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Summer schedule of some subarctic passerine birds with reference to postnuptial moult

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Abstract

HAUKIOJA, ERKKI. (Zoology Dept., Univ., Turku 50, Finland) Summer schedule of some subarctic passerine birds with reference to postnuptial moult. REP KEVO SUBARTIC RES STAT 7. 60—69. Illus. 1971. — The time and duration of the postnuptial moult in 11 passerine species in Finnish Lapland in 1970 is reported. The relationship between breeding, moulting, and migration is discussed. Partial overlap between breeding and the moult was observed, but not between the moult and migration.

Passerine birds frequently breed and moult at least once per year. In order to be well adapted to local conditions the above phases have to be timed in such a way that the whole year cycle can be completed. In subarctic and arctic environments the short summer causes extra difficulties because for many species the period of favourable conditions is so short that it is an evident limiting factor. This is especially true of species which moult immediately after breeding.

The breeding biology of certain subarctic bird populations is the subject of intensive study nowadays in northern Fennoscandia (HILDÉN 1967, ENEMAR 1969). The other main period influencing the timing of the summer schedule, the moult, has received very little attention in subarctic or arctic environments. DOLNIK & BLUYMENTAL (1967) have reported that in northern regions, where the completion of the moult is impossible, birds moult during migration and, in addition they tend to moult more quickly. These materials, however, were collected from areas not far north. The only large moult study in subarctic conditions concerns the redpoll *(Acanthis flammea)* (EVANS et al. 1967), and it does not reveal any considerable overlap between migratory and moulting periods. In addition, the duration of moult was a little shorter in northern Norway than in England only in the case of males.

The present paper deals with the problem largely on the basis of moult data collected in the Kevo area, Finnish Lapland (ca. 69.5° N, 27° E) in 1970.

1. Materials and methods

An intensive mist-net programme for catching passerines for moult examination was begun on the 16th of July and ended on the 18th of August. Before the middle of July some birds were studied by Mr. Y. Sihvo near the study area and these are included in the present material. The netting terrain was mainly a rather luxuriant birch and willow thicket near the Kevo Subarctic Research Station. In addition, some netting trips were made to birch thickets nearby.

The moult was described by filling a special moult card for every passerine bird caught. The moult of the remiges, which forms that part of the information on the cards which is used in this paper, was described in the ordinary way (CORNWALLIS & SMITH 1960) by numbering each feather from zero to five according to its stage of renewal (0 = an old feather, 5 = a new feather). The term primary or moult score, used later, means the sum of the primaries 1—9. It is 0 for a bird not yet in moult and 45 (= 9 × 5) for a bird with fresh primaries. Every bird was ringed and therefore the examination of the same individuals more than once during the moult could be detected.

The number of birds handled was a little over 1200, and the number of adults dealt with in this paper about 500.

The information from each moult card was transferred to a punched card. These were then processed using an IBM 1130 computer. The programme system was one which I have made for processing the data of a moult inquiry sent to Finnish ringers. The duration of the primary moult, which is generally the same as that of the whole moult, was computed according to a regression equation if the materials collected satisfied the necessary conditions for computing values which might be regarded as reflecting true figures. A straight line has on many occasions been found to describe well the rise of the primary scores of a population (Newton 1967). The duration of the moult was also calculated on the basis of the rise in moult scores of any individual examined at least twice during the moult. A more detailed description of the system will be presented elsewhere.

2. Breeding and moult

First of all the data for those species for which material comprised more than 30 adults is dealt with. The beginning and duration of the breeding period (sources quoted) as well as the moult is given. The growth period (daily mean temperature ≥ + 5°C) ends on average on Sept. 16th at Utsjoki, and passerines living on animal food while moulting probably have to complete their moult by this time at the latest. Possible overlapping of major cycles (breeding, moulting, and migration) is discussed. Those species of which 10—30 individuals were examined, are treated in rather less detail.

