

Age dependent variation in wing length of Bearded Tits *Panurus biarmicus*

BO NIELSEN

Abstract

I have studied the increase of wing length among Bearded Tits from their juvenile plumage to their autumn plumage. The increase is large, 8.5% for males and 7.3% for females. During 1992 I obtained data on several other feather measurements of these two plumages in order to find the ecological background of the increase in wing length. From juvenile plumage to autumn plumage tail length increased with 14-16%. There were also an increase in feather mass. The average mass of the innermost primary was 3.32 mg in juveniles and 4.10 mg in their autumn plumage. Indices of wing pointedness and aspect ratio

show that adults grow a more pointed wing than juveniles. Different hypotheses to explain the age related increase in wing length are discussed. I argue that the shorter wings in juveniles is an evolutionary adaptation. The reason should be to bring down the time until fledging in order to reduce the risk of predation. I could find no data in favour of the alternative hypothesis, that starvation of nestlings reduces the growth rate of feathers. Moreover there might also be different wing length optima for juvenile and adult birds.

Bo Nielsen, Lindrothsgatan 28, S-703 67 Örebro, Sweden

Received 4 May 1993, Accepted 9 August 1993, Edited by A. Hedenström

Introduction

A common feature among passerines is that their wing length increases with age, especially after their first moult. There might be two proximate reasons for this phenomenon. The shorter wing length in juveniles compared to adults can depend either on a selection against short winged individuals, i.e. short winged individuals die in a higher degree than long winged ones and there is no actual increase of wing length, or on an actual increase of wing length for the individual birds during their moult (Nilsson 1992).

If the second reason is valid, that the individual birds have a shorter wing in their juvenile plumage and increases it during the moult, then there can be different reasons to that. One reason can be that the access of food during the nestling time in many cases is so low that the wing feathers cannot grow out to their full length, i.e. there is a nutritional constraint which forces the individual to develop a shorter wing with a sub-optimal flying capacity (Slagsvold 1983). Another explanation can be that the individual,

by allocating more energy to general development rather than to flight feather growth, may shorten the fledging time which could reduce the risk of predation (Nilsson 1992). The flight-feathers, i.e. primaries, secondaries and tail-feathers, are the last feathers to be fully developed in a young bird and a shorter wing length makes it possible for a juvenile bird to minimize the time to fledging. Yet another explanation can be an adaptation to different wing length optima for juvenile and adult birds. A short rounded wing increases the manoeuvrability while a longer more pointed wing makes the bird more efficient for flights over longer distances, for example during migration (Alatalo et al. 1984).

Juvenile as well as adult Bearded Tits *Panurus biarmicus* undergo a complete moult during the summer (Svensson 1992). The young birds then show a pronounced increase in wing length. Therefore, it is a suitable species to analyse the ecological variables that may contribute to the gene-

ral pattern of wing length increases observed in passerines.

Methods

This study of the Bearded Tit during its moult from juvenile plumage (age 1Y) to autumn plumage (age 1Y+) was carried out at Lake Kvismaren, a shallow reed marsh 15 km SSE Örebro, South Central Sweden. At Lake Kvismaren a daily ringing programme is run from the end of June to the end of September. The ringing is alternated between three different sites. The majority of the Bearded Tits has been captured in pure stands of reed at Källviken. Besides the daily ringing routine, occasional trapping of Bearded Tits have been carried out during May and June in connection with studies of breeding biology of other species of birds in the Kvismare area.

This study covers the following set of data. The wing length has been measured in all Bearded Tits ringed at Lake Kvismaren between 1985 and 1992, including recaptures made after completed moult (n=1021). The increase of wing length of specific individuals ringed as juveniles (age 1Y) before the start of their moult and recaptured after completed moult (age 1Y+) has been compared (n=45). In four cases the same individual was recaptured more than once and in these cases I used the average value of the measurements. At Lake Kvismaren the wing length is measured by the maximum method (Svensson 1984) to the nearest millimeter. Other measurements are also made according to Svensson (1984).

