialis apricaria (Linnaeus, 1758)

Observed at Hel — 10 Apr. 64 (24 SE).

Gallinago gallinago (Linnaeus, 1758)

Observed at both points: Mierzeja Wiślana — 3 Apr. 67 (a tooting one), 11 Apr. 67 (1 E); Hel — 13 Apr. 63 (1 NW), 17 Apr. 63 (6 SE), 29 Apr. 63 (1 SE).

Scolopax rusticola Linnaeus, 1758

Trapped and observed while flying SE only at Hel: observed — 8 Apr. 63 (1), 10 Apr. 63 (3), 11 Apr. 63 (3), 11 Apr. 64 (1); trapped — 10 Apr. 63 (1), 11 Apr. 64 (2), 13 Apr. 63 (2), 13 Apr. 64 (1), 24 Apr. 66 (1), 3 May 66 (1).

Numenius sp. Brisson, 1760

Observed at Hel — 9 Apr. 64 (1 NW), 10 Apr. 64 (1 SE), 14 Apr. 65 (15 SE).

Numenius arquata (Linnaeus, 1758)

Observed at both points: Mierzeja Wiślana — 1 Apr. 66 (1 E), 5 Apr. 67 (2 E), 8 Apr. 67 (1 E); Hel — 9 Apr. 63 (1 SE), 11 Apr. 63 (1 SE), 22 Apr. 63 (1 SE), 26 Apr. 63 (2 SE).

Numenius phaeopus (Linnaeus, 1758)

Observed at Hel: 15 Apr. 65 (1 SE), 16 Apr. 65 (1 SE), 5 May 64 (1 N), 6 May 64 (1 SE).

Limosa limosa (Linnaeus, 1758)

Observed at Hel: 11 Apr. 64 (1 SE), 12 Apr. 64 (1 NW), 7 May 64 (voice).

Tringa sp. Linnaeus, 1758

Observed: Mierzeja Wiślana — 28 March 66 (1 S); Hel — 11 Apr. 67 (1 S).

Tringa erythropus (Pallas, 1764)

Observed at Hel: 4 May 63 (7), 5 May 63 (2).

Tringa totanus (Linnaeus, 1758)

Observed at Hel: 6 Apr. 65 (1 NW), 13 Apr. 64 (1 SE), 14 Apr. 64 (1 NW), 14 Apr. 65 (1 S), 4 May 63 (12).

Tringa nebularia (Gunnerus, 1767)

Observed at Hel: 18 Apr. 64 (1 NW), 4 May 63 (5), 5 May 63 (2).

Tringa ochropus Linnaeus, 1758

Observed at Hel: 15 Apr. 63 (1 SE), 17 Apr. 63 (1 SE), 21 Apr. 63 (1); found dead: 22 Apr. 65.

Tringa hypoleuca Linnaeus, 1758

Observed: Mierzeja Wiślana — 9 Apr. 67 (1 E); Hel — 2 May 63 (4).

Stercorarius sp. Brisson, 1760

Observed at Hel: 1 May 64 (1 NW), 2 May 64 (1 NW).

Larus marinus Linnaeus, 1758

Migration (observations): Table I.

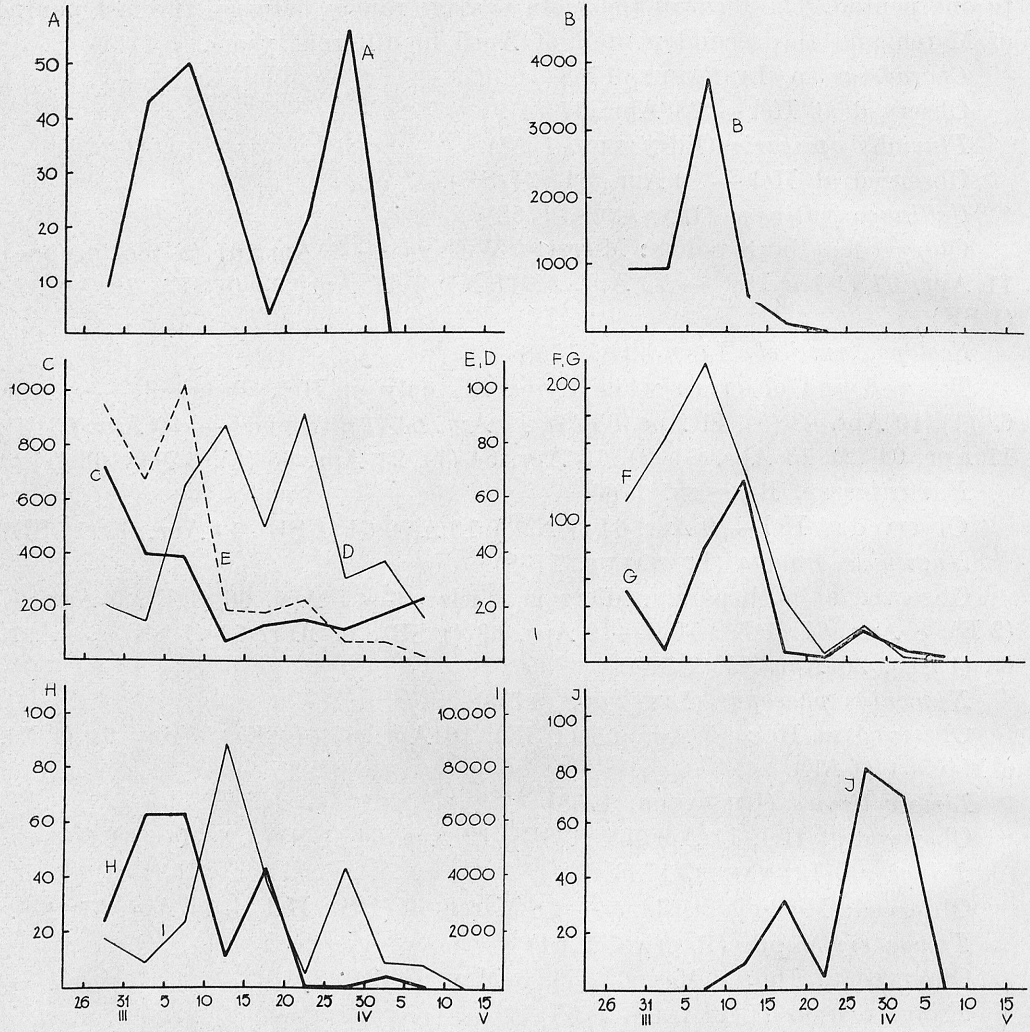

Fig. 7. Cumulative pentad graphs of passage (P_{5s}). Results of observations (O). A — *Grus grus*, B — *Vanellus vanellus*, C — *Larus* sp., D — *Larus fuscus*, E — *L. argentatus*, F — *L. canus*, G — *L. ridibundus*, H — *Columba oenas*, I — *C. palumbus*, J. — *Dendrocopos major*. For other explanations see Fig. 6

Observed at Hel. Maximum daily passage — 15 (8 Apr. 66).

Larus fuscus Linnaeus, 1758 and *Larus argentatus* Pontoppidan, 1763

Migration (observations): Table I, Fig. 7C.

Non-determined specimens of these species were observed at Hel throughout the observations period at this point, single specimens being seen at the Mierzeja Wiślana. Maximum daily passage — 208 (29 March 64). Fifty-five per cent of specimens flew NW.

Larus fuscus (Fig. 7D). Adults of this species were observed at Hel throughout the observation period of this point, whereas only single specimens were seen at the Mierzeja Wiślana. Maximum daily passage — 53 (9 Apr. 64).

Larus argentatus (Fig. 7E). Adults were observed throughout the observation period at the Hel point, none being seen at the Mierzeja Wiślana. Maximum daily passage — 73 (9 Apr. 64).

Larus canus LINNAEUS, 1758

Migration (observations): Table I, Fig. 7F.

Recorded chiefly from Hel (Mierzeja Wiślana — 1 observation on 28 March 66). Maximum daily passage — 42 (10 Apr. 63).

Larus ridibundus LINNAEUS, 1766

Migration (observations): Table I, Fig. 7G.

Passage observed at Hel — maximum: 52 (2 Apr. 65). Birds feeding on the Zalew Wiślany were seen at the Mierzeja Wiślana.

Hydroprogne caspia (PALLAS, 1770)

Observed at both points: Mierzeja Wiślana — 20 Apr. 66 (1 E), 21 Apr. 66 (4 W); Hel — 26 Apr. 65 (2 NW), 27 Apr. 65 (2 NW).

Sterna sp. LINNAEUS, 1758

Observed at Hel — 10 May 64 (1 SE).

Sterna sandvicensis LATHAM, 1787

Observed at Hel — 29 Apr. (1 SE).

Uria aalge (PONTOPPIDAN, 1763)

Found at Hel — 1 May 63.

Cephus grylle (LINNAEUS, 1758)

One specimen entangled in a fishing net was ringed at Hel on 8 Apr. 65; one was found on the beach on 1 May 63. Several oiled specimens were collected according to W. KANIA's oral information.

Columba oenas LINNAEUS, 1758

Migration (observations): Table I, Fig. 7H.

Observed chiefly at Hel; two observations at the Mierzeja Wiślana — 27 March 67 (1), 2 Apr. 67 (4). Maximum daily passage — 27 (17 Apr. 66).

Columba palumbus LINNAEUS, 1758

Migration (observations): Table I, Fig. 7I.

Numerous migrants observed at both points. Maximum daily passage: Mierzeja Wiślana — 732 (28 March 67); Hel — 2,277 (13 Apr. 65).

Streptopelia turtur (LINNAEUS, 1758)

Observed at Hel — 9 May 64 (1 SE).

Cuculus canorus LINNAEUS, 1758

Observed at Hel — 30 Apr. 64 (1 NW).

Asio otus (LINNAEUS, 1758)

Biometry: Table II.

Seen at Hel, flying out to the sea in the evening: 30 March 65 (1). Ten specimens trapped at Hel — 27 March 64, 29 March 64, 8 Apr. 64, 13 Apr. 65, 14 Apr. 65 (2), 16 Apr. 65, 20 Apr. 67, 21 Apr. 66, 23 Apr. 67.

Aegolius funereus (LINNAEUS, 1758)

Migration (trapping): Table I; biometry: Table II.

Trapped only at Hel.

Caprimulgus europaeus LINNAEUS, 1758

Captured at Hel — 29 Apr. 64.

Apus apus (LINNAEUS, 1758)

Observed at Hel — 7 May 64 (4), 8 May 64 (10), 10 May 64 (1).

Alcedo atthis LINNAEUS, 1758

Trapped at the Mierzeja Wiślana — 29 March 67 (1), 12 Apr. 67 (1).

Upupa epops LINNAEUS, 1758

Mierzeja Wiślana: observed — 15 Apr. 67 (1), 19 Apr. 67 (1), 25 Apr. 66 (3); trapped — 25 Apr. 66 (1); Hel: observed — 17 Apr. 66 (1); trapped — 16 Apr. 65 (1), 27 Apr. 64 (1), 6 May 66 (1).

Picus viridis LINNAEUS, 1758

One specimen observed and one trapped at Hel — 2 Apr. 66.

Dryocopus martius (LINNAEUS 1758)

Observed at Hel — 13, 17 and 18 Apr. 64 and at the Mierzeja Wiślana — 1 Apr. 66.

Dendrocopos major (LINNAEUS 1758)

Migration (observations): Table I, Fig. 7J (trapping): Table I; biometry: Table II.

Observed and trapped at Hel chiefly in 1963 (147 specimens observed and 60 trapped); in the other years observed and trapped sporadically (respectively, 49 and 13 specimens altogether). Maximum daily passage — 45 (29 Apr. 63).

Dendrocopos minor (LINNAEUS, 1758)

Trapped at Hel — 21 Apr. 64.

Jynx torquilla LINNAEUS, 1758

Migration (trapping): Table I; biometry: Table II.

Eremophila alpestris (LINNAEUS, 1758)

Observed at the Mierzeja Wiślana — 10 Apr. 66 (30 E, 20 E).

Lullula arborea (LINNAEUS, 1758)

Migration (observations): Table I, Fig. 8A.

Passage observed at both points. Maximum daily passage: Mierzeja Wiślana — 74 (31 March 66), Hel — 135 (10 Apr. 64). Three specimens trapped. Huge differences in the time of passage in particular years.

Alauda arvensis LINNAEUS, 1758

Migration (observations): Table I, Fig. 8B.

Passage observed at both points. Maximum daily passage: Mierzeja Wiślana — 150 (2 Apr. 66), Hel — 819 (10 Apr. 64). Small differentiation of the passage time of main wave; distinct two-wave structure in 1963, 1966 and 1967.

Riparia riparia (LINNAEUS, 1758)
Observed (9 May 64) and trapped (8 May 64) at Hel.

Hirundo rustica LINNAEUS, 1758
Migration (observations): Table I, Fig. 8C.

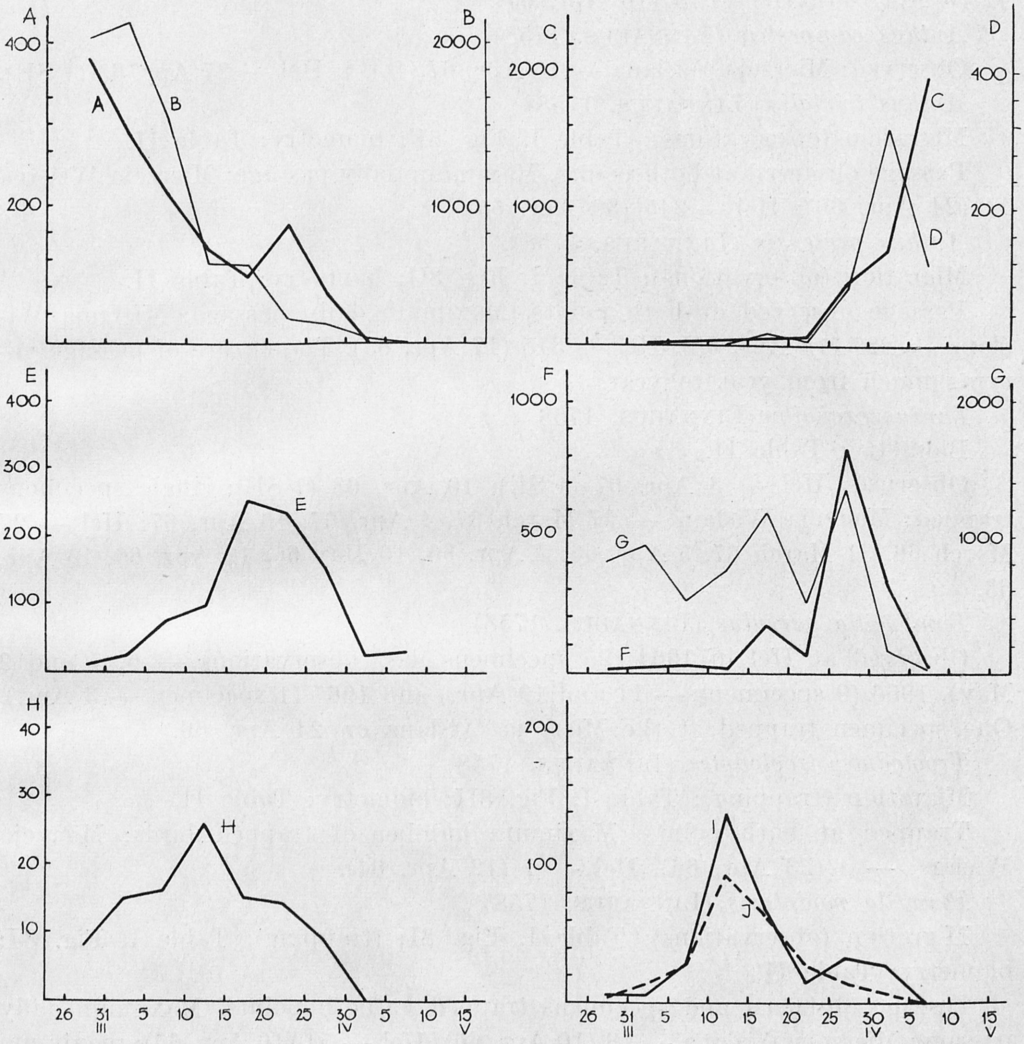

Fig. 8. Cumulative pentad graphs of passage (P_{5S}). Results of observations (O) and trapping (V). A — *Lullula arborea* (O), B — *Alauda arvensis* (O), C — *Hirundo rustica* (O) D — *Delichon urbica* (O), E — *Motacilla alba* (O), F — *Anthus trivialis* (O), G — *Anthus pratensis* (O), H — *Troglodytes troglodytes* (V), I — *Prunella modularis* (O), J — *P. modularis* (V). For other explanations see Fig. 6

Passage observed at both points, 14 specimens trapped at Hel. Maximum daily passage: Hel — 278 (8 May 64).

Delichon urbica (LINNAEUS, 1758)
Migration (observations): Table I, Fig. 8D.

Passage observed at Hel. Maximum daily passage — 11 (5 May 63).

Motacilla alba Linnaeus, 1758

Migration (observations): Table I, Fig. 8E; biometry: Table II.

Passage observed at both points. Maximum daily passage: Mierzeja Wiślana — 47 (6 Apr. 66), Hel — 73 (16 Apr. 64).

Anthus campestris (Linnaeus, 1758)

Observed: Mierzeja Wiślana — 16 Apr. 67 (1 W); Hel — 27 Apr. 65 (1 SE),

Anthus trivialis (Linnaeus, 1758)

Migration (observations): Table I, Fig. 8F; biometry: Table II.

Passage observed at both points. Maximum daily passage: Mierzeja Wiślana 14 (24 Apr. 66); Hel — 245 (30 Apr. 65).

Anthus pratensis (Linnaeus, 1758)

Migration (observations): Table I, Fig. 8G; biometry: Table II.

Passage observed at both points. Maximum daily passage: Mierzeja Wiślana — 227 (19 Apr. 66), Hel — 315 (17 Apr. 63). The nature of passage varying much from year to year.

Lanius excubitor Linnaeus, 1758

Biometry: Table II.

Observed: Hel — 8 Apr. 67 (1 SE), 10 Apr. 63 (1 SE); single specimens trapped: Mierzeja Wiślana — 27 March 67, 4 Apr. 67, 10 Apr. 67; Hel — 27 March 66, 31 March 67, 5 Apr. 66, 7 Apr. 66, 10 May 65, 12 Apr. 66, 15 Apr. 63.

Bombycilla garrulus (Linnaeus, 1758)

Observed at Hel in 1964 (25 specimens, last observations — 6, 7 and 9 May), 1966 (9 specimens — 11 and 19 Apr.) and 1967 (1 specimen — 3 Apr.). One specimen trapped at the Mierzeja Wiślana on 24 Apr. 66.

Troglodytes troglodytes (Linnaeus, 1758)

Migration (trapping): Table I, Fig. 8H; biometry: Table II.

Trapped at both points. Maximum number of trapped birds: Mierzeja Wiślana — 4 (23 Apr. 66), Hel — 7 (12 Apr. 64).

Prunella modularis (Linnaeus, 1758)

Migration (observations): Table I, Fig. 8I; (trapping): Table I, Fig. 8J; biometry: Table II.

Passage observed and specimens trapped at both points. Maximum daily passage: Mierzeja Wiślana — 13 (10 Apr. 66), Hel — 54 (10 Apr. 65); maximum number of birds trapped per day — 18 (Hel — 14 Apr. 65). The graphs in Fig. 8I and J constructed of data from observation and trapping, differ somewhat from each other. Observations indicate the existence of the other wave of passage between 26 Apr. and 5 May, whereas trapping does not point at it. This difference might be ascribed to the inaccuracy of methods for the determination of migration intensity, but the picture obtained from visual observations agrees with that of autumn migration (Nitecki, 1969). In both cases the passage consists of two waves and, in addition, the less numerous spring wave corresponds with the less numerous autumn wave.

Locustella naevia (Boddaert, 1783)

Biometry: Table II.

Hel: observed — 3 (9 May 64), trapped — 1 (5 May 66), 2 (8 May 64) and 4 (15 May 66).

Locustella luscinioides (Savi, 1884)

Singing heard at the Mierzeja Wiślana on 25 Apr. 66.

Acrocephalus scirpaceus (Herman, 1804)

Two specimens caught in a pine coppice on the Hel Peninsula (4 May 66, 15 May 66).

Sylvia borin (Boddaert, 1783)

Trapped at Hel: 8 May 66 (1), 15 May 66 (2).

Sylvia atricapilla (Linnaeus, 1758)

Migration (trapping): Table I, Fig. 9A; biometry: Table II.

Trapped at Hel in 1964 and 1966.

Sylvia curruca (Linnaeus, 1758)

Migration (trapping): Table I, Fig. 9B; biometry: Table II.

Trapped at both points.

Sylvia communis Latham, 1787

Trapped singly at Hel — 5, 6, 10 and 13 May 66.

Phylloscopus sp. Boie, 1826

Passage observed at the Mierzeja Wiślana (12 and 14 Apr. 67, 20, 21, 23, 24 and 25 Apr. 66 — 19 specimens flying W and one E) and Hel (2 and 5 May 63 — 3 birds flying SE).

Phylloscopus collybita Vieillot, 1817

Migration (trapping): Table I, Fig. 9C; biometry: Table II.

Trapped at both points, more numerous on the Mierzeja Wiślana. Maximum daily number of specimens traped: Mierzeja Wiślana — 15 (25 Apr. 66), Hel — 7 (13 Apr. 64). Passing specimens of *Phylloscopus* observed at the Mierzeja Wiślana most likely belonged to this species (W movement).

Phylloscopus trochilus (Linnaeus, 1758)

Migration (trapping): Table I, Fig. 9D; biometry: Table II.

Trapped at both points; more numerous at the Mierzeja Wiślana. Maximum daily numbers of specimens trapped: Mierzeja Wiślana — 33 (25 Apr. 66), Hel — 9 (10 May 66).

Phylloscopus sibilatrix (Bechstein, 1793)

Migration (trapping): Table I, Fig. 9E; biometry: Table II.

Trapped at both points. Maximum daily number of specimens trapped: Mierzeja Wiślana — 7 (25 Apr. 66), Hel — 19 (8 May 64).

Regulus regulus (Linnaeus, 1758)

Migration (observations): Table I, Fig. 9F; (trapping): Table I, Figs. 9G and 16; biometry: Table II.

Observed and trapped at both points. Maximum daily passage: Mierzeja Wiślana — 258 (6 Apr. 66), Hel — 53 (14 Apr. 63); maximum daily number of specimens trapped: Mierzeja Wiślana — 543 (6 Apr. 66), Hel — 516 (6 Apr. 66).

Regulus ignicapillus (Temminck, 1820)
Migration (trapping): Table I; biometry: Table II.
Trapped singly at both points.

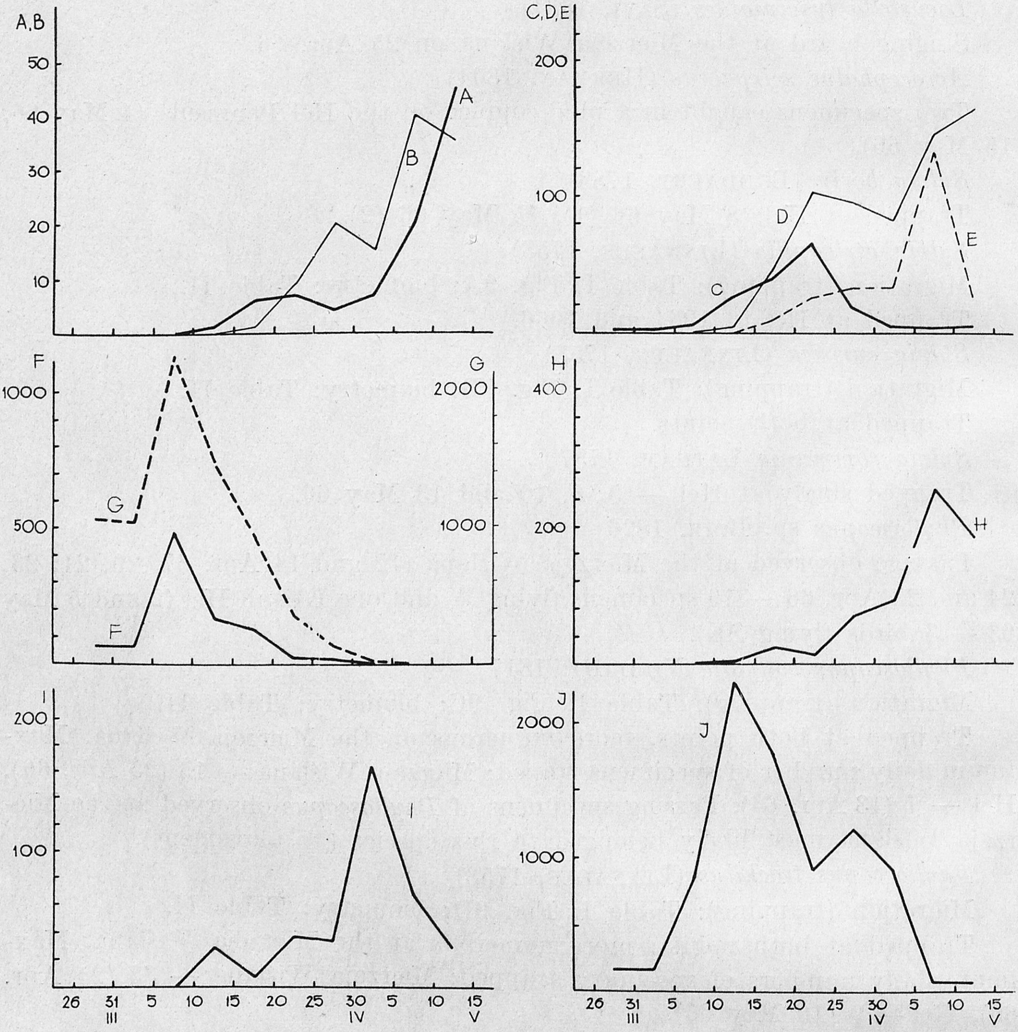

Fig. 9. Cumulative pentad graphs of passage (P_{5s}). Results of observations (O) and trapping (V). A — *Sylvia atricapilla* (V), B — *S. curruca* (V), C — *Phylloscopus collybita* (V), D — *Ph. trochilus* (V), E — *Ph. sibilatrix* (V), F — *Regulus regulus* (O), G — *R. regulus* (V), H — *Ficedula hypoleuca* (V), I — *Phoenicurus phoenicurus* (V), J — *Erithacus rubecula* (V). For other explanations see Fig. 6

Muscicapa striata (Pallas, 1764)
Trapped at Hel: 7 May 66, 9 May 64, 14 May 66.
Ficedula hypoleuca (Pallas, 1764)
Migration (trapping): Table I, Fig. 9H; biometry: Table II.

Trapped at both points. Maximum daily number of specimens trapped: Mierzeja Wiślana — single specimens, Hel — 48 (8 May 64).

Ficedula albicollis (Temminck, 1815)

Trapped: Mierzeja Wiślana — 26 Apr. 66, Hel — 26 Apr. 64, 29 Apr. 64.

Ficedula parva (Bechstein, 1793)

Trapped at Hel — 13 Apr. 66.

Saxicola rubetra (Linnaeus, 1758)

Biometry: Table II.

Trapped: Mierzeja Wiślana — 25 Apr. 66, Hel — 28 Apr. 64, 8 May 64 (4), 10 May 66 (3).

Phoenicurus phoenicurus (Linnaeus, 1758)

Migration (trapping): Table I, Fig. 9I; biometry: Table II, p.

Trapped at both points. Maximum daily number of specimens trapped: Mierzeja Wiślana — 15 (25 Apr. 66), Hel — 35 (4 May 66).

Phoenicurus ochruros (Gmelin, 1774)

Biometry: Table II.

Trapped singly at both points: Mierzeja Wiślana — 31 March 67, 16 Apr. 67, 21 Apr. 66; Hel — 30 March 65 (2), 7 Apr. 65 (2), 9 Apr. 64, 12 Apr. 64, 13 Apr. 63, 13 Apr. 64, 14 Apr. 64, 17 Apr. 63, 18 Apr. 65, 20 Apr. 65, 6 May 64.

Luscinia svecica (Linnaeus, 1758)

Biometry: Table II.

Trapped at Hel: 11 Apr. 64, 13 Apr. 64, 13 Apr. 65, 14 Apr. 64, 16 Apr. 67, 20 Apr. 66 (2), 20 Apr. 67, 27 Apr. 63.

Luscinia luscinia (Linnaeus, 1758)

Trapped at Hel: 14 Apr. 66, 9 May 66, 12 May 66 (3).

Erithacus rubecula (Linnaeus, 1758)

Migration (trapping): Table I, Figs. 9J and 23; biometry: Table II.

Trapped in large numbers at both points. Single specimens on passage were recorded. Maximum daily number of specimens trapped: Mierzeja Wiślana — 91 (7 Apr. 66), Hel — 462 (11 Apr. 64).

Annual pentad graphs clearly show the asynchronism of passage at the two observation points; they are one — or two-peak curves, showing different degrees of the concentration of passage.

Oenanthe oenanthe (Linnaeus, 1758)

Observed at the Mierzeja Wiślana — 22 Apr. 66 (1 W).

Turdus viscivorus (Linnaeus, 1758

Migration (observations): Table I, Fig. 10A.

Observed at both points. Maximum daily passage: Mierzeja Wiślana — 34 (21 Apr. 66), Hel — 20 (28 Apr. 65).

Turdus pilaris Linnaeus, 1758

Migration (observations): Table I, Fig. 10B; biometry: Table II.

Observed and trapped at both points. Maximum daily passage: Mierzeja Wiślana — 498 (13 Apr. 67), Hel — 342 (13 Apr. 63).

Turdus philomelos C. L. Brehm, 1831 + *Turdus iliacus* Linnaeus, 1766

Migration (observations): Table I, Figs. 2 and 10C.

Passage observed at both points. Maximum daily passage: Mierzeja Wiślana — 1,821 (21 Apr. 66), Hel — 2,676 (13 Apr. 63). The very high index of return (0.85) is probably caused by the fact that thrushes wander chiefly at night (most of the onward passage is therefore unobservable). The divergence of the curves constructed from the findings from observation and trapping (Fig. 10) is presumably due to the great predominance of night passage over the day one outside the main period of migration. The results of trapping are given below.

Turdus philomelos

Migration (trapping): Table I, Fig. 10D; biometry: Table II.

Trapped at both points. Maximum daily result of trapping: Mierzeja Wiślana — 25 (10 Apr. 67), Hel — 45 (13 Apr. 63). The annual pentad curves of passage have mostly two peaks. The passages at these two points are characterized by a fairly close synchronism.

Turdus iliacus

Migration (trapping): Table I, Fig. 10E; biometry: Table II.

Trapped at both points. Maximum daily results of trapping: Mierzeja Wiślana — 29 (12 Apr. 67), Hel — 57 (13 Apr. 63). Migration mostly with one peak and a considerable concentration of passage.

Turdus torquatus Linnaeus, 1758

Observed at both points: Mierzeja Wiślana — 22 Apr. 66 (4 W); Hel — 17 Apr. 66 (2 E). Trapped at the Mierzeja Wiślana 15 Apr. 66, 17 Apr. 66, 22 Apr. 66 (3).

Turdus merula Linnaeus, 1758

Migration (observations and trapping): Table I, Fig. 10F, G; Biometry: Table II.

Observed and trapped at both points. Maximum daily passage: Hel — 287 (15 Apr. 64); maximum daily results of trapping: Mierzeja Wiślana — 8 (5 Apr. 66), Hel — 40 (8 Apr. 64). The greatest intensity of daily passage occurs in the period of intense daily passage of other thrushes and is probably due to imitation (diurnal passage appears in the period after the maximum nocturnal passage).

Aegithalos caudatus (Linnaeus, 1758)

Migration (observations): Table I, Fig. 10H; (trapping): Table I; biometry: Table II.

Observed and trapped at both points. This species was evidently more numerous in 1963 and 1966. Maximum daily passage: Hel — 50 (19 Apr. 63); maximum daily result of trapping: Hel — 30 (8 Apr. 63).

Parus cristatus Linnaeus, 1758

Biometry: Table II.

Trapped at both points: Mierzeja Wiślana — 16 Apr. 67; Hel — 26 March 64, 27 March 64, 27 March 65, 28 March 66, 4 Apr. 65 (2), 1 Apr. 63.

Parus palustris Linnaeus, 1758

Trapped at both points: Mierzeja Wiślana — 1 Apr. 67, 4 Apr. 66, 19 Apr. 67, 23 Apr. 67; Hel — 19 Apr. 64, 25 Apr. 64.

Parus montanus Conrad v. Baldenstein, 1827

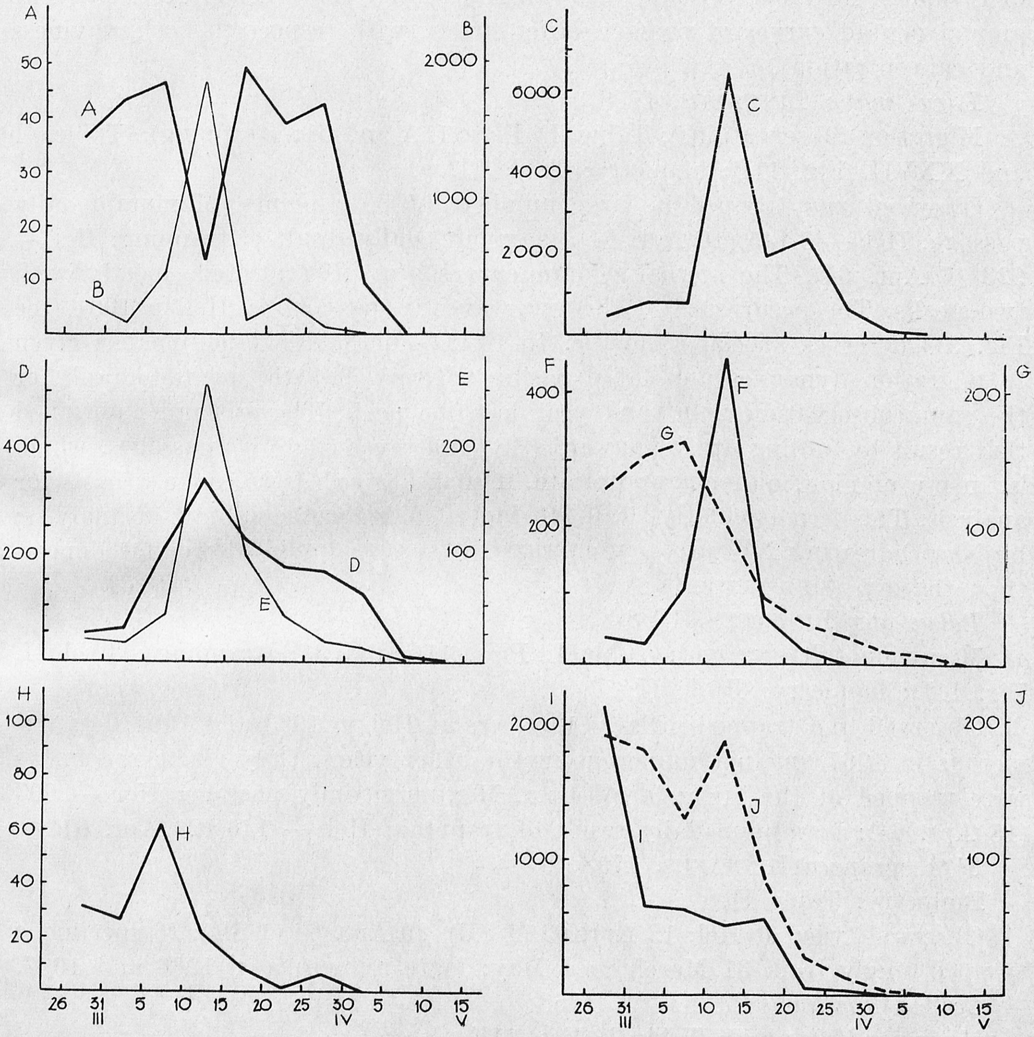

Fig. 10. Cumulative pentad graphs of passage (P_{5s}). Results of observations (O) and trapping (V). A — *Turdus viscivorus* (O), B — *T. pilaris* (O), C — *T.* (*philomelos*+*iliacus*) (O), D — *T. philomelos* (V), E — *T. iliacus* (V), F — *T. merula* (O), G — *T. merula* (V), H — *Aegithalos caudatus* (V), I — *Parus caeruleus* (O), J — *P. caeruleus* (V)

Biometry: Table II.