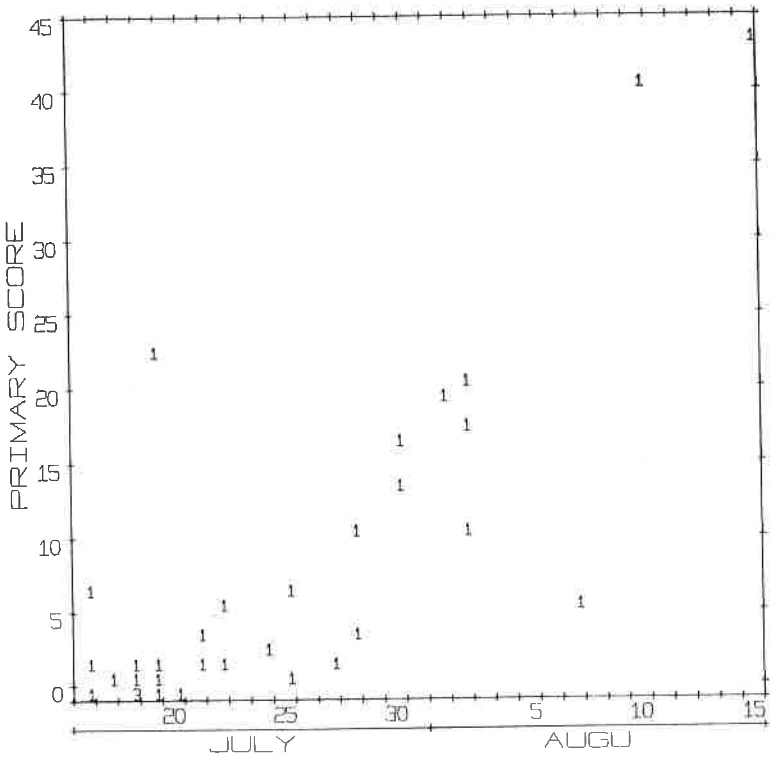

Fig. 1. Primary scores of adult bluethroats, *Luscinia svecica*, in Finnish Lapland in 1970.

Luscinia svecica

Laying occurs at the beginning of June (HILDÉN 1967). Incubation and nestling periods last a little less than four weeks (v. HAARTMAN 1969). The moult is rather well synchronized throughout the whole population (Fig. 1). Table 1 gives basic information concerning the time and duration of the moult. The moulting period, about 40 days, is one of the shortest observed in passerine birds, but not shorter than that of the closely related species, thrush nightingale, *Luscinia luscinia* (BERGER 1967). The fact that rather few adults (but many juveniles) were caught at the beginning of August probably means that adults are not willing or able to fly at the peak of their moult (see BERGER 1967; HAUKIOJA & KALINAINEN 1970). No moulting specimens were observed among birds which were probably breeding and the short moult means that the moult can be finished at the breeding sites. There is, therefore, no need for the major cycles to overlap.

Turdus iliacus

The laying period begins at the end of May (HILDÉN 1967; v. HAARTMAN 1969). A second brood is possible (v. HAARTMAN 1969) or regular (TYRVÄINEN 1969) in high latitudes; the later opinion is based on rather heterogeneous material. Incubation and nestling periods last about four weeks (TYRVÄINEN 1969).

Fig. 2 gives the primary scores of birds caught and Table 2 the time and duration of the moult. The moult is evidently faster

Table 1. Rate, duration and time of the postnuptial moult in the bluethroat, *Luscinia svecica*, in the Kevo area, Finnish Lapland.

```
AGE                                                ADULTS
SEX                                                  BOTH
YEAR                                                 1970
LOCALITY
  LATIT.                                        68 - 69 N
  LONG.                                         26 - 27 E
FIRST BIRD EXAMINED (DATE)                         16. 7.
FIRST BIRD IN MOULT EXAMINED (DATE)                16. 7.
LAST BIRD IN MOULT EXAMINED (DATE)                 15. 8.
LAST BIRD EXAMINED (DATE)                          15. 8.
SAMPLE SIZE (TOTAL)                                    34
SAMPLE SIZE (MOULTING)                                 27
REGRESSION EQUATION                       Y= -2.0+1.11X
(EQUATION COMPUTED USING ALL DATA)
LINEARITY TEST
  F 1                                                  14
  F 2                                                  11
  F                                                  1.92
DAILY INCREASE OF MOULT SCORE
  FROM REGRESSION EQUATION                           1.11
   SE                                               0.991
   N                                                   27
  FROM RECAPTURES                                    1.17
   SE                                               0.157
   N                                                    3
START OF MOULT                                     17. 7.
  95 PER CENT SPREAD (DAYS)                            21
END OF MOULT                                       26. 8.
DURATION OF MOULT (DAYS)
  FROM REGRESSION EQUATION                             40
  FROM RECAPTURES                                      38


CARDS USED HAVE BEEN WRITTEN BY FOLLOWING PERSONS
HAUKIOJA E               13, KALINAINEN P             11
LEHIKOINEN E              5, NIEMELA P                 4
MYRSKY H                  1
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Table. 2. Rate, duration and time of the postnuptial moult in the redwing, *Turdus iliacus*, in the Kevo area, Finnish Lapland.

