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# Primary moult of the Brambling *Fringilla montifringilla* in northern Sweden

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**Abstract**

The postnuptial wing moult of the Brambling was studied in a subalpine birch forest near Ammarnäs (65° 58' N, 16° 07' E) in Swedish Lapland. 580 moult cards were collected during an annual ringing scheme in the years 1984–1989. Regression analysis of moult data, with date as the independent value, showed an average moult duration for males and females of 47 days. Raggedness values support the moult speed estimated from the regression analysis. The moult speed shown here for the Brambling is much faster than for the Chaffinch and might be due to some constraint for moulting during early autumn.

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## Introduction

The complete moult once a year of flight and body feathers is one of the major events together with breeding in the annual life cycle of a small passerine such as the Brambling *Fringilla montifringilla*. There are two main moult patterns described for non-tropical passerines: post-nuptial moult – a complete moult in the breeding area after breeding, and winter moult – a complete moult in the winter quarters (Streseman & Streseman 1966, Ginn & Melville 1983). Among passerines in Europe all non-migrants, all short-distance migrants and some tropical migrants moult during the summer; thus it is only some tropical migrants that moult during winter (Ginn & Melville 1983, Svensson 1984).

Moult and breeding are two energetically demanding events for a bird and normally moult and breeding do not overlap. Passerines breeding in northern Scandinavia, which are moulting during summer, have to moult during a short period after breeding before climatic conditions force them to leave the breeding area.

As other European passerine birds which are residents or short-distance migrants, Bramblings moult during the summer. In northern Sweden Bramblings leave their breeding areas during September (SOF 1990) and migrate through southern Sweden during October. The median ringing date at Ottenby Bird Observatory (56° 12' N, 16° 24' E) is 16 October (Ottenby Bird Observatory, unpubl.). And at Ljunghusen (55° 23' N, 12° 55' E) in the southwesternmost part of Sweden, the median ringing date is 6 and 15 October for females and males, respectively (Anon. 1990). Regularly juvenile Bramblings arrive to southern parts of Sweden already in late July-early August (S. Bensch, pers. comm.). According to Jenni (1982) the timing of autumn migration shows a rather low variation between years, but final wintering areas varies considerably between years due to variations of the beech mast crop in different areas.

The aim of this study is to estimate the timing and duration of primary moult in relation to the breeding cycle for Bramblings breeding in northern Sweden.

## Method

Moult data were collected from Bramblings caught in mist-nets in a subalpine birch forest close to Lake Tjulträsk, Ammarnäs (65° 58' N, 16° 07' E), Swedish Lapland, as a part of the LUVRE-project (Enemar et al. 1984). Birds were trapped in six years during the following periods: 12 July–15 August 1984, 12 July–17 August 1985, 16 July–21 August 1986, 17 July–21 August 1987, 18 July–31 August 1988, and 17 July–21 August 1989. Twenty-two nets were used daily, normally between 0700 and 1300. All trapped birds were ringed, aged and sexed according to Svensson (1984), and their body mass was estimated to the nearest 0.1 g using a 50 g pesola spring-balance.

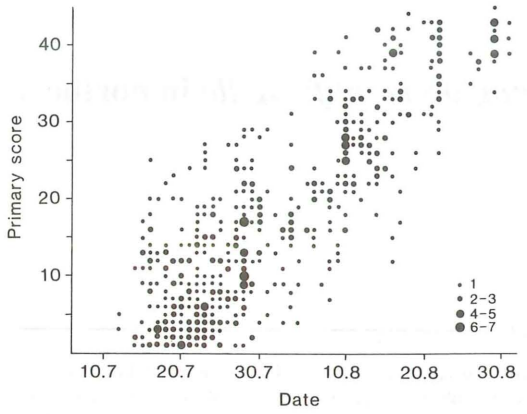


Fig. 1. Primary score versus date for adult Bramblings caught during 1984–1989. n = 580.

