Sexual dimorphism in the bill size in owls: a comparison of external and osteological characters

Pohlavní dimorfizmus ve velikosti zobáku u sov: srovnání vnějších a osteologických znaků

MLÍKOVSKÝ J.

Dipl.-Biol. Jiří Mlíkovský, CSc., Vršovická 11, CZ-101 00 Praha 10, Czech Republic; e-mail mlikovsky@sendme.cz.

ABSTRACT. Bill length and height were studied in four species of Central European owls. Sexual size dimorphism was not detected in any of the four species when bony jaws were measured, but *Tyto alba* and *Strix aluco* females had both longer and higher bills than conspecific males when the dimensions were measured externally. This indicates that the differences were caused solely by the extent of the rhamphotheca.

INTRODUCTION

Sexes of many owl species differ in size (EAHART & JOHNSON 1970, SNYDER & WILEY 1976, ANDERSSON & NORBERG 1981, MCGILLIVRAY 1987). MLÍKOVSKÝ & PIECHOCKI (1983) observed, that the degree of sexual size dimorphism can differ for different parts of the body (see also PIECHOCKI 1984). Bill size (expressed as length and height) was found to be sexually size dimorphic in some species, while other species were monomorphic in this respect (MLÍKOVSKÝ & PIECHOCKI 1983, PIECHOCKI 1984). In this paper, I study the contribution of rhamphoteca to the variation in bill shape between sexes.

MATERIAL AND METHODS

External characters were measured in the Institute of Zoology of the Martin Luther University in Halle/Saale, Germany, in 1950-1978 by the University staff. External bill length (EL) was measured from forehead feathers to its tip. External bill height (EH) was measured in the front of forehead feathers. See MLÍKOVSKÝ & PIECHOCKI (1983) for details.

Osteological characters were measured in the zoological institutes in München, Bonn and Kiel, Germany, by LANGER (1980). They will be referred to as *internal* throughout the present paper. Internal bill length (IL) was measured from the caudal end of processus frontales of the premaxillare to apex premaxillaris. Internal bill height (IH) was measured on the same place as external bill height, but was limited to the upper jaw.

In all cases, only adult individuals/specimens were measured. All measured birds probably originated from Germany. Standard statistical methods were used; differences between means were tested by the two-tailed t-test (e.g. SACHS 1974), because morphological characters are under conditions fulfilled in this paper generally known to be normally distributed (e.g. ROHLF 1990, WARHEIT 1992).

RESULTS AND DISCUSSION

Avian bill is formed from upper and lower bony jaws, which are covered by horny rhamphotheca (see LUCAS & STETTENHEIM 1972). Unlike bones, rhamphotheca is more or less continuously both growing and being abraded (see LÜDICKE 1933). Fully ossified bones remain unchanged throughout the life of a bird, while the size and shape of rhamphotheca can vary even seasonally.

A comparison of the data on the bill length and height, as measured on the basis of bones (LANGER 1980), and external characters, i.e. bones *plus* rhamphotheca (MLÍKOVSKÝ & PIECHOCKI 1983), showed that the sexes do not differ in internal dimensions of bills in the four species (see Tab. 1). On the other hand, bills of females were found to be both longer and higher than those of males in two of the species – *Tyto alba* and *Strix aluco* –, when measured externally. This indicates that observed differences between the sexes were caused exclusively by the extent of rhamphotheca, not by dimensions of bony jaws.

Table 1 - Sexual size dimorphism in bills of selected European owls. The data were derived from published sources (LANGER 1980, MLÍKOVSKÝ & PIECHOCKI 1983). The latter papers include detailed statistical description studied samples. See „Material and methods" for the definition of individual dimensions.

Tab. 1 - Pohlavní rozdíly ve velikosti zobáku u vybraných druhů evropských sov. Údaje jsou čerpané z publikovaných prací (LANGER 1980, MLÍKOVSKÝ & PIECHOCKI 1983), kde jsou uvedené i detailní statistické charakteristiky daných souborů. Jednotlivé rozměry jsou definované v sekci „Material and methods".

Dimension	Male			Female			F/M ratio	t-test
	Mean	SD	n	Mean	SD	n		
Tyto alba								
EL	18.9	0.90	94	19.4	0.96	126	1.03	0.0003
EH	12.0	0.48	98	12.3	0.62	101	1.03	0.0002
IL	29.8	0.48	11	30.2	1.45	13	1.01	0.415
IH	39.8	1.01	11	39.1	1.22	13	0.98	0.164
Strix aluco								
EL	19.7	1.32	20	21.3	1.94	33	1.08	0.0026
EH	14.8	1.42	21	15.8	0.97	41	1.07	0.0022
IL	29.1	0.84	7	27.8	1.70	5	0.96	0.142
IH	45.3	1.48	7	45.3	0.54	5	1.00	1.000
Asio otus								
EL	16.9	1.75	23	17.0	1.43	50	1.01	0.800
EH	13.0	1.67	56	13.0	1.67	56	1.00	1.000
IL	25.0	0.89	15	26.1	0.94	20	1.04	0.0019
IH	37.6	1.06	15	37.7	0.66	20	1.00	0.741
Asio flammeus								
EL	15.8	1.44	6	17.7	1.86	4	1.12	0.0922
EH	13.3	0.96	6	14.1	0.85	4	1.06	0.518
IL	26.3	0.82	16	26.8	0.92	9	1.02	0.196
IH	38.4	1.32	16	39.4	0.95	9	1.03	0.078

For a long time, the size and shape of rhamphotheca has been known to vary seasonally (e.g. CLANCEY 1948, DAVIS 1954), and with the age of birds (e.g. HANTGE & SCHMIDT-KOENIG 1958, BUB & NOLL 1985). None of these types of variation has been studied in owls thus far, but the present study showed that the size of rhamphotheca can be sex-dependent in some owl species. It remains to be studied, whether the differences are caused by some heritable factor(s), or whether they are the result of different bill usage.