```
AGE                                                ADULTS
SEX                                                  BOTH
YEAR                                                 1970
LOCALITY
  LATIT.                                        68 - 69 N
  LONG.                                         26 - 27 E
FIRST BIRD EXAMINED (DATE)                         16. 7.
FIRST BIRD IN MOULT EXAMINED (DATE)                16. 7.
LAST BIRD IN MOULT EXAMINED (DATE)                 16. 8.
LAST BIRD EXAMINED (DATE)                          16. 8.
SAMPLE SIZE (TOTAL)                                    49
SAMPLE SIZE (MOULTING)                                 34
REGRESSION EQUATION                        Y= -3.1+1.12X
(PERIOD USED IN COMPUTATION  19. 7.-16. 8.)
LINEARITY TEST
  F 1                                                   8
  F 2                                                   7
  F                                                  1.22
DAILY INCREASE OF MOULT SCORE
  FROM REGRESSION EQUATION                           1.13
   SE                                               0.795
   N                                                   17
  FROM RECAPTURES                                    1.40
   SE                                               0.345
   N                                                    4
START OF MOULT                                     18. 7.
END OF MOULT                                       27. 8.
DURATION OF MOULT (DAYS)
  FROM REGRESSION EQUATION                             40


CARDS USED HAVE BEEN WRITTEN BY FOLLOWING PERSONS
HAUKIOJA E               19, KALINAINEN P             24
LEHIKOINEN E              4, NIEMELA P                 2
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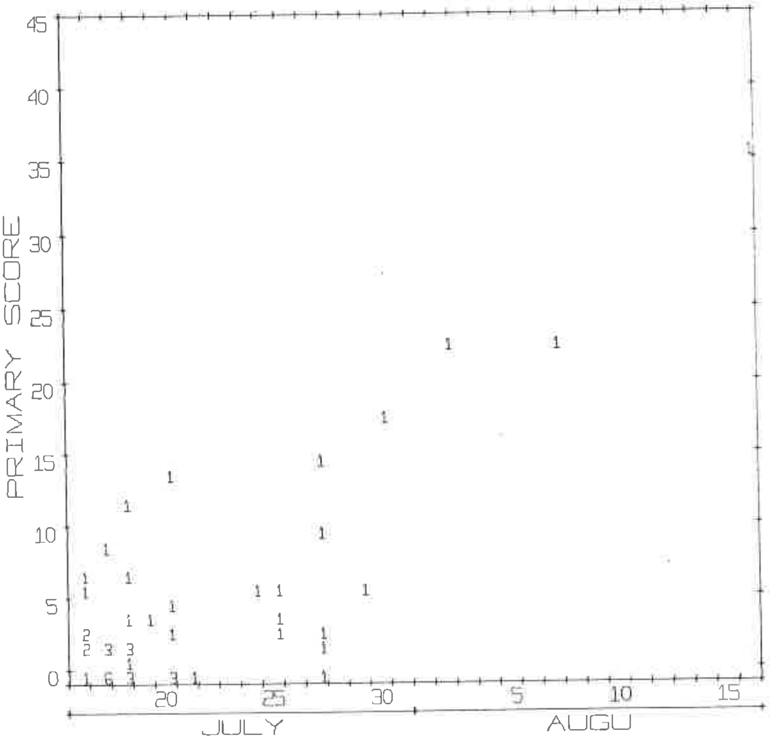

Fig. 2. Primary scores of adult redwings, *Turdus iliacus,* in Finnish Lapland in 1970.

in the Kevo area than in southern Finland where Haukioja & Kalinainen (1970) report that the moult lasts about 52 days. This figure was for redwings examined at least twice while moulting. However, more materials is needed for accurate results. The gap in Fig. 2 at the beginning of August may be caused by birds moving to other habitats to moult, because they are unwilling and/or unable to fly or because they start migration.