Trapped at both points: Mierzeja Wiślana — 25 March 67, 26 March 67 (2), 1 Apr. 67, 3 Apr. 66, 5 Apr. 66, 5 Apr. 67, 14 Apr. 67, 18 Apr. 67; Hel — 4 Apr. 66, 25 Apr. 66

Parus caeruleus Linnaeus, 1758

Migration (observations and trapping): Table I, Fig. 10I, J; biometry: Table II.

Observed and trapped at both points. Maximum daily passage: Mierzeja Wiślana — 66 (3 Apr. 66), Hel — 316 (31 March 66). Maximum daily results of trapping: Mierzeja Wiślana — 23 (3 Apr. 66), Hel — 41 (11 Apr. 65). The annual pentad curves of passage differ much (with respect to both waviness and concentration).

Parus major LINNAEUS, 1758

Migration (observations): Table I. Figs. 11A and 31; (trapping): Tables I and XXVII, Fig. 11B; biometry: Table II. p.

Observed and trapped in large numbers at both points. Maximum daily passage: Hel — 5,145 (10 Apr. 64); maximum daily result of trapping: Hel — 923 (7 Apr. 64). The annual pentad curves are differentiated, mostly with two peaks. The occurrence of the two-wave SE passage at Hel in 1964 (see Fig. 31) deserves special emphasis. In CZAJA-TOPIŃSKA'S (1969) paper given to migration dynamics and fat deposits in Great Tits the pentad graph for the same observation point and year has one peak. The authoress obtained that result by adding up the onward (SE) and reversed (NW) passages, which is, in my opinion, quite inappropriate, if such a graph is to make a basis for analysis. This is particularly so, if fat deposit is to be the subject of analysis; birds withdrawing NW are characterized by a considerably lower fat deposit than those passing onwards.

Parus ater LINNAEUS, 1758

Migration (observation): Table I; Figs. 11C and 35; (trapping): Table I, Fig. 11D; biometry: Table II.

Observed and trapped in large numbers at Hel in 1963 and 1964; less numerous in 1967 and not numerous in the other years. Only single specimens were trapped at the Mierzeja Wiślana. Maximum daily passage: Hel — 603 (18 Apr. 64); maximum daily result of trapping: Hel — 146 (20 Apr. 64).

Sitta europaea LINNAEUS, 1758

Biometry: Table II.

Observed twice at Hel: 12 Apr. 63 (1 SE), 20 Apr. 63 (1 SE); 23 specimens trapped singly from 31 March to 4 May; more numerous in 1966 and 1967.

Certhia familiaris LINNAEUS, 1758

Migration (trapping): Table I, Fig. 11E.

Trapped at both points. Maximum daily result of trapping: Hel — 17 (4 Apr. 66).

Certhia brachydactyla C. L. BREHM, 1820

Biometry: Table II.

Single specimens trapped at both points: the first specimen on 27 March 66, 10 in the period of 1—10 Apr., and the last on 14 Apr. 63

Emberiza citrinella LINNAEUS, 1758

Migration (observations): Table I, Fig. 11F; biometry: Table II.

Observed and trapped at both points. Maximum number observed per day — 27 (Hel — 28 March 67, 19 Apr. 64). Most numerous in 1964.

Emberiza hortulana LINNAEUS, 1758

Observed at Hel: 27 Apr. 65 (1 SE), 30 Apr. 65 (5 SE), 30 Apr. 64 (1 SE, 2 NW), 2 May 63 (5 SE), 2 May 64 (3 SE), 3 May 64 (1 SE, 1 NW); trapped at Hel: 1 May 63, 4 May 66.

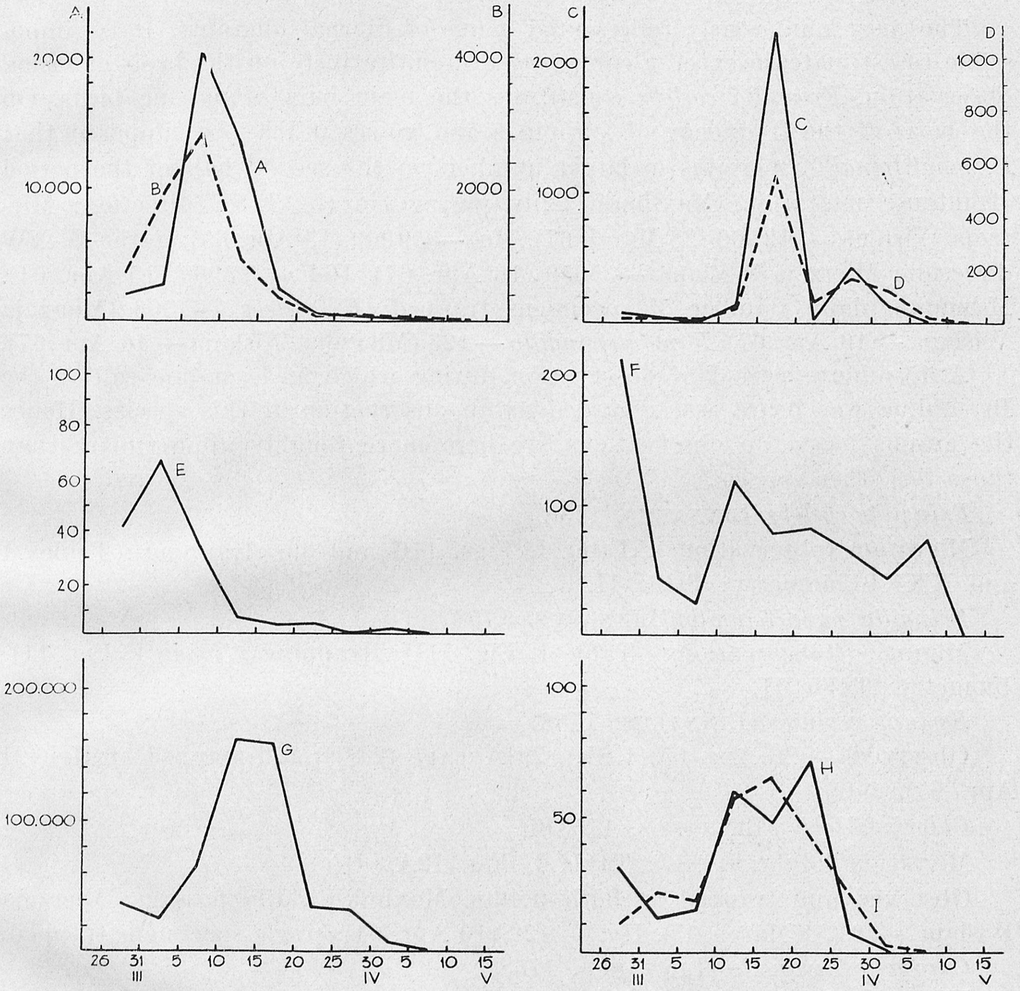

Fig. 11. Cumulative pentad graphs of passage (P_{5s}). Results of observations (O) and trapping (V). A — *Parus major*, (O), B — *Parus major* (V), C — *P. ater* (O), D — *P. ater* (V), E — *Certhia familiaris* (V), F — *Emberiza citrinella* (0), G — *Fringilla (coelebs)* (O), H — *F. montifringilla* (O), I — *F. montifringilla* (V). For other explanations see Fig. 6

Emberiza schoeniclus (LINNAEUS, 1758)

Migration (observations and trapping): Table I; biometry: Table II.

Observed and trapped at both points.

Plectrophenax nivalis (LINNAEUS, 1758)

Observed at Hel — 28 March 65 (1 SE), 29 March 65 (4).

Junco hyemalis (LINNAEUS, 1758)

One specimen (♀) trapped at Hel — 5 May 63 (BUSSE, 1963).

Fringilla sp. LINNAEUS, 1758

The most numerously represented genus of diurnal migrants. It is impossible to estimate the specific composition quantitatively on the basis of visual observation. *Fringilla coelebs* constitutes the main bulk of passing birds. On the basis of the frequency of trappings and voices it may be supposed that *F. montifringilla* migrates in larger numbers in the second half of the period of intense migration. Maximum daily passage in the E-SE direction: Mierzeja Wiślana — 12200 (28 March 67), Hel — 39900 (13 Apr. 65); in the W-NW direction: Mierzeja Wiślana — 5950 (16 Apr. 67), Hel — 17900 (15 Apr. 64). Maximum daily number of specimens trapped: *F. coelebs* — 368 (Mierzeja Wiślana — 16 Apr. 67); *F. montifringilla* — 123 (Mierzeja Wiślana — 16 Apr. 67).

A 15-minute period of observation during which at least one call of the Brambling was heard was regarded as an observation of this species. Hence the graphs based on observations are here more roughly approximate than those for other species.

Fringilla coelebs LINNAEUS, 1758

Migration (observations): Table I, Figs. 11G and 36; (trapping): Tables I and XXXI, biometry; Table II,

Fringilla montifringilla LINNAEUS, 1758

Migration (observations): Table I, Fig. 11H; (trapping): Table I, Fig. 11I; biometry: Table II,

Serinus serinus (LINNAEUS, 1758)

Observed — 26 Apr. 65 (1 SE), 29 Apr. 65 (2 SE) and trapped at Hel (21 Apr. 64).

Chloris chloris (LINNAEUS, 1758)

Migration (observations): Table I, Fig. 12A.

Observed and trapped at both points. Maximum daily passage: Mierzeja Wiślana — 9 (31 March 67), Hel — 122 (10 Apr. 64); single specimens trapped.

Carduelis carduelis (LINNAEUS, 1758)

Migration (observations): Table I, Fig. 12B; biometry: Table II.

Observed and trapped at both points. Maximum daily passage: Hel — 180 (17 Apr. 64); single specimens trapped.

Carduelis spinus (LINNAEUS, 1758)

Migration (observations and trapping): Table I, Fig. 12C, D; biometry: Table II.

Observed and trapped in large numbers at both points. Maximum daily passage: Mierzeja Wiślana — 370 (21 Apr. 66), Hel — 4830 (18 Apr. 64); maximum daily results of trapping: Hel — 87 (19 Apr. 64), Mierzeja Wiślana — single specimens. Great variation of passage as regards its intensity and nature in different years.

Acanthis flammea (LINNAEUS, 1758)

Migration (observations and trapping): Table I, Fig. 12 E, F; biometry: Table II.

Observed and trapped at both points, most numerously in 1963 and 1964 at Hel and in 1966 at the Mierzeja Wiślana. Maximum daily passage: Mierzeja Wiślana — 45 (4 Apr. 66), Hel — 416 (6 Apr. 63): Passage difficult to determine accurately as regards numbers because these birds form mixed flocks with *C. spinus*.

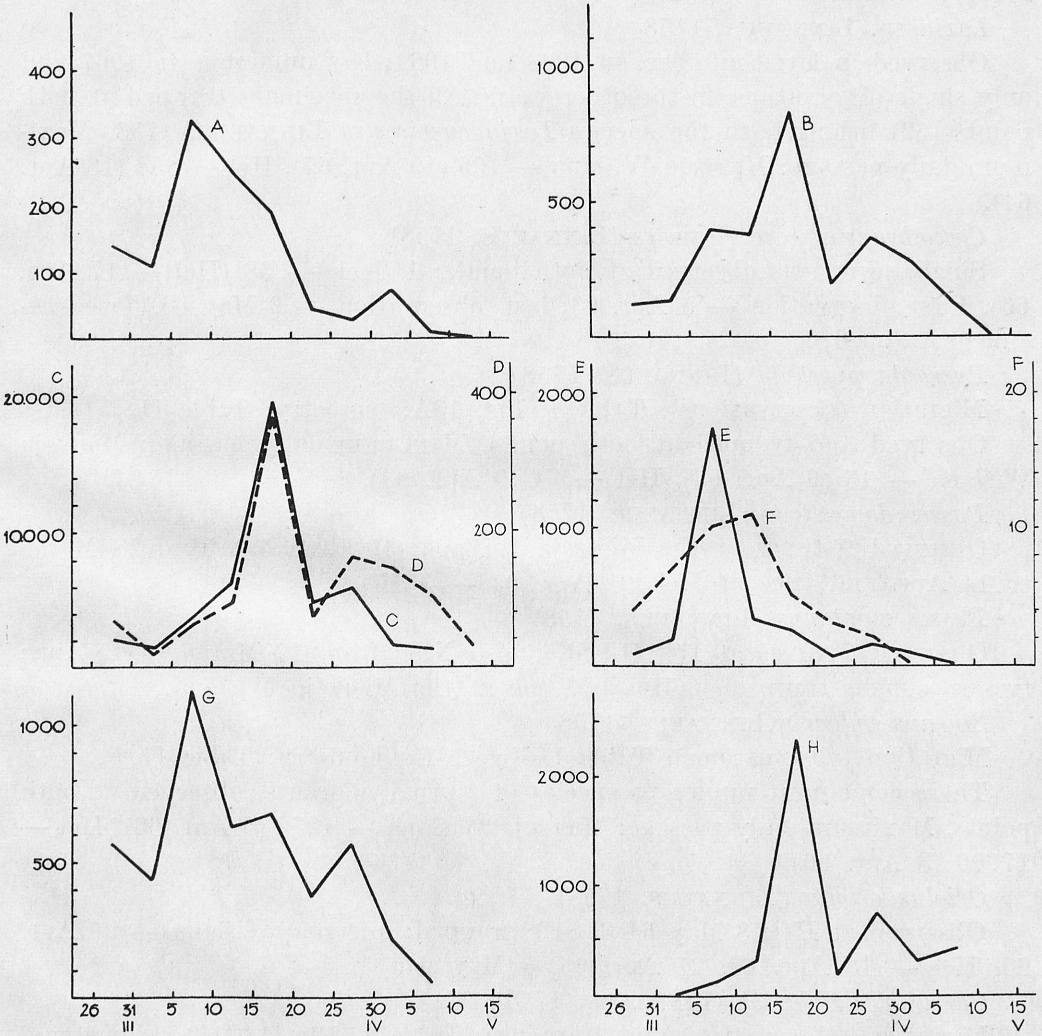

Fig. 12. Cumulative pentad graphs of passage (P_{5s}). Results of observations (O) and trapping (V), A — *Chloris chloris* (O), B — *Carduelis carduelis*, C—*C. spinus* (O), D — *C. spinus* (V), E — *Acanthis flammea* (O), F — *A. flammea* (V), G — *A. cannabina* (O), H — *Loxia (curvirostra)* (O). For other explanations see Fig. 6

Acanthis flavirostris (LINNAEUS, 1758)

Observed: Mierzeja Wiślana — 1 Apr. 67 (1 E), Hel — 6 Apr. 63 (1), 10 Apr. 64 (27).

Acanthis cannabina (LINNAEUS, 1758)

Migration (observations): Table I, Fig. 12G.

Observed at both points, 3 specimens trapped. Maximum daily passage: Mierzeja Wiślana — 15 (2 Apr. 66), Hel — 879 (10 Apr. 64).

Loxia sp. LINNAEUS, 1758

Observed in large numbers in 1963 and 1964; less numerous in 1967 and only single observations in the other years. All the specimens trapped at both points (52) belonged to the species *Loxia curvirostra* LINNAEUS, 1758. Maximum daily passage: Mierzeja Wiślana — 166 (19 Apr. 67), Hel — 853 (18 Apr. 64).

Coccothraustes coccothraustes (LINNAEUS, 1758)

Single specimens observed at both points; 1 flock — 38 (Hel — 17 Apr. 66). First observation — 5 Apr. 63; last observation — 2 May 63. Two specimens trapped.

Pyrrhula pyrrhula (LINNAEUS, 1758)

Migration (observations): Table I, Fig. 13A; biometry: Table II.

Observed and trapped at both points. Maximum daily passage: Mierzeja Wiślana — 15 (6 Apr. 66), Hel — 61 (9 Apr. 63).

Passer domesticus (LINNAEUS, 1758)

Observed 9 times at the Mierzeja Wiślana (19 E, 16 W) from 28 March to 14 Apr. and once at Hel (21 Apr. 64 — 3 SE).

Passer montanus (LINNAEUS, 1758)

Observed 7 times at Hel (12 SE and 7 NW) from 27 March to 15 Apr.; two specimens trapped at Hel and one at the Mierzeja Wiślana.

Sturnus vulgaris LINNAEUS, 1758

Migration (observations): Table I, Fig. 13B; biometry: Table II.

The second most numerous species of diurnal migrants, observed at both points. Maximum daily passage: Mierzeja Wiślana — 1275 (3 Apr. 66), Hel — 17600 (3 Apr. 66).

Oriolus oriolus (LINNAEUS, 1758)

Observed at Hel: 8 May 64 (3 SE); trapped: Mierzeja Wiślana — 26 Apr. 66, Hel — 13 Apr. 65, 27 Apr. 65, 8 May 64.

Garrulus glandarius (LINNAEUS, 1758)

Migration (observations and trapping): Table I, Fig. 13C, D; biometry: Table II.

Observed and trapped at both points. Maximum daily passage: Mierzeja Wiślana — 80 (31 March 67), Hel — 42 (30 Apr. 65).

Pica pica (LINNAEUS, 1758)

Migration (observations): Table I, Fig. 13E.

Passing specimens observed at both points. Maximum daily passage: Hel — 5 (3 Apr. 64, 15 Apr. 67).

Nucifraga caryocatactes (LINNAEUS, 1758)

Observed at the Mierzeja Wiślana — 9 Apr. 67.

Corvus monedula (LINNAEUS, 1758)

Migration (observations): Table I, Fig. 13F.

Observed at both points, often in mixed flocks with *C. frugilegus*. Maximum daily passage: Mierzeja Wiślana — 36 (27 March 66), Hel — 180 (10 Apr. 64). One flock heard flying out to the sea after dark.

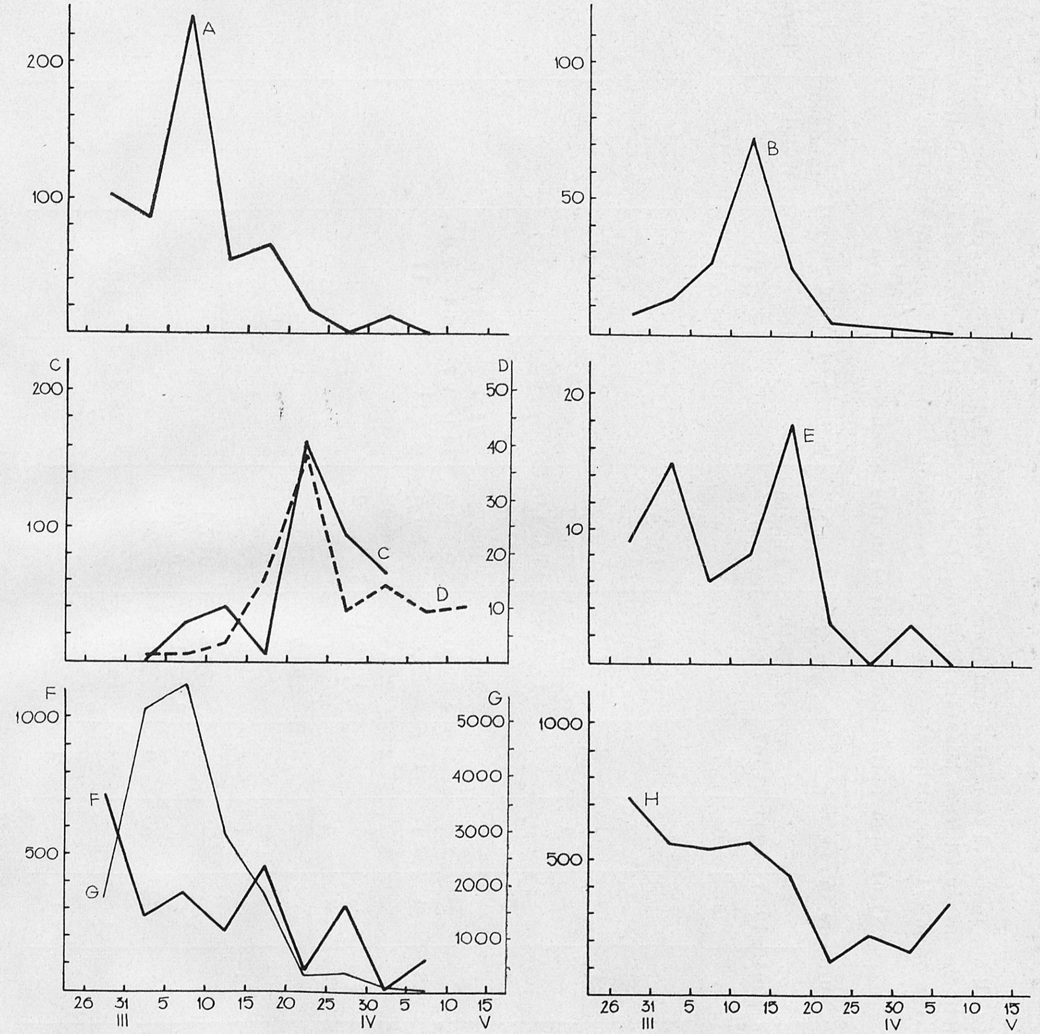

Fig. 13. Cumulative pentad graphs of passage (P_{5s}). Results of observations (O) and trapping (V). A — *Pyrrhula pyrrhula* (O), B — *Sturnus vulgaris* (O), C — *Garrulus glandarius* (O), D — *G. glandarius* (V), E — *Pica pica* (O), F — *Corvus monedula* (O), G — *C. frugilegus* (O), H — *C. corone cornix* (O). For other explanations see Fig. 6

Corvus frugilegus LINNAEUS, 1758

Migration (observations): Table I, Fig. 13G.

Table II

List of biometric data covering all the material from Hel and Mierzeja Wiślana — $(H+MW)B_S$. Explanation: columns 3—7 — the upper figures are the numbers of specimens measured from Mierzeja Wiślana, the lower figures those from Hel; the definitions of biometric parameters in columns 8—14 are given on p. 171; the arithmetic mean (M), standard deviation (σ), standard error (m) and number of specimens (N) of each parameter are given in the arrangement $\sigma \begin{matrix} M \\ N \end{matrix} m$

Species	Sex and Age	Numbers in Years					Wing Length S	Tail Length 0	Indices of Wing Shape		Standard Weight w	Fat Deposit t	Actual Weight W
		1963	1964	1965	1966	1967			e	l			
1	2	3	4	5	6	7	8	9	10	11	12	13	14
Accipiter nicus	♂♂ ad	2	1	1	— 1	— 2	202.6 — — 7	155.4 — — 5					
	♂♂ im	11	5	3	1 —	— 8	201.4 4.1 0.8 27	163.2 4.05 1.0 16					
	♀♀ im	16	8	4	2 1	— 11	201.7 4.0 0.6 42	160.7 3.0 0.6 26	71.9 11.0 1.7 11	156.5 6.4 2.0 11			
	♀♀ ad	4	1	3	— 4	2 2	237.9 8.4 2.1 15	196.0 7.2 2.2 11					
Asio otus	—	—	3	4	— 1	— —	298.7 — — 8	152.7 — — 7					
Aegolius funereus	—	—	3	7	— 5	— 9	172.5 6.0 1.3 22	107.1 4.5 0.9 24					
Dendrocopos major	♂♂	18	—	1	— —	4 1	140.7 2.2 0.4 26		28.8 — — 5	80.2 — — 5			

	♀♀	33	1	—	— —	5 1	140.4 3.4 0.6 35		27.0 — — 6	75.8 — — 6			
Jynx torquilla	—	2	4	2	1 3	— —	90.23 2.90 0.81 13	71.73 2.80 0.85 11					34.7 1.65 0.51 10
Motacilla alba	♂♂	1	—	5	3 1	6 —	87.88 3.54 0.89 16	87.27 3.05 0.78 15	55.57 4.29 1.13 14	56.00 3.80 1.00 14		T 1.53 — — 15	20.43 2.30 0.60 14
	♀♀	1	—	—	1 1	3 —	89.3 — — 6	91.0 — — 5				T 1.2 — — 6	22.7 — — 6
Anthus trivialis	—	3	10	3	7 9	1 —	88.41 2.64 0.46 32	64.14 2.25 0.42 29	51.93 3.73 0.95 15	52.30 3.88 1.00 15		T 0.91 — — 22	21.30 1.90 0.42 20
Anthus pratensis	—	1	2	3	1 1	1 3	78.2 1.76 0.50 12	59.10 2.10 0.64 11	36.6 — — 7	38.6 — — 7		T 2.0 — — 7	16.1 — — 8
Lanius excubitor	—	2	—	1	2 4	1 1	114.0 2.2 0.7 11	115.7 — — 9	35.1 — — 7	60.3 — — 7			65,6 — — 7
Troglodytes troglodytes	—	9	16	25	8 27	7 6	48.57 1.88 0.19 97	31.73 1.86 0.20 84	1.14 2.28 0.33 49	12.55 2.18 0.31 49		T 1.62 — — 70	8.68 1.15 0.14 64
Prunella modularis	—	48	30	90	1 44	2 39	69.09 2.18 0.14 234	58.94 2.42 0.18 189	14.27 2.67 0.18 209	23.94 3.20 0.21 209	18.16 1.32 0.10 155	—0.51 0.77 0.075 105	17.65 1.53 0.12 155
Locustella naevia	—	—	2	—	— 6	— —	64.6 — — 8	57.1 — — 8	26.0 — — 8	29.5 — — 8			
Sylvia atricapilla	♂♂	—	12	—	1 10	— —	75.22 1.44 0.31 23	63.13 2.22 0.42 23	27.40 3.42 1.1 10	37.80 2.78 0.84 10		T 1.23 — — 13	16.29 1.16 0.31 14

1	2	3	4	5	6	7	8	9	10	11	12	13	14
	♀♀	—	8	—	1 8	— —	76.24 1.89 0.46 17	63.63 2.14 0.53 16	26.2 — — 8	37.0 — — 8		T 1.4 — — 8	17.4 — — 8
Sylvia curruca	—	10	15	2	6 39	— —	65.66 1.96 0.23 71	55.72 2.42 0.31 61	18.82 3.19 0.51 39	24.36 2.91 0.47 39		T 0.73 — — 22	10.50 1.12 0.24 22
Phylloscopus collybita	—	7	35	19	68 14	25 6	62.33 2.62 0.21 159	50.50 2.60 0.21 159	10.34 2.82 0.28 104	23.23 3.12 0.31 104	7.46 0.66 0.057 134	—0.31 0.41 0.035 134	7.15 0.78 0.067 134
Phylloscopus trochilus	—	17	57	10	107 78	36 6	68.39 2.20 0.13 291	52.78 2.22 0.13 291	26.68 3.24 0.22 217	37.18 3.22 0.22 217	8.41 0.74 0.052 199	—0.12 0.39 0.028 193	8.29 0.84 0.059 199
Phylloscopus sibilatrix	—	19	52	4	16 19	4 —	76.89 2.13 0.20 108	51.82 3.95 0.60 92	45.93 4.20 0.64 43	50.32 4.20 0.64 43		T 1.21 — — 75	9.08 0.82 0.098 71
Regulus regulus	♂♂	79	233	430	376 481	182 376	54.55 1.34 0.030 2002	40.61 1.48 0.034 1923	5.72 1.88 0.056 1105	21.32 2.18 0.066 1105	5.16 0.48 0.014 1089	+0.18 0.32 0.010 1069	5.34 0.51 0.015 1089
	♀♀	98	151	542	743 560	263 959	52.42 1.23 0.022 3050	38.83 1.38 0.025 2951	4.83 1.71 0.040 1840	19.84 2.12 0.049 1840	5.10 0.51 0.013 1430	—0.05 0.25 0.006 1399	5.05 0.52 0.014 1430
Regulus ignicapillus	♂♂	—	4	4	— 1	2 3	53.20 1.64 0.42 15	40.47 1.75 0.45 15	5.20 1.94 0.63 10	20.60 2.38 0.77 10		T 1.45 — — 11	4.60 0.61 0.16 15
	♀♀	—	3	2	2 1	— 9	51.41 1.24 0.30 17	38.82 0.98 0.24 17	3.36 2.13 0.58 14	19.69 1.72 0.47 14		T 1.8 — — 6	4.43 0.50 0.13 14
Ficedula hypoleuca	♂♂	18	94	1	2 41	3 2	79.43 1.87 0.15 155	53.76 1.96 0.17 139	40.27 3.88 0.58 45	50.32 3.32 0.50 45		T 1.95 — — 99	12.16 1.03 0.10 96

	♀♀	4	29	—	— 13	— —	77.73 1.31 0.19 45	52.85 1.53 0.24 40	35.08 1.98 0.55 13	46.92 2.92 0.81 13		T 1.79 — — 28	11.55 0.85 0.16 29
Saxicola rubetra	—	—	5	—	— 4	— —	76.0 — — 9	46.7 — — 9					
Phoenicurus phoenicurus	♂♂	11	25	1	22 64	1 —	79.94 1.60 0.15 121	59.64 1.75 0.17 111	28.20 3.32 0.36 83	42.93 3.82 0.42 83	14.79 0.95 0.14 47	+0.20 0.55 0.079 48	14.99 1.10 0.16 47
	♀♀	—	10	—	3 42	— —	77.94 1.24 0.20 49	59.29 1.65 0.24 49	26.85 2.99 0.47 40	41.30 3.28 0.52 40			
Phoenicurus ochruros	—	1	6	5	1 —	2 —	83.30 3.27 0.84 15	61.29 2.86 0.77 14				T 1.38 — — 13	13.75 1.30 0.37 12
Luscinia svecica	♂♂	1	3	1	— 1	— 1	75.0 — — 7	57.8 — — 6					
Erithacus rubecula	—	532	1079	1256	395 803	318 569	71.79 2.03 0.029 5051	59.95 2.25 0.034 4419	4.22 2.64 0.083 1304	30.97 1.11 0.020 1034	15.68 3.00 0.083 3064	—0.23 0.54 0.010 2891	15.45 1.24 0.022 3064
Turdus pilaris	—	19	—	1	3 1	4 —	144.96 4.19 0.79 28	105.7 — — 9	84.0 — — 8	96.0 — — 8			100.0 — — 7
Turdus philomelos	—	239	179	170	114 121	215 84	116.7 2.90 0.09 1113	83.4 3.22 0.11 874	61.2 5.09 0.22 558	69.2 5.42 0.23 558			65.0 4.64 0.17 714
	ad				— 35	44 39	117.3 2.68 0.25 118	85.1 3.31 0.30 118	62.5 4.73 0.51 85	71.0 4.78 0.51 85			65,3 4.28 0.49 76
	imm				60 86	171 45	116.3 2.42 0.13 362	82.9 2.95 0.15 362	61.5 4.83 0.22 292	70.50 4.79 0.28 292			64.9 4.05 0.24 262

1	2	3	4	5	6	7	8	9	10	11	12	13	14
Turdus iliacus	—	1	53	55	7 50	126 71	116.4 2.90 0.16 347	80.4 3.24 0.17 347	66.6 5.90 0.35 260	75.3 5.52 0.34 260			58.1 4.30 0.25 294
	ad				— 27	31 29	116,6 2.50 0.28 82	81.0 3.06 0.34 82	67.5 4.50 0.55 67	76.3 4.70 0.57 67			58.1 4.30 0.56 60
	imm				7 23	95 42	115.9 2.76 0.22 160	80.8 2.98 0.24 160	67.2 3.20 0.26 147	75.8 4.87 0.40 147			57.9 3.72 0.33 130
Turdus merula	♂♂ ad	6	32	16	2 7	1 6	131.7 3.79 0.48 62	112.0 5.90 0.79 56	32.5 5.00 1.3 17	56.6 4.4 1.1 17			91.0 7.9 1.0 59
	♂♂ imm	35	102	52	15 27	11 11	128.8 3.28 0.21 241	107.6 5.20 0.36 209	29.4 4.62 0.56 68	54.3 5.01 0.60 68			86.5 6.25 0.44 201
	♀♀ ad	34	48	56	13 12	10 26	126.7 3.50 0.26 185	106.3 5.00 0.41 152	27.1 5.06 0.60 73	51.7 4.95 0.58 73			84.0 6.15 0.53 148
	♀♀ imm	18	93	26	12 26	13 20	125.1 3.39 0.24 191	104.5 4.22 0.32 176	27.2 4.01 0.54 55	51.0 4.80 0.65 55			83.3 6.81 0.45 169
Aegithalos caudatus	—	91	4	—	16 46	2 24	64.12 1.82 0.20 85	91.12 4.06 0.44 85	—1.58 1.93 0.23 69	27.55 2.84 0.34 69			8.01 0.73 0.84 74
Parus cristatus	—	1	2	3	— 1	1 —	64.0 — — 8	50.0 — — 7					10.3 — — 7
Parus montanus		1	—	—	2 2	3 1	61.9 — — 9	55.7 — — 8	—4,6 — — 8	19.4 — — 8			9.5 — — 6

Parus caeruleus	—	122	70	274	69 112	11 34			2.94 2.33 0.14 295	21.40 2.68 0.16 295	10.07 0.80 0.040 402	+0.11 0.50 0.025 402	10.18 0.95 0.047 402
	ad	32	13	24	4 16	1 3	66.64 2.00 0.23 72	53.24 1.65 0.24 46					
	imm	90	57	250	65 96	10 26	65.25 1.93 0.085 521	52.58 2.04 0.048 431					
Parus major	♂♂ ad		1719	152	20 29	14 2	75.91 1.92 0.075 645	65.47 2.40 0.095 645	—0,81 3.15 0.30 111	25.62 3.21 0.30 111	17.87 1.06 0.033 1049	—0.10 0.66 0.020 1049	17.17 1.25 0.039 1049
	♂♂ imm		798	89	17 109	27 5	75.34 1.82 0.095 373	64.23 2.26 0.12 373	—0.50 2.38 0.20 143	25.56 2.54 0.24 143	17.77 1.19 0.054 484	—0.07 0.65 0.029 484	17.70 1.36 0.062 484
	♀♀ ad		658	162	9 32	5 7	73.67 2.05 0.092 451	62.66 2.22 0.30 451	—0.84 3.07 0.30 103	25.55 3.10 0.31 103	16.93 1.10 0.048 530	—0.14 0.75 0.032 533	16.79 1.34 0.058 530
	♀♀ imm	1363	333		53 235	45 19	73.01 1.93 0.058 1097	61.81 2.22 0.067 1097	—0.69 2.51 0.15 281	23.03 2.28 0.14 281	16.81 1.05 0.032 1055	—0.08 0.68 0.021 1055	16.73 1.25 0.038 1055
Parus ater	—	370	431	—	— —	— —	59.78 1.78 0.063 801	46.77 2.10 0.10 431			8.25 0.77 0.033 569	+0.10 0.30 0.013 569	8.35 0.83 0.035 569
Sitta europaea	—	1	1	—	1 9	3 4	85.50 1.42 0.34 18	46.61 1.49 0.36 18	17.31 2.69 0.75 13	33.62 2.34 0.65 13			20.3 — — 9
Certhia familiaris	—	19	27	15	14 61	6 11	63.45 1.85 0.15 143				7.87 0.84 0.093 83	+0.30 0.44 0.048 83	8.17 0.95 0.10 83
Certhia brachydactyla	—	2	—	1	1 1	1 2	63.1 — — 8		5.0 — — 5	24.6 — — 5			

1	2	3	4	5	6	7	8	9	10	11	12	13	14
Emberiza citrinella	♂♂	6	19	11	5 3	12 5	89.47 2.97 0.38 60	76.26 3.36 0.45 54	37.41 4.39 0.78 32	40.47 4.26 0.76 32	29.01 2.18 0.34 42	—0.04 0.58 0.09 42	29.97 2.26 0.35 42
	♀♀	2	6	2	2 1	12 4	85.00 1.57 0.31 26	73.58 3.21 0.63 26	35.18 4.83 1.07 17	39.18 4.50 1.10 17	27.48 2.40 0.53 20	+0.17 0.62 0.14 20	27.65 2.47 0.55 20
Emberiza schoeniclus	♂♂	2	—	2	1 1	1 —	79.1 — — 7	66.2 — — 5					
	♀♀	1	—	3	3 —	1 —	75.4 — — 8	62.6 — — 7					16.6 — — 7
Fringilla coelebs	♂♂ ad	148	89	163	90 25	207 7	89.68 2.26 0.083 730	68.76 2.42 0.10 590	38.36 4.01 0.19 452	44.16 4.30 0.20 452	21.73 1.45 0.071 418	—0.33 0.69 0.071 413	21.40 1.63 0.080 418
	♂♂ imm	97	98	451	153 39	312 19	87.76 2.23 0.065 1169	66.97 2.38 0.075 1070	36.76 3.84 0.13 838	41.16 3.88 0.14 838	21.44 1.44 0.050 820	—0.31 0.68 0.024 822	21.13 1.60 0.056 820
	♀♀ ad	75	188	273	71 17	291 23	82.95 1.94 0.063 948	62.79 2.20 0.075 863	34.11 3.53 0.15 586	38.96 3.65 0.15 586	19.37 1.05 0.045 560	—0.37 0.90 0.038 555	19.00 1.39 0.059 560
	♀♀ imm	82	146	307	97 15	585 9	82.27 2.05 0.058 1241	62.18 2.13 0.064 1150	33.95 3.48 0.12 874	38.11 3.74 0.13 874	19.45 1.29 0.042 917	—0.53 0.45 0.015 912	18.19 1.36 0.045 917
Fringilla montifringilla	♂♂ ad	4	3	8	5 1	34 5	92.27 2.02 0.26 60	65.62 2.28 0.30 56	see text	see text	21.85 1.20 0.17 48	—0.35 1.26 0.18 47	21.50 1.74 0.25 48
	♂♂ imm	12	7	18	13 2	66 6	91.05 2.58 0.24 120	64.34 2.65 0.26 108	„ „	„ „	22.02 1.86 0.19 99	—0.63 1.13 0.11 99	21.39 2.18 0.22 99
	♀♀ ad	3	8	10	9 1	28 4	86.11 2.40 0.31 59	60.35 2.44 0.33 55	„ „	„ „	20.93 1.62 0.22 55	—0.78 1.14 0.16 52	20.15 1.98 0.27 55

	♀♀ imm	9	2	18	20 8	96 5	86.09 2.34 0.20 138	60.71 2.44 0.21 129	„ „	„ „	20.52 1.47 0.13 120	—0.52 1.06 0.10 115	19.68 1.81 0.16 120
Carduelis carduelis	♂♂	—	6	4	— —	— —	81.11 — — 10	51.3 — — 10					16.0 — — 10
Carduelis spinus	♂♂ ad	?	96	40	3 2	— 2	72.82 2.00 0.17 135	45.13 1.66 0.14 135	51.23 3.12 0.50 41	51.41 2.96 0.46 41	11.82 0.96 0.045 126	+0.45 0.51 0.045 126	12.27 1.09 0.10 126
	♂♂ imm	?	181	90	4 17	— —	72.61 1.75 0.11 236	45.31 2.06 0.13 236	50.12 3.75 0.40 90	50.42 3.49 0.37 90	12.04 1.13 0.077 216	+0.36 0.49 0.033 216	12.40 1.24 0.084 216
	♀♀ ad	?	68	44	1 5	— 1	71.39 1.81 0.18 101	44.06 1.95 0.19 101	48.11 3.56 0.67 29	49.21 3.62 0.67 29	11.50 1.02 0.10 115	+0.61 0.57 0.053 115	12.11 1.17 0.11 115
	♀♀ imm	?	111	102	1 7	2 2	70.51 1.72 0.12 220	43.88 1.95 0.13 220	47.09 3.78 0.43 75	47.55 3.69 0.42 75	11.60 0.99 0.067 208	+0.57 0.58 0.040 208	12.57 1.15 0.080 208
Acanthis flammea	♂♂	6	—	—	4 4	2 3	74.39 1.83 0.44 18	56.33 1.25 0.36 12				T 2.1 8 — — 11	12.5 — — 8
	♀♀	9	—	—	1 3	— 2	73.29 2.08 0.56 14	58.2 — — 6	42.2 — — 6	43.2 — — 6			
Pyrrhula pyrrhula	♂♂	—	—	2	— 4	4 2	94.17 1.40 0.40 12	71.50 1.50 0.43 12	30.7 4.1 1.2 12	41.7 4.3 1.2 12		T 1.2 — — 6	30.4 — — 9
	♀♀	1	3	1	3 8	6 2	91.17 1.24 0.26 23	69.30 1.92 0.40 23	30.4 3.7 0.9 16	38.2 4.3 1.1 16		T 2.00 — — 13	30.12 2.24 0.55 17
Sturnus vulgaris	♂♂	19	4	1	—	1 —	130.8 2.33 0.47 25						

1	2	3	4	5	6	7	8	9	10	11	12	13	14
	♀♀	19	1	1	2 —	2 —	128.8 2.32 0.47 21						
Garrulus glandarius	—	1	—	3	5 19	69 2	180.9 4.9 0.6 79	155.6 5.8 0.6 79	28.6 6.9 1.1 38	64.9 9.1 1.5 38			

Passage observed at both points. Maximum daily passage: Mierzeja Wiślana — 207 (28 March 67), Hel — 2566 (10 Apr. 64).

