Factors influencing the spring arrival of the Brambling *Fringilla montifringilla* in northern Finland

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The arrival of the Brambling in spring was studied at Utajärvi, N Finland (64°57'N, 26°58'E), during 7 successive years (1967—73). The results of this study are compared with the conclusions of Dolnik & Blyumenthal (1967) regarding the influence of various factors, including social interaction, on the dynamics of migration.

The average date of arrival of the Brambling was 3 May. It was affected by several environmental factors, correlating strongly with temperature and the food supply. The air temperature, snow cover and conifer seed crop together explained 89 % of the annual variation in the date of arrival. Social interaction between the Brambling and the Chaffinch was a subsidiary factor modifying the time of arrival. The results thus agree well with the conclusions of the above authors.

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Introduction

At high latitudes, the favourable time for arrival of migratory birds varies from spring to spring (Slagsvold 1976). The factors influencing the timing of the spring migration of the Brambling *Fringilla montifringilla* include increasing daylength, weather conditions and food supplies (Lofts & Marshall 1960, 1961, Mikkonen 1981). On the basis of the literature and their own studies, Dolnik & Blyumenthal (1967) suggested that the migration of birds is regulated by the amount of fat reserves in the body, the availability of food, the weather, and the migratory behaviour of flocks of the same or other species (cf. Alerstam 1978). They found that the last-named factor often has an important influence on the dynamics of migration.

In this paper I test the influence of various external factors on the time of arrival of the Brambling in an area in northern Finland where several proximate factors are of special importance in spring.

Study area and methods

The data were collected at Utajärvi, Juorkuna (64°57'N, 26°58'E) during 1967—73. The observation days averaged 17 per spring between 5 April and 15 May. The Bramblings were counted on a 2.8-km census line between 6.00 and 9.00. The study area and the habitats along the census line have been described by Mikkonen (1981).

The daily temperatures were recorded at the Pelso Meteorological Station, Vaala. The depth of the snow cover was measured at the Särkijärvi observation point of the Meteorological Institute, Utajärvi. The abundance of the pine and spruce cone crop, expressed on an arbitrary scale from 1 to 10, was taken from the annual reports issued in 1967—73 by the National Board of Forestry.

TABLE 1. Dates of arrival of the Brambling at Utajärvi, Juorkuna, in the springs of 1967—73. The temperatures (°C) are the means of the daily maximum temperatures during 11—30 April. The snow cover values (cm) were recorded on 2 May. The cone crop is that of the pine and spruce.

Year	Date of arrival			External factors		
	First individual	True arrival	Chaffinch correction	Temperature	Snow cover	Cone crop
1967	28 April	28 April	28 April	+6.1	12	4
1968	28 April	28 April	30 April	+5.4	6	3
1969	4 May	4 May	4 May	+4.4	23	5
1970	4 May	4 May	7 May	+2.4	19	6
1971	2 May	7 May	7 May	+2.1	35	8
1972	22 April	3 May	3 May	+4.7	0	6.5
1973	27 April	5 May	5 May	+3.8	8	6.5
Mean	29.3 April	2.7 May	3.4 May	+4.1	15	5.6
SD	4.3	3.5	3.4	1.48	11.9	1.69
CV %	15	11	10	36	79	30

The first few individuals sighted in spring are not always sure indicators of the arrival of a migratory species; they may simply be "vagrants" (Hildén 1966, 1967, Mikkonen 1981). Here, the date of true arrival was considered to be the first observation day on which more than one Brambling was seen.

Multiple and partial correlations and regressions were calculated to analyse the dependence of the date of arrival on various external factors (see Power 1969, 1971, Richardson 1978). These were temperature, snow cover, and the cone crop of conifers. The time of arrival was calculated as the number of days from the beginning of April (April 1 = 1). The level of significance is indicated as follows: *NS* = $P > 0.10$, O = $P < 0.10$, * = $P < 0.05$, ** = $P < 0.01$, *** = $P < 0.001$.

Results

The first individuals of the Brambling were seen in late April or early May (Table 1). On average, the true arrival began on 3 May. The date varied less from year to year than did the values of the external factors (Table 1). It correlated significantly with the daily temperature during 11—30 April and highly significantly with the conifer cone crop (Fig. 1 and Table 2). The air temperature, snow cover and cone crop together explained 89 % of the annual variation in the time of arrival (Table 3, using R^2). The effects of the cone crop and the temperature on the date of arrival were stronger than that of the snow cover (Table 4).