Some observations were made of parents beginning to moult but evidently still feeding fledglings. Most adults, however, begin to moult just after the young have become independent. Second broods, if such occurred at all in 1970, were probably rare as was revealed by young aged according to their postjuvenal moult. Therefore, most adults at least have time to complete their moult at the breeding sites. If the apparently very fast moult is a real phenomenon, birds nesting twice can probably do this, too. The possibility of the moult and migration overlapping cannot, however, be completely disproved by this material.

Phylloscopus trochilus

Laying occurs from the middle of June onwards (Hildén 1967). Incubation and nestling pariods last a little less than four weeks (v. Haartman 1969).

Fig. 3 gives the primary scores of willow warblers caught. The scatter in scores is rather large. This is because males, which are less active in feeding young (v. Haartman 1969), begin to moult earlier than females. The mean date for beginning the moult is near the 10th of July, that is a week later than in southern Finland (Haukioja & Kalinainen 1968) and about two weeks later than the beginning of moult in England (Williamson 1962). The rate of increase of primary scores (1.41 ± 0.258, five recaught does not deviate much from that in southern Finland. During the most intensive moult birds are unwilling and/or unable to fly and, consequently, not many are caught.

There is no need for the major cycles to overlap.

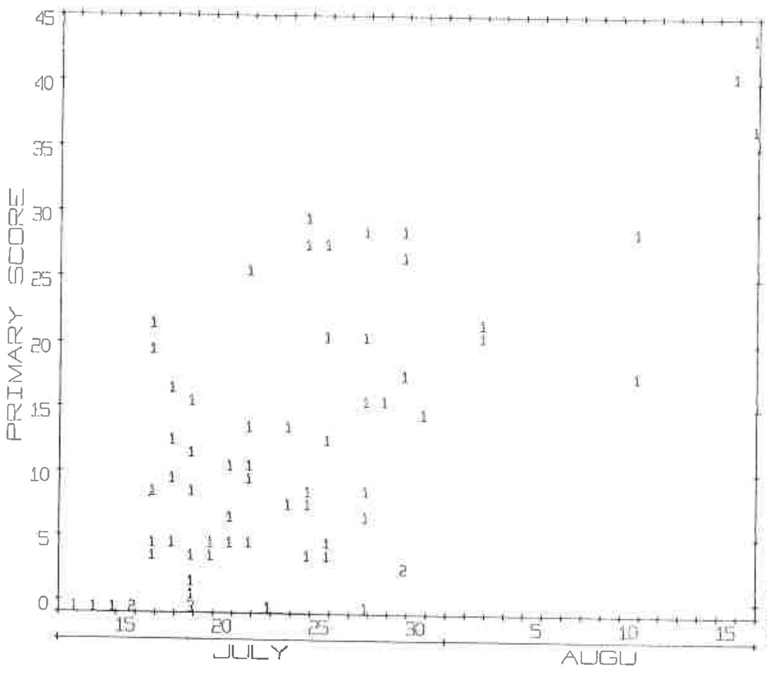

Fig. 3. Primary scores of adult willow warblers, *Phylloscopus trochilus*, in Finnish Lapland in 1970.