During 1992 we have also collected data on tail length (n=287), complete wing formula (n=120) and wing area (n=111). From the wing formula I have calculated an index of wing pointedness (Hedenström 1989). First, the length of the longest primary was set to zero. Then I measured the distance from the tip of each primary to the tip of the longest primary (see Svensson 1984). The primaries were then counted with ascendent numbering. The index of wing pointedness (WPI) is then $WPI = (\sum P - \sum D) / W * 100$ (Hedenström 1989). P is the distance from the tip of each proximal primary to the tip of the longest primary up to and including the eighth primary, D is the same distance for the distal primaries out to and including the second primary and W is wing length. From the estimated wing area I have calculated an aspect ratio (Pennycuick 1989) which is the wing span squared divided by wing area. Differently from Pennycuick, I have used the span of one wing

squared divided with the area of one wing, multiplied with 2. Furthermore I have used mm and mm² instead of m and m². These methods both give values which describe the form of the wing. A higher value refers to a more pointed wing. In order to study the quality of the feathers and to measure the rate of growth in the flight feathers the innermost primary was collected from some individuals (n=29). The quality of the feathers has been estimated by weighing them to the nearest 0.01 mg. The feathers were dried in room temperature during one month. Thereafter they were kept in sealed test-tubes. The rate of growth was calculated by measuring the average width of the 5 growth-bars which were observed above and the 5 growth-bars observed below 2/3 of the feather length from the base. In some cases it was difficult to observe 10 growth-bars. In these cases 9 or 8 growth-bars have been used. A growing feather gets its growth-bars through

Table 1. Mean wing-length and tail-length for different ages and sexes of Bearded Tits captured at Lake Kvismaren between 1985 and 1992. The ages is given according to (Svensson 1992). 1Y is a bird in juvenile plumage and 1Y+ is a bird in autumn plumage.

Medelvinglängd och medelstjärtlängd hos skäggesar fångade i Kvismaren mellan 1985 och 1992, uppdelat på olika kön och åldrar. Åldrarna ges enligt (Svensson 1992). 1Y är en fågel i juvenil dräkt, 1Y+ är en fågel i höstdräkt.

	Mean <i>Medel</i>	SD <i>SD</i>	Number <i>Antal</i>
<i>Wing length Vinglängd</i>			
Males (age 1Y)	58.01	1.37	254
<i>Hanar (ålder 1Y)</i>			
Males (age 1Y+)	62.96	1.31	252
<i>Hanar (ålder 1Y+)</i>			
Females (age 1Y)	57.05	1.36	256
<i>Honor (ålder 1Y)</i>			
Females (age 1Y+)	61.21	1.39	259
<i>Honor (ålder 1Y+)</i>			
<i>Tail length Stjärtlängd</i>			
Males (age 1Y)	71.17	3.49	104
<i>Hanar (ålder 1Y)</i>			
Males (age 1Y+)	82.71	2.66	45
<i>Hanar (ålder 1Y+)</i>			
Females (age 1Y)	67.08	3.44	95
<i>Honor (ålder 1Y)</i>			
Females (age 1Y+)	76.58	2.40	43
<i>Honor (ålder 1Y+)</i>			

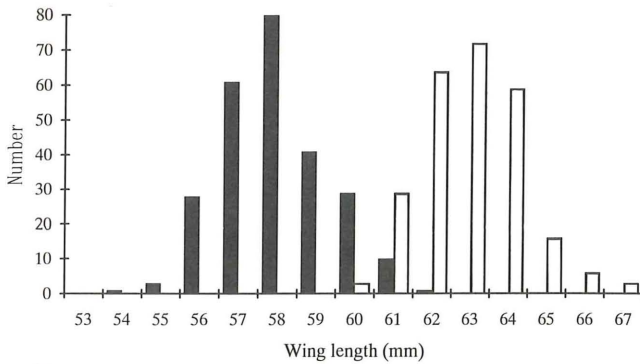


Fig. 1. The distribution of wing length in male Bearded Tits 1985-1992. Juvenile birds are indicated by shaded bars, $n=254$ and birds in autumn plumage by open bars, $n=252$.

Fördelningen av vinglängder hos hanar 1985-1992. Fyllda staplar visar juveniler, $n=254$ och ofyllda staplar visar fåglar i höstdräkt, $n=252$.