In some years, the first few Bramblings arrived with flocks of Chaffinches *Fringilla coelebs* (in 1968 and 1970). If these individuals are excluded, and the onset of migratory period is deter-

TABLE 2. Simple correlation coefficients between the date of arrival of the Brambling and external factors at Utajärvi, Juorkuna, in the springs of 1967—73. The coefficients were calculated from the data in Table 1. A = the date of true arrival (see text), B = the date of arrival corrected for the influence of association with migrating Chaffinch flocks.

	Temperature	Snow cover	Cone crop
Snow cover	—0.66NS		
Cone crop	—0.80*	+0.44NS	
Arrival date A	—0.86*	+0.56NS	+0.92**
Arrival date B	—0.96***	+0.55NS	+0.82*
No. of years	7	7	7

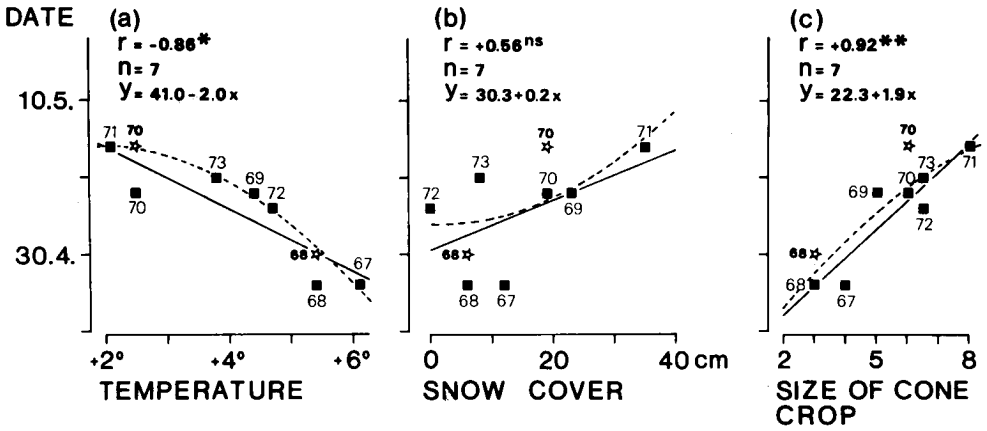

FIG. 1. Linear correlation and regression of the date of arrival of the Brambling on the temperature, snow cover, and cone crop of pine and spruce at Utajärvi, Juorkuna, in the springs of 1967—73. The data used are shown in Table 1. The broken line is the parabolic regression line obtained when the onset of migratory season was determined from the appearance of the first flocks of the Brambling. ☆ date of arrival when the influence of association with Chaffinch flocks has been eliminated. In (a) the parabolic regression equation is $Y=35.4+1.8x—0.5x^2$ and $r= —0.996^{***}$, in (b) $Y=32.0—0.02x+0.005x^2$ and $r = +0.58^{NS}$, and in (c) $Y=21.2 + 2.9x—0.1x^2$ and $r = +0.82^{*}$.

mined from the appearance of the first pure Brambling flocks, the correlation of the date of arrival with the temperature becomes closer, and that with the size of the cone crop less strong (Tables 2 and 4). Correction for the effect of the Chaffinch flock increases the multiple correlation coefficient with the temperature, snow cover and cone crop (Table 3). Social interaction thus explains a certain part of the yearly variation in the dates of arrival of the Brambling.

Discussion

The date on which migratory birds arrive at the breeding grounds has been demonstrated to depend on the physiological state of the birds, certain environmental factors in the wintering grounds, the migratory passage and conditions in the breeding areas (e.g. Farner 1950, Lack 1960, Berthold 1975, Hildén et al. 1979). Ultimate factors preprogramme the timing of migration and proximate factors modify it (Immelmann 1971, Richardson 1978). The chief controlling factors may vary from species to species (e.g. Alerstam 1978, Richardson 1978), and different species reach readiness for migration at different times in the spring due to differences in their photostimulation thresholds (Dolnik 1963, Lofts & Murton 1968). In addition, the reactions of the same species to other proximate factors change during the migratory season (see Nice 1937, Alerstam 1978, Mikkonen 1981).

The Brambling and the Chaffinch are taxonomically closely related species. In the study area, the Chaffinch starts to arrive on 16 April, on average, or much earlier than the Brambling (Mikkonen 1971, 1981). The main flocks of the two species occur at different times, with some overlap (Mikkonen 1981).

TABLE 3. Multiple correlation coefficients between the date of arrival of the Brambling and external factors at Utajärvi, Juorkuna, in the springs of 1967—73. For further explanations see text to Table 2.

External factors		Date of arrival A	Date of arrival B
Temp. + Snow	R1.23	0.864*	0.968**
Temp. + Cone crop	R1.24	0.943**	0.966**
Snow + Cone crop	R1.34	0.933**	0.843*
Temp. + Snow + Cone crop	R1.234	0.945*	0.970**
No. of years		7	7

TABLE 4. Partial correlation coefficients between the date of arrival of the Brambling and external factors at Utajärvi, Juorkuna, in the springs of 1967—73. For further explanations see text to Table 2.