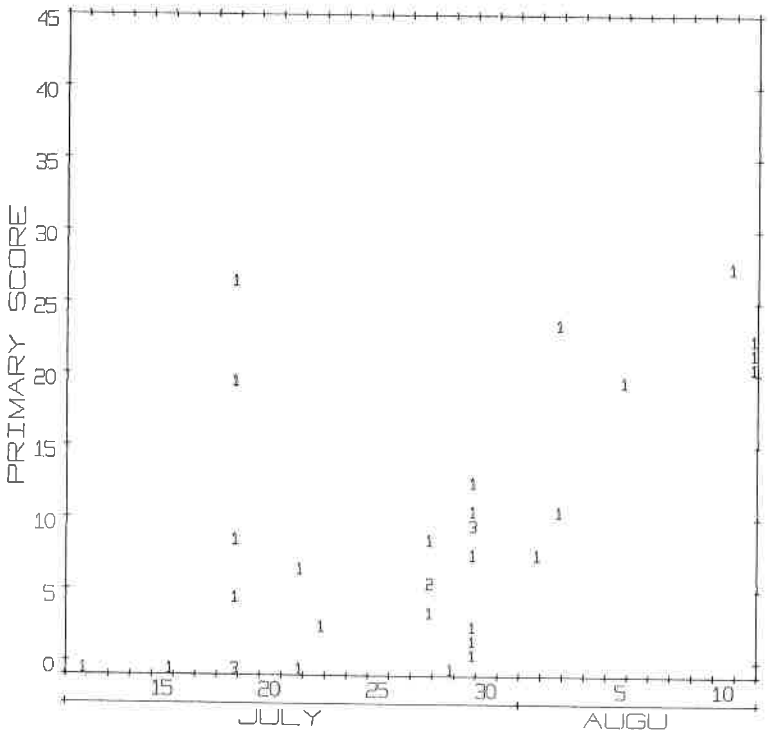

Fig. 4. Primary scores of adult meadow pipits, *Anthus pratensis*, in Finnish Lapland in 1970.

Anthus pratensis

Laying begins during the first half of June (Hildén 1967). Incubation and nestling periods last about four weeks (v. Haartman 1969).

Fig. 4 gives the primary scores observed. The scatter in scores is rather large. One bird was examined twice during the moult (seven days apart, rise of primary score eight points). This indicates that the duration of moult is about the same magnitude (40—50 days) as in southern Finland (Haukioja & Kalinainen 1968).

There are no data about overlap of breeding and moulting. There is probably enough time to complete the moult at breeding sites, especially, if the moult of the latest birds is faster than of the first ones (see Stresemann & Stresemann 1966).

Acanthis flammea

Laying lasts from the beginning of June to the latter half of July. Incubation and nestling periods last about 3.5 weeks. Second broods probably occur (Hildén 1969). Female redpolls still at the stage of laying were caught at the end of July, 1970, in the Kevo area.

Fig. 5 gives the scores of redpolls caught. The daily increase of moult scores from recaptures was 0.50 ± 0.099, n = 13. This is much less than that reported by Evans et al. (1967) from northern Norway. It is, however, probable that, also in the Kevo area, the rate of increase of the primary scores is greater at the peak of the moult. The majority of the population probably began to moult between the 20th—25th July, 1970.

Birds known to have dependent young were not observed to moult. Thus there is very little need for the major cycles to overlap provided that the duration of moult calculated by Evans et al. (1967), about 50 days, is valid for the population studied.

Fringilla montifringilla

Laying occurs mainly in the middle or the latter half of June (Hildén 1967; v. Haartman 1969). Incubation and nestling periods last (a little less than) four weeks.

Moult scores are given in Fig. 6 and the time and duration of the moult in Table 3. Times of the moult clearly differ between sexes. For males the start of moult is the 5th of July, and, for females, the 19th of July. The length of the moult is perhaps shorter than in the chaffinch *(Fringilla coelebs)* in southern Finland (Haukioja & Kalinainen 1970).

Most males moult while the bulk of the population has nestlings/fledglings, but I do not know whether these moulting specimens feed their young. Moulting and migration probably do not overlap.