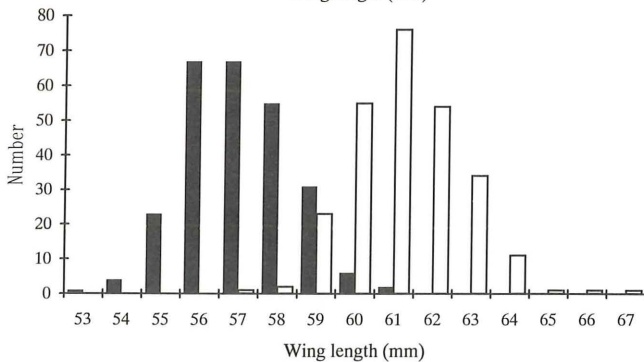


Fig. 2. The distribution of wing length in female Bearded Tits 1985-1992. Juvenile birds shaded bars, $n=256$ and birds in autumn plumage, open bars, $n=259$.

Fördelningen av vinglängder hos honor 1985-1992. Fyllda staplar visar juveniler, $n=256$ och ofyllda staplar visar fåglar i höstdräkt, $n=259$.

different pigmentation of the feather when growing during daytime and nighttime. This means that one light and one dark bar are equal to the growth in a 24 h period. For more details on methodology see Grubb (1989) and Nilsson et al. (in press).

Both adult and juvenile Bearded tits undergo a complete summer moult. After the moult is completed it is not possible to separate juvenile individuals (age 1Y) from adults (age 1Y+). According to moult data collected on 24 individuals at Lake Kvismaren between 1989 and 1991, the Bearded Tit mainly moults from the middle of July to the middle of September (Nielsen 1992). The sexes have been analysed separately since these can be told apart by the colour of their bills even on newly fledged birds (Svensson 1992).

Results

Difference in wing length between the sexes

The Bearded Tit has a large variation in wing length within the species. Unworn birds varies between 53

and 67 mm. There is no difference in the wing length range between the sexes neither for birds in juvenile plumage nor birds in autumn plumage. There is however a statistically significant difference in mean wing length (Table 1). Juvenile unmoulted males have 1 mm longer wings than juvenile unmoulted females (t -test: $t_{508} = 7.90$ $P < 0.001$). In autumn plumage the males have on average 1.8 mm longer wing than the females (t -test: $t_{509} = 14.69$ $P < 0.001$).

Difference in wing length before and after the summer moult

Both sexes of Bearded Tits show a substantial increase in wing length in connection with the summer moult (Table 1, Fig. 1 and Fig. 2). The wing length then increases on average with 4.9 mm for males (t -test: $t_{504} = 41.50$ $P < 0.0001$) and with 4.1 mm for females (t -test: $t_{513} = 34.19$ $P < 0.0001$). Thus, the increase in wing length is 8.5% for males and 7.3% for females. To verify how well this corresponds with known individuals, I have checked the birds which have been measured as juveniles (age 1Y), and been

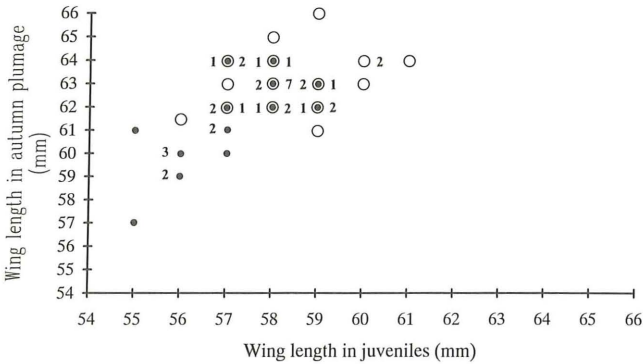


Fig. 3. The increase in wing length of the same individual measured as a juvenile and in autumn plumage 1985-1992. Data represents 25 males (○, numbering to the right) and 20 females (●, numbering to the left).

Vinglängdsökning hos samma individ, uppmätt dels som juvenil och dels i höstdräkt 1985-1992. Data från 25 hanar (○, antalsmarkering till höger) och 20 honor (●, antalsmarkering till vänster).

