

Patterns of Sexual Size Dimorphism in Various Chicken Breeds

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„The relative sexual size dimorphism of larger species is normally larger than the sexual size dimorphism of smaller species“

Hypothesis:

Correlated answer of the smaller sex on selection for body size in the larger sex

Fairbairn (1997)

Introduction

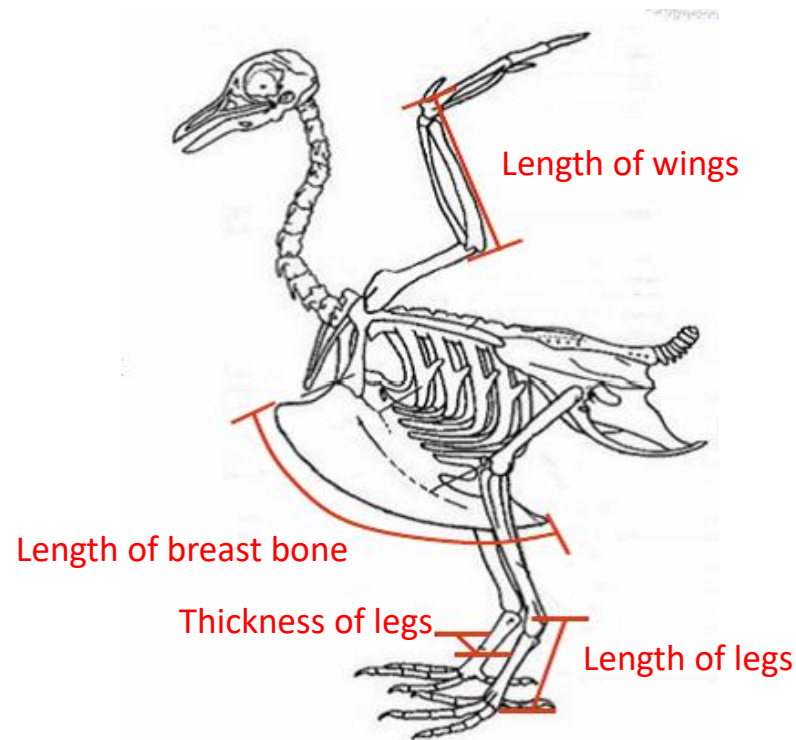


- For a long time only interest in species underlying natural selection
- Domesticated sheep and goats with smaller sexual size dimorphism than their wild relatives, Rensch's Rule only in wild animals significant (Polák & Frynta 2009)
- No apparent differences between wild and domesticated cattle (Polák & Frynta 2010)
- Rensch's Rule confirmed for wild pheasants but not for domesticated chicken (Remeš & Székely 2010)
- Goal of the study:
Analysis of patterns of sexual size dimorphism of different body measurements in domesticated chicken

Material and Methods- Animals



- 68 livestock and ornamental breeds \geq 15 adult animals
- 1387 animals
- Body measurements
- Removal of outliers