Table 3. Rate, duration and time of the postnuptial moult in the brambling, *Fringilla montifringilla*, in the Kevo area, Finnish Lapland.

```
                                                      ADULTS
AGE
                                                        BOTH
SEX
                                                        1970
YEAR
LOCALITY
                                                   68 - 69 N
  LATIT.                                           26 - 27 E
  LONG.
FIRST BIRD EXAMINED (DATE)                             3. 7.
FIRST BIRD IN MOULT EXAMINED (DATE)                   15. 7.
LAST BIRD IN MOULT EXAMINED (DATE)                    17. 8.
LAST BIRD EXAMINED (DATE)                             17. 8.
SAMPLE SIZE (TOTAL)                                      127
SAMPLE SIZE (MOULTING)                                   119
REGRESSION EQUATION                          Y= -5.7+0.79X
(PERIOD USED IN COMPUTATION  16. 7.-17. 8.)
LINEARITY TEST                                            22
  F 1                                                     94
  F 2                                                   0.94
  F
DAILY INCREASE OF MOULT SCORE
  FROM REGRESSION EQUATION                              0.79
   SE                                                  0.080
   N                                                     118
                                                        0.78
  FROM RECAPTURES                                      0.097
   SE                                                     14
   N
                                                       9. 7.
START OF MOULT
  95 PER CENT SPREAD (DAYS)                               28
                                                       4. 9.
END OF MOULT
DURATION OF MOULT (DAYS)
  FROM REGRESSION EQUATION                                57
  FROM RECAPTURES                                         58


CARDS USED HAVE BEEN WRITTEN BY FOLLOWING PERSONS

HAUKIOJA E          28, KALINAINEN P                      59
LEHIKOINEN E        29, NIEMELA P                          1
SIHVO Y O            9, MYRSKY H                           1
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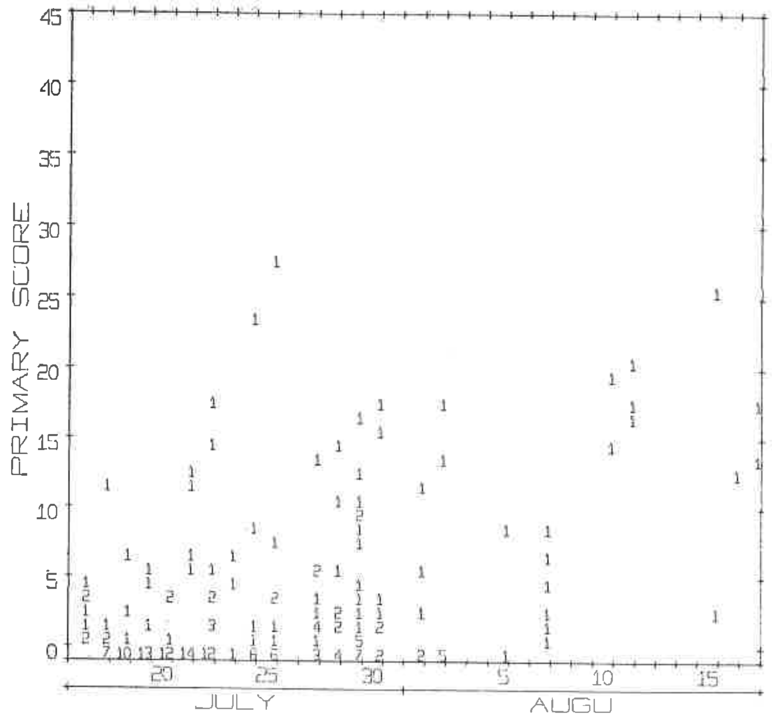

Fig. 5. Primary scores of adult redpolls, *Acanthis flammea,* in Finnish Lapland in 1970. Some specimens with apparently fresh plumage in July are neglected.

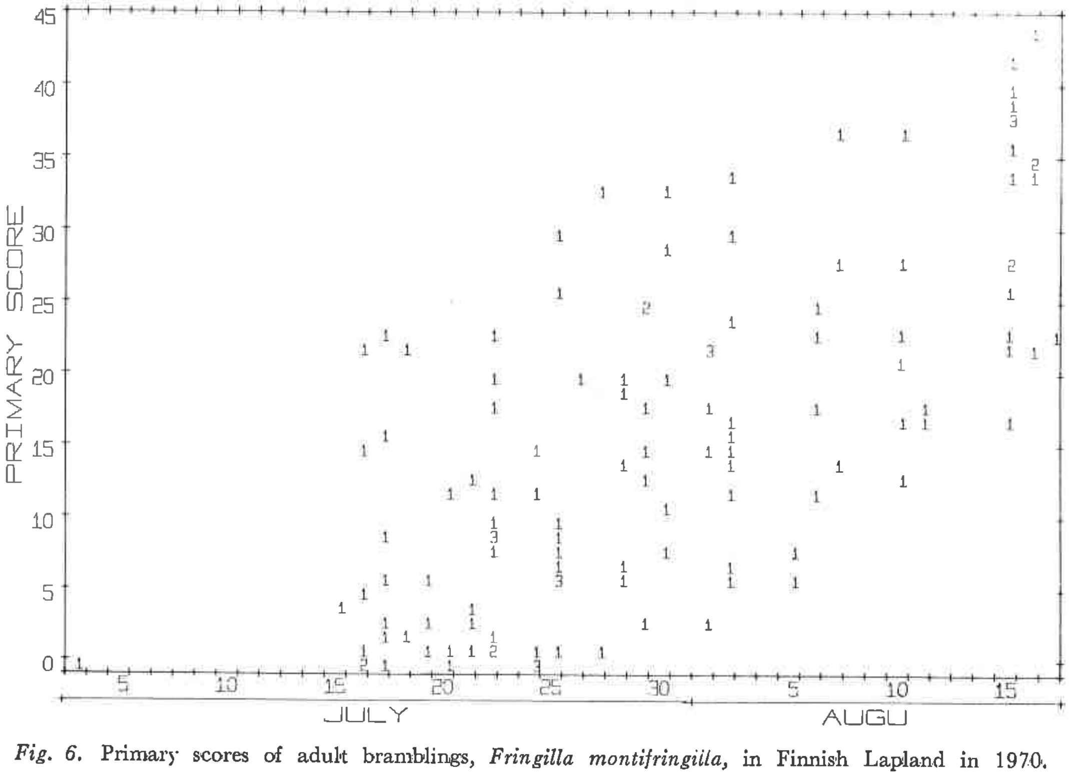

Fig. 6. Primary scores of adult bramblings, *Fringilla montifringilla,* in Finnish Lapland in 1970.

Emberiza schoeniclus

Laying begins at the beginning of June (HILDÉN 1967). Incubation and nestling periods last about three weeks (HAUKIOJA 1970).

The scores obtained are given in Fig. 7. As estimated by eye, the moult begins just after the middle of July. According to birds examined at least twice during the moult, the daily increase of the moult score was 0.72 ± 0.180, n = 10. This is a little less than in southern Finland where the moult lasts about 55 days (Haukioja, unpublished).

Overlapping of major cycles is not necessary, especially if the latest birds moult faster than the earliest.

Other species