Corvus corone cornix LINNAEUS, 1758

Migration (observations): Table I, Fig. 13H.

Passage observed at both points. Maximum daily passage: Mierzeja Wiślana — 62 (4 Apr. 66), Hel — 168 (11 Apr. 64). Index of return till 25 Apr. — 0.23, after 25 Apr. — 1.12 (probably flights observed are chiefly those of the local population to its feeding grounds).

Corvus corax LINNAEUS, 1758

Observed at both points, one or two specimens each time, throughout the period of observations.

IV. BIOMETRIC CHARACTERISTICS OF PASSAGE

The most generalized basic biometric data — $(H + MW)B_s$ — concerning all the species of which at least 6 specimens have been measured are given in Table II. It contains material covering all the main biometric parameters discussed in this paper:

Wing length — measured by the flattened chord method (CORNWALLIS and SMITH, 1960);

Tail length — measured by the method of the Operation Baltic („to the back" — BUSSE and KANIA, 1970);

Indices of wing end shape („e" and „l") obtained from the quantitative wing formula: $e = \Sigma p - \Sigma d$, $l = \Sigma p + \Sigma d$, where Σp is the sum of distances of the ends of the proximal remiges from the wing tip and Σd the sum of distances of the ends of distal remiges (HOŁYŃSKI, 1965; BUSSE, 1967a);

Standard weight (w) — mean weight allowing for fat deposit, obtained from the formula $w = W - t$, where W is the actual weight and t the fat deposit (see below);

Fat deposit (t or T). T — mean degree of fat deposit acc. to the scale (BUSSE and KANIA, 1970), t — mean deviation in grams from the T_2 degree of fat deposit (BUSSE, 1970);

Actual weight (W) — mean weight not modified by correction t.

The arithmetic mean (M), standard deviation (σ), mean error of mean (m) and number of specimens (N) are given for each parameter and they permit the full utilization of the data for comparative purposes. The following polygraphic arrangement of these values is used in the tables:

$$\sigma \frac{M}{N} m$$

I have carried out complete or only partial analyses, based on the scheme discussed in Section II (Figs. 3 and 4), for particular species according to the material that I have had at my disposal.

Accipiter nisus

In addition to the standard measurements presented in Table II, the lengths of beak and tarsometatarsus were measured and the results are given in Table III.

Table III

Measurements of the beak and tarsometatarsus in *Accipiter nisus* on the basis of material from Hel and Mierzeja Wiślana together — $(H+MW)B_s$

Sex	N	Beak			Tarsometatarsus		
		M	σ	m	M	σ	m
1	2	3	4	5	6	7	8
♂♂	34	11,6	0,54	0,093	56,5	2,76	0,48
♀♀	15	14,2	0,75	0,19	63,7	2,37	0,62

Aegolius funereus

Beak length: M = 15.8 mm (N = 14, σ = 1.67).

Prunella modularis

Although the division of passages into two waves was not very distinct (p. 149), I compared the biometric parameters of two alleged groups (Table IV). The comparison shows that the birds that migrate earlier are bigger. The difference in wing length is statistically highly significant ($p > 0.00003$), those in tail length and symmetry index of wing-tip „e” are close to the level of significance ($p = 0.04$ and 0.02) and the differences in index „l” and standard weight „w” are not significant. The direction of differences corresponds with Nitecki's (1969) data for autumn waves. The possibility that the differences observed resulted from the differentiation of the sex composition of these two groups cannot — as yet — be excluded, because Dementiev et al. (1954) write that males and females differ somewhat in measurements.

Phylloscopus collybita

The wing and tail correlation chart compiled for all the specimens trapped in the spring shows the existence of two well-marked groups (Fig. 14A). These groups most likely correspond to sexes, since according to the data from literature (Dementiev et al., 1954; Williamson, 1962) Chiffchaff males are distinctly larger than females. The unequal numbers of specimens in the two groups can be explained by the fact that the time of observation at the point where most specimens were recorded (Mierzeja Wiślana) did not cover the final portion of the passage of this species, when females fly in the largest numbers. Biometric parameters of both groups are included in Table V (all the differences are statistically significant). A comparison of Chiffchaffs flying over the Hel Peninsula with those from the Mierzeja Wiślana is given in Table VI. The groups of alleged males differ significantly only in weight, which however

Table IV

Biometric differentiation of cumulative territorial-temporal groups in *Prunella modularis* for Hel and Mierzeja Wiślana together — (H + MW)B_G. Arrangement of data: $\sigma \genfrac{}{}{0pt}{}{M}{N} m$; for other explanations see p. 171

Dates	Wing Length S	Tail Length O	Indices of Wing Shape		Standard Weight w	Fat Deposit t	Actual Weight W
			e	l			
1	2	3	4	5	6	7	8
to 20 IV	69.33 2.14 0.15 194	59.06 2.46 0.19 160	14.42 2.80 0.21 171	24.05 3.16 0.24 171	18.17 1.25 0.10 140	—0.47 0.85 0.086 97	17.70 1.51 0.13 140
from 21 IV	67.95 2.02 0.31 41	58.28 2.16 0.40 29	13.55 2.42 0.39 38	23.37 3.38 0.54 38	18.11 1.49 0.38 15	—1.0 — — 8	17.13 1.62 0.42 15

Table V

Biometric parameters of presumable sex groups of *Phylloscopus collybita* for Hel and Mierzeja Wiślana together — (H + MW)B_s.

Arrangement of data: $\sigma \substack{M \\ N} m$; for other explanations see p. 171

Sex	Wing Length S	Tail Length 0	Indices of Wing Shape		Standard Weight w	Fat Deposit t	Actual Weight W
			e	l			
1	2	3	4	5	6	7	8
♂♂	63.27 1.65 0.14 131	51.42 1.65 0.14 131	10.67 2.93 0.33 83	23.90 3.04 0.33 83	7.55 0.59 0.056 113	—0,27 0.41 0.036 112	7.28 0.72 0.068 113
♀♀	57.50 1.24 0.23 28	46.18 1.75 0.33 28	9.05 1.59 0.34 21	20.47 0.53 0.33 21	6.69 0.42 0.096 19	—0.53 0.24 0.052 21	6.16 0.49 0.12 19

Table VI

Biometric parameters of cumulative territorial groups of *Phylloscopus collybita* — B_s. Arrangement of data: $\sigma \begin{matrix} M \\ N \end{matrix} m$; for other explanations see p. 171

Sex	Point	Wing Length S	Tail Length O	Indices of Wing Shape		Stand. Weight w	Fat Deposit t	Actual Weight W
				e	l			
1	2	3	4	5	6	7	8	9
♂♂	Hel (H)	63.14 1.61 0.22 57	51.77 1.42 0.19 57	9.80 2.48 0.55 21	24.29 2.93 0.64 21	7.17 0.51 0.078 42	—0.22 0.35 0.053 41	6.95 0.62 0.095 42
	Mierzeja Wiślana (MW)	63.32 1.68 0.19 74	51.15 1.75 0.20 74	10.95 3.07 0.39 62	23.77 3.07 0.39 62	7.78 0.57 0.068 71	—0.30 0.41 0.049 71	7.48 0.71 0.084 71
♀♀	Hel (H)	57.50 1.35 0.36 14	45.86 1.77 0.48 14					
	Mierzeja Wiślana (M)W	57.50 1.12 0.30 14	46.50 1.68 0.45 14			6.77 0.51 0.13 15	—0.57 0.17 0.044 15	6.20 0.54 0.14 15

is not enough to admit the existence of a territorial differentiation of specimens that fly over these two observation points.

Phylloscopus trochilus

The wing and tail length correlation chart (Fig. 14B) shows the presence of two groups analogous to those in *Ph. collybita.* They are however less distinct as there are intermediate specimens. The quantitative relations of these groups — 269 males and 22 females — are natural, since, as in *Ph. collybita*, the observation period at the points did not include the whole passage. The differentiation of the time of passage of males and females is also reflected by the data published by Durman (1967) and Rabøl (1967). A comparison of biometric parameters is given in Table VII. All the parameters but the index of wing symmetry „e" differ significantly. The distribution of values obtained for the indices of wing shape („e" and „l") of alleged males is shown in Fig. 15. In females these values are lower, reaching 32 for „e" and 38 for „l". In comparison with the foregoing the trapping of 6 specimens with distinctly higher „e" and „l" values (e = 36, 36, 36, 40, 40, 41 and l = 44, 46, 46, 50, 50, 51) on the Mierzeja Wiślana on 20—25 April 1966 seems interesting. A comparison of alleged males trapped at Hel and Mierzeja Wiślana is given in Table VIII. Only the tail length differs significantly, but the other parameters have the same direction of differences. The existence of a wider territorial differentiation in the Willow Warbler is also indicated by Durman's (1967) and Rabøl's (1967) data; the wing length represented most numerously was 67 mm at Bardsey in Great Britain, 69 mm at Hosselø in Denmark and 70 mm on the Polish

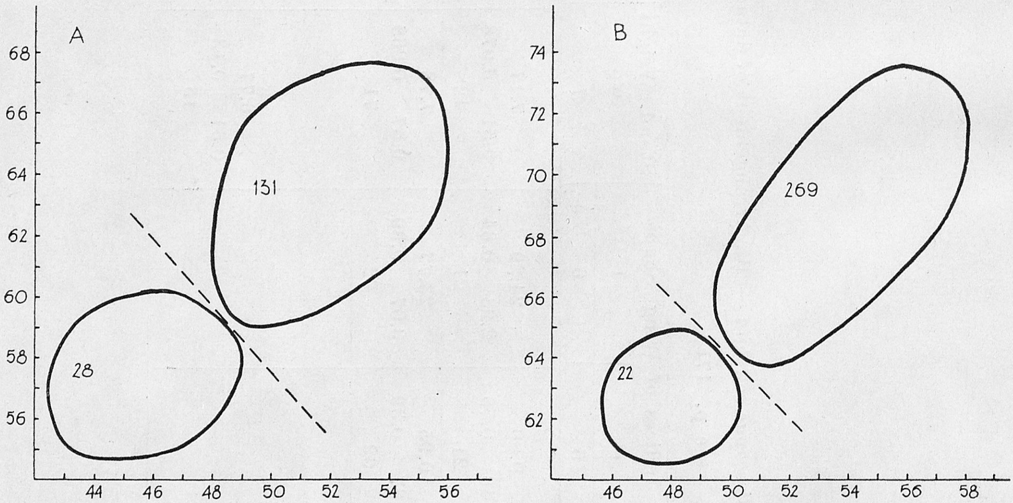

Fig. 14. A simplified chart of correlation of the wing and tail (acc. to Busse's (1968) method). Numbers of specimens in groups given in the drawing. A — *Phylloscopus collybita*, B — *Phylloscopus trochilus*; solid line — simplified contour, dashed line — boundary between groups. The horizontal axis indicates the length of tail, the vertical axis that of wing

Table VII

Biometric parameters of presumable sex groups of *Phylloscopus trochilus* for Hel and Mierzeja Wiślana together — (H + MW)B_s.

Arrangement of data: $\sigma \overset{M}{N} m$, for other explanations see p. 171

Sex	Wing Length	Tail Length	Indices of Wing Shape		Standard Weight	Fat Deposit	Actual Weight
	S	0	e	l	w	t	W
1	2	3	4	5	6	7	8
(♂♂)	68.84 1.65 0.10 269	53.07 1.90 0.12 269	26.83 3.16 0.22 206	37.37 3.14 0.22 206	8.48 0.70 0.22 187	—0.13 0.40 0.030 180	8.35 0.81 0.059 187
(♀♀)	63.05 1.11 0.24 22	48.18 1.15 0.24 22	23.82 3.62 1.10 11	33.64 2.67 0.81 11	7.49 0.62 0.18 12	—0.07 0.45 0.12 13	7.42 0.76 0.22 12

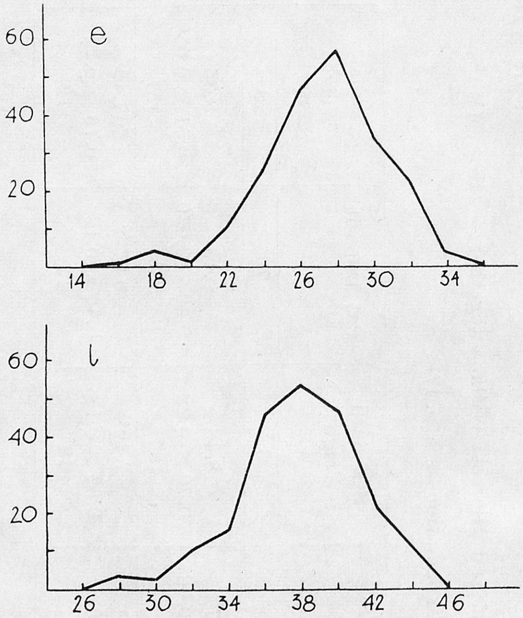

Fig. 15. Distribution of the values of the wing shape indices „e" and „l" in *Phylloscopus trochilus* (alleged males). The horizontal axis indicates the values of index, the vertical axis the number of specimens

coast. It may be supposed therefore that after more material has been gathered it will be possible to demonstrate this differentiation also within the area of the Polish coast.

Regulus regulus

A population analysis of the passage of this species has already been carried out on the basis of variation in the sex composition of passage in course of time (Busse and Machalska, 1969). A great number of specimens trapped makes a close biometrical analysis of this problem possible.

On the basis of daily graphs of passage (P_1 — Fig. 16) the material has been divided into basic units (B_{py}), which after a preliminary comparative analysis are combined into annual territorial—temporal groups (B_{Gy}). The result of this grouping coincides as a rule with the result of the analysis of sex composition (Busse and Machalska, 1969). Small changes occurred at the Hel point in 1965 and 1967. In 1965 the boundary between the two groups was shifted from 20 April to 16 April on the basis of a greater biometric differentiation, which was particularly well seen as regards the indices of wing shape in females. This shifting is also acceptable in the light of criteria assumed in the study quoted (cumulative graphs of sex composition), for the stoppage of a rapid increase in the proportion of females occurred on 16 April and the swing on 20 April was very slight in the graph. These two facts, put together, may indicate a partial overlap of the passage periods of two groups. The perfect

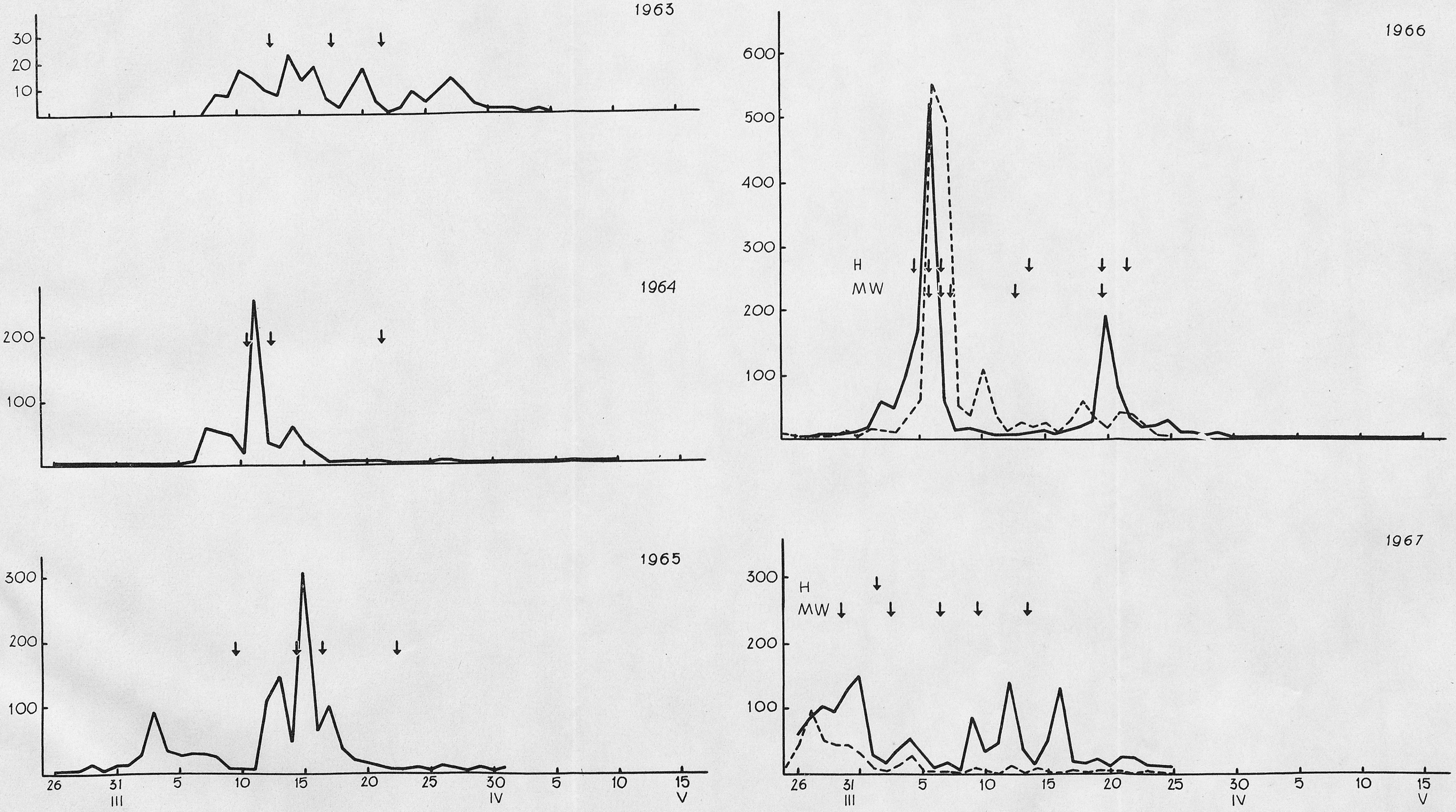

Fig. 16. Daily graphs of passage (P_1) of *Regulus regulus*. Results of trapping. The arrows indicate the assumed division of biometric material into basic units (B_{py}). The vertical axis represents numbers of specimens

Table VIII

Biometric parameters of cumulative territorial groups of male *Phylloscopus trochilus* for Hel and Mierzeja Wiślana separately — B_s.

Arrangement of data: $\sigma \underset{N}{\overset{M}{}} m$, for other explanations see p. 171

Point	Wing Length	Tail Length	Indices of Wing Shape		Standard Weight	Fat Deposit	Actual Weight
	S	0	e	l	w	t	W
1	2	3	4	5	6	7	8
H	68.70 1.71 0.15 133	53.26 1.90 0.16 133	26.32 3.18 0.35 82	37.23 2.78 0.31 82	8.39 0.68 0.086 62	—0.04 0.47 0.062 56	8.35 0.82 0.10 62
MW	68.94 1.53 0.13 136	53.88 1.88 0.16 136	27.17 3.10 0.28 124	37.46 3.33 0.30 124	8.50 0.69 0.062 125	—0.16 0.40 0.036 124	8.34 0.80 0.072 125

Table IX

Biometric parameters of basic units of *Regulus regulus* — B_{py}. Arrangement of data: $\sigma \genfrac{}{}{0pt}{}{M}{N} m$. The thick lines between the successive units represent the significance of the difference between the values of the parameter at a level of 0.01. For other explanations see p. 171

Year, Sex, Point	Group, Unit	Wing Length S	Tail Length 0	Indices of Wing Shape e	Indices of Wing Shape l	Standard Weight w	Fat Deposit t	Actual Weight W
1	2	3	4	5	6	7	8	9
1964 ♂♂								
H	I a to 11 IV	53.87 1.11 0.10 127	39.91 1.71 0.15 127			5.27 0.41 0.036 129	+0.12 0.14 0.013 127	5.39 0.44 0.039 129
	I b 12—13 IV	53.55 1.10 0.13 66	40.47 1.66 0.20 66			5.28 0.48 0.048 103	+0.10 0,17 0.017 102	5.38 0.51 0.051 103
	I c 14—22 IV	53.40 1.44 0.23 40	40.70 2.01 0.32 40					
♀♀								
H	I a to 11 IV	51.96 1.68 0.34 25	38.52 1.60 0.32 25			5.19 0.45 0.095 23	+0.07 0.22 0.047 22	5.26 0.50 0.104 23
	I b 12—13 IV	51.48 0.99 0.14 50	38.10 1.52 0.21 50			5.03 0.52 0.065 63	+0.02 0.25 0.032 61	5.05 0.56 0.070 63
	I c 14—22 IV	51.09 1.19 0.14 76	39.29 1.65 0.19 76			5.28 0.74 0.085 76	+0.14 0.20 0.023 75	5.42 0.76 0.087 76
1965 ♂♂								

H	I a to 9 IV	54.84 1.49 0.10 230	40.76 1.67 0.11 230	5.34 2.28 0.23 100	21.46 2.62 0.27 94	5.33 0.52 0.035 223	+0.07 0.20 0.013 222	5.40 0.56 0.038 223
	I b 11—14 IV	54.89 1.21 0.11 112	40.82 1.38 0.13 112	7.40 1.79 0.36 25	21.96 2.86 0.57 25	5.04 0.41 0.041 103	—0.04 0.21 0.022 88	4.98 0.46 0.046 103
	I c 15—16 IV	54.62 1.20 0.16 56	40.59 1.47 0.20 56	6.39 2.60 0.62 18	21.83 2.76 0.64 18	4.97 0.35 0.051 46	—0.08 0.22 0.033 45	4.89 0.42 0.062 46
	II 17—22 IV	55.25 1.06 0.19 32	40.81 1.20 0.20 32	6.00 2.76 0.63 19	20.43 3.00 0.082 19	5.05 0.35 0.063 30	—0.08 0.17 0.031 30	4.97 0.39 0.071 30
♀♀								
H	I a to 9 IV	52.65 1.43 0.17 63	39.44 1.72 0.21 63	4.32 1.60 0.32 25	18.58 1.91 0.39 25	5.16 0.48 0.060 64	+0.03 0.22 0,028 64	5.19 0.53 0.066 64
	I b 11—14 IV	52.61 1.16 0.11 112	38.80 1.40 0.13 112	6.04 2.17 0.43 26	20.08 2.44 0.48 26	4.72 0.31 0.031 107	—0.09 0.18 0.019 95	4.63 0.35 0.034 107
	I c 15—16 IV	52.88 1.11 0.077 207	38.89 1.34 0.093 207	6.59 2.50 0.35 53	21.89 2.88 0.40 53	4.85 0.35 0.028 157	—0.09 0.19 0.015 156	4.76 0.40 0.032 157
	II a 17—22 IV	53.27 1.30 0.11 140	39.16 1.42 0.12 140	5.40 2.22 0.23 78	19.19 2.22 0.25 80	4.86 0.39 0.033 136	—0.07 0.21 0.018 136	4.79 0.45 0.039 136
	II b from 23 IV	53.25 0.88 0.19 20	39.55 1.14 0.25 20	5.07 1.83 0.49 14	19.23 3.36 0.93 14	4.94 0.40 0.095 18	—0.05 0.10 0.024 18	4.89 0.41 0.098 18
1966 ♂♂								
H	I a to 4 IV	55.05 1.06 0.077 192	40.91 1.24 0.090 192	5.14 1.71 0.13 170	20.67 1.88 0.14 170			

1	2	3	4	5	6	7	8	9
	I b 5 IV	54.94 1.02 0.13 66	40.58 1.25 0.15 66					
	I c 6 IV	55.01 1.12 0.11 103	41.21 1.20 0.12 103					
	7—19 IV	54.71 1.48 0.18 69	40.90 1.50 0.18 69	4.78 1.60 0.22 51	20.20 1.95 0.27 51			
	II after 20 IV	54.78 1.09 0.15 51	40.69 1.53 0.22 51					
MW	I a to 5 IV	54.37 1.21 0.13 91	40.70 1.38 0.15 91	6.50 1.42 0.15 92	22.09 2.14 0.22 92	5.35 0.35 0.038 85	—0.09 0.18 0.038 85	5.25 0.38 0.041 85
	I b 6 IV	54.24 1.17 0.11 108	40.73 1.23 0.12 108	5.96 1.42 0.17 82	21.34 2.04 0.25 82	5.55 0.35 0.065 28	—0.21 0.12 0.023 28	5.34 0.38 0.072 28
	I c 7 IV	54.43 1.36 0.20 44	40.48 1.52 0.23 44	6.13 1.62 0.24 43	22.09 2.07 0.31 43	5.72 0.30 0.049 37	—0.22 0.14 0.024 37	5.50 0.33 0.054 37
	I d 9—11 IV	54.62. 1.47 0.20 55	40.36 1.38 0.19 55	5.80 2.07 0.28 54	22.09 2.12 0.29 54	5.41 0.41 0.056 54	0.00 0.32 0.043 54	5.41 0.52 0.071 54
	II a 13—19 IV	54.83 1.42 0.19 58	40.16 1.12 0.15 58	5.35 1.59 0.19 69	19.89 1.77 0.21 69	5.37 0.33 0.043 59	—0.02 0.25 0.032 59	5.35 0.42 0.055 59
	II b after 20 IV	53.73 1.01 0.31 11	40.18 1.19 0.36 11					

♀♀								
H	I a to 4 IV	52.62 1.00 0.18 29	38.69 0.95 0.18 29	4.52 1.23 0.43 29	19.14 1.81 0.33 29			
	I b 5 IV	52.63 1.58 0.25 41	39.02 1.20 0.19 41					
	I c 6 IV	52.40 1.03 0.085 149	38.93 1.21 0.099 149					
	7—19 IV	52.38 1.10 0.11 102	39.18 1.08 0.11 102	4.21 1.59 0.20 63	19.02 1.98 0.25 63			
	II a 20—21 IV	52.35 1.06 0.089 147	38.96 1.27 0.10 147					
	II b after 22 IV	52.23 1.22 0.13 92	38.92 1.33 0.14 92	4.30 1.40 0.17 66	19.18 1.79 0.22 66			
MW	I a to 5 IV	52.37 1.15 0.17 43	38.63 1.14 0.17 43	5.46 1.78 0.20 42	20.60 1.78 0.27 42	5.12 0.24 0.037 43	—0.12 0.19 0.029 43	4.98 0.30 0.046 43
	I b 6 IV	51.92 0.99 0.065 234	38.34 1.17 0.076 234	5.20 1.31 0.10 158	20.49 1.90 0.15 158	5.36 0.31 0.046 48	—0.17 0.18 0.028 46	5.19 0.37 0.054 48
	I c 7 IV	52.09 0.90 0.77 137	38.52 1.28 0.11 137	4.87 1.48 0.13 135	20.22 1.66 0.14 135	5.29 0.24 0.022 121	—0.25 0.18 0.016 119	5.04 0.30 0.027 121
	I d 9—11 IV	52.33 1.07 0.098 118	38.50 1.23 0.11 118	4.61 1.88 0.17 117	20.50 1.76 0.16 117	5.12 0.35 0.032 116	—0.04 0.32 0.029 46	5.08 0.47 0.047 116

1	2	3	4	5	6	7	8	9
	II a 13—19 IV	52.58 1.24 0.12 112	38.41 1.30 0.12 111	4.30 1.88 0.18 108	18.80 1.79 0.17 108	5.21 0.44 0.041 111	—0.01 0.26 0.025 111	5.20 0.51 0.049 111
	II b after 20 IV	51.92 0.99 0.099 99	38.28 1.14 0.11 100	5.08 1.54 0.16 97	18.70 1.89 0.19 97	5.16 0.40 0.046 77	—0.02 0.24 0.028 77	5.14 0.47 0.053 77
1967 ♂♂								
H	I a to 29 III	54.24 1.52 0.11 198	40.24 1.54 0.11 198	5.45 1.72 0.13 176	21.23 2.22 0.17 176			
	I b 30 III— 2 IV	54.86 1.02 0.12 73	40.63 1.16 0.14 73	4.69 1.71 0.22 61	20.56 2.35 0.30 61			
	3—13 IV	55.16 1.09 0.12 77	41.05 1.36 0.15 77	5.28 1.70 0.20 73	20.71 2.23 0.27 73			
	II after 14 IV	54.61 1.37 0.26 28	40.75 1.45 0.27 28	5.24 1.55 0.28 25	21.04 2.52 0.50 25			
♀♀								
H	I a to 29 III	52.31 1.33 0.11 150	38.55 1.49 0.12 150	4.76 1.42 0.11 162	19.85 2.28 0.19 162			
	I b 30 III— 2 IV	52.90 1.06 0.071 227	39.25 1.27 0.084 227	4.05 1.38 0.10 179	19.25 1.81 0.14 179			
	3—9 IV	52.92 1.06 0.083 165	39.34 1.18 0.092 165	4.34 1.62 0.13 151	19.28 1.89 0.15 151			

	II a 10—13 IV	52.93 1.07 0.073 209	59.36 1.23 0.085 209	4.48 1.82 0.14 176	19.52 1.95 0.15 176			
	II b after 14 IV	52.49 1.26 0.088 208	30.14 1.53 0.11 208	4.73 1.72 0.13 170	19.85 2.21 0.17 170			

parallelism of the passage curves for Hel and Mierzeja Wiślana in 1967 suggests the accordance of the divisions into groups. However, as the biometrical analysis did not settle the question whether to leave the boundary between the groups at Hel at 6 April or to shift it to 1 April, the questionable unit (2—9 April) has not been included in either group. An illustration of the final division into basic units (B_{py}) and annual territorial-temporal groups (B_{Gy}) is given in Fig. 17. Table IX contains the biometric documentation of this division. As will be seen from this Table the significant differences occur both between specimens numbered in different groups (males: index of wing pointedness „l”, 1966; females: wing length, tail length, 1966; both indices of wing shape, 1965) and between those belonging in the same group (males: wing length, 1966, 1967; tail length, 1966; index of wing symmetry „e”, 1965, 1966, 1967; standard weight „w”, 1965, 1966; females: wing length, 1966, 1967; tail length, 1964, 1967; index of wing symmetry „e”, 1965, 1966, 1967; index of wing pointedness „l”, 1965, 1967; standard weight „w”, 1964, 1965, 1966). The occurrence of significant differences in tail length between the males trapped on two consecutive days (Hel — 5 and 6 April 1966) is a particularly interesting case. The presence of differences inside groups (inside populations) indicates a great complexity of the biometric structure of populations on passage (possibly also in breeding grounds). Machalska (in litt.) found a similar differentiation while analysis the autumn passage of the same species.

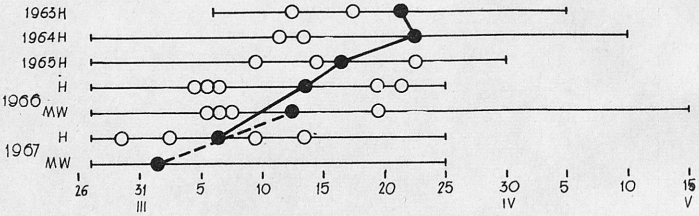

Fig. 17. Division into basic units and territorial-temporal groups in *Regulus regulus*. The lines indicate the beginning and end of observation at the points: H — Hel, MW — Mierzeja Wiślana. Open circlets — boundaries of basic units (B_{py}), filled circlets — boundaries of annual territorial-temporal groups (B_{Gy}). Boundaries of cumulative territorial-temporal groups: solid line — Hel, dashed line — Mierzeja Wiślana

Table X contains data for the determination of the annual territorial-temporal differentiation (B_{Gy}) in 1966—1967. The significance and direction of the differences are shown in Fig. 18 where particular population groups are represented by circles (groups from Hel — H I and H II, and from the Mierzeja Wiślana — MW I and MW II). One set of four circles represents the differentiation of one parameter. The mean values of a parameter for any two groups under comparison may appear equal, which is marked by a thin arrow with two heads pointing at appropriate circles (e. g. in the case of the wing length of males from groups MW I and MW II in 1967), or they may differ.

