

## MORPHOMETRICAL COMPARISON BETWEEN ESTONIAN AND NORWEGIAN GREAT SNIPES (*Gallinago media*)

John Atle KÅLÅS<sup>a</sup>, Andres KURESOO<sup>b</sup>, Leho LUIGUJÕE<sup>b</sup>, and  
Sten Levin SVARTAAS<sup>a</sup>

<sup>a</sup> Norwegian Institute for Nature Research, Tungasletta 2, N-7005 Trondheim, Norway; e-mail: john.atle.kalas@nina.nina.no

<sup>b</sup> Institute of Zoology and Botany, Riia 181, EE-2400 Tartu, Estonia; e-mail: akuresoo@zbi.ee

Received 26 February 1997, revised 29 April 1997, accepted 3 June 1997

**Abstract.** To increase our insight into the present level of morphological differences between two geographically well separated great snipe populations we here compare morphometry (bill, total head, tarsus, wing, body mass) and plumage (white on tail) of great snipes breeding in Estonia to a published analogous sample from Norway. Great snipes breeding in Estonia differ significantly from snipes breeding in central Norway both regarding the included morphological measurements and plumage character. When comparing Estonian and Norwegian birds both sexes show the same direction of divergence for all the measured variables. However, all traits did not diverge in the same direction: Estonian snipes had shorter bill and total head opposed to longer tarsus and more white on their tail compared to Norwegian birds. We shortly discuss possible processes involved in making these two populations morphologically different (bill: likely natural selection as the environmental conditions differ in the two areas; tail coloration: possibly also sexual selection as this is an important character during mate choice; but stochastic processes and phenotypic plasticity may also be of importance).

**Key words:** *Gallinago media*, Estonia, Norway, morphometry, body mass, plumage.

### INTRODUCTION

Low exchange of genes between populations may result in genetically different populations. Such differences may be expressed through variation in morphological traits. The differences may be brought about by selection (both natural and sexual) and, for small populations, by stochastic processes (genetic drift, founder effects) (Futuyma, 1986).

The great snipe (*Gallinago media* (Lath.)) is a lekking bird species. In lekking species the males display on traditional display grounds (leks) that the females visit for the sole purpose of mating (Höglund & Alatalo, 1995). The ecology and breeding behaviour of great snipe implies a low rate of gene exchange between sub-populations. Important factors here are a naturally scattered breeding occurrence because their preference for rich breeding habitats (Kålås et al., 1997) and a high return rate to breeding sites both for males and females (Fiske et al., 1997) as well as for young birds (J. A. Kålås, unpubl.). At great snipe leks normally less than half of the males are getting copulation (Höglund & Lundberg, 1987) and the same males are reproducing in successive years (Fiske et al., 1994). In addition, population sizes differ between years up to two times comparing years with 'bottom' and 'peak' number of breeding birds (J. A. Kålås, unpubl.). These aspects also increase the probability of stochastic processes to be involved in reducing genetic variation and increasing genetic differences between sub-populations.

During the past 150 years the breeding occurrence of the great snipe has been dramatically reduced (Gromadzka et al., 1985; Panchenko, 1985; Løfaldli et al., 1989; Tomkovich, 1992; Kuresoo & Leibak, 1994). This has increased fragmentation of populations and thereby increased the potential for getting genetically different populations within this species. At present great snipes breed more uniformly in the Scandinavian mountain range (Kålås et al., 1997) and in northern parts of European Russia (Tomkovich, 1992). In a few scattered areas their breeding has been recorded in Poland (Gromadzka et al., 1985), Estonia (Kuresoo & Leibak, 1994), Belarus (Nikiforov et al., 1989), Ukraine, and central parts of European Russia (Tomkovich, 1992). In the middle of the 19th century the great snipe also was commonly breeding in Germany, Poland, Denmark, central parts of European Russia as well as in the Scandinavian lowlands.

To increase our insight into the present level of morphological differences between two geographically well separated great snipe populations we here compare morphometry of birds breeding in Estonia to an analogous sample from Norway (Höglund et al., 1990b). The sampling of data from Estonian great snipes also included blood sampling. These samples will later be used in a more comprehensive study on genetic and morphological differences among a number of different great snipe populations.