*Handpennepoäng mot datum för gamla bergfinkar fångade åren 1984–1989, n = 580.*

The wing moult of adult Bramblings was scored on the left wing according to Ginn & Melville (1983), where an old feather scores 0 and a new fully grown feather scores 5. Among the primaries only the nine large ones were used in the analysis, excluding the outermost 10th which in finches is a rudimentary feather. By this method, an old unmoulted wing has a primary score (PS) of 0 and a completely new and fully grown wing has a PS of 45. The primaries were numbered descendantly, i. e. in the sequence they are shed, from the innermost (P1) to the outermost (P9). The six secondaries and three tertials were numbered ascendantly, from the outermost (S1, T1) to the innermost (S6, T3). All growing feathers were measured to the nearest mm with a thin ruler inserted between the feathers, allowing an estimation of individual feather growth rate of recaptured birds.

Duration of moult was analysed by linear regression analysis with date as independent variable. This gives an estimate of the duration of moult for the population (Ginn 1975, Pimm 1976, Sondell 1977). But when the trapping season fails to cover the whole moulting period, regression analysis with date as independent variable gives the best estimate for an average individual's moult duration (E. Haukioja, pers. comm.). The length of the trapping season as well as the start of moult varied between years, and 1986 was the year when most of the moulting season was covered. Therefore, we used the 1986 data set only to estimate duration of moult. Another estimate of individual moult duration was derived from individuals recaptured more than four days after ringing.

Raggedness values, a measure of the "hole" in the wing (absent wing area), were collected according to Haukioja (1971a).

A newly shed feather (PS = 1) has a raggedness value of 4 and a new fully grown feather as well as an old feather has a raggedness value of 0. The sum of the PS and the raggedness value are always 5 for each feather, except for an old feather. The individual raggedness values for each feather were then summed for the whole wing, with both primaries and secondaries included.

## Results

A total of 637 adult (mean = 106/year, range 68–163) Bramblings were caught during the six seasons. Of them, 580 adult birds were in active moult (mean = 97/year, range 44–152). Of the moulting Bramblings 14 individuals were recaptured when still in moult during the same season.

### *Description of moult*

Similarly to most small passerines, the Brambling begin moult by shedding the innermost one or two primaries (P1 and P2). These two feathers normally grow out to at least two thirds of the full length before the shedding of the next feather (P3). The moult then proceeds outwards with the dropping of the other feathers one by one, with several feathers growing at the same time. Primary moult score for all individuals and years are plotted against date in Fig 1.

When the primary score has reached a value of approximately 20 the secondary moult normally starts with shedding of the outermost secondary (S1; Fig 2). The moult then proceed inwards, countercurrently to the primaries. Secondary moult seems to be completed a few days after the end of the primary moult, but the low number of birds in late moult stages did not allow any further analysis.

Tertial moult normaly starts a little earlier than the secondary moult, at a primary score of about 10 (Fig 2). In most cases the central tertial (T2) is dropped first followed by the smallest one (T3) and finished with the outermost tertial (T1).

Feather growth rate was estimated from the controls to be 3–4 mm per day until the feathers were almost fully grown when the speed seemed to slow down.

### *Duration of moult*

According to the regression analysis of the 1986 data set, with date as independent variable, the duration of moult was estimated at 48 days for males ($y = 0.94x - 9.75$, n = 52), and 46 days for females ($y = 0.98x - 12.07$, n = 48). Since the regression lines were not

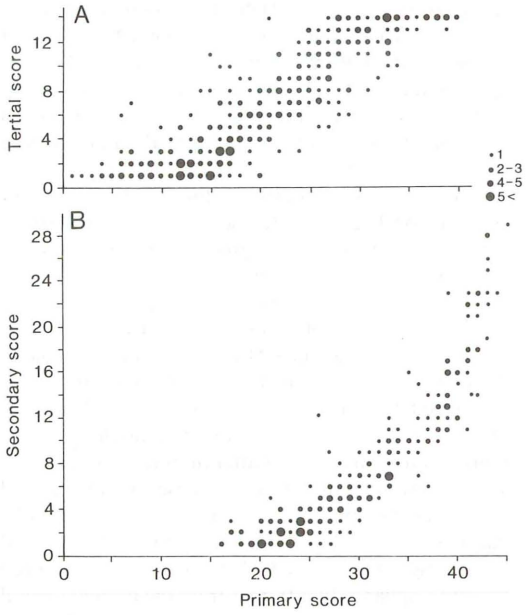


Fig. 2. Increase in tertial score (A) and secondary score (B) compared with the increase in primary score for adult Bramblinds. n = 416 and n = 241, respectively.