Turdus pilaris — 11 adults examined, 9 in moult. Rather synchronized moult in all individuals. The moult begins at the end of July. According to one individual caught twice during the moult (14 days apart) the moult is quicker (1.14 points/day) than in southern Finland where the corresponding value was 0.80 ± 0.013 (HAUKIOJA & KALINAINEN 1970). It this trend is real, there is no need for overlapping cycles. However, the shorter moulting period observed (also in the redwing) is not unambiguous proof that the whole moult is more rapid, because the shedding of secondaries and tail feathers does not seem to be as accelerated as the primary moult. More material is needed to discuss this more thoroughly. At least some individuials complete their primary moult in the Kevo area.

Phoenicurus phoenicurus — 15 adults examined, 12 in moult. The scatter in scores is rather large. On the basis of birds recaught (two), the moult lasts about 50 days, which does not deviate much from that reported by SNOW (1969) in England. The moult lasts from the beginning of July to the latter half of August or later. The earliest birds certainly complete their moult in the Kevo

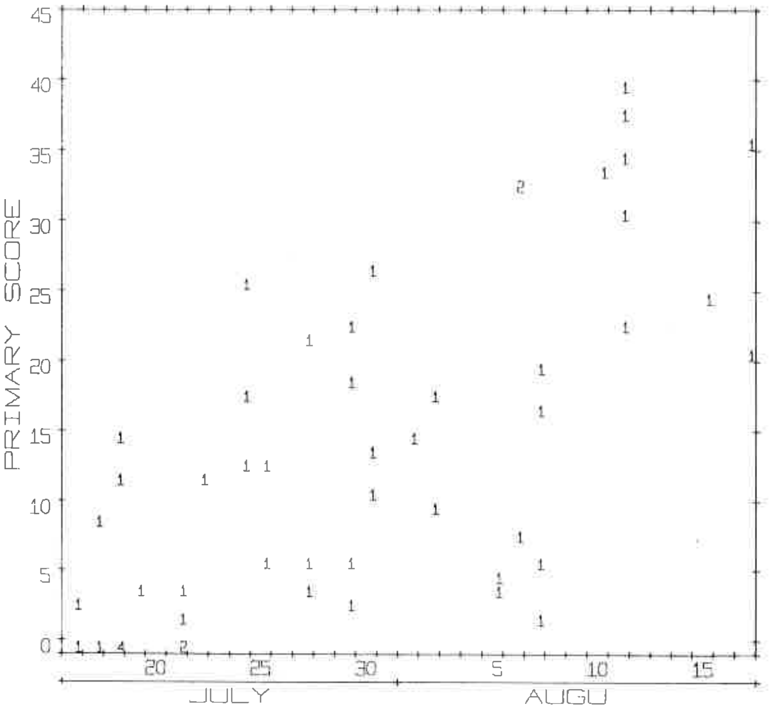

Fig. 7. Primary scores of adult reed buntings, *Emberiza schoeniclus*, in Finnish Lapland in 1970.

area, but it is not known whether this is also true of birds moulting later. No information about possible overlap between breeding and moulting seasons is available.

Motacilla alba — 13 adults examined, all in moult. Moulting begins in the middle of July and, judging from one bird examined more than once (30 days apart, rise of moult score 29 points), it lasts 45—50 days. There is no evidence of possible overlap between breeding and the moult, there is probably no need for overlap of the moult and migration.

Pinicola enucleator — 21 adults examined, 20 in moult. Moult is well synchronized throughout the population and began about the 10th of July. Judging from four birds examined at least twice, the moult lasts 60—70 days. Birds feeding fledglings were nearly all in moult.

Summarizing the above results from the Kevo area, the following conclusions can be made:

— The postnuptial moult lasts about as long as in southern Finland or is probably shorter (in thrushes),

— the lack of time during which favourable conditions prevail has on some occasions been overcome by overlap of the nestling/fledgling periods with the moulting period (this was observed, as well as in the species mentioned earlier, in the yellow wagtail, (*Motacilla flava*) and the Laplands bunting (*Calcarius lapponicus*), J. Hakala, pers. com.) and,

— overlapping of migratory and moulting periods was not confirmed in any case.

3. Discussion

In general, the timing of all phases of an annual cycle has been achieved in some passerines in such a way that it has been possible for them to settle even in subarctic and arctic environments. In these conditions the need to complete all phases of a summer schedule in a very short time has made the moult, which generally covers a longer period than breeding (NEWTON 1968; HAUKIOJA & KALINAINEN 1970), an important factor in the completion of the cycle (see PITELKA 1958). Therefore, to undestand some aspects of population dynamics, exact knowledge of the moult is important.