Table X

Means of biometric parameters of annual territorial-temporal groups of *Regulus regulus* for Hel and Mierzeja Wiślana separately — B_{Gy}. σ, m, N are given in Table XII, for other explanations see p. 171

Year, Group	Point	Wing Length S	Tail Length O	Indices of Wing Shape e	Indices of Wing Shape l	Wing Length S	Tail Length O	Indices of Wing Shape e	Indices of Wing Shape l
1	2	3	4	5	6	7	8	9	10
		♂♂				♀♀			
1966									
I	H	55.02	40.93	5.14	20.67	52.49	38.91	4.52	19.14
	MW	54.36	40.62	6.16	21.83	52.08	38.45	4.99	20.47
II	H	54.78	40.69			52.30	38.95	4.30	19.18
	MW	54.69	40.16	5.35	19.89	52.27	38.19	4.91	18.72
1967									
I	H	54.41	40.35	5.29	21.02	52.67	38.97	4.39	19.51
	MW	54.50	40.76	6.25	22.05	52.19	38.85	5.34	20.80
II	H	54.61	40.75	5.24	21.04	52.71	39.25	4.60	19.69
	MW	54.50	40.19	6.87	21.33	52.08	38.34	4.87	19.93

A difference which is not significant is represented by a thin arrow connecting two circles and pointing at the group with the higher value of this parameter. A statistically significant difference is marked by a thick arrow that points at the group with the higher mean value. Significant differences constitute the basis for the distinction of groups and therefore their symbols (thick arrows) do not connect the symbols of groups. The biometric differentiations of males and females are considered separately and the symbols of groups have two lines of comparison, one for either sex, in the figure. The accordance of the directions of arrows along these lines suggests the existence of differentiations, even though they do not represent statistically significant differences; for the fact that a difference is not significant statistically does not prove its lack in reality.

The Hel — Mierzeja Wiślana differentiation index values differ between group I and group II (I: z♂♀ = 0.8, z♂♂ = 0.9, z ♀♀ = 0.7; II: z♂♀ = 0.4, z♂♂ = 0.2, z♀♀ = 0.5). The differentiation of waves is also various at either observation point (Hel: z♂♀ = 0.1, z♂♂ = 0.0, z♀♀ = 0.1; Mierzeja Wiślana: z♂♀ = 0.5, z♂♂ = 0.4, z♀♀ = 0.6). The differences between the observation points can be also detected by comparing the oscillations in the lengths of wing and tail in consecutive years (Fig. 19); 3 cases in 8 have opposite directions of changes (one of these changes is statistically significant). Similarly, 5 cases in 12 have opposite oscillations of the values of these parameters for

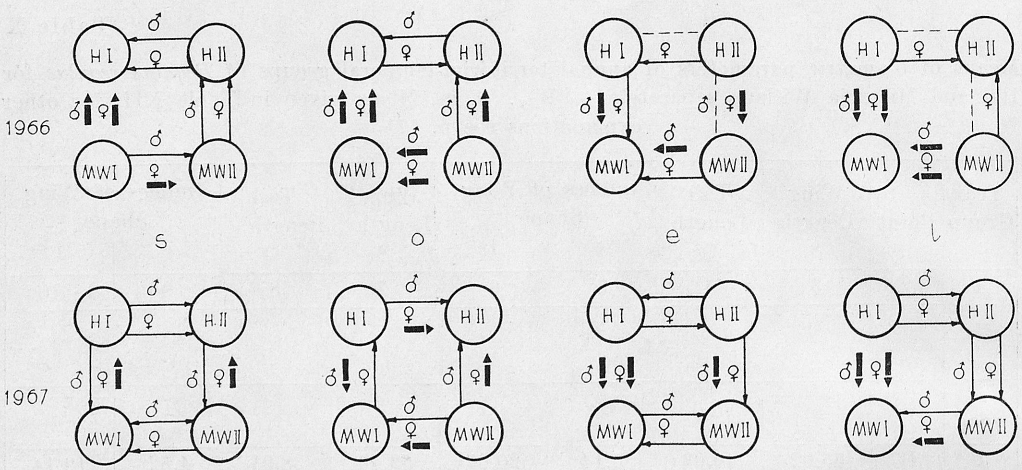

Fig. 18. A diagram showing the differentiation of annual territorial-temporal groups (B_{Gy}) in *Regulus regulus*. Thin arrow — statistically non-significant difference, thick arrow — statistically significant difference; arrows point at the group with the greater value of the parameter. H — group from Hel, MW — group from Mierzeja Wiślana. More explanation will be found in the text. S — wing length, O — tail length, e — index of symmetry of wing-tip, 1 — index of pointedness of wing-tip

An exemplary interpretation of the diagram of the differentiation of the wing length in 1967: the mean wing lengths of the females and males of group H I (Hel I) are smaller than those of group H II, but they do not differ significantly; at the same time the mean for the males from this group is smaller than the mean for group MW I (Mierzeja Wiślana I), but here the difference is not significant either. There is however a significant difference in wing length between the females of group H I and those of MW I, the former being larger than the latter. A comparison of groups H II and MW II shows the same situation as with groups H I and MW I, whereas comparing MW I and MW II we find that the means for the males are equal and the females of group MW I are larger than those of group MW II, but this last difference is not significant

waves (here, too, one difference is statistically significant). An analysis of the values of the parameters for a further degree of generalization, i. e. for the cumulative territorial-temporal groups (B_G — data: Table XI; significance and directions of differences: Fig. 20), confirms the existence of differences between both the observation points and waves. Here the differentiation is still more distinct and the values of the index „z" are on the average highe- than at the level of annual groups (B_{Gy}): the Hel — Mierzeja Wiślana differenr tiation for group I is 0.8 (for B_{Gy} also 0.8), for group II — 0.6 (B_{Gy}—0.4); the differentiation of groups I and II at Hel is 0.4 (B_{Gy}—0.1) and at the Mierzeja Wiślana — 0.5 (B_{Gy}—0.5). A comparison of males and females shows that these last are more differentiated: $z_{♀♀} = 0.48$ (B_{Gy}) and 0.65 (B_G) against, respectively, 0.37 and 0.50 in males.

The demonstration of both territorial and temporal differentiations allows the presentation of variation in the biometric parameters of a population from year to year thanks to the successful identification of definite populations in successive years. This variation is documented with the data given in Table

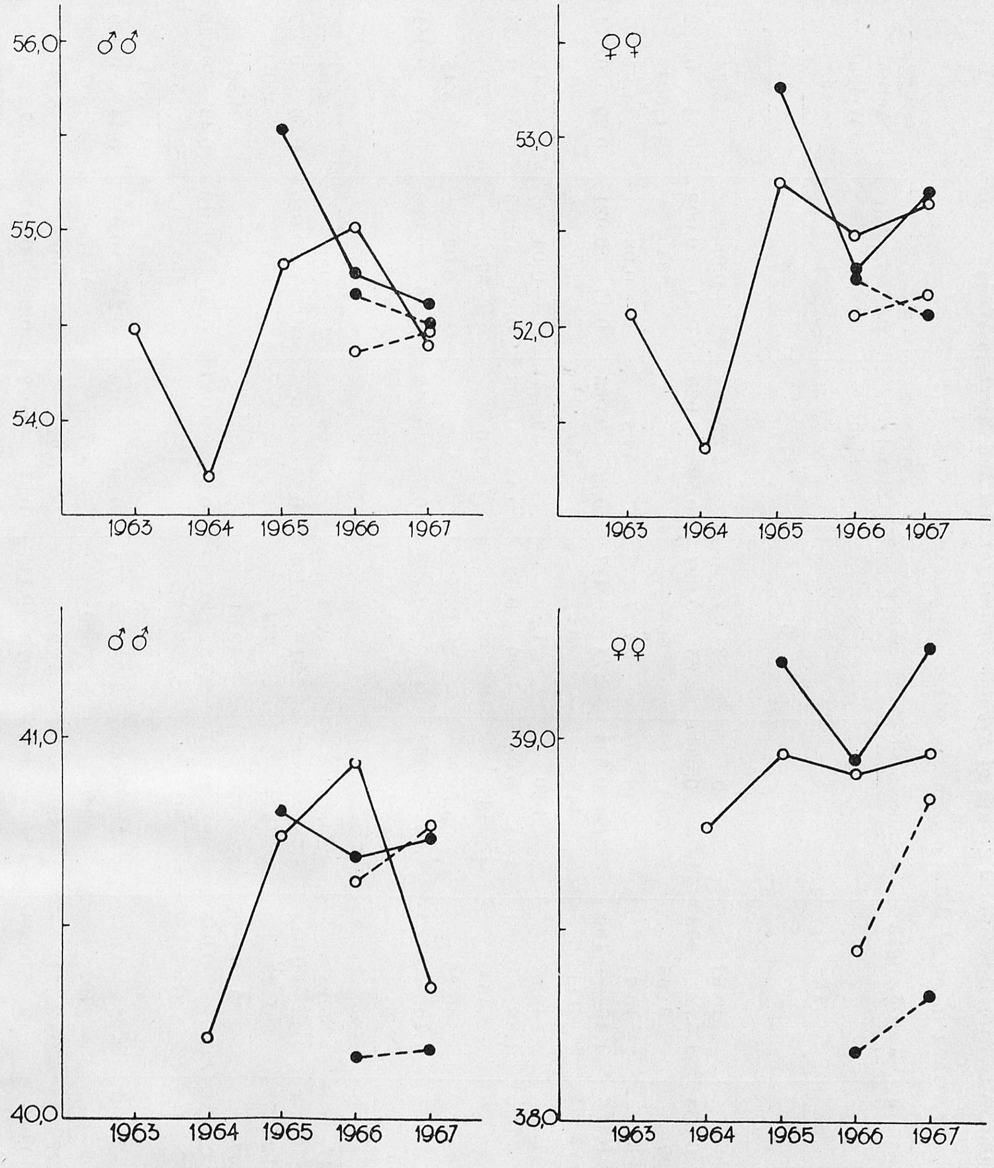

Fig. 19. Oscillation in the length (in mm) of the wing (upper graphs) and tail (lower graphs) for annual territorial-temporal groups (B_{Gy}) of *Regulus regulus*. Open circlets — group I, filled circlets — group II, solid line — Hel, dashed line — Mierzeja Wiślana

XII and the significance of the differences is illustrated by a graph in Fig. 21, in which the values of the biometric parameters in particular years are represented by suitably marked circles; circles described with dashed lines, which denote lack of data for a given year, are used to maintain a uniform graphic arrangement. The significance of the differences was tested for all combinations (following the rule „each with each") and the results is illustra-

Table XI

Biometric parameters of cumulative territorial-temporal groups of *Regulus regulus* for Hel and Mierzeja Wiślana separately — B$_G$.

Arrangement of data: $\sigma \substack{M \\ N} m$, for other explanations see p. 171

Sex, Point	Group	Wing Length S	Tail Length O	Indices of Wing Shape e	Indices of Wing Shape l	Standard Weight w	Fat Deposit t	Actual Weight W
1	2	3	4	5	6	7	8	9
♂♂								
H	I	54.55 1.39 0.038 1329	40.61 1.53 0.043 1263	5.40 1.98 0.084 558	21.04 2.25 0.097 558	5.22 0.50 0.020 604	+0.06 0.21 0.009 584	5.28 0.54 0.022 604
	II	54.85 1.16 0.105 124	40.71 1.46 0.139 111	5.48 2.21 0.334 44	20.77 2.74 0.417 44	5.05 0.35 0.063 30	—0.08 0.17 0.031 30	4.97 0.39 0.071 30
MW	I	54.41 1.22 0.056 464	40.67 1.36 0.063 464	6.20 1.64 0.081 435	21.89 1.90 0.091 435	5.49 0.45 0.023 370	—0.04 0.25 0.013 370	5.45 0.51 0.027 370
	II	54.62 1.41 0.153 85	40.16 1.15 0.125 85	5.62 1.63 0.178 84	20.13 1.82 0.198 84	5.43 0.39 0.042 85	+0.02 0.26 0.029 85	5.45 0.47 0.051 85
♀♀								
	I	52.47 1.26 0.036 1192	38.93 1.43 0.043 1129	4.73 1.78 0.082 474	19.74 2.31 0.109 474	4.99 0.55 0.025 490	—0.03 0.22 0.010 473	4.96 0.59 0.027 490
	II	52.47 1.25 0.045 852	39.15 1.37 0.048 816	4.70 1,81 0,081 501	19.51 2.13 0.095 501	4.86 0.37 0.030 154	—0.06 0.20 0.016 154	4.80 0.43 0.035 154
MW	I	52.11 1.06 0.040 702	38.55 1.25 0.047 702	5.07 1,57 0,066 600	20.28 1.78 0.073 600	5.25 0.36 0.016 507	—0.11 0.24 0.011 493	5.14 0.44 0.020 507
	II	52.21 1.15 0.065 304	38.28 1.19 0.068 304	4.90 1.80 0.106 290	19.08 1.92 0.113 290	5.22 0.37 0.022 279	+0.02 0.28 0.017 279	5.24 0.47 0.028 279

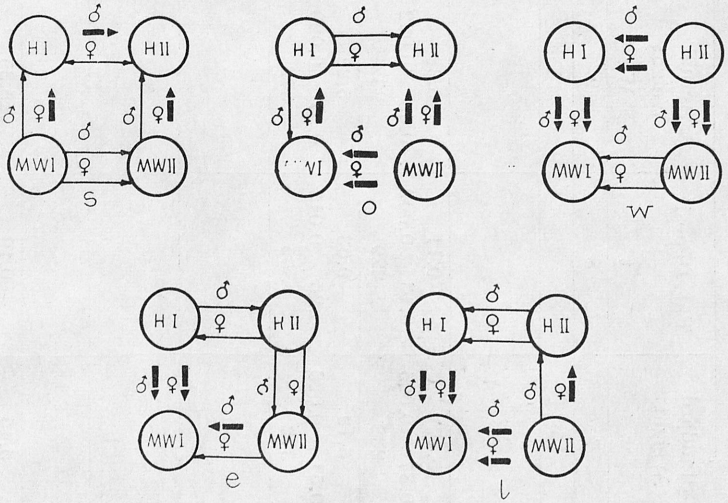

Fig. 20. A diagram of the cumulative territorial-temporal differentiation (B_G) in *Regulus regulus* S — wing length, O — tail length, w — standard weight, e — index of symmetry of wing-tip, 1 — index of pointedness of wing-tip. For other explanations see Fig. 18 (p. 188)

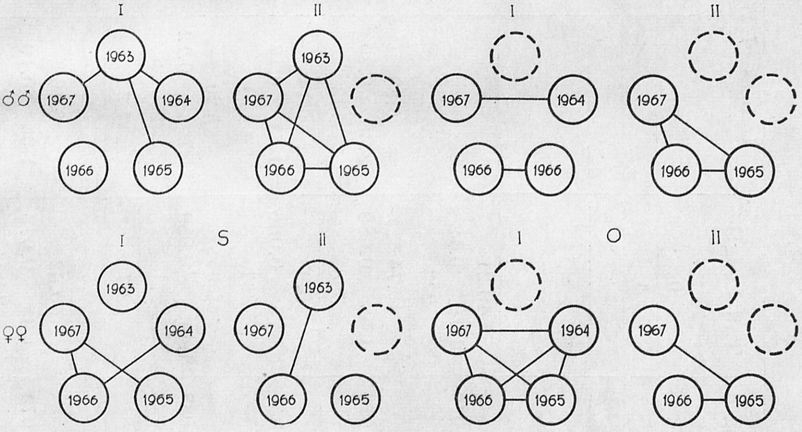

Fig. 21. A diagram of the oscillation differentiation of annual territorial-temporal groups (B_{Gy}) in *Regulus regulus*. Significance of differences in values for all years at Hel: circle-connecting line — non-significant difference, no line — significant difference, circle described with dashed line — no data for given year. S — wing length, O — tail length. More explanation will be found in the text on p. 189

An exemplary interpretation of the diagram of the wing-length differentiation in the females of group I in this drawing is as follows: the mean length of wing in 1963 is significantly different from the means for all the remaining years (no circle-connecting lines); differences are not significant between the means for 1964 and 1966, 1965 and 1967, 1966 and 1967 (lines are present) and they are significant between the means for 1964 and 1965, 1964 and 1967, 1965 and 1966 (no lines)

Table XII

Variability of parameters of annual territorial-temporal groups of *Regulus regulus* in successive years for Hel and Mierzeja Wiślana separately — B_{Gy}. Arrangement of data: $\sigma \frac{M}{N} m$, for definitions of indices "z" and "s" see p. 133 and 134, for other explanations p. 171

Sex, Point	Group, Year, Index	Wing Length S	Tail Length 0	Indices of Wing Shape e	Indices of Wing Shape l	Standard Weight w	Fat Deposit t	Actual Weight W
1	2	3	4	5	6	7	8	9
♂♂	I							
H	1963	54.48 1.42 0.18 66						
	1964	53.70 1.20 0.079 233	40.21 1.79 0.12 233			5.27 0.37 0.025 232	+0.11 0.13 0.009 229	5.38 0.48 0.032 232
	1965	54.82 1.39 0.070 398	40.74 1.58 0.080 398	5.83 2.38 0.20 143	21.60 2.71 0.23 143	5.19 0.51 0.026 372	+0.03 0.25 0.013 355	5.22 0.57 0.029 372
	1966	55.02 1.09 0.057 361	40.93 1.25 0.066 361	5.14 1.71 0.13 170	20.67 1.88 0.14 170			
	1967	54.41 1.45 0.088 271	40.35 1.46 0.089 271	5.29 1.87 0.12 235	21.02 2.18 0.14 235			
	s	4.6	2.7	1.3	1.5			
	z	0.6	0.5					
MW	1966	54.36 1.27 0.074 298	40.62 1.35 0.079 298	6.16 1.64 0.10 273	21.83 2.08 0.13 273	5.45 0.40 0.028 204	—0.10 0.20 0.014 204	5.35 0.45 0.031 204
	1967	54.50 1.10 0.085 166	40.76 1.32 0.10 166	6.25 1.60 0.13 162	22.05 1.72 0.14 162	5.53 0.51 0.040 166	+0.03 0.23 0.018 166	5.56 0.56 0.043 166

♂♂	II							
H	1963	54.77 0.90 0.248 13						
	1964							
	1965	55.25 1.06 0.19 32	40.81 1.20 0.20 32	6.00 2.76 0.63 19	20.42 3.00 0.68 19	5.05 0.35 0.063 30	—0.08 0.17 0.031 30	4.97 0.39 0.071 30
	1966	54.78 1.09 0.15 51	40.69 1.53 0.22 51					
	1967	54.61 1.37 0.26 28	40.75 1.45 0.27 28	5.24 1.55 0.28 25	21.04 2.52 0.50 25			
	s	0.7	0.6					
	z	0.0	0.0					
MW	1966	54.69 1.46 0.18 69	40.16 1.15 0.14 69	5.35 1.59 0.19 69	19.89 1.77 0.21 69	5.37 0.33 0.040 69	—0.01 0.25 0.030 69	5.36 0.41 0.050 69
	1967	54.50 1.17 0.29 16	40.19 1.12 0.28 16	6.87 1.15 0.29 15	21.33 1.60 0.41 15	5.67 0.53 0.132 16	+0.17 0.22 0.056 16	5.84 0.57 0.143 16
♀♀	I							
H	1963	52.06 1.16 0.146 62						
	1964	51.36 1.29 0.10 151	38.77 1.72 0.14 151			5.20 0.65 0.051 162	+0.05 0.19 0.015 152	5.25 0.69 0.054 162

1	2	3	4	5	6	7	8	9
	1965	52.76 1.16 0.060 382	38.96 1.44 0.074 382	5.90 2.31 0.23 104	20.60 3.04 0.30 104	4.85 0.41 0.023 328	—0.07 0.20 0.011 315	4.78 0.46 0.025 328
	1966	52.49 1.06 0.072 220	38.91 1.18 0.080 219	4.52 1.23 0.43 29	19.14 1.81 0.33 29			
	1967	52.67 1.21 0.062 377	38.97 1.42 0.073 377	4.39 1.45 0.078 341	19.51 2.05 0.11 341			
	s	6.1	2.4	3.4	2.2			
	z	0.6	0.0					
MW	1966	52.08 1.01 0.044 532	38.45 1.22 0.053 532	4.99 1.52 0.072 451	20.47 1.85 0.088 451	5.22 0.30 0.017 328	—0.15 0.25 0.014 324	5.07 0.39 0.021 328
	1967	52.19 1.18 0.091 170	38.85 1.31 0.101 170	5.34 1.71 0.15 157	20.80 1.48 0.28 157	5.26 0.42 0.032 169	—0.06 0.17 0.013 169	5.20 0.46 0.035 169
♀♀	II							
H	1963	51.97 1.40 0.23 36						
	1965	53.27 1.25 0.099 160	39.21 1.41 0.11 160	5.35 1.99 0.21 92	19.10 2.42 0.25 92	4.86 0.37 0.030 154	—0.06 0.20 0.035 154	4.80 0.43 0.035 154
	1966	52.30 1.12 0.072 239	38.95 1.30 0.084 239	4.30 1.40 0.17 66	19.18 1.79 0.22 66			
	1967	52.71 1.21 0.059 417	39.25 1.38 0.068 417	4.60 1.78 0.096 343	19.69 2.09 0.11 343			

	s	0.9	1.2	2.1	1.2			
	z	0.2	0.3					
MW	1966	52.27 1.17 0.081 211	38.19 1.25 0.086 211	4.91 1.70 0.12 205	18.72 1.84 0.13 205	5.19 0.40 0.019 188	—0.01 0.26 0.019 188	5.18 0.48 0.035 188
	1967	52.08 1.09 0.113 93	38.34 1.10 0.115 93	4.87 1.99 0.22 85	19.93 1.83 0.20 85	5.46 0.35 0.03 91	—0.10 0.25 0.025 91	5.36 0.43 0.045 91

ted diagrammatically by connecting respective circles (lack of significance) or leaving them not connected (differences found significant). Thus the lack of any significant difference is represented by lines that connect the symbols of years in all possible combinations (e. g., males — wing length, group II; females — tail length, group I); another extreme case (all differences significant) does not appear in this figure but it would be represented graphically by separate circles, not connected by any straight lines. As the data are incomplete, the degree of variation in individual parameters can be measured, using the indices „z" and „s", only for the wing and tail lengths. In both cases the variation in group I is greater than that in group II (I: z = 0.43, s = 3.95; II: z = 0.12, s. = 0.85).

All the data quoted above lead to the following general statements on the passage of Goldcrests:

1. The analysis of the parameters of annual and cumulative territorial-temporal groups indicates the existence of biometric differentiation both between the Hel and Mierzeja Wiślana observation points and between the subsequent groups of birds passing over these points. This confirms the conclusions made previously on the basis of variation in sex composition (Busse and Machalska, 1969).

2. The significant differences between basic units within a group signal the occurrence of a still subtler differentiation than that I managed to point out in this study.

3. The Goldcrest shows variation in the values of the biometric parameters of populations in consecutive years. This variation varies from population to population.

Phoenicurus phoenicurus

The small number of Redstarts trapped in the spring does not permit the confirmation of the differentiation found between the groups flying over Hel and the Mierzeja Wiślana in the autumn (Busse, 1972). The parameter values of these two groups do not differ significantly (Table XIII). A comparison of the data concerning the spring passage with those from the autumn passage (Table XIV) shows that in spring the mean wing length is smaller than it is in autumn (one difference significant) and so are the actual weight of males (no significant differences) and the tail length of birds from the Mierzeja Wiślana (no difference significant either), whereas the tail length of birds from Hel is smaller in autumn (differences significant for both sexes). The fact that the length of feathers (wing, tail) is smaller in spring (worn feathers) than in autumn (new feathers) is quite natural; on the other hand, the reversed direction of this difference suggests that different groups of birds pass over Hel in spring and in autumn. It is obvious that the members of the spring group would have to have longer tails than the birds which migrate in the autumn. On account of the scantiness of autumn material it cannot, as yet, be settled which of the groups distinguished (Busse, 1972) might be taken into account. This problem is therefore left open for the present.

Tabela XIII

Biometric parameters of cumulative territorial-temporal groups of *Phoenicurus phoenicurus* for Hel and Mierzeja Wiślana separately — B_G. Arrangement of data: $\sigma \, \substack{M \\ N} \, m$, for other explanations see p. 171

Sex	Point	Wing Length S	Tail Length O	Indices of Wing Shape e	Indices of Wing Shape l	Standard Weight w	Fat Deposit t	Actual Weight W
1	2	3	4	5	6	7	8	9
♂♂	H	79.94 1.63 0.16 98	59.58 1.85 0.20 88	27.94 3.02 0.38 62	42.71 3.58 0.45 62	14.50 1.05 0.21 25	+0.46 0.54 0.11 25	14.96 1.18 0.24 25
	MW	79.96 1.40 0.30 23	59.43 1.44 0.31 23	29.00 3.68 0.80 21	43.80 4.40 0.96 21	14.36 0.79 0.17 22	—0.09 0.35 0.074 23	14.27 0.87 0.18 22
♀♀	H	77.94 1.42 0.20 49	59.29 1.65 0.24 49	26.85 2.99 0.47 40	41.30 3.28 0.52 40			

Table XIV

Comparison of spring and autumn parameter values in cumulative territorial groups of *Phoenicurus phoenicurus* for Hel and Mierzeja Wiślana separately — B_G. Arrangement of data: M±m, for other explanations see p. 171

Sex Season, Group	♂♂			♀♀		
	Wing Length S	Tail Length O	Standard Weight w	Wing Length S	Tail Length O	Standard Weight w
Spring H	79.94±0.43	59.58±0.51	14.50±0.54	77.94±0.53	59.29±0.61	
Autumn SW-S *	80.18±0.27	58.85±0.41	14.88±0.22	78.48±0.22	58.22±0.36	
Spring MW	79.96±0.77	59.43±0.79	14.36±0.43			
Autumn SW-F *	80.63±0.25	59.91±0.38	14.61±0.22			

* Determination of autumn populations after Busse (1972).

Erithacus rubecula

The Robin is another species for which a close biometric analysis can be carried out because of the large number of specimens trapped (7204).

Daily graphs of passage (P_1 — Fig. 22) permit the division of the material into basic units, which in extreme cases embrace a two-day period (15—16 April 1965). In 1963—1965 the basic units were not joined together into annual territorial-temporal groups (Fig. 23), since the Robin's wing formula was not examined then and it seems impossible to discriminate the groups without analysing the indices of wing shape. Changes in the value of these indices were used as the basis for the consolidation of the basic units into groups in 1966—1967. The biometric characteristics of the basic units the differentiations and their significance are in Table XV. As in *R. regulus*, differences occur between units belonging to different groups as well as within one and the same group. A characteristic picture of variation of the wing and tail lengths in Robins is a descending curve; the values of these parameters are smaller and smaller usually from the very beginning of the passage to its end. According to Payevsky (1969), Robin females are smaller than males and in course of time their proportion in the number of birds flying over an observation point increases gradually and consequently the curve is descending in shape. Although the possibility of influence of this phenomenon should not be disregarded, it does not elucidate the facts associated with the correlation of the wing and tail dimensions. In an earlier methodical paper (Busse, 1968) as an example I used the differentiation of the correlation of the wing and tail lengths in the Robins trapped at Hel in the spring of 1966. Figs. 3, 4, 7 and 8 of the quoted

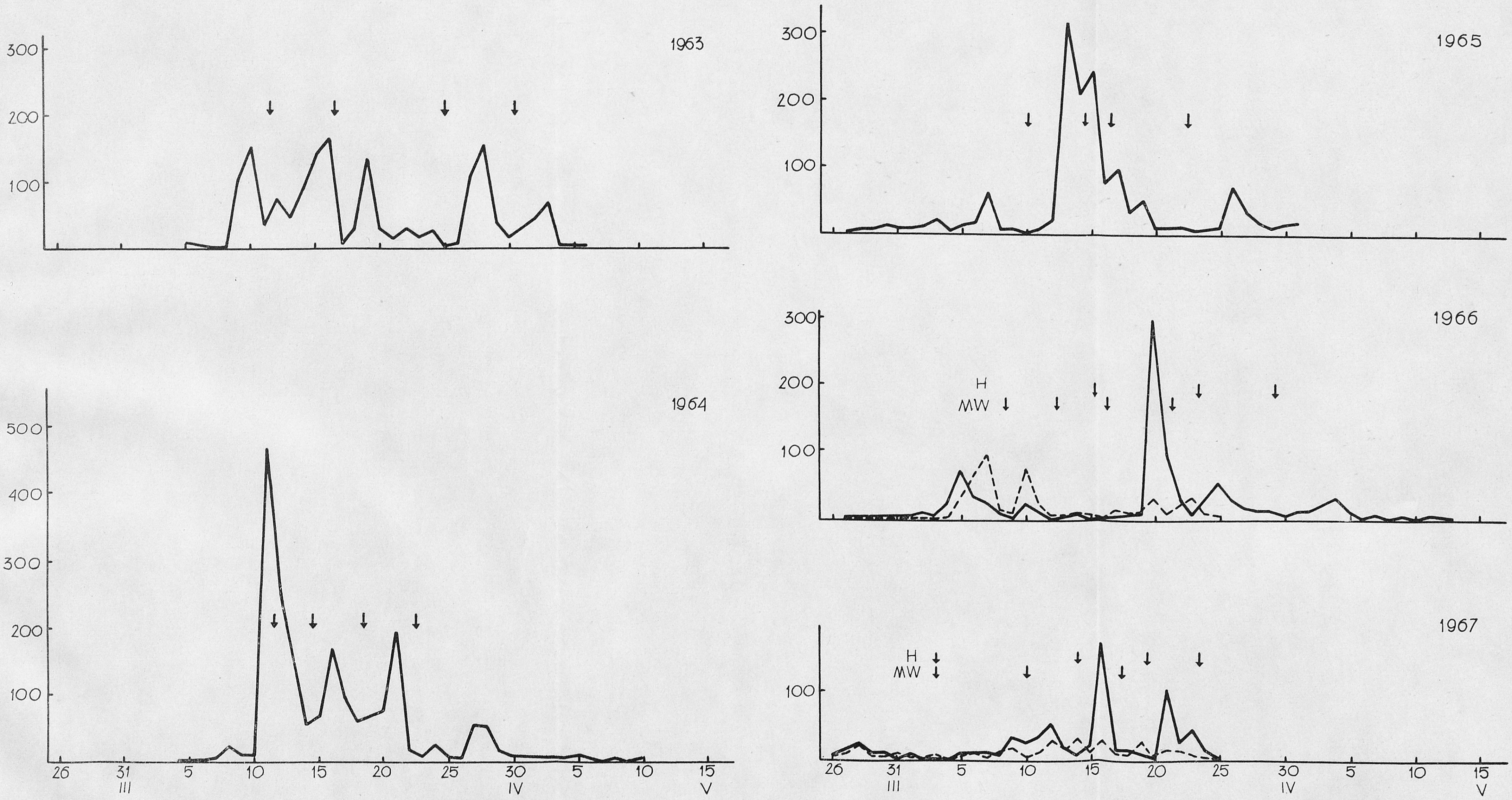

Fig. 22. Daily graphs of passage (P_1) of *Erithacus rubecula*. Results of trapping. The arrows indicate the division of the biometric material into basic units (B_{py}). The vertical axis represents the number of specimens

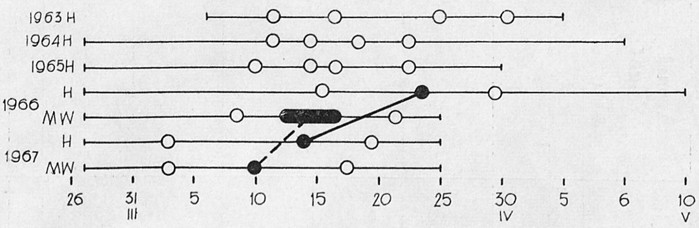

Fig. 23. Division into basic units and territorial-temporal groups in *Erithacus rubecula*. For explanations see Fig. 17 (p. 186)

paper indicate the existence of three (and not two as in sex differentiation) subgroups among the migrating specimens and show that the changes in frequency during the passage occur within all the three groups observed. Fig. 24 suggests that the simple differentiation of sex composition is also doubtful as the cause of decrease in the wing and tail lengths. The picture obtained cannot be explained by the differentiation of sex composition, especially in so far as the values for the Mierzeja Wiślana are concerned. The full interpretation of this diagram is faced with difficulties connected with the ignorance of the spatial structure of the species with respect to biometric differentiations. The hypothesis arises, or rather a still undocumented supposition, that Fig. 24 is an approximate picture of the distribution of units distinguished during the passage in the breeding grounds, the scale of the drawing and the geographical situation being naturally unknown. This hypothesis might appear well-grounded only if the gradients of variation of the wing and tail in the terrain were identical as regards size and perpendicular to each other (like the coordinate axes in the diagram). It would therefore be a very special case. The emerging problem of the spatial structure of a species and population is unusually complex, especially if the annual oscillations found in the values of biometric parameters are also taken into consideration. Further studies on this problem will have to be preceded with a very detailed description of migration in a number of species.

As I have already mentioned, the discrimination of groups larger than basic units was possible only in 1966 and 1967. The biometric parameters of the annual territorial-temporal groups (B_{Gy}) are given in Table XVI, whereas Fig. 25 shows the direction and significance of differences. In the Robin the differentiations are still greater than they are in the Goldcrest. That is true of both the differentiation between the observation points (z = 0.63 for group I and 0.50 for group II) and that between the groups (z = 0.75 for both points). It is an interesting fact that while there is a great differentiation between the groups (considerable number of significant differences), the direction of differences may change in particular years (e. g. wing length: H I — MW I, index of wing symmetry „e": H II — MW II). A comparison of the two observation points as wholes (without distinguishing groups I and II), presented

Table XV

Biometric parameters of basic units of *Erithacus rubecula* — B_{py}. Arrangement of data: $\sigma \genfrac{}{}{0pt}{}{M}{N} m$. The thick lines between the successive units represent the significance of the difference between the values of the parameter at the level of 0.01. For other explanations see p. 171.

