

**Supplementary material**

## Appendix 1

Table A1: Linear measures of total claw length (linear and curved) and keratinous claw tip length of the central front toe and back toe claws in Palearctic passerines. Data are means  $\pm$  SD.

Species	Central front toe claw				Back toe claw			
	Linear length	Curved length	Tip length	n	Linear length	Curved length	Tip length	n
<i>Acrocephalus schoenobaenus</i>	5.2 $\pm$ 0.11	5.6 $\pm$ 0.13	2.4 $\pm$ 0.24	2	6.7 $\pm$ 0.37	7.7 $\pm$ 0.17	2.5 $\pm$ 0.30	2
<i>Acrocephalus scirpaceus</i>	5.9 $\pm$ 0.53	6.5 $\pm$ 0.56	2.7 $\pm$ 0.44	4	7.4 $\pm$ 0.46	8.7 $\pm$ 0.57	3.1 $\pm$ 0.59	4
<i>Alauda arvensis</i>	6.5	6.9	3.4	1	15.9	16.2	6.1	1
<i>Anthus pratensis</i>	5.0 $\pm$ 0.45	5.3 $\pm$ 0.43	2.7 $\pm$ 0.52	3	10.8 $\pm$ 0.79	11.2 $\pm$ 0.58	6.1 $\pm$ 0.65	3
<i>Anthus trivialis</i>	5.0 $\pm$ 0.11	5.4 $\pm$ 0.16	2.3 $\pm$ 0.27	2	7.9 $\pm$ 0.07	8.8 $\pm$ 0.16	3.9 $\pm$ 0.65	2
<i>Cyanistes caeruleus</i>	4.9 $\pm$ 0.21	5.8 $\pm$ 0.13	2.2 $\pm$ 0.15	5	6.2 $\pm$ 0.19	7.4 $\pm$ 0.24	2.6 $\pm$ 0.09	6
<i>Emberiza schoeniclus</i>	6.0	6.5	2.5	1	7.3	8.4	3.1	1
<i>Erithacus rubecula</i>	5.1 $\pm$ 0.26	5.7 $\pm$ 0.40	2.3 $\pm$ 0.28	10	6.3 $\pm$ 0.2	7.4 $\pm$ 0.28	2.5 $\pm$ 0.24	10
<i>Ficedula albicollis</i>	4.7	5.6	2.5	1	5.3	6.4	2.4	1
<i>Ficedula hypoleuca</i>	4.6 $\pm$ 0.50	5.3 $\pm$ 0.65	2.4 $\pm$ 0.34	3	5.1 $\pm$ 0.26	6.2 $\pm$ 0.66	2.2 $\pm$ 0.26	3
<i>Fringilla coelebs</i>	5.5 $\pm$ 0.37	6.2 $\pm$ 0.47	2.5 $\pm$ 0.56	7	6.5 $\pm$ 0.46	7.6 $\pm$ 0.46	2.9 $\pm$ 0.48	7
<i>Hippolais icterina</i>	4.8 $\pm$ 0.23	5.4 $\pm$ 0.32	2.1 $\pm$ 0.24	5	5.3 $\pm$ 0.45	6.5 $\pm$ 0.69	1.9 $\pm$ 0.49	5
<i>Luscinia megarhynchos</i>	5.3 $\pm$ 0.62	6.0 $\pm$ 0.72	2.3 $\pm$ 0.20	4	6.6 $\pm$ 0.66	7.7 $\pm$ 1.00	2.8 $\pm$ 1.03	4
<i>Motacilla alba</i>	4.0	4.3	1.3	1	7.6	6.7	2.8	1
<i>Muscicapa striata</i>	3.5 $\pm$ 0.52	4.0 $\pm$ 0.28	1.5 $\pm$ 0.05	2	4.2 $\pm$ 0.08	4.9 $\pm$ 0.03	1.6 $\pm$ 0.05	2
<i>Oenanthe oenanthe</i>	5.1 $\pm$ 0.29	5.6 $\pm$ 0.33	2.3 $\pm$ 0.23	2	6.7 $\pm$ 0.03	7.5 $\pm$ 0.05	3.2 $\pm$ 0.07	2
<i>Passer domesticus</i>	5.9 $\pm$ 0.52	6.6 $\pm$ 0.44	2.1 $\pm$ 0.41	2	7.5 $\pm$ 0.60	8.8 $\pm$ 0.95	2.3 $\pm$ 0.23	2
<i>Periparus ater</i>	5.1 $\pm$ 0.16	5.8 $\pm$ 0.16	2.4 $\pm$ 0.26	7/10	7.0 $\pm$ 0.31	8.1 $\pm$ 0.41	2.9 $\pm$ 0.31	10
<i>Phoenicurus phoenicurus</i>	4.4 $\pm$ 0.31	4.8 $\pm$ 0.46	1.9 $\pm$ 0.22	4	5.2 $\pm$ 0.53	5.9 $\pm$ 0.43	2.2 $\pm$ 0.32	4