*Ökningen för tertialernas (A) och armpennornas (B) ruggningspoäng i jämförelse med ökningen för handpennornas poäng hos gamla bergfinkar, n = 416 resp. n = 241.*

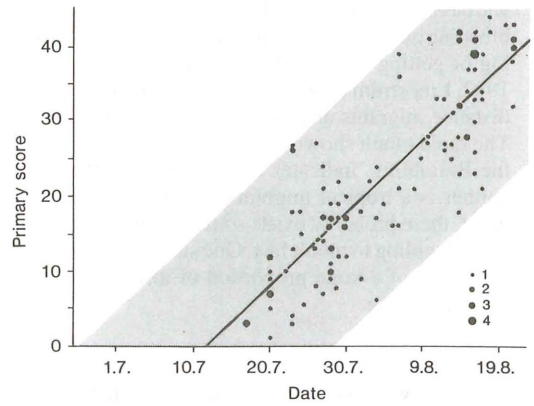


Fig. 3. Primary score versus date for adult Bramblings caught in 1986. Stippled area indicates the moult period for most of the birds of the population. n = 100.

*Handpennepoäng mot datum för gamla bergfinkar fångade 1986. Det prickade området visar ruggningsperioden för flertalet fåglar i populationen. n = 100.*

significantly different from each other (ANCOVA $F_1$ = 0.112 and $F_1$=0.401, $p$=0.738 and $p$=0.528 respectively), data for the two sexes were pooled for further analysis. The pooled regression line for males and females gave a moult duration of 46.5 days (y = 0.97x – 11.36, n = 100), Fig 3.

On the basis of feather growth of recaptured birds, moult duration was between 45 and 180 days (mean = 94 days). Nine birds were caught in early moult stages, PS < 6, when moult rate is slower than average (see Ginn 1975). The other four birds were in heavy moult, between PS 15–23 when first caught, and the moult duration was estimated at 45, 64, 68, and 90 days (mean = 67 days), respectively.

Mean raggedness values for Bramblings and some other passerines with a primary score between 30 and 39 and their estimated duration of moult are shown in Table 1.

## Discussion

According to the regression analysis, shown in Fig. 1, the Brambling has a relatively rapid moult in northern Sweden, comparable with the moult durations shown for an insectivorous migrant such as the White Wagtail *Motacilla alba* (Haukioja 1971a). But it was a bit

Table 1. Mean raggedness values for Bramblings *Fringilla montifringilla* and four other passerine species with summer moult and with a primary score between 30–39. Data, except for Brambling, from Haukioja (1971a), with duration of moult estimated from recaptures.

*Genomsnittliga raggednessvärden för bergfink och fyra andra tättingar med sommarruggning och med handpennepoäng mellan 30 och 39 Data, utom för bergfink, från Hankioja (1971a), med ruggningstidens längd uppskattad från återfångster.*

| Species | Moult days | Raggedness of wing *Vingens raggedness* | | |
|---|---|---|---|---|
| *Art* | *Ruggningstid dagar* | Mean *Medel* | S.E. | N |
| Brambling *Bergfink* | 34 | 12.4 | 0.33 | 84 |
| Bluethroat *Blåhake* | 42–45 | 19.8 | 1.06 | 9 |
| Willow Warbler *Lövsångare* | 39 | 17.6 | 1.00 | 11 |
| White Wagtail *Sädesärla* | 46 | 13.7 | 0.42 | 12 |
| Whitethroat *Törnsångare* | 43 | 21.5 | 2.92 | 6 |