* Tail measured by classic method

Year, Point	Group, Unit	Wing Length S	Tail Length 0	Indices of Wing Shape		Standard Weight w	Fat Deposit t	Actual Weight W
				e	l			
1	2	3	4	5	6	7	8	9
1963								
H	I a to 11 IV	73.20 1.70 0.18 91	57.52 * 2.29 0.24 91					
	I b 13—16 IV	72.46 1.72 0.16 116	57.00 * 2.10 0.19 116					
	I c 18—24 IV	72.34 1.81 0.18 96	56.24 * 2.44 0.25 96					
	I d 26—30 IV	71.00 1.69 0.16 110	55.70 * 2.23 0.21 110					
	I e from 1 V	70.44 1.69 0.15 118	55.63 * 2.26 0.21 118					
1964								
H	I a to 11 IV	71.83 1.75 0.10 299	60.25 2.11 0.12 299			16.11 1.04 0.060 308	+0.03 0.41 0.025 271	16.14 1.12 0.064 308

	I b 12—14 IV	71.40 2.10 0.14 222	59.87 2.40 0.16 222			16.01 1.00 0.058 299	—0.06 0.50 0.030 268	15.95 1.12 0.065 299
	I c 15—18 IV	70.54 2.20 0.19 130	59.61 2.71 0.24 130			15.62 1.22 0.110 123	—0.46 0.46 0.043 118	15.16 1.31 0.118 123
	I d 19—22 IV	70.14 1.69 0.11 250	58.71 2.08 0.13 250			15.13 0.88 0.049 323	—0.25 0.50 0.028 318	14.88 1.02 0.057 323
	I e after 23 IV	70.00 1.59 0.12 178	58.16 2.55 0.15 178			15.24 0.91 0.066 191	+0.11 0.52 0.038 191	15.35 1.04 0.075 191
1965								
H	I a to 9 IV	73.11 1.86 0.12 133	61.20 2.13 0.19 133			15.96 0.97 0.085 131	—0.28 0.51 0.054 128	15.68 1.10 0.096 131
	I b 11—14 IV	72.55 1.87 0.086 467	60.[illegible] 2.15 [illegible].10 467			15.47 0.91 0.042 462	—0.30 0.54 0.027 396	15.17 1.06 0.049 462
	I c 15—16 IV	72.52 2.20 0.13 274	60.21 2.22 0.13 274			15.56 1.06 0.072 220	—0.53 0.46 0.032 204	15.03 1.16 0.078 220
	I d 17—22 IV	72.50 2.04 0.14 198	59.58 2.12 0.15 198			15.33 1.66 0.120 194	—0.42 0.48 0.035 193	14.91 1.72 0.124 194
	I e after 23 IV	72.22 1.74 0.13 184	59.85 2.06 0.15 184			15.76 1.11 0.082 182	—0.76 0.50 0.037 180	15.75 1.22 0.090 182
1966								
H	I a to 15 IV	72.89 1.48 0.11 175	60.94 1.68 0.13 175	3.25 2.53 0.29 75	30.87 2.59 0.30 75			

1	2	3	4	5	6	7	8	9
	I b 16—23 IV	71.14 1.77 0.092 368	59.86 2.16 0.11 368	2.84 2.51 0.33 57	31.00 2.70 0.36 57			
	II a 24—29 IV	70.70 1.57 0.13 140	59.07 1.84 0.15 140	2.96 2.28 0.25 80	29.42 2.80 0.31 80			
	II b from 30 IV	70.39 1.53 0.14 120	58.90 2.04 0.19 120	3.71 2.02 0.52 65	29.74 2.46 0.31 65			
MW	I a to 8 IV	72.33 1.64 0.13 168	60.48 2.24 0.17 168	4.80 2.47 0.19 171	32.50 2.85 0.22 171	15.93 0.82 0.084 96	—0.55 0.48 0.050 92	15.38 0.95 0.098 96
	I b 9—12 IV	72.48 1.66 0.17 92	60.33 2.03 0.21 92	4.66 3.08 0.32 92	32.40 2.94 0.31 92	16.37 1.06 0.11 90	—0.29 0.46 0.048 89	16.08 1.12 0.12 90
	II a 17—21 IV	72.12 2.14 0.26 68	58.51 2.46 0.30 68	5.03 2.14 0.27 61	29.79 2.98 0.38 61	16.28 1.24 0.15 69	—0.02 0.41 0.050 69	16.26 1.30 0.16 69
	II b after 22 IV	72.23 1.88 0.24 65	58.66 2.04 0.25 65	4.47 2.69 0.34 61	28.95 2.66 0.34 61	15.91 1.07 0.13 64	—0.43 0.45 0.056 63	15.48 1.16 0.14 64
1967								
H	I a to 2 IV	72.98 1.68 0.18 86	60.26 1.02 0.21 86	3.82 2.29 0.28 68	31.91 2.62 0.32 68			
	I b 4—14 IV	73.34 1.62 0.12 181	61.31 1.99 0.15 181	4.78 2.52 0.21 148	31.31 2.94 0.24 148			
	II a 15—19 IV	72.22 1.85 0.16 131	60.71 2.00 0.17 131	5.15 2.42 0.24 99	29.57 2.62 0.26 99			

	II b from 20 IV	71.74 2.06 0.16 171	60.10 2.14 0.16 171					
MW	I a to 2 IV	72.43 1.44 0.19 56	60.12 1.92 0.26 56	4.00 3.27 0.46 51	32.00 0.97 0.13 51	15.05 0.97 0.13 55	—0.26 0.51 0.069 55	14.79 1.10 0.15 55
	I b 4—9 IV	72.65 1.30 0.19 46	60.15 1.77 0.26 46	4.68 2.82 0.10 44	31.82 0.67 0.44 44	15.84 0.67 0.10 44	—0.36 0.48 0.073 44	15.48 0.83 0.12 44
	II a 11—17 IV	71.87 1.77 0.15 133	59.26 1.94 0.17 133	3.31 2.46 0.21 157	31.01 0.54 0.20 157	14.83 0.93 0.080 138	—0.32 0.48 0.041 138	14.51 1.04 0.089 138
	II b from 18 IV	71.29 1.64 0.18 83	59.48 2.07 0.23 83	4.60 2.86 0.32 77	30.13 2.80 0.32 77	15.23 1.12 0.13 75	+0.11 0.75 0.086 75	15.34 1.35 0.15 75

in Table XVII, confirms the existence of the differentiations demonstrated before at the level of annual groups; the differences are statistically significant for the wing and tail lengths and for the index of wing pointedness „l", and they are close to the level of significance for the index of wing symmetry „e".

Table XVIII and Fig. 26 illustrate the variation of the biometric parameters with time. The values of the indices „z" and „s" are very high for both the wing and the tail length, showing huge fluctuations of the parameters in consecutive years.

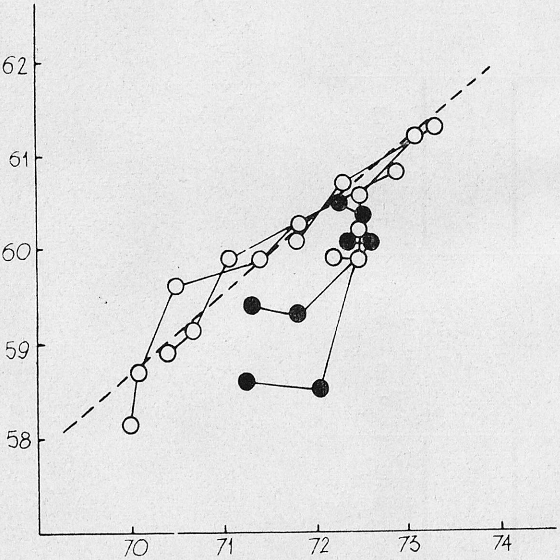

Fig. 24. Correlation of the mean lengths of the wing and tail for basic units (B_{py}) of *Erithacus rubecula*. Open circlets — Hel, filled circlets — Mierzeja Wiślana. The lines connect successive basic units of one year. The dashed line represents the constant wing to tail length ratio of 0.838. Horizontal axis — wing length, vertical axis — tail length

The data presented above permit the following conclusions about the passage of Robins:

1. Robins show a distinct differentiation between the Hel and Mierzeja Wiślana observation points and within these points between successive groups. The biometric differences cannot be referred exclusively to variation in the sex composition, for it does not explain all the facts observed.

2. The analysis of the parameter values in the Robin reveals the occurrence of variation below the level of populations; this variation is even more differentiated here than it is in the Goldcrest.

3. The results obtained from the analysis of the correlation of measurements suggest that the biometric structure of populations is an extremely complicated problem.

Table XVI

Biometric parameters of annual territorial-temporal groups of *Erithacus rubecula* for Hel and Mierzeja Wiślana separately — B_{Gy}. Arrangement of data: $\sigma\,{}^{M}_{N}\,m$, for other explanations see p. 171

Year	Group	Wing Length S	Tail Length 0	Indices of Wing Shape		Standard Weight w	Fat Deposit t	Actual Weight W
				e	l			
1	2	3	4	5	6	7	8	9
1966								
H	I	71.70 1.87 0.081 543	60.77 1.95 0.083 543	3.12 2.54 0.221 132	30.92 2.66 0.233 132			
	II	70.56 1.56 0.097 260	58.98 1.94 0.121 260	3.30 2.20 0.183 145	29.56 2.63 0.222 145			
MW	I	72.38 1.66 0.103 260	60.62 2.18 0.135 260	4.75 2.66 0.164 263	32.47 2.84 0.182 263	16.14 0.97 0.071 186	—0.42 0.47 0.035 181	15.72 1.08 0.079 186
	II	71.69 2.05 0.177 135	58.59 2.28 0.199 133	4.75 2.48 0.226 122	29.38 2.90 0.264 121	16.11 1.20 0.104 133	—0.23 0.49 0.043 132	15.88 1.30 0.112 133
1967								
H	I	73.20 1.65 0.101 267	60.97 2.02 0.124 267	4.58 2.51 0.172 216	31.55 2.85 0.194 216			
	II	71.85 1.99 0.115 302	60.43 2.12 0.121 302	5.15 2.41 0.242 99	29.57 2.62 0.262 99			
MW	I	72.47 1.35 0.135 102	60.14 1.86 0.184 102	4.32 2.76 0.283 95	31.92 3.02 0.318 95	14.40 0.91 0.091 99	—0.30 0.49 0.049 99	14.10 1.06 0.106 99
	II	71.65 1.74 0.118 216	59.35 2.00 0.136 216	3.78 2.68 0.183 212	30.72 2.62 0.171 234	15.01 1.07 0.073 213	—0.20 0.61 0.042 213	14.81 1.23 0.084 213

Table XVII

Biometric parameters of cumulative territorial groups of *Erithacus rubecula* for Hel and Mierzeja Wiślana seperately — B_s.

Arrangement of data: $\sigma \overset{M}{N} m$, for other explanation see p. 171

Point	Wing Length	Tail Length	Indices of Wing Shape		Standard Weight	Fat Deposit	Actual Weight
	S	O	e	l	w	t	W
1	2	3	4	5	6	7	8
H	71.75 2.08 0.032 4338	60.00 2.26 0.037 3708	4.02 2.52 0.104 591	30.59 2.86 0.117 591	15.59 1.12 0.023 1433	—0.21 0.53 0.011 2267	15.45 1.24 0.025 2433
MW	72.04 1.77 0.067 713	59.71 2.21 0.083 711	4.39 2.69 0.102 713	31.27 3.08 0.115 713	15.64 1.15 0.046 631	—0.29 0.55 0.022 624	45.35 1.27 0.051 631

Table XVIII

Variability of biometric parameters in annual territorial-temporal groups of *Erithacus rubecula* in succesive years for Hel and Mierzeja Wiślana seperately — B_{Gy}. Arangement of data: $\sigma \begin{matrix} M \\ N \end{matrix} m$, for definitions of indices "z" and "s" see p. 133 and 134; for other explanations p. 171

Point	Year, Index	Wing Length	Tail Length	Indices of Wing Shape		Standard Weight	Fat Deposit	Actual Weight
		S	O	e	l	w	t	W
1	2	3	4	5	6	7	8	9
H	1963	71.82 1.84 0.079 531						
	1964	70.89 2.00 0.061 1079	59.41 2.37 0.072 1079			15.65 1.12 0.032 1244	—0.05 0.52 0.015 1166	15.60 1.23 0.035 1244
	1965	72.55 1.97 0.056 1256	60.32 1.67 0.047 1256			15.56 1.02 0.030 1189	—0.31 0.56 0.017 1101	15.25 1.16 0.033 1189
	1966	71.33 1.79 0.063 803	59.81 2.12 0.074 803	3.18 2.37 0.14 277	30.21 2.74 0.16 277			
	1967	72.48 1.88 0.079 569	60.70 2.03 0.085 569	4.77 2.50 0.14 315	30.92 2.92 0.16 315			
	s	8.7	5.5					
	z	0.9	1.0					
MW	1966	72.14 1.82 0.093 395	59.80 2.38 0.12 393	4.75 2.36 0.13 385	31.50 3.22 0.16 385	16.11 1.07 0.060 319	—0.34 0.50 0.028 313	15.77 1.18 0.066 319
	1967	71.91 1.68 0.094 318	59.60 1.99 0.11 318	3.94 2.71 0.15 329	31.07 2.80 0.16 329	15.13 1.00 0.057 312	—0.23 0.63 0.035 311	14.90 1.18 0.067 312

4. The variation of the Robin's parameter values in consecutive years is very great.

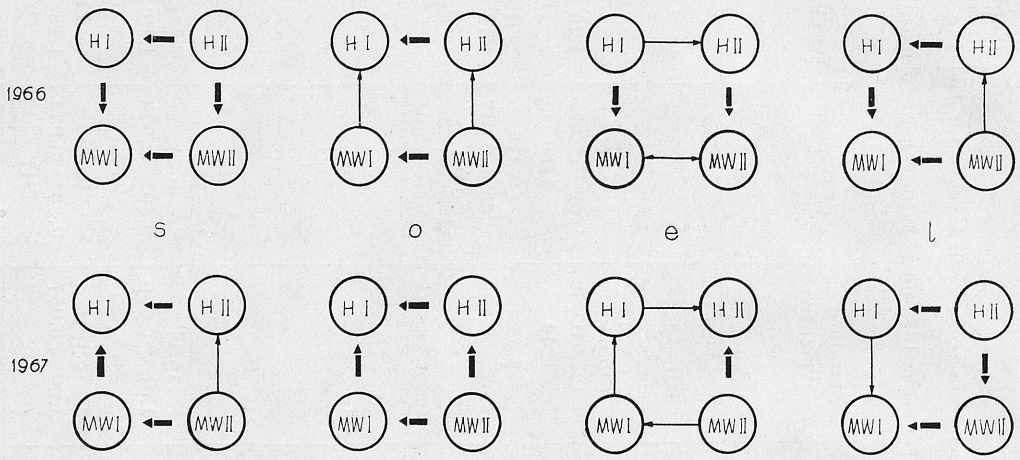

Fig. 25. A diagram of the differentiation of annual territorial-temporal groups (B_{Gy}) in *Erithacus rubecula*. For explanations see Fig. 18

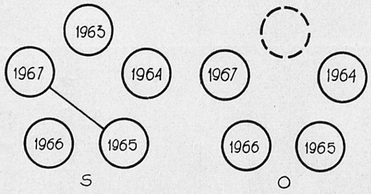

Fig. 26. A diagram of the oscillation differentiation of annual territorial groups (B_y) in *Erithacus rubecula*. S — wing length, O — tail length. For other explanations see Fig. 21 (p. 191)

Turdus philomelos

The graphs of the passage of the Song Thrush suggest the possibility of its temporal differentiation. This hypothesis has not however been confirmed by the results of biometry, for the birds migrating till 20 April and making group I of the $(\mathrm{H} + \mathrm{MW})$ B_{Gy} type differ from those migrating later in only one point out of the 24 possible differences. Naturally, the fact that the differences have not been detected does not prove that no differences exist here. Too small a number of specimens examined, especially in the alleged group that migrated later, probably prevents their detection. Unlike these possible group differentiations with time, the differentiations between the observation points can be demonstrated both in particular years, on the material of annual territorial groups (B_Y), and for the whole period of activity at the observation points, on the material of cumulative territorial groups (B_s). The biometric differences between Song Thrushes flying over Hel and the Mierzeja Wiślana are given in Table XIX and Fig. 27. The differentiation is fairly distinct ($z = 0.6$), although the directions of differences in wing length are opposite in 1966 and 1967. The differentiations considered for the whole passage of a given observation point are less distinct (Table XX: $z_{ad} = 0.0$, $z_{im} = 0.5$, $z_{indet} = 0.4$).

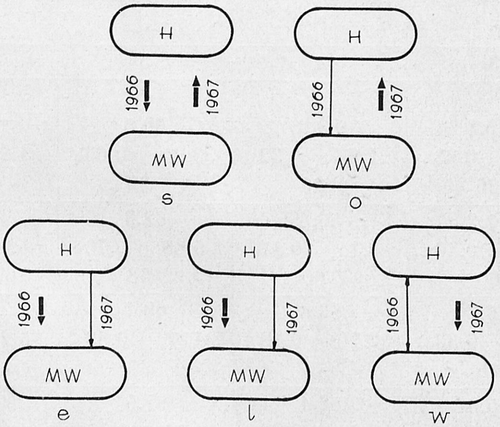

Fig. 27. A diagram of the differentiation of annual territorial groups (B_y) in *Turdus philomelos*. S — wing length, O — tail length, w — standard weight, e — index of symmetry of wing-tip 1 — index of pointedness of wing-tip. For other explanations see Fig. 18 (p. 188)

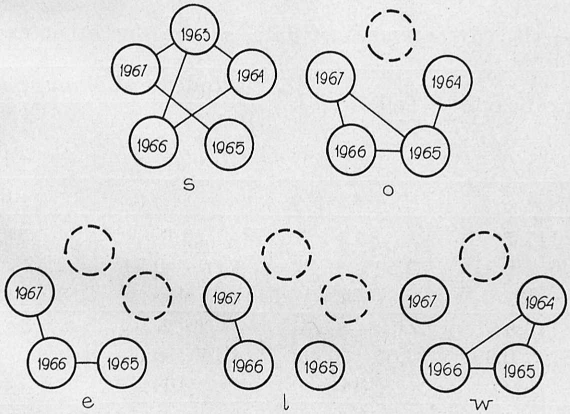

Fig. 28. A diagram of the oscillation differentiation of annual territorial groups (B_y) in *Turdus philomelos*. For explanations see Figs. 27 and 21

The fluctuations of the parameter values with time are relatively small ($z = 0.44$, $s = 1.93$), although the data given in Table XXI and Fig. 28 refer to all the birds regardless of their age. Adult and young Song Thrushes differ in measurements (see Table II) and an increase in variation might have been expected with the cumulative values of parameters, but it has not been observed.

Table XIX

Biometric parameters of young specimens (imm.) in annual territorial groups of *Turdus philomelos* for Hel and Mierzeja Wiślana separately — B_y. Arrangement of data: $\sigma \genfrac{}{}{0pt}{}{M}{N} m$, for other explanations see p. 171

Year	Point	Wing Length S	Tail Length O	Indices of Wing Shape		Actual Weight W
				e	l	
1	2	3	4	5	6	7
1966	H	115.8 2.19 0.23 86	83.2 2.96 0.32 86	59.5 3.95 0.63 39	67.1 4.24 0.67 39	65.5 3.91 0.74 28
	MW	117.2 3.10 0.40 60	83.5 3.14 0.41 60	62.3 5.68 0.76 58	69.8 5.63 0.75 58	65.5 4.26 0.56 58
1967	H	116.7 2.22 0.33 45	83.6 2.70 0.40 45	60.7 4.88 0.83 35	68.6 5.24 0.85 35	62.1 3.07 0.59 27
	MW	115.9 2.49 0.19 171	82.4 2.84 0.22 171	61.9 4.59 0.87 160	69.5 4.32 0.34 160	65.2 3.96 0.32 150

Table XX

Biometric parameters of cumulative territorial groups of *Turdus philomelos* for Hel and Mierzeja Wiślana separately — B_s. Arrangement of data: $\sigma \genfrac{}{}{0pt}{}{M}{N} m$, for other explanations see p. 171

Age	Point	Wing Length S	Tail Length O	Indices of Wing Shape		Actual Weight W
				e	l	
1	2	3	4	5	6	7
ad	H	117.7 2.66 0.31 74	85.3 3.59 0.42 74	63.5 4.95 0.74 45	71.1 2.52 0.38 45	64.4 2.40 0.42 33
	MW	116.6 2.57 0.39 44	84.8 3.05 0.46 44	61.2 4.14 0.66 40	70.9 4.60 0.72 40	65.9 3.72 0.57 43
im	H	116.2 2.26 0.20 131	83.3 2.88 0.25 131	60.2 4.43 0.52 74	67.8 4.80 0.56 74	63.8 3.89 0.52 55
	MW	116.4 2.58 0.17 231	82.7 2.97 0.20 231	61.9 4.88 0.33 218	69.9 4.71 0.32 218	65.3 4.04 0.28 207
??	H	116.7 2.95 0.11 784	83.4 3.30 0.14 545	60.3 5.26 0.33 252	67.2 5.81 0.36 252	64.9 4.91 0.24 421
	MW	116.8 2.72 0.15 329	83.3 3.21 0.18 329	62.0 4.80 0.27 306	70.4 3.21 0.18 306	65.6 4.00 0.23 293

Table XXI

Variability of biometric parameters in annual territorial-temporal groups of *Turdus philomelos* in successive years for Hel and Mierzeja Wiślana separately — B_{Gy}. Arrangement of data: $\sigma \overset{N}{\underset{M}{}} m$, for definitions of indices "z" and "s" see p. 133 and 134 for other explanations p.171

Point	Year, Index	Wing Length	Tail Length	Indices of Wing Shape		Actual Weight
		S	O	e	l	W
1	2	3	4	5	6	7
H	1963	116.5 2.84 0.38 239				
	1964	115.7 2.82 0.22 170	82.7 3.17 0.24 170			64.2 5.11 0.39 172
	1965	118.0 2.94 0.23 170	83.4 3.18 0.24 170	59.3 5.38 0.47 133	66.6 6.08 0.53 133	64.8 5.20 0.41 161
	1966	116.3 2.38 0.22 121	83.7 3.10 0.28 121	61.0 4.56 0.61 56	68.6 2.39 0.48 56	65.9 3.96 0.56 43
	1967	117.4 2.59 0.28 84	84.5 3.50 0.38 84	61.8 5.20 0.66 63	69.4 5.48 0.70 63	62.2 3.76 0.56 45
	s	2.9	1.6	1.2	1.6	2.4
	z	0.4	0.3	0.3	0.7	0.5
MW	1966	118.1 2.66 0.25 114	84.2 3.13 0.29 114	62.5 5.40 0.50 106	66.7 5.48 0.53 106	66.1 4.20 0.42 100
	1967	116.1 2.50 0.17 215	83.0 3.05 0.21 215	61.7 3.46 0.32 200	70.2 4.39 0.31 200	65.3 3.81 0.27 193

Turdus iliacus

On account of the small number ofsp ecimens trapped, the birds migrating through the observation points under study can be compared only in approximation (Table XXII). As in *T. philomelos*, differentiation is present, but it is not very distinct in my material ($z_{ad} = 0.0$, $z_{im} = 0.2$, $z_{indet} = 0.4$). The main cause of failure to demonstrate differences here is probably the small size of the sample.

Turdus merula

The Blackbird is characterized by distinct sexual-and-age dimorphism involving both its coloration and biometric characters (Table II). Differences in most of the parameters are significant for both sex and age groups. Only the differences in the values of the indices of wing shape between young and old birds of both sexes and the difference in weight between young and old females are not significant. None of the differences between the birds from Hel and the Mierzeja Wiślana is significant (Table XXIII, Fig. 29). The po-

Table XXII

Biometric parameters of cumulative territorial groups of *Turdus iliacus* for Hel and Mierzeja Wiślana separately — B_s. Arrangement of data: $\sigma \genfrac{}{}{0pt}{}{M}{N} m$, for other explanations see p. 171

Age	Point	Wing Length S	Tail Length O	Indices of Wing Shape e		Actual Weight W
				e	l	
1	2	3	4	5	6	7
ad	H	116.5 2.73 0.38 51	85.5 3.08 0.43 51	67.6 4.53 0.75 38	75.9 4.57 0.74 38	57.4 4.84 0.85 32
	MW	116.7 2.08 0.37 31	80.3 2.90 0.52 31	67.3 4.37 0.83 29	76.9 4.79 0.89 29	59.0 3.36 0.63 28
im	H	116.5 2.91 0.36 59	81.7 3.45 0.45 59	67.1 5.85 0.86 46	74.5 5.15 0.76 46	57.7 3.58 0.53 45
	MW	115.5 2.66 0.26 101	79.3 2.83 0.28 101	67.3 4.79 0.48 101	76.6 4.72 0.47 101	58.0 3.81 0.41 85
??	H	116.5 3.11 0.21 215	81.0 3.26 0.22 215	66.0 6.28 0.49 130	74.1 6.08 0.53 130	58.0 5.39 0.40 181
	MW	115.8 3.38 0.29 132	79.5 2.87 0.25 132	67.3 4.66 0.41 130	76.5 4.68 0.41 130	58.2 3.83 0.36 113

ssibility of certain differentiations is however suggested by the conformity of the directions of differences in body weight and in the index of wing pointedness „l".

Aegithalos caudatus

The correlation chart of wing and tail lengths compiled for 85 specimens trapped in the spring reveals the existence of two groups, which differ above all in tail length. This differentiation is illustrated in Fig. 30; the two groups, each homogeneous internally, differ sharply from each other. They constitute, respectively, 61 and 39 per cent of the total of these birds, which would permit their interpretation as the result of sexual dimorphism, unless they had been compared with the birds trapped in the autumn (Mierzeja Wiślana — 13 October 1969). The correlation chart for these last birds does not show any distinct division into two groups and the distribution of the tail lengths, in spite of its two peaks, does not resemble the spring distribution. An attempt made to check the hypothesis of sexual dimorphism using a correlation chart of the measurements of 30 skins from the collection of the Institute of Zoology, Polish Academy of Sciences, in Warsaw gave no definite results; in both groups that

Table XXIII

Biometric parameters of cumulative territorial groups of *Turdus merula* for Hel and Mierzeja Wiślana separately — B_s. Arrangement of data: $\sigma \underset{N}{\overset{M}{}} m$, for other explanations see p. 171

Age, Sex	Point	Wing Length S	Tail Length O	Indices of Wing Shape e	Indices of Wing Shape l	Actual Weight W
1	2	3	4	5	6	7
♂♂ ad	H	131.7 3.79 0.48 62	112.0 5.90 0.79 56	32.5 5.00 1.35 17	56.6 4.39 1.07 17	91.0 7.93 1.03 59
♂♂im	H	128.9 3.26 0.22 215	107.5 5.35 0.40 183	28.5 4.73 0.73 43	53.8 5.62 0.87 43	86.7 6.72 0.51 177
	MW	128.5 2.43 0.48 26	108.2 3.80 0.75 26	31.0 3.93 0.79 25	55.0 3.88 0.72 25	84.7 4.32 0.88 24
♀♀ ad	H	126.8 3.58 0.28 165	106.5 5.31 0.46 132	26.8 4.91 0.66 55	51.6 4.55 0.61 55	84.3 6.78 0.60 127
	MW	126.2 2.71 0.60 20	105.0 3.35 0.74 20	27.9 5.38 1.25 18	51.7 4.57 1.06 18	81.6 3.84 0.83 21
♀♀ im	H	125.1 3.46 0.27 167	104.2 4.21 0.34 152	27.7 4.28 0.71 37	50.8 5.31 0.88 37	83.4 5.74 0.47 145
	MW	125.2 2.81 0.57 24	105.4 3.19 0.65 24	26.10 4.13 0.98 18	51.5 4.16 0.99 18	83.2 5.74 0.59 24

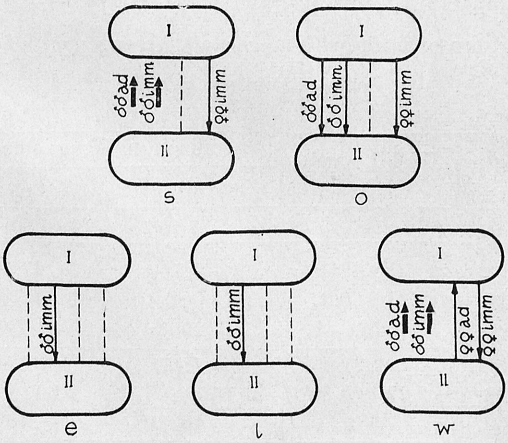

Fig. 29. A diagram of the differentiation of cumulative territorial groups (B_s) in *Turdus merula*. For explanations see Figs. 27 and 18

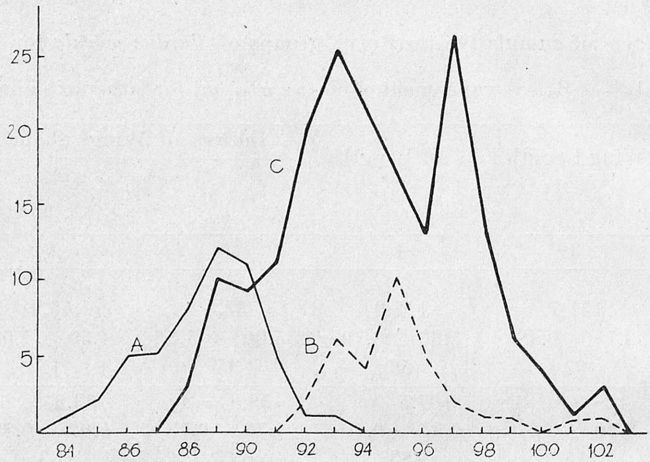

Fig. 30. Distribution of tail lengths in *Aegithalos caudatus*. A — spring group A, B — spring group B, C — autumn birds trapped at Mierzeja Wiślana observation point on 13 Oct. 1969. Horizontal axis — tail length, vertical axis — number of specimens

could be distinguished there were specimens identified as males and females. To be sure, in very many cases (especially in the autumn) the preparers of skins gave incorrect sex determinations, which I had the opportunity to verify so far as other species are concerned. Thus the problem of the existence of groups in the correlation chart remains open. The groups distinguished differ significantly in wing and tail lengths, whereas the other parameters show no significant differences (Table XXIV).

Table XXIV

Biometric parameters of groups of *Aegithalos caudatus* distinguished in correlation chart (Fig. 30) for Hel and Mierzeja Wiślana together — $(H+MW)B_s$.A — group of birds with with shorter tail, B — group of birds with longer tail. Arrangement of data: $\sigma \ {M \atop N} \ m$, for other explanations see p. 000

Group	Wing Length S	Tail Length O	Indices of Wing Shape		Actual Weight W
			e	l	
1	2	3	4	5	6
A	63.60 1.81 0.25 52	88.48 2.21 0.31 52	—1.76 2.18 0.40 29	27.52 3.09 0.57 29	7.97 0.65 0.12 30
B	64.94 1.50 0.26 33	92.21 2.27 0.39 33	—1.47 1.73 0.27 40	27.58 2.60 0.41 40	9.24 0.71 0.11 38
Total	64.12 1,82 0.20 85	91.12 4.06 0.44 85	—1.59 1.93 0.23 69	27.55 2.84 0.34 69	8.01 0.73 0.084 74

Parus caeruleus

I shall hardly touch on the biometry of the Blue Tit because of the finding of sexual-and-age dimorphism in its dimensions (Table XXV). Young birds of two sexes differ significantly in wing and tail dimensions but not in the indices of wing shape, there being no data available for adult birds. Since the method for sex determination on the basis of the coloration of the wing coverts was not introduced until 1966, the results of comparison of the young birds from 1965 (Table XXVI — sex not discriminated) should be treated with discretion. The birds of group I are larger than those of group II (difference in tail length significant), which might reflect the predominance of females during the later phase of passage. This is however denied by a clearcut difference in the pointedness and symmetry of wing (the difference is significant for the index „e” or close to the level of significance for „l”, which characters are not differentiated with regard to sex (Table XXV).

Table XXV

Biometric differentiation of sex-and-age groups of *Parus caeruleus* at Hel in 1966 — $(H)B_y$.

Arrangement of data: $\sigma \genfrac{}{}{0pt}{}{M}{N} m$, for other explanations see p. 171.

Sex and Age	Wing Length S	Tail Length O	Indices of Wing Shape	
			e	l
1	2	3	4	5
♂♂ im	65.80 1.53 0.19 66	53.02 2.09 0.26 66	2.13 1.70 0.35 23	20.48 2.39 0.50 23
♀♀ im	64.04 0.96 0.13 58	51.74 1.46 0.19 58	2.00 2.02 0.41 24	20.50 1.73 0.35 24
♀♀ ad	65.23 1.48 0.41 13	52.77 1.67 0.46 13		

Parus major

A division into basic units, which are at the same time conjectural groups, was plotted on the daily graphs of passage (P_1 — Fig. 31). The number of specimens measured does not permit a subtler division. In examining such distinct groups special attention should be given to the problem of their sex and age composition. A number of facts difficult to interpret can be seen in Table XXVII, which illustrates the sex and age structure. A small number of males (except in 1964, the year of very intense migration) may be explained by a generally smaller tendency for males to migrate, which is also a well-known phenomenon in other species (e. g., in *Fringilla coelebs* — DEELDER, 1949). It is however more difficult to elucidate the large proportion of old spe-

Table XXVI

Biometric parameters of annual territorial-temporal groups of *Parus caeruleus* at Hel in 1965 — (H)B_{Gy}. Arrangement of data: $\sigma \begin{matrix} M \\ N \end{matrix} m$, for other explanations see p. 171

Group (dates)	Wing Length S	Tail Length O	Indices of Wing Shape e	 l	Standard Weight w	Fat Deposit t	Actual Weight W
1	2	4	5	6	7	8	9
I (to 9 IV)	65.75 1.96 0.16 148	53.11 1.99 0.16 148	2.52 2.06 0.31 44	21.36 2.84 0.43 44	10.57 0.89 0.069 161	+0.05 0.27 0.021 161	10.62 0.93 0.072 161
II (from 10 IV)	65.42 1.94 0.19 102	52.26 1.89 0.18 102	4.42 2.32 0.27 74	22.73 3.39 0.39 74	10.53 0.99 0.095 108	+0.07 0.27 0.026 108	10.60 1.03 0.099 108

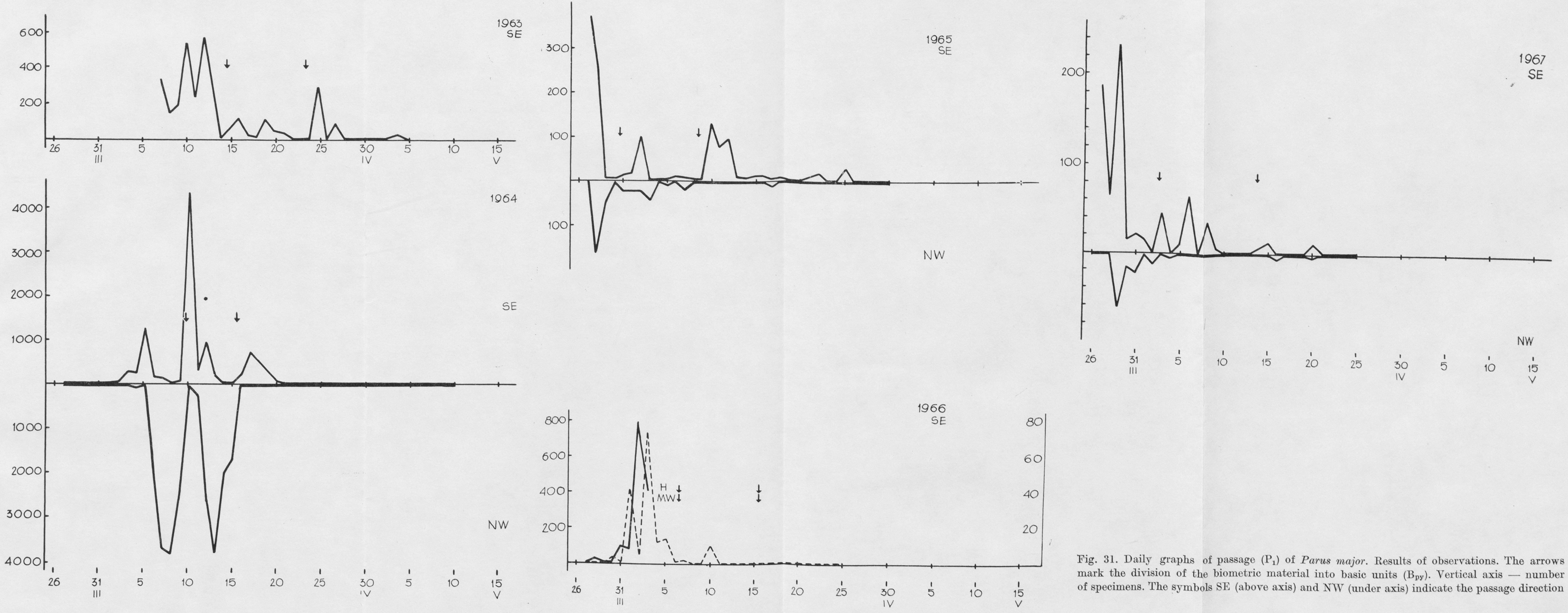

Fig. 31. Daily graphs of passage (P_1) of *Parus major*. Results of observations. The arrows mark the division of the biometric material into basic units (B_{py}). Vertical axis — number of specimens. The symbols SE (above axis) and NW (under axis) indicate the passage direction

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Table XXVII

Percentage sex-and-age composition of annual territorial-temporal groups of *Parus major* for Hel and Mierzeja Wiślana separately — B_{Gy}

	Hel				Mierzeja Wiślana			
	Groups (1)			Total (2)	Groups (1)			Total (2)
	I	II	III		I	II	III	
1963								
N	409	115	19	543				
% ♂♂	38.7	33.1	53.0	38.0				
1964								
N	3568	738	232	4538				
% ♂♂	57.3	38.2	34.1	55.5				
adults in the total of ♂♂, in %	68.1	72.7	58.3	67.5				
adults in the total of ♀♀, in %	32.5	32.7	32.6	32.6				
1965								
N	329	114	293	736				
% ♂♂	25.2	31.6	41.6	32.7				
adults in the total of ♂♂, in %	55.4	75.0	64.7	63.1				
adults in the total of ♀♀, in %	16.2	51.3	48.0	32.7				
1966								
N	342		31.7	34.1	32.8		48.3	37.4
% ♂♂	34.5		63	405	70		29	99
adults in the total of ♂♂, in %	19.5		30.0	21.0	56.5		50.0	54.1
adults in the total of ♀♀, in %	11.6		14.0	12.0	14.09		13.0	14.5
1967								
N	71		38	109	63		25	88
% ♂♂	32.4		42.1	35.8	38.1		56.0	43.2
adults in the total of ♂♂, in %	9				25.0		36.0	36.8
adults in the total of ♀♀, in %	14.6				10.3		9.0	10.0

cimens among the males in the spring of 1964 (67 %) and its being markedly larger than the proportion of old females. Czaja-Topińska (1969) discusses this question with reference to the spring of 1964 on the Hel Peninsula in comparison with the autumn situation on the Mierzeja Wiślana. She states that some of the specimens regarded as young in the autumn are recognized as old in the spring (birds of the first brood), but this interpretation is groundless, for so far Great Tits have not been noted to moult in the winter, which is a prerequisite to the change of the age classification of a bird in the spring. As it is rather difficult to determine age in Tits, I have carried out a statistical biometric check of determination by examining the distributions of wing and tail lengths in different sex and age groups. Fig. 32 shows an example of such a check (group I, 1964), in which the unlikeness of the distributions of the wing lengths suggests the correctness of the determination. Thus, rejecting Czaja-Topińska's (1969) interpretation, I am rather inclined to see the cause of the high proportion of adult birds in the action of intense selection in winter

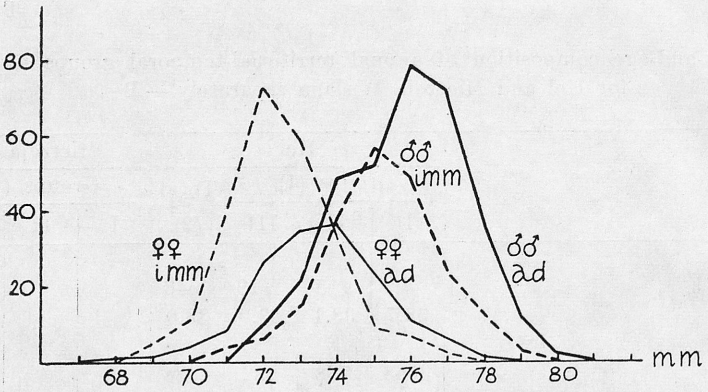

Fig. 32. Distribution of wing lengths in *Parus major* trapped at Hel on 27 March — 9 Apr. 1964. Horizontal axis — wing length, in mm, vertical axis — number of specimens

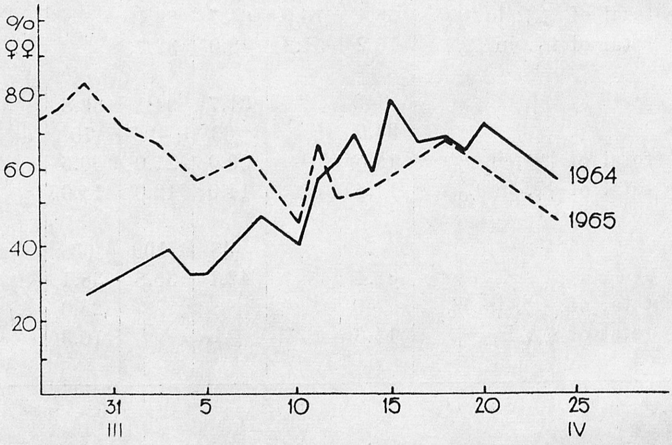

Fig. 33. Changes in the quantitative relation of sexes during the passage of *Parus major* in 1964 and 1965

quarters. The percentage of young birds perishing in the winter quarters is considerably higher than that of adult birds, which results in a change in their proportion compared with the state in the autumn. A similar interpretation, but concerning changes in the sex composition in *R. regulus*, has been given by Busse and Machalska (1970). This explanation seems also to confirm the fact that the phenomenon under discussion occurs most drastically in the years of intense migration and therefore when the selection pressure is particularly great. The changes in the sex composition during migration are equally interesting though still more difficult to explain (Fig. 33). In two successive years of intense migration (1964 and 1965) the changes have opposite directions. No sensible interpretation of this phenomenon occurs to me.