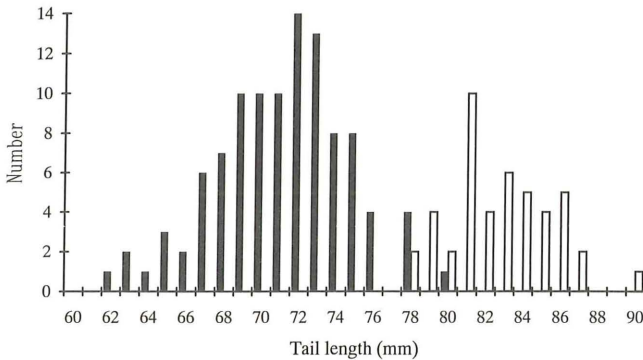


Fig. 4. The distribution of tail length in male Bearded Tits 1992. Juvenile birds shaded bars, n=104 and birds in autumn plumage open bars, n=45.

Fördelningen av stjärtlängder hos hanar 1992. Fyllda staplar visar juveniler, n=104 och ofyllda staplar visar fåglar i höstdräkt, n=45.

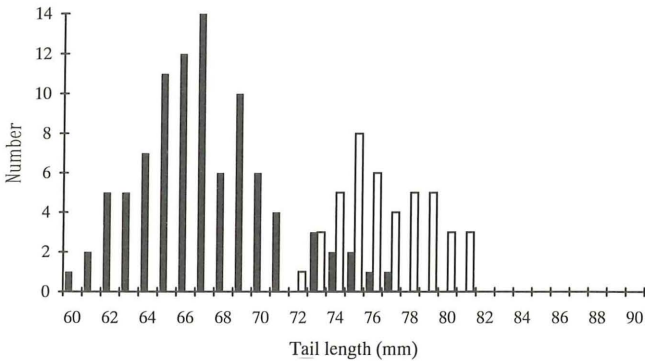


Fig. 5. The distribution of tail length in female Bearded Tits 1992. Juvenile birds shaded bars, n=95 and birds in autumn plumage open bars, n=43.

Fördelningen av stjärtlängder hos honor 1992. Fyllda staplar visar juveniler, n=95 och ofyllda staplar visar fåglar i höstdräkt, n=43.

recaptured and measured in autumn plumage (age 1Y+), after completed summer moult (Fig. 3). The average increase in wing length for males is 4.8 mm (SD=1.37, n=25) and for females 4.3 mm (SD=1.10, n=20).

Difference in tail length in relation to sex and summer moult

The males have 4.1 mm longer tail than the females before moult and 6.1 mm longer tail after the sum-

mer moult (Table 1). As for the wing length, there is a large increase in the tail length for both sexes in connection with the summer moult. The tail length of males was on the average 11.5 mm longer (16.2%) after moult. For females the increase of tail length was on the average 9.5 mm (14.2%) (Table 1, Fig. 4 and Fig. 5). These increases are both highly significant (males $t_{147} = 22.0$, $P < 0.0001$; females $t_{136} = 18.7$, $P < 0.0001$). The increase corresponds well with known individuals which have been measured as

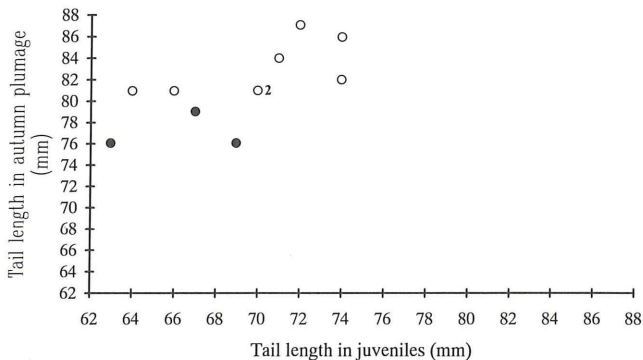


Fig. 6. The increase in tail length of the same individual measured as a juvenile and in autumn plumage 1992. Data represents 8 males (○, numbering to the right) and 3 females (●).