External factors		Date of arrival A	Date of arrival B
Temperature	r12.3	—0.79°	—0.94**
	r12.4	—0.55NS	—0.89*
	r12.34	—0.42NS	—0.89*
Snow	r13.2	—0.02NS	—0.40NS
	r13.4	+0.43NS	+0.36NS
	r13.24	+0.18NS	+0.37NS
Cone crop	r14.2	+0.75°	+0.31NS
	r14.3	+0.90*	+0.77°
	r14.23	+0.76NS	+0.26NS
No. of years		7	7

Proximate factors markedly modifying the arrival of the Brambling are the ambient temperature, snow cover and seed supplies in the breeding grounds (Mikkonen 1981). This may be an adaptation to the variable conditions in different springs. The temperature and food supplies are specially important for migrants in the far north and clearly influence the date of arrival of the Brambling. The snow cover restricts food supplies and also correlates strongly with temperature.

If the influence of social interaction between the Chaffinch and Brambling is eliminated, the correlation of the date of arrival with temperature increases and that with the size of the cone crop decreases. This indicates that in northern Finland the influence of temperature is more important than that of the food supply and snow cover in late April and early May. Social flight is a subsidiary factor modifying the date of arrival of the Brambling; exceptionally early arrival dates can be explained by association with migrating Chaffinch flocks.

Social flight may have an adaptive advantage, allowing the first Bramblings to benefit from favourable weather conditions and find better feeding places (see Dolnik & Blyumenthal 1967). This conclusion is suggested by the correlation coefficients, and is supported by field observations. But in northern Finland association with Chaffinches also involves the risk of individuals arriving too early, especially in early springs (see Slagsvold 1976).

On the whole, my results support the conclusion of Dolnik & Blyumenthal (1967) that the food, weather and migratory behaviour of other birds influence the dynamics of migration (cf. Alerstam 1978).

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Selostus: **Järripeipon kevätmuuttokauden alkamisajankohtaan vaikuttavista tekijöistä Pohjois-Suomessa**

Järripeipon kevätmuuttoa tutkittiin Pohjois-Suomessa, Utajärven Juorkunankylässä (64° 57'N, 26°58'E) vuosina 1967—73. Saatuja tuloksia verrattiin Dolnikin & Blyumenthalin

(1967) kirjallisuustietojen ja omien tutkimustulosten pohjalta esittämään hypoteesiin, että lintujen muuttoa säätelevät ruumiin vararavinnon määrä, tarjolla olevan ruuan määrä, sääolot ja saman lajin tai muiden lajien parvien muuttokäyttäytyminen. He korostivat sosiaalisen vuorovaikutuksen merkitystä lajin muuttodynamiikassa.

Tutkimusalueella järripeipon kevätmuuttokausi alkoi keskimäärin 3.5. Huhtikuun 11—30 päivien maksimilämpötilat ja havupuiden siemensadon määrä korreloivat voimakkaasti muuttokauden alun kanssa (kuva 1). Lumisuudella ei yksinään ollut tilastollisesti merkitsevää vaikutusta. Ilman lämpötila, lumisuus ja siemenravinnon määrä yhdessä selittivät 98 % muuttokauden alkamisajankohdassa esiintyneestä vuosivaihtelusta (käyttäen R^2).

Vuosina 1968 ja 1970 ensimmäiset järripeipot saapuivat peippoparvien mukana. Kun tämä sosiaalinen käyttäytymistapa eliminoitiin, niin muuttokauden alkamisajankohdan ja lämpötilan välinen korrelaatiokerroin kohosi ja alkamisajankohdan ja siemensadon määrän välinen korrelaatiokerroin laski (taulukot 2, 3 ja 4). Korrelaatiokertoimien muutosten ja kenttähavaintojen pohjalta parvikäyttäytyminen on tärkeä lisätekijä, joka vaikuttaa järripeipon muuttokauden alkamisajankohtaan. Sosiaalisella seuraamislennolla on adaptiivista merkitystä järripeipolle etenkin Pohjois-Suomessa, missä varhaiskeväällä sopivaa ravintoa on vielä vähän tarjolla ja sääolot voivat muuttua äkkiä. Parvien mukana yksilöt löytävät ruokailupaikkoja tehokkaammin kuin yksinään.

Tämän työn tulokset tukevat järripeipon osalta edellä esitettyä hypoteesia ja sosiaalisen vuorovaikutuksen osuutta lintujen muuttodynamiikassa.

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