## METHODS

A total of 29 great snipes were caught with mist-nets on three different leks (approximately 18 km between the two outermost leks) in the flood plain of the Emajõgi River close to Tartu (58° 23' N, 26° 44' E, 40 m altitude) on 6–9 May 1996. Permission to catch snipes was given by the Estonian Ministry of the Environment. In addition, we measured eight great snipes at the Zoological

Museum, University of Tartu. These were all collected in the surroundings of Tartu in the period 10 May–11 June, 1949 and 1950.

The snipes were ringed and we measured the following morphometric variables: *bill length* – from tip of bill to feathering, measured to the nearest 0.1 mm with a calliper (Prater et al., 1977); *total head length* – from tip of bill to the back of the skull, measured to the nearest 0.1 mm with a calliper (Green, 1980); *tarsus length* – measured to the nearest 0.1 mm with a calliper (Prater et al., 1977); *wing length* – maximum flattened cord of the wing, measured to the nearest 1.0 mm using a ruler with a stop point (Prater et al., 1977); and *body mass* – determined to the nearest 1.0 g with a Pesola spring balance. We also included one measurement of a plumage character: *white on tail* – length of the continuous white part of the outermost tail feather from the tip to the first dark spot, measured to the nearest 0.1 mm with a calliper. During lekking the males frequently expose their tail and the amount of white on tail seems to be important in mate choice (Höglund & Lundberg, 1987; Höglund et al., 1990a; see also Fiske et al., 1994).

To be able to look at morphometric differences between two geographically well separated great snipe populations we compare our Estonian measurements to a recent analogous sample from a Norwegian great snipe population published by Höglund et al. (1990b). For both of these studies all the measurements were taken by the same person (J. A. Kålås).

Museum specimens are susceptible to shrinkage and are often difficult to measure in an identical way to live birds. This is particularly the case for bony parts like bill and tarsus (Bjordal, 1993). For the museum specimens we therefore present only data on white on tail. This measurement includes the tip of the feather which is very little susceptible to shrinkage and is easy to measure.

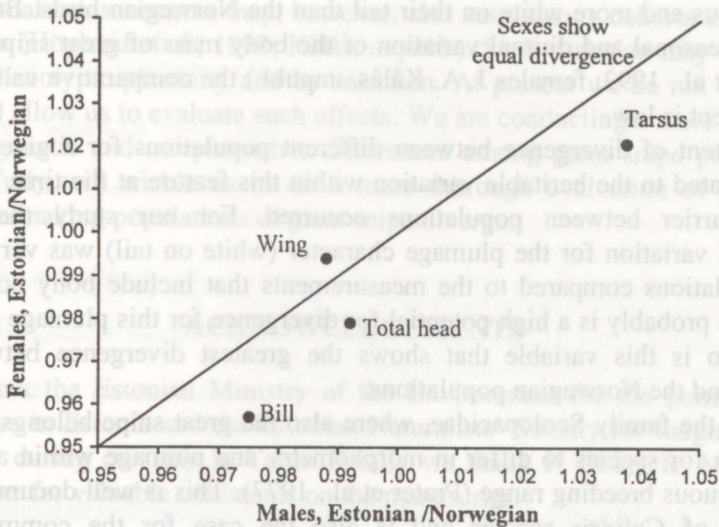
To test for differences between the two populations we used *t*-tests as described by Sokal and Rohlf (1981).

## RESULTS

Most of the morphometric measurements of the Estonian great snipe did differ significantly from the Norwegian sample for both sexes (Table). The divergence was also in the same direction for both sexes with the Estonian snipes having shorter bill, shorter total head, and longer tarsus compared to the Norwegian snipes (Fig.). For bill and total head our data indicate that the largest divergence has evolved for the females, while the males show the largest divergence for tarsus (Fig.). The males caught in Estonia had also significantly shorter wings and a lower body mass than the Norwegian males. No such significant differences were found for the females. For all these measurements the differences between these two populations were rather small and the average measurements of the Estonian birds ranged between 95.7 and 103.8% of the Norwegian birds.