Stjärtlängdsökning hos samma individ, uppmätt dels som juvenil och dels i höst-dräkt 1992. Data från 8 hanar (○, antalsmarkering till höger) och 3 honor (●).

juveniles (age 1Y) and have been recaptured in autumn plumage (age 1Y+). The average increase in tail length for males is 12.8 mm (SD=2.68, n=8) and for the females 10.7 mm (SD=2.62, n=3) (Fig. 6).

growth per 24 h for juveniles was 1.41 mm (SD=0.20, n=10), and for the autumn plumage 1.28 mm per 24 h (SD=0.20, n=13). The difference was however not significant (t-test: $t_{21} = 1.48, P > 0.1$).

Age related difference in feather quality and feather growth rate

The mass of a feather depends on how long it is and how much feather mass it has per unit of length. An ANCOVA with the mass as the dependent variable shows that there is a significant effect of age ($F_{1,27}=68.9, P < 0.001$) as well as of length ($F_{1,27}=7.28, P=0.012$). The feathers of the juvenile birds (age 1Y) weighed on the average (+/-SE) 3.32 mg +/- 0.07 (n=11) while the corresponding value for individuals in autumn plumage (age 1Y+) is 4.10 mg +/- 0.05 (n=18). These average values has been adjusted for the effect of the length (Fig. 7).

The rate of feather growth was slightly higher for the juvenile feathers than for the feathers which were grown during the summer moult. The average rate of

Age related variation in wing area and wing pointedness

Both index of wing pointedness and aspect ratio increase from the juvenile plumage to the autumn plumage, even though the individual variation is high. The average index of wing pointedness for juveniles is 11.64 (SD=3.56, n=58) and for birds in autumn plumage 15.99 (SD=4.24, n=62). The average aspect ratio for juveniles is 3.68 (SD=0.22, n=54) and in autumn plumage 3.82 (SD=0.16, n=62). The increase is in both cases significant (pointedness of wing, t-test: $t_{118} = 6.10 P < 0.0001$), (aspect ratio, t-test: $t_{114} = 3.87 P < 0.001$). For three males, which were ringed as juveniles and recaptured after completed moult, the full wing formula was taken at all occasions. In two of the cases the area of

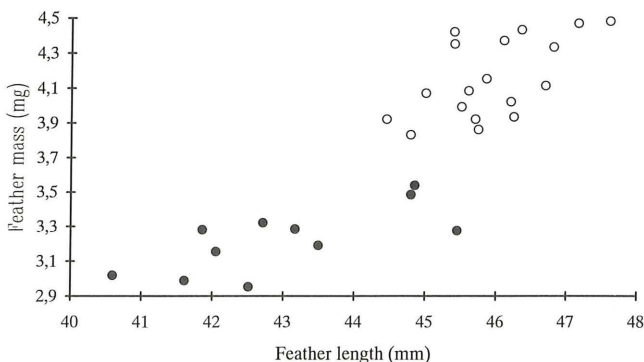


Fig. 7. Weight versus length for the innermost primary in juveniles and for birds in autumn plumage. Data represents 11 juveniles (●) and 18 individuals in autumn plumage (○).

Vikten i relation till längden av den innersta handpennan hos juveniler och fåglar i höstdräkt. Data från 11 juveniler (●) och från 18 individer i höstdräkt (○).

the wing was also taken. All these individuals showed increased wing pointedness as well as aspect ratio.

Discussion

The present study clearly shows that individual Bearded Tits acquire a longer wing length after their first complete summer moult. This is demonstrated both by the total material and by the recapture data of individuals (Fig. 1, Fig. 2 and Fig. 3). Thus selection against short winged individuals cannot explain the shorter wings in juveniles compared to adults.

There can be three different reasons to an actual shorter wing length in juveniles. First, juveniles are forced to grow a shorter wing because of nutritional constraints in the form of different degrees of starvation during the nestling time and shortly afterwards (Slagsvold 1983). If so it is likely to assume that the nutritional conditions for different individuals have varied. This would probably have resulted in a larger variation in wing length among juveniles than among adults. This was not the case. Instead, the data shows that juvenile birds (age 1Y) and birds in autumn plumage (age 1Y+) form two well defined groups of wing lengths, with a similar variance for both age groups. The recapture data show that short winged as well as long winged individuals have a similar increase in wing length (Fig. 3). If the increase in wing length was dependent on a nutritional constraint it would be likely to assume that a regression line in the recapture data (Fig. 3) would differ from 1/1, since large and small individuals probably are more exposed to starvation. This was not the case, which speaks against nutritional constraints as a proximal explanation to the general pattern of shorter wings in juveniles compared with adults.