For instance, the number of broods it is possible to raise and, similarly, the maximum reproductive capacity are determined by the time by which breeding has to be completed. This, in turn, depends on the following phases, moult and/or migration.

Another central problem in the population dynamics of birds is the determination of the clutch size. A general trend is that the size of clutches in passerines and certain other groups is larger in northern than southern parts of the northern temperate zone (LACK 1947). For instance, clutches of seven eggs in open-nesting passerines are much commoner in a subarctic environment than in southern Finland (HILDÉN 1967; v. HAARTMAN 1969). This difference is more remarkable when account is taken of the fact that, although the birds have larger clutch sizes and therefore the stress when feeding young is greater in subarctic regions, the energy consumption of the parents must also be higher there if they begin to moult while rearing young. It may be mentioned that moulting while feeding fledglings is exceptional in passerines in southern Finland (HAUKIOJA & KALINAINEN 1970). The partial overlap between breeding and the moult is probably one factor why the increase in clutch sizes from central Europe to the north is rather small compared with the increase from the tropics to central Europe (LACK 1948). However, what is said above does not explain why the increase in clutch size occurs but, if it is individual selection which determines the reproductive rate of passerines (HAUKIOJA 1970), a more efficient food consumption in some way or other is probable.

Looking at the problem from another side, the moulting period as a part of the summer schedule may make a more northern distribution impossible for some species. As far as I know, this has not been taken into account for any species. However, the moult is so long and probably difficult (DAWSON 1967; HAUKIOJA 1969) a period that this point of view must also be considered.

Direct proof of possible overlap between moulting and migration is nearly impossible when materials have been collected from one place only. In many species (the bluethroat, the willow warbler, the brambling, the reed bunting, the fieldfare, the redstart, the yellow wagtail) it was confirmed that at least some specimens completed their moult in an extreme subarctic environment. The opinion that the moult and migration must overlap in the north (DOLNIK & BLUYMENTAL 1967) was thus not confirmed but neither could it be completely rejected in all species. However, the above author's data (p. 439, Fig. 3) only prove that *some* individuals are still in moult when the migratory period of the population begins. This is the same as at same latitudes in Finland, from where I have considerable material. Periods of moulting and migration also overlap there, but passerines which moult when migrating are probably as rare as in England (EVANS 1969).

Only the postnuptial moult has been treated above. However, young also have to complete their later summer activities, including the postjuvenal moult, during the same short period as adults. This part of the problem will, however, be treated in another connection.

Acknowledgements. I wish to thank all those who have helped in catching and examining birds, and the personnel of the Kevo Subarctic Research Station.

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