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Repeatability of Measurements and Shrinkage after Skinning: the Case of the Great Grey Shrike *Lanius excubitor*

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Abstract. In studies on avian systematics and ecology, data from birds in museum collections are often used. Therefore, it is very important to test how representative such material is. However, museum specimens are usually handled, preserved and kept in different ways, which complicates the comparative use of measurements taken. Birds can be frozen, freeze-dried and skinned in the traditional way. The last way is most widely used in museum collections and the measurements of skins are widely used in handbooks. However, different specialists take measurements, e.g. taxonomists, parasitologists, ecologists, etc. We simulated this situation in practice and compared the measurements of five persons working on the same material – fifty skins of the Great Grey Shrike *Lanius excubitor*. Because the material (bird skins) was also measured at a fresh stage, we estimated the shrinkage ratio of skins under museum conditions, as well.

Among the four measurements taken (maximum wing chord, tarsus, bill and tail length), the most repeatable was maximum wing chord, and the least repeatable bill length. We also found that after skinning all measurements decreased by 2-5 %.

Key words: avian collections, *Lanius excubitor*, repeatability of measurements, shrinkage, Slovakia

1. INTRODUCTION

The data of birds in museum collections are often of high importance for studies on avian systematics and ecology. All important studies on morphometry of birds have predominantly used data from museum skins of the large museums (e.g. Cramp & Simmons 1993). Therefore, it is useful to test how representative such material is. However, museum specimens are often handled, preserved and kept in different ways, which complicates the comparative use of measurements taken (Knox 1980, Vepsäläinen 1968, Bjordal 1983). Birds can be frozen, freeze-dried and skinned in the traditional way. The last method is the most widely used in museum collections and many biometrical characteristics are based on skins (e.g. Bjordal 1983; Engelmoer & Roselaar 1998; Dougall 1998). However, it is well-known that differences occur between particular researchers, even when biometric methods were strictly defined (Svensson 1992; Harper 1994; Engelmoer & Roselaar 1998; Gosler et al. 1998). Proposals for the improvement of the researcher-dependent variation were made (Busse 1983; Gosler et al. 1998). And it is also important to mention the discussions on observer-dependent differences that were focussed on studies of living birds in field studies (Harper 1994; Engelmoer & Roselaar 1998; Gosler et al. 1998). Many authors suggested that due to more standardised conditions, measurements taken from museum skins should have better comparability than those taken in the field (e.g. Engelmoer & Roselaar 1998). The only serious problem in this context is the skin shrinkage when dry museum skins are used (Vepsäläinen 1968; Knox 1980; Bjordal 1983).

In the current paper, individual differences in measurements of Great Grey Shrikes *Lanius excubitor* are shown. This shrike species has a large geographical range and a lot of taxonomical problems exist (Eck 1990, 1994; Panov 1995; Lefranc & Worfolk 1997; Schön 1998). We have tested five commonly used metric traits in bird studies and checked the repeatability of the measurements between observers and, because this material was also measured at a fresh stage, also performed a test of skin shrinkage under museum conditions.

2. MATERIAL AND METHODS

Great Grey Shrikes were collected in North-Eastern Slovakia (49°3' N – 49°27' N; 20°30' E – 21°47' E) at the boundary between Eastern and Western Carpathians between 1957 and 1983. The birds were collected throughout the entire year. Specimens were prepared by means of traditional techniques for making study skins. Arsenic was used for the preservation of the skin. Skilled taxidermists prepared skins in fresh stage, mostly on the day of collection, frequently directly during the field expeditions. The birds are skinned in the classical museum bird skin position.

The important feature of the dataset is that the same person, not being aware of a future use of his data, measured all birds. All measurements were taken on freshly obtained birds. Specimens were weighed in accuracy to 0.05g. Lengths of both wings, body and tail were measured to 0.5

mm, bill length to 0.05mm. The collector measured the tarsus as the distance between the sole side of opened foot, abutted on calipers at right angle and measured to the proximal point of tarsometatarsus (compare with Svensson 1992) with an accuracy of 0.05mm.

We randomly chose 50 specimens of great grey shrikes in our collection and took the same measurements in the same way as the collector, with the exception of the tarsus length. It was not possible to take this measurement in the same way, because the feet of the skins could not be opened; therefore we followed the instructions of Svensson (1992). Since we were only interested in changes in the measurements, sex and age classes were pooled, although some characters show sexual dimorphism at a certain level (authors' data, unpubl.). Small differences occurred between measurements in the sample due to skin damage or other deformations.

One-way analysis of variance (ANOVA) was carried out in order to obtain variance components. The repeatability was calculated as intra-class correlation coefficients (Sokal & Rohlf 1995) with standard error for repeatability values as described in Becker (1992).