Table XXVIII

Biometric parameters of annual territorial-temporal groups of *Parus major* at Hel — $(H)B_{Gy}$.

Arrangement of data: $\sigma \frac{M}{N} m$, for other explanations see p. 171

Year, Sex, Age	Group	Wing Length S	Tail Length O	Standard Weight w	Fat Deposit t	Actual Weight W
1	2	3	4	5	6	7
1964						
♂♂ ad	I	75.80 1.68 0.098 332	65.69 2.23 0.12 332	17.93 1.07 0.041 694	—0.08 0.61 0.023 694	17.85 1.23 0.047 694
	II	75.39 1.93 0.17 124	65.08 2.35 0.21 124	17.84 0.88 0.070 159	—0.23 0.76 0.060 159	17.61 1.17 0.092 159
	III	75.00 2.14 0.32 45	64.75 2.54 0.38 45	17.07 0.98 0.15 45	—0.45 0.69 0.10 45	16.62 1.16 0.17 45
♂♂ im	I	75.19 1.57 0.11 209	64.23 2.14 0.15 209	17.65 1.36 0.075 324	+0.12 0.63 0.035 324	17.77 1.43 0.079 324
	II	74.34 1.78 0.25 50	63.54 2.10 0.30 50	17.61 0.89 0.12 57	—0.42 0.59 0.079 57	17.19 1.07 0.14 57
	III	74.47 1.97 0.35 32	63.78 2.31 0.41 32	17.21 0.87 0.15 33	—0.50 0.52 0.086 33	16.71 1.01 0.17 33
♀♀ ad	I	73.53 1.70 0.14 154	62.92 2.35 0.19 154	16.93 1.12 0.075 222	—0.25 0.65 0.043 222	16.68 1.29 0.087 222
	II	72.36 1.73 0.18 90	62.33 1.81 0.19 90	16.83 0.92 0.090 102	—0.35 0.60 0.059 102	16.48 1.10 0.11 102
	III	72.38 1.91 0.27 50	61.84 2.38 0.33 50	16.44 1.18 0.16 52	—0.46 0.58 0.081 52	15.98 1.32 0.18 52
♀♀ im	I	72.47 1.47 0.10 238	61.53 2.26 0.15 238	16.78 1.01 0.049 409	—0.21 0.56 0.028 409	16.57 1.16 0.057 409
	II	71.84 1.85 0.14 186	61.12 2.24 0.16 186	16.68 0.90 0.059 231	—0.33 0.56 0.037 231	16.35 1.06 0.070 231
	III	72.03 1.52 0.16 96	61.03 2.32 0.24 96	16.46 1.02 0.10 101	—0.41 0.49 0.049 101	16.05 1.14 0.11 101

1	2	3	4	5	6	7
1965						
♂♂ ad	I	77.19 1.80 0.28 42	66.50 1.97 0.30 42	18.04 0.88 0.13 44	+0.36 0.83 0.13 44	18.40 1.21 0.18 44
	II	76.45 2.16 0.42 27	65.93 2.04 0.47 27	17.91 0.84 0.16 27	—0.30 0.64 0.12 27	17.61 1.07 0.21 27
	III	76.89 2.00 0.23 75	64.86 2.26 0.26 75	17.72 0.97 0.11 80	+0.08 0.82 0.091 80	17.80 1.27 0.14 80
♂♂ im	I	76.34 1.42 0.25 32	64.91 2.40 0.43 32	17.73 0.69 0.12 33	+0.41 0.69 0.12 33	18.14 0.97 0.17 33
	II	76.45 2.40 0.80 9	65.80 2.43 0.75 9			
	III	76.80 1.66 0.25 41	64.34 2.56 0.40 41	18.10 0.98 0.16 37	+0.08 0.74 0.12 37	18.18 1.22 0.20 37
♀♀ ad	I	75.07 1.66 0.26 40	63.55 2.31 0.37 40	17.35 0.40 0.063 40	+0.35 0.96 0.15 40	17.70 1.04 0.16 40
	II	74.71 1.89 0.30 38	63.53 1.41 0.22 38	17.33 0.88 0.14 38	—0.06 0.66 0.11 38	17.27 1.10 0.18 38
	III	75.03 1.78 0.20 79	62.20 2.18 0.24 79	17.05 1.08 0.12 76	—0.35 0.78 0.098 76	17.38 1.53 0.15 76
♀♀ im	I	74.42 1.53 0.11 197	62.72 2.01 0.14 197	17.12 0.99 0.71 197	+0.48 0.58 0.042 197	17.60 1.15 0.082 197
	II	74.13 1.51 0.24 38	62.13 1.99 0.32 38	17.24 0.62 0.10 37	—0.22 0.71 0.12 37	17.02 0.94 0.15 37
	III	74.99 1.87 0.20 85	62.47 2.23 0.24 85	17.07 1.13 0.13 80	+0.21 0.66 0.074 80	17.28 1.31 0.15 80

The biometric analysis of groups has been limited to 1964 and 1965 because of the lack of sufficient material. It permits the study of group differentiation with time but not comparisons between points. However, a number of recoveries (autumn — Mierzeja Wiślana, spring — Hel) indicates that these groups are mixed to a high degree. Table XXVIII contains a comparison of biometric parameters of groups, and the direction and significance of the differences are shown in Fig. 34. The estimation of the differentiation of grousp exclusively on the basis of the significance of differences leads to the inference that these differences are relatively small („z" is 0.22 for groups I and II, 0.08 for groups II and III and 0.37 for groups I and III). In the case of a species in which both the sex and age of specimens can be determined the conclusion may also be reached by estimating the accordance of the directions of not significant differences. In the present instance the differentiation between groups II and III may be regarded as existing in fact, although this seems doubtful when we judge it from the significance of differences only.

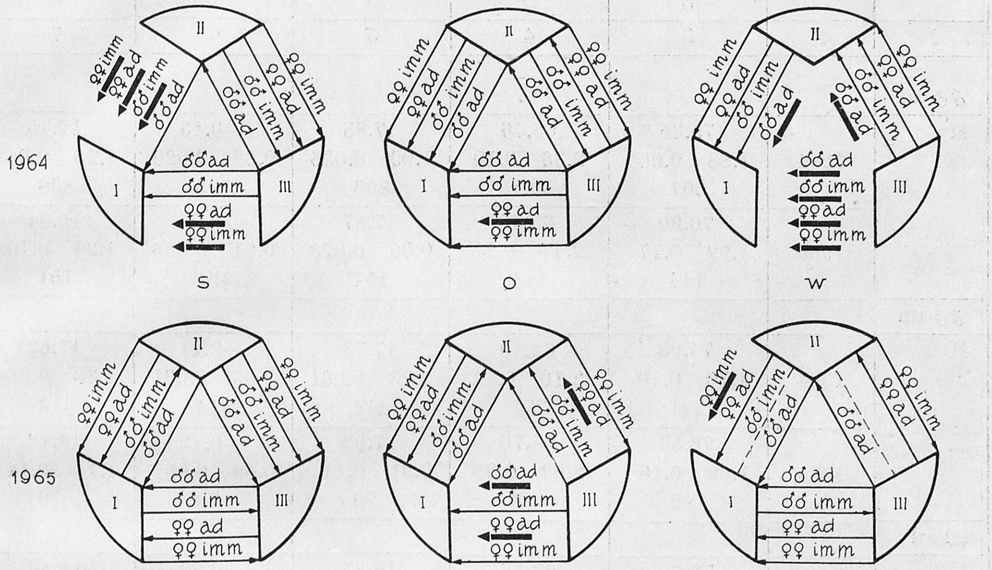

Fig. 34. A diagram of the differentiation of annual territorial-temporal groups, (H + MW)B_{Gy}, in *Parus major*. For explanations see Fig. 18

The variation of parameters with time seems to be fairly conspicuous in the Great Tit (Table XXIX — wing length: z = 1.0; tail length: z = 0.5; standard weight: z = 0.5).

The following general conclusions about the migration of the Great Tit may be drawn from the foregoing data:

1. In further studies of migrations of the Great Tit special attention should be given to the problem of sex-and-age structure, i. e. to the variation in composition in years with migration differing in intensity and to the differences in this structure between the spring and autumn seasons.

2. The biometric differentiation of successive groups needs more documentation.

Parus ater

The migration of this invasive or sub-invasive species occurred in two distinct waves in 1963 and 1964 (Fig. 35). Treating these waves as basic units, I compared the biometric parameters in the birds of which they were made

Table XXIX

Variability of biometric parameters in annual territorial groups of *Parus major* in 1964—1966 for Hel and Mierzeja Wiślana separately — B_y. Arrangement of data: $\sigma \genfrac{}{}{0pt}{}{M}{N} m$, for other explanations see p. 171

Sex, Age, Point	Year	Wing Length S	Tail Length O	Standard Weight w	Fat Deposit t	Actual Weight W
1	2	3	4	5	6	7
♂♂ ad						
H	1964	75.35 1.88 0.084 501	65.46 2.36 0.10 501	17.88 1.09 0.036 898	—0.13 0.62 0.020 898	17.75 1.25 0.042 898
	1965	76.90 1.99 0.17 144	65.55 2.47 0.21 144	17.87 0.96 0.078 151	+0.07 0.81 0.065 151	19.94 1.26 0.102 151
♂♂ im						
H	1964	74.98 1,70 0.10 291	64.10 2.16 0.13 291	17.73 1.23 0.061 414	—0.11 0.63 0.031 414	17.62 1.38 0.068 414
	1965	76.59 1.69 0.18 82	64.70 2.52 0.28 82	17.93 0.91 0.11 70	+0.19 0.69 0.081 70	18.12 1.14 0.14 70
♀♀ ad						
H	1964	72.98 1.83 0.11 294	62.55 2.24 0.13 294	16.83 1.11 0.057 376	—0.30 0.64 0.033 379	16.53 1.28 0.066 376
	1965	74.94 1.87 0.14 157	62.87 2.15 0.17 157	17.15 0.97 0.078 154	+0.26 0.80 0.065 154	17.41 1.26 0.10 154
♀♀ im						
H	1964	72.16 1.65 0.072 520	61.34 2.25 0.10 519	16.70 0.99 0.036 741	—0.27 0.55 0.020 741	16.43 1.13 0.042 741
	1965	74.54 1.68 0.094 320	62.59 2.03 0.11 319	17.07 0.98 0.056 314	+0.38 0.69 0.039 314	17.45 1.20 0.068 314
	1966	73.77 1.60 0.11 201	61.85 2.10 0.14 212			
MW	1966	73.04 1.44 0.21 46	61.37 2.11 0.31 46			

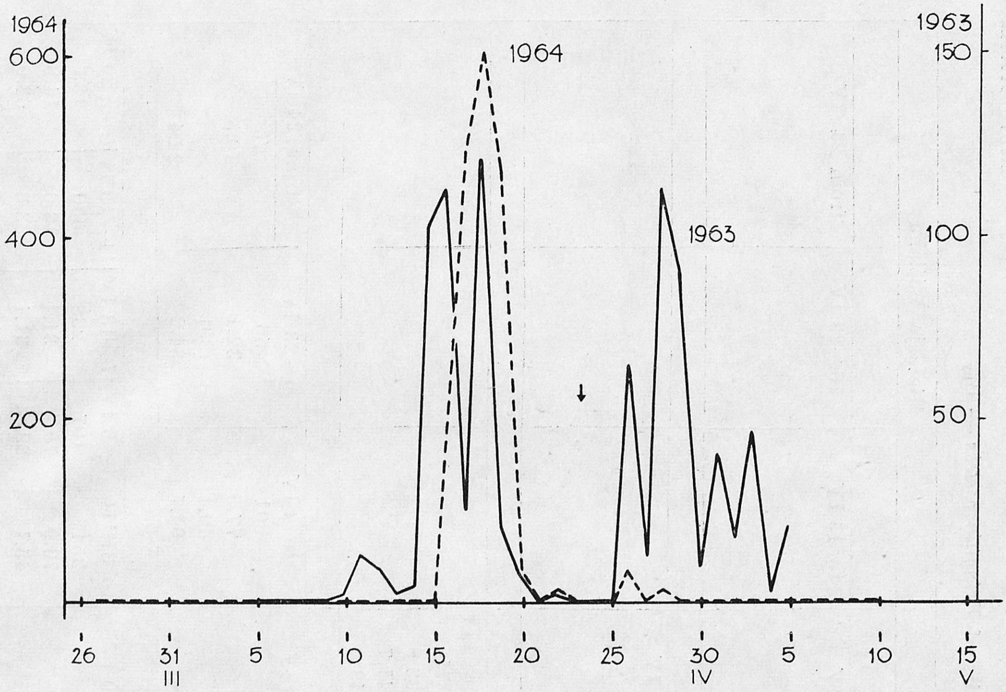

Fig. 35. Daily graphs of passage (P_1) of *Parus ater* in 1964 and 1965. Results of observations The arrow marks the division of the biometric material into basic units (B_{py}). Vertical axis — number of specimens

Table XXX

Biometric parameters of annual territorial-temporal groups of *Parus ater* at Hel in 1963—1964 — (H)B_{Gy}. Arrangement of data: $\sigma \genfrac{}{}{0pt}{}{M}{N} m$, for other explanations see p. 171

Year	Group	Wing Length S	Tail Length O	Standard Weight w	Fat Deposit t	Actual Weight W
1	2	3	4	5	6	7
1963	I	60.44 1.50 0.14 107	44.64 * 2.09 0.20 107			
	II	59.39 1.61 0.10 263	44.56 * 1.93 0.12 263			
1964	I	59.98 1.78 0.093 363	46.94 2.20 0.12 363	8.20 0.68 0.030 504	+0.10 0.29 0.013 504	8.30 0.74 0.032 504
	II	59.13 1.91 0.23 68	45.86 1.78 0.21 68	8.39 0.62 0.077 65	+0.30 0.29 0.036 65	8.69 0.69 0.085 65

* Tail measured by classic method

Table XXXI

Percentage sex-and-age composition of basic units of *Fringilla coelebs* — B_{py}

	Hel					Mierzeja Wiślana				
1963										
Dates	to 13 IV	14—22 IV	from 23 IV			to 15 IV	16—23 IV	from 24 IV		
N	389	88	42							
% ♂♂	71.0	25.0	42.8							
adults in the total of ♂♂, in %	66.0									
adults in the total of ♀♀, in %	49.5	49.1	(44)							
1964										
Dates	to 15 IV	16—23 IV	from 24 IV							
N	136	255	142							
% ♂♂	61.0	17.3	46.5							
adults in the total of ♂♂, in %	56.1	50.0	42.4							
adults in the total of ♀♀, in %	69.6	61.5	38.1							
1965										
Dates	to 8 IV	9—14 IV	15—17 IV	18—23 IV	from 24 IV					
N	156	603	393		71					
% ♂♂	83.2	58.5	31.0		33.8					
adults in the total of ♂♂, in %	33.9	24.7	23.1		41.7					
adults in the total of ♀♀, in %	30.8	45.3	34.1	53.5	43.5					
1966										
Dates	to 8 IV	9—23 IV	from 24 IV			to 8 IV	9—23 IV	from 24 IV		
N	53	8	73			301	56	76		
% ♂♂	90.1		43.9			77.5	32.1	10.5		
adults in the total of ♂♂, in %	35.1		43.3			40.1	(30)			
adults in the total of ♀♀, in %			51.5			64.7	34.2	22.4		
1967										
Dates	to 6 IV	7—19 IV	from 20 IV			to 31 III	1—6 IV	7—13 IV	14—19 IV	from 20 IV
N	36	55	18			354	107	238	530	183
% ♂♂	83.2	30.9	(17)			76.9	79.4	31.1	13.6	14.8
adults in the total of ♂♂, in %		(41)				45.1	29.4	31.1	33.3	63.0
adults in the total of ♀♀, in %		66.7				53.5	41.5	36.8	25.6	39.8

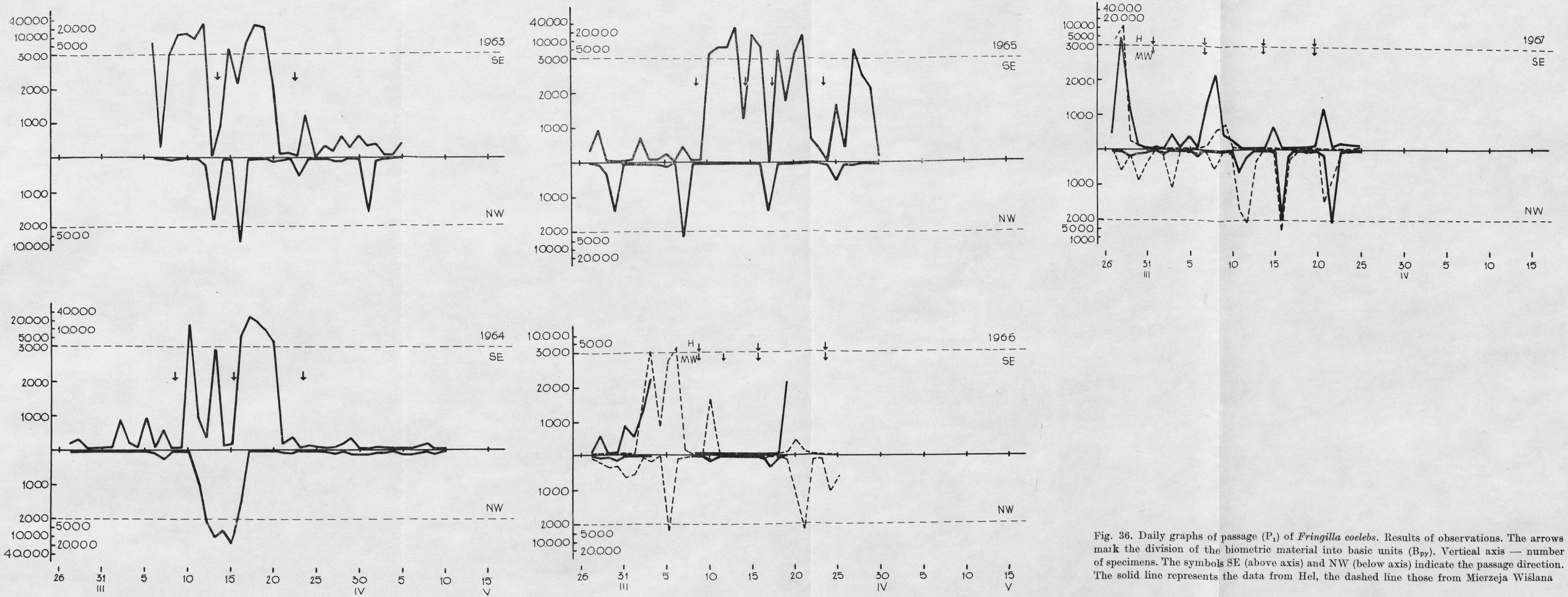

Fig. 36. Daily graphs of passage (P_1) of *Fringilla coelebs*. Results of observations. The arrows mark the division of the biometric material into basic units (B_{py}). Vertical axis — number of specimens. The symbols SE (above axis) and NW (below axis) indicate the passage direction. The solid line represents the data from Hel, the dashed line those from Mierzeja Wiślana

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up. The significant differences found in the wing and tail lengths made it possible to acknowledge them as separate territorial-temporal groups (Table XXX). The differentiation of these groups is fairly distinct ($z = 0.6$), but the influence of possible differences in the sex and age composition of these groups cannot be excluded.

Fringilla coelebs

As in the Great Tit, the daily graphs of passage (P_1 — Fig. 36) were used as the basis for distinguishing basic units. Here, emphasis should be laid on the great concentration of the passage, in which it differs clearly from the autumn passage (Kania, in press). In the autumn the passage consists of a number of waves, of which Kania found six. The mechanism of origin of such waves was the subject dealt with by some Soviet authors (among others, Dolnik and Blumental, 1964). In the spring there are in general no such short waves; instead, heavy passage lasts for spells of a number of days. This makes the study of the spring migration of the Chaffinch very difficult, since probably the basic units are not homogeneous ones. This is the more possible since the passages of males and females coming from the same area not simultaneous (Payevsky, 1969).

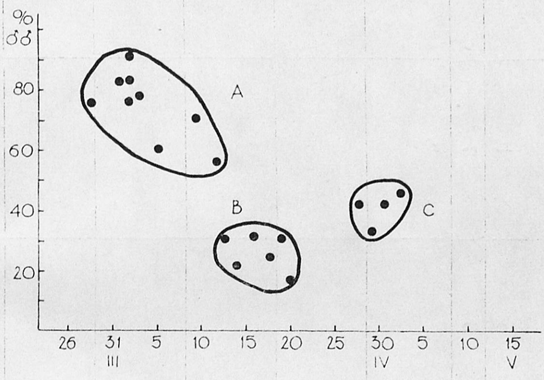

Fig. 37. Quantitative relations of sexes (percentage share of males) inside basic units (B_{py}) of *Fringilla coelebs*. A, B, C — working groups

Changes in the sex composition of migrating birds were one of the essential points in Kania's (in litt.) first trials of distinction of population groups. Basing myself on this observation, I carried out analogous calculations for the spring passage (Table XXXI). Fig. 37 shows the number of males in particular basic units. Three distinct groups have been distinguished: A) very many males at the outset of passage (58.5—90.1%), B) very few males (17.3—32.1%) and C) an average share of males in the population (33.8—46.5%). This arrangement suggests that the birds of groups A and B belong to the same population, as it is improbable for two populations with the male : female ratios as 3:1 and 1:3 to exist side by side. The average number of males in both groups is 52%, which value is quite probable. This interpretation of passage however

Tabela XXXII

Biometric parameters of basic units and terrirotial-temporal groups of *Fringilla coelebs* for Hel and Mierzeja Wiślana separately — B_{py}, B_{Gy}. Arrangement of data: $\sigma \overset{M}{N} m$. The thick lines between the successive units represent the significance of the difference between the values of the parameter at a level of 0.01. For other explanations see p. 171. * Tail measured by classic method

Year Point Sex, Age	Group	Date	Wing Length S	Tail Length 0	Indices of Wing Shape e	l	Standard Weight w	Fat Deposit t	Actual Weight W
1	2	3	4	5	6	7	8	9	10
1963 H									
♂♂ ad	I	to 13 IV	89.49 2.48 0.21 135	66.83* 2.50 0.21 135					
♂♂im	I	to 13 IV	87.93 2.15 0.24 81	64.00* 2.15 0.24 81					
♀♀ ad	I	to 13 IV	83.19 1.81 0.28 42	59.88* 1.66 0.25 42					
	II	14—22 IV	82.81 1.48 0.29 26	59.08* 1.61 0.32 26					
♀♀im	I	to 13 IV	83.13 2.56 0.38 47	60.06* 2.52 0.37 47					
	II	14—22 IV	82.74 2.10 0.40 27	60.30* 2.05 0.39 27					

1964 H									
♂♂ ad	I	to 15 IV	88.30 2.38 0.38 40	68.07 3.07 0.49 40			23.30 1.55 0.25 39	+0.37 0.69 0.11 37	23.67 1.69 0.27 39
	II	16—23 IV	89.36 1.78 0.38 22	69.55 2.19 0.47 22			22.37 1.42 0.31 21	+0.01 0.55 0.12 21	22.38 1.82 0.40 21
	III	from 24 IV	89.33 2.23 0.43 27	67.96 2.54 0.49 27			22.48 1.68 0.33 26	+0.25 0.71 0.14 26	22.73 1.82 0.36 26
♂♂im	I	to 15 IV	87.56 1.95 0.31 39	66.97 2.25 0.36 39			22.71 1.58 0.28 32	+0.38 0.64 0.11 31	23.09 1.70 0.30 32
	II	16—23 IV	85.41 2.48 0.53 22	67.23 3.13 0.67 22			21.55 1.27 0.28 20	0.00 0.62 0.14 20	21.55 1.41 0.31 20
	III	from 24 IV	85.60 2.62 0.43 37	65.89 2.42 0.40 37			21.30 1.15 0.19 37	+0.17 0.63 0.10 36	21.47 1.31 0.22 36
♀♀ad	I	9—15 IV	81.19 2.15 0.38 31	63.39 2.50 0.45 31			20.14 1.49 0.26 32	+0.20 0.65 0.11 32	20.34 1.62 0.29 32
	II	16—23 IV	82.38 2.08 0.18 128	62.95 2.52 0.22 128			20.00 1.34 0.12 123	+0.04 0.58 0.052 123	20.04 1.46 0.13 123
	III	from 24 IV	82.35 2.00 0.37 29	62.14 2.20 0.41 29			19.39 1.14 0.21 28	+0.11 0.68 0.13 28	19.50 1.32 0.25 28
♀♀ im	I	9—15 IV	81.19 2.49 0.55 20	61.15 2.12 0.47 20					
	II	16—23 IV	81.63 1.65 0.19 79	62.22 2.01 0.23 79			20.04 1.31 0.15 77	—0.03 0.64 0.074 77	20.01 1.46 0.17 77

1	2	3	4	5	6	7	8	9	10
	III	to 24 IV	81.23 1.81 0.26 47	61.71 1.90 0.28 47			19.34 1.15 0.17 45	+0.30 0.68 0.10 43	19.64 1.34 .0 45
1965 H									
♂♂ ad	I a	to 8 IV	89.98 2.78 0.43 43	70.00 1.90 0.29 43	36.12 3.96 0.81 24	42.21 364 0.74 24	21.93 1.64 0.25 42	—0.28 0.69 0.10 42	21.65 1.78 0.27 42
	I b	9—14 IV	90.35 2.39 0.26 83	68.29 2.48 0.27 83	36.08 4.00 0.54 56	41.73 4.66 0.62 56	21.66 1.57 0.17 83	+0.36 0.58 0.065 81	22.02 1.67 0.18 83
	I total		90.33 2.46 0.22 126	68.95 2.42 0.22 126	36.10 4.00 0.44 80	42.10 4.09 0.46 80	21.76 1.60 0.14 126	+0.14 0.65 0.058 126	21.90 1.74 0.16 126
	II	15—23 IV	89.27 2.63 0.52 26	68.31 2.25 0.44 26	34.54 3.53 0.73 24	38.71 3.81 0.76 24	21.96 1.50 0.30 24	+0.35 0.65 0.13 24	22.31 1.63 0.33 24
	III	after 24 IV	90.91 1.88 0.57 11	69.81 1.99 0.60 11					
♂♂ im	I a	to 8 IV	88.51 1.79 0.19 86	68.07 2.31 0.25 86	36.34 3.62 0.51 50	40.14 3.28 0.47 50	21.43 1.37 0.15 85	—0.29 0.63 0.068 85	21.14 1.50 0.16 85
	I b	9—14 IV	88.76 2.42 0.15 262	67.11 2.74 0.17 262	35.70 3.86 0.29 179	39.95 3.80 0.28 179	21.72 1.36 0.086 252	+0.23 0.59 0.038 245	21.95 1.48 0.093 252
	I total		88.63 2.31 0.12 348	67.21 2.69 0.14 348	35.94 3.82 0.25 228	40.00 3.70 0.24 228	21.65 1.50 0.082 336	+0.10 0.64 0.035 330	21.75 1.50 0.086 336
	II	15—23 IV	57.96 2.22 0.23 90	67.29 2.53 0.27 90	33.81 3.35 0.38 78	37.74 3.60 0.41 78	21.74 1.46 0.15 88	—0.01 0.69 0.073 88	21.73 1.61 0.17 88

	III	from 24 IV	87.46 1.99 0.55 13	66.69 2.12 0.59 13	35.30 2.56 0.77 11	38.40 2.36 0.79 11			
♀♀ ad	I a	to 8 IV	8	8	5	5			
	I b	9—14IV	83.55 2.02 0.19 111	62.64 2.18 0.21 111	33.60 3.50 0.47 56	37.82 2.96 0.39 56	19.82 1.01 0.10 108	+0.02 0.72 0.070 106	19.84 1.24 0.12 108
	I c	15—17 IV	83.47 2.24 0.57 15	62.53 2.24 0.57 15	10	10			
	I total		83.51 2.02 0.17 134	62.91 2.18 0.19 134	33.46 3.34 0.40 71	37.89 2.98 0.35 71	19.82 1.01 0.10 108	+0.02 0.72 0.070 106	19.84 1.24 0.12 108
	II	18—23 IV	83.75 1.86 0.17 119	63.77 2.00 0.18 119	31.91 4.03 0.38 111	36.22 3.84 0.36 111	20.30 1.12 0.10 116	+0.04 0.68 0.063 115	20.34 1.31 0.12 116
	III	from 24 IV	83.20 1.70 0.38 20	61.85 2.12 0.47 20	33.07 3.94 1.00 20	37.87 3.98 1.02 15	19.73 1.41 0.31 20	—0.13 0.64 0.14 20	19.60 1.55 0.34 20
♀♀ im	I a	to 8 IV	83.06 1.51 0.36 18	63.83 1.30 0.31 18	33.30 2.08 0.58 13	37.46 3.78 1.05 13			
	I b	9—14 IV	83.74 2.18 0.19 132	62.80 2.24 0.19 132	33.81 4.09 0.52 62	37.60 4.00 0.51 62	19.87 1.11 0.10 128	+0.02 0.63 0.056 126	19.89 1.28 0.11 128
	I c	15—17 IV	83.38 1.47 0.27 29	62.62 2.08 0.38 29	33.76 3.60 0.78 21	37.86 3.78 0.82 21	19.64 1.68 0.31 30	—0.24 0.61 0.11 30	19.42 1.78 0.32 30
	I total		83.61 2.04 0.15 179	62.72 2.22 0.16 179	33.42 3.81 0.39 96	37.66 3.86 0.39 96	19.77 1.21 0.10 158	—0.03 0.65 0.052 156	19.74 1.38 0.11 158

1	2	3	4	5	6	7	8	9	10
	II	18—23 IV	83.54 2.02 0.22 102	63.63 2.29 0.23 102	31.43 3.82 0.40 91	34.55 4.45 0.47 91	20.30 1.12 0.11 102	+0.02 0.66 0.065 102	20.32 1.30 0.13 102
	III	from 24 IV	83.08 1.75 0.34 26	62.58 2.37 0.46 26	33.20 2.91 0.58 25	36.08 2.68 0.54 25	20.15 1.03 0.20 26	—0.42 0.62 0.12 26	19.73 1.02 0.24 26
1966									
H ♂♂ ad	I	to 8 IV	88.62 1.27 0.35 13	69.60 1.97 0.55 13	37.93 3.28 0.86 14	42.36 2.50 0.66 14			
	III	from 24 IV	89.50 1.89 0.54 12	70.33 3.18 0.91 12	37.83 2.76 0.79 12	43.50 2.40 0.68 12			
MW ♂♂ ad	I	to 8 IV	90.00 2.04 0.21 93	68.35 2.27 0.24 93	39.11 3.39 0.41 91	45.36 4.32 0.45 91	22.24 1.45 0.18 64	—0.59 0.46 0.057 63	21.65 1.52 0.19 64
♂♂ im	I	to 8 IV	86.52 1.72 0.36 23	67.13 1.89 0.39 23	36.57 2.29 0.48 21	41.24 2.64 0.67 21	21.50 1.21 0.13 88	—0.85 0.33 0.035 88	20.65 1.25 0.13 88
	III	from 24 IV	86.38 1.73 0.43 16	67.12 1.96 0.49 16	36.70 3.47 1.15 15	40.80 5.01 1.28 15			
MW ♂♂ im	I	to 8 IV	87.27 1.89 0.16 134	66.84 2.00 0.17 134	37.71 3.53 0.30 137	41.98 3.62 0.31 137			
	?	9—23 IV	87.75 1.09 0.31 12	66.50 1.80 0.51 12	35.30 3.36 0.96 12	39.25 4.05 1.15 12			
H ♀♀ ad	III	from 24 IV	82.82 1.76 0.43 17	62.94 1.73 0.42 17	34.72 3.17 0.86 14	39.00 2.74 0.74 14			

MW ♀♀ ad	I	to 8 IV	82.58 2.04 0.31 43	62.70 1.89 0.29 43	35.47 3.00 0.45 43	38.98 3.58 0.54 43	19.39 0.88 0.16 32	—0.92 0.24 0.044 32	18.47 0.91 0.16 32
	?	9—23 IV	81.61 1.59 0.44 13	62.50 2.01 0.56 13	34.20 2.89 0.80 13	39.50 3.62 1.00 13			
	III	from 24 IV	83.67 1.73 0.44 15	62.47 2.12 0.54 15	36.79 4.08 1.16 14	41.36 3.96 1.07 14			
H ♀♀ im	III	from 24 IV	81.40 2.08 0.52 15	62.50 2.26 0.56 15	34.00 3.61 0.92 15	37.53 2.84 0.73 15			
MW ♀♀ im	I	to 8 IV	81.88 1.43 0.29 24	62.33 2.17 0.44 24	34.38 3.23 0.70 21	38.37 3.14 0.68 21			
	?	9—23 IV	83.20 1.88 0.34 25	61.40 1.93 0.39 25	34.00 3.31 0.66 24	38.39 3.46 0.72 24	20.41 1.13 0.23 24	—0.77 0.42 0.086 24	19.64 1.20 0.25 24
	III	from 24 IV	82.17 1.76 0.26 47	61.62 1.89 0.28 47	35.77 4.18 0.60 47	40.28 3.83 0.55 47	19.97 0.95 0.13 51	—0.88 0.29 0.041 50	19.09 1.00 0.14 51
1967									
H ♂♂ ad	II	7—19 IV	7	7	7	7			
MW ♂♂ ad	I a	to 31 III	89.83 1.82 0.17 121	68.70 2.25 0.20 121	39.52 3.39 0.32 116	45.80 3.88 0.36 116	21.39 1.27 0.11 121	—0.63 0.53 0.048 121	20.76 1.38 0.12 121
	I b	1—6 IV	89.36 2.23 0.45 25	68.48 2.10 0.42 25	39.63 4.05 0.82 24	44.88 3.36 0.69 24	21.73 1.00 0.20 25	—0.46 0.53 0.11 25	21.27 1.13 0.23 25