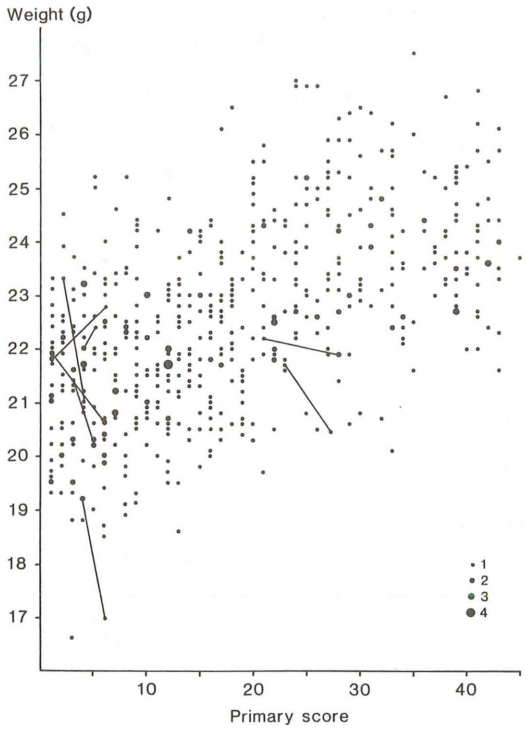


Fig. 4. Weight versus primary score for adult Bramblings. Lines connect birds caught at two different times. n = 552.

*Vikt mot handpennepoäng för gamla bergfinkar. Linjer binder samman fåglar som fångats vid två olika tillfällen. n = 552.*

slower than in tropical migrants such as Yellow Wagtail *Motacilla flava*, Willow Warbler *Phylloscopus trochilus*, Bluethroat *Luscinia svecica*, and Whitethroat *Sylvia communis* .(Haukioja 1971a, Sondell 1987, Bensch & Grahn in prep). The moult duration of the Brambling found here (46.5 days) is much shorter than the moult duration for the closely related Chaffinch *Fringilla coelebs* (70 days, Haukioja 1971b, Sondell & Schildt 1985). Further, Haukioja (1971b) states that "It may be mentioned that the lenght of the moult is about two weeks longer in the Chaffinch than in the Brambling in northern Lapland". Newton (1968) studied Chaffinches and used two different methods to estimate the duration of moult. From recaptures he obtained a moult duration of 72 days and from a method where a line was fitted by eye in a diagram with moult score plotted against date, which gives an accurate estimate of an average individual's speed of moult (Ginn 1975), he got 73 days. British Redpolls *Carduelis flammea cabaret* seem to be the only, mainly seed eating bird (Newton 1972) that has a more rapid moult, 35–40 days, (recalculated from Evans 1966, Evans et al. 1967). Snow Buntings *Plectrophenax nivalis* studied on Greenland have an extremely short duration of moult (28 days; Green & Summers 1975, recalculated in Pimm 1976), but they seem to feed on insects to a large extent during summer (Haftorn 1971).

Moult speed is regulated either by the number of simultaneously growing feathers, described by the raggedness value, or by the growth rate of individual feathers. The raggedness values shown here, Table 1, are comparable with that of the White Wagtail which has a similar speed of moult (Haukioja 1971a).

Moult speed calculated from recaptures is probably the most accurate method for estimating duration of moult. But it requires that there is no effect of handling. During our study, recaptures of adult moulting Bramblings more than four days after ringing were very few. The low average moult rate of these birds compared with the estimation from the regression analysis may be due to a handling effect indicated in Fig. 4. Recaptured Bramblings often showed a decrease in weight between captures, apparently different from the normal overall weight gain during the moult period (Fig. 4). This shows that one should be cautious when using recaptures for estimating duration of moult.

Bramblings show a nomadic breeding behaviour (Mikkonen 1983, Hogstad 1985, Lindström 1987), breeding at a new place each year. Thus, they lack breeding site tenacity which is common among many other birds (Andersson 1980). Despite nine years of ringing and a total 1707 Bramblings ringed, only two ringed birds have been captured at the same site in two different breeding seasons (Lindström 1987). Willow warblers, Bluethroats and Snow Buntings leave their breeding quarters early either because food is diminishing or getting inaccessible (c. f. Högstedt & Persson 1982, Lindström et al. 1985) or because they are long-distance migrants and need more time for migration. The rapid moult shown here by regression analysis for the Brambling, indicates that, even if the Brambling neither is a tropical migrant nor a long-distance migrant, there probably exists some constraint that force the Brambling to moult fast. One such constraint could be a need of a large proportion of insects in the diet when moulting.