3. RESULTS

Depending on the measurement, a distinct portion of data variance is due to differences between observers (Table 1, Fig. 1). The most reliable measurements are wing and tail length. The bill length, instead of being the most precise measurement, is virtually unreproducible.

Table 1: Repeatability estimates of skin measurements, *Lanius excubitor*, N = 50

Measurement	F [cm]	p	R	LCI	UCI
Wing length	19.89	0.0000	0.7907	0.7072	0.8619
Tarsus length	5.74	0.0000	0.4869	0.3485	0.6334
Bill length	1.69	0.0085	0.1211	0.0188	0.2627
Tail length	18.94	0.0000	0.7821	0.6961	0.8557

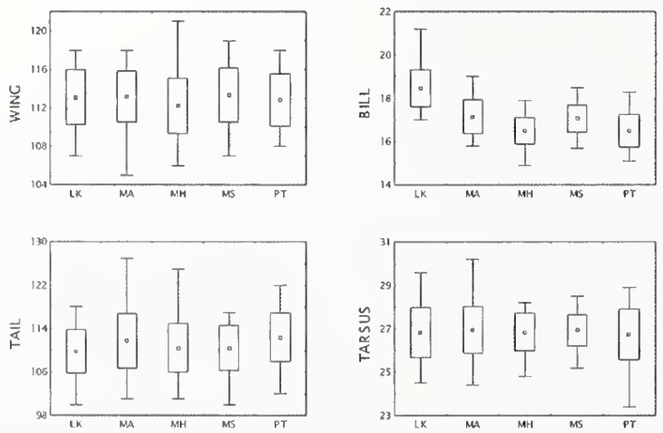

Fig. 1: Differences in the skin measurements depending on the observer. Boxes represent standard deviations and bars represent the range of data.

The mean shrinkage rate differed among observers for all measurements, excluding tarsus length (one-way ANOVA, Table 2). When pooled, the mean shrinkage rate can achieve the level of 5 % (Fig. 2).

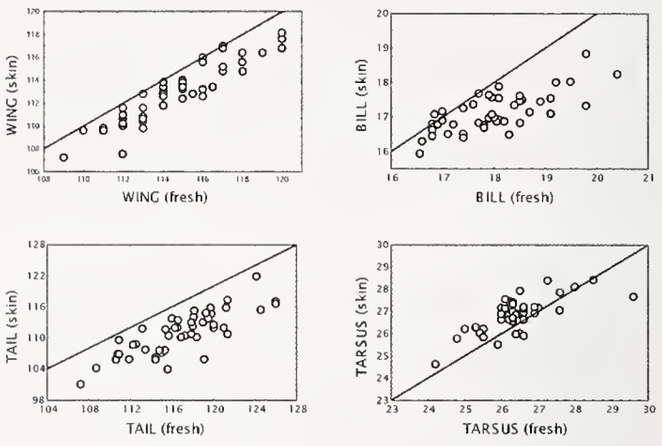

Fig. 2: Measurements of freshly collected birds (x axes) plotted against corresponding values obtained on skins (y axes). The solid line shows the theoretical situation of no shrinkage (the function y=x).

4. DISCUSSION

We have found that a considerable proportion of the variance in the skin measurements can be attributed to an observer effect.

Similarly, Szulc (1964) studied three small passerines (Siskin *Carduelis spinus*, Robin *Erithacus rubecula*, and Blue Tit *Parus caeruleus*) and she noted a great inter-observer variation in the measurements. Among these, the bone measurements (beak and tarsus) were more variable than the feather measurements (wing and tail length).

Interesting is the fact that the bill length measurement performed by different observers has very low consistency, despite all members of the group being skilled field ornithologists and experienced in taking measurements. This can be caused by the fact that this particular measurement has no strictly defined marginal points, so that each observer can understand it in his own way.

To avoid differences between observers, we suggest that the data in geographical and/or environmental studies should be taken by one person or a specifically instructed team (see also Busse 1983; Gosler et al. 1998). However, this is often impossible in practice. Therefore, we suggest putting researcher as a first potential source of measurement variation in data analyses.

Measurement	n	Mean	LCI	UCI	Min	Max	F	p
Wing length	245	-1.5	-1.67	-1.33	-2.14	-1.15	4.45	0.0017
Bill length	225	-4.67	-5.44	-3.91	-8.28	2.72	50.43	0.0000
Tail length	240	-5.06	-5.4	-4.72	-6.03	-3.8	6.36	0.0001
Tarsus length	210	1.77	1.3	2.25	1.22	2.16	0.47	0.7566

Table 2: Shrinkage rate for different measurements. Confidence intervals (95 %) around means are given (LCI, UCI); the range of means is calculated for each observer separately (Min, Max); F statistics and its significance for the null hypothesis, that there is no difference in shrinkage rate between observers.