Means and standard deviation (SD) for four morphological measurements, body mass, and one plumage character for great snipes breeding in Estonia. For comparison, data for Norway from Höglund et al. 1990b (\*) are included, *t*-tests were used to test for differences between the two populations

Variable	Bill, mm		Total head, mm		Tarsus, mm		Wing, mm		Body mass, g		White on tail, mm	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Males												
Estonia (n = 22)	60.5	1.79	93.3	1.88	38.7	0.90	146.8	2.86	152.8	5.59	22.9	4.46
Norway (n = 115–146)*	62.2	1.7	94.1	1.6	37.3	0.9	148.6	2.6	156.6	6.35	16.8	3.2
<i>t</i>	5.68		2.74		6.35		4.85		6.64		14.22	
<i>p</i>	<0.001		0.007		<0.001		<0.001		<0.001		<0.001	
Estonian as % of Norwegian	97.3		99.2		103.8		98.8		97.6		136.3	
Females												
Estonia (n = 7)	65.2	1.83	98.6	1.48	39.5	0.57	150.1	2.73	185.1	18.5	16.5	2.62
Norway (n = 50–70)*	68.1	1.8	100.7	1.8	38.7	0.9	151.0	2.5	183.6	14.5	14.6	2.7
<i>t</i>	5.27		3.98		2.15		1.43		0.98		2.87	
<i>p</i>	<0.001		<0.001		0.035		0.16		0.33		0.006	
Estonian as % of Norwegian	95.7		97.9		102.1		99.4		100.8		113.0	



Divergence between Estonian and Norwegian breeding great snipes for males and females expressed as the Estonian measurements (this study) divided by the Norwegian ones (Höglund et al., 1990b).

The plumage character, white on tail, showed a much higher divergence between the two populations than the morphometric measurements. Both for males and females there was a better developed white area on the tail for the Estonian population (Table). However, this was the most pronounced for the Estonian males where the average length of the white tip of the outermost tail feather was 136% of the Norwegian, compared to 113% for the females. The Estonian museum specimens sampled 45 years ago had similar white on tail (males:  $21.4 \text{ mm} \pm 4.27 \text{ (SD)}$ ,  $n=6$ ; females: 13.2 and 16.9 mm,  $n=2$ ) as our 1996 sample.

## DISCUSSION

Because of a high return rate to breeding sites both for great snipe males and females (Fiske et al., 1997) as well as for young birds (J. A. Kålås, unpubl.) the exchange of genes between the Estonian and Scandinavian populations has probably been low. The dramatic population reduction during the latest 150 years has further segregated these populations and at present we expect there to be no exchange of genes between them. Based on this we expected to find morphometric divergence between these two populations.

Our study shows that great snipes breeding in Estonia differ from snipes breeding in central Norway both in morphometry and plumage. In this study it is expressed by the Estonian snipes having shorter bill, total head and wing, and

longer tarsus and more white on their tail than the Norwegian birds. Because of the large seasonal and diurnal variation of the body mass of great snipe (males: Höglund et al., 1992; females J. A. Kålås, unpubl.) the comparative value of this measurement is low.

The extent of divergence between different populations for a given feature will be related to the heritable variation within this feature at the time when the genetic barrier between populations occurred. For our study the within-population variation for the plumage character (white on tail) was very high in both populations compared to the measurements that include bony body parts. Thus there probably is a high potential for divergence for this plumage character and it also is this variable that shows the greatest divergence between the Estonian and the Norwegian populations.

Within the family Scolopacidae, where also the great snipe belongs, it is not uncommon for species to differ in morphometry and plumage within a more or less continuous breeding range (Prater et al., 1977). This is well documented for a number of *Calidris* species and is also the case for the common snipe (*Gallinago gallinago*), which is one of the closest related species to the great snipe. For this species birds breeding in Iceland, Faeroes, Orkney, and Shetland are grouped as a sub-species *Gallinago g. faeroeensis*, while the nominate species breeds in the rest of Europe (del Hoyo et al., 1996). This indicates that genetic differences may occur between quite continuous populations even for a group of animals that have a high potential for dispersion.