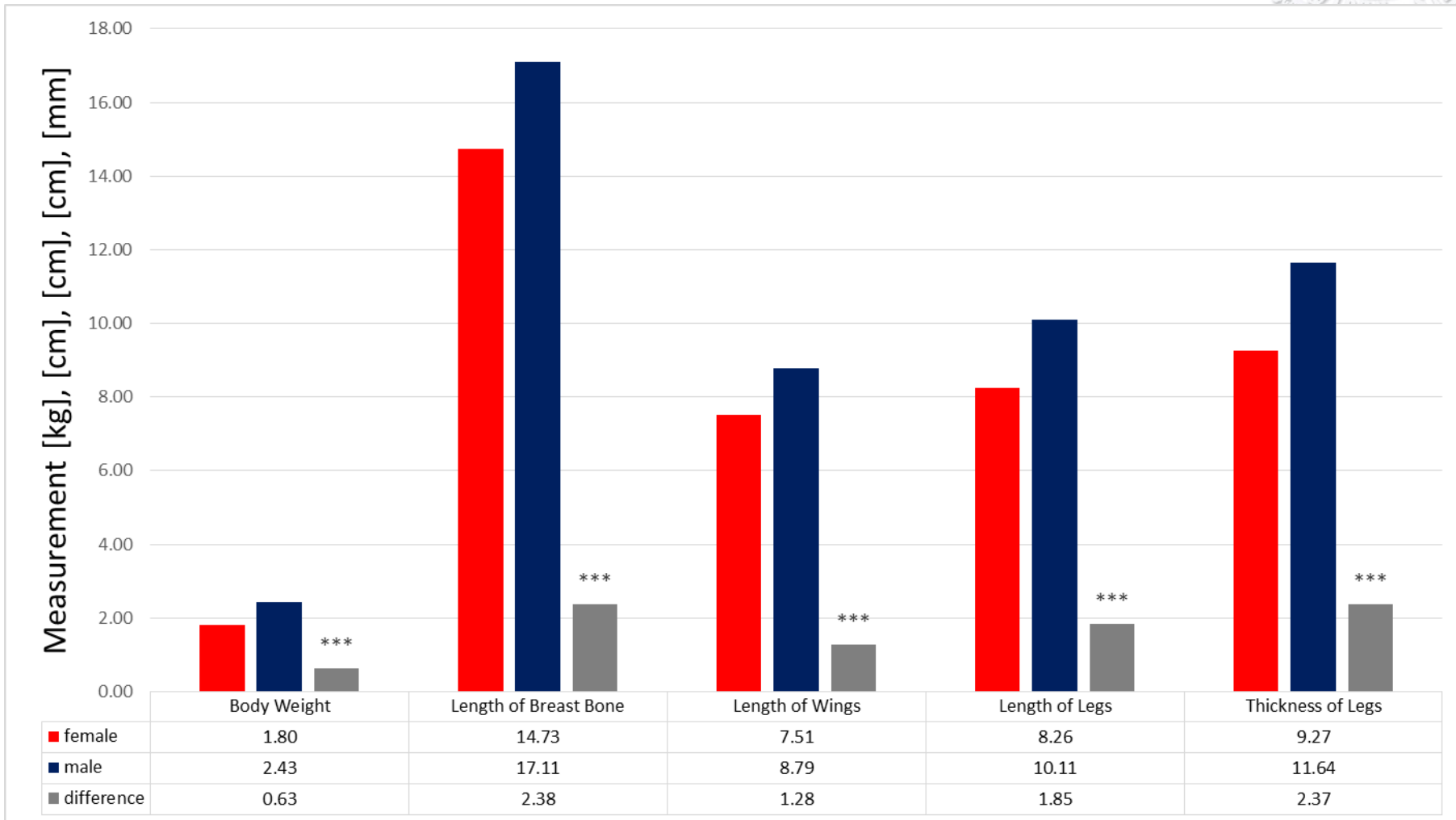
Source: Weigend et al. (2014)

Material and Methods - Animals



Region	Group of Breeds	Abbreviation	Number of Breeds
Asia	Asian type breeds	AT	14
	Bantam breeds	AB	7
	Crested breeds	AC	2
	Game type and related breeds	GT	5
	Long tailed breeds	LT	3
Europe	Bantam breeds	EB	8
	Crested breeds	EC	3
	Intermediate type breeds	IT	5
	Northwest-European breeds	NW	15
	Mediterranean type breeds	MT	6