Research performed in museum collections is very attractive because material is easily available. But many problems may arise. For example, SLAGSVOLD & SKIPNES (1982) analysed corvids in Norwegian museums and found that 85 % of all birds were sexed, but data on body weight existed only for 36 % of the specimens. Sometimes, museum specimens were sexed wrongly, and birds with different kinds of abnormalities seemed to be over-represented in the museum collections (e.g. albinos).

One of the most discussed problems is skin shrinkage after preparation. In our study of great grey shrikes we observed a mean shrinkage of ca. 5 %, depending on measurement. This value is rather high in comparison with values in other studies on waders and passerines (1 – 4 %, cf. VEPSÄLÄINEN 1968; KNOX 1980; BJORDAL 1983). However, the data of these authors were obtained from relatively small sample sizes and in short time after preparation. The time between bird collection with first measurements and the second measurement for the evaluation of shrinkage was as long as 16-42 years, what is fairly more than in other studies. Since we do not know the correlation between shrinkage and time and we do not know whether different taxa show the same shrinkage, there is another serious problem when we use skins from museum collections.

We suggest the following recommendations for the improvement of measurements obtained from skin material:

- It is recommended to exactly define the method of measurement taking.
- Within one study, measurements should be taken by one person.
- Skin age should be included into the analysis as a covariant to avoid biases due to shrinkage.

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LITERATURE

BECKER, W. A. (1992): Manual of Quantitative Genetics. Academic Enterprises, Pullman, Washington, 192 pp.

BJORDAL, H. (1983): Effects of deep freezing, freeze-drying and skinning on body dimensions of House Sparrows *Passer domesticus*. Fauna norv. Ser. C. Cinclus **6**: 105-108.

BUB, H. (1981): Kennzeichen und Mauser europäischer Singvögel, 2. Teil Stelzen, Pieper und Würger (Motacillidae und Laniidae). Ziemsen Verlag, Wittenberg Lutherstadt.

BUSSE, P. (1983): Biometrical standards in the Operation Baltic. Ring **116**: 125-138.

CRAMP, S. & PERRINS, C. M. (eds.) (1993): The Birds of the Western Palearctic. Vol. 7. Oxford University Press, Oxford.

ENGELMOER, M. & ROSELAAR, C. S. (1998): Geographical variations in waders. Kluwer Academic Publishers, Dordrecht.

EVANS, P. R. (1964): Wader measurements and wader migration. Bird Study **11**: 23-38.

GOSLER, A. G., GREENWOOD, J. J. D., BAKER, J. K. & DAVIDSON, N. C. (1998): The field determination of body size and condition in passerines: a report to the British Ringing Committee. Bird Study **45**: 92-103.

HAFTORN, S. (1982): Variation in body measurements of the Willow Tit *Parus montanus,* together with a method for sexing live birds and data on the degree of shrinkage in size after skinning. Fauna norv. Ser. C. Cinclus **5**: 16-26.

HELM, B. & ALBRECHT, H. (2000): Human handedness causes directional asymmetry in avian wing length measurements. Anim. Behav. **60**: 899-902.

HOGSTAD, O. (1983): Wing length variation and movement pattern of the Three-toed Woodpecker *Picoides tridactylus* in Fennoscandia. Fauna norv. Ser. C. Cinclus **6**: 81-86.

KNOX, A. (1980): Post-mortem changes in wing lengths and wing formulae. Ring. Migr. **3**: 29-31.

LEFRANC, N. & WORFOLK, T. (1997): Shrikes. A guide to the Shrikes of the World. Pica Press, Sussex.

PANOV, E. N. (1995): Superspecies of shrikes in the former USSR. Proc. West. Found. Vert. Zool. **6**: 26-33.

SCHÖN, M. (1998): Zur Evolution der parapatrischen nördlichen und südlichen Raubwürger, *Lanius [excubitor]*, in der Gruppe der Großen Grauwürger (Aves: Passeriformes: Laniidae). Von morphologischen Unterscheidungen über funktionale Betrachtung auf ökologische Unterschiede schließen – und umgekehrt? Zool. Abhandl. Staat. Mus. Tierkd. Dres. **50** Suppl.: 145-153.

SLAGSVOLD, T. & SKIPNES, K. (1982): How representative of bird populations are specimens in museum collections: data on Norwegian Corvids. Fauna norv. Ser. C. Cinclus **5**: 27-35.

Sokal, R. R. & Rohlf, F. J. (1995): Biometry. Freeman, New York, 887 pp.

Szulc, B. (1964): A tentative assessment of certain morphological measurements used in ornithology. Ekol. Pol. B, 10: 19-25.

Vepsäläinen, K. (1968): Wing length of Lapwing *(Vanellus vanellus)* before and after skinning, with remarks on measuring methods. Ornis Fennica **45**: 124-126.

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