The documented morphometric divergence between the Estonian and Norwegian great snipes may have been brought about by selection, and/or by stochastic processes (genetic drift, founder effects), also phenotypic plasticity may be involved. Natural selection may have been important as the two great snipe populations breed in areas with very different environmental conditions. For example, the Estonian population is breeding on flood plains at a low altitude (Kuresoo & Leibak, 1994), while the Norwegian one is breeding in open fens around the tree line at approximately 1000 m altitude (Løfaldli et al., 1992). These habitats obviously differ both in available food items, seasonal variation in availability of food, predator densities, etc. Therefore it seems reasonable to propose that the divergence in bill length is a response to different feeding conditions between these areas. As the great snipe is a lekking species, sexual selection may also be important. In Norway great snipes have a maximum display activity during the middle of the night in late May–early June (Kålås et al., 1995), while our field work during this study indicates that the snipes in Estonia have a peak display activity late in the evening and early morning in early May. Even if the Estonian snipes seem to reduce their display rate during the middle of the night it is considerably darker during most of the display period in Estonia than in Norway. The great snipe males do expose their tails frequently during displaying (Höglund & Lundberg, 1987; Fiske et al., 1994) and more white on tails in the Estonian snipes may be a consequence of sexual selection.

The actual measurements may, however, also vary among cohorts and among age classes (Höglund et al., 1992; Kålås, unpubl.). Such variation may be caused both by phenotypic plasticity and by selection. At present we do not have data that would allow us to evaluate such effects. We are conducting a more extensive study on genetic and morphometric differences among great snipe populations that hopefully will enable us to do a more thorough evaluation of processes involved in making populations of great snipe diverge.

## ACKNOWLEDGEMENTS

We thank the Estonian Ministry of the Environment for the permission to catch snipes in Estonia and the Estonian Naturalists' Society for lodging J.A.K. and S.L.S. during our stay in Tartu. Finally we thank P. Fiske, R. Mänd, and S. A. Sæther for valuable comments on the manuscript.

## REFERENCES

- Bjrdal, H. 1993. Effects of deep freezing, freeze-drying and skinning on body dimensions of House Sparrows *Passer domesticus*. *Fauna norv.* Ser. C, Cinclus, **6**, 105–108.
- Fiske, P., Kålås, J. A. & Sæther, S. A. 1994. Correlates of male mating success in the lekking great snipe (*Gallinago media*). *Behav. Ecol.*, **5**, 210–218.
- Fiske, P., Kålås, J. A. & Sæther, S. A. 1997. *Effects of Gender and Male Mating Success on Survival in a Lekking Bird*. Manuscript in the Norwegian Institute for Nature Research, Trondheim.
- Futuyma, D. J. 1986. *Evolutionary Biology*. Sinauer Associates Inc., Sunderland.
- Green, G. H. 1980. Total head length. *Wader Study Group Bull.*, **29**, 18.
- Gromadzka, J., Stawarczyk, T. & Tomialojc, L. 1985. Breeding waders in Poland. *Wader Study Group Bull.*, **43**, 29–33.
- del Hoyo, J., Elliot, A. & Sargatal, J. 1996. *Handbook of the Birds of the World*. Vol. 3. *Hoatzin to Auks*. Lynx Editions, Barcelona.
- Höglund, J. & Alatalo, R. V. 1995. *Leks*. Princeton Univ. Press.
- Höglund, J. & Lundberg, A. 1987. Sexual selection in a monomorphic lek breeding bird: Correlates of male mating success in the great snipe (*Gallinago media*). *Behav. Ecol. Sociobiol.*, **21**, 211–216.
- Höglund, J., Erikson, M. & Lindell, J. E. 1990a. Females of the lek breeding great snipe, *Gallinago media*, prefer males with white tails. *Anim. Behav.*, **40**, 23–32.
- Höglund, J., Kålås, J. A. & Løfaldli, L. 1990b. Sexual dimorphism in lekking Great Snipe. *Ornis Scand.*, **21**, 1–6.
- Höglund, J., Kålås, J. A. & Fiske, P. 1992. The cost of secondary sexual characters in lekking Great Snipe (*Gallinago media*). *Behav. Ecol. Sociobiol.*, **30**, 309–315.
- Kålås, J. A., Fiske, P. & Sæther, S. A. 1995. The effect of mating probability on risk-taking: An experimental study in lekking Great Snipe. *Am. Nat.*, **146**, 59–71.
- Kålås, J. A., Fiske, P. & Höglund, J. 1997. Food supply and breeding occurrences: The West-European population of the lekking great snipe (Aves). *J. Biogeo.* (in press).
- Kuresoo, A. & Leibak, E. 1994. Breeding status of snipes in Estonia and in the eastern Baltic region. *IWRB Publ.*, **31**, 81–84.