Absolute Sexual Size Dimorphism

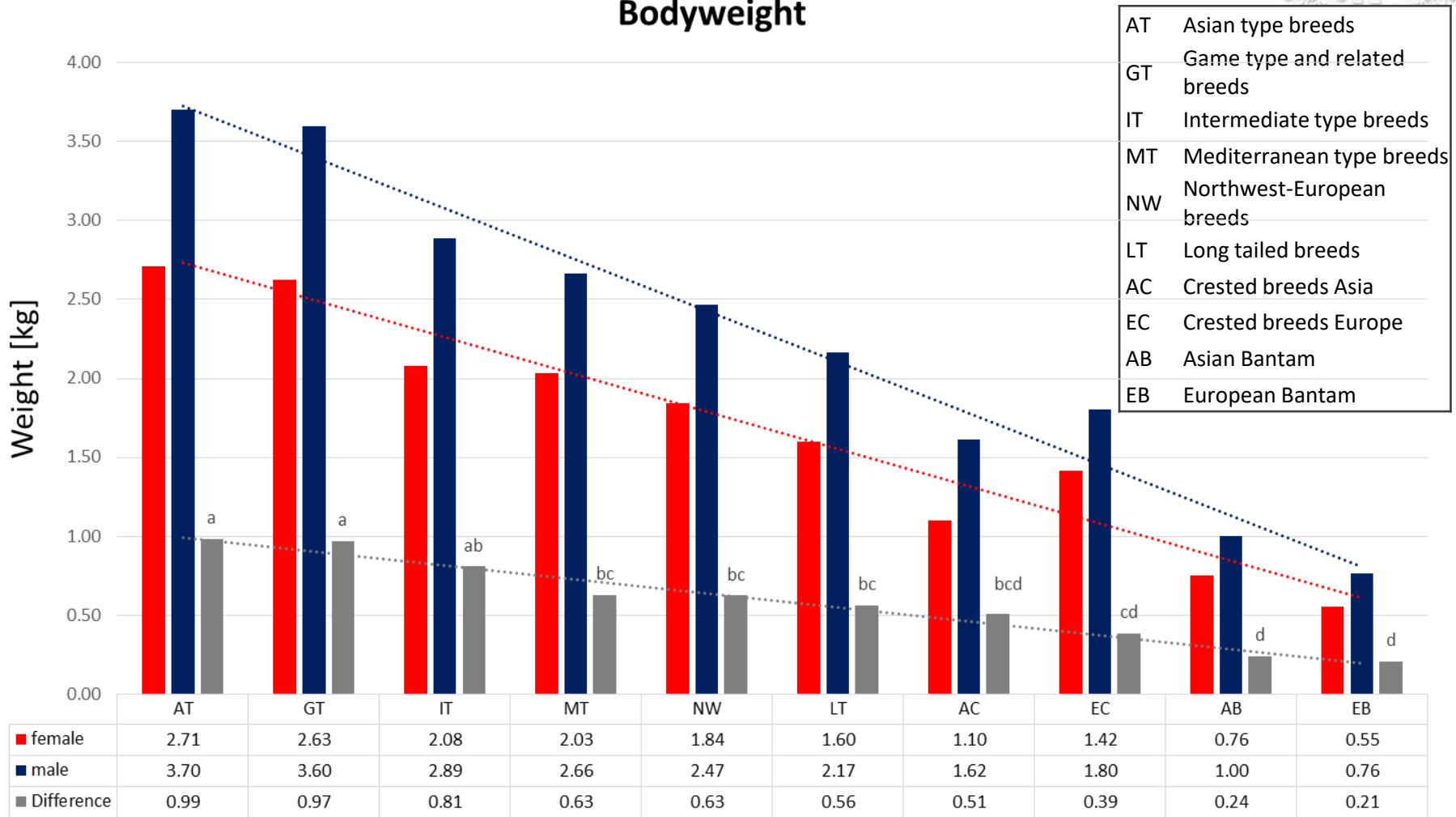


* $p \leq 0.05$; ** $p \leq 0.01$; *** $p \leq 0.001$

Absolute Sexual Size Dimorphism



Bodyweight



AT	Asian type breeds
GT	Game type and related breeds
IT	Intermediate type breeds
MT	Mediterranean type breeds
NW	Northwest-European breeds
LT	Long tailed breeds
AC	Crested breeds Asia
EC	Crested breeds Europe
AB	Asian Bantam
EB	European Bantam