Secondly, the reason for the shorter wing length in young birds can be an evolutionary adaptation where the individual uses the available energy to speed up its general development rather than flight feather growth and thereby shorten the time to fledging (Nilsson 1992). The low variation in wing length among the different age groups (Fig. 1 and Fig. 2) and the similar increase of wing length in short winged and long winged individuals in the recapture data (Fig. 3) indicate that this explanation is valid in the case of the Bearded Tit. Furthermore, the lower quality of the flight feathers, the shorter feathers (Fig. 7) and the equal or higher growth rate in the juvenile feathers compared to the adult ones indicate that it is important to minimize the energy and time consumption until fledging time.

Thirdly, the reason for the shorter wing among juveniles compared to birds in autumn plumage can be an adaptation to different optima in wing length (Alatalo et al 1984), i.e. juveniles have a short rounded wing which increases the manoeuvrability and birds in autumn plumage have a longer more pointed wing, which is more efficient for flights over longer distances. The index of wing-pointedness as well as aspect ratio increase after completed summer moult, which indicate that the two groups of wing length also may be an adaptation to different optima of wing length. However, both indices on pointedness and aspect ratio show a large overlap between juveniles and adults.

I suggest that the difference in wing length between juveniles and adults depends on an evolutionary adaptation for shorter wings in juveniles. The reason may be that it is important for the juvenile Bearded Tit to minimize the time as nestling or the time to independence. An evolutionary contributory reason can be that the parents save energy and time by letting the nestlings in the first brood be independent early, which facilitate the raising of a second brood. An adaptation to different optimal wing lengths and wing formulae for the two age groups might be an additive cause to the shorter wing length in juveniles, since the feathers of the juvenile plumage are only used for short flights and during foraging, while the feathers of the autumn plumage may be used also for long flights, during the often extensive autumn movements (Björkman & Tyrberg 1982, Nielsen 1992).

Acknowledgements

I will thank many persons at the university of Lund, especially Staffan Bensch, Dennis Hasselquist, Anders Hedenström, Åke Lindström and Owe Persson for invaluable help with ideas, views on the work and working methods. Staffan Bensch together with Lars Gotborn and Roger Gyllin have been very helpful with comments on the manuscript. I also acknowledge the staff at Kvismare bird observatory whose help with the field work have made this study possible. I will especially thank Robert Lager, Patrik Rhönnsstad and Örjan Östman.

Contribution No. 77 from Kvismare Bird Observatory.

References

- Alatalo, R. V., Gustafsson, L. & Lundberg, A. 1984. Why do young passerine birds have shorter wings than older birds? *Ibis* 126:410-415.

- Björkman, G. 1975. Skäggesen (*Panurus biarmicus*) i Tåkern. *Vår Fågelvärld* 34:296-310.
- Björkman, G. & Tyrberg, T. 1982. Skäggesen i Sverige 1965-1979. *Vår Fågelvärld* 2:73-94.
- Grubb, T.C. Jr. 1989. Ptilochronology: feather growthbars as indicators of nutritional status. *The Auk* 106:314-320.
- Hedenström, A. 1989. Which wing-index should be used? *Ibis* 131:154.
- Nielsen, B. 1992. Skäggesen i Kvismaren 1991. *Fåglar i Kvismaren* 7(2):2-7.
- Nilsson, J.-Å. 1992. Variation in wing length in relation to sex and age of Marsh Tits *Parus palustris*. *Ornis Svecica* 2:7-12.
- Nilsson, J.-Å., Källander, H., & Persson, O. A prudent hoarder: effects of longterm hoarding in the European Nuthatch. Unpubl, accepted *Behaviour ecology*.
- Pennycuik, C.J. 1989. *Bird Flight Performance: a practical calculation manual*. Oxford University Press, Oxford, pp. 10-14.
- Slagsvold, T. 1983. Morphology of the Hooded Crow *Corvus corone cornix* in relation to age, sex and latitude. *J. Zool., Lond.* 199:325-344.
- Svensson, L. 1984. *Identification Guide to European Passerines*, pp. 9-22.
- Svensson, L. 1992. *Identification Guide to European Passerines*, pp. 52-53, 232.