- Løfaldli, L., Höglund, J., Kålås, J. A. & Fiske, P. 1989. Dobbeltbekkasinens tilbakegang i Skandinavia - et historisk tilbakeblikk. *Vår Fuglefauna*, **12**, 39–43.
- Løfaldli, L., Kålås, J. A. & Fiske, P. 1992. Habitat selection and diet of Great Snipe *Gallinago media* during breeding. *Ibis*, **134**, 35–43.
- Nikiforov, M. E., Yaminski, B. V. & Shklyarov, L. P. 1989. *Ptitsy Belorussii*. Vyshéjsh. shk., Minsk (in Russian).
- Panchenko, V. G. 1985. Great Snipe. In *Migrations of Birds of Eastern Europe and Northern Asia, Gruiformes–Charadriiformes* (Vikse, J. A. and Mihelons, H. A., eds.). Acad. of Sciences of the USSR, Moscow, 235–239.
- Prater, A. J., Marchant, J. H. & Vuorinen, J. 1977. Guide to the identification and ageing of holarctic waders. *BTO Guide 17*. BTO, Tring, Herts.
- Sokal, R. R. & Rohlf, F. J. 1981. *Biometry: The Principles and Practice of Statistics in Biological Research*. W.H. Freeman and Company, New York.
- Tomkovich, P. S. 1992. Breeding-range and population changes of waders in the former Soviet Union. *Brit. Birds*, **85**, 344–365.

## EESTI JA NORRA ROHUNEPI (*Gallinago media*) ASURKONDADE MORFOMEETRIKILINE VÖRDLUS

John Atle KÅLÅS, Andres KURESOO, Leho LUIGUJÕE ja  
Sten Levin SVARTAAS

Vördlevalt on analüüsitud geograafiliselt eraldunud Eesti ja Norra rohunepe haudeasurkondade morfomeetrikilisi (noka, pea, jookse e. *tarsus*'e ja tiiva mõõtmel, linnu kehamass) ja sulestiku (sabamuster) tunnuseid.

Emajõe uhtniitudel (Tartus ja lähikonnas ca 15 km raadiuses) 1996. aasta kevadel püütud rohunepeid erinevad oluliselt Kesk-Norra mägismaal püütud lindudest nii morfomeetrikiliste näitajate kui ka sulestiku mustri poolest. Kahe rohunepe asurkonna morfomeetrikiliste tunnuste lahknemine on erisuunaline. Näiteks Eesti lindudel on lühem pea ja nokk, samas aga pikem jookse ja valgem saba. Märkimist vääril ka see, et emas- ja isaslindudel avaldub tunnuste lahknemine vaid ühes suunas: Eesti linnud on kõnealusel võrdlusel sõltumata soost lühinokalised, pikajalgised ja valgeseabised.

On arutletud morfomeetrikiliste erinevuste võimalike tekkemehhanismide üle. Noka puhul seletab lahknevuse teket kõige paremini looduslik valik reaktsioonina oluliselt erinevatele elupaigatingimustele jõgede uhtniitudel (Eesti) ja mägi-karjamaadel (Norra). Saba värvimustri suure erinevuse (Eesti valimis on sabad tunduvalt valgemad) on oletatavasti tingitud suguline valik, kuna sabamuster on üks tähtsamaid tunnuseid, mille järgi liigile väga spetsiifilistel turniiridel emaslinnud partnereid valivad. Samas pole välistatud, et sabamustri erinevus kahel asurkonnal on lihtsalt stohhastilise protsessi tagajärg või peegeldab see liigi fenotüübilist plastilisust.

Autoritel on esitatud oletuste kontrollimiseks plaanis laiendada uuringute geograafilist haaret ning kasutada edaspidi võrdleval analüüsil lisaks rohunepe morfomeetrikiliste tunnustele ka geneetiliselt parameetreid.