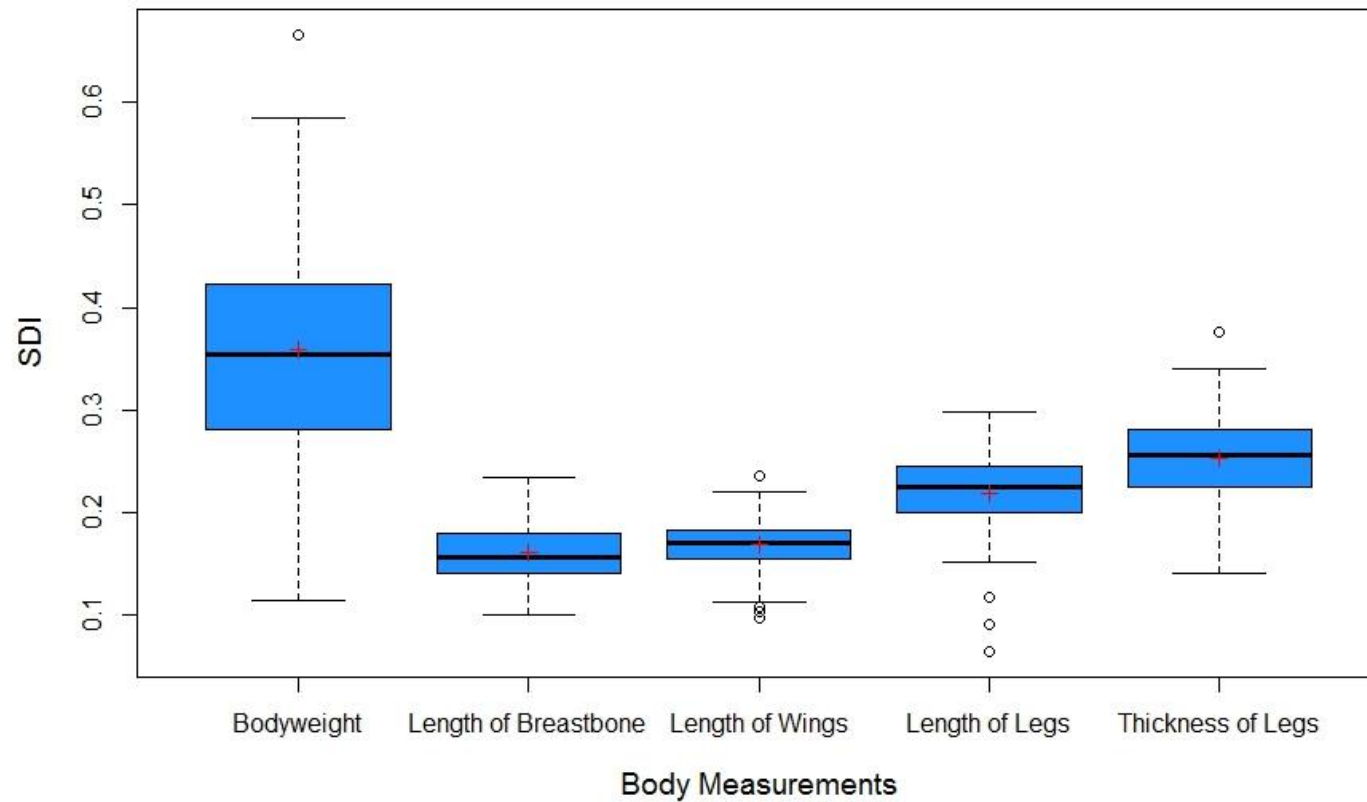
Relative Sexual Size Dimorphism - SDI



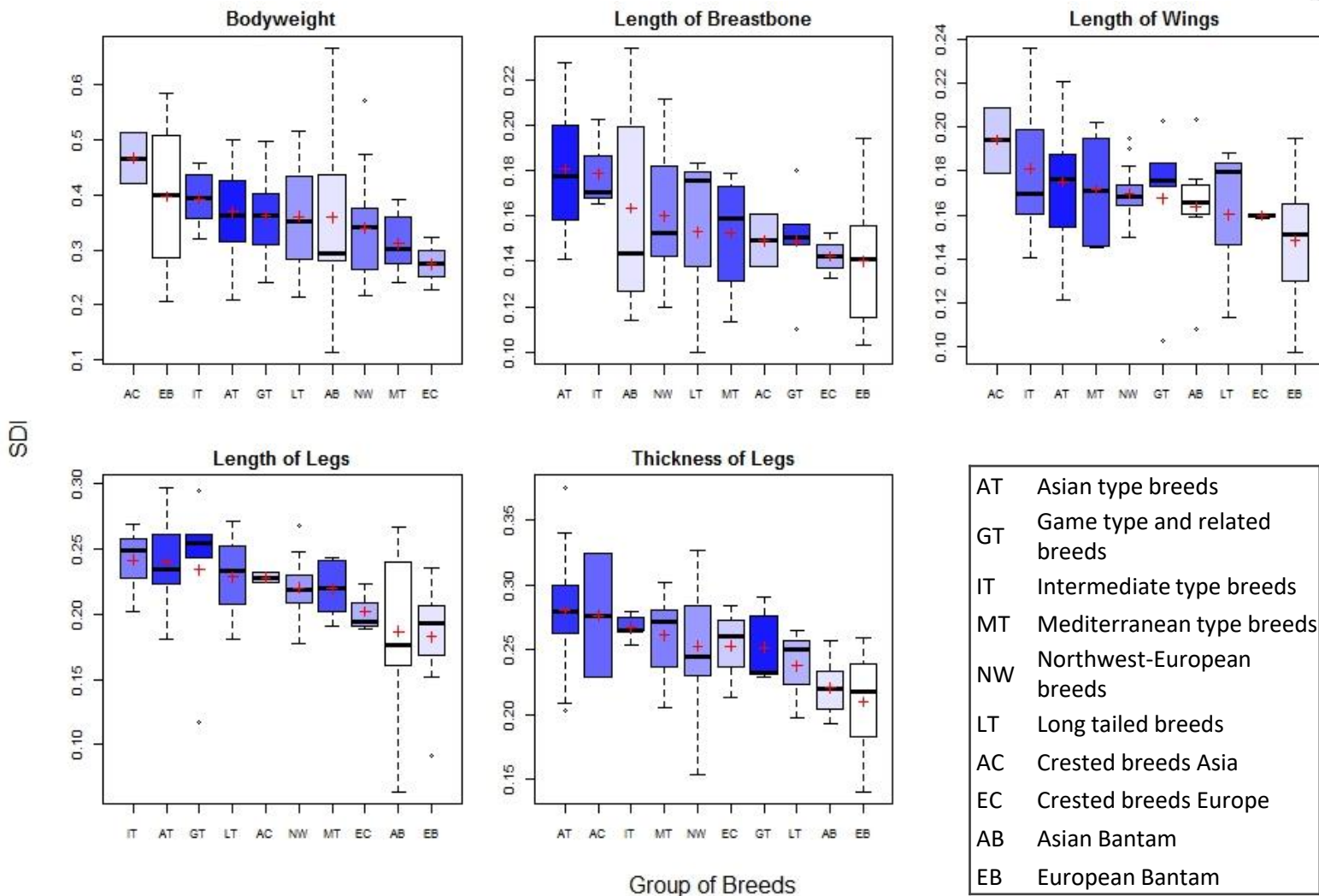
$$\text{SDI} = \frac{\text{body measurement male}}{\text{body measurement female}} - 1$$

SDI = Sexual Dimorphism Index;
Adapted from Remeš & Székely (2010)