1	2	3	4	5	6	7	8	9	10
	I c	7—13 IV	89.70 1.57 0.33 23	68.13 1.27 0.26 23	39.65 2.42 0.50 23	45.83 2.53 0.53 23	22.19 1.30 0.28 22	—0.57 0.64 0.14 22	21.62 1.45 0.31 22
	I total		90.25 1.88 0.14 169	68.59 2.14 0.16 169	39.53 3.52 0.28 162	45.67 3.68 0.29 163	21.55 1.27 0.10 168	—0.60 0.56 0.043 168	20.96 1.39 0.11 168
	II	from 14 IV	89.08 1.87 0.30 38	68.92 2.52 0.41 38	38.73 3.10 0.48 41	44.34 3.42 0.53 41	21.40 1.62 0.27 36	—0.66 0.47 0.079 35	20.74 1.68 0.28 36
MW ♂♂ im	I a	to 31 III	87.73 2.02 0.17 145	66.95 2.40 0.20 145	38.16 3.96 0.34 140	43.23 3.30 0.28 140	21.03 1.19 0.10 145	—0.71 0.42 0.035 143	20.30 1.27 0.11 145
	I b	1—6 IV	87.30 1.51 0.20 60	66.38 1.97 0.26 60	38.21 3.56 0.46 61	43.02 2.94 0.38 61	21.25 1.14 0.15 61	—0.62 0.49 0.063 61	20.63 1.24 0.16 61
	I total		87.60 1.90 0.13 205	66.79 2.18 0.15 205	38.14 3.45 0.24 201	43.11 3.21 0.23 201	21.11 1.12 0.078 206	—0.70 0.41 0.028 214	20.41 1.20 0.083 206
	II	7—13 IV	86.92 1.54 0.22 51	65.75 1.85 0.26 51	36.95 3.36 0.47 50	41.76 3.21 0.45 50	21.13 1.15 0.16 51	—0.62 0.54 0.076 51	20.51 1.25 0.18 51
	III	from 14 IV	87.12 1.76 0.23 56	66.20 1.92 0.26 56	37.10 3.74 0.49 58	41.55 3.21 0.42 58	20.91 1.65 0.23 51	—0.60 0.53 0.074 51	20.31 1.73 0.24 51
H ♀♀ ad	II	7—19 IV	82.17 1.78 0.37 23	63.96 2.15 0.45 23	33.87 3.04 0.63 23	38.22 2.83 0.59 23			
MW ♀♀ ad	I	to 6 IV	83.37 1.75 0.24 54	62.43 1.83 0.25 54	35.15 3.40 0.49 52	41.25 3.65 0.51 52	19.71 1.15 0.16 56	—0.75 0.47 0.063 55	18.96 1.24 0.17 56

	II a	7—13 IV	83.25 1.44 0.18 60	62.62 1.92 0.25 60	34.17 2.52 0.34 60	40.00 2.78 0.36 60	19.50 1.10 0.13 60	—0.85 0.44 0.050 60	18.65 1.10 0.14 60
	II b	14—19 IV	82.60 1.64 0.15 116	61.98 1.96 0.18 116	34.47 2.87 0.27 117	39.68 2.80 0.26 117	19.21 0.84 0.079 115	—0.74 0.54 0.050 114	18.47 1.00 0.110 115
	II total		82.83 1.66 0.12 176	62.15 2.02 0.16 176	34.37 2.78 0.21 177	39.79 2.81 0.21 177	19.31 0.91 0.069 175	—0.78 0.50 0.038 174	18.53 1.04 0.079 175
	III	from 20 IV	82.13 1.52 0.19 61	62.82 1.68 0.22 61	36.11 2.95 0.40 53	40.08 3.13 0.43 53	19.72 0.92 0.13 53	—0.03 0.55 0.076 53	19.69 1.08 0.15 53
MW ♀♀ im	I	to 6 IV	82.34 1.51 0.22 47	62.40 1.77 0.26 47	34.59 3.04 0.45 46	39.37 2.86 0.42 46	19.39 1.80 0.16 48	—0.87 0.36 0.052 48	18.52 1.13 0.16 48
	II a	7—13 IV	82.17 1.66 0.16 103	62.10 2.01 0.20 103	34.11 2.78 0.27 104	38.76 2.89 0.28 104	19.35 0.98 0.10 103	—0.90 0.25 0.025 103	18.45 1.01 0.10 103
	II b	14—19 IV	81.64 1.60 0.087 341	61.46 1.90 0.10 341	33.97 2.98 0.17 324	38.31 2.90 0.16 324	18.96 0.94 0.052 323	—0.78 0.49 0.027 323	18.18 1.06 0.059 323
	II total		81.69 1.63 0.078 444	61.61 1.96 0.093 444	34.04 2.94 0.14 433	38.49 2.95 0.046 433	19.05 0.95 0.046 426	—0.80 0.45 0.022 426	18.25 1.05 0.051 426
	III	from 20 IV	81.08 1.57 0.16 94	62.36 2.06 0.21 94	35.53 2.75 0.31 79	39.09 2.60 0.29 79	19.37 1.10 0.12 82	—0.24 0.56 0.063 81	19.13 1.23 0.14 82

encounters some difficulties in the course of the biometric analysis of basic units (Table XXXII). In the graphs representing the indices of wing shape „e" and „l" (Fig. 38) there occur very characteristic downward swings for units belonging to group B from Fig. 37. This is particularly distinct for 1965; here the differences are statistically significant both for males and females, which should be interpreted as a group (population) — type differentiation. This discrepancy however appeared to be apparent. I shall try to explain its causes as exemplified by the passage of 1965.

In 1965 the observations at the Hel point probably covered the passage of the Chaffinch virtually from the very beginning (Fig. 36). In addition, in that year a considerable number of specimens (1223) were caught in a Heligoland trap and owing to peculiar meteorological conditions the changes in the intensity of trapping corresponded closely to the changes in the intensity of passage. Moreover, it is worth while mentioning that the share of males in groups A and B taken together (52.5%) corresponds exactly to their mean proportion in these groups in all the years of observation together. In consequence, the year 1965 may be treated as a model for considerations on the structure of the spring passage of the Chaffinch. In such considerations based on the model we must make the following simplifying assumptions: 1) the sex composition of groups A and B (groups I and II in Table XXXII) is the same, males forming 52%, and 2) the division into basic units resulting from the graph agrees with the real group boundaries for males.

Fig. 39 shows cumulative graphs of the passage of male and female Chaffinches. The curves of the two sexes are shifted in relation to each other because of the shift of migration of males and females in time. The further course of reasoning is simple; since 48 females must pass to each batch of 52 males (in order to keep the 52% share of males in the population in the breeding-area), 120 females will fall to 130 males trapped in the first unit (up to point A_1 in the graph). The basic unit ended for males at point A_1 (8 April), but the appropriate number of passing females had not been obtained until about 10 April (point a_1). An analogous reasoning may be carried out for points A_2 — a_2, B—b, etc. Thus, the change of the population of males occurred at point A_2 (14 April) and that of females not before point a_2 (20 April), which means that males and females, „not pertaining to each other" but belonging to different populations, flew together for 5 days (15—20 April). The picture of the group structure of the passage is obtained by plotting the passage time of successive groups on the time scale (at the top of Fig. 39). This part of Fig. 39 shows why on biometric grounds the females trapped on 15—17 April have been included in group I and the males in group II. It can also be seen from it that in all probability distinguished group II of females is not homogeneous and its distinct dissimilarity from group I should be ascribed to a considerable deviation of the parameter values in females of group II proper from those in females of group I. In interpreting biometric data, one must therefore keep in mind that the phenomenon of the superimposition of populations (groups)

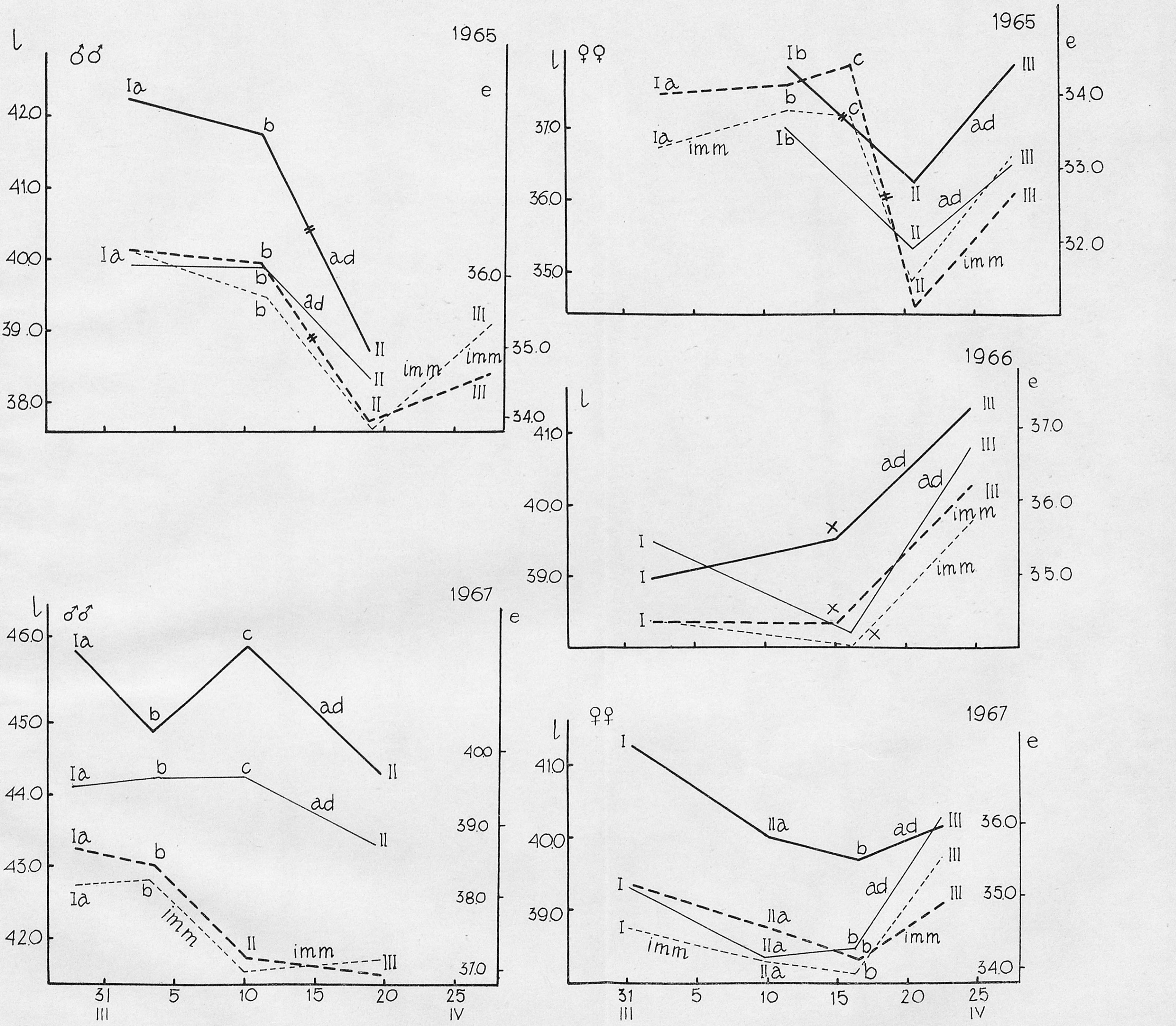

Fig. 38. Variation in wing shape indices in *Fringilla coelebs*. Thin lines — values of symmetry index „e"; thick lines — values of index of wing pointedness „l "

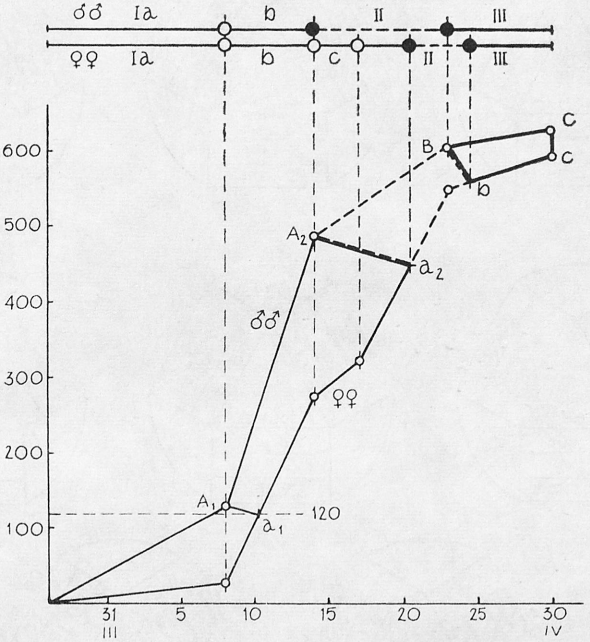

Fig. 39. A cumulative graph of the passage of *Fringilla coelebs* specimens differing in sex in 1965, showing the overlap of the groups. For the explanations of the upper part of the drawing see Fig. 17 (p.186); a description of the lower part will be found in the text on p. Vertical axis — number of specimens

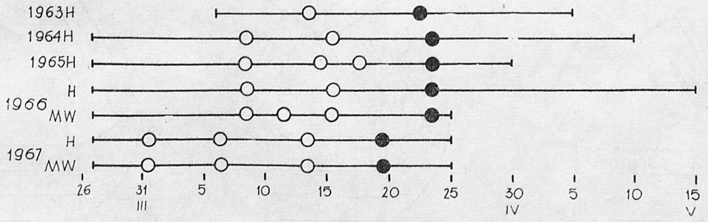

Fig. 40. Division into basic units and annual territorial-temporal groups in *Fringilla coelebs*. For explanations see Fig. 17 (p.186). The division into groups I and II is not included because of the overlapping of the passages of males and females from different groups

causes the blurring of actually existing differences. The shift of the migration time of males and females from group I is greater than that in group II (Fig. 39). This is also indicated by the distribution of groups A, B and C in Fig. 37. This statement is quite in harmony with the data obtained for the Goldcrest (Busse and Machalska, 1969).

Coming back to Table XXXI, I must emphasize the high percentage of old birds in the population; it is 23.1—66.0% (on the average 41.2%) for males and 22.4—66.7% (on the average 45.2%) for females.

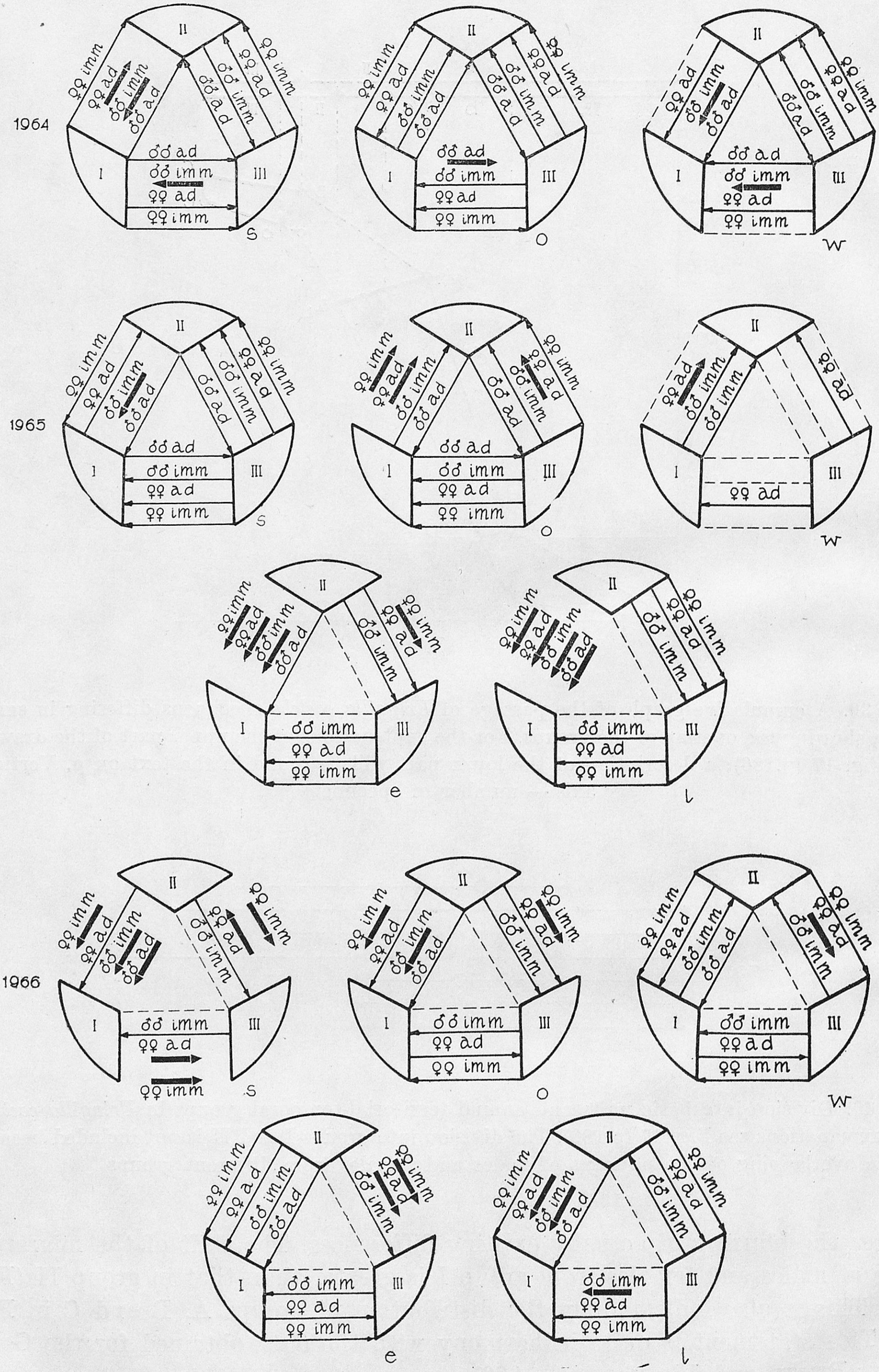

Fig. 41. A diagram of the differentiation of annual territorial-temporal groups, $(H + MW)B_{Gy}$ in *Fringilla coelebs*. S — wing length, O — tail length, w — standard weight, e — index of symmetry of wing-tip, 1 — index of pointedness of wing-tip. For other explanations see Fig. 18 (p. 188)

Table XXXIII

Biometric parameters of cumulative territorial-temporal groups of *Fringilla coelebs* for Hel and Mierzeja Wiślana together — $(H+MW)B_G$. Arrangement of data: $\sigma \overset{M}{\underset{N}{}} m$, for other explanations see p. 171

Sex, Age	Group	Wing Length S	Tail Length O	Indices of Wing Shape e	Indices of Wing Shape l
1	2	3	4	5	6
♂♂ ad	I	89.73 2.29 0.10 567	68.69 2.36 0.11 441	38.54 3.92 0.21 347	44.46 4.14 0.22 347
	II	89.28 2.04 0.20 101	68.81 2.32 0.23 99	37.39 3.88 0.47 72	42.47 4.33 0.51 72
	III	89.75 2.18 0.30 55	70.02 2.61 0.37 50	37.50 3.88 0.79 24	42.58 4.28 0.87 24
♂♂ im	I	88.00 2.18 0.075 839	67.09 2.38 0.086 758	37.71 3.67 0.15 593	41.58 3.71 0.15 593
	II	87.41 2.22 0.16 183	66.92 2.56 0.19 185	35.29 3.90 0.33 137	39.63 4.09 0.35 137
	III	87.73 2.38 0.20 135	66.26 2.15 0.19 129	36.98 4.04 0.42 92	41.00 3.71 0.40 92
♀♀ ad	I	83.07 2.09 0.12 304	62.77 2.18 0.13 262	34.50 3.42 0.27 166	39.46 3.64 0.28 166
	II	82.90 1.92 0.087 482	62.85 2.26 0.11 423	33.43 3.52 0.21 311	38.40 3.60 0.20 311
	III	82.62 1.83 0.15 149	62.46 1.99 0.18 125	35.53 3.54 0.36 96	39.76 3.50 0.36 96
♀♀ im	I	83.05 2.20 0.12 318	62.69 2.20 0.13 270	34.00 3.56 0.28 163	38.23 3.58 0.28 163
	II	82.08 1.88 0.073 661	62.04 2.18 0.086 634	33.62 3.39 0.15 531	37.85 3.56 0.15 531
	III	81.58 1.91 0.12 237	62.12 2.03 0.13 230	35.05 3.49 0.28 166	38.82 3.33 0.27 166

A biometric analysis of the passage and that of the sex composition have led to the distinction of three groups that migrated successively. The boundary between groups II and III is shown in the diagram of basic units (Fig. 40). The boundaries between groups I and II are not marked out, because the passages of males and females overlapped. The differentiation of the annual teritorial-temporal groups (B_{Gy}) is illustrated in Fig. 41 (data from Table XXXII). The indices of differentiation „z" are not very high (0.41 for groups I and II, 0.19 for II and III, and 0.14 for I and III), but the fairly great accordance of the directions of the differences suggests that the differentiation is actual. This is confirmed by a comparison of differentiations in the cumulative territorial-temporal groups (B_G — Table XXXIII, Fig. 42). Here the index „z" reaches much higher values than it does for annual the groups; it is 0.5 for groups I and II and for II and III, and 0.4 for I and III, the directions of the differences being at the same time conspicuously uniform. It is interesting that both the values of the index „z" and the test of accordance of directions seem to indicate that in respect of biometry groups I and III come closer to each other than to the middle group (II).

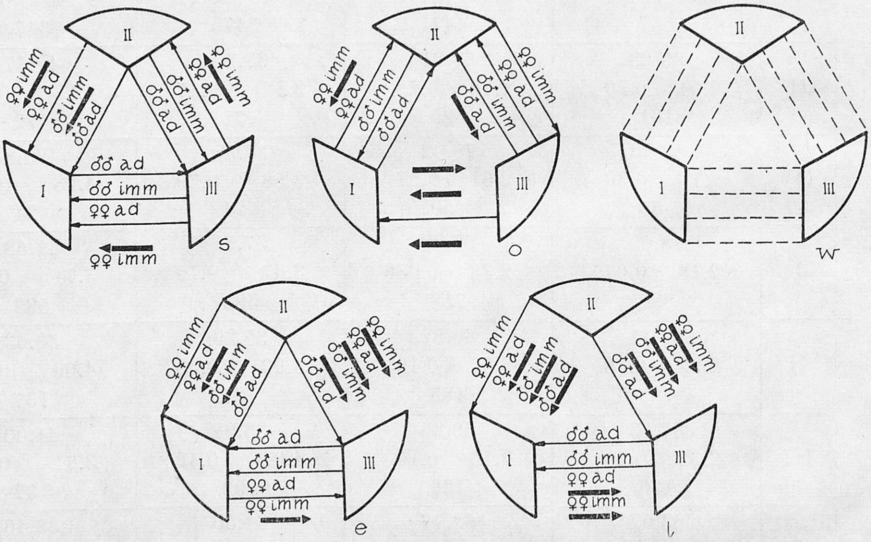

Fig. 42. A diagram of the differentiation of cumulative territorial-temporal groups, (H + MW)B_G, in *Fringilla coelebs*. For explanations see Figs. 41 and 18

It was assumed in the considerations carried out so far on the group differentiation in Chaffinches that materials from observation points were uniform, as suggested by Kania (in press). Since I have at my disposal some material, to be sure rather scanty, for a biometric comparison of the birds passing through both observation points, I have used it to construct Table XXXIV. The differences observed are variable with regard to direction, although in 4 out of the 12 cases they are statistically significant (z = 0.3). However, since the

Table XXXIV

Biometric differentiation of males in annual territorial groups of *Fringilla coelebs* in 1966—1967 — B$_y$. Arrangement of data: $\sigma \begin{smallmatrix} M \\ N \end{smallmatrix} m$, for other explanations see p. 171

Year, Age	Point	Wing Length S	Tail Length O	Indices of Wing Shape	
				e	l
1	2	3	4	5	5
1966					
ad	H	89.04 1.66 0.33 25	70.00 2.64 0.53 25	37.70 3.04 0.53 30	42.90 3.10 0.56 30
	MW	89.99 2.00 0.20 99	68.32 2.24 0.22 99	39.11 3.90 0.39 99	45.16 4.48 0.45 99
im	H	86.46 1.74 0.28 39	67.13 1.91 0.31 39	37.39 3.66 0.61 36	41.06 3.88 0.65 36
	MW	87.33 1.83 0.15 153	66.77 2.02 0.16 153	37.58 3.81 0.30 149	41.79 3.72 0.30 149
1967					
im	H	87.44 1.61 0.37 19	68.84 1.98 0.46 19	38.84 3.81 0.95 16	41.20 3.19 0.82 16
	MW	87.40 1.85 0.10 312	66.51 2.13 0.13 312	37.75 3.52 0.20 309	42.60 3.28 0.19 309

juxtaposition includes all the three temporal groups for either observation point, these differences should not be overrated but rather treated as indicative of the possibility of such a differentiation.

There are considerable oscillations in the biometric parameters of the Chaffinch with time (Table XXXV, Fig. 43). This is true of all the parameters in all the sex-and-age groups.

The following general conclusions about the passage of the Chaffinch may be drawn from the foregoing data:

1. The passage time of Chaffinches is clearly differentiated between males and females. This differentiation decreases gradually in consecutive groups.

2. The differentiation of the migration time in specimens of different sexes in conjunction with a considerable concentration of passage causes the overlap of the passage of females of one population with that of males of the population migrating next. This however does not disturb the principle of population isolation, which seems to be binding in a number of species in the autumn (Busse, 1972). The modification of this principle presented above may prove

Table XXXV

Variability of parameters in annual territorial groups of *Fringilla coelebs* in successive years for Hel and Mierzeja Wiślana together — (H+MW)B_y. Arrangement of data: $\sigma \begin{matrix} M \\ N \end{matrix} m$, for other explanations see p. 171

Sex Age	Year, Index	Wing Length	Tail Length	Indices of Wing Shape		Standard Weight	Fat Deposit	Actual Weight
		S	0	e	l	w	t	W
1	2	3	4	5	6	7	8	9
♂♂ ad	1963	89.57 2.44 0.20 148						
	1964	89.88 1.54 0.16 89	69.01 2.86 0.30 89			23.05 1.59 0.17 86	+0.24 0.66 0.072 84	23.29 1.72 0.18 86
	1965	90.20 2.54 0.20 163	68.91 2.39 0.19 163	35.78 4.06 0.38 113	41.25 4.13 0.39 113	21.78 1.58 0.13 150	+0.18 0.66 0.055 147	21.96 1.72 0.14 150
	1966	89.20 2.01 0.18 124	68.66 2.42 0.22 124	38.97 3.77 0.33 130	44.64 4.30 0.38 130	22.24 0.46 0.18 64	—0.59 0.46 0.057 63	21.65 1.52 0.19 64
	1967	89.62 1.89 0.13 207	69.63 2.22 0.15 207	39.40 3.44 0.24 204	45.40 3.63 0.25 204	21.52 1.34 0.094 204	—0.61 0.55 0.038 203	20.91 1.45 0.10 204
	s	1.58	1.77	3.30	3.57	3.98		
	z	0.2	0.3	0.7	0.7	0.7		
♂♂ im	1963	88.05 2.14 0.22 97						
	1964	86.34 2.54 0.26 98	66.61 2.60 0.26 98			21.87 1.54 0.16 89	+0.21 0.64 0.068 87	22.08 1.66 0.18 89

	1965	88.52 2.30 0.11 451	67.27 2.64 0.12 451	35.32 3.78 0.21 317	39.28 3.78 0.21 317	21.68 1.42 0.069 424	+0.08 0.64 0.031 418	21.74 1.55 0.076 424
	1966	87.15 1.84 0.13 192	66.84 2.00 0.14 192	37.40 3.79 0.27 193	41.65 3.77 0.28 193	21.50 1.21 0.13 88	—0.85 0.33 0.035 88	20.65 1.25 0.13 88
	1967	87.42 1.82 0.10 331	66.64 2.19 0.12 331	37.82 3.50 0.19 325	42.63 3.28 0.18 325	21.64 1.11 0.064 308	—0.67 0.47 0.026 316	20.97 1.21 0.069 308
	s	4.76	1.53	2.60	3.87	2.11		
	z	0.8	0.2	0.7	1.0	0.0		
♀♀ ad	1963	83.00 1.73 0.20 75						
	1964	82.18 2.15 0.16 188	62.93 2.56 0.19 188			20.03 1.35 0.10 183	+0.08 0.62 0.046 183	20.11 1.49 0.11 183
	1965	83.55 2.00 0.12 273	63.12 2.20 0.13 273	32.56 3.84 0.27 197	36.92 3.66 0.26 197	19.69 1.15 0.074 244	+0.02 0.69 0.045 241	19.71 1.34 0.086 244
	1966	82.97 1.93 0.20 88	62.67 1.93 0.21 88	35.27 3.33 0.36 84	39.96 3.54 0.38 84	19.39 0.88 0.16 32	—0.92 0.24 0.044 32	18.47 0.91 0.16 32
	1967	82.74 1.72 0.10 324	62.46 1.97 0.11 324	34.76 3.04 0.17 305	39.97 3.10 0.18 305	19.11 1.00 0.059 284	—0.63 0.61 0.059 282	18.48 1.17 0.070 284
	s	2.74	1.30	3.04	3.69	3.87		
	z	0.5	0.2	0.7	0.7	0.7		
♀♀ im	1963	82.84 2.46 0.27 82						

1	2	3	4	5	6	7	8	9
	1964	81.46 1.86 0.15 146	61.92 2.03 0.17 146			19.79 1.27 0.12 122	+0.09 0.66 0.60 120	19.88 1.42 0.13 122
	1965	83.54 2.08 0.12 307	63.19 2.27 0.13 307	32.63 4.10 0.28 212	36.15 4.24 0.29 212	20.04 1.12 0.071 286	—0.05 0.66 0.040 284	19.99 1.38 0.081 286
	1966	82.25 1.90 0.18 112	61.85 2.06 0.19 112	34.85 3.85 0.37 107	39.09 3.66 0.36 107	20.07 1.34 0.15 75	—0.85 0.35 0.040 74	19.22 1.38 0.16 75
	1967	81.72 1.67 0.069 586	61.80 1.99 0.082 586	34.31 2.98 0.13 558	38.59 2.87 0.12 558	19.13 1.01 0.043 556	—0.76 0.51 0.022 554	18.40 1.13 0.048 556
	s	5.17	3.49	5.70	3.71	4.51		
	z	0.7	0.5	0.7	0.7	0.5		

essential for future studies on the mechanism of population isolation during migration.

3. Three population groups can be distinguished on the basis of the biometric data and by analysing the differentiation of the sex composition, groups I and III appearing to stand closer to each other than to group II.