Sammanfattning

Åldersrelaterad variation i vinglängd hos skäggesen Panurus biarmicus.

Det är vanligt att tättingar ökar sin vinglängd med tilltagande ålder, speciellt efter den första ruggningen. Skäggesen är en lämplig art för att analysera de ekologiska förklaringarna till den vinglängdsökning som kan ses hos tättingar eftersom såväl juvenila som adulta skäggesar genomför en komplett ruggning under sommaren. Ungfåglarna uppvisar då en stor vinglängdsökning.

Jag har analyserat vinglängdsdata från 1021 skäggesar som ringmärkts och kontrollerats vid Kvismaren mellan 1985 och 1992. Vidare har jag insamlat uppgifter om stjärtlängd, fullständig vingformel och vingarea under 1992. Dessutom har den innersta handpennan insamlats från några individer för att jämföra fjädrarnas tillväxttakt och kvalitet. Enskilda individers ökning av vinglängden har fastställts hos de individer vilka ringmärkts som juvenila (ålder 1Y) före vingpennruggningens start och kontrollerades efter genomförd vingpennruggning (ålder 1Y+). Materialet är uppdelat på kön eftersom även nyligen flygga skäggesar kan könsbestämmas med hjälp av näbbfärgen.

Resultat

Skäggesen har en stor inomartsvariation i vinglängd. Oslitna fåglar varierar mellan 53 och 67 mm. Det föreligger ingen absolut vinglängdsskillnad mellan könen hos vare sig unga individer eller hos de i höstdräkt. Däremot finns det en statistiskt säkerställd skillnad i medelvinglängd (Tabell 1). Juvenila oruggade hanar har 1 mm längre vinge än juvenila oruggade honor. I höstdräkt har hanarna 1,8 mm längre vinge än honorna. Bägge könen uppvisar en betydande ökning av vinglängden efter avslutad sommarruggningen (tabell 1 samt fig. 1 och 2). Vinglängden har då ökat i genomsnitt med 4,9 mm (8,5%) för hanarna och 4,1 mm (7,3%) för honorna. Detta stämmer väl med kända individer som ringmärkts som juvenila (ålder 1Y) och kontrollerats i höstdräkt (ålder 1Y+) efter genomförd sommarruggning (fig. 3). Ökningen av medelvinglängden för hanar är 4,8 mm och för honor 4,3 mm. Hanarna har 4,1 mm längre stjärt än honorna före sommarruggningen och 6,1 mm längre efter (tabell 1). I likhet med vinglängden ökade stjärtlängden signifikant för bägge könen i samband med sommarruggningen. Hanarnas stjärtlängd var i genomsnitt 11,5 mm (16,2%) längre. Honornas stjärtlängd var i genomsnitt 9,5 mm (14,2%) längre (tabell 1, fig. 4 och fig. 5). Ökningen stämmer väl när man jämför med kända individer vilka ringmärkts som juvenila (ålder 1Y) och kontrollerats i höstdräkt (ålder 1Y+). Medelökningen av stjärtlängden för denna grupp av hanar är 12,8 mm och för honorna 10,7 mm (fig. 6).

Vikten på en fjäder beror dels på hur lång den är, dels på hur mycket fjädermassa den har per längdenhet. En ANCOVA med vikten som den beroende variabeln visar att det finns en signifikant effekt av såväl ålder som av längd. De juvenila fåglarnas (ålder 1Y) fjädrar vägde i genomsnitt (+/-SE) 3,32 mg +/- 0,07 (n=11) medan motsvarande värde för individer i höstdräkt (ålder 1Y+) är (4,10 mg +/- 0,05 (n=18). Dessa medelvärden är justerade för längdens effekt på vikten (fig. 7).