Relative Sexual Size Dimorphism - SDI



Relative Sexual Size Dimorphism - SDI



SDI – Standard Deviations and Correlations



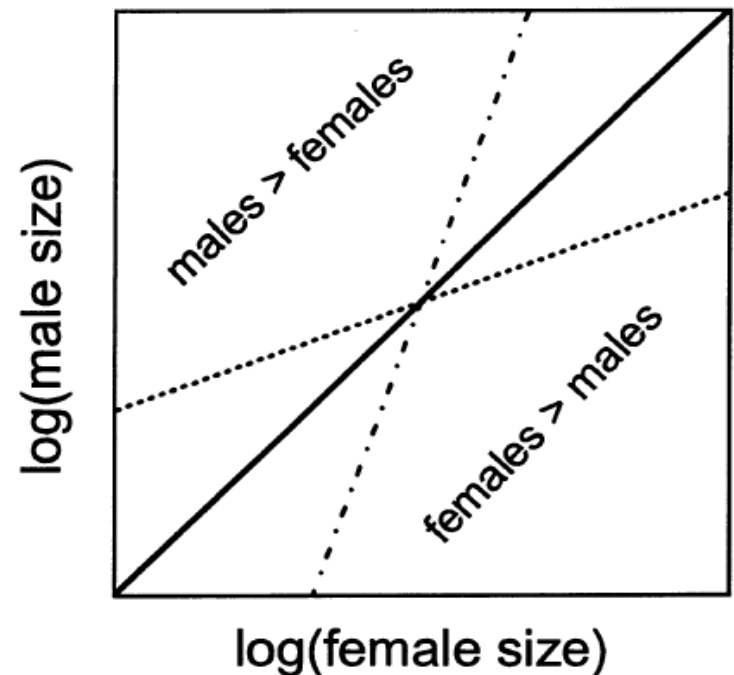
	Bodyweight	Length of Breastbone	Length of Wings	Length of Legs	Thickness of Legs
Bodyweight	0.103	0.276	0.381	0.355	0.173
Length of Breastbone		0.032	0.583	0.623	0.287
Length of Wings			0.027	0.774	0.443
Length of Legs				0.042	0.489
Thickness of Legs					0.044

Diagonal: standard deviation; above diagonal: correlations

Rensch's Rule



- male size = $\alpha(\text{female size})^\beta$
- $\log(\text{male size}) = \log(\alpha) + \beta \log(\text{female size})$
- Isometry: $\beta = 1$
- Positive allometry (Rensch):
 $\beta > 1$
- Negative allometry:
 $\beta < 1$



Source: Fairbairn (1997)

Rensch's Rule



	Body-weight	Length of Breastbone	Length of Wings	Length of Legs	Thickness of Legs	Breeds
Over all	0.984	1.027	1.028 *	1.068 ***	1.060 ***	68
Asian type breeds	0.957	0.954	0.977	0.985	1.057	14
Northwest-European breeds	1.126	1.047	1.057	1.124 **	1.058	15
Mediterranean type breeds	0.989	0.899	1.060	1.094	1.262	6
Intermediate type breeds	0.946	0.947	0.950	0.841	1.076	5
Game type and related breeds	1.214	1.062	1.175	1.181	0.981	5
Crested breeds Europe	0.879	0.878	0.963	-1.899	0.491	3
Long tailed breeds	0.920	1.207	1.278	1.430	1.296	3
Asian Bantam	0.727	0.936	1.047	1.141	1.081	7
European Bantam	0.898	0.992	0.986	1.007	0.966	8

* $p \leq 0.05$; ** $p \leq 0.01$; *** $p \leq 0.001$

Conclusion



- Male chickens are always significantly larger than female chickens
- Absolute sexual size dimorphism depends on overall body size, dependency less seen for the relative sexual size dimorphism
- Largest sexual size dimorphism is seen in the Bodyweight, followed by Thickness of Legs, Length of Legs, Length of Wings and Length of Breast Bone
- High correlations of SDI within the skeleton measurements
- Isometry at the Bodyweight, little positive allometry at the skeleton measurements
- Higher allometry in some groups, but most time without significances

References



- Fairbairn DJ (1997):** Allometry for Sexual Size Dimorphism. Pattern and Process in the Coevolution of Body Size in Males and Females. *Annual Review of Ecology and Systematics* 28: 659–687.
- Polák J, Frynta D (2009):** Sexual size dimorphism in domestic goats, sheep, and their wild relatives. *Biological Journal of the Linnean Society* 98: 872–883.
- Polák J, Frynta D (2010):** Patterns of sexual size dimorphism in cattle breeds support Rensch's rule. *Evolutionary Ecology* 24: 1255–1266.
- Remeš V, Székely T (2010):** Domestic chickens defy Rensch's rule: sexual size dimorphism in chicken breeds. *Journal of Evolutionary Biology*: 2754–2760.
- Rensch B (1950):** Die Abhängigkeit der relativen Sexualdifferenz von der Körpergröße. *Bonner Zoologische Beiträge*: 58–69.
- Weigend S, Janßen-Tapken U, Erbe M, Ober U, Weigend A, Preisinger R, Simianer H (2014):** Biodiversität beim Huhn Potenziale für die Praxis. *Züchtungskunde* 86: 25–41.



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for Listening**