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## Sammanfattning


*Handpenneruggning hos bergfinken* Fringilla montifringilla *i norra Sverige.*

Bergfinkens kompletta ruggning, vilken genomförs efter fullbordad häckning, studerades säsongerna 1984–1989 vid Tjulträsk nära Ammarnäs (65° 58' N, 16° 07'E). Fångsten, som är en del av LUVRE-projektet, bedrevs årligen i fjällbjörkskogen under perioden juli – augusti, med smärre variationer mellan säsongerna.

Samtliga fåglar ringmärktes, åldersbestämdes och könsbestämdes. Dessutom noterades ruggningen enligt ett system där varje vingpenna erhåller 0–5 poäng. 0 poäng innebär att fjädern är gammal. När den tappas och en ny börjar växa ut ökar poängen och en helt utvuxen ny fjäder erhåller 5 poäng. Hos finkar är den yttersta handpennan mycket liten och här exkluderad varför en helt nyruggad fågel har 45 s. k. handpennepoäng.

Ruggningshastigheten bestämdes med linjär regression, med datum som oberoende variabel. Såväl fångstsäsongen som den genomsnittliga ruggningshastigheten varierade mellan åren och därför användes bara data från 1986 som var det året då den största delen av bergfinkens ruggningscykel täcktes. Ruggningshastigheten extrapolerades också från fåglar som kontrollerats under ruggning med mer än fyra dagars mellanrum.

Totalt fångades 637 adulta, varav 580 ruggande, bergfinkar under de sex säsongerna.

Som ett mått på hålet i vingen användes det s. k. raggednessvärdet (RV), där hålet efter en nyss släppt penna ger RV = 4 och en gammal eller helt utvuxen ny ger RV = 0. Varje enskild pennas raggedness summerades för vänster vinge.

Ruggningen började med att de två innersta handpennorna släpptes. När dessa vuxit till minst 2/3 fortsatte ruggningen utåt och resterande pennor släpptes en och en. Armpenneruggningen påbörjades sedan vanligen när handpennepoängen var omkring 20, Fig 2a. Yttersta armpennan släpptes först och ruggningen fortsatte sedan inåt. Ruggningen av tertialerna startade i allmänhet då handpennepoängen var runt 10, Fig 2b.

Regressioinsanalysen visade att ruggningshastigheten, vad det gäller handpennorna, för hanar var 48 dagar och för honor 46 dagar. Skillnaden var dock inte signifikant och i den fortsatta analysen sammanfördes därför honor och hanar till en grupp med en ruggningshastighet på 46.5 dagar, Fig 3. Endast 13 ruggande bergfinkar återfångades efter minst fyra dagar. Dessa beräknades ha en ruggningstid mellan 45 och 180 dagar, medel 94 dagar. Med hänsyn tagen till de individer som var i den mest ruggningsintensiva perioden blev medelruggningstiden 67 dagar, n = 4.

Ruggningstiden, 46.5 dagar, som här beskrivits är förhållandevis snabb, i paritet med den ruggningstid som visats för insektsätande flyttfåglar som sädesärla och betydligt kortare än för bofinken som har en ruggningstid kring 70 dagar. Ruggningshastigheten regleras av antalet samtidigt växande pennor, raggednessvärdet och tillväxthastigheten för enskilda pennor. De raggednessvärden som erhållits i denna studie,

Tabell 1, är fullt jämförbara med raggedenessvärden för sädesärla som har en ruggningshastighet på 46 dagar. Bergfinkens ruggningshastighet kan eventuellt också förklaras av att tillväxthastigheten för enskilda pennor, 3–4 mm per dag, tenderar att vara något snabbare än hos andra finkar.

Den långa ruggningstiden beräknad för återfångade fåglar kan troligen förklaras av en hanteringseffekt. De återfångade fåglarna verkade minska i vikt mellan fångsttillfällena medan den allmänna bilden under ruggningen är en viktuppgång, Fig 4. Denna viktminskning visar att man bör vara försiktig när man använder återfångade fåglar för att beräkna ruggningshastigheter.

Nordligt häckande insektsätande fåglar är tvungna att lämna häckningsområdena p g a att födan tryter. Bergfinkens snabba ruggning antyder att det finns någon faktor som tvingar även den att rugga fort. Möjligen kan det vara så att bergfinken är i behov av insektsföda under ruggningen för att kunna bygga upp nya fjädrar.