4. The oscillations of the Chaffinch's biometric parameters are very great in successive years.

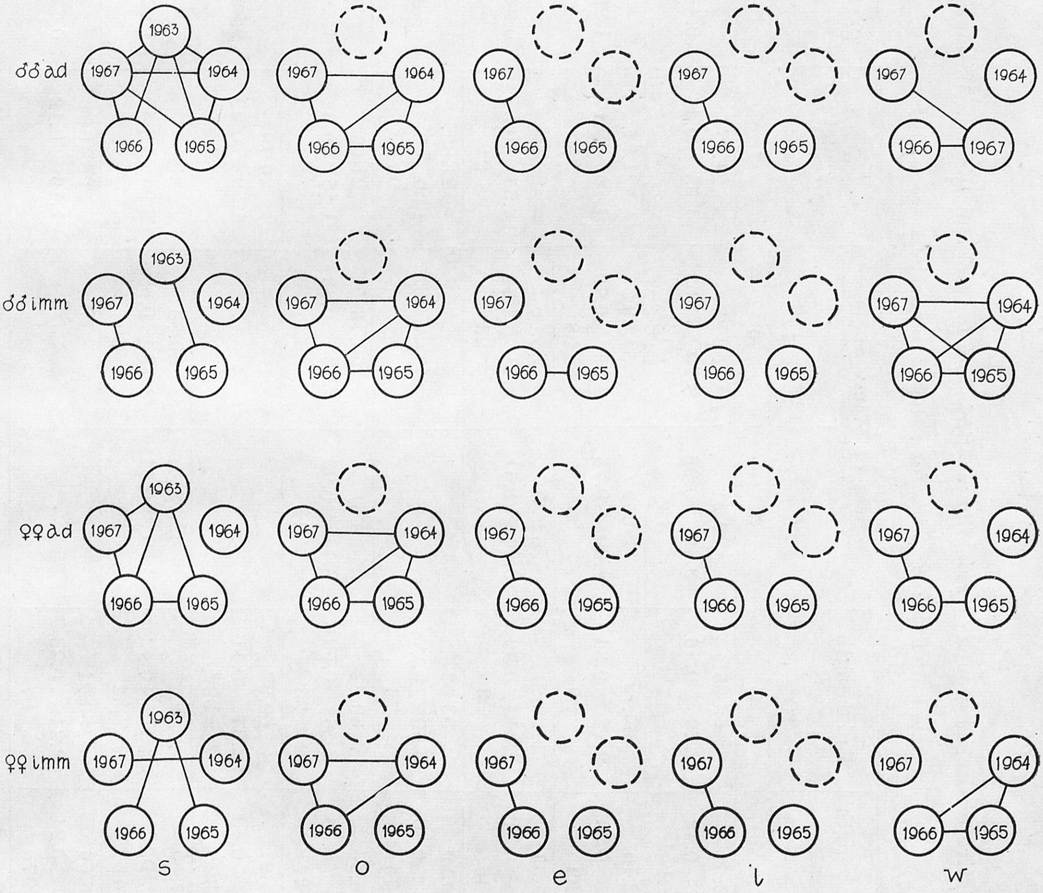

Fig. 43. A diagram of the oscillation differentiation of annual territorial-temporal groups (B_{Gy}) in *Fringilla coelebs*. For explanations see Fig. 21

Fringilla montifringilla

A comparison of the general biometric parameters of birds migrating through both observation points (Table XXXVI) shows the occurrence of differentiation among young birds ($z_{im} = 0.7$). Significant differences have been found in the wing and tail lengths between both male and female immatures. Table XXXVI lacks some data concerning the wing shape in Bramblings migrating

Table XXXVI

Biometric parameters of cumulative territorial groups of *Fringilla montifringilla* for Hel and Mierzeja Wiślana separately — B_s. Arrangement of data: $\sigma \genfrac{}{}{0pt}{}{M}{N} m$, for other explanations see p. 171

Sex Age	Point	Wing Length S	Tail Length O	Indices of Wing Shape e	 l	Standard Weight w	Fat Deposit t	Actual Weight W
1	2	3	4	5	6	7	8	9
♂♂ ad	H	92.57 1.91 0.42 21	66.65 2.29 0.56 17	49.31 3.45 0.96 13	52.23 3.70 1.03 13	21.87 1.53 0.44 12	+0.71 0.48 0.14 11	22.58 1.61 0.46 12
	MW	92.10 2.06 0.33 39	65.18 2.12 0.34 39	50.59 4.60 0.75 38	54.29 4.35 0.70 38	21.87 1.10 0.17 36	—0.73 1.29 0.21 36	21.14 1.63 0.27 36
♂♂ im	H	92.47 2.09 0.31 45	66.21 2.24 0.39 33	52 .70 6.80 1.51 23	55.00 5.41 1.12 23	22.60 2.65 0.54 24	+0.28 0.94 0.19 24	22.88 2.82 0.57 24
	MW	90.20 2.31 0.26 75	63.52 2.40 0.27 75	—	—	21.82 1.50 0.17 75	—0.90 0.74 0.084 75	20.92 1.67 0.19 75
♀♀ ad	H	86.26 2.33 0.45 27	60.52 2.56 0.53 23	48.31 3.44 0.96 13	50.46 3.00 0.83 13	21.03 1.45 0.32 20	+0.12 1.38 0.34 17	21.15 2.00 0.44 20
	MW	85.97 2.46 0.43 32	60.22 2.34 0.41 32	—	—	20.79 1.69 0.29 35	—1.22 0.39 0.066 35	19.57 1.73 0.29 35
♀♀ im	H	87.10 2.06 0.32 41	62.25 2.37 0.42 32	49.13 3.50 0.64 30	50.83 3.73 0.68 30	20.80 2.04 0.42 24	+0.41 1.22 0.28 19	21.21 2.38 0.48 24
	MW	85.66 2.31 0.24 97	60.21 2.21 0.23 97	—	—	20.40 1.16 0.12 96	—1.10 0.77 0.079 96	19.30 1.40 0.14 96

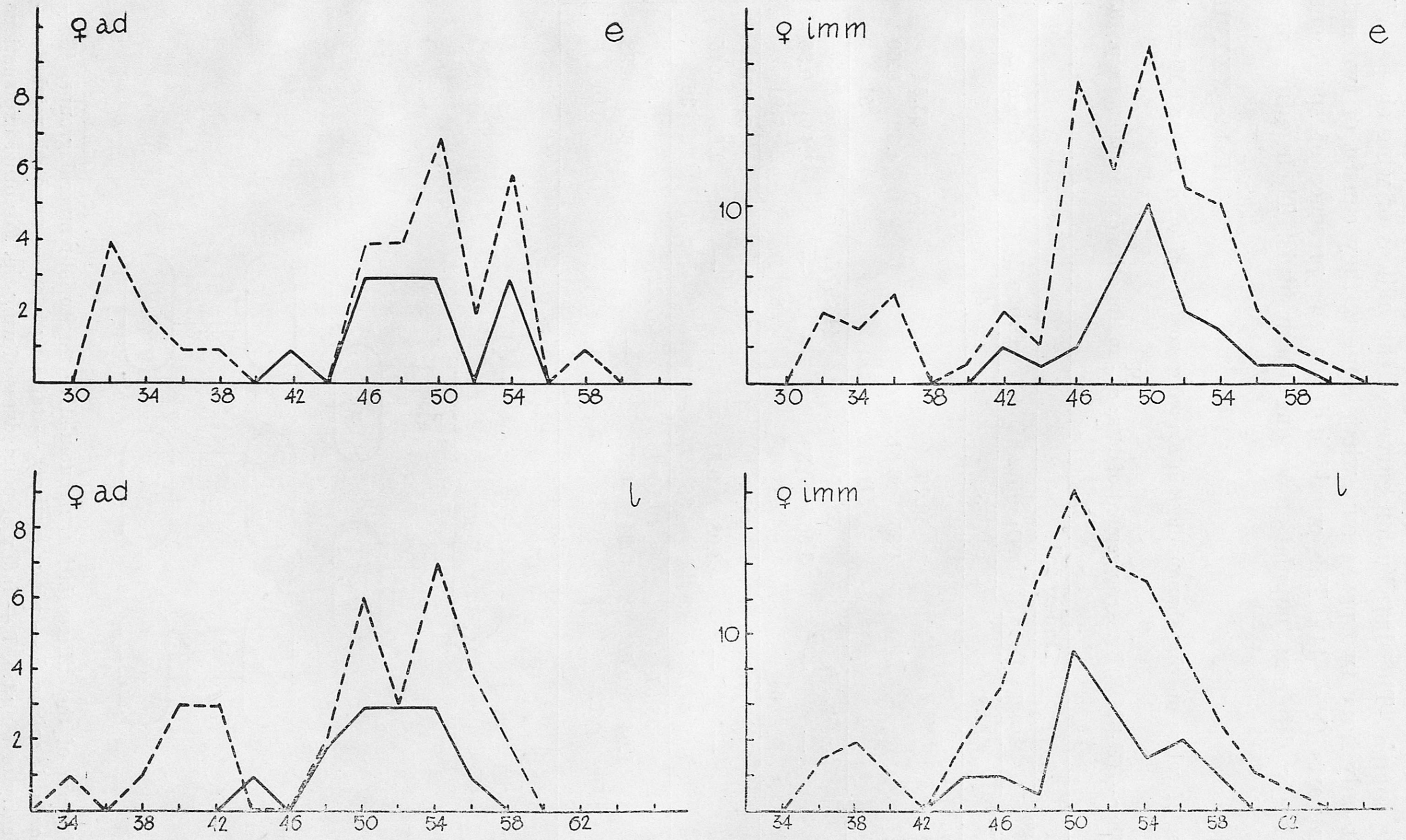

Fig. 44. Distribution of the values of the indices of wing shape „e" and „l" in *Fringilla montifringilla*. Solid line — Hel, dashed line — Mierzeja Wiślana

over the Mierzeja Wiślana. This has been caused by the very great heterogeneity of the sample. The distribution curves of the indices of wing shape „e" and „l" not only have two peaks but, what is more, they consist of two not overlapping parts (Fig. 44). This would indicate the presence of specimens of a completely different population among these birds. Their admixture,

Table XXXVII

Differentiation of values of wing shape indices in *Fringilla montifringilla* for Hel and Mierzeja Wiślana together — (H + MW) B_S. Arrangement of data: $\sigma \frac{M}{N} m$, for other explanations see p. 133

Sex and Age	Index "e"		Index "l"	
	Group 1	Group 2	Group 1	Group 2
1	2	3	4	5
♂♂ ad		50.26 4.35 0.61 51		53.54 4.32 0.60 51
♂♂ im	(39.30) — — 6	53.07 3.66 0.39 91	(43.07) — — 6	55.32 3.44 0.36 91
♀♀ ad	(33.00) — — 8	49.56 3.08 0.51 36	(39.00) — — 8	51.89 2.69 0.45 36
♀♀ im	33.67 1.94 0.55 12	49.10 3.94 0.37 113	(37.22) — — 9	50.95 3.99 0.38 116

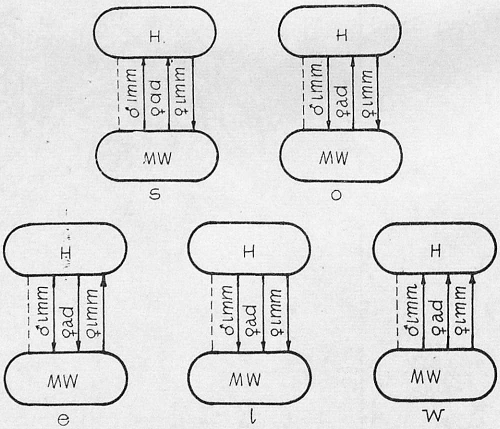

Fig. 45. A diagram of the differentiation of cumulative territorial-temporal groups, (H + MW)B_G, in *Carduelis spinus*. S — wing length, O — tail length, w — standard weight, e — index of symmetry of wing-tip, l — index of pointedness of wing-tip. For other explanations see Fig. 18

Table XXXVIII

Biometric parameters of cumulative territorial-temporal groups of *Carduelis spinus* for Hel and Mierzeja Wiślana together — (H+MW)B_G.

Arrangement of data: $\sigma \genfrac{}{}{0pt}{}{M}{N} m$, for other explanations see p. 171

Sex, Age	Group, Dates	Wing Length S	Tail Length O	Indices of Wing Shape e	l	Standard Weight w	Fat Deposit t	Actual Weight W
1	2	3	4	5	6	7	8	9
♂♂ ad	I to 25 IV	73.03 2.00 0.18 116	45.12 1.67 0.15 116	51.23 3.12 0.50 41	51.41 2.96 0.46 41	11.93 0.95 0.092 108	+0.46 0.47 0.045 108	12.39 1.06 0.10 108
	II from 26 IV	71.58 1.56 0.36 19	45.21 1.58 0.35 19			11.19 0.81 0.19 18	+0.37 0.51 0.12 18	11.56 0.95 0.23 18
♂♂ im	I to 25 IV	72.80 1.66 0.13 172	45.24 2.10 0.16 172	49.99 3.96 0.47 72	50.18 3.73 0.44 72	13.21 1.15 0.089 167	+0.37 0.46 0.035 167	13.58 1.24 0.096 167
	II from 26 IV	72.11 1.90 0.24 64	45.50 1.96 0.24 64	50.71 2.31 0.56 18	51.39 2.15 0.51 18	12.01 1.03 0.15 49	+0.32 0.56 0.081 49	12.33 1.18 0.17 49
♀♀ ad	I to 25 IV	71.39 1.81 0.18 101	44.06 1.95 0.19 101	48.11 3.56 0.67 29	49.21 3.62 0.67 29	11.83 1.06 0.11 98	+0.62 0.51 0.052 98	12.09 1.18 0.12 98
	II from 26 IV	—	—	—	—	11.66 0.82 0.20 17	+0.58 0.74 0.18 17	12.24 1.11 0.27 17
♀♀ im	I to 25 IV	70.49 1.73 0.13 181	43.83 1.98 0.15 181	47.09 3.78 0.43 75	47.55 3.69 0.42 75	11.57 0.99 0.076 173	+0.57 0.53 0.040 173	12.14 1.13 0.086 173
	II from 26 IV	70.59 1.73 0.28 39	44.13 1.82 0.29 39	—	—	11.72 0.98 0.17 35	+0.59 0.75 0.13 35	12.31 1.23 0.21 35

relatively abundant at the Mierzeja Wiślana (24 specimens — 10.2%), presumably also occurs at Hel, although in a considerably smaller number (here 3 such specimens can be counted — 3.8%). Table XXXVII illustrates the differentiation of the average values of the wing shape indices between the two groups.

Carduelis spinus

A biometric analysis of Siskins' groups, which appear in the cumulative graph of the P_{5s} type (Fig. 12C, P_5) but are not very distinct in annual graphs (Busse, 1974), suggests the occurrence of some differentiations (Table XXXVIII, Fig. 45). The differences found are however not very distinct and a more reliable statement will not be possible until more material has been collected.

V. GENERAL REMARKS

If in writing about some elements of the work methods it was possible to discuss them and refer to other authors' opinions in this respect, the general discussion of the results is incomparably more difficult. The system of degrees in generalization of material concerning migration, here proposed and based on the methods employed by other authors to present data, is nothing but their ordering and gathering into a whole. The scheme of analysis of data and the degree system of generalization of biometric materials have however only little corroboration from earlier papers. This is so because there have not been any biometric studies on a large scale so far. Materials from single observation points have been published and analysed in a time sequence (Evans, 1964a; Durman, 1967; Rabøl, 1967), materials from the territory of Europe in a territorial arrangement (Scott, 1962; Soikkeli, 1966; Blondel, 1967), but I have not met with any attempts to combine biometric studies made in several places at the same time in literature. The first steps in this direction were made under the scheme of the Operation Baltic (Busse, 1967a, 1968, 1972; Busse and Kania, 1970; Nitecki, 1969; Kania, in press) and the present publication is their continuation.

The results obtained in the course of this biometric analysis are not related to other authors' studies, since the few existing biometric papers contain practically no comparable materials. Ash (1969), Fry, Ash and Ferguson-Lees (1970) and Moreau and Dolp (1970) carried out their work in Africa, on passeriform species trapped only in small numbers on the Polish coast of the Baltic. The most interesting biometric studies covering summer and autumn (Evans, 1964a; Soikkeli, 1966; Griffiths, 1970) are concerned with Dunlins, which are not trapped at all in this country in the spring. The papers by Scott (1962, 1965), Blondel (1967), Durman (1967) and Rabøl (1967) contain materials which are very fragmentary and incomparable for methodic reasons.

The biometric differentiations at the level of populations and subpopulations presented in this paper are a new element in the studies on migration and they cannot, as yet, be related to any other kinds of differentiations (e. g. migratory or ecological ones), because in the species discussed no other differentiations have been found up to now. The oscillations of the values of biometric parameters detected in the same population in successive years undermine the statements — common though not expressed distinctly — on the constant nature of biometric parameters of subspecies or populations. The possibility pointed out in this paper that the passages of males and females belonging to different populations may overlap was not taken into consideration in earlier publications. Although the principle of population isolation connected with this problem has already been mentioned before (Busse, 1969, 1972), further studies are necessary so that it may become a subject for a factual discussion based on an adequate amount of material.

Thus the newness of the problems and the scarcity of documentation make a classic discussion of the results impossible but they permit the listing of suggestions for further studies in this direction. The following main problems emerging from the material being worked out and calling for solution should be mentioned in the first place:

1. the unravelling of the spatial biometric structure of a species and its association with both local conditions and population evolution,
2. the oscillation of biometric parameters, their conditioning and sex-and-age specificity, and
3. the isolation and overlapping of populations during migration.

In order to investigate these problems it is necessary to possess a huge biometric material from a number of years, for, on the one hand, adequate numbers of facts must be gathered as the basis for the formation of firm hypottheses and, on the other hand, specific conditions occurring in one year may make it possible to see into the phenomena which are too complex under a normal set of conditions.

Translated into English
by Jerzy Zawadzki

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STRESZCZENIE

Materiał do pracy został zebrany w ramach działalności Akcji Bałtyckiej w latach 1963—1967 na punkcie Hel (54°46′N, 18°28′E) i 1966—1967 na punkcie Mierzeja Wiślana (54°21′N, 19°19′E). Czas pracy w poszczególnych latach przedstawia rys. 1. Badania były prowadzone standardowymi metodami Akcji Bałtyckiej, opisanymi w pracy Busse, Kania (1970). Tam też zostały opublikowane szkice umiejscowienia punktów badawczych (Hel z lat 1962—1967 i Mierzeja Wiślana II).

Praca podzielona jest na dwie zasadnicze części: faunistyczny opis przelotu i opracowanie danych biometrycznych schwytanych ptaków.

Faunistyczny opis przelotu opiera się na ilościowym przedstawieniu wyników obserwacji wizualnych i chwytania gatunków liczniejszych. Dla gatunków rzadszych podano obserwacje jednostkowe. W celu ułatwienia orientacji w stopniach uogólnienia (czy dokładności) materiału dotyczącego dynamiki migracji, w pracy niniejszej jest stosowany ujednolicony system oznaczeń. Wszystkie dane obrazujące tę dynamikę (ilości ptaków schwytanych lub zaobserwowanych w poszczególnych okresach) oznaczone są symbolem „P". Indeksy cyfrowe (1 lub 5) przy literze P informują, jakich jednostek czasowych dotyczą przedstawione dane: P_1 symbolizuje dzienną dynamikę migracji, P_5 — dynamikę pentadową. Indeksy literowe („y" lub „s") określają, czy dane pochodzą z poszczególnych lat (y), czy też są to sumy materiału ze wszystkich omawianych lat łącznie (s). Zasadniczo używane są symbole o dwóch indeksach (P_{5y}, P_{5s}), tylko symbol P_{1y} został uproszczony do P_1, gdyż dzienna dynamika wędrówki jest rozpatrywana wyłącznie oddzielnie dla poszczególnych lat. Symbol P_s oznacza dane nie nadające się do grupowania (np. początek i koniec przelotu, zawartość samic itp.). Przed symbolem stopnia uogólnienia może występować w nawiasie skrót punktu czy punktów badawczych, z których pochodzi materiał. Podkreślić należy, że wszystkie trzy zasadnicze stopnie uogólnienia (P_1, P_{5y}, P_{5s}) są konieczne dla uzyskania pełnego obrazu zjawiska, przedstawiając różne jego aspekty.

Dyskusja adekwatności wyników wizualnych obserwacji przelotu obejmuje zagadnienia związane z obserwacjami gatunków o mieszanym typie wędrówki (np. rodzaj *Turdus* — rys. 2), zajmuje się ograniczeniami wynikającymi z przelotu ptaków na dużej wysokości, możliwościami lokalnej zmiany trasy przelotu, a także ograniczonymi możliwościami pojedynczego obserwatora. Omówione zniekształcenia wyników zmuszają do ostrożnej interpretacji faktów, lecz, zdaniem autora, nie dyskwalifikują materiału uzyskanego tą metodą.

Opracowanie biometryczne obejmuje porównanie wartości statystycznych różnych cech biometrycznych, zwanych tu parametrami biometrycznymi populacji (długość skrzydła, długość ogona, wskaźniki kształtu skrzydła „e" i „l" — Hołyński 1965, Busse 1967 a, oraz ciężar standardowy — Busse 1970 b). Podstawowymi wartościami są tu średnie arytmetyczne (M), porównywane dla sprawdzenia dwóch hipotez zerowych:

1. hipotezy równości średnich —

$$M_A - M_B = 0\ (?)$$

2. hipotezy równości wahań wartości średnich w kolejnych latach

$$(M_{A1} - M_{A2}) - (M_{B1} - M_{B2}) = 0\ (?)$$

Do testowania różnic przyjęto test „t" (szczegóły w tekście), uznając za istotne statystycznie różnice na poziomie 0,01. Analiza przebiegała następująco:

Na podstawie wykresu dziennego (P_1) dzielono materiał na partie określone czasem przelotu. Partie te nazywane są dalej jednostkami podstawowymi (oznaczenie B_{py}: B — symbol danych biometrycznych, p — podstawowy, y — indeks identyczny z „y" systemu oznaczeń dynamiki migracji, stosowany do zaznaczenia, że materiał pochodzi z jednego roku). Zasadniczym momentem określającym granice jednostek podstawowych jest układ szczytów i minimów przelotu. Porównanie parametrów biometrycznych wyróżnionych jednostek podstawowych stanowi punkt wyjścia do określenia, czy badany gatunek jest zróżnicowany na grupy wędrujące przez dany punkt w sekwencji czasowej, czy też przelatujące ptaki nie są tak między sobą zróżnicowane. W pierwszym przypadku jednostki podstawowe łączy się po kilka w zespoły zwane dalej rocznymi grupami terytorialno-czasowymi (B_{Gy}). Przy braku zróżnicowań wszystkie jednostki sumuje się razem, otrzymując szczególny przypadek — roczną grupę terytorialną (B_y). W następnym etapie ustala się odpowiedniość wyróżnionych grup rocznych w kolejnych latach i osiąga kolejny stopień uogólnienia — sumaryczne grupy terytorialno-czasowe (B_G), otrzymane przez sumowanie odpowiednich grup rocznych (B_{Gy}). Szczególnym przypadkiem jest uzyskanie sumy dla wszystkich osobników z danego punktu, zwanej sumaryczną grupą terytorialną (B_s.) Grupy sumaryczne mogą już być określone jako populacje. Kolejność operacji przy analizie materiału pochodzącego z jednego punktu przedstawia rysunek 3. Realizacja pełnego programu tej analizy była możliwa tylko u gatunków obficie chwytanych (*Regulus regulus*, *Erithacus rubecula*, *Parus major*, *Fringilla coelebs*); dla innych gatunków przeprowadzono analizę częściową, obejmującą tylko wyższe stopnie uogólnienia.

W niniejszej pracy umiejscowienie granic międzygrupowych (międzypopulacyjnych) jest wynikiem poszukiwania największych zróżnicowań powtarzających się w różnych latach w takiej samej sekwencji czasowej. Stąd też między jednostkami podstawowymi istnieje szereg istotnych zróżnicowań poszczególnych parametrów. Przyjęto tu założenie, że zróżnicowanie pojedynczego parametru na poziomie jednostek podstawowych może mieć zupełnie inną wymowę niż na innych poziomach uogólnienia — problem ten wymaga jednak dalszych badań. Stwierdzenie zróżnicowań kilku parametrów przez szereg lat stanowi znacznie istotniejszą przesłankę podziału populacyjnego niż pojedyncza różnica na poziomie jednostek podstawowych.

Przy analizie biometrycznej poszukiwano nie tylko różnic między kolejnymi grupami wędrującymi przez ten sam punkt, lecz także i międzypunktowych zróżnicowań terytorialnych. Przy analizie terytorialnej nie bada się zróżnicowań na poziomie jednostek podstawowych. Analiza ta polega na porównaniu odpowiadających sobie poziomem uogólnienia wielkości dla obu miejscowości, a następnie ewentualnym łączeniu ich dla wspólnego porównania z innymi terenami. Przebieg tej analizy przedstawia rysunek 4.

Przy syntezie efektów badań nad różnicami międzygrupowymi za wykładnik wielkości zróżnicowania przyjęto wskaźnik:

$$z = \frac{\text{ilość znalezionych różnic istotnych}}{\text{ilość różnic zbadanych}}$$

Wskaźnik ten jest bardzo prosty i uniwersalny, jednak równocześnie mało dokładny; może on przybierać wartość od 0 (brak zróżnicowania) do 1 (wszystkie zbadane różnice istotne).

Dla wszechstronnego wykorzystania posiadanych materiałów konieczne jest stosowanie szeregu stopni uogólnienia: zaobserwowanie różnic na każdym poziomie popiera ogólny wniosek istnienia realnego zróżnicowania (z tym że brak tych różnic nie świadczy jeszcze o jednorodności).

Prócz analizy zróżnicowań populacyjnych część biometryczna obejmuje również informacje o istnieniu oscylacji parametrów biometrycznych w kolejnych latach. Do tego celu zostały wykorzystane wartości parametrów uzyskane na poziomach grup rocznych (B_{Gy} i B_y), a zestawione w sekwencji wieloletniej. Wielkość występujących oscylacji została przedstawiona w postaci wskaźników zróżnicowania „z" i stabilności „s" (Busse, 1967 b, wzór w tekście). Wartości obu tych wskaźników są większe przy większych oscylacjach (rys. 5), przy czym wskaźnik „s" jest bardziej precyzyjny.

Informacje o przelocie zostały podane w trzech uzupełniających się postaciach: w tabeli sumarycznej typu $(H + MW)P_s$ (tab. I), na pentadowych wykresach sumarycznych typu $(H + MW)P_{5y}$ (rys. 6—13) i w tekście. W tekście podane są wszystkie zaobserwowane i schwytane gatunki. Przy gatunkach rzadszych podane są wszystkie stwierdzenia, a materiał dotyczący gatunków występujących liczniej został krótko omówiony w tekście i w miarę możliwości umieszczony w tabeli i na wykresach. Dane o przelocie dziennym (P_1) niektórych gatunków zostały zamieszczone w rozdziale IV; roczne wykresy pentadowe (P_{5y}) są częścią osobnego opracowania (Busse, 1974).

Zamieszczony w tabeli I i wspomniany w tekście „wskaźnik powrotu" (kolumna 9) jest stosunkiem ilości osobników, które przeleciały w kierunkach W—NW (powrotnych), do ilości osobników lecących w kierunkach właściwych dla wiosennej wędrówki (NE—E—SE).

Ze względu na koncentrację uwagi na ptakach przelatujących nad lądem, dane dotyczące ptaków wodnych nie są pełne i nie mogą być traktowane jako wyczerpująca informacja faunistyczna.

Podstawowe, najbardziej uogólnione — $(H+MW)B_s$ — dane biometryczne dla wszystkich gatunków, z których zmierzono co najmniej 6 osobników, zostały podane w tabeli II. Charakterystyka każdego parametru obejmuje średnią arytmetyczną (M), odchylenie standardowe (σ), średni błąd średniej (m) i ilość osobników (N). Ze względów graficznych zastosowano w tabelach układ tych elementów w formie:

$$\begin{array}{ccc} & M & \\ \sigma & & m \\ & N & \end{array}$$

Spośród opracowanych pod względem biometrycznym gatunków na omówienie zasługują gatunki liczniejsze, których analiza była pełniejsza:

Regulus regulus

1. Analiza parametrów rocznych i sumarycznych grup terytorialno-czasowych wykazuje istnienie zróżnicowania biometrycznego zarówno między punktami, jak i kolejnymi grupami ptaków przelatujących przez te punkty. Potwierdza to słuszność wniosków wyciągniętych na podstawie zmienności składu płciowego (Busse, Machalska, 1969).

2. Istotne różnice między jednostkami podstawowymi w obrębie grupy sygnalizują istnienie jeszcze bardziej subtelnego zróżnicowania niż to się dało udokumentować w niniejszym opracowaniu.

3. U mysikrólika istnieje zmienność wartości parametrów biometrycznych populacji w kolejnych latach. Zmienność ta jest różna dla różnych populacji.

Erithacus rubecula

1. U rudzika daje się wykazać wyraźne zróżnicowanie biometryczne między punktami, a w obrębie punktów, między kolejnymi grupami ptaków. Przypisywanie różnic biometrycznych wyłącznie zmienności składu płciowego (Payevsky, 1969) nie daje się utrzymać.

2. Zmienność subpopulacyjna u rudzika jest większa niż u mysikrólika.

3. Wyniki analizy korelacji wymiarów sugerują istnienie niezwykle skomplikowanego problemu struktury biometrycznej populacji.

4. Zmienność wartości parametrów w kolejnych latach jest u rudzika bardzo duża.

Parus major

1. Na szczególną uwagę przy dalszych badaniach wędrówek bogatki zasługuje zagadnienie struktury płciowo-wiekowej: stwierdzono zmienność składu w latach o różnym nasileniu migracji oraz różnice w tej strukturze między wiosną i jesienią.

2. Zróżnicowanie biometryczne kolejnych grup jest niezbyt wyraźne i wymaga dalszego udokumentowania.

Fringilla coelebs

1. U zięby występuje wyraźne zróżnicowanie czasu przelotu samców i samic: u kolejnych grup zróżnicowanie to jest coraz mniejsze.

2. Zróżnicowanie czasu migracji osobników różnej płci, w połączeniu ze znaczną koncentracją przelotu, powoduje nakładanie się przelotu samic z jednej populacji i samców z populacji wędrującej później, a równocześnie nie zakłóca zasady izolacji populacyjnej, jaka zdaje się obowiązywać u szeregu gatunków jesienią. Przedstawiona tu modyfikacja tej zasady może się okazać istotna dla przyszłych badań tego zagadnienia.

3. Na podstawie danych biometrycznych i analizy zróżnicowania składu płciowego można wyróżnić trzy grupy populacyjne, przy czym grupy I i III zdają się być do siebie bardziej zbliżone niż do grupy II.

4. Oscylacje wartości parametrów biometrycznych w kolejnych latach są u zięby bardzo znaczne. Możliwe, że przyczyniają się do tego trudności z precyzyjnym podziałem na fale.

РЕЗЮМЕ

Материал к работе собрано во время Балтийской акции в 1963—1967 гг. на Хеле (54°46'С, 18°28°В) и в 1966—1967 гг. на Висляной Межее (54°21'С, 19°19'В). Время работы в отдельные годы изображено на рис. 1. Исследования проведено стандартными методами Балтийской акции, описанными в работе Буссе, Каня (1970). Там опубликовано схему локализации исследовательских пунктов (Хель с 1962—1967 гг. и Висляна Межея II).

Работа состоит из двух основных частей: фаунистического описания перелёта и разработки биометрических данных пойманных птиц.

Фаунистическое описание перелёта основывается на количественном представлении результатов визуальных наблюдений и отлова более многочисленных видов. Для более редких видов дано одиночные наблюдения. С целью облегчения ориентировки в степени обобщения (или точности) материала, касающегося динамики миграции, в работе применёно унифицированную систему обозначений. Все данные представляющие эту динамику (количество пойманных птиц или наблюдаемых в отдельные периоды) обозначены символом „P”. Цифровые индексы (1 или 5) при букве P информируют, каких временных единиц касаются представленные данные: P_1 символизирует дневную динамику миграции, P_5— пентадную динамику. Индексы „y” или „s” определяют происхождение данных из отдельных лет (y) или суммы материала из всех рассматриваемых годов взятые вместе (s). В основном мы употребляем символы с двумя индексами (P_{5y}, P_{5s}), только символ P_{1y} упрощён к P_1, так как дневная динамика миграции рассмаривается исключительно отдельно для отдельных лет. Символ P_s определяет данные, которых нельзя группировать (нпр. начало и конец перелёта, содержимое самок и т.п.). Перед символом степени обобщения может быть сокращение исследовательского пункта или пунктов в скобках, из которых происходит материал. Следует ещё подчеркнуть, что все три основные степени обобщения (P_1, P_{5y}, P_{5s}) необходимы для получения полного образа явления, представляя различные его аспекты.

Дискуссия тождественности результатов визуальных наблюдений перелёта включает вопросы связанные с наблюдениями за видами со смешанным типом миграции (нпр. род дрозд — рис. 2), занимается ограничениями вытекающими из перелёта птиц на большой высоте, возможности локального изменения трассы перелёта, а также ограниченными возможностями отдельного наблюдателя. Рассмотренные изменения результатов вынуждают к осторожному толкованию фактов, но по мнению автора, не дисквалифицируют полученного этим методом материала.

Биометрическая обработка включает сравнение статистических данных различных биометрических признаков, называемых здесь биометрическими параметрами популяции (длина крыла, длина хвоста, показатели формы крыла „e" и „l" — Хольньски, 1965; Буссе 1967a, а также стандартный вес — Буссе, 1970b). Основными величинами являются здесь средние арифметические (M), сравнение для проверки двух нулевых гипотез:

$$M_A - M_B = 0\ (?)$$

2. гипотезы равенства колебаний средних величин в очередных годах

$$(M_{A1} - M_{A2}) - (M_{B1} - M_{B2}) = 0\ (?)$$

К тестованию разниц принято тест „т" (подробности в тексте), признавая за статистически существенные разницы на уровне 0,01. Ход анализа протекал следующим образом:

На основании дневного графика (P_1) материал разделено на партии, определённые временем перелёта. Эти партии в дальнейшем называются основными единицами (определение B_{py}: B — символ биометрических данных, p — основной, y — индекс идентичен „y" системы обозначений динамики миграции, применяемый к определению, что материал происходит из одного года). Основным моментом определяющим границы главных единиц является система максимумов и минимумов перелёта. Сравнение биометрических параметров выделенных основных единиц является исходным пунктом для определения или исследованный вид дифференцирован на мигрирующие группы через данный пункт в прогрессии времени, или же пролетающие птицы между собой не дифференцированы. В первом случае основные единицы объединяется по несколько в ассоциации, называемые в дальнейшем территориально-временными (B_{Gy}). При отсутствии дифференциации, все единицы суммируются вместе и получается годичная территориальная группа (B_y). На следующем этапе устанавливается соответственность выделенных годичных групп в очередных годах и достигается очередную степень обобщения — суммарные территориально-временные группы (B_G), полученные путём сложения соответствующих годичных групп (B_{Gy}). Особенным случаем является получение суммы для всех особей из данного пункта, называемой суммарной территориальной группой (B_s). Суммарные группы могут быть уже определены, как популяции. Очерёдность действий при анализе материала, происходящего из одного пункта представляет рисунок 3. Выполнение полной программы этого анализа было возможно лишь у видов, пойманных в большом количестве (*Regulus regulus, Erithacus rubecula, Fringilla coelebs*); для других видов проведено частичный анализ, охватывающий лишь высшую степень обобщения.

В настоящей работе локализация междугрупповых границ (межпопуляционных) является результатом поиска наибольших неоднородностей повторяющихся в различных годах в одинаковой временной последовательности. Отсюда между основными единицами существует ряд существенных неоднородностей отдельных параметров. Здесь принято предпосылку, что дифференциация отдельного параметра на уровне основных единиц может иметь совсем иной смысл, чем на других уровнях обобщения. Эта проблема, однако, требует дальнейших исследований. Констатирование дифференциации нескольки параметров в течение ряда лет является более существенной предпосылкой популяционного раздела, чем отдельная разница на уровне основных единиц.

При биометрическом анализе мы отыскивали не только разниц между очередными мигрирующими группами через один и тот же пункт, но также и междупунктовыми территориальными дифференциациями. При территориальном анализе не исследуется разниц на уровне основных единиц. Этот анализ заключается на сравнении соответствующих себе уровнем обобщения двух местностей, а затем на возможном их объединении для общего сравнения с другими местностями. Ход этого анализа изображает рис. 4.

При синтезе эффектов исследований по межгрупповым разницам, показателем величины дифференциации принято индекс:

$$z = \frac{\text{количество найденных существенных разниц}}{\text{количество изученных разниц}}$$

Этот индекс является очень простым и универсальным, однако одновременно, не точный; он может иметь значения от 0 (нет дифференциации) до 1 (все исследованные разницы существенны).

Для всестороннего использования имеющихся материалов необходимо применять ряд степеней обобщения: наличие разниц на каждом уровне поддерживает общее заключение существования реальной дифференциации (с тем, что отсутствие этих разниц ещё не свидетельствует об однородности).

Кроме анализа популяционных дифференциаций, биометрическая часть также охватывает информации о существовании колебаний биометрических параметров в очередных годах. С этой целью использовано значения параметров, полученные на уровнях годичных групп (B_{Gy} и B_y), а составленные в многолетней последовательности. Величина отмеченных колебаний представлена в виде показателей дифференциации „z” и стабильности „s” (Буссе, 1967b, формула в тексте). Величины обоих этих показателей больше при больших колебаниях (рис. 5) причём показатель „s” более точный.

Информации о перелёте представлены в трёх дополняющихся образах: в суммарной таблице типа (H+MW) P_s (табл. I), на пентодных суммарных графиках типа (H+MW) P_{5y} (рис. 6—13) и в тексте. В тексте представлено все отмеченные и пойманные виды. При более редких видах представлено все подтверждения, а материал касающийся видов отмеченных в большем количестве, кратко оговорён в тексте и по мере возможности помещён в таблице и на графиках. Данные по дневном перелёте (P_1) некоторых видов помещены в IV разделе; годичные пентоидные графики (P_{5y}) являются частью отдельной работы (Буссе, 1974).

Помещённый в I таблице и упомянутый в тексте „показатель поворота” (колонка 9) является отношением количества особей, которые пролетели в направлениях З-СЗ (обратных), к количеству летящих особей в направлениях свойственных для весенней миграции (СВ-В-ЮВ).

В связи с концентрацией внимания над птицами, пролетающими над сушей, данные касающиеся водных птиц неполны и не могут представлять исчерпывающей фаунистической информации.

Основные, очень обобщённые — (H+MW) B_s — биометрические данные для всех видов, из которых измерено не менее 6 особей, представлено в таблице II. Характеристика каждого параметра охватывает среднюю арифметическую (M), стандартное отклонение (σ), среднюю ошибку средней (m) и количество особей (N).

Систему этих элементов применено в форме:

$$\sigma \genfrac{}{}{0pt}{}{M}{N} m$$

Среди изученных, в биометрическом отношении, видов следует подчеркнуть более многочисленные виды, анализ которых был более полным:

Regulus regulus

1. Анализ годичных и суммарных параметров территориально-временных групп обнаруживает существование биометрической дифференциации между пунктами и очередными группами, перелетающих через эти группы птиц. Это подтверждает правильность заключений на основании изменчивости количественного отношения полов (Буссе, Махальска, 1969).

2. Существенные разницы между основными единицами в пределах группы сигнализируют существование ещё более тонкой дифференциации, чем это можно было обосновать в этой работе.

3. У королька отмечено изменчивость биометрических параметров популяции в очередных годах. Эта изменчивость различна у различных популяций.

Erithacus rubecula

1. У зарянки наблюдается резкую биометрическую дифференциацию между пунктами и в пределах пунктов, между очередными группами птиц. Приписывание биометрических разниц исключительно изменчивости количественного отношения полов (Паевбкий, 1969) является неверным.

2. Субпопуляционная изменчивость у зарянки больше, чем у королька.

3. Результаты анализа корреляции размеров подсказывают существование необычайно сложного биометрического строения популяции.

4. Изменчивость величин параметров в очередных годах у зарянки очень большая.

Parus major

1. На особенное внимание, при дальнейших исследованиях миграции большой синицы, заслуживает проблема полово-возрастной структуры: констатировано изменчивость состава в годы с различной интенсивностью миграции, а также разницы в этой структуре между весной и осенью.

2. Биометрическая дифференциация очередных групп не особенно отчётлива и требует дальнейшего обоснования.

Fringilla coelebs

1. У зяблика отмечено отчётливую дифференциацию времени перелёта самцов и самок; у очередных групп эта дифференциация всё меньше.

2. Дифференциация времени миграции особей различного пола, в связи со значительной концентрацией перелёта, вызывает наложение перелёта самок из одной популяции и самцов из мигрируюшей популяции позже, и, одновременно, не нарушает принципа популяционной изоляции, который, вероятно, обязывает осенью у ряда видов. Представленная здесь модификация этого принципа может оказаться существенной для будущих исследований этой проблемы.

3. На основании биометрических данных и анализа дифференциации полового состава можно выделить три популяционные группы, причём I и III группы кажутся более близкими между собой, чем ко II группе.

4. Колебания значений биометрических параметров в очередных годах у зяблика более значительны. Возможно, что содействуют этому трудности точного разделения на волны.

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