Tillväxttakten var något högre hos de juvenila pennorna än för pennorna som anlades under sommarruggningen. Medeltillväxten hos juvenila var 1,41 mm per dygn och under övergången till höstdräkten 1,28 mm per dygn. Skillnaden var dock inte signifikant. Utifrån vingformeln har jag räknat ut ett vingspetsighetsindex och utifrån vingarean sidoförhållandet. Båda ökar i medeltal från den juvenila fjäderdräkten till höstdräkten, även om spridningen är stor.

Vingspetsighetsindex hos juveniler är i medeltal 11,64 och hos fåglar i höstdräkt är indexet i medeltal 15,99. Sidoförhållandet hos juveniler är 3,68 (SD=0,22, n=54) och i höstdräkten är den 3,82 (SD=0,16 n=62). Ökningen är i båda fallen signifikant. För tre hanar vilka ringmärktes som juvenila och kontrollerades efter genomförd ruggning togs den fullständiga vingformeln vid båda tillfällena. I två av fallen fanns även data på vingarea. Alla individerna ökade både vingspetsighetsindex och sidoförhållandet.

Diskussion

Materialet visar att enskilda skäggesindivider erhåller en större vinglängd efter sin kompletta ruggning under sin första sommar. Detta framgår tydligt både av det totala materialet och av kontrollerna (fig. 1, fig. 2 och fig. 3). Detta utesluter att selektionen skulle missgynna kortvingade individer och att detta skulle förklara den längre vingen hos adulta fåglar. Det kan finnas tre orsaker till att juvenila fåglar har en reellt kortare vinglängd än adulta. För det första kan orsaken till den kortare vinglängden hos de unga fåglarna vara att de enskilda juvenila skäggesindivider tvingas till en kortare vinglängd än de adulta genom näringsmässiga begränsningar under tiden i boet och strax därefter (Slagsvold 1983). Då är det rimligt att anta att näringsförutsättningarna för olika individer varierat. Om olika ungfåglar har haft olika förutsättningar torde ungfåglarna uppvisa en större spridning i vinglängd än de adulta. Detta var dock inte fallet. Materialet visar istället att ungfåglar (ålder 1Y) och fåglar i höstdräkt (ålder 1Y+) uppvisar två väl avgränsade grupper av vinglängder, utan någon större spridning för någon av grupperna. Kontrollmaterialet visar vidare att såväl kortvingade som långvingade individer har en ungefär lika stor

ökning av vinglängden (fig. 3). Om ökningen av vinglängden var direkt orsakad av näringsmässiga begränsningar i form av svält torde också en regressionslinje i kontrollmaterialet (fig. 3) visa en avvikelse från 1/1 vilket inte är fallet, eftersom storväxta respektive småväxta individer sannolikt är mer utsatta för svält. Detta utesluter näringsmässiga begränsningar som en proximal förklaring till den generellt kortare vingen hos ungfåglar jämfört med adulta. En andra orsak kan vara att den kortare vinglängden hos unga fåglar är en evolutionär anpassning där individen använder den befintliga energin till att skynda på sin generella tillväxt och underprioriterar penntillväxten. Därigenom kan den minimera tiden som bounges respektive tiden till den blir fullbildad (Nilsson 1992). Den låga spridningen i vinglängd hos de olika åldersgrupperna (fig. 1 och fig. 2) och den likartade ökningen av vinglängden hos kortvingade och långvingade individer i kontrollmaterialet (fig. 3) stöder detta. Vidare tyder den sämre fjäderkvaliteten, de kortare fjädrarna (fig. 7) och den lika höga eller högre tillväxttakten för de juvenila fjädrarna jämfört med de adulta på att det är viktigt för ungfågeln att minimera energi- och tidsåtgången för att bli fullbildad. Slutligen kan anledningen till den kortare vingen hos unga fåglar jämfört med fåglar i höstdräkt vara en anpassning till olika vinglängdsoptima (Alatalo et al 1984), dvs unga fåglar har en kort rund vinge vilket ökar manövrerbarheten och fåglar i höstdräkt har en spetsigare och längre vinge som underlättar flygning över längre distanser. Såväl vingspetsighetsindex som sidoförhållande ökar efter genomförd sommar-ruggning. Detta tyder på att de två grupperna av vinglängder också är en anpassning till olika vinglängdsoptima.

Meddelande nr 77 från Kvismare fågelstation.