SOUHRN

U řady druhů sov se samci od samic liší velikostí. Míra pohlavního dimorfizmu může být přitom u různých částí těla různá (MLÍKOVSKÝ & PIECHOCKI 1983, Piechocki 1984). V této práci je studována příčina pohlavního dimorfizmu ve velikosti zobáku u vybraných druhů středoevropských sov. Srovnávány byly délka a výška zobáku podle vnějších rozměrů (MLÍKOVSKÝ & PIECHOCKI 1983) a podle rozměrů na lebce (LANGER 1980). Ukázalo se, že kostěný zobák je u všech studovaných druhů monomorfní, zatímco u sovy pálené a puštíka obecného se ve vnějších rozměrech zobáky samců a samic liší (viz tab. 1). Z tohoto srovnání plyne, že zjištěné rozdíly jsou způsobené výhradně rozsahem ramfotéky, která kostěný základ zobáku potahuje.

Ramfotéka na rozdíl od kostí téměř stále roste a také se obrušuje. Již delší dobu je také známo, že se její rozsah může měnit s roční dobou (např. CLANCEY 1948, DAVIS 1954) i s věkem ptáka (např. HANTGE & SCHMIDT-KOENIG 1958, BUB & NOLL 1985). V této práci bylo prokázáno, že rozsah ramfotéky může být specifický i pro pohlaví. Není však známo, jestli za zjištěnými rozdíly stojí dědičné faktory nebo jestli u sov samci a samice používají zobák natolik různým způsobem, že se různé používání odrazí v různém obrusu a tedy rozsahu ramfotéky. Podrobnější výzkum ramfotéky sov může být perspektivní i z hlediska možné identifikace stáří a pohlaví sov.

REFERENCES

ANDERSSON, M. & NORBERG, R. Å. 1981: Evolution of reversed size dimorphism and role of partitioning among predatory birds, with a scaling of flight performance. - *Biological Journal of the Linnean Society, 15: 105-130.*

BUB, H. & NOLL, W. 1985: Kann die Schnabelform ein Altersmerkmal sein? - *In: BUB, H. (ed.): Kennzeichen und Mauser europäischer Singvögel. Allgemeiner Teil: 140-146. Wittenberg Lutherstadt: A. Ziemsen Verlag. Neue Brehm-Bücherei, 570.*

CLANCEY, P.A. 1948: Seasonal bill variation in Tree-Sparrow. - *British Birds, 41: 115-116.*

DAVIS, J. 1954: Seasonal variation in bill length of certain passerine birds. – *Condor, 56: 142-149.*

EAHART, C. M. & JOHNSON, N. K. 1970: Size dimorphism and food habits of North American owls. - *Condor, 72: 251-264.*

HANTGE, E. & SCHMIDT-KOENIG, K. 1958: Vom Herbstzug des Steinschmetzers (Oe. oenanthe) auf Wangerooge und Langeoog. - *Journal für Ornithologie, 99: 142-159.*

LANGER, G. 1980: Vergleichend morphologische Untersuchungen an Einzelknochen in Mitteleuropa vorkommender mittelgrosser Eulenarten. - *Unpub. Diss., Ludwig-Maximilians-Universität, München, 211 pp.*

LUCAS, A.M. & STETTENHEIM, P.R. 1972: Avian anatomy: integument. - *Agriculture Handbook 362. Washington, D.C.: USDA.*

LÜDICKE, M. 1933: Wachstum und Abnutzung des Vogelschnabels. - *Zoologische Jahrbücher, 57: 465-534.*

McGILLIVRAY, W.B. 1987: Reversed size dimorphism in 10 species of northern owls. - *In: NERO, R.W., CLARK, R.J., KNAPTON, R.J. & HAMRE, R.H. (Eds.): Biology and conservation of northern forest owls: 59-66. Fort Collins: USDA Forest Service.*

MLÍKOVSKÝ, J. & PIECHOCKI, R. 1983: Biometrische Untersuchungen zum Geschlechtsdimorphismus einiger mitteleuropäischer Eulen. - *Beiträge zur Vogelkunde, 29: 1-11.*

PIECHOCKI, R. 1984: Todesursachen, Gewichte und Maße vom Uhu (Bubo b. bubo). - *Hercynia (N. F.), 21: 52-66.*

ROHLF, F. J. 1990: Morphometrics. - *Annual Review of Ecology and Systematics, 21: 299-316.*

SACHS L. 1974: Angewandte Statistik. - *Berlin: Springer-Verlag, 548 pp.*

SNYDER, N.F.R. & WILEY, J.W. 1976: Sexual size dimorphism in hawks and owls of North America. - *Ornithological Monographs, 20: 1-96.*

WARHEIT, K. I. 1992: The role of morphometrics and cladistics in the taxonomy of fossils: a paleornithological example. - *Systematic Biology, 41: 345-369.*

(Received 31.1. 2001, accepted 17.7. 2001)