<i>Phylloscopus collybita</i>	4.5 ± 0.24	4.9 ± 0.29	1.9 ± 0.35	7	5.5 ± 0.34	6.6 ± 0.42	2.2 ± 0.28	7
<i>Phylloscopus trochilus</i>	4.5 ± 0.20	5.1 ± 0.19	1.7 ± 0.29	4/3	5.3 ± 0.14	6.2 ± 0.10	1.7 ± 0.17	4
<i>Regulus regulus</i>	4.0 ± 0.25	4.6 ± 0.36	1.7 ± 0.04	2	6.0 ± 0.04	7.2 ± 0.18	2.2	2/1
<i>Saxicola rubetra</i>	5.7 ± 0.15	6.2 ± 0.20	2.6 ± 0.05	2	6.6 ± 0.52	7.2 ± 0.54	2.6 ± 0.12	2
<i>Sylvia atricapilla</i>	5.0 ± 0.39	5.9 ± 0.52	2.2 ± 0.31	6	5.6 ± 0.36	6.9 ± 0.46	2.0 ± 0.23	6
<i>Sylvia borin</i>	4.6 ± 0.08	5.2 ± 0.19	1.6 ± 0.06	2	5.4 ± 0.06	6.5 ± 0.19	1.4 ± 0.51	2
<i>Sylvia cantillans</i>	4.2 ± 0.11	4.8 ± 0.23	1.7 ± 0.22	4/5	4.8 ± 0.21	5.6 ± 0.28	2.1 ± 0.23	4/5
<i>Sylvia communis</i>	5.0 ± 0.16	5.6 ± 0.16	2.2 ± 0.45	5	5.7 ± 0.29	6.7 ± 0.34	2.2 ± 0.34	5
<i>Turdus merula</i>	9.1 ± 0.53	10.2 ± 0.60	3.6 ± 0.18	2	10.6 ± 0.57	11.9 ± 0.90	4.3 ± 0.42	2
<i>Turdus philomelos</i>	6.8 ± 0.37	7.7 ± 0.41	3.0 ± 0.44	7	8.5 ± 0.39	10 ± 0.53	3.4 ± 0.41	7

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Table A2: Overview of daily growth rates (mean  $\pm$  SD) in avian claws from various passerines, penguins and waterbird species. Body mass data are derived from (1) and (2), n gives number of individuals, and study indicates c - captive or f - free-ranging individuals.

Species	Claw growth rate (mm d <sup>-1</sup> )				n	Study	Reference
	Body mass (g)	central front toe	outer front toe	back toe			
Passeriformes							
<i>Corapipo altera</i>	12.4	0.03 $\pm$ 0.01				f	3
<i>Cyanistes caeruleus</i>	11.5	0.04 $\pm$ 0.01	0.04 $\pm$ 0.01		10	f	4
<i>Erithacus rubecula</i>	17.0	0.04 $\pm$ 0.02	0.04 $\pm$ 0.02		11	f	4
<i>Fringilla coelebs</i>	21.1	0.04 $\pm$ 0.01	0.03 $\pm$ 0.01		11	f	4
<i>Parus major</i>	18.0	0.05 $\pm$ 0.01	0.05 $\pm$ 0.02		5	f	4
<i>Passer hispaniolensis</i>	27.8	0.034 $\pm$ 0.01		0.04 $\pm$ 0.01	10	c	5
<i>Periparus ater</i>	9.4	0.03 $\pm$ 0.01	0.03 $\pm$ 0.01		15	f	4
Sphenisciformes							
<i>Spheniscus demersus</i>	3000					0.114 $\pm$ 0.03	8 c 6
Anseriformes							
<i>Anas platyrhynchos</i>	1080	0.068 $\pm$ 0.015			6	c	7
<i>Cygnus columbianus</i>	6000	0.076 $\pm$ 0.011			9	c	7
lesser scaup, pintail, mallard	820-1080					0.06 – 0.13	c? 8

1: Cramp, S. 2004. Birds of the Western Palearctic interactive. Oxford University Press, Oxford.

2: Dunning, J. B. 1993. CRC handbook of avian body masses, Boca raton, CRC Press.

3: Boyle, W. A., Guglielmo, C. G., Hobson, K. A. and Norris, D. R. 2011. Lekking birds in a tropical forest forego sex for migration. –Biol.

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- 4: Bearhop, S., Furness, R. W., Hilton, G. M., Votier, S. C. and Waldron, S. 2003. A forensic approach to understanding diet and habitat use from stable isotope analysis of (avian) claw material. –*Func. Ecol.* 17: 270-275.
- 5: this study
- 6: Barquete, V., Strauss, V. and Ryan, P. G. 2013. Stable isotope turnover in blood and claws: A case study in captive African Penguins. –*J. Exp. Mar. Biol. Ecol.* 448: 121-127.
- 7: S. Hahn unpublished data, methods in Hahn, S., Hoyer, B. J., Korthals, H. and Klaassen, M. 2012. From food to offspring down: Tissue-specific discrimination and turn-over of stable isotopes in herbivorous waterbirds and other avian foraging guilds. –*PloS One*, 7: e30242.
- 8: R.G. Clark unpublished data in Oppel, S. and Powell, A. N. 2008. Assigning king eiders to wintering regions in the Bering Sea using stable isotopes of feathers and claws. –*Mar. Ecol. Progr. Ser.* 373: 149-156.

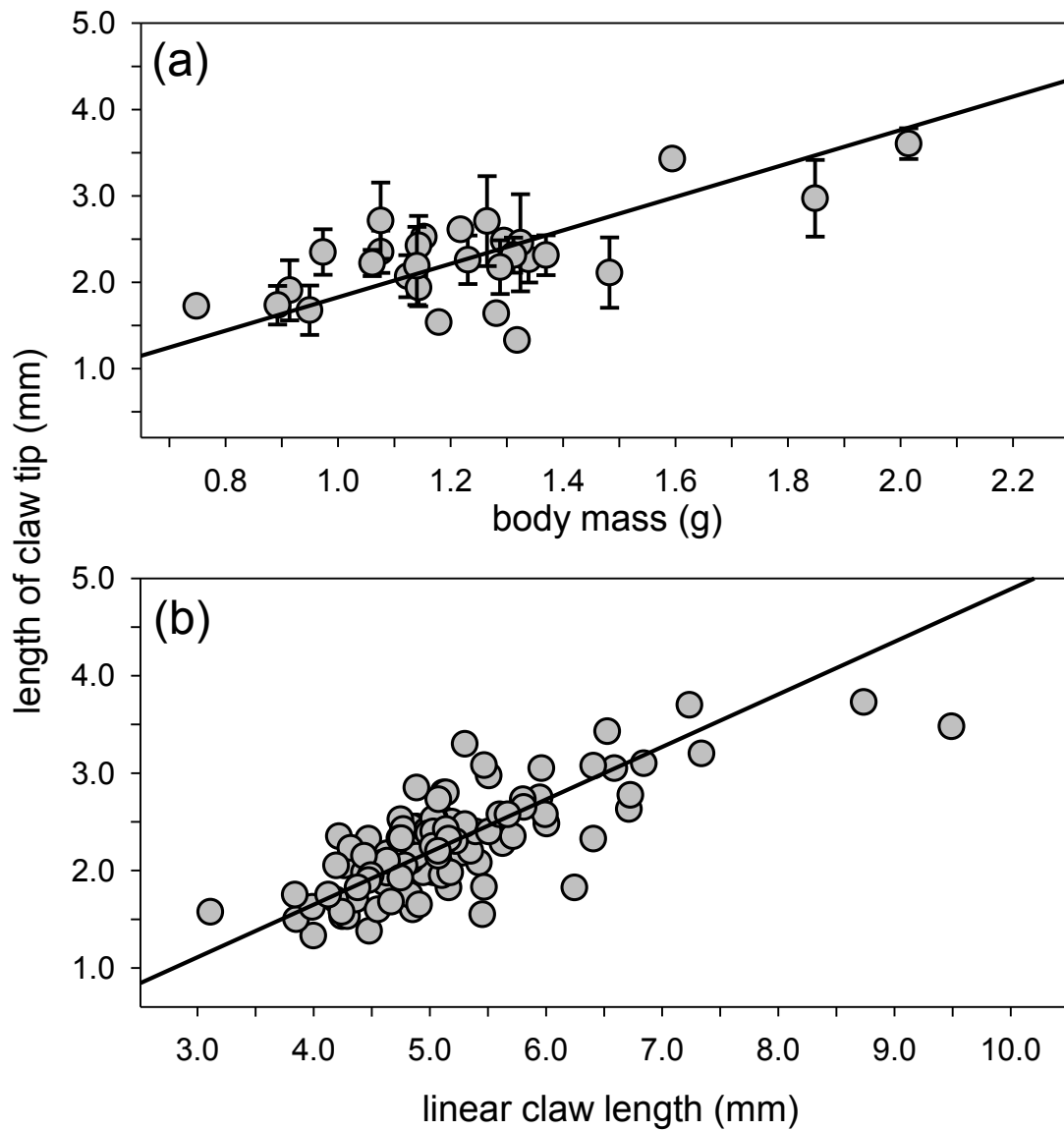


Figure A1. Relationship of claw tip length with (a) logarithmic average body mass or (b) linear claw length in central front toes of 29 passerine species. Claw tip length in (a) is given as means  $\pm$  SD; lines give reduced major axis linear regressions (for statistics see Table 1).

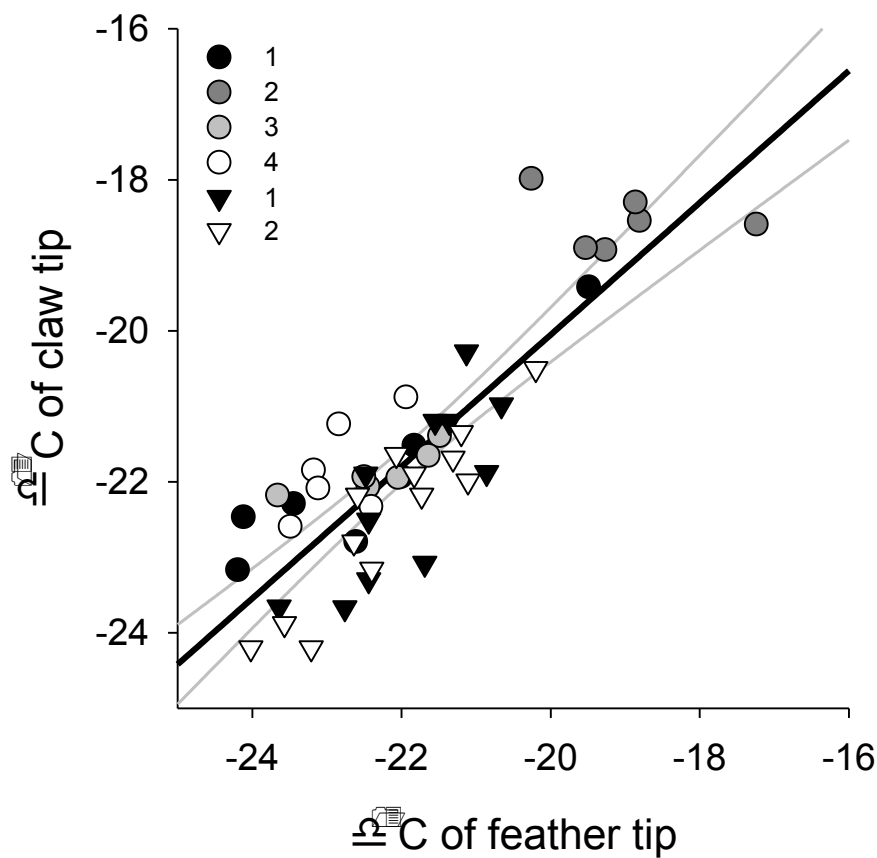


Figure A2. Relationship of stable carbon isotope ratio ( $\delta^{13}\text{C}$ ) of individual primary feathers with the corresponding claw tip which had been grown during the same period in six passerine species. The linear regression line (black) is  $\delta^{13}\text{C}_{\text{claw}} = 0.874 \pm 0.076$  (SE)  $\times$   $\delta^{13}\text{C}_{\text{feather}} - 2.58 \pm 1.65$  ( $r^2 = 0.74$ ,  $p < 0.001$ ,  $n = 49$ ), grey lines give the 95% confidence intervals. Circles symbolize 1 – tree pipit (*Anthus trivialis*), 2 – spotted flycatcher (*Muscicapa striata*), 3 – common redstart (*Phoenicurus phoenicurus*), and 4 – garden warbler (*Sylvia borin*) (this study), the triangles symbolize 1 – thick-billed vireos (*Vireo crassirostris*) and 2 – bananaquits (*Coereba flaveola*) from Bearhop, S. et al (Funct. Ecol. 2003, 